



ASTROSCIENCE EXPLORATION NETWORK

presents an in-person conference

**Pioneering the dissemination of
astroscience in sub-Saharan Africa**

JUNE 1st-2nd, 2023

M'KANGO GOLFVIEW HOTEL, LUSAKA

we call for presentations from
global scientists focussed on astrosciences
as well as related fields

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Astroscience Exploration Network is a NoRCEL innovative initiative
NoRCEL is an organisational member of the Royal Society of Biology

The Unveiling of:

PIONEERING THE DISSEMINATION OF ASTROSCIENCE IN SUB-SAHARAN AFRICA (Evolving Education in Africa)

Introduction—Background and Vision

NoRCEL was inaugurated in 2013 and from its humble beginnings it has been the vision of its founder and Chairman, Sohan Jheeta, to build an astroscience education entity—the NoRCEL Science Institute; NoRCEL being an acronym of the “Network of Researchers on the Chemical Emergence of Life.” This network has at its core the persistent theme of promoting astroscience education across the global south and is neither a registered charity nor a Non-Governmental Organisation (NGO), but a not-for-profit organisation. We are a completely voluntary collective of scientific researchers which could be considered akin to a task force in helping to establish a level playing field for all, regardless of status, in respect of the astroscience subjects, namely astrobiology, astrochemistry and astrophysics. If one was asked to define what NoRCEL is, the answer could be as follows: “a movement” and “a game changer,” but in essence we are an academic research network aiming to air and share scientific ideas far and wide. At our core we remain the Network of Researchers on the Chemical Emergence of Life.”

Sohan Jheeta HND, BSc, MSc, PhD
Founder and Chairman of NoRCEL
Fellow of the Royal Society of Biology
Fellow of the Royal Microscopical Society

Past outreach work in the Global South and on the African Continent

We have already delivered scientific oral presentations and workshops in the following countries: India, Jordan, Malawi, Sharjah (UAE), South Africa, Tanzania, Zambia and Zimbabwe—see <https://www.sohanjheeta.com/jordan-outreach-photos>. In addition, we have been promulgating online access to astroscience on the African continent as well as in Brazil and Mexico—see “NoRCEL’s Innovative Initiatives” below. Tentative results seem to show that both impact and reach are flourishing (Jheeta et al., 2022).

We have highlighted the importance of science education in Africa and aim to raise awareness in line with the global north by publishing several articles in COSPAR’s bulletin: “Space Research Today,” as well as other journals. Our latest article is entitled: NoRCEL’s engagement in Africa: The AstroScience Exploration Network (ASEN) (Jheeta et al., 2023).

The Mission Statement

NoRCEL has set itself a task to design and implement an astroscience course for the African nations.

The NoRCEL Team

At NoRCEL, we have an experienced volunteer international team that is capable of seeing an objective through.



NoRCEL's Innovative initiatives

The Network is an umbrella organisation for several entities; each one handled by a local network or hub, thus NoRCEL is continuously giving voice to local talent. We understand the requirement of meeting local needs since these initiatives are handled by the respective local NoRCEL members.



- Frontiers of Sciences (FoS)—science-in-society group... highlighting the discoveries of our time;
- NoRCEL Sessions—introduces prominent scientists to other junior scientists and the general public alike on a monthly basis;
- Microbial World Network (MWN)—focusses in discovery of the emergence of life using a top-down approach by studying micro-organisms;
- AstroScience Exploration Network (ASEN)—delivering astrospace education on the sub-Saharan continent;
- Blue Earth Project (BEP)—asking and answering tough and difficult questions about the issues affecting our home planet;
- South East Asian Hub (SEAHub)—promulgates the science of the emergence of life across South-East Asia;
- Latin American Hub (LAHub)—Local hub hosting biennial meetings and group interested in passing on knowledge about emergence of life science across the South American continent; and
- Team: Emergence of Life (Team Emergence)—active in Turkey and surrounding countries and disseminates emergence of life science.

Very Special Guest Speakers

1) Biography of Professor Svatopluk Civiš, CSc., DSc



Professor Civiš is an experienced scientific researcher and head of Department of Spectroscopy at the J. Heyrovsky Institute of Physical Chemistry, CAS in Prague, having undertaken various previous research posts including ones in both Germany and Canada. He has over 200 publications with many citations to his name. Some of his most important works include: TiO₂-catalyzed synthesis of sugars from formaldehyde in extraterrestrial impacts on the early Earth? (2016); and the origin of methane and biomolecules from a CO₂ cycle on terrestrial planets (2017). In addition, he has had two e-books published since 2019. The award of a significant European grant enabled him to work on the Partypys area of project the project ERDF/ESF “Centre of Advanced Applied

Sciences” (No. CZ.02.1.01/0.0/0.0/16_019/0000778), and the Ministry of Education, Youth, 473 and Sports of the Czech Republic (Project No. LM2018114). (CAAS). Furthermore, he has been lecturing and supervising students for over 20 years, both at home and abroad and has been an invited speaker in many countries around the world.

2) Biography of Dr Jacques Arnould



Born in 1961, Jacques Arnould is engineer in agronomy and forestry, has a Ph.D. in History of Sciences and a Ph.D. in Catholic Theology.

He is taking an active interest in the interrelation between sciences, cultures and societies with a particular interest for two set of themes: the first related to the life sciences and evolution; the second related to space conquest. Since 2001, he is an Ethics Adviser to the French Space Agency (CNES) as well as collaborating with, since 2000, International Space University (Strasbourg, France) as adjunct faculty. In addition, he was the past President of the Scientific Committee of the Air and Space Museum of Le Bourget (Paris, France); the Secretary of the College of French Terminology for Astronautics (Ministère de la Culture, Académie française); belongs to the International Academy of Astronautics and to the Académie Royale de Belgique; and was selected for the International Astronautical Federation Hall of Fame 2022. Finally, he received in 2004 the Labruyère Prize from the Académie Française and in 2011 the Audiffred Prize from the Académie des sciences morales et politiques.

Among his books published in English about Space Activities:

- Icarus' Second Chance. The Basis and Perspectives of Space Ethics, Springer, 2011
- God, the Moon, and the Astronaut, ATF Theology, 2016
- Impossible horizon. The essence of space exploration, ATF Press, 2017
- Ethics Handbook for the Space Odyssey, ATF, 2020.

The Big NoRCEL Brainstorming Questions

1. What do you understand astrospace to be?
2. What future of (astro)space would you like to see?
3. What role would you like to play for making this a reality?
4. Which obstacles need to be overcome to get there?
5. What support would you need?

Submitted abstracts

Day One, 1st June 2023

Origin of methane and biomolecules from CO₂ cycle on terrestrial planets

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Abstract

The chemical evolution of early terrestrial planets is a long-standing enigma which involves the uncertainty of chemical atmospheric composition and plausibility of biomolecules synthesis. In this study, new alternative scenario of the origin of methane on Mars and terrestrial planets is suggested. Martian and other planetary atmospheres rich in carbon dioxide can be abiotically converted into a mixture of methane and carbon monoxide by ‘methanogenesis’ on porous mineral photoactive surfaces upon soft UV irradiation. On young planets exposed to heavy bombardment by interplanetary matter, the process can be followed by synthesis of biomolecules in reprocessing of such reactive reducing atmosphere by impact-induced shock waves. The proposed mechanism of methanogenesis may help answer the question on the formation of methane and carbon monoxide by photochemical processes, the formation of biomolecules on early Earth and other terrestrial planets, and the source and seasonal variