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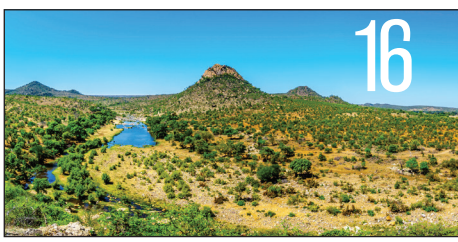
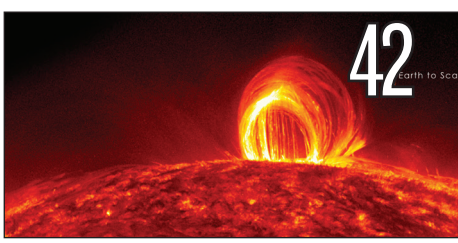
CONTENTS

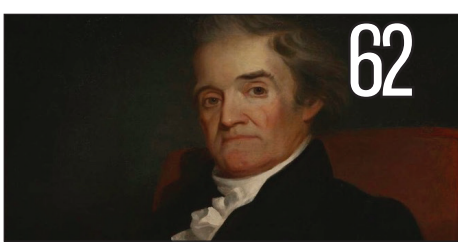
FEATURES

GENERAL

REGULARS







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ISSN: 1991-0452

2019 Q1 - 13457

This issue of **watt**now features Aerospace. Aerospace is the human effort in science, engineering, and business to fly in the atmosphere of Earth and surrounding space. Aerospace organisations research, design, manufacture, operate or maintain aircraft or spacecraft.

Our first article, on page 16, written by Dr Lelanie Smith, Manager on the Arend Project from the University of Pretoria, shares with us the design project which focuses on developing modular drone solutions for wildlife protection and application.

Page 12 sports an excerpt of a white paper, published by Airbus in 2018 about the different segments industry can address the challenges Africa faces - "Aerospace Technologies in Africa".

The Department of Science and Technology has welcomed the adoption of the Integrated Environmental Management Plan for phase one of the Square Kilometre Array (SKA). Read the story on page 34.

Dudley Basson did not disappoint with his extensive article on "Coronal Mass Injections" on page 42.

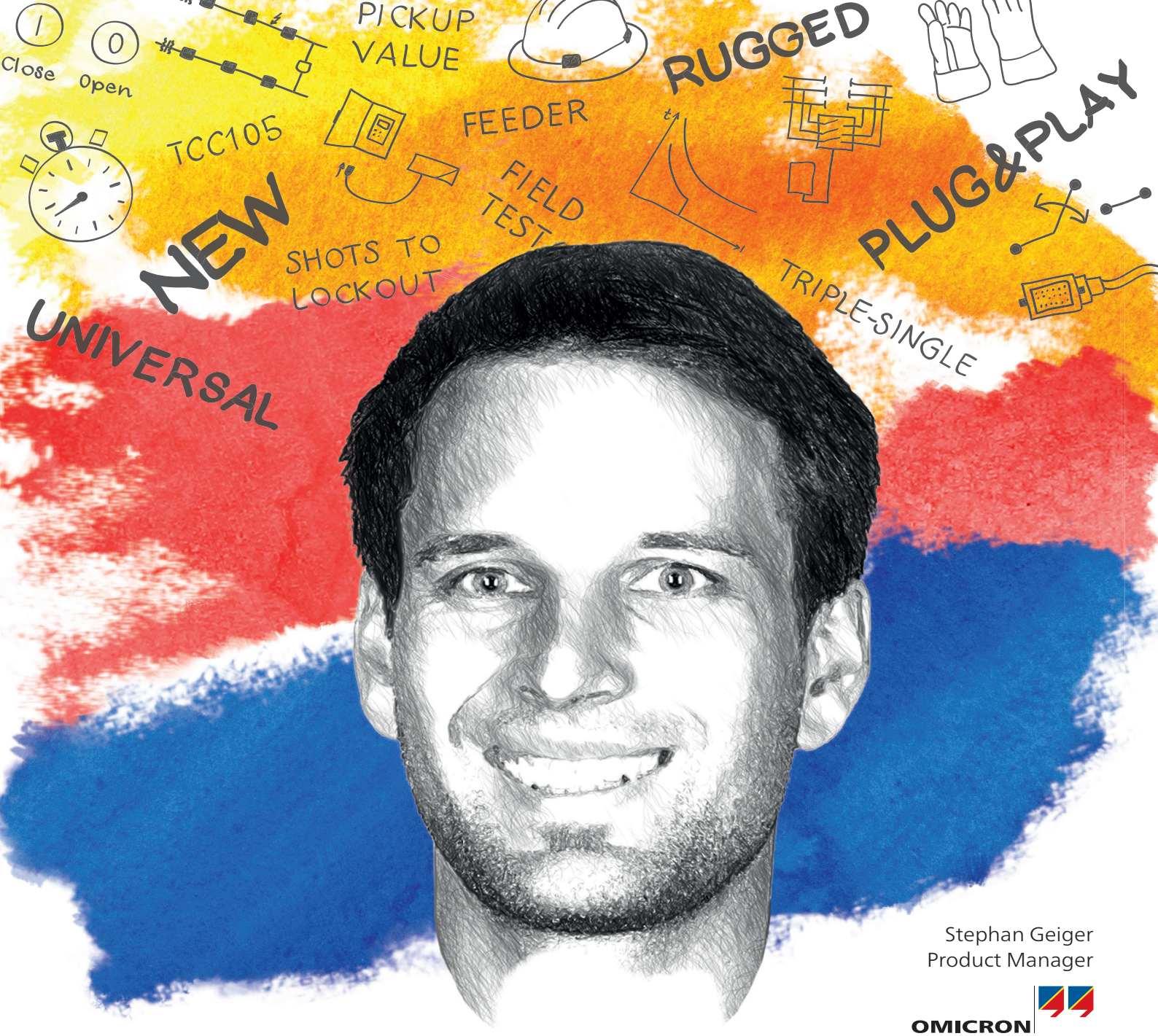
The SAIEE recently inaugurated its 2019 President, Mr George Debbo, who is currently touring the country for his inaugural address. For those of you who cannot make these events, watch out for the next issue of the **watt**now, which features the SAIEE and all our committees, sections, interest groups, etc. George is busy writing his presentation into article format which will be published in the May issue. For those of the SAIEE stalwarts who would like to share with us your anecdotal stories about the SAIEE, please send it to me by 3 May.

To all our readers celebrating Easter, Happy Easter.

Herewith the April issue, enjoy the read.

Minx

Visit www.saiee.org.za to answer the questions related to these articles to earn your CPD points.



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SAIEE Inaugurates new President

George Debbo
2019 SAIEE President

Digital Transformation addresses the changes that have taken place in the world around us as a result of the deployment and application of digital technology. Such changes have influenced all aspects of our lives, including professional and personal. Within the professional realm, such changes have impacted the way businesses are run and conducted as well as our contact and interface with such entities. Within the private space, Digital Transformation has changed how we communicate and socialise as well as how we consume information, including that which forms part of our entertainment.

A key benefit of Digital Transformation is that it has allowed the disadvantaged sector of our society, especially on the continent of Africa, access to several services from which they were previously excluded. Digital Transformation has contributed significantly to enabling inclusivity in areas such as economic and social development of the disadvantaged sectors of our society. This address discusses both the benefits and disadvantages of Digital Transformation, as well identifies the key digital technologies that have contributed to both Digital Transformation as well as Digital Disruption, the latter also being a significant contributor to Digital Transformation. The address will also cover the current barriers that are hindering the progress being achieved with Digital Transformation, especially within the South African context, and proposes how the South African Institute of Electrical Engineers (SAIEE) can get involved in the public debate related to Digital Transformation, and the setting of policy in this context.

ABOUT GEORGE DEBBO

Debbo has been an integral part of the telecommunication industry in South Africa for over four decades. He started his career in the South African Post Office (SAPO), which later transformed into Telkom SA on commercialisation in 1991. As a pupil technician, he progressively rose through the ranks to Executive level before he left in 1999 to further pursue his career in the vendor community.

During his time at Telkom, he was responsible for many engineering projects including research to increase the robustness of pulse code modulation systems to lightning interference. He was actively involved with the deployment of synchronous digital hierarchical (SDH) technology into the transmission network. In 1994, he championed the implementation of long haul optical fibre and the formulation of the Vision 2000 strategy. This strategy was formulated to complete the modernising of the telecommunications network by converting outstanding electro-mechanical exchanges to digital exchanges. By eradicating the waiting list, Telkom added one million telephone lines into underserviced areas (predominantly the previously independent TBVC states).

Debbo was responsible for two of the most significant projects Telkom has ever launched in South Africa. The first project was the deployment of telecommunications infrastructure to service the first democratic General Election in 1994, for which he earned the Telkom Managing Director's Award. In 1995 he headed the development of the infrastructure required to support telecommunication and television services for the Rugby World Cup.

In 1999 Debbo left Telkom to join the vendor community, first as Technical Director for Marconi South Africa and then as Chief Technical Officer for Ericsson Sub Saharan Africa, following Ericsson's global acquisition of Marconi PLC in 2006. During his time within the vendor community, he was responsible for many significant projects including the deployment of ADSL technology in South Africa, the implementation of the first metropolitan and access fibre network in Africa which took place in Kampala Uganda and the deployment of the first 4G mobile network which took place in Angola. In 2012 George left Ericsson to set up his own business as an Independent Telecommunications Consultant.

Today Debbo's prime area of interest is in software programmable networks and virtualisation. He is currently carrying out applications research in this area and is

Sy Gourrah
Deputy President

Prof Sunil Maharaj
Senior Vice President

Prince Moyo
Junior Vice President

Marius van Rensburg
Honorary Vice President

Dr Hendri Geldenhuys
Immediate Past President

Viv Crone
Honorary Treasurer

regularly called upon to address conferences on this technology.

In terms of academic qualifications, Debbo has a BSc (Elec.Eng) and an MSc (Elec.Eng) degree, both obtained from the University of the Witwatersrand and is a registered Professional Engineer with the Engineering Council of South Africa (ECSA).

Now, as part of the President's inaugural tour and to deliver his address, George Debbo will be visiting some of the SAIEE Centres nationwide.
Visit the events calendar on the SAIEE website - www.saiee.org.za to see when he will be in your area.

2019 SAIEE OFFICE BEARERS

During the proceedings of the evening, the following 2019 Office Bearers we inaugurated for 2019:

Deputy President: Mrs Sy Gourrah
Senior Vice President: Prof Sunil Maharajah
Junior Vice President: Mr Prince Moyo
Honorary Treasurer: Mr Viv Crone
Honorary Vice President: Mr Marius van Rensburg
Immediate Past President: Dr Hendri Geldenhuys

We wish them all well in their future endeavours carrying the SAIEE flag high!

From left: Prince Moyo (SAIEE Junior VP), Prof Pat Naidoo (Past President), Jacob Machinjike (Past President), Dr Hendri Geldenhuys (Immediate Past President), Sicelo Xulu (SAIEE CEO), Stan Bridgens (Past President), and Leanetse Matutoane (Ops Manager).

A thorn amongst the roses?
From left: Tshego Cornelius, André Hoffmann (Past President), Sharon Mushabe and Prudence Madiba.

DEHN Africa expands with new senior appointment in renewables sector

Lightning and surge protection specialist DEHN Africa, part of DEHN + SÖHNE, Germany, has recently strengthened its offering in the renewables arena with the appointment of William van Wyk to the position of Business Development Manager: Renewables.

DEHN Africa Managing Director, Hano Oelofse, explains, *"The renewable energy landscape is an exciting area that increasingly reflects the future of the energy sector in its entirety. Here at DEHN Africa we have been offering our solutions in the renewables arena for some years now. The appointment of William signals our intention to grow this area in a focused and consolidated manner, in keeping with current local and global trends."*

Van Wyk's new role entails developing and promoting DEHN's extensive product and service range within the renewables segment, working actively across the entire southern African region. DEHN's renewable offerings can be applied across the photovoltaic solar, thermal solar, wind energy and hydro-generation areas.

He says, *"I'm looking forward to adding positive value to DEHN Africa and helping to build a strong DEHN Africa brand, engaging with both local and international clients. My previous employment history includes 10 years in branch management in the pulp and paper industry, as well as eight years in specialised electrical sales and sales management. I believe that my strengths include my knowledge of the market segment, my 18 years accumulated sales and sales management experience and my knowledge of regional African markets."*

"Joining DEHN Africa will allow me to apply my accumulated experience in a young and dynamic environment and challenge myself. I truly believe in the services and products DEHN Africa brings to the market and the value it adds to consumers," concludes Van Wyk.

Willem van Wyk
Business Development Manager: Renewables

North West University award top achiever

From left: Prof George van Schoor, Director of the School of Electrical, Electronic and Computer Engineering, Prof Jan de Kock and Riekert Jansen van Vuuren.

At the recent North West University Awards Evening, Mr Riekert Jansen van Vuuren walked away with the coveted Top Achiever's award sponsored by the SAIEE.

Riekert completed his third year in Electrical and Electronic Engineering at North West University with an average of 87%.

This makes him the top student of his class in 2018.

Congratulations from all of us at SAIEE.

SAIEE inducted new Fellow

At Dr Hendri Geldenhuys's last Council meeting as SAIEE President, he inducted a new Fellow to the SAIEE.

Mr Jan Oberholzer is the Chief Operating Officer for Eskom Holdings SOC Limited responsible for the effective leadership of the Group's Generation, Transmission, Distribution, Customer Service and Group Capital Divisions.

For a few years, he was an independent professional providing professional services in the African Power Industry focussing on a) business and performance management, b) business development, c) capital programme management and d) project & construction management.

Dry-Type Transformer Excels On Mobile Process Plant

Four dry-type transformers supplied by Trafo Power Solutions are proving their worth on a mobile process plant in Sierra Leone.

Four dry-type transformers from Trafo Power Solutions have been proving their worth on a mobile process plant on a Sierra Leone mine since last year; so successful have they been that the customer has ordered six more for its recent Phase Two upgrade.

"The mine required a solution that would withstand the demanding conditions of a mobile process plant needing to be moved frequently over rugged mining terrain – as often as once a month," says Trafo Power Solutions managing director David Claassen. *"They could not risk using a conventional oil-cooled transformer as they needed to avoid any risk of fire or oil leaks. They also needed a product that would require little to no maintenance."*

The second contract was a repeat of the initial order, and comprises two 800 KVA units, one 1,600 KVA unit and one 2,000 KVA unit as well as a further two transformers, 1,600 kVA and 800 kVA which will replace two existing oil filled transformers. Demonstrating its flexibility in meeting specific customer requirements, Trafo Power Solutions designed the solution to cater for the mine's unusual voltage levels of 13,2 KV/480 V at 60 Hz.

The transformers are installed in a six metre long E-house on the mobile process plant, which is moved around the site on skids as required by the mining plan.

"We were able to customise the design of the transformers for the customer's specific application," says Claassen. *"This required a special reinforced frame to accommodate the constant vibration of the working plant, as well as the bumping motion when the skid-mounted plant is dragged to a new location. The design also included anti-vibration damping on the transformer feet, to further mitigate the impact of the vibration."*

Ithemba Trust and Bureau Veritas inspire educators on International Women's Day in South Africa

Chairperson of the Ithemba Trust, Ms Yvonne Kgame, with representatives from Bureau Veritas and educators from Ntsikana Primary School in Daveyton School, recently celebrated International Women's Day 2019 in South Africa.

The Ithemba Trust, a women's empowerment body, together with Bureau Veritas Southern Africa, celebrated their inaugural inspirational International Women's Day at Ntsikana Primary School in Daveyton, Gauteng. The Trust was launched in June 2018 and has to date been involved in several projects benefiting girls and young women in South Africa.

The Ithemba Trust chairperson, Ms Yvonne Busisiwe Kgame, a passionate leader with a 30-year career in education and television underpinned by a powerful desire to serve and make a difference, used her renowned and much-loved story-telling style to address some 30 educators at the school. Embodying the ethos of International Women's Day to encourage action and change, Ms Kgame acknowledged women's achievements throughout history and across nations to motivate and inspire those taking care of the education of our next generation, future leaders and game-changers. She said: "As teachers, you need to teach with purpose. Passion and purpose lead to greatness. Be a bold teacher and empower your students to become great."

Learners and educators alike were inspired and encouraged to achieve their maximum potential and create legacies for generations to come. Sisanda Mamanzi, an employee of Bureau Veritas and former learner at the school, also addressed the educators after which they sang together with Ms Kgame and the learners. In acknowledgement of this auspicious occasion, the Ithemba Trust provided surprise gifts for attendees before everyone enjoyed networking and light refreshments. Before closing the event, the Principal thanked Mam Yvonne, as she is fondly known and shared the value of positive and empowering inspirational words shared through the age-old tried and tested method of storytelling.

Aligned to the Bureau Veritas Southern Africa's strong social awareness ethos, the Trust focuses on empowering females from previously disadvantaged backgrounds with a focus on education of young Black Women in the STEM disciplines of science, technology, engineering and mathematics. After graduation, the company will absorb the young ladies into the business and upskill them with soft skills on work readiness. By providing enterprise development assistance to those that wish to launch their own companies and work will be subcontracted to them to ensure they can sustain their businesses and achieve success. The Trust will focus on beneficiaries hailing from areas in which BVSA employees live and work. To date, the trust has provided two full bursaries for students Keletso Moekona and Sanelisiwe Mabaso to study a BEng Mining at the University of Johannesburg and BSC Biological Sciences at Wits University respectively.

The independent Trustees include Messrs Yvonne Busisiwe Kgame and Zwelakhe Onwell Msomi, long-standing members of the South African business communities and highly respected and passionate about education and the transformation of women. The Trustees have enjoyed leadership roles in local and international corporates and the education sector; bringing a powerful combined experience set to the Trust. They have also been heavily involved in non-profit organisations and charities on both local and global scales. Ms Sal Govender, Vice President of Bureau Veritas Southern Africa, is also a Trustee.

Commenting at the celebration, District HR Manager: Southern Africa, Ms Beatrice Scharneck said: *"Bureau Veritas South Africa is committed to making a difference in the lives of others through the Ithemba Trust. It is our goal and ambition to create empowered and well-schooled females within the STEM disciplines through education and enterprise development. We are passionate about creating legacies and ultimately building a nation. We are poised to improve the lives of women; the backbone of society."*

South Africa's first industry body for the Internet of Things (IoT)

The First IoT Council of South Africa AGM

The IOT Industry Council of South Africa (IOTIC) announced that it has been formally constituted as a new industry representative body, holding its first Annual General Meeting on the 15th of March in Johannesburg.

The Council brings together leading South African and global technology integrators, innovators and thinkers at the cutting edge of the evolution of the Internet of Things (IoT) in this country. It will act as a collective voice for the IoT industry in South Africa, representing companies that provide devices, network connectivity, application software and systems integration services in this exciting new technology space.

Founding members of the IOT Industry Council of South Africa are Internet Solutions, Nerospec IOT, Real Telematics Systems (RTS), Sqwidnet, Activate Group, Comsol Networks, CST Electronics, Dimension Data, Eseye, Macrocomm, Microsoft, MTN, SoftwareAG and Vodacom.

With the formal establishment of this IOT Industry Council, the founding members are pleased to now invite any organisation that is interested in accelerating South Africa's adoption of IOT and the Fourth Industrial Revolution to join. Members can apply for membership as Full Members (commercial industry players), Observer Members (government organisations, NGOs, research organisations), or Individual Members (analysts, academics, entrepreneurs) through the Website, www.iotcouncil.org.za.

IOT technology brings amazing capabilities to improve efficiencies, reduce waste, allocate resources better – providing for real-time visibility into the real world environment, at a fraction of the cost of older technologies.

"The IoT Industry Council is dedicated to helping business, and public sector organisations gain insight into the capabilities that IoT technology brings. These are fundamental if we are to bring about a "Fourth Industrial Revolution" in our country, to grow our economy, create new jobs, and compete with our BRICS peers. We can help those wanting to dive into this new world of IOT to develop their IoT strategy. We can connect them with relevant IoT consulting, product and services providers. We can grow confidence through best practices and a formal Code of Conduct," says Roger Hislop, Executive Head for IOT at Internet Solutions, and the newly elected chair of the Council for this coming year. *"We see ourselves as an organisation serving the public good, promoting exciting new technologies that translate into highly effective solutions to make South Africa a better place for all."*

IoT is a transformational technology that can ensure South African businesses, manufacturers, and agriculture producers can be globally and regionally competitive. *"Growing our IOT technology industry opens up an incredible range of opportunities for big and small businesses alike to take great technology to the world,"* says Hislop. *"There are many South African companies doing extraordinary things already. This sector can solve day-to-day operational problems for those adopting it, and create an incredible opportunity for technology export to the rest of the world."*

Through the IOT Industry Council, members will connect with their industry peers, find new collaborations with partners that can deliver value to South African businesses and local government.

Other benefits of joining include:

- Match-making of buyers and sellers
- Sharing technical and business resources in best-practice implementation, security, resilience, privacy and governance
- Resolving differences, addressing challenges and developing programmes that drive the industry forward.

SAIEE Load Research Chapter Launch

Presenters (from left): Marcus Dekenah, Monde Soni, Jaco Alberts, Lloyd Setlhogo and Hendri Geldenhuys.

On the 4th April 2019, a newly formed SAIEE Load Research Chapter (LRC) was launched. This inaugural event took place at the South African Institute of Electrical Engineers' Council Chamber in Johannesburg.

According to its terms of reference, the LRC aims to bring together all industry players that are involved or merely interested in the load research field. This initiative brings together a variety of players from academia, consultants, utilities, software developers, municipalities, etc.

The scope of the load research is said to include tracking of load behaviour as it is changing due to new technologies on the customer side. The LRC will focus on both the load (consumption) and distributed generation (especially the embedded generation behind the meter). The ultimate goal is to adapt old models and create new models that are fit for the new realities that emerge. The LRC will provide a platform for industry players to share their research findings and experiences on the subject as well as the related issues.

The event was a success with representatives from all industry role players.

The following presentations were presented:

- Monde Soni - Introduction of the LR Chapter
- Hendri Geldenhuys - Importance of LR in the context of South African ESI
- Jaco Alberts - Review of the typical engineering applications of LR in SA (who are the "users" and what do they typically need)
- Marcus Dekenah - Current state of LR in SA and the future (what are we "making", what should we be "making", how could we get there.)
- Lloyd Setlhogo - Dissemination of LR results in SA (how do we get the results from the "makers" to the "users")

The members elected the following office bearers for the LRC:
Monde Soni - Chairperson
Marcus Dekenah - Vice Chairperson
Lloyd Setlhogo - Secretariat

The office bearers will prioritise the:

1. Events calendar for the next 12 months – this calendar will have planned events such as seminars, webinars and panel discussions that will be hosted by the Chapter in the immediate future. The schedule will be shared with the LRC members, and it will also be published in the **watt**now magazine.
2. Monthly member meetings – members of the LRC will receive an invitation for the monthly member meetings. The Chairperson indicated that these meetings will be a combination of remote sessions (such as teleconference, Skype, etc.) and local venue meetings. The details will be made available to the members soon.

The LRC invite all persons interested in the load research subject to join and contribute towards the betterment of the ESI in South Africa. To be part of the LRC, contact the Lloyd Setlhogo (Secretariat). Please note that you will be expected to register with SAIEE once you have joined the Chapter. The schedule for the upcoming, exciting and CPD accredited events will be released in due course.

SAIEE are missing the following members... we need your help!

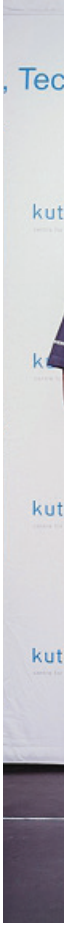
To not just delete uncontactable members, the SAIEE is hoping to make contact with the following members who can not be reached via email or telephone.

If your name is on the list, or you know a person on the list, please ask them to contact the SAIEE Membership Department and speak to either Joanne Griffin or Connie Makhalemele-Maseko on 011 487 3003. Alternatively, log into/or create your online profile on www.saiee.org.za with your correct details.

We hope to hear from you soon!

MEMNO	TITLE	INITIALS	FULL NAMES	SURNAME	REGION	GRADE
260	Mr	B K	Bhagoobhai Kika	Bawa	De Duer	Senior Member (6+)
15094	Mr	A	Baza	Athenkosi	Ladyfrere	Student
7634	Mr	J G	Johannes Gerhardt	Bekker	Germiston	Member (10+)
13488	Mrs	O E T	Ouma Enesia Tlou	Bosaletsi	Boksburg	Member
11606	Mr	P C	Pieter Conradie	Botha	Pretoria	Member (6+)
11782	Mr	C	Carl	Burger	kuilsriver	Member (6+)
11584	Mr	A P	Alwyn Petrus	Burger	Pretoria	Member (10+)
634	Mr	S C	Simon Charles	Bush	Craighall	Member (10+)
10504	Mrs	T	Teresa	Carolin	Gauteng	Member (10+)
9189	Mr	E J L	Edmund James Linda	Cele	Gauteng	Member (10+)
7745	Mr	N D	Nolan Dassiah	Chetty	Gauteng	Member (6+)
14514	Mr	A	Amos	Chimombe	Pretoria	Member
774	Prof	A R	Clark	Alan Robert	Gauteng	Member (10+)
8724	Mr	W A	Willem Adriaan	Clarke	Johannesburg	Member (10+)
10577	Mr	A H	Allen Harold	Crouch	East London	Member (10+)
10466	Mr	J P	Jacobus Paul	de Kock	Pretoria	Senior Member (40+)
13901	Mr	B J	Brett James	Duncan	Ferndale	Member
12793	Mr	T J	Theunis Johannes	Duvenhage	Western Cape	Member (6+)
10818	Mr	K P	Kevin Peter	Gibb	Johannesburg	Member (10+)
1780	Mr	N J S	Nicolaas Johannes Salmon	Grobler	Honeydew	Senior Member (6+)
11877	Mr	N R	Nicholas Robert	Hall	Durban	Member
15423	Miss	X	Ian Frank	Han	Cape Town	Member
11137	Dr	R T	Raymond Trevor	Harris	Port Elizabeth	Member (10+)
1981	Mr	W F	Wilhelm Ferdinand	Heymann	Blanco Western Cape	Member (10+)
14945	Ms	M F	Mary Frances	Hodgson-Jervis	Cape Town	Member
14283	Dr	S R	Stanley Robert	Holm	Pretoria	Senior Member (40+)
14608	Mrs	L	Lin	Jiang	Woodmead	Member
120193	Mr	S R	Sgidi Richard	Mabaso	Estcourt KZN	Associate
15451	Mr	P C	Piet Cedric	Mahlangu	Malvern JHB	Member
14394	Mr	M W	Mzwandile Welcome	Manana	Richards Bay	Student

2018 matric students awarded for STEM results



Khanyisa Dyonashe's 89% overall achievement put her first in the class for the Promaths group last year, along with a group of fellow learners whose impressive marks placed them among the top matriculants in the Eastern Cape. It's these remarkable learners that the Datatec Education and Technology Foundation, in partnership with the Kutlwanong Centre for Maths, Science and Technology, recognised and honoured at a ceremony in East London recently.

Maya Makanjee, the chairperson of the Datatec Foundation, addressed the guests and students and commended the learners for putting in the hard work required to accomplish these beautiful results. She congratulated Kutlwanong, too, for being "an effective, well-managed vehicle" that has enabled Datatec to make a small but meaningful contribution to education in South Africa. "*We realise the road ahead is long and arduous, but if we could multiply these types of partnerships in other communities, we would slowly but surely transform lives and alleviate poverty,*" she said.

The strategic partnership between Kutlwanong and the Datatec Foundation began ten years ago to help improve the quality of maths and science education in South Africa's underprivileged schools. It's a partnership that underscores how vital corporate interventions are to give previously disadvantaged learners the necessary skills for a better education. "*We are proud to say that this partnership has produced hundreds of distinctions in maths and science, as well as bachelor, diploma and higher certificate passes, and, most importantly, university graduates,*" said Makanjee.

The programme is run in the rural and township high schools of Mdantsane in the Eastern Cape, and its success is reflected in the students' meagre dropout rate, as pupils feel privileged to be part of the Pro Maths programme. The founder and CEO of Kutlwanong, Tumelo Mabitsela, spoke of how the plan cultivated and instilled a general culture of discipline and hard work that spills over into all school subjects and, as a result, most of the learners in the programme qualified for bursaries and gained access to university to pursue science, technology, engineering and mathematics (STEM) related careers.

The World Economic Forum's Global Competitiveness Report 2017-2018 ranked South Africa 128 out of 139 countries for the quality of its maths and science higher education. There are several reasons for this, but one is that the country is in dire need of teachers who are adequately equipped to teach these subjects. This is a focus at Kutlwanong, who gives teachers training and support. Teachers involved in the programme commit their time over weekends and school holidays and meet weekly to prepare lessons for the coming week.

Alumnus Noluvuyo Molose, who completed matric in 2012 with exemplary results through the Kutlwanong programme, spoke to Grade 11 learners and matriculants about her path to becoming a trainee accountant at Birchbruce Chartered Accountants. She encouraged learners to make the most of their matric-result achievements and further their learnings

through higher education. She reminded them that Pro maths Alumni Chapters are based at eleven universities throughout South Africa, including Wits University, University of KwaZulu-Natal Westville Campus and the Cape Peninsula University of Technology amongst others, to support newly enrolled students through their journey.

Department of Education Representative also attended the awards ceremony, Anil Pillay He emphasised the importance of attaining a sound education to improve career prospects and ensure a positive future. Mbasa Mguguma from Khulani High School was recognised as the top performer in maths with an outstanding score of 97% and Someleze Mjekula from Ulwazi High School was the top performer in physical science with a remarkable achievement of 100%.

Kutlwanong Centre for Maths, Science and Technology has 22 Pro Maths Centres throughout South Africa and has helped over 20 000 pupils over the past 13 years. WN

AERONAUTICAL ENGINEERING AT THE UNIVERSITY OF PRETORIA

The Mechanical and Aeronautical Engineering Department at the University of Pretoria runs a multinational, multidisciplinary vertically-integrated engineering design project focused on developing modular drone solutions for wildlife protection applications. Dr Lelanie Smith, manager of the AREND project, started this initiative as a result of a request from the University of Boulder, Colorado in 2014. It was requested on the basis that it formed part of a team responsible for developing a technological solution for the rhino poaching in the Kruger National Park and take part in a competition that was meant to be held at the end of 2014.

BY | DR L SMITH

Initially a total of four universities on three continents were involved in the project; Colorado University (CU) Boulder (USA), Helsinki Metropolia University of Applied Sciences (Finland), University of Pretoria (UP) (South Africa), and the University of Stuttgart (US) (Germany) with each university responsible for a different subsystem.

UP and US took charge of the airframe development for the drone, CU of the payload and avionics and Metropolia of the ground sensor system.

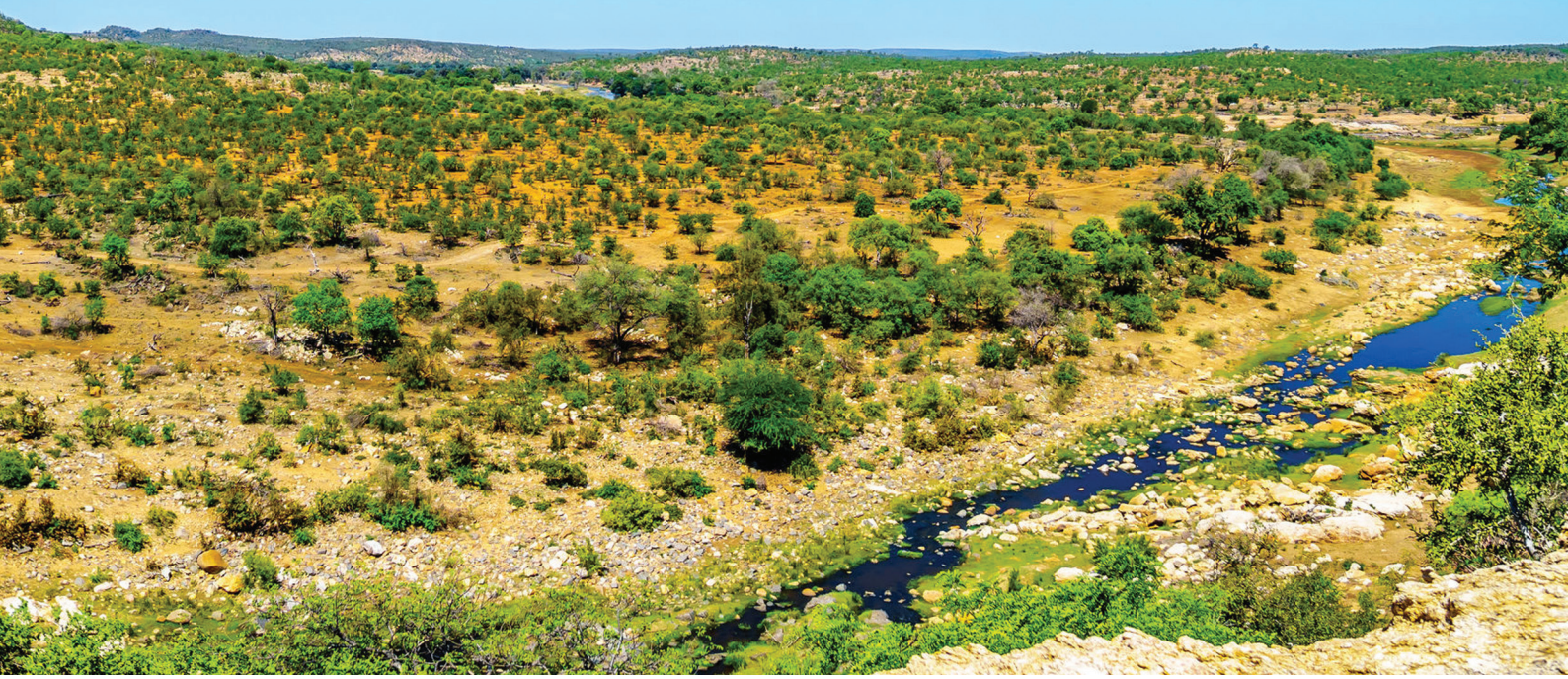
By the end of 2014, the competition was cancelled, but the team decided to continue to work on the project.

The team from SU came to South Africa to test-fly the airframe that same year. During 2015, the project was integrated into four project-based modules in the Mechanical and Aeronautical engineering curriculum, working on the next phase of integrating the payload and avionics as well as designing the necessary hardware. The team leader from CU came to UP at the end of 2015 to integrate and test the systems.

Since 2017, all activities moved to UP, with a couple of international exchange students from different universities coming over to work on parts of the system. About 20 students from 2nd year to Master's level take part in the work under Lelanie's guidance yearly. Figure 1 indicates one of the subsystem testing phases and the team involved with this stage during the end of 2017.

The vision of the project and background
The AREND unmanned aerial vehicle (UAV) was developed as a specialised aerial sensor aircraft that supports the

The AREND UAV



anti-poaching operations conducted by rangers in nature reserves in South Africa. AREND which stands for Aircraft for Rhino and ENvironmental Defence was designed and tested to distinguish between humans and large animals such as rhinoceros in harsh environments.

However, the project became a research and design platform for UAV related questions, since we are not invested in a specific airframe or sensor payload system, we merely offer the opportunity for students to learn and experiment with novel ideas as well as for some local industry partners.

Currently, there is a significant exchange of knowledge and mentorship to students involved in the project from the local industry, especially from the CSIR, Paramount Aerial Monitoring Solutions and Epsilon Engineering.

Fig 1: The Subsystem testing team

The AREND UAV

continues from page 43

THE CONCEPT

It is possible to buy multiple components or even full drone solutions off-the-shelf and provide a solution to wildlife management, however, because the intention of project AREND is to provide students with education and a platform for innovative solutions a specific concept of operations and essential system requirements were developed.

A short overview of the concept of operation and its impact on the final design decisions is that the vast area of the Kruger National Park (KNP) made it difficult to envision a surveillance drone application. A decision was made to design a drone for range rather than endurance. By dividing the KNP into six segments, with a drone base in each, where the drone could easily cover 30km search radii at a maximum speed of 72km/h. The design airspeed was a product of the time allowed to reach the area of interest, the time allotted to search within the region of interest, the size of the area of interest as well as wind and turbulence conditions in the KNP. Additional requirements were that flight must be silent, and an upper limit to the flight speed is dictated by the payload sensor system (sensor resolution, target resolution, frame rate and search frame size) to process observations of sufficient quality (Koster et al., 2016).

The battery capacity allows for 90min of search time once the targeted area has been reached. The design was kept within civil regulatory requirements, where the total weight was kept below 20kg and altitude at 120m. The altitude requirement drove the design decisions for the camera payload system and this, in turn, affected to speed required for search section of flight for optimal image capturing. An onboard processor is used to process the high-resolution images and only send GPS coordinates through the communication link to avoid bandwidth challenges. Figure 2 shows the final design of the AREND UAV.

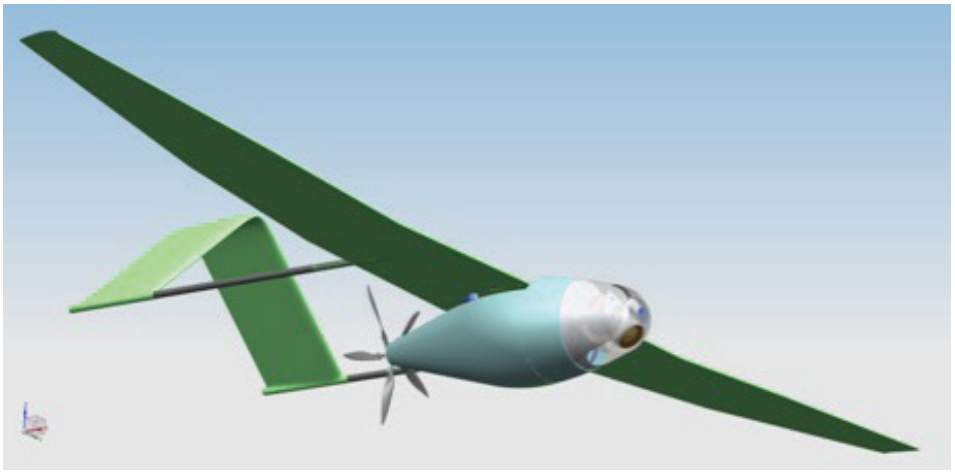


Fig 2: The AREND UAV

A SHORT OVERVIEW OF SUBSYSTEMS

The AREND consists of a pusher propeller configuration which led to implementing tail booms and an inverted tail-boom. The AREND UAV consists of multiple subsystems, which include the gimbal, landing skid, the Emergency Parachute Recovery Landing System (EPRS), catapult launching system and the electronic controls, power and propulsion systems.

The fuselage was designed as streamlined as possible while still carrying the required 3kg payload. The skid and EPRS are integrated into the centrally structured spine design of the fuselage. The nose gimbal was designed to protect the most expensive part of the payload for all landing scenarios. A catapult launch device was designed with the assistance of the AMS team and used as the launching mechanism. The aircraft is placed on a dolly which is connected to the rail of the catapult and is then launched through this system.

In 2018 the AREND UAV had its first successful flight (Figure 3), and the team is now ready to integrate the final aspects of the payload and embedded system to start testing the electronic components. The driving requirements for the embedded system design mostly align with the operational needs for the entire system: quickly and silently deliver a payload within the search sector, support modular payload sensors and provide user-friendly controls while complying with local and international laws and regulations. By achieving these requirements, the embedded system shall provide manual radio control with autonomous capabilities, maintain a communication link within a 30 km radius search sector, support modularly implemented payloads and minimise drag impacts on the airframe from embedded system components (Koster et al., 2016).

By allowing for modular sensor payloads, the embedded system divides into two

Fig 3: AREND UAV during April 2018 test flight.

major subsystems: the primary flight control subsystem and the variable payload subsystem. The primary embedded subsystem consists of the propulsion system, the autopilot and flight control system, the communication link for manual control and the central power distribution system. The payload embedded subsystem consists of the payload sensors, the camera gimbal and a dedicated power distribution system. The data communication link and payload processor are shared between the primary and payload embedded subsystems for telemetry and sensor data downlink and to integrate payload sensors with flight controls, respectively (Koster et al., 2016).

THE FUTURE OF AREND

At present, the team is working on preliminary tests with the catapult launch system after which the attention will move to the embedded systems and variable payloads. AREND will provide a platform for UP and local industry to test-run sensor payload concepts and a variety of aircraft configurations to improve aerodynamic efficiency. This will take place within the engineering education context by providing students with mentorship and opportunities for soft skill development and innovative, practical problem solving and application. We are dependent on the expertise and financial support from industry and remain open to any relief, locally or internationally. If you are interested in helping or wanting to follow us, we have a Facebook page - @teamAREND. wn

REFERENCES

Koster, J.N., Buysse, A., Smith, L., Huyssen, J.R., Hotchkiss, J., Malangoni, J. and Schneider, J., "AREND - A sensor aircraft to support wildlife rangers," 57th AIAA_ASCE_AHS_ASC Structures, Structural Dynamics,

Earn CPD Credits

Aerospace technologies in Africa

Airbus released The Great Enabler: Aerospace in Africa - a white paper on the role of aerospace technologies and their impact on socio-economic development in Africa.

The extensive report looks at how different segments of the industry can address a core set of challenges on the continent by: increasing access to healthcare; enhancing food security by making African agriculture more competitive and sustainable; promoting education, training and innovation; empowering businesses with innovative products and solutions; and breaking down barriers to the movement of people and goods across Africa.

COMPILED BY | M AVRABOS

The report was officially launched at a special summit convening African government officials, policymakers, business leaders, entrepreneurs, intergovernmental bodies and multilateral development organisations in Toulouse, France.

"The aerospace industry offers solutions to many of the socio-economic challenges Africa is facing on the path to sustainable development. A paradigm shift from thinking about aerospace as an isolated industry to a key enabler of socio-economic change is necessary to realise its benefits for a prosperous future. That is what this White Paper is aiming at, by highlighting different ways in which aerospace technology can support social and economic development in Africa," said Mikail Houari, President of Airbus for Africa and the Middle East.

The white paper analyses the role of aerospace technologies in sectors with the greatest possible impact on social and economic development including manufacturing and industrialisation, civil aviation, agriculture, healthcare and humanitarian assistance:

ON MANUFACTURING AND INDUSTRIALISATION

Many African countries are final consumers in the global aerospace value chain. Joining the ranks of producers in this value chain is challenging for many but not impossible.

The examples of Africa's current leaders in aerospace – South Africa, Tunisia and Morocco – demonstrate the complexities but also the opportunities for African countries to develop aerospace manufacturing and industrialisation capacity.

Key among these opportunities is Africa's potential demographic dividend, which will be achieved by investing in its youthful and increasingly techno-savvy population.

THE AVIATION SECTOR

The key question remains how to connect people to markets and goods in a faster, cheaper and more efficient way to maximise the sector's role as an economic engine and a vehicle for greater integration in Africa.

AGRICULTURE

This is perhaps the most significant pillar of the continent's sustainable development. However, despite employing more than 60% of Africa's population, the sector contributes only about 15% of the continent's GDP as underlying challenges persist. Aerospace technology such as precision farming could potentially reverse this situation by enabling farmers to produce more with less.

HEALTHCARE

Access to healthcare is still a challenge for many rural populations. While building on the existing technologies in the sector - new technology will further change the dynamics of access to medical care and emergency response in terms of quantity, distance and data collection.

The report also stresses the need for transparent government policies to harness the power of aerospace technology, concluding with crucial recommendations on human capital development, partnerships and financing.

The research was based on 30 in-depth interviews with a cross-section of stakeholders in Africa.

Aerospace Technologies in Africa

continues from page 21

Herewith an excerpt of "*The Great Enabler - Aerospace in Africa*".

Historically, the global aerospace industry has driven social and economic transformation around the world. Aerospace has since the beginning enabled many technological breakthroughs facilitating the connection of people, countries and cultures, providing access to global markets and generating trade and tourism.

Aerospace technologies have furthered our horizons, expanded access to education and information to the most remote areas on the planet, and revolutionised how people and businesses connect and create wealth thus improving the living standards of millions of people around the globe.
The aerospace industry offers solutions to many of the socio-economic challenges Africa is facing on the path to sustainable development. A paradigm shift from thinking about aerospace as an isolated industry to a key-enabler of socio-economic change is necessary to realise its benefits for a prosperous future. That is what this White Paper is aiming at, by highlighting different ways in which aerospace technology can enable social and economic development in Africa.

GOVERNMENT, POLICY AND AEROSPACE

Building a robust commercial aerospace industry in Africa is no longer a question of if but how. For those countries that are already part of the global aerospace value chain as well as those in the process of becoming so, the critical success factors are human capital development and creation of a business-friendly environment to become competitive.

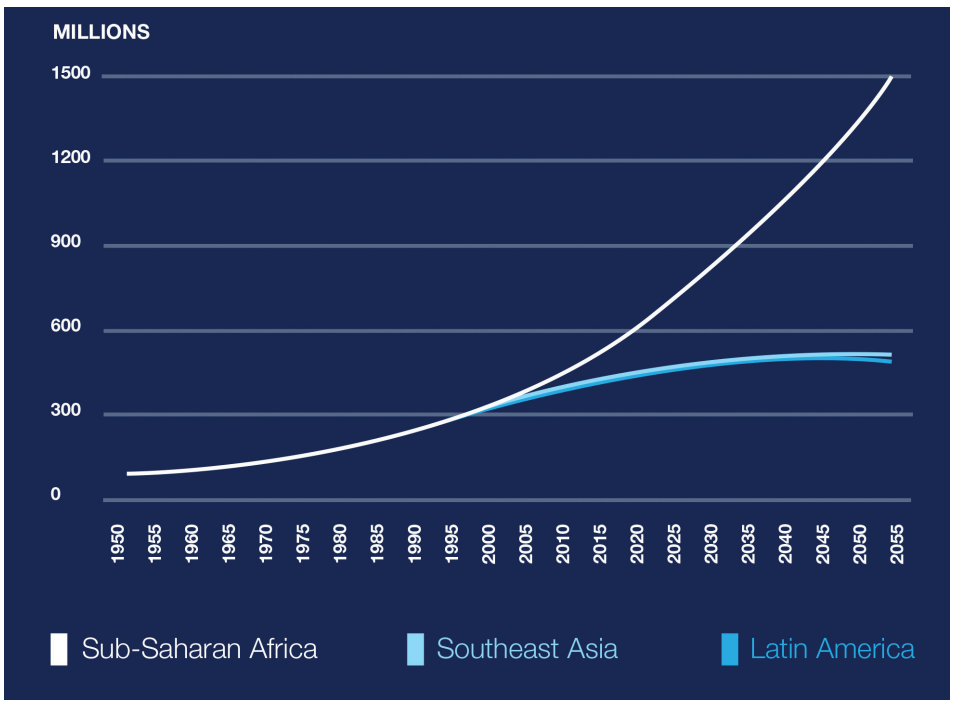


Figure 1: Trend in Working-Age Population (15-64) in Africa

To pursue these approaches in aerospace, government officials and policymakers must implement clear and realistic strategies to enable countries to reap the benefits of this robust and impactful industry.

THE OPPORTUNITY FOR COMPETITIVENESS

Africa's competitive advantage relative to many emerging and developed markets is what interviewees referred to as its potential demographic dividend – the potential for growth resulting from changes in the age structure of its population accompanied by investments in skills development and entrepreneurship.

In the last 30 years, Africa's population has almost doubled – from around 550 million in 1985 to 1.2 billion in 2015. This rapid growth is projected to continue well into this century. 46% of that growth is expected to come from young people between the ages of 15 and 24. According to the latest estimate, the populations of 26 African countries are expected to double their current size between 2017 and 2050.

The competitive opportunities offered by Africa's population growth align closely with opportunities and changes in the aerospace industry at large. To understand these opportunities, one must first look at demand and trends in commercial aerospace globally. The commercial aircraft segment offers a good example.

Air transport's centre of gravity, as measured by demand for air transport services, has moved South and East over the last thirty years. In 2017, 30% of emerging country populations took a flight. By 2037, 85% of emerging country populations will fly. As such, the global fleet of aircraft is expected to double over the next 20 years.

Figure 2: Demand for Air Travel Moves South and East

HUMAN CAPITAL DEVELOPMENT IS AFRICA'S TICKET TO COMPETITIVENESS

Harnessing the power of Africa's youthful population to create competitiveness does not happen passively. For a country or region to become competitive in a labour and capital-intensive industry like aerospace, there must be accelerated investments in people to create the right skills.

Therefore, government policies should focus on investing in this human capital – by imparting high-level skills that are essential for the development and growth of the aerospace industry in their respective countries. In Africa, policies, strategies and plans to boost competitiveness in commercial aerospace start with human capital development. The task for government is to support and stimulate this development. In many respects, Africa has a core prerequisite for developing a competitive advantage in aerospace, thanks to its increasingly techno-savvy and youthful population.

The continent has the youngest population in the world, with 200 million people between ages 15 and 24. This enterprising and techno-savvy generation has an appetite for innovation, technology and digitalisation. The driving force of change in Africa stems from a need and urgency to find fast and practical solutions to the socio-economic challenges people live with each day.

If we look at the history of financial technology (Fintech), we find that Africa was among the first regions to adopt the concept in the form of mobile payment solutions. The idea was first developed by a student from Moi University in Kenya who came up with software that could allow people to send, receive, and withdraw money from their mobile devices back in 2005.

Mobile network operator Safaricom saw an opportunity and acquired the rights and full ownership of the project, which has spread widely since. The number of Africans who have mobile money accounts now exceeds the number of those with traditional bank accounts.

This underlying dynamic – where ambition and ideas meet technology and resources – is what government officials and policymakers should seek to replicate and support across the continent both before and after their inception. Simply put, the shared goal between the public and private sectors is to increase the number of these interactions and create an environment that supports both the individuals who have ideas and institutions that have capital and know-how. This is what leads to growth.

SOME CHALLENGES PERSIST

In parallel to bolstering a competitive workforce, governments must also work to reduce persistent barriers to competitiveness. Challenges to competitiveness and human capital development in Africa persist in the areas of infrastructure and education, respectively. The imperative of investment in these areas comes from the simple fact that both create and enable skilled jobs.

INFRASTRUCTURE

Interviewees were quick to point out the disparity between high hopes for technology and workforce development in Africa and many of the deficits in infrastructure and education. Interestingly, some pointed to the "leapfrog" narrative – the notion that Africans have skipped the agrarian and industrial revolutions in favour of mobile and other digital technologies that connect people and businesses - as a liability that may be misguiding in the development of something like a home-grown aerospace sector.

The critical view is that relying on the power of the leapfrogging phenomenon alone overshadows the need to build and further develop adequate infrastructure and quality education – necessary components of global competitiveness.

Aerospace Technologies in Africa

continues from page 23

Physical infrastructure – including roads, airports, electrical grids and telecommunication networks – forms the backbone of commerce and, by extension, competitiveness. It requires a great deal of technical expertise and public funding in its own right. Experts believe African countries need to accelerate their investments significantly in infrastructure development. The latest estimate from the African Development Bank suggests that Africa's infrastructure needs amount to $130–170 billion a year, with a financing gap in the range of $68–$108 billion.

EDUCATION

When it comes to education, there is no shortage of a critical mass of labour in Africa; instead, there is a shortage of a critical mass of highly skilled labour required to be competitive in the aerospace sector.

Competitiveness is linked closely with the quality of a given country's primary, secondary and higher education systems. While Africa's younger generation is considerably more educated than older generations, thanks in part to decades of government investment, the need to improve education systems and opportunities at each level remains. There is a fundamental skills mismatch between African graduates and jobs in a high-skilled technical sector like aerospace. Less than 25% of students who graduate from African universities have degrees in science, technology, engineering and mathematics (STEM).

In addition, many interviewees cited brain drain as one of the education challenges hampering the growth of the aerospace sector on the continent. Skilled and talented minds tend to leave to the continent due to inadequate resources such as equipment and research and development capacity.

CREATING A HEALTHY BUSINESS ENVIRONMENT

The footprint of the global aerospace industry has changed significantly with globalisation – moving away from primarily home-based manufacturing and integrating other countries that now play increasingly important roles in the supply and value chains. There is a consensus among Original Equipment Manufacturers (OEMs) and other aerospace manufacturers that Africa is among the most promising markets in the world in terms of future economic and business growth, showing further interest in future investment and long-term presence in African markets. To take advantage of this, improving the business environment is a key ingredient and indicator of competitiveness in its own right.

Government visions and policies need not be aerospace-specific to generate activity in the sector. They need merely to address the systemic policy and investment challenges – in infrastructure, education and workforce development – faced by any industry aspiring for growth globally.

POLICY AND STRATEGY

The fact of the matter is that some governments in Africa have created highly competitive aerospace clusters by articulating industrialisation policies, making deliberate investments in technical education, and creating an environment attractive to entrepreneurs and investors alike. The aerospace sector has enjoyed notable growth and stability in South Africa, Morocco and Tunisia, where national governments had clear strategic visions and policies for the development of the industry at large.

Other countries that have adopted strategies to enable the development of aerospace include Ethiopia and Cote d'Ivoire.

The positive remarkable of the first Growth and Transformation Plan (GTPI) in Ethiopia has led to achievements in real GDP growth, infrastructure development, social development and capacity-building at all levels. During the implementation period of GTPI, public participation, the common cause and spirit of development, and a sense of ownership are credited with stimulating real growth and prosperity for Africans. These achievements led to the introduction of a second Growth and Transformation Plan (GTPII), which places a high focus on creating an industrialisation policy that explicitly includes the aerospace sector. The country has also set an ambitious target known as Vision 2025, which aims to make Ethiopia the leading manufacturing hub in Africa, including within the aerospace industry. As part of that vision, Ethiopian Airlines, whose global expansion has driven the broader economic development policy agenda in Ethiopia, entered into an agreement with South Africa's Aerosud to establish a joint-venture – an aerospace manufacturing company that plans to manufacture and supply various aircraft parts to OEMs.

Côte d'Ivoire has also implemented an economic development policy model that has been successful in driving foreign investment to the country and created interest in its aerospace potential. The 2012 Investment Code offers incentives including tax reductions and exemptions from value-

SOCIETAL NEEDS	POLICY FRAMEWORK	INFORMATION AND PRODUCTS
FOOD SECURITY	COMPREHENSIVE AFRICA AGRICULTURE DEVELOPMENT PROGRAMME (CAADP)	RAINFALL, YIELD, PRODUCTION, CROPS DISTRIBUTION, SOIL AND LAND SUITABILITY
WATER RESOURCES	AFRICAN WATER VISION 2025	HYDROGRAPHY, AQUIFERS, WATER BODIES, QUALITY, WASTE WATER
MARINE AND COASTAL ZONES	2050 AFRICA'S INTEGRATED MARITIME STRATEGY (AIMS)	COASTAL ZONE DEGRADATION AND FISHING POTENTIAL
ENVIROMENT	NEPAD ENVIROMENT ACTION PLAN	ECOSYSTEMS, BIODIVERSITY, VEGETATION AND LAND COVER
WEATHER AND CLIMATE	CLIMATE FOR DEVELOPMENT IN AFRICA (CLIMDEV AFRICA) AND THE INTEGRATED AFRICAN STRATEGY ON METEOROLOGY	RAINFALL, TEMPERATURE, WIND, AEROSOL AND CLIMATE TRENDS AND EXTREMES
SECURITY AND DISASTER RESPONSE	AFRICA REGIONAL STRATEGY ON DISASTER RISK REDUCTION AND THE CONVENTION ON CYBER SECURITY AND PERSONAL DATA PROTECTION	RISK AND VULNERABILITY DATA
HEALTH PLANNING	AFRICA HEALTH STRATEGY	DISEASE VECTORS, ENVIRONMENTAL FACTORS, POPULATION DISTRIBUTION
GOVERNANCE AND COMMERCE	E-GOVERNMENT STRATEGY	LOCATION-BASED MOBILE SERVICES, MAPPING OF GOVERNMENT INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INFRASTRUCTURE
INFRASTRUCTURE	PROGRAMME FOR INFRASTRUCTURE DEVELOPMENT IN AFRICA (PIDA)	SPATIAL INFORMATION ON KEY INFRASTRUCTURE, SUCH AS TRANSPORT INFRASTRUCTURE, ENERGY SOURCES AND POWER SYSTEMS, AND DISTRIBUTION NETWORKS
INFORMATION AND COMMUNICATION	REFERENCE FRAMEWORK FOR HARMONIZATION OF TELECOM / ICT POLICES AND REGULATIONS IN AFRICA	TELECOMMUNICATIONS, INTERNET, TELEVISION BROADCASTING, MOBILE COMMUNICATIONS, E-COMMERCE, E-GOVERENMENT AND E-LEARNING
INNOVATION	SCIENCE, TECHNOLOGY AND INNOVATION STRATEGY FOR AFRICA (STISA)	FOOD SECURITY, DISEASE PREVENTION, COMMUNICATIONS AND SECURITY

Table 1: Policy Framework Responsive to Key Challenges on the African Continent and the Space-based information products that support it.

On January 31, 2016, the African Union adopted the African Space Strategy and subsequent Space Policy – representing the first concrete steps toward realizing an African Outer space program. The policy is considered a flagship program under the wider African Union Agenda 2063. Conceptually, the strategy's adoption and implementation is supported by adjacent frameworks – notably the Science, Technology and Innovation Strategy for Africa 2024. More-over, is was an expression of consensus that all member nations see space technology specifically as touching each and every existing development framework for the continent's social and economic needs. While these frameworks prioritize and address specific socioeconomic challenges, they also create fertile ground for the development of a competitive African aerospace sector.

Aerospace Technologies in Africa

continues from page 25

added taxes (VAT) on equipment for private investors. The code also includes planned industrial zones that provide benefits to investors depending on the location of the investment. There are also incentives to promote the development of factories and transportation infrastructure key to the country's broader economic growth.

At the continental level, the African Union's Agenda 2063, which is a strategic framework for the socio-economic transformation of the continent over the next 50 years, is an excellent place to start for national governments in search of a playbook for aerospace development.

INVESTMENT: PARTNERSHIPS AND FINANCING

Creating policies that promote attractive business environments where industries like commercial aerospace can thrive cannot happen without investment. These policies merely set the stage for establishing partnerships with the private sector and development finance institutions (DFIs) to unlock financing where it is needed.

Today, the private sector in Africa is acting as a key driver of the continent's economic development – more so than in years past. To capture the opportunities of knowledge transfer and drive more foreign direct investment (FDI), African governments are entering into public-private partnerships (PPPs) with local and global private sector organisations.

In June of 2018, the Government of Côte d'Ivoire signed a Memorandum of Understanding (MoU) with Airbus to establish a framework of collaboration to support the development of the country's aerospace industry, which the government has identified as strategic for its socio-economic development for many of the reasons outlined in Figure 1 above. Under this agreement, Airbus will work closely with the government through sharing expertise to support efforts in building a viable aerospace sector. This includes a component of training and skills development.

Interest from international investors ideally and predictably follows the policies and partnerships forged locally in a given sector. Overall, the United Nations Conference on Trade and Development (UNCTAD) estimated that overall FDI inflows to Africa fell to $42 billion in 2017 – a 21% decrease from 2016. However, there is a positive correlation between FDI inflows and those African countries that have taken steps to lay the groundwork in either aerospace or advanced manufacturing capacity. New legislation on PPPs in Tunisia, an important manufacturing hub and growing aerospace ecosystem, kept FDI inflows relatively stable at nearly $1 billion in 2017. In Morocco, another country where government incentives and investments have been offered to aerospace and other advanced manufacturing sectors, FDI inflows across industries increased by 23% to $2.7 billion in 2017. Countries with established or emerging national air carriers, such as Ethiopia, Morocco, and Egypt, were among the top five African host economies for FDI in 2017.

In conclusion, many of the policy opportunities and hurdles African governments face – in workforce development, infrastructure and education – are not new challenges and certainly not unique to building a competitive aerospace industry. The transformational visions and strategies set forth at the continental level are healthy and sound frameworks. They serve a critical function in raising awareness about the challenges and opportunities Africa faces. As some trailblazing African countries begin to build viable and valuable aerospace capacity, getting these critical components right takes on new urgency for national governments as they benchmark against their peers and explore the economic possibilities in front of them.

MANUFACTURING AND INDUSTRIALISATION

Building industrial capacity has long been a critical priority for African economic development due to the potential benefits in terms of creating jobs, developing SMEs, turning innovation into commercially viable products and increasing competitiveness. As such, industrialisation is a key feature of the African Union's Agenda 2063.

Building home-grown aerospace, industrial capacity is critical. The scale of high-value skills, direct and indirect jobs, increase in government revenues as well as local and foreign investment is alluring. The rise of aerospace manufacturing clusters and the economic resilience that comes with them – in South Africa, Tunisia and Morocco - makes this point.

THE STATE OF AEROSPACE INDUSTRIAL CAPACITY IN AFRICA

Most examinations of the global aerospace industry begin by valuing "all in-country activities on the development, production, maintenance and support of aircraft and spacecraft."11 In 2017, the global aerospace industry, including sub-tier suppliers, who account for 54% of the industry's overall production, was valued at $838 billion.

Industry size ($B)	South Africa	Morocco	Tunisia
	$1.8	$1.1	$0.43

Table 2: Industry Size of Africa's Top Aerospace Clusters

Three African countries - South Africa, Tunisia, and Morocco – are among the 45 largest aerospace manufacturing nations in the world, as measured by the value of components produced, mainly for export. The rise of Tunisia and Morocco in the past two decades has been primarily powered by their proximity to key European aerospace powers.

The key benefit of the aerospace industry, especially in Africa, is the number of highly skilled jobs it creates – both directly and indirectly. South Africa's aerospace sector directly employs around 15,000 highly skilled engineers and is estimated to support at least 60,000 further skilled jobs in the economy. This is a multiplier effect of roughly 1:4.

In Tunisia, it is determined that aerospace manufacturing directly employs more than 9,000 people.13 Morocco's aerospace manufacturing cluster, which consists of more than 110 companies, directly employs around 11,500 people.

South Africa and Morocco are ranked 33rd and 36th respectively in terms of the total size of their aerospace industry. Morocco has more than 100 aerospace facilities dedicated to aerostructures, components and wire harnesses.14 In Tunisia, there are around 70 export-oriented aerospace companies that employ about 13,000 people. The Tunisian Aerospace Industry Association (GITAS), a leading Tunisian aerospace industry trade organisation, has 40 member companies.

Morocco's push for international investment in its aerospace sector may serve as a template for emerging nations seeking to develop an aerospace industry. Morocco has seen a rapid growth of its aeronautical sector; official figures through 2016 said the industry had seen export sales grow tenfold, to $1 billion. Revenue growth has risen 17 per cent per year, on average, since 2009.

CHALLENGES TO BUILDING AN AEROSPACE ECOSYSTEM

The prerequisites for any African country aspiring to build an aerospace ecosystem and find its place in the global supply and value chains include adequate infrastructure, human capital and access to financing.

Developing aerospace clusters requires stable and efficient infrastructure – from power-supply, access roads, free zones, ports, and other facilities. Countries like Tunisia plan further massive investments in the development and provision of free zones, industrial areas, ports, airports, highways, and energy generation, alongside the creation of the Tunisia Aeronautic Valley to host new entrants to the sector. Morocco boasts many economic free zones that provide an essential platform for the country's growing aeronautics sector. These include Casablanca's Aeropole Nouaceur and Midparc free zones, in addition to zones with aerospace facilities in Tangier; Kenitra, north of Rabat; Oujda, in northeast Morocco; and Sale, near Rabat.

Necessary infrastructure such as power supply and road access still represent challenges even for more massive aerospace clusters. According to the senior executive of Tunisian FIPA, many African countries still have substantial infrastructure gaps, which increase the cost of doing business. These countries must develop a "high industrial readiness index" by accelerating investments in other critical infrastructure such as roads, ports and rail, aviation and ICT, which will position them as a competitive destination of choice Investing in human capital is also critical for building an aerospace ecosystem. Although creating a strong base of highly skilled aerospace professionals is still a challenge for those aspiring to join the commercial aerospace value-chain, some countries have made significant steps towards this by taking deliberate strategies at the national level. For instance, the Morocco-based Aviation Professions Institute (IMA), which gives vocational training for professionals in the sector, aims to train 800 aviation and aerospace professionals per year. The institute is the result of a partnership between the Government of Morocco, the Group of Moroccan Aviation and Aerospace Industrialists (GIMAS) and the Union of Metallurgical Profession Industries (UIMM).

Another significant challenge closely linked to the industrial infrastructure gap is access to private financing due to an unfavourable view of the perceived risks

Aerospace Technologies in Africa

continues from page 27

and returns compared to other emerging markets. None were advocating for a retreat of capital from Africa but only felt that in a lot of countries the discussion of aerospace industrialisation was slightly premature – often describing the relationship between adequate infrastructure and equity as a "chicken and egg" scenario. Nevertheless, international finance experts see a viable path forward in the long-term through two critical solutions for attracting capital, in conjunction with infrastructure improvements: the ability to secure a sovereign guarantee on financing and the existence of a profitable future business plan.

BUILDING PARTNERSHIPS AND INVESTING IN ENTREPRENEURS TO GROW ECOSYSTEMS

A one-size-fits-all approach rarely works, especially in a place as geographically, economically and culturally diverse as Africa. Nonetheless, two distinct schools of thought emerged among interviewees on how African countries are aspiring to build aerospace; industrial capacity can get there.

The first is focused on collaboration with Africa's existing aerospace hubs to allow the region to capture more value from the aerospace clusters that do exist, relying on cooperation between countries - and companies. The second is focused on putting the basic building blocks of an aerospace technology ecosystem in place in countries that do not have a clear link to an existing hub. These two approaches do not necessarily exclude each other.

For those more interested in building ecosystems from the ground up, the focus is on government and private sector initiatives to support skills growth and talent development. Contributors to this paper agree that education is a base for building a local aerospace industry for the future. Kenya and South Africa are examples interviewees commonly cited as African countries adept at sourcing and cultivating talent to support their industrial ambitions. Strong higher education institutions and frequent collaboration between the government and private sectors are cited as pillars of that strength.

The rise of foreign and African investment in innovation and entrepreneurial hubs across Africa serves a complementary function primary, secondary and higher education on the continent. The popularity and proliferation of accelerators, incubators and other programs supporting entrepreneurship in Africa are likely to be a driving force behind any growth in its aerospace industry. These hubs do not need to be aerospace specific to help the industry's development. As a result, we see an increasing number of OEMs and engine manufacturers investing in incubators of their own and establishing venture funds. Increasing the industry's engagement with hardware and software innovators is ultimately a hedge against competition from new places and in line with how customer needs are evolving. This is especially true in advanced data analytics and artificial intelligence realms. In our interviews, entrepreneurial ecosystems – that convene universities, the private sector and entrepreneurs - were commonly cited as a critical and competitive necessity not only for workforce development but in attracting capital at scale – often alongside more formal education.

GSMA estimates that there are now 442 active tech hubs in Africa. In summer of 2018, Google announced plans to open its first global Artificial Intelligence research centre in Accra, Ghana. The company also decided on Lagos in Nigeria when setting up its first Launchpad Accelerator outside its home market in the U.S. Facebook followed suit by launching its hub, even in Lagos. More established African-born hubs like MEST and AfriLabs have also increased their footprint across the continent.

Sweeping pan-African policy frameworks are focused heavily on a paradigm shift toward prioritising STEM education and offering incentives for young talent to remain in Africa and contribute to aerospace industry growth. The task falls mainly to national governments to encourage and support this sort of skill development. Projects such as Airbus BizLab, Flatlab and other similar incubators are a step in the right direction as long as they are complemented by supportive, business-friendly policies at the local level and continuing government investment in technical education.

CIVIL AVIATION - AN ESSENTIAL ECONOMIC ENGINE

Despite the global economic growth, civil aviation in Africa has long been a victim of the same challenges – namely a lack of bilateral agreements on civil aviation, high operating costs, volatile taxation and persistent perceptions of poor safety. For years, getting from point A to point B by air was only possible through hubs outside Africa. The introduction of direct intra-African flights proved non-competitive in terms of pricing. This hampered African economic development and reduced African countries' ability to trade efficiently with the world. This section assesses the

current state of air transport in Africa and how aviation can make an immense contribution to the continent's socio-economic development.

African aviation supports approximately 7 million jobs and contributes more than $80 billion in GDP. In the past, the African market was even more fragmented. In 1999, twelve African countries agreed in principle to implement the landmark Yamoussoukro Decision, launching the first attempt at market integration and liberalisation, which would add an estimated 155,000 new aviation-related jobs and $1.3 billion in annual GDP for the continent. However, this effort was never quite realised in full – perhaps only by the few who moved to implement liberalisation policies with their neighbours and were, in turn, rewarded for it.

According to a 2014 IATA report on the economic benefits of implementing the Yamoussoukro Decision, an agreement of a more liberal air transport market between South Africa and Kenya in the early 2000s was credited with increasing passenger traffic by nearly 70%. Allowing the operation of a low-cost carrier (LCC) between South Africa and Zambia led to an approximately 40% reduction in fares and a sizable increase in traffic. When Morocco signed an open skies agreement with the EU in 2006, traffic increased by an estimated 160% and the number of routes between Morocco and the EU more than tripled between 2005 and 2013.

Today, the promise of African air transport is mainly defined in terms of the demographic, economic and policy hurdles faced by the underserved African air transport market. Africa is home to 16% of the world's people but accounts for less than 3% of global air service.20 For Africans, the cost of a plane ticket is prohibitively expensive: 45% higher than anywhere else in the world according to industry officials we spoke with. The continent accounts for 30% of earth's total land area but remains the most challenging terms of road network density. In terms of the distance between its largest population centres, Africa has the third largest distance between them, only behind Latin America and Asia Pacific.

LIBERALISATION REMAINS THE BIG PRIZE

During 2018, the long-running global push to open African skies benefited from the signing of the Single African Air Transport Market (SAATM) by 23 countries, committing to shift toward a continental approach in liberalising the market, which would increase connectivity and reduce the unit costs for both airlines and passengers. IATA supported the African Union's efforts with SAATM as the only feasible solution for meaningful industry growth.

Perhaps most significantly, enhanced air service can facilitate many other sectors by supporting increased trade, attracting new businesses to the region, encouraging investment and boosting productivity.

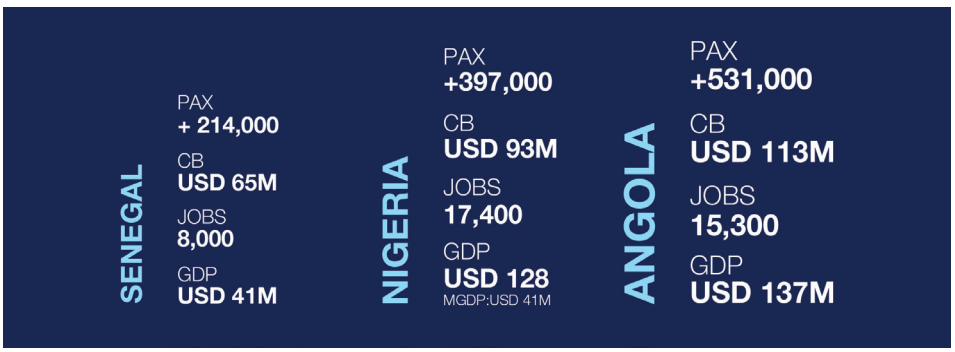


Figure 3: IATA/InterVISTAS Estimated Impact of Liberalisation in Senegal, Nigeria and Angola (2014)

Figure 4: Historical Tourism Export Revenues in Africa

Aerospace Technologies in Africa

continues from page 29

Industries and activities that would otherwise not exist in an area can be drawn by improved air transport connectivity.

The induced benefits to trade, investment and productivity not directly related to aviation activities from liberalised air services were estimated at 42,000 jobs across the 12 countries studied, generating additional incremental GDP of $343 million.

However, SAATM is also viewed with scepticism and reservations by certain governments and airlines on the continent, who do not see its immediate benefits.

Interestingly, intra-African tourism is developing despite SAATM to some considerable extent; and contributes more to overall tourism traffic than many give it credit for. This growth is attributed to the increasing size of Africa's middle class.

Successful implementation of SAATM will have a positive impact beyond tourism. In the 12 countries IATA's report examined in 2014, open skies could generate an estimated $1.3 billion of additional spending. Tourism has the potential to stimulate the growth in a wide range of economic sectors – from manufacturing to construction, to more advanced industries such as telecommunications, finance and professional services. Indirect socioeconomic benefits extend to sub-sectors such as taxi and transportation services as well as food sales, both of which provide jobs for thousands of people on the continent.

The growth of tourism and indirectly air transport is dependent on other government policies like free travel and visa liberalisation. The African Union's goal of an utterly visa-free continent by 2020 should significantly boost regional traffic.

Last year the African Union launched the African Passport program, but this document is currently available only to top diplomats. Seychelles is now the only country to offer visa-free access to all other African nationals.

Rwanda implemented a visa-on-arrival system in 2013 that enables African citizens to stay in the country for up to 90 days and since then has seen the number of visitors increase by more than 100%.

TACKLING THE CHALLENGE OF LOCAL TALENT RETENTION AND TRAINING

The global shortage of qualified pilots may well hinder a growing aviation sector. According to an Airbus forecast, Africa will require over 21,000 new pilots and 22,000 new technicians to operate, support and maintain the continent's future aircraft fleet by 2035. Airline executives interviewed for this report cited talent retention as a critical challenge and opportunity for Africa.

The training and licensing process are currently very fragmented, and unlike Europe, where captains from one country can work for other European carriers, African aviation professionals are often constrained to their home countries. Airline executives agree that investing in African talent, training and education can lead to talented people leaving for better-paid jobs in the Middle East or Asia.

The solution for aviation brain drain according to Girma Wake, former CEO of Ethiopian Airlines, could be in establishing a cross-country licensing model and setting up Centers of Excellence where aviation talent of different nationalities could

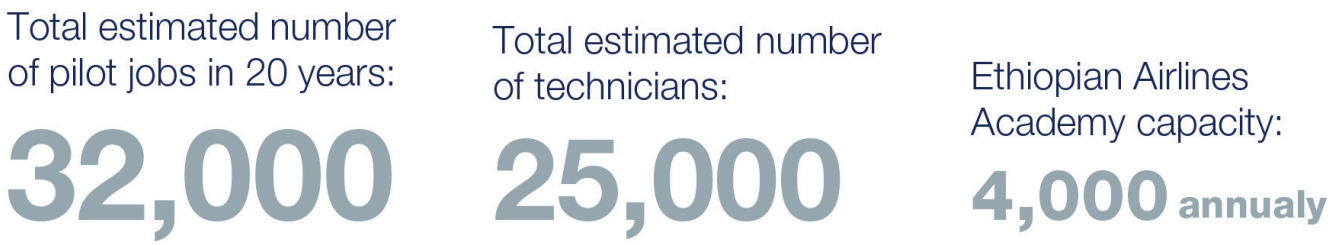


Figure 5: Training and Job Opportunities offered by Air Transport Africa

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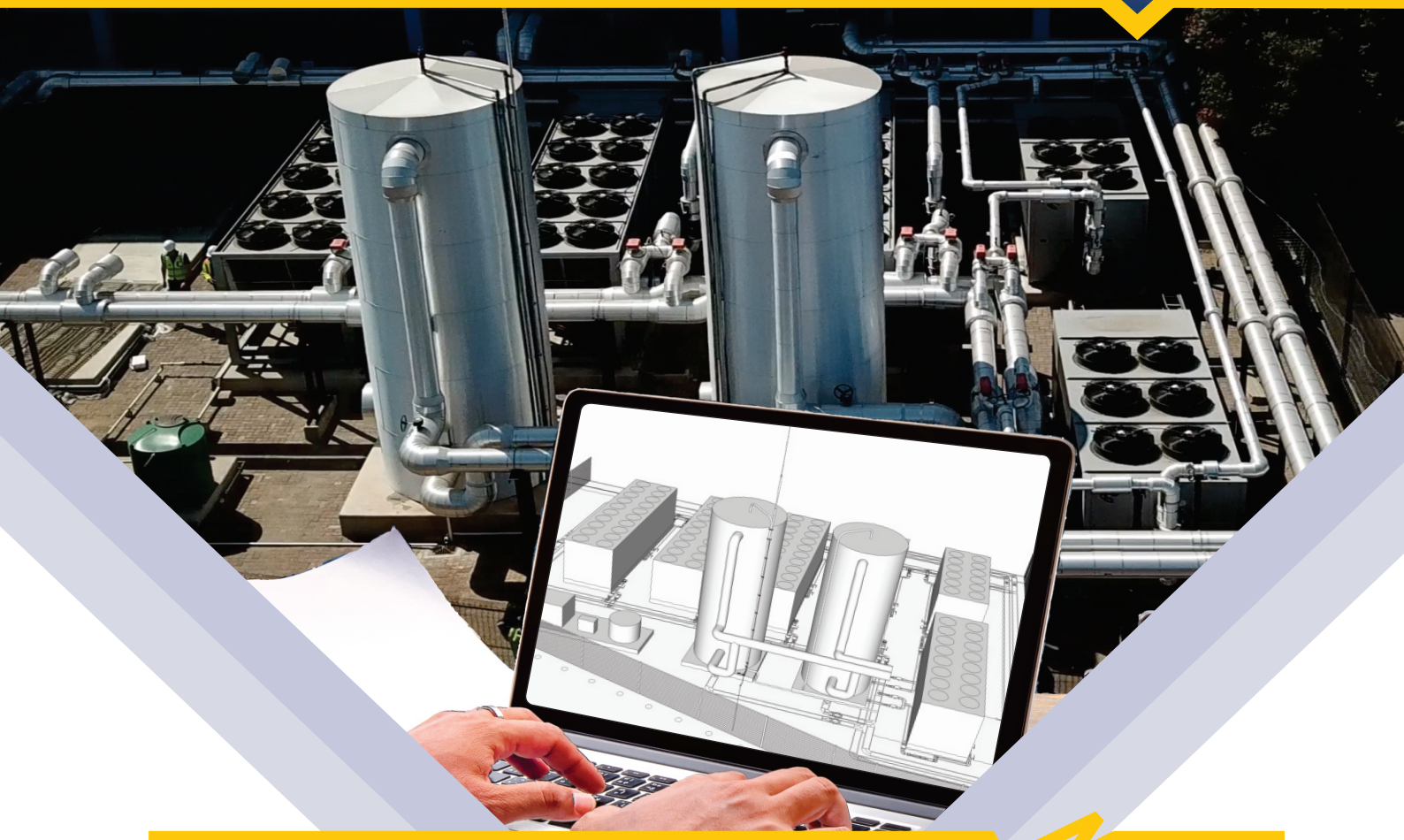

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Aerospace Technologies in Africa

continues from page 30

receive their training. As IATA's senior executive pointed out, many non-African pilots are operating in Africa because they have experience and young African pilots have a hard time breaking into the system. Regional cooperation and cross-country licensing are vital to keeping the best and the brightest aviation talent on the continent.

Partnership on issues like the pilot shortage, which threaten the viability of the industry at large, is essential. Some countries like Ethiopia and Nigeria are pioneering training academies to fulfil their needs but are also open to cooperation with other African countries. IATA's Airline Training Fund in Africa offered training to nearly 2,500 African aviation professionals this year alone.

FACILITATING AIRCRAFT AND INFRASTRUCTURE FINANCING: OPPORTUNITIES IN PUBLIC-PRIVATE PARTNERSHIPS

Access to capital was unanimously defined as another key challenge facing air transport in Africa. Financing experts such as Benoit Chevalier of One2Five Advisory firmly believe that the future is in PPPs and building an ecosystem with motivated stakeholders.

Developing a competitive commercial airline through a partnership between public and private entities can complement each other. Such partnerships are in fact, necessary.

The African Development Bank (AfDB) is currently developing its Aviation policy. Financing fleet growth and the ancillary needs of airlines is one of the key issues to address: Some of our interviewees confirm that creating economies of scale (i.e. pan-African alliances) would be a good way forward to reduce the unit cost of aircraft and to obtain the trust of the financing institutions.

The long-term benefits of implementing frameworks like SAATM will take time, but there are other policy mechanisms that interviewees thought deserved attention – like the Cape Town Convention and Protocol - which enhances legal certainty and lowers the cost of acquiring and leasing modern, fuel-efficient aircraft and many other mobile assets.

Putting in place the right infrastructure needed to make an economy run is paramount to attracting capital.

In the last 10 years, countries such as Ethiopia, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, Rwanda, South Africa, Tanzania, Uganda, and others have entered into forms of PPPs on infrastructure projects across several industries, including the construction of roads, power generation, telecommunications, and now, aerospace manufacturing.

Development finance organisations such as the World Bank, the International Finance Corporation (IFC), and African Development Bank (AfDB) also have vast portfolios of projects, including in the air transport segment – often dealing with airport revitalisation, connecting multi-modal infrastructure and, occasionally, supporting airlines.

This is particularly notable given that the mission of such institutions is to eradicate poverty and create wealth, thus corroborating and reinforcing the essential link between aviation, infrastructure and the wider socio-economic development of the continent. In 2017, the World Bank's global portfolio for air transport development projects stood at $1.03 billion with numerous projects across Africa and other developing markets. As of 2017, the African Development Bank has invested in 30 airport projects across Africa.

Between 2004 and 2017, around 30 African countries have developed laws or are in the process of drafting PPP laws. However, there have been 17 transactions related to PPPs at a total investment of $8 billion, excluding energy and telecommunication projects. Africa's Program for Infrastructure Development in Africa (PIDA) envisages 400 such PPP projects, many of which will have direct or indirect links to supporting air transport infrastructure.

As a policy and practical matter, the public sector's ability to secure financing is key to increasing the number and viability of PPPs according to finance experts interviewed.

THE FUTURE OF AIR TRANSPORT IN AFRICA

SAATM is a massive opportunity for the 23 African governments that have signed it as well as the remaining countries expected to sign – a chance to grow connectivity, increase revenues, codeshare and build alliances between airlines to drive income into African economies. Those countries generate around 70% of the total air travel and are a powerful force capable of bringing long-awaited change.

It's clear that governments need to shift their focus from protectionism to collaboration and from total ownership control to building partnerships with the private sector. Africa

can certainly benefit from more private airlines and private concessions of airport infrastructure. Tourism has huge potential on the continent, and its further growth is dependent on the full implementation of a visa-free regime for inter-African tourists and more intra-African travel options for international tourists.

The perception of poor safety remains the battle airlines and governments need to win. The reality is that Africa's safety record has been outstanding in the past two years, but there is very little messaging internationally to highlight and support that fact. Lingering perceptions of a poor safety record hurt all African airlines.

CONCLUSION

Aerospace offers solutions and applications to solve or begin to address many of the socio-economic challenges Africa is grappling with on the path to sustainable development.

A shift in thinking about the sector as private industry to a great enabler of socio-economic transformation - is necessary to realise its vast benefits for a prosperous and sustainable future.

From the numerous testimonials of how aerospace technologies are being applied to power social and economic transformation - in government, manufacturing, civil aviation, agriculture and healthcare– emerged a set of standard, cross-sector values that are instructive for the future.

These themes form a broad framework of solutions that are capable of unlocking the potential of the aerospace sector not solely for the industry's benefit, but for that of Africans as they chart the course to 2063.

We distilled these themes into three more general recommendations, which apply to public and private stakeholders across the aerospace industry. wn

Download the complete White Paper here.
The Great Enabler: Aerospace in Africa

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Another milestone for the SKA radio telescope in South Africa

The Department of Science and Technology (DST) has welcomed the adoption of the Integrated Environmental Management Plan (IEMP) for phase one of the Square Kilometre Array (SKA) in South Africa.

COMPILED BY | M AVRABOS

On Friday, 22 March 2019, the Minister of Environmental Affairs, Ms Nomvula Mokonyane, gazetted the adoption of the Integrated Environmental Management Plan (IEMP) for the Square Kilometre Array Phase 1 Mid-Frequency Array (SKA1_MID) in South Africa.

The IEMP is the environmental management instrument for SKA1_MID (and an exclusion for requiring environmental authorisation in terms of NEMA), and is the first of a number of licenses required for the construction of the radio telescope in the Karoo region of South Africa.

This is the first time, at a national level, that an environmental instrument like the IEMP has been adopted in South Africa. This approach has been provided for in terms of Chapter 5 of the National Environmental Management Act, to enable for the

streamlining and simplification of the environmental legislative framework for large-scale strategic developments such as the SKA.

The IEMP provides a consolidated management plan including the minimum requirements for the construction and operation phases of the SKA1_MID, and includes the environmental principles to be adopted, the environmental monitoring and control activities, as well as the long-term research monitoring programmes to be implemented on the SKA site in the Karoo.

"The development of the IEMP for the first phase of the SKA, and the gazetting of its adoption by Minister Mokonyane, is yet another milestone towards the realisation of the SKA mid-frequency array in South Africa. It follows soon after the signing of the SKA Convention (and the forming of the Intergovernmental Organisation), and one month after the approval of the detailed design of the infrastructure and power for the SKA in South Africa," said Dr Rob Adam, Managing Director of the South African Radio Astronomy Observatory.

The MeerKAT and the SKA projects are one of the 18 Strategic Integrated Projects (SIPs), of the Presidential Infrastructure Coordinating Committee (PICC), which was established to fast-track the development of social and economic infrastructure in the country. The Department of Environmental Affairs has committed to working with the PICC to facilitate efficient environmental management processes for the various SIPs.

The Council for Scientific and Industrial Research (CSIR) was appointed to undertake the SKA1_MID Strategic Environmental Assessment (SEA).

The SEA study, which took three years to complete, covered an area of approximately 628,200 hectares of land in the Karoo, divided into two sub-areas: The *"SEA Core Study Area"*, which consists of 38 land parcels, and covers an area of approximately 131 200 hectares; and the *"SEA Spiral Arm Study Area"*, which includes 131 land parcels, and covers an area of approximately 497,000 hectares. The overall study area

SKA Milestone

continues from page 36

falls within four local municipalities: the Kareeberg Local Municipality, the Hantam Local Municipality, the Siyatemba Local Municipality and the Karoo-Hoogland Local Municipality. The largest towns surrounding the SEA study area are Carnarvon, Williston, Van Wyksvlei and Brandvlei.

The SEA process was guided by a Special Advisory Committee, which included key government departments and state agencies. In addition, provincial and local government consultations were undertaken to further inform local and provincial authorities. Consultations with other key stakeholders from conservation agencies and representatives from other key sectors (e.g. Civil Aviation, Defence, Heritage Resources) also took place, to share information and obtain inputs and expert advice on specific issues/technical aspects of the SEA.

The SEA assessed the potential impacts that the proposed activities for the construction and operation of the SKA1_MID may have on local agriculture, heritage (including archaeology, paleontology, cultural heritage and visual/landscape aspects), terrestrial ecology and biodiversity, including avifauna, aquatic ecosystems, as well as socio-economic aspects. Specialist findings and recommendations were included in Chapter 3 (State of the Environment), Chapter 5 (Environmental Management Programme) and Chapter 6 (Research and Monitoring Programmes) of the IEMP. Further aspects of sensitivity in terms of aviation, defence, telecommunications, weather services, mining, water use, waste management, noise and traffic effects were also investigated in consultation with the relevant authorities and stakeholders. The specialist reports were reviewed by independent experts, who provided input and contributed to improving the scoping level.

The National Research Foundation, through its national facility, the South African Radio Astronomy Observatory, and the International SKA Organisation, will now be required to comply with the conditions contained in the Government Gazette Notice. The The SKA SEA and IEMP report reads:

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR THE SKA PHASE 1 MID-FREQUENCY ARRAY

The MeerKAT and the SKA projects are one of the 18 Strategic Integrated Projects of the Presidential Infrastructure Coordinating Committee, as part of the National Development Plan. The National Development Plan is intended to transform the economic landscape in the country, create a significant number of new jobs, strengthen the delivery of basic services and support the integration of African economies.

The Department of Environmental Affairs has committed to contribute to the implementation of the National Development Plan by undertaking Strategic Environmental Assessments, to integrate the regulatory environmental requirements for the Strategic Integrated Projects, while safeguarding the environment.

In 2015, the Council for Scientific and Industrial Research was appointed to undertake a Strategic Environmental Assessment for the SKA Phase 1 Mid-Frequency Array, which is to be constructed in the Karoo Region of South Africa.

WHAT IS A STRATEGIC ENVIRONMENTAL ASSESSMENT?

As defined by Sadler and Verheem (1996), the a Strategic Environmental Assessment is a systematic process for evaluating the environmental consequences of proposed policy, plan or programme initiatives, in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision making on par with economic and social considerations.

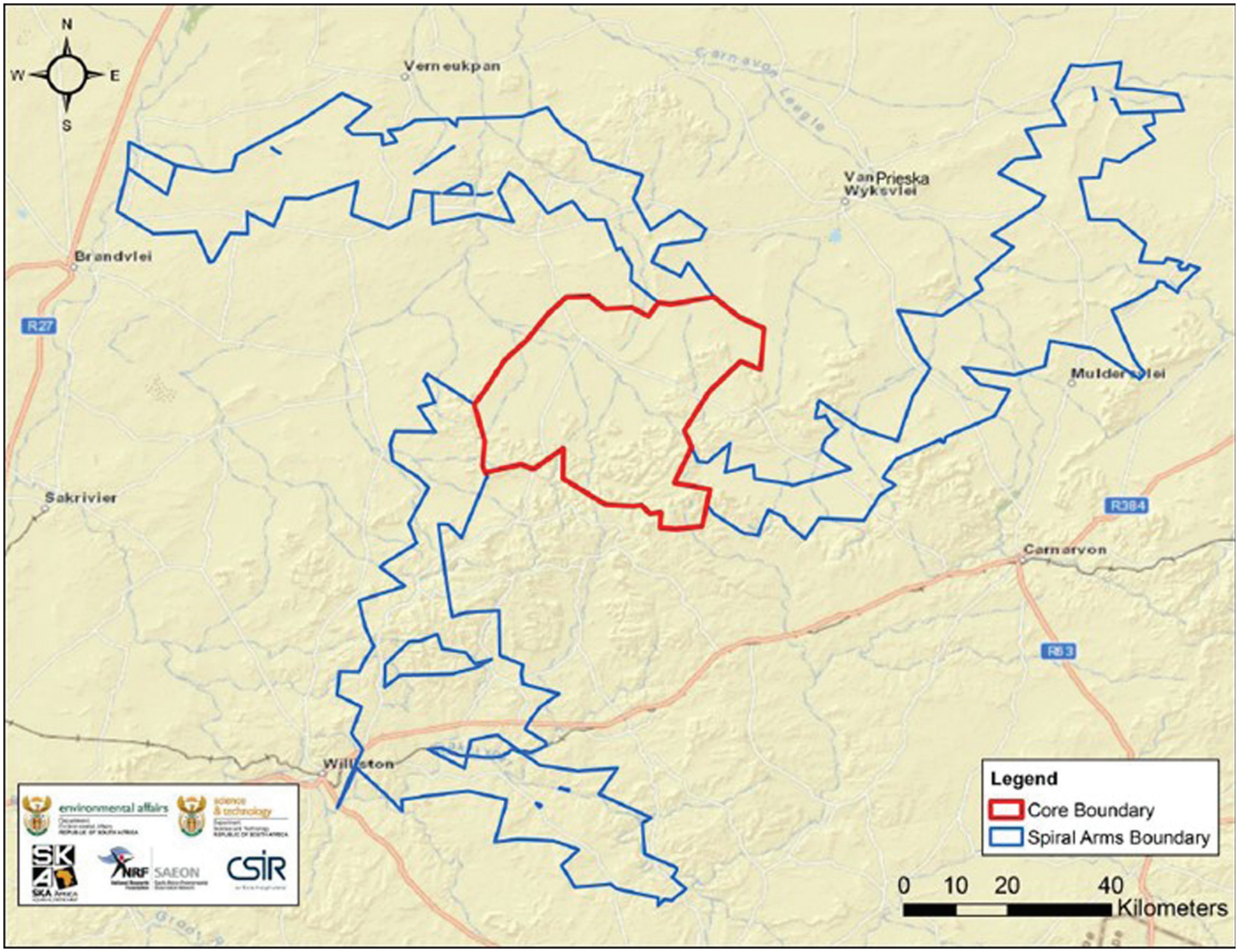
In South Africa, Strategic Environmental Assessments are undertaken to evaluate the opportunities and constraints of large scale strategic developments at the regional and national scales.

SKA PHASE 1 MID-FREQUENCY ARRAY STRATEGIC ENVIRONMENTAL ASSESSMENT STUDY AREA

The Strategic Environmental Assessment covered an area of approximately 628,200 hectares of land in the Karoo, which was divided into two sub-areas.

The "SEA Core Study Area" (outlined in red on the map), which consists of 38 land parcels, and covers an area of approximately 131 200 hectares; and the *"SEA Spiral Arm Study Area"* (outlined in blue on the map), which includes 131 land parcels, and covers an area of approximately 497,000 hectares.

The overall study area falls within four local municipalities; the Kareeberg Local Municipality, the Hantam Local Municipality, the Siyatemba Local Municipality and the Karoo-Hoogland Local Municipality. The largest towns surrounding the study area are Carnarvon, Williston, Van Wyksvlei and Brandvlei.



The Strategic Environmental Assessment process, which took three years to complete, was guided by a Special Advisory Committee, and included key government departments and state agencies.

In addition, provincial and local government consultations were undertaken to further inform local and provincial authorities.

Consultations with other key stakeholders from conservation agencies and representatives from other key sectors (e.g. Civil Aviation, Defence, Heritage Resources) also took place, to share information and obtain inputs and expert advice on specific issues/technical aspects of the Strategic Environmental Assessment.

The Strategic Environmental Assessment assessed the potential impacts that the proposed activities for the construction and operation of the SKA Phase 1 Mid-Frequency Array may have on local agriculture, heritage (including archaeology, palaeontology, cultural heritage and visual/landscape aspects), terrestrial ecology and biodiversity, including; avifauna, aquatic ecosystems, as well as socio-economic aspects.

INTEGRATED ENVIRONMENTAL MANAGEMENT PLAN FOR THE SKA PHASE 1 MID-FREQUENCY ARRAY

The IEMP is the outcome of the Strategic Environmental Assessment.

It provides a consolidated management plan including the minimum requirements for the construction and operation phases

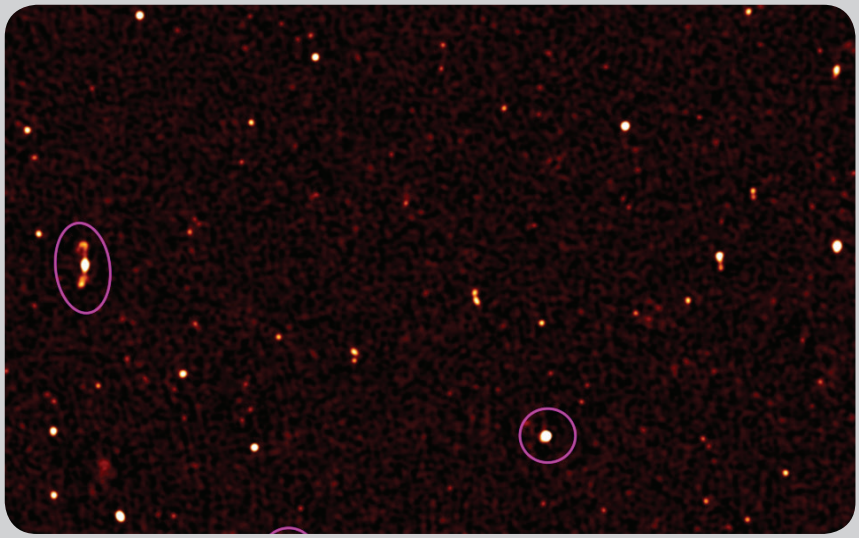
SKA Milestone

continues from page 37

of the SKA Phase 1 Mid-Frequency Array, including the environmental principles to be adopted, the environmental monitoring and control activities, as well as the long-term research monitoring programmes to be implemented on the SKA site in the Karoo.

The National Research Foundation and the International SKA Organisation are legally required to comply with Chapter 2, and the management outcomes of Chapter 5, of the Integrated Environmental Management Plan.

The IEMP supersedes the MeerKAT Environmental authorisations obtained for the KAT 7 MeerKAT EIAs. wn



View showing 10% of the full MeerKAT First Light radio image. More than 200 astronomical radio sources (white dots) are visible in this image, where prior to MeerKAT only five were known (indicated by violet circles). This image spans about the area of the Earth's moon.

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Autonomous cybersecurity

HOW AUTONOMOUS IT AND SECURITY SOLUTIONS WILL ENABLE PROACTIVE IT DEPARTMENTS

The cybersecurity of a business is still mostly reliant on the people within each company's IT department. This is not sustainable long-term and organisations need to start looking to autonomous security measures to relieve some of the pressure felt by IT teams.

BY | PIETER ENGELBRECHT
BUSINESS UNIT MANAGER | ARUBA

The impact that cybercrime has on business alone signifies the importance of having robust and reliable cybersecurity measures in place.

However, the rate by which cyber attacks are currently and will continue to take place, along with the increased sophistication thereof, has propelled the importance of cybersecurity to the forefront of critical operational needs.

Cybersecurity is not just reliant on deploying secure ICT systems but also on the people who create, monitor and update them, along with those who resolve security threats when alerted to them.

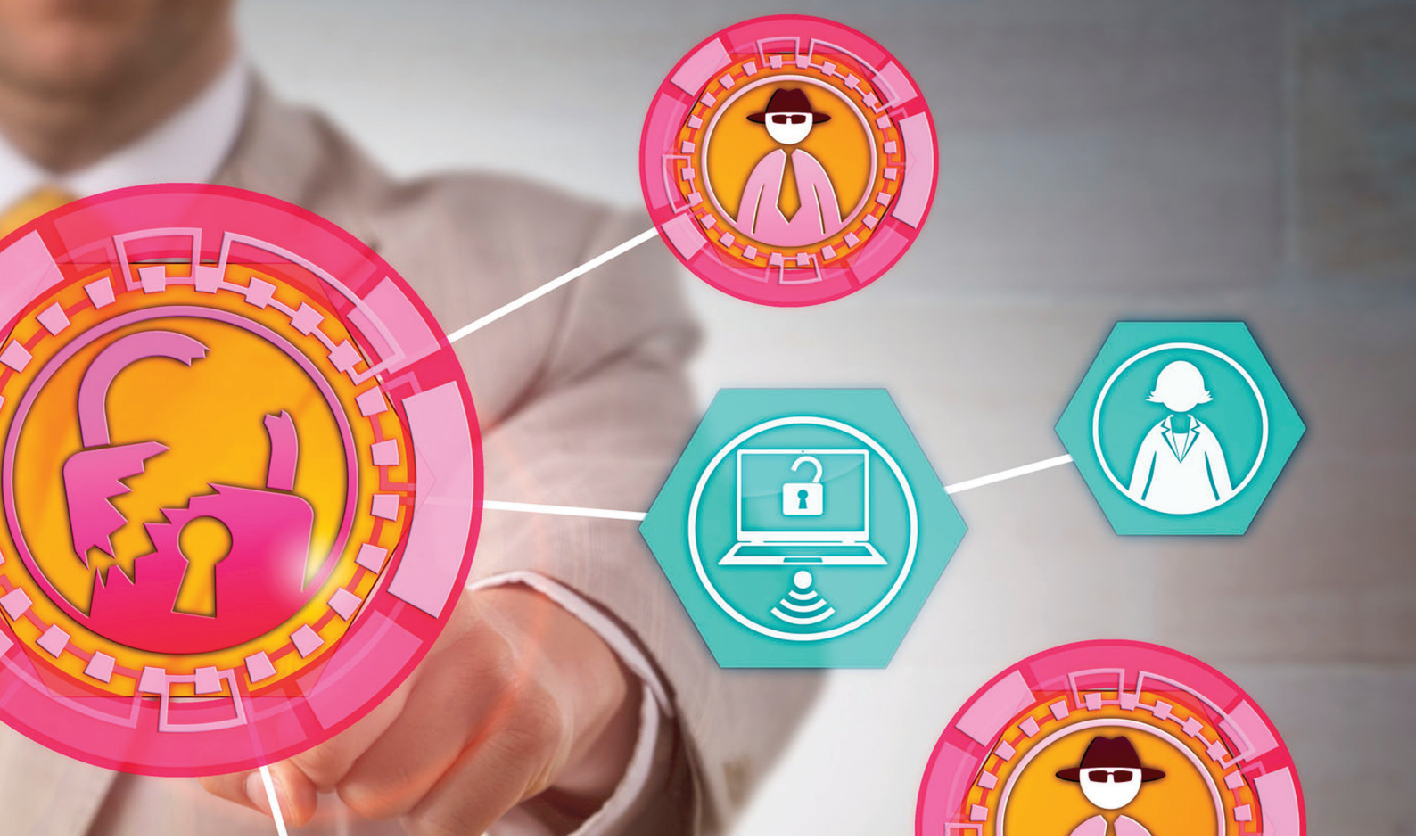
This has put a strain on the IT departments of numerous organisations rendering them mostly reactive rather than proactive.

REACTIVE IT

A reactive IT team is unable to do any planning; they cannot see problems coming and therefore are only aware that issues have arisen as a result of the tangible effects they have on systems, networks and the overall business. This often leaves them scrambling to fix the problems as they come up.

Investigating a single security alert can take a significant amount of time due to the scale and complexity of the data involved.

Without the time to make better decisions, this can result in increased downtime, loss of money and can leave the department feeling discouraged as they're not able to create, develop or improve on anything and are instead relegated to a task-oriented role rather than an innovative one.



A recent survey conducted by computer software company, Oracle, found that organisations received around 17 180 IT security and management related alerts every week, with 60% of IT executives lamenting the damage that the required amount of resources to manage and maintain infrastructure had on their organisation's competitiveness.

Autonomous IT and security solutions will take this pressure off of IT personnel through automated preventive and corrective actions, which will remove the cost and risk from IT operations and increase the rollout speed of other IT-related applications by freeing up the time of IT teams to serve the business better. What this means is that IT departments will have the ability to move from being reactive to being proactive.

PROACTIVE IT

Utilising proactive IT units will enable businesses to have control over their approach to and the future direction of their IT, and can thus make use of technology as a strategic tool to reduce the amount of time invested in operational tasks and increasing the time spent on tactical and strategic responsibilities.

This leaves them free to help prevent problems, instead of just fixing them, and after that business, executives will be able to make strategic IT decisions that will positively impact business operations and processes.

Not only are proactive IT solutions easier to integrate into a budget than unexpected and unaccounted for problem fixes, but utilising autonomous IT and security processes will ensure that there are systems in place to address emergencies that take place with little warning or time for preparation. The result of this is that many common issues will no longer even exist.

THE SKILLS GAP

In addition to these benefits, autonomous systems could also help to alleviate the pressure of the cybersecurity skills gap which Cybersecurity Ventures predicts will widen exponentially by 2021.

Business leaders are starting to take cybersecurity concerns more seriously than ever before and to prioritise long-term defence structures, are increasingly looking for permanent IT security professionals to do so.

Cybercrime is expected to triple the number of open cybersecurity positions over the next five years, and as every IT position is currently also a cybersecurity position, this presents a massive problem – of which autonomous IT solutions could be the remedy.

The definition of autonomy is the capability of operating without human control. Being able to do this with security-related and other mundane IT tasks will allow these departments to improve operational efficiency and pursue tech-related strategies that can help the business stay competitive, differentiate themselves within the market they operate and undergo transformation at a faster pace.

And, the best thing is that autonomous IT and security solutions are no longer just a dream, but a concrete reality. wn

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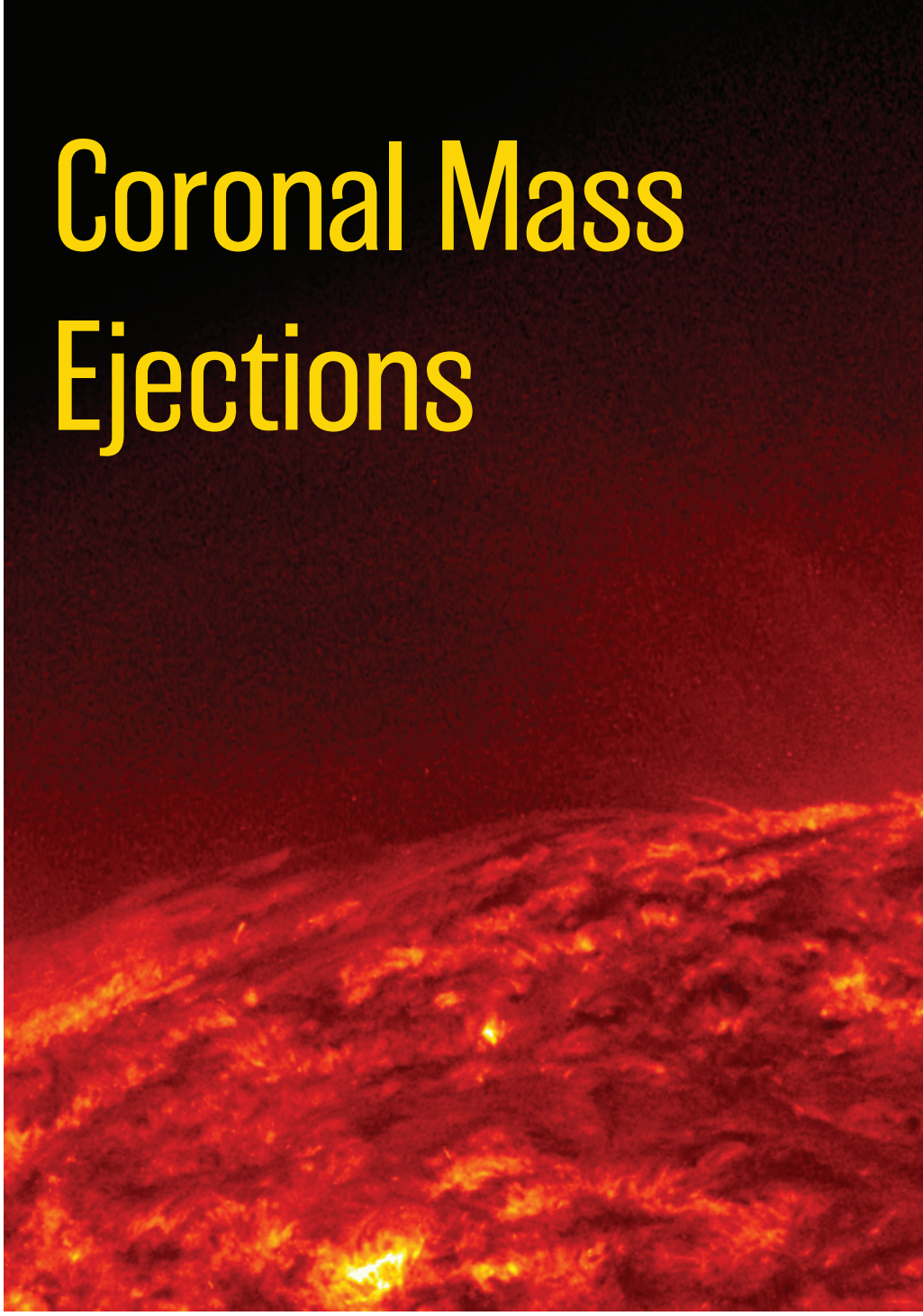
Coronal Mass Ejections



Solar Coronal Mass Ejections (CMEs) may seem far removed from concerns on planet Earth but they can have serious implications for the power distribution grids.

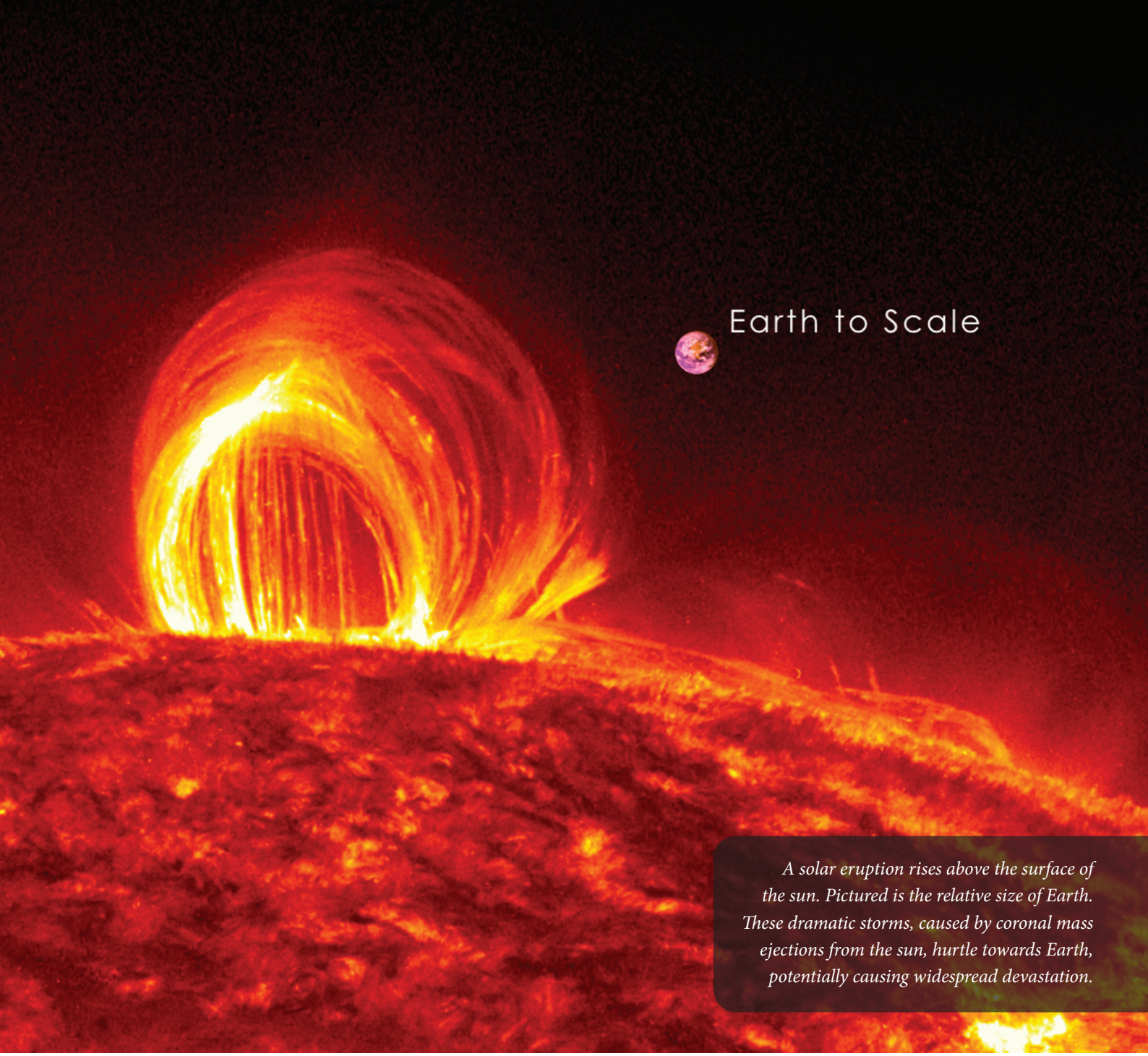
CMEs are huge ejections of plasma from the surface of the Sun. In January 2019, scientists of the National Centre for Atmospheric Research (NCAR)/ University Corporation for Atmospheric Research used, for the first time, a single cohesive computer model to simulate the entire life cycle of a solar flare: from the buildup of energy thousands of km below the solar surface, to the emergence of tangled magnetic field lines, to the explosive release of energy in a brilliant flash.

BY DUDLEY BASSON

This comprehensive new simulation captures the formation of a solar flare in a more realistic way than previous efforts, and it includes the spectrum of light emissions known to be associated with flares.

NCAR scientist Matthias Rempel said: *"This was a stand-alone simulation that was inspired by observed data. The next step is to directly input observed data into the model and let it drive what's happening. It's an important way to validate the model, and the model can also help us better understand what it is we're observing on the Sun."*

Melanie Windridge, plasma physicist and science communicator, commented: *"Storms caused by coronal mass ejections from the Sun could engulf the Earth, disrupting radio waves, GPS coordinates and overloading electrical systems. A large influx of energy could permanently damage transformers shutting down power supply around the world. The more technologically advanced we become the more vulnerable we are to space weather events".*



A solar eruption rises above the surface of the sun. Pictured is the relative size of Earth. These dramatic storms, caused by coronal mass ejections from the sun, hurtle towards Earth, potentially causing widespread devastation.

The most severe CME to affect the Earth was the Carrington event of 1859. The CME was so severe that aurorae were seen around the world and even over the Caribbean. Telegraph systems all over Europe and North America were disrupted, in some cases shocking the telegraph operators.

At this time there were no electric power distribution grids or sensitive microelectronic devices. A repeat of the Carrington event could have devastating consequences. Fortunately CME's, although frequent, will usually miss encountering the Earth as this presents a very small target – from the Sun, the Earth will appear as a dot in the sky. The threat is however real, and measures must be in place to protect vital installations.

All electrical distribution grids are well protected against lightning strikes but this protection is irrelevant to the risk from a CME. The threat from a CME is similar to that from the EMP (Electromagnetic pulse) of a nuclear explosion.

If the CME is expected, small electronic devices can be unplugged, or better still be placed in a Faraday box. The worst risk is to electrical distribution transformers and cell phone towers, which could result in extremely costly and time consuming outages.

Electrical currents of electrons or plasma flowing in space, without voltage or resistance, have quite different characteristics to those flowing in a conductor. It may seem likely that the space

Coral Mass Ejections

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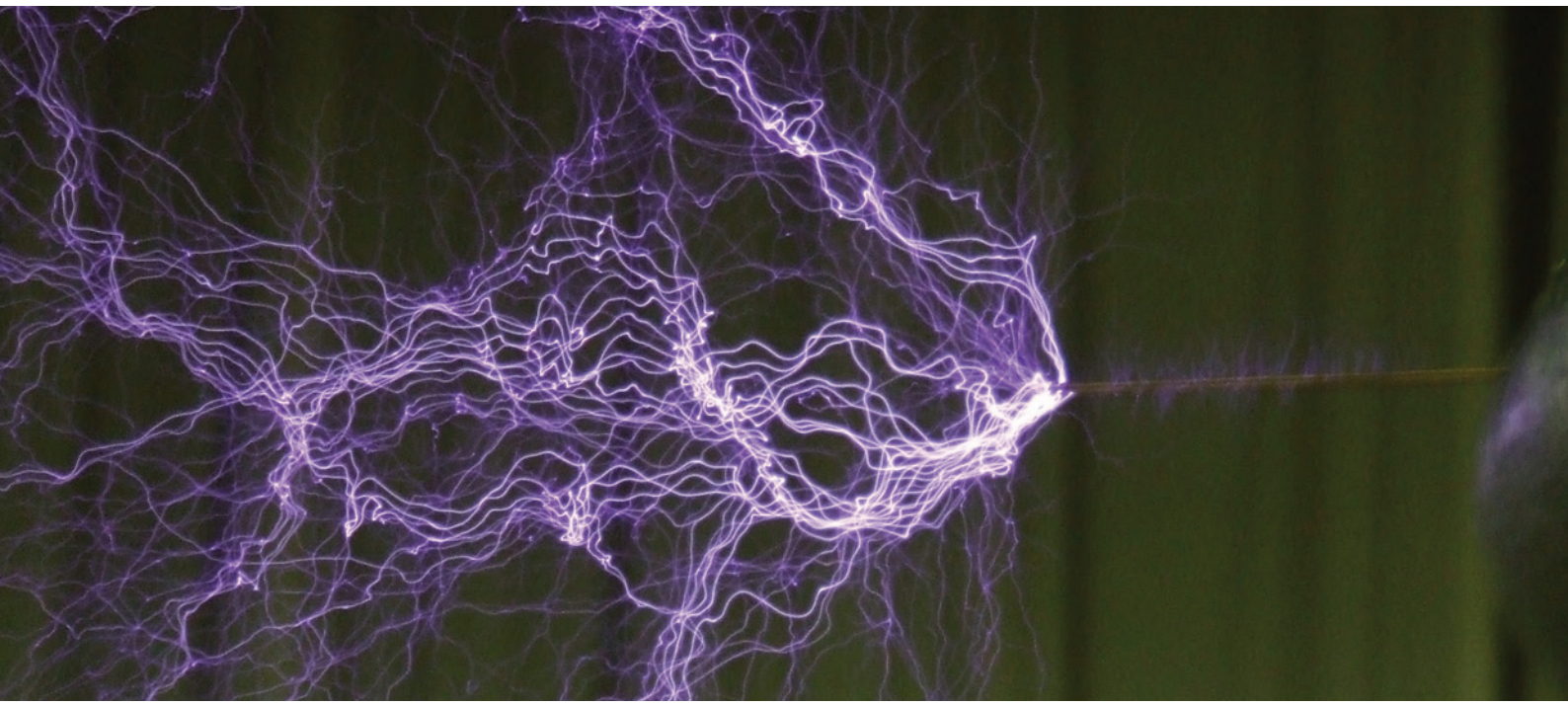


Plasma discharges from a Tesla coil constricted by Z-pinch

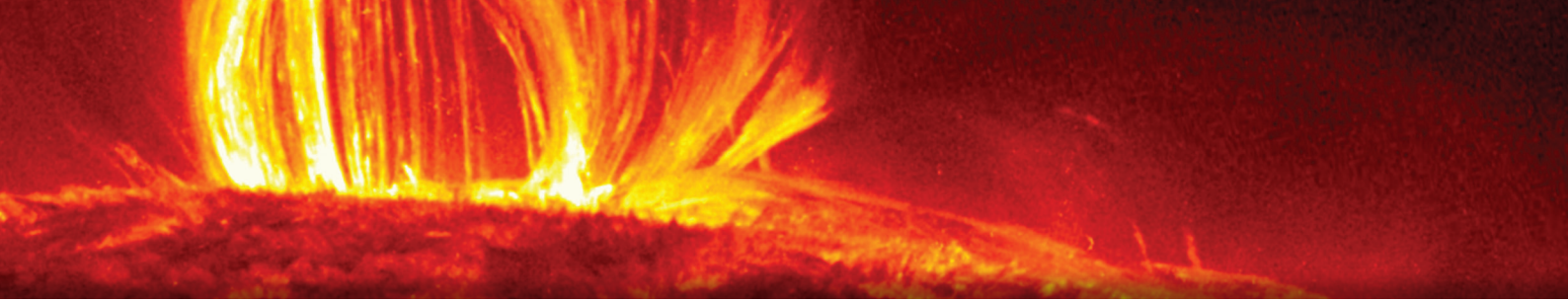
currents would disperse due to the mutual repulsion between the charges, much like the dispersion of a gas jet, but this is not the case. Currents in space are self constricting due to the current's own magnetic field. This is also known as Z-pinch. This effect can commonly be seen in the sky during a thunderstorm. The fine tracery of the discharges can be seen to travel great distances without the slightest sign of dispersion.

Norwegian scientist Kristian Birkeland (1876-1917) did pioneering work on the auroral flares around the Earth's north magnetic pole, and the magnetic substorms in the magnetosphere, which could greatly influence the Earth's magnetic field. In 1908 he deduced that enormous currents of up to a million amps were flowing from the Sun to the Earth's poles and interfering with the magnetosphere. These currents follow the Earth's magnetic field to augment the rings of auroral light around the poles. These currents from the Sun are known as Birkeland currents. Due to the Z-pinch effect they become constricted filaments which form themselves into spirals, which in turn can twist with other currents to form magnetic ropes. The ropes can have a diameter of as much as the diameter of the Earth. Currents encountering the Earth's magnetic field will spiral along the direction of the field.

Despite the huge magnitude of the current, the current density is extremely low. Birkeland was fortunately able to consult his former tutor, mathematical giant Henri Poincaré (1854-1912) for assistance with the abstruse mathematics required. In regions of space where there are no resultant magnetic fields or movements of electrons, these can become electron diffusion regions. It is here that violent magnetic reconnection events can occur. The Earth's diffusion regions have been investigated by the THEMIS and MMS space missions.

The Sun is classified as a yellow dwarf star though there is nothing small about this monster; there are in fact far many stars smaller than the Sun than larger. It has a diameter of 1,3914 million km and contains 99,86 % of the mass of the Solar System – 1,9885 x 10^{30} kg, consisting of 73,46 % hydrogen and 24,85 % helium. The temperature at the core is 15,7 x 10^{6} K and 5800 K at the surface. The corona can in places be more than 200 times as hot as the surface.

The nuclear reaction at the core is tremendous. In one second 600 x 109 kg of hydrogen is fused into helium producing



384,6 yottawatts. Some 2 % of the energy is emitted as neutrinos. The energy is emitted as gamma radiation which is repeatedly absorbed and re-emitted until it emerges mostly as visible light and heat at the surface – a process which can take from 10 000 to 170 000 years. The power produced per cubic metre of the core is surprisingly low, not at all like the output of a thermonuclear fusion weapon – 276 W/m^3 – similar to the heat generated by a compost heap.

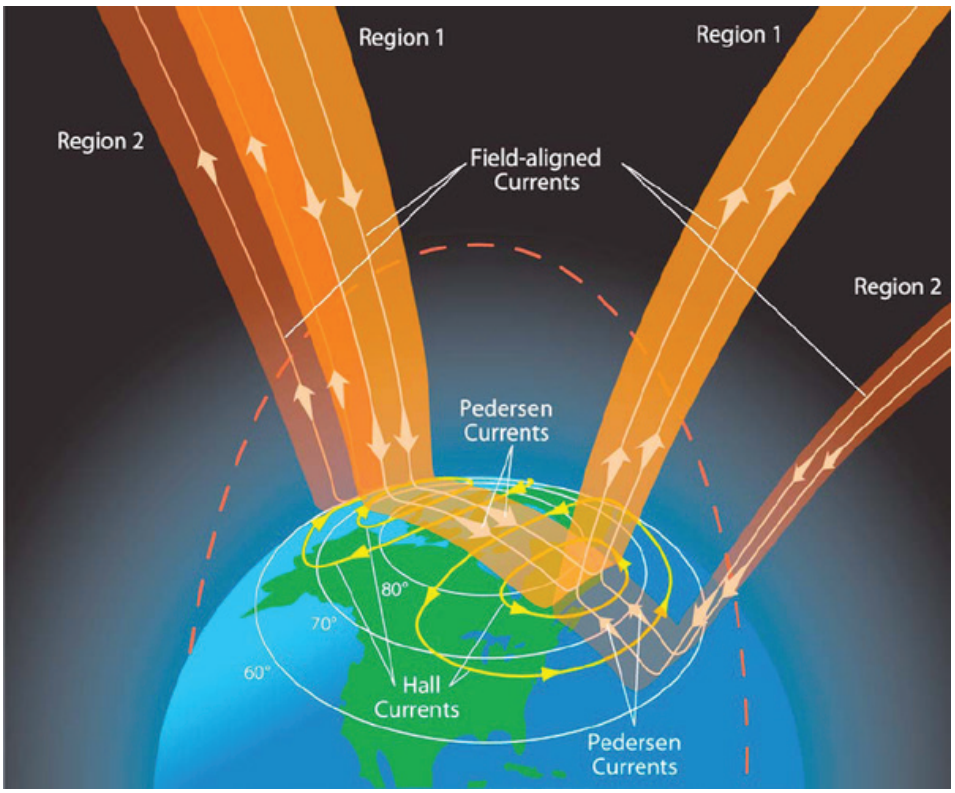
The photosphere is the part of the Sun which we can observe with visible light. This is surrounded by the atmosphere which comprises the chromosphere, solar transition region, corona and heliosphere.

The solar wind is a plasma stream released from the upper atmosphere of the Sun's corona, consisting mostly of electrons, protons and alpha particles with energies of 0,5 to 10 keV.

These particles are able to escape the Sun's gravity due to their high energy resulting from the high temperature of the corona. These particles can attain speeds of 250 to 750 km/s.

The existence of the solar wind was at first suggested in 1859 by Carrington, however Birkeland was the first to suggest that the wind consisted of both ions and electrons. Ludwig Bierman noticed that the tail of a comet will always point away from the Sun regardless of the direction of the comet, and that this was due to a steady stream of particles emitted by the Sun.

The solar wind is observed to exist in two fundamental states: the slow solar wind and the fast solar wind. The slow solar wind has a velocity of 300-500 km/s with a temperature of 1,4-1,6 x 10^5 K, and the fast wind a velocity of 750 km/s and a temperature of 8 x 10^5 K.



Birkeland currents follow the Earth's magnetic field and transfer as Pedersen currents to the point of exit.

The slow solar wind appears to originate from a region around the Sun's equatorial belt that is known as the "streamer belt" where coronal streamers are produced by magnetic flux open to the heliosphere draping over closed magnetic loops.

The fast solar wind appears to originate from coronal holes, which are funnel-like regions of open field lines in the Sun's magnetic field. The plasma source is small magnetic fields created by convection cells in the solar atmosphere.

The solar winds can be greatly disrupted and overwhelmed by CMEs and magnetic reconnections. Research into heliophysics and solar winds is ongoing and several advanced spacecraft have been developed for this purpose.

A large number of solar terrestrial telescopes have been in use in the 20th century. These are quite different to the night sky telescopes as they can only be used when the Sun is visible and special precautions must be taken to protect the instruments from the solar heat. The instruments are usually mounted on towers (painted white) to raise them above atmospheric disturbances caused by solar heating of the ground. The observation instruments must also be protected from the intense radiation by filters, Fresnel wedges and cooling.

Coral Mass Ejections

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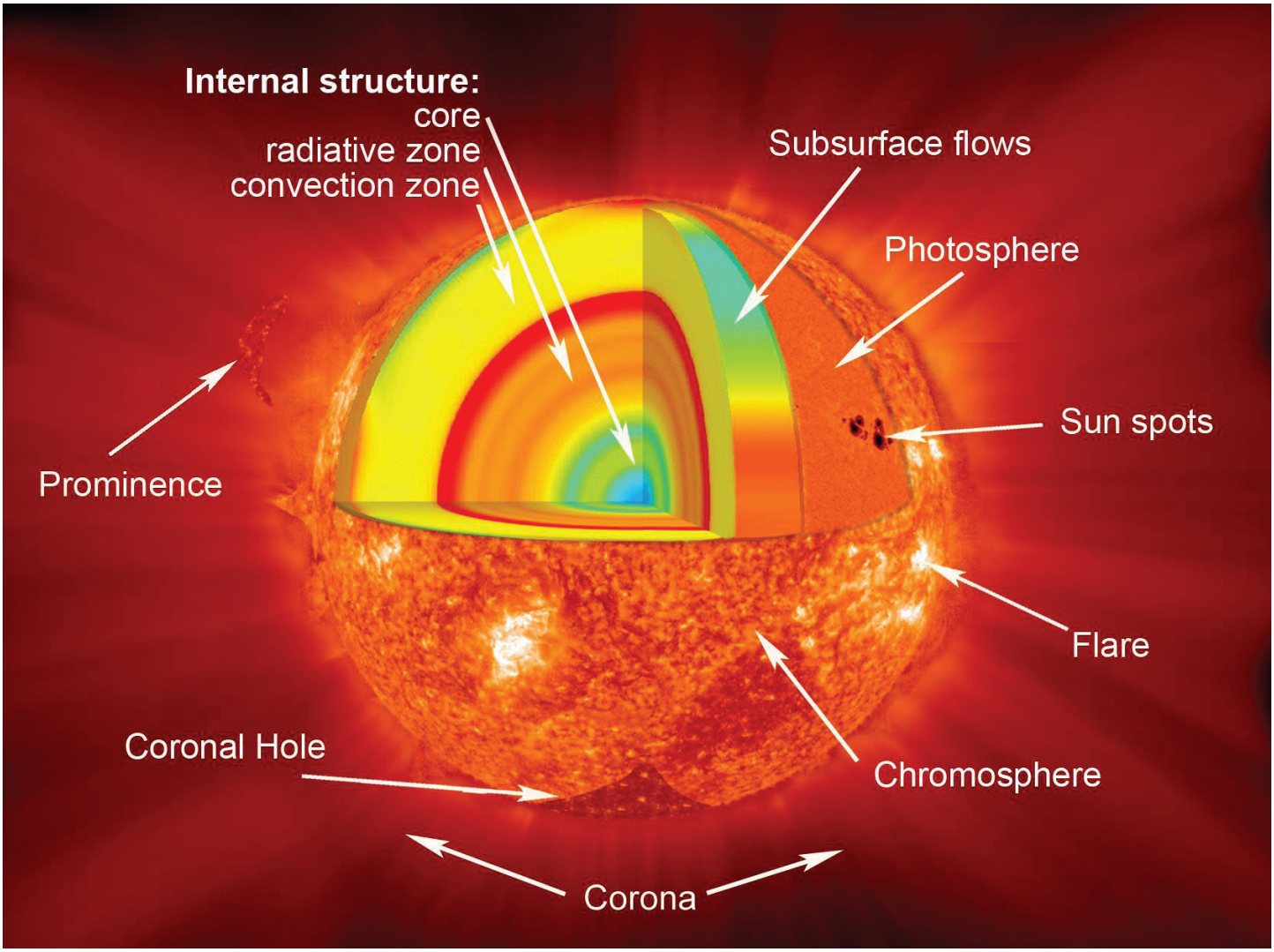


The zones and features of the sun.

The Snow solar observatory was built on Mount Wilson in 1904, followed by an 18 m tower in 1908 and a 46 m tower in 1912. The 18 m tower is currently used for helioseismology and the 46 m tower for UCLA's Solar Cycle Program.

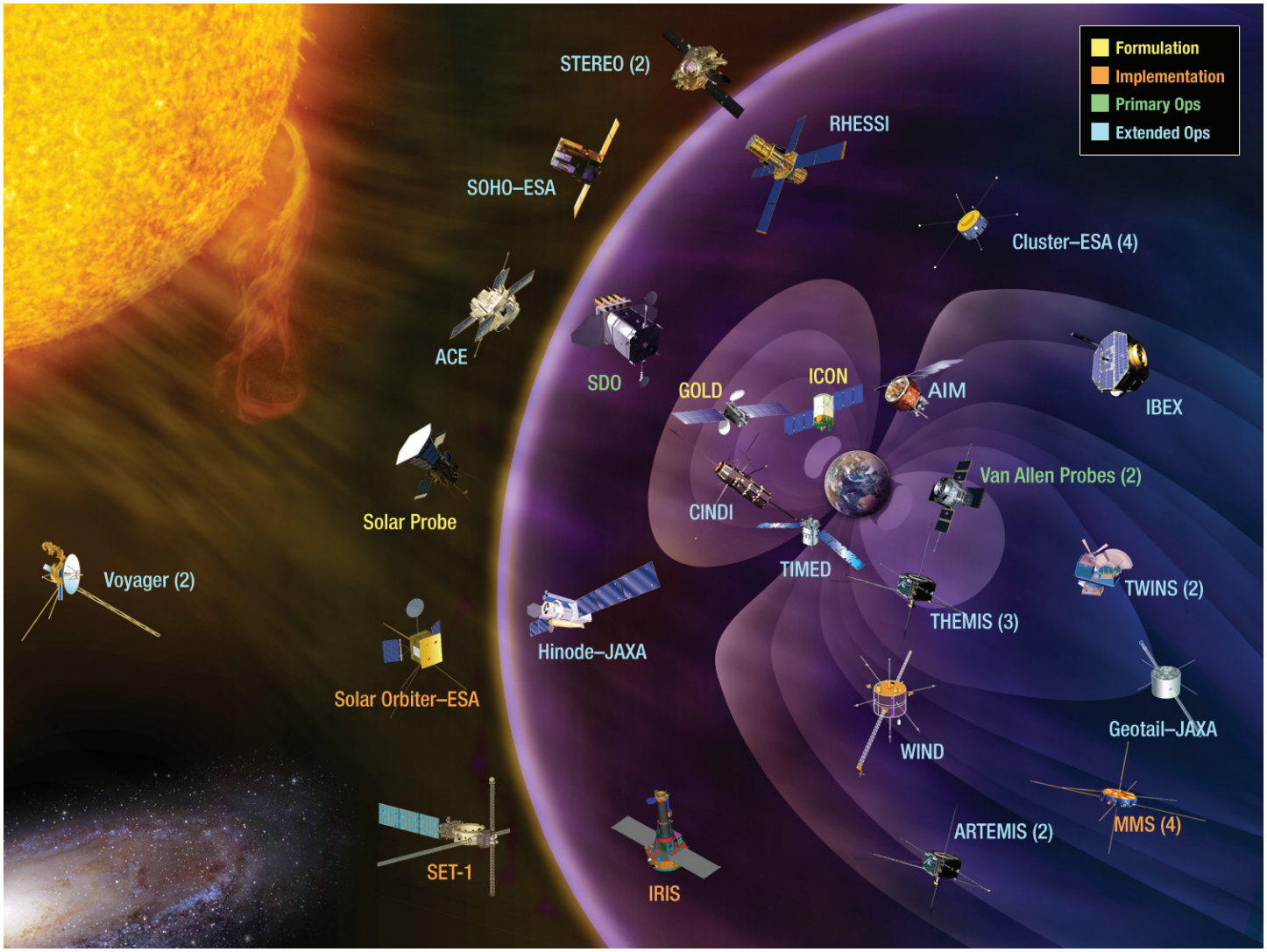
The Daniel K Inouye Solar Telescope (DKIST) funded by the National Science Foundation, is under construction on the Haleakala volcano of the Hawaiian island of Maui and is expected to be completed in 2019. This will have a 4 m aperture as well as adaptive optics. The high resolution should be able to discern features on the Sun as small as 20 km. This will be the world's largest solar telescope.

Solar astronomy is now dominated by the heliophysics space missions, as these have capabilities unobtainable from terrestrial telescopes.

HELIOPHYSICS SPACE MISSIONS

Huge advances in solar science have been made by specialised space satellites with advanced instrumentation for solar studies in a wide range of eletromagnetic wavelengths, as well as magnetic studies and solar wind particle studies.

The Lagrangian points of a planet orbiting a sun are of vital importance to space missions. These are points where a small object can be placed with some stability,



Evolving Heliophysics System Observatory.

and orbit as a whole with the planet. These five points were discovered by Lagrange while working on the three body problem. The first three were identified earlier by Euler. L1, being between the Earth and the Sun, is useful for Solar observations. L2 is useful for space observatories and will accommodate the future James Webb Space Telescope (JWST). The Hubble telescope is in orbit around the Earth. L3 is not useful as it always remains behind the Sun.

Trojans (stray asteroids) tend to accumulate at the L4 and L5 points of planetary orbits. Jupiter has more than a million trojans. Spacecraft stationed at the Lagramgian points need to have fuel and thrusters ready to prevent them from drifting away should the need arise.

Let us take a look at a selection of recent and current heliophysics space missions.

ULYSSES

The Ulysses space mission was a joint venture by NASA, and ESA and with participation from Canada's Nation Research Council.

The primary mission was to study the Sun at all latitudes, in particular the poles, which cannot be effectively studied from within the ecliptic. This required an out-of-ecliptic orbit which had never before been attempted.

Coral Mass Ejections

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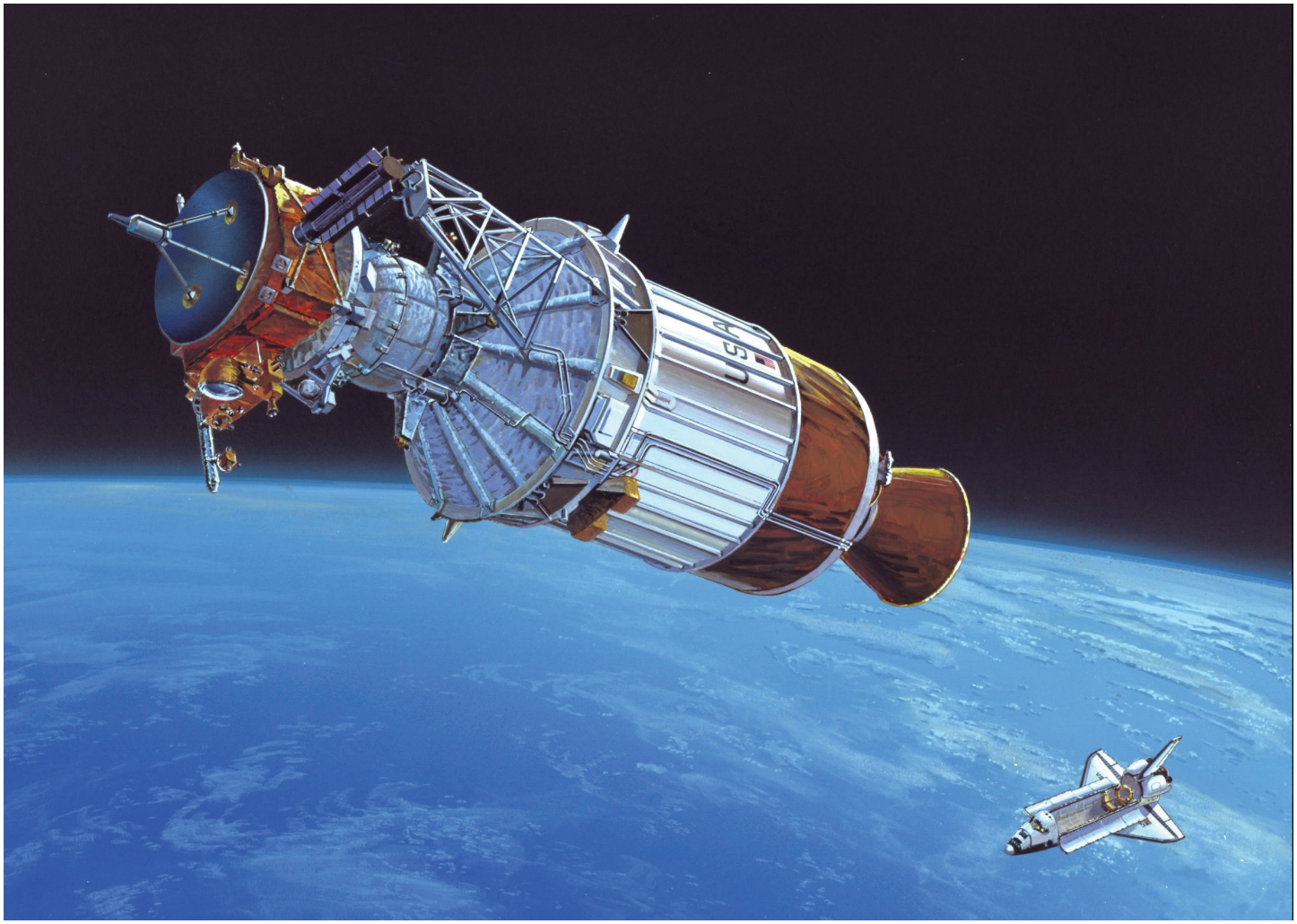


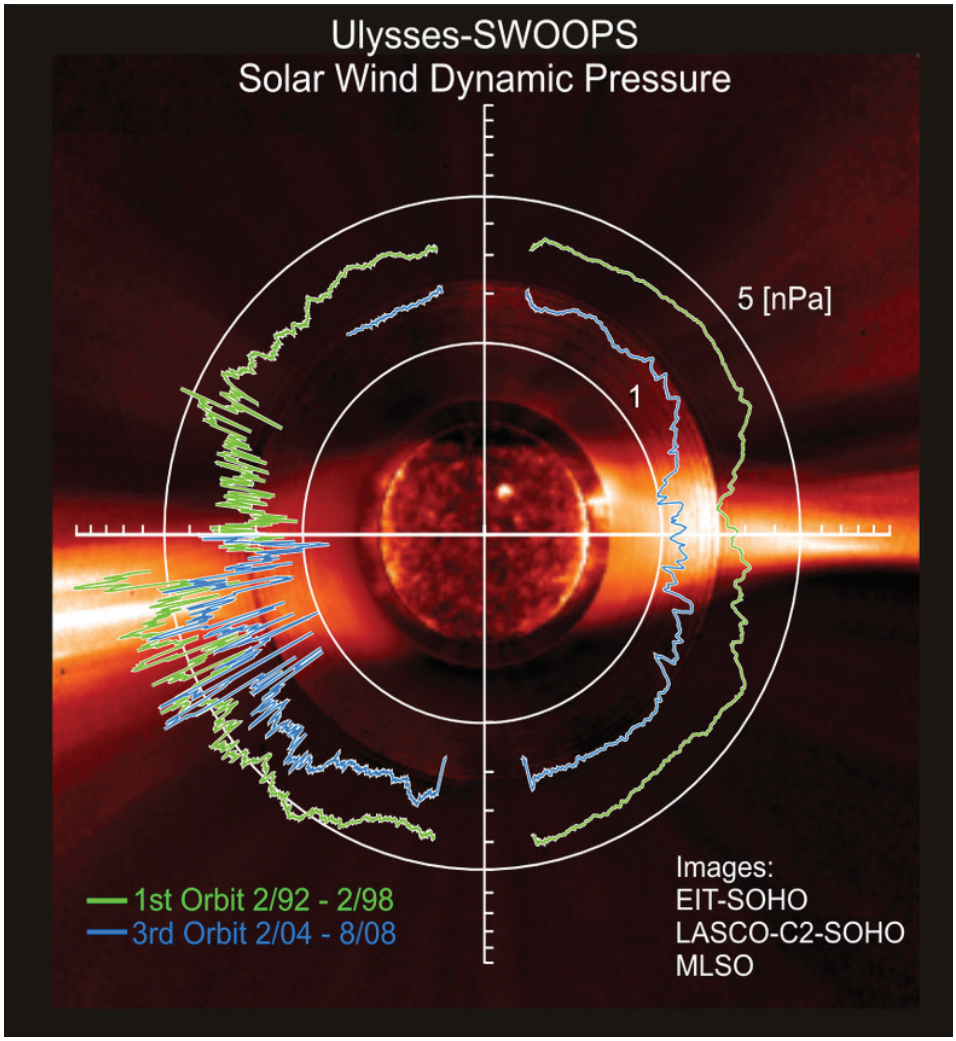
Ulysses after deployment by Space Shuttle and with rocket motor still attached.

To launch a spacecraft into an out-of-ecliptic solar orbit directly from the Earth would require a prohibitive quantity of fuel. The orbit was achieved by launching the craft from space shuttle Discovery on 6 October 1990 and, accelerated by a solid fuel rocket motor, letting it take a gravity assist by passing under the south pole of Jupiter. From there it went into an out-of-ecliptic six-year solar orbit with a perihelion of one AU and an aphelion of six AU. The craft was able to make three scans of the Sun; in 1994/1995, 2000/2001 and 2007/2008. Operations continued until 30 June 2009. In addition to the Sun, Ulysses also studied several comets.

Due to the extended periods remote from the Sun, it was necessary to power the craft by means of a Radioisotope Thermoelectric Generator (RTG). The spacecraft was designed to withstand both the heat of the inner Solar System and the cold at Jupiter's distance. Extensive blanketing and electric heaters protected the probe against the cold temperatures of the outer Solar System.

Hydrazine monopropellant was used for course corrections out bound to Jupiter, and later used exclusively to repoint the spin axis (and thus, the antennae) at Earth. The spacecraft was controlled by eight thrusters in two blocks.

Thrusters were pulsed in the time domain to perform rotation or translation. Four Sun sensors detected orientation. Ulysses was equipped with several antennae and a large suite of specialized scientific instruments.



Ulysses showed plasma ejection at much higher velocity at the poles than the equator. This diagram shows only plasma velocity and not magnetic field shape

GLOBAL GEOSPACE SCIENCE (GGS) WIND

This heliophysics space mission, manufactured by Martin Marietta Astro Space Division, was launched on 1 November 1994 with the following mission objectives:

- Provide complete plasma, energetic particle, and magnetic field input for magnetospheric and ionospheric studies.
- Determine the magnetospheric output to interplanetary space in the up-stream region.
- Investigate basic plasma processes occurring in the near-Earth solar wind.
- Provide baseline ecliptic plane observations to be used in heliospheric latitudes from ULYSSES.

The satellite was placed in a halo orbit at Earth's L1 Lagrangian point on a three year mission but remains operational. It has sufficient fuel to last for 50 years at the L1. WIND has contributed data to over 4610 scientific papers. It has also created baseline data for upcoming Solar Probe and Solar Orbiter missions and supplemented data from the STEREO mission. WIND was equipped with a large number of specialised scientific instruments and has made a number of significant discoveries.

SOLAR AND HELIOSPHERIC OBSERVATORY (SOHO)

SOHO is a project of international co-operation between ESA and NASA forming part of the Solar-Terrestrial Science Program (STSP).

It was launched on 2 December 1995 with a planned mission life of two years. The mission life has been extended several times and may possibly continue until 2022. SOHO was placed in a lissajous orbit at the Earth's L1 Lagrangian point, as placing it directly in line with the Sun would have made communications difficult. SOHO went missing on 25 June 1998 but was found by using RADAR of the Arecibo Big Dish on 4 August and rehabilitated.

The principal scientific objectives of the SOHO mission are to reach a better understanding of the structure and dynamics of the solar interior using techniques of helioseismology, and to gain better insight into the physical processes that form and heat the Sun's corona, maintain it and give rise to its acceleration into the solar wind.

SOHO is a three-axis stabilized spacecraft with a total mass of 1850 kg; 1150 W of power is provided by the solar panels. The payload of twelve specialised scientific instruments (about 610 kg) consumes 450 W in orbit. SOHO has produced a large wealth of data on the Sun which would have been unobtainable from terrestrial solar telescopes.

Coral Mass Ejections

continues from page 49

SOHO's ability to blank the Sun's glare allowed it to discover a large number of comets. Michal Kusiak of Polish Uniwersytet Jagielloński (founded in 1364) discovered SOHO's 1999th and 2000th comets on 26 December 2010.

SOHO's 3000th comet was discovered in September 2015 by Worachate Boonplod, of Samut Songkhram, Thailand.

ADVANCED COMPOSITION EXPLORER (ACE)

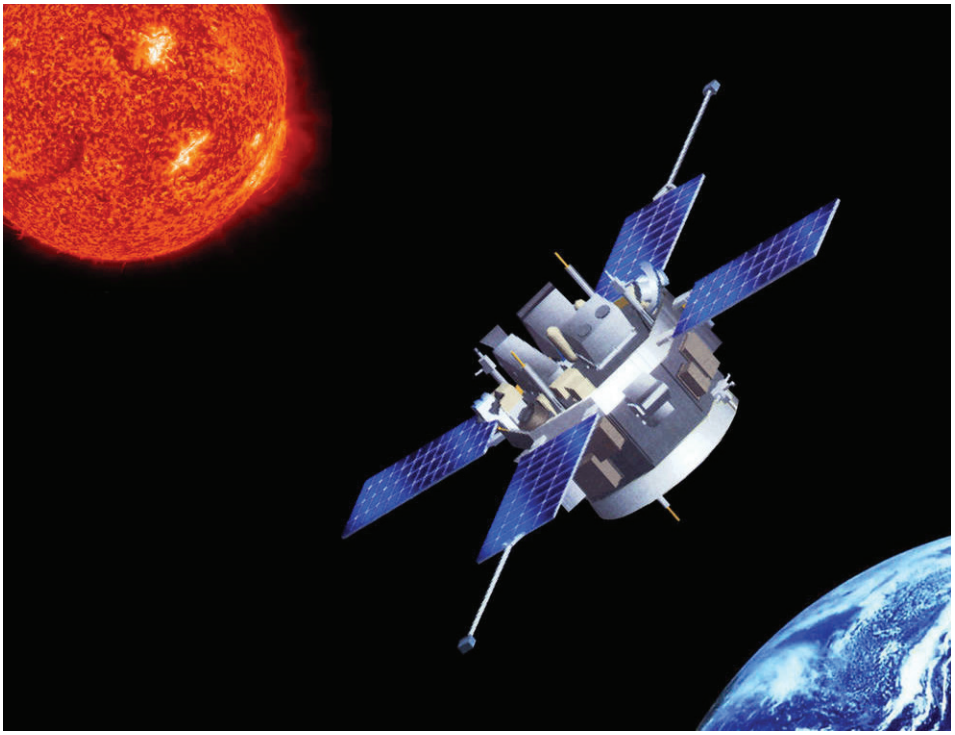
ACE is a NASA Solar and space exploration mission to study matter comprising energetic particles from the solar wind, the interplanetary medium and other sources. Real time data from ACE is used by the National Oceanic and Atmospheric Administration's (NOAA) Space Weather Prediction Centre, to improve forecasts and warnings of solar storms.

Ace was launched on 25 August 1997 and placed in a lissajous orbit at the L1 Lagrangian point of Earth's orbit. The craft remains operational and has sufficient propellant to maintain its orbit until 2024.

ACE provides an essential service of solar storm warnings which will be continued by the Solar Dynamics Observatory (SDO).

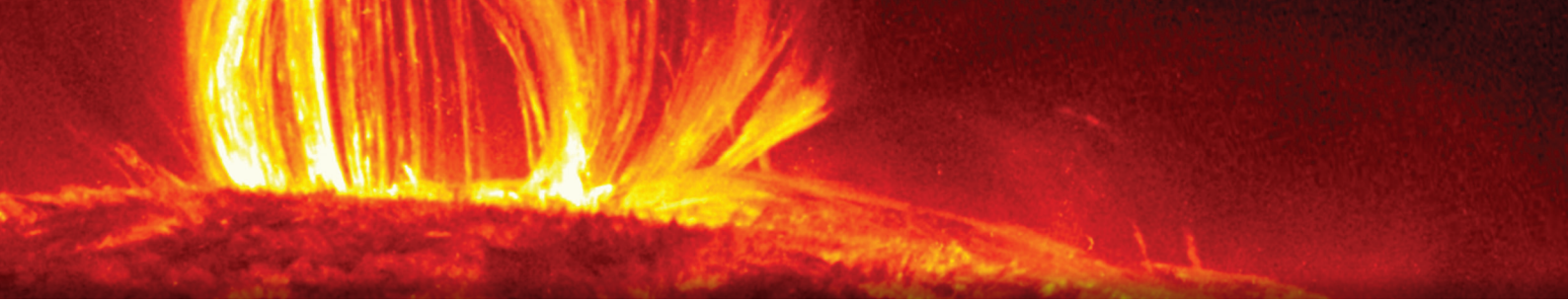
REUVEN RAMATY HIGH ENERGY SOLAR SPECTROSCOPIC IMAGER (RHESSI)

RHESSI was a solar flare observatory launched by NASA into a geocentric orbit on 5 February 2002. Its primary mission was to explore the physics of particle acceleration and energy releases in solar flares.



Advanced Composition Explorer (ACE)

Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI)



The primary scientific objective of RHESSI was to understand the following processes that take place in the magnetized plasmas of the solar atmosphere during a flare:

- Impulsive energy release,
- Particle acceleration,
- Particle and energy transport.

These high-energy processes play a major role at sites throughout the universe ranging from magnetospheres to active galaxies. Consequently, the importance of understanding these processes transcends the field of solar physics; it is one of the major goals of space physics and astrophysics.

The high energy processes of interest include the following:

- The rapid release of energy stored in unstable magnetic configurations,
- The equally rapid conversion of this energy into the kinetic energy of hot plasma and accelerated particles (primarily electrons, protons and ions),
- The transport of these particles through the solar atmosphere and into interplanetary space,
- The subsequent heating of the ambient solar atmosphere.

These processes involve:

- Particle energies to many GeV,
- Temperatures of tens or even hundreds of millions of degrees,
- Densities as low as 100 million particles per square cm,
- Spatial scales of tens of thousands of kilometers, and
- Magnetic containment times of seconds to hours.

It is impossible to duplicate these conditions in laboratories on the Earth.

The acceleration of electrons is revealed by hard X-ray and gamma-ray bremsstrahlung while the acceleration of protons and ions is revealed by gamma-ray lines and continuum. Gamma ray lines are of interest in studies of dark matter annihilations. The proximity of the Sun means not only that these high-energy emissions are orders of magnitude more intense than from any other cosmic source but also that they can be better resolved.

RHESSI was decommissioned on 16 August 2018 and is expected to plunge into the Earth's atmosphere by 2022.

HINODE (SUNRISE)

This JAXA/NASA/PPARC mission was launched into a geocentric orbit on 22 September 2006 from the Uchinoura Space Centre Japan. Originally a three year mission to explore the magnetic fields of the Sun, it remains functional with a possible mission extension to 2022.

Hinode took high resolution images of the 2012 Venus transit of the Sun.

The payload contains three specialized instruments to investigate the interaction between the Sun's magnetic field and its corona.

The SOT – Solar Optical Telescope is a 0,5 m Gregorian optical telescope with a field of view od 400 arcseconds and a resolution of 0,2 arcsecond. The focal plane package contains a Broadband Filter Imager and the Spectropolarimeter which produces sensitive vector magnetograph maps of the photosphere.

The XRT – X-ray Wolter-1 Telescope uses grazing incidence optics to image the corona's hottest components, 500 x10^3 K to 10^7 K. The imaging field is 34 arcminutes capable of imaging a full view of the Sun.

The EIS – Extreme-Ultraviolet Imaging Spectrometer obtains spacially resolved spectra in two wavelength bands:
17,0 – 21,2 nm and 24,6 – 29,2 nm.

The temperature equivalent of these bands is from 50 x 10^3 K to 20 x 10^6 K. The EIS is used to identify the physical processes involved in heating the solar corona.

SOLAR TERRESTRIAL RELATIONS OBSERVATORY (STEREO)

STEREO was launched on 25 October 2006 as part of NASA's Solar Terrestrial Probes program.

This mission consisted of two space solar observatories, the one leading the Earth in its orbit and the other trailing. By December 2007 the observatories were leading and trailing the Earth by 0,4 AU giving an excellent stereoscopic view of solar storms and the ejection of material from the Sun. The stereoscopic view is essential for following the progress of a CME on its path from the Sun towards the Earth. Spectacular images of solar activity have been obtained.

A sensational image of comet Encke was obtained when it passed through a solar storm while within the orbit of Mercury. The CME first deflected the tail of the comet and then detached it completely, leaving the comet with the indignity of flying without a tail. The interaction between the CME and the comet's plasma tail were the result of opposite magnetic fiels which later became connected with a consequent release of energy.

Coral Mass Ejections

continues from page 51

The two spacecraft continued to spread apart at about 44 degrees per year.

In late 2009 they passed through the L4 and L5 Lagrangian points of the Earth's orbit where they searched for trojan objects. Trojan objects are commonly found at the L4 and L5 points of a planetary orbit.

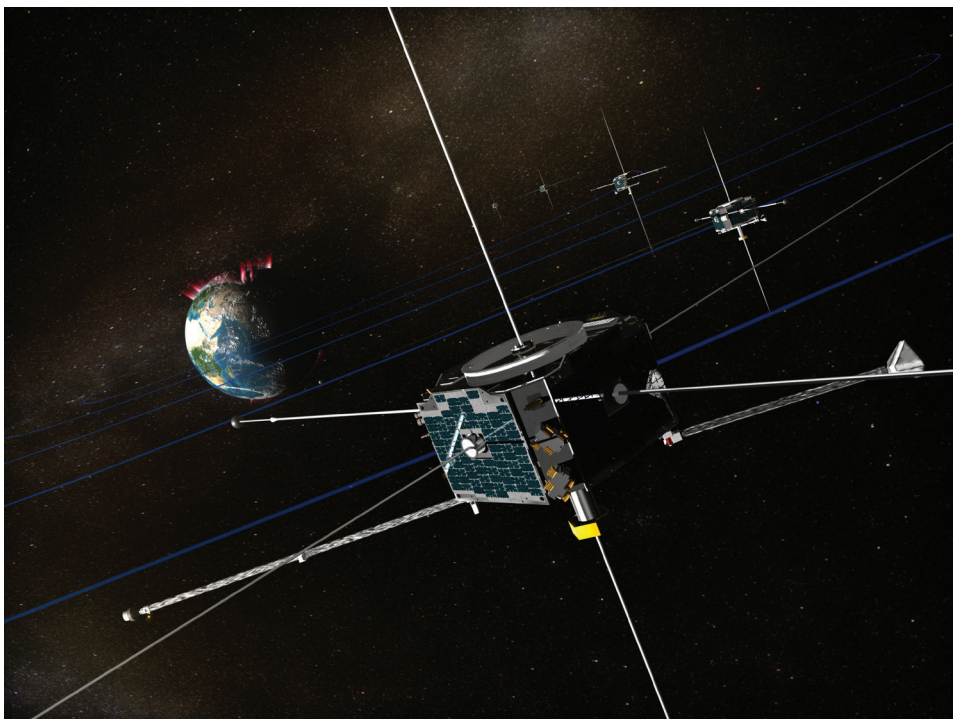
On 6 February 2011 they were 180 degrees apart given a full view of the Sun.

On July 23 2012, STEREO-A was in the path of the solar storm of 2012 which was similar in strength to the Carrington event. Its instrumentation was able to collect and relay a significant amount of data about the event. STEREO-A was not harmed by the solar storm.

Communication with the two spacecraft was lost when they arrived at the L3. Attempts to regain contact with the craft were terminated on 17 October 2018.

The spacecraft were each equipped with four instruments:

- SECCHI – Sun Earth Connection Coronal and Heliospheric Investigation comprising extreme UV imager and coronagraphs.
- SWAVES – Stereo-WAVES: interplanetary radio burst tracker tracing the generation and evolution of travelling radio disturbancs to Earth.
- IMPACT – In-situ Measurement of particles and CME transients.
- PLASTIC – PLAsma and SupraThermal Ion Composition. This instrument will provide plasma characteristics of protons, alpha particles and their effect on terrestrial communications.



Artist's concept of THEMIS in orbit.

TIME HISTORY OF EVENTS AND MACROSCALE INTERACTIONS DURING SUBSTORMS (THEMIS)

NASA's THEMIS was designed to study energy releases from the Earth's magnetosphere known as substorms, magnetic phenomena that intensify auroras near the Earth's poles.

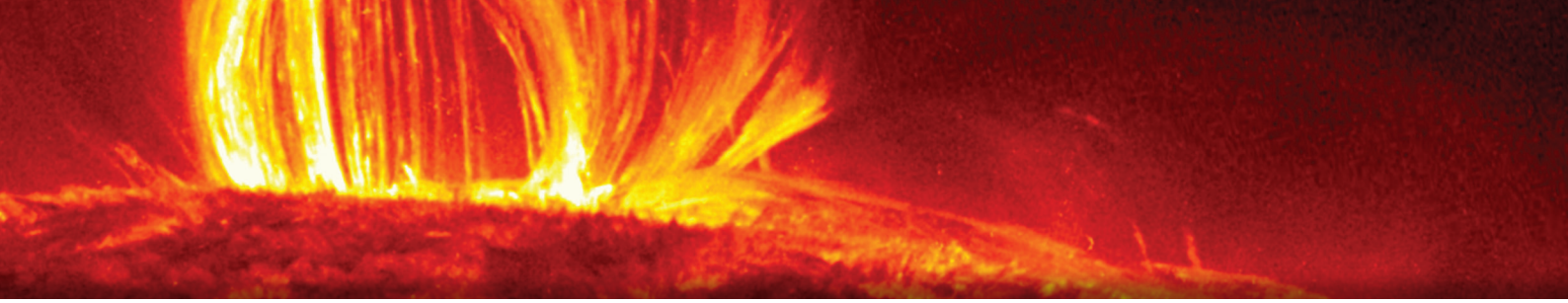
Launched on 17 February 2007 Themis originally comprised a fleet of five spacecraft of which two were subsequently placed in halo orbits at Lagrangian points of the Moon's orbit. The satellites each have a mass of 77 kg, carry 49 kg of fuel and have a power consumption of 37 W.

The satellites each carry identical instrumentation: a fluxgate magnetometer, an electrostatic analyser, a solid state telescope, a search-coil magnetometer and an electric field instrument.

From 15 February to 15 September 2007 the five craft coasted in a string-of-pearls configuration after which they were repositioned for data collection in the magnetotail. A most remarkable result was achieved when evidence was found of magnetic ropes connecting Earth's upper atmosphere directly to the Sun. It was estimated that the ropes pump 650 000 amperes into the Arctic.

On 26 February 2008, THEMIS probes were able to determine, for the first time, the triggering event for the onset of magnetospheric substorms. This was found to be a magnetic reconnection event 96 seconds prior to auroral intensification.

The THEMIS mission made an additional remarkable discovery – magnetic portals called "electron diffusion regions" which



occur where the magnetic fields of the Sun and the Earth connect.

These are typically located a few tens of thousands of kilometres above the Earth's surface. These portals allow huge quantities of solar wind particles to move unhindered from the Sun to the Earth, causing geomagnetic substorms and intensifying auroras. The magnetic portals are very difficult to locate and can be small and short lived or vast, yawning and sustained. When THEMIS concluded in 2010, two of its five spacecraft were repurposed as the ARTEMIS mission. The two satellites were moved to lunar orbits to study the Moon's interactions with the Sun.

SOLAR (ISS)

This is an ESA science observatory which is part of the International Space Station.

SOLAR is also known as the Solar Monitoring Observatory (SMO).

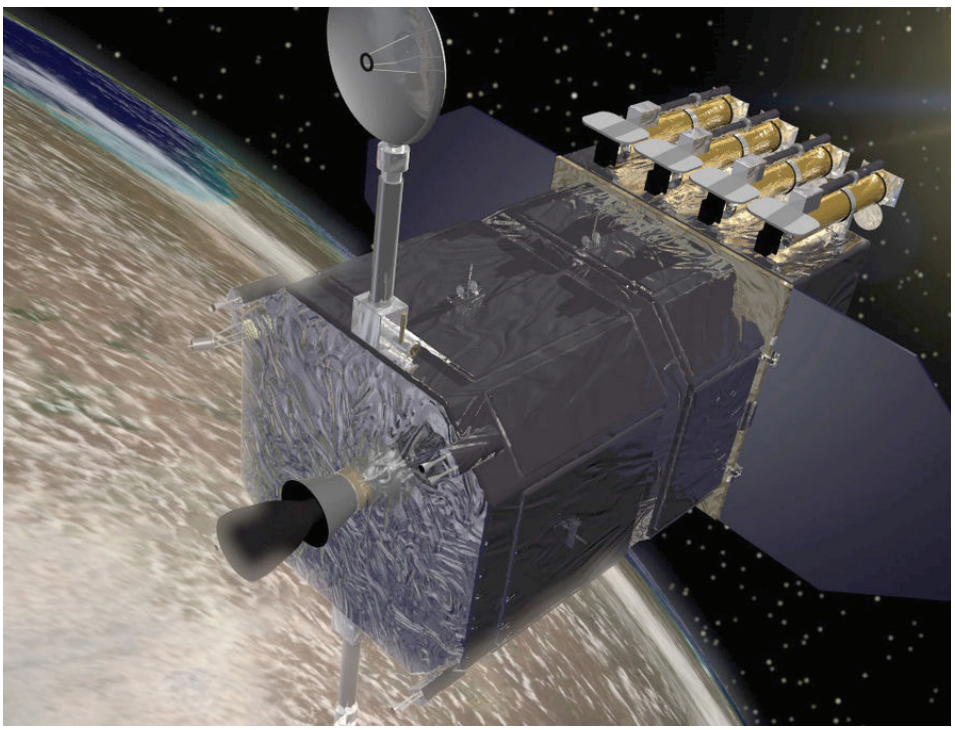
It was externally mounted on the Columbus Laboratory of the ISS in 2008. The SOLAR platform and its instruments are controlled from the Belgian User Support and Operations Centre at the Belgian Institute for Space Aeronomy. The three instruments are:

SOVIM (SOlar Variations and Irradiance Monitor). This is designed to measure solar radiation in the near-ultraviolet, visible and infrared wavelengths.

SOLSPEC (SOLar SPECtral irradiance measurements). Measurements in the 165 to 3000 nanometre range with high spectral resolution.

SOL-ACES (Auto-Calibrating Extreme ultraviolet and ultraviolet Spectrometers). This consists of four grazing incidence grating spectrometers.

In 2012 the entire 450 ton space station was rotated so that SOLAR could observe a full rotation of the Sun. A solar rotation takes about 24-28 days depending on the latitude.



Solar Dynamics Observatory (SDO)

PICARD MISSION

The PICARD mission is dedicated to the measurement of total spectral solar irradiance, the diameter and shape of the Sun and the Sun's interior by the helioseismology method, as well as the influence of solar activity on the climate of the Earth.

This was launched together with the Prisma spaceraft in a low geocentric orbit on 15 June 2010 from the Dombarovskiy Cosmodrome, Russia. The mission ended on 4 April 2014.

Picard carried a payload of three instruments:

- SOVAP (Solar Variability PICARD) composed of a differential radiometer and a bolometric sensor to measure total solar irradiance.
- PREMOS (PREcision Monitor sensor) a set of 3 photometers to study the ozone formation and destruction, and to perform helioseismologic observations, and a differential radiometer to measure the total solar irradiance.
- SODISM (Solar Diameter Imager and Surface Mapper) an imaging telescope and CCD which allows measuring the solar diameter and shape with an accuracy of a few milliarcseconds and to perform helioseismology observations,

SOLAR DYNAMICS OBSERVATORY (SDO)

The Solar Dynamics Observatory was launched by NASA on 11 February 2010

Coral Mass Ejections

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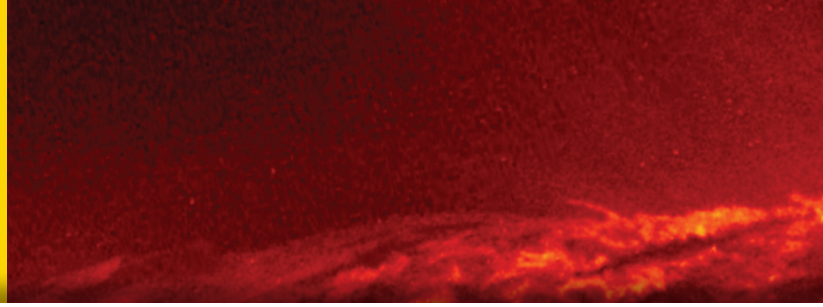


and placed in a circular geosynchronous orbit at 35789 km altitude. The SDO was the first mission of the Living with a Star program.

The goal of the SDO is to understand the influence of the Sun on the Earth and near-Earth space by studying the solar atmosphere on small scales of space and time and in many wavelengths simultaneously. SDO has been investigating how the Sun's magnetic field is generated and structured, how this stored magnetic energy is converted and released into the heliosphere and geospace in the form of solar wind, energetic particles, and variations in the solar irradiance.

SDO is a 3-axis stabilized spacecraft, with two solar arrays, and two high-gain antennas, in an inclined geosynchronous orbit around Earth. The payload includes three instruments:

HELIOSEISMIC AND MAGNETIC IMAGER (HMI)

The HMI studies solar variability and characterizes the Sun's interior and the various components of magnetic activity. HMI takes high-resolution measurements of the longitudinal and vector magnetic field over the entire visible solar disk, extending the capabilities of SOHO's MDI instrument. HMI observations will enable establishing the relationships between the internal dynamics and magnetic activity in order to understand solar variability and its effects.

EXTREME ULTRAVIOLET VARIABILITY EXPERIMENT (EVE)

EVE measures the Sun's extreme ultraviolet irradiance with improved spectral resolution, accuracy and precision over preceding measurements made by previous missions. The Sun's output of energetic extreme ultraviolet photons is primarily what heats the Earth's upper atmosphere and creates the ionosphere. Solar EUV (Extreme ultraviolet) radiation changes over the Sun's 11-year cycle, which has a significant impact on atmospheric heating, satellite drag, and communications system degradation, including disruption of the GPS.

ATMOSPHERIC IMAGING ASSEMBLY (AIA)

The AIA provides continuous full-disk observations of the solar chromosphere and corona in seven extreme ultraviolet channels, spanning a temperature range from 20 kilokelvin to in excess of 20 megakelvin. The 12-second cadence of the image stream with 4096 by 4096 pixel images at 0,6 arcsec/pixel provides unprecedented views of the various phenomena that occur within the evolving solar outer atmosphere. The four telescopes providing the individual light feeds for the instrument were designed and built at the Smithsonian Astrophysical Observatory.

The following video clips produced by SDO are truly awe inspiring:
NASA | SDO Year One
NASA | SDO: Year 5
SDO: Year 6 Ultra-HD

A remarkable solar model was displayed over Federation Square, Melbourne, from 4 June to 4 July 2010. This was a huge helium filled balloon scaled to one 100 millionth of the size of the Sun (about 14 metres). The balloon was illuminated and animated by five projectors using images animated by mathematical equations which never repeat. The project used SDO and SOHO imaging overlaid by animations derived from Navier-Stokes, reaction diffusion, perlin noise and fractal flame equations. Spectators could disturb the animations in real-time by using an iPhone. Perlin noise equations are used to give computer generated animations a 'natural' look.

DEEP SPACE CLIMATE OBSERVATORY (DSCOVR)

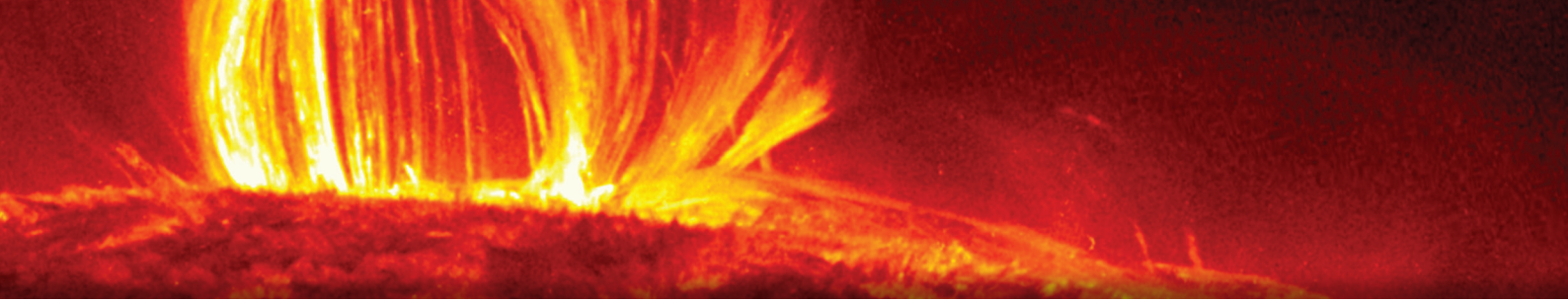
DSCOVR is a NOAA space weather, space climate and Earth observation satellite. It was launched by SpaceX on 11 February 2015 and placed at the L1 point of Earth's orbit.

DSCOVR has succeeded ACE and become the primary system for warnings in the case of Solar magnetic storms.

DSCOVR's orbit also gives Earth scientists a unique vantage point for studies of the atmosphere and climate by continuously viewing the sunlit side of the planet. The EPIC camera provides global spectral images of Earth and insight into Earth's energy balance. EPIC's observations provide a unique angular perspective, and are used in science applications to measure ozone amounts, aerosol amounts, cloud height and phase, vegetation properties, hotspot land properties and UV radiation estimates at Earth's surface.

Payload instruments are:

- PlasMag (Plasma Magnetometer) measures solar wind for space weather early warning predictions. Being placed at the L1 gives 15 to 60 minutes warning of CMEs approaching Earth. Instruments utilised are: Magnetometer for measuring magnetic field; Faraday cup for measuring positively charged particles; and an electrostatic analyser for measuring electrons.

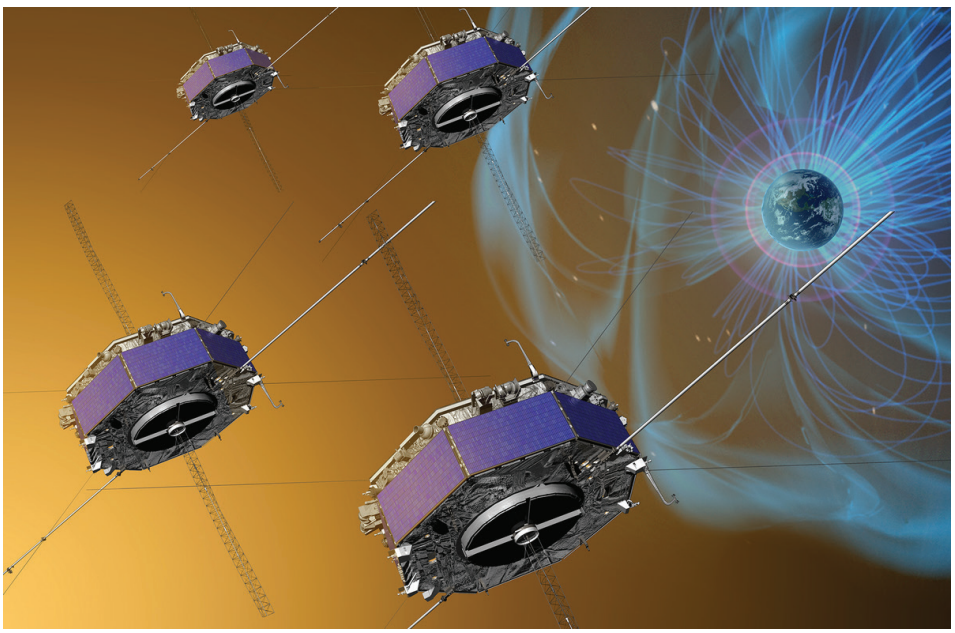


- EPIC (Earth Polychromatic Imaging Camera) is a 30,5 cm aperture camera with a 0,61° field of view capable of viewing the entire Earth. Ten narrowband channels from 317 to 779 nm are used. Final resolution is 25 km per pixel.
- Nistar (NIST advanced radiometer) measures irradiance of the sunlit face of the Earth to study changes in Earth's radiation budget caused by natural and human activity. Measurements are in four channels in infrared, visible and ultraviolet wavelengths.

MAGNETOSPHERIC MULTISCALE MISSION (MMS)

MMS was launched by NASA on 13 March 2015. This is a constellation of four identical craft flying in a tetrahedral formation. This mission is designed to gather information on the microphysics of magnetic reconnection, energetic particle acceleration and turbulence processes that occur in many astrophysical plasmas. This mission will allow for measurements of the critical electron diffusion region where magnetic reconnections occur. Its orbit is optimised to spend extended periods in locations where reconnection is known to occur: at the dayside magnetopause, the place where the pressure from the solar wind and the planet's magnetic field are equal; and in the magnetotail which is formed by pressure from the solar wind on the planet's magnetosphere and which can extend a great distance away from its originating planet.

Magnetic reconnection is a phenomenon in which energy may be efficiently transferred from a magnetic field to the motion of charged particles. Each spacecraft is equipped with several experiments divided into three suites:



Magnetospheric Multiscale Mission (MMS)

- The Hot Plasma Suite has two instruments to measure plasma particle counts, directions and energies during reconnection using four dual electron spectrometers and four dual ion spectrometers.
- The Energetic Particles Detector Suite uses two instruments to detect particles at energies far exceeding those detected by the Hot Plasma Suite.
- The Fields Suite uses six instruments to measure magnetic and electric field characteristics.

On 15 November 2018, researchers of the University of New Hampshire (UNH) published details of a difficult to view magnetic reconnection event in the Earth's magnetotail, in the Journal Science. Roy Torbert of the Space Science Center at UNH and deputy principal investigator for NASA's MMS mission declared: "*This was a remarkable event. We have long known that it occurs in two types of regimes: asymmetric and symmetric but this is the first time we have seen a symmetric process. This is important because the more we know and understand about these reconnections, the more we can prepare for extreme events that are possible from reconnections around the Earth or anywhere in the universe.*"

Magnetic reconnections occur around Earth every day due to magnetic field lines twisting and reconnecting. It happens in different ways in different places, with different effects. Particles in highly ionized plasmas, can be converted and cause a single powerful explosion, just a fraction of a second long, that can lead to strong streams of electrons flying away at high speeds.

For the first reported asymmetrical event on 16 October 2015, and now this symmetrical event on 11 July 2017, NASA's MMS mission made history by flying through magnetic reconnection events near

Coral Mass Ejections

continues from page 55

the Earth. The four MMS spacecraft were only inside the events for a few seconds, but the instruments which UNH researchers helped to develop were able to gather data at an unprecedented speed of one hundred times faster than ever before.

PARKER SOLAR PROBE (PSP)

The NASA Parker Solar Probe was launched on 12 August 2018 and placed in an elliptical solar orbit with a perihelion of 24 million km and an aphelion of one AU.

The mission is named in honour of physicist Eugene Parker, professor emeritus at the University of Chicago.

The mission goals are:

- Trace the flow of energy that heats the corona and accelerates the solar wind.
- Determine the structure and dynamics of the magnetic fields at the sources of solar wind.
- Determine what mechanisms accelerate and transport energetic particles.

Andy Driesman, Parker Solar Probe project manager and a researcher at Johns Hopkins University's Applied Physics Lab in Maryland, which built and manages the project, said of the first orbit in a statement: *"It's been an illuminating and fascinating first orbit. We've learned a lot about how the spacecraft operates and reacts to the solar environment, and I'm proud to say the team's projections have been very accurate."*

Nour Raouafi, a project scientist on the probe who's also at APL remarked: *"We've always said that we don't know what to expect until we look at the data. The data we have received hints at many new things that we've not seen before and at potential new discoveries. Parker Solar Probe is delivering on the mission's promise of revealing the mysteries of our sun."*

The mission design uses repeated gravity assists at Venus to incrementally decrease its orbital perihelion to achieve a final altitude (above the solar surface) of approximately 6,16 million km and a speed of 690 000 km/h.

The spacecraft trajectory will include seven Venus flybys over nearly seven years to gradually shrink its elliptical orbit around the Sun, for a total of 24 orbits.

The near Sun radiation environment (650 kW/m^2) is predicted to cause spacecraft charging effects, radiation damage in materials, and electronics and communication interruptions, so the orbit will be highly elliptical with short times spent near the Sun.

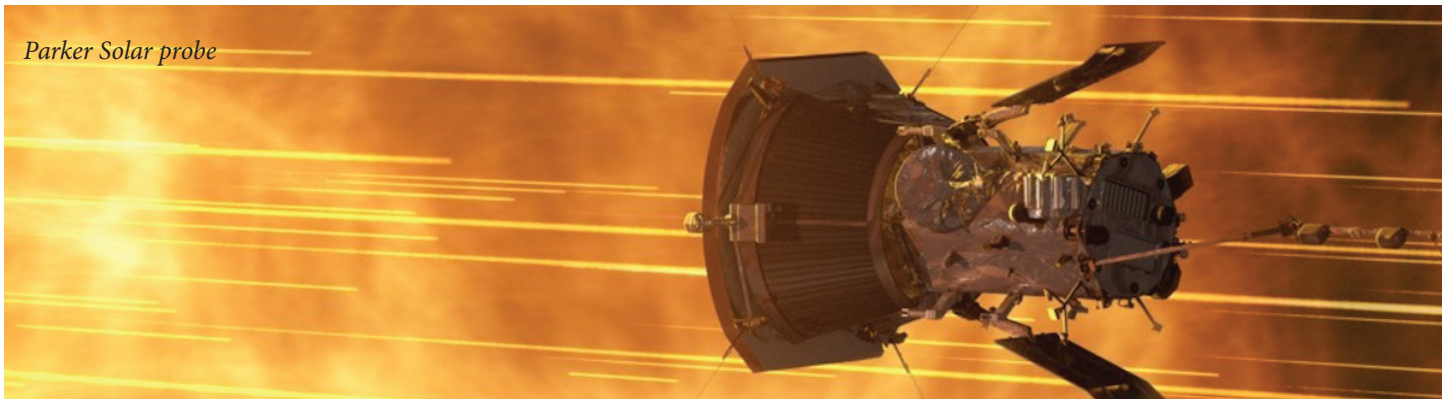
The hexagonal solar shield, mounted on the Sun-facing side of the spacecraft is 11,4 cm thick, and is made of reinforced carbon-carbon composite, with white reflective alumina surface. It is designed to withstand temperatures outside the spacecraft of about 1370 °C

During PSP's 24 total flybys, its instruments will help researchers understand the inner workings of the sun and how it accelerates solar material at high speeds, as well as what makes the star's corona, so much hotter than the solar surface.

PSP started its second solar flyby on 4 April 2019 at an altitude of 24 million km. The orbital period, initially 150 days, will decrease to 88 days by end of mission.

To achieve its goals, the mission will perform five major investigations, each with their own suite of instruments:

- Electromagnetic Fields Investigation.
- Integrated Science Investigation of the Sun.
- Wide-field Imager for Solar Probe.
- Solar Wind Electrons Alphas and Protons.
- Heliospheric Origins. wn



Parker Solar probe

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MAY 2019	
6 - 7	Advanced Microsoft Excel: Practical Data Management Applications For Engineers
14-15	Sans 10142 -1. 2017 Edition 2 & Ohs Act
16 - 17	Network Frequency Control With Increasing Renewable Power Plants
21 - 22	Fundamentals Of Developing Renewable Energy Plants
22 - 23	Leadership And Management Principles And Practice In Engineering
27 - 31	Eskom Cigre Transformer Course
28 - 29	Financial Skills Masterclass
29 - 31	Substation Design And Equipment Selection
JUNE 2019	
4 - 5	Optical Fibre Technology And Networks (OFTN)
5 - 6	Earthing And Lightning Protection
11 - 12	Photovoltaic Solar Systems
12 - 14	Fundamentals Of Medium Voltage Protection
19 - 20	LV, MV & HV Switchgear Operation, Saftey, Maintenance & Management
25 - 26	Design Of Economical Earthing Systems For Utility Electrical Installations
26 - 28	Tendering And Contracting Using The NEC - (New Engineering Contract)
JULY 2019	
1 - 2	High Voltage Testing And Measurement
2	Road To Registration For Engineering Candidates
9 - 10	Fundamentals Of Power Distribution
11 - 12	Electrical Engineering For Non-Electrical Engineers
16 - 18	Cigre Sc B1 Tutorial Session: Cable System Relaibility Workshop
16 - 17	Incident Investigation And Management (Incl. Root Cause Analysis)
18 - 19	Fundamentals of Developing Renewable Energy Plants
23 - 24	Fundamentals of LTE Mobile Communications
23 - 24	Advanced Excel For Engineering Professionals
30 July - 1 August	Power Systems Protection

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Our Expert Answers

Information provided by Zest WEG Group

QUESTION ONE

How do you protect electric motors against overload and short circuit conditions?

ANSWER ONE

The best option to protect electric motors against overload and short circuit conditions is by installing both overload and magnetic circuit breakers. This ensures that the devices back each other up and protect other devices in the circuit as the upstream protection devices safeguard the downstream protection devices from excessive short-circuit current. This is necessary should a device not be able to switch the prospective short-circuit current without a backup in the case of a fault.

The majority of winding failures in electric motors are caused, either directly or indirectly, by overloading (either prolonged or cyclic) or single phasing. The excessive heating caused by overloading will lead to the deterioration of the winding insulation until an electrical fault occurs.

QUESTION TWO

What is overload protection?

ANSWER TWO

Overload protection is essentially protection against running over-current which causes overheating. Overload protection typically operates on an inverse time curve where the tripping time becomes less as the current increases. This means an overload relay isn't going to trip on momentary or short-term over-current events which are considered normal for the piece of equipment the overload protection device is protecting.

For example, some equipment may create inrush currents on startup. These inrush currents typically last only a few seconds and rarely cause a problem. Overload relays are used in an electric motor circuit to protect electric motors from damage caused by prolonged periods of over-current.

QUESTION THREE

How does the thermal protection principal work?

ANSWER THREE

Thermal protection works using a bimetallic strip which bends due to the heat caused by the current flowing to the electric motor and activates a trip lever. This trip lever switches one or several auxiliary contacts which interrupts the supply to the contactor and disconnects the electric motor from the circuit.

A thermal overload relay, commonly called a 'thermal overload', is a device which is usually connected directly to a contactor. It offers overload protection only and must, therefore, be coupled with an upstream magnetic circuit breaker for short circuit protection. Thermal overloads are generally cost-effective, reliable and simple to install so are widely used for electric motor control.

QUESTION FOUR

How does electronic motor protection work?

ANSWER FOUR

Electronic motor protection relays or electronic overload relays are not fitted with bimetallic strips. These are sophisticated devices that use electronics to monitor the motor current continually and protect against overload.

Electronic overload relays offer an extensive range of communications options such as Profibus, Modbus, DeviceNet, Modbus TCP, Profinet, and Ethernet or serial connections to PLC's. Electronic overload relays also offer a full range of monitoring and protection functions, as well as greater accuracy and flexibility when compared to a standard thermal overload relay but are more expensive.

Most electronic overload relay models don't offer short circuit protection and must be coupled with an upstream magnetic circuit breaker for short circuit protection.

QUESTION FIVE

What is short circuit protection?

ANSWER FIVE

A short circuit occurs when a current travels along an unintended path, often where essentially no or a very low electrical impedance is encountered.

Short circuit protection is protection against excessive currents or current beyond the acceptable current rating of equipment, and it operates instantly. As soon as an overcurrent is detected the device trips and breaks the circuit.

QUESTION SIX

How does the magnetic protection principal work?

ANSWER SIX

Magnetic protection uses an electromagnetic mechanism to trip the circuit instantly when the current reaches a certain threshold. It is generally set to trip at ten or more times the electric standard motor running current to avoid tripping during normal motor starting.

QUESTION SEVEN

What is the most cost-effective device that can be used to protect electric motors against overload and short circuits?

ANSWER SEVEN

Also known as a motor circuit breaker, a motor protection circuit breaker is a switchgear device which includes both overload and short circuit protection in a single compact frame. It differs from a standard MCB (miniature circuit breaker) in that it allows the user to preset the exact motor sizing for perfect protection. Motor circuit breakers are very common in industrial motor starting applications.

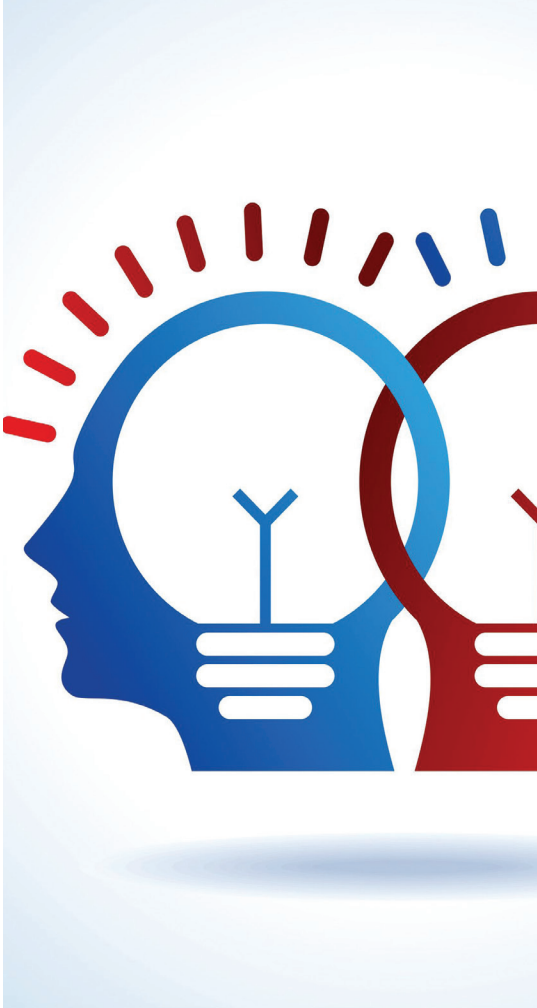
QUESTION EIGHT

Why do electric motors require both thermal overload and short circuit protection?

ANSWER EIGHT

Since a thermal overload relay will not interrupt the circuit in the case of a short-circuit the installation of additional upstream protection is necessary for short circuit protection.

There are several IEC standards covering protection devices for use in electric motor starting and protection applications. Selecting the correct and most appropriate components for an application is essential and will provide considerable benefits such as reduced downtime as well as lower maintenance costs. wn



April in History

April is the fourth month of the year in the Gregorian calendar, the fifth in the early Julian, the first of four months to have a length of 30 days, and the second of five months to have a length of less than 31 days.

COMPILED BY |
JANE BUISSON-STREET
FSAIEE | PMIITPSA | FMIITSPA

1 APRIL

1904 Henry Ford, was age 39 when construction of the first purpose-built Ford factory was authorised by the stockholders, just 10 months after Ford Motor Company was founded.

2 APRIL

1800 Ludwig van Beethoven lead the premiere of his First Symphony in Vienna.

3 APRIL

1866 A hat shaping machine was patented by Rudolph Eickemeyer and G. Osterheld.

4 APRIL

1873 The Kennel Club ("KC") was founded. It is the oldest and first official registry of purebred dogs in the world, as well as being the official kennel club of the United Kingdom.

5 APRIL

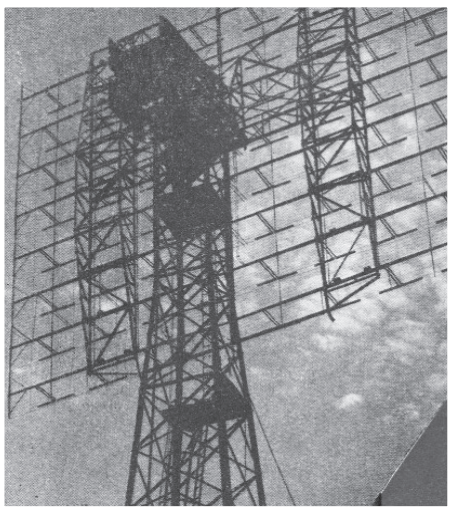
1881 Hermann von Helmholtz (a German physiologist and physicist) presented The Faraday Lecture before the Fellows of the Chemical Society in London. Helmholtz recognized Michael Faraday as being the person who most advanced the general scientific method, saying *"His principal aim was to express in his new conceptions only facts, with the least possible use of hypothetical substances and forces."*

6 APRIL

1652 Van Riebeeck arrived at the Cape with three ships, and the intention to set up a refreshment station for ships passing by on their trade route.

7 APRIL

1959 The first distinguishable echo was recorded of a radar signal bounced off the Sun.



It is considered to be a milestone in the emerging field of radar astronomy. A three-person team from the Radioscience Laboratory, Stanford University, California, USA, led by electrical engineering Professor Von R. Eshleman, recorded an echo from the outer corona of the sun, 17 minutes after transmission. They used an IBM computer for signal processing.

8 APRIL

2016 SpaceX successfully made the first soft return landing of a reusable Falcon 9 rocket booster on to a robotic drone ship at sea. SpaceX, a private spaceflight company, therefor accomplished a feat done by nobody ever before.

9 APRIL

2017 Rugby union SANZAAR ((South Africa, New Zealand, Australia and Argentina Rugby) the body which operates Super Rugby and The Rugby Championship competitions) announced that three teams would be eliminated from Super Rugby after the current season. One team from Australia and two from South Africa will be axed, reducing the competition to 15 teams.

10 APRIL

1925 The Great Gatsby by F. Scott Fitzgerald was first published in New York City, by Charles Scribner's Sons. The story, which primarily concerns the young and mysterious millionaire Jay Gatsby and his quixotic passion and obsession with the beautiful former debutante Daisy Buchanan, sold poorly and Fitzgerald died in 1940 believing himself to be a failure. During World War II it experienced a revival and became part of high school curricula worldwide in the following decades. Today, The Great Gatsby is considered to be a literary classic.

11 APRIL

1972 A smoking deterrent - a pseudo-cigarette package that produces simulated coughing sounds when the package is picked up - was issued a US patent to its inventor, Lewis R Toppel of Chicago, Illinois. According to the patent abstract, "The simulated coughing noises are produced from a battery-driven disk recording played through a miniature loudspeaker in the package".

12 APRIL

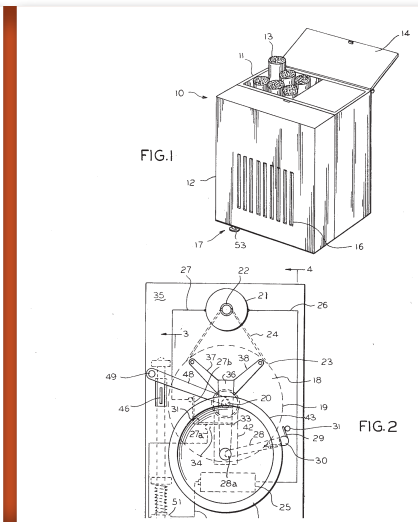
1985 On board the Space Shuttle Discovery mission 51-D when it blasted off was the first yo-yo taken into space. The yellow plastic Duncan Imperial yo-yo, a gyroscope and other toys were 'played with' during the time in orbit in order to compare their behaviour in microgravity with normal play on the Earth's surface.

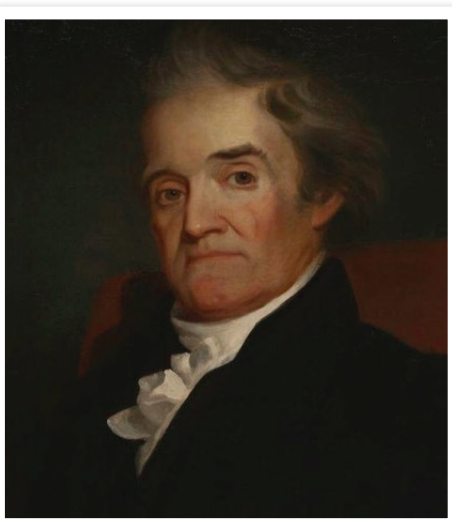
13 APRIL

1964 The acting profession's top award went to a black actor for the first time; Sidney Poitier won the best actor Oscar for his role in Lilies of the Field. In the film, released the year before, he played construction worker Homer Smith whom a group of nuns believe was sent to them by God to build their church.

14 APRIL

1828 The first edition of Noah Webster's dictionary was published under the name "American Dictionary of the English Language." Webster was an American lexicographer who began work on it during 1807 and completed it while in France and England in 1824–25. It was produced a two-volume lexicon containing 12,000 words and 30,000 to 40,000 definitions that had not appeared in any





April in History

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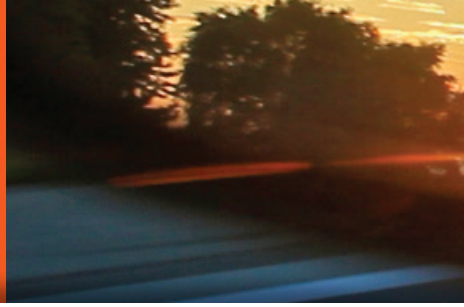


earlier dictionary. Because it was based on the principle that word usage should evolve from the spoken language, the work was attacked for its "Americanism," or unconventional preferences in spelling and usage, as well as for its inclusion of non-literary words, especially technical terms in the arts and sciences.

15 APRIL

2008 The first procedure in Britain to implant "bionic" eyes was carried out at Moorfields Eye Hospital, London, on two blind patients with retinal pigmentosa but intact optic nerves. After the 4-hour operation, the patients were able to perceive an array of spots of light showing crude shapes and movements.

16 APRIL

2016 Axl Rose (previously with Guns 'n Roses) was confirmed as the replacement singer for AC/DC. Brian Johnson had left the band due to a potentially career-ending hearing problem.

17 APRIL

2014 NASA's Kepler space telescope confirmed the discovery of the first Earth-size planet in the habitable zone of another star. Kepler-186f is an exoplanet orbiting the red dwarf Kepler-186, about 582 light-years (178.5 parsecs, or nearly 5.298×1015 km) from the Earth.

18 APRIL

1925 The first Woman's World's Fair in U.S. was officially opened in Chicago, Illinois, by Mrs Calvin Coolidge. For eight days, it displayed women's progress in 70 industries. This showed the diversification since the 1893 World's Fair, where the only example of woman's handiwork was the sewing exhibit.

19 APRIL

1957 Researchers ran the first FORTRAN program. Short for "FORmula TRANslator," FORTRAN enabled computer programmers to work in a "high-level" language which greatly simplified program writing. The first FORTRAN program (other than internal IBM testing) ran at Westinghouse, producing a missing comma diagnostic. It was successful.

20 APRIL

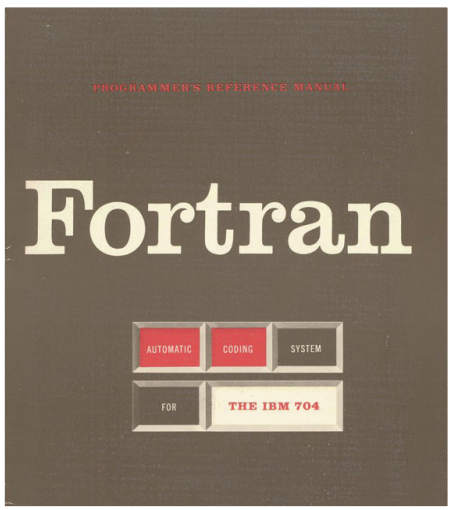
1902 Pierre and Marie Curie isolated one gram of radium, the first sample of the radioactive element. They had refined it from eight tons of pitchblende ore.

21 APRIL

2018 Nabi Tajima, a Japanese supercentenarian and the world's oldest person at the time, died at age 117 in southern Japan. She was the last validated person born in the year 1900.

22 APRIL

2010 The Boeing X-37, also known as the Orbital Test Vehicle (OTV), is a reusable unmanned spacecraft. It was boosted into space by a launch vehicle, then re-entered Earth's atmosphere and lands



as a spaceplane. The X-37 was operated by the United States Air Force for orbital spaceflight missions intended to demonstrate reusable space technologies. The Boeing X-37 began its first orbital mission. It successfully returned to Earth on December 3, 2010.

23 APRIL

1990 Namibia became the 160th member of the United Nations and the 50th member of the Commonwealth of Nations.

24 APRIL

1922 The first segment of the Imperial Wireless Chain that provided wireless telegraphy between Leafield in Oxfordshire, England, and Cairo, Egypt, came into operation. The Imperial Wireless Chain was a strategic international communications network of powerful long range radiotelegraphy stations, created to link the countries of the British Empire. The stations exchanged commercial and diplomatic text message traffic transmitted at high speed by Morse code using paper tape machines. Although the idea was conceived prior to WWI, the United Kingdom was the last of the world's great powers to implement an operational system.

25 APRIL

1983 American schoolgirl Samantha Smith was invited to visit the Soviet Union by its leader Yuri Andropov after he read her letter in which she expressed fears about nuclear war.

26 APRIL

1803 Thousands of meteor fragments fell from the skies of L'Aigle, France; this event convinced European scientists that meteors do exist.

27 APRIL

2005 Airbus A380 aircraft had its maiden test flight. The A380 was introduced into service on the 25th October 2007 by Singapore Airlines.

28 APRIL

1973 Pink Floyd's eighth album, The Dark Side of the Moon, recorded in Abbey Road Studios, England, went to number one on the US charts, beginning a record-breaking 741-week chart run. The album was released on 1 March 1973 by Harvest Records.

29 APRIL

2018 Brazil surfer Rodrigo Koxa broke the record for the largest wave ever surfed. The wave occurred off the coast of Nazaré, Portugal and measured 24.4 metres.

30 APRIL

1905 Einstein completed his thesis, with Alfred Kleiner, Professor of Experimental Physics, serving as pro-forma advisor.

As a result, Einstein was awarded a PhD by the University of Zürich, with his dissertation *"A New Determination of Molecular Dimensions"*. wn

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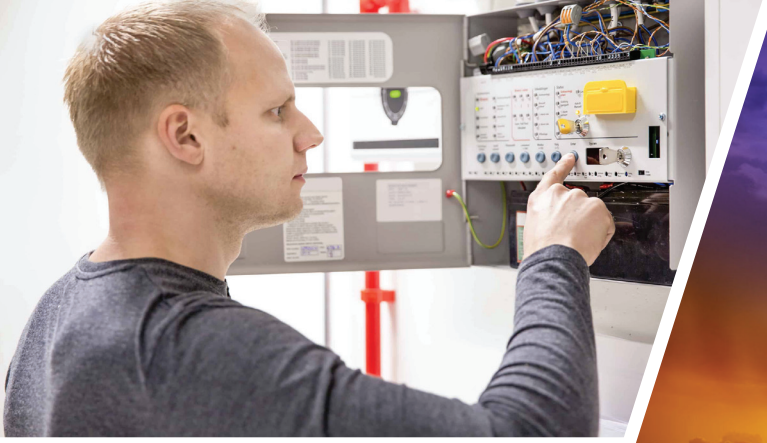

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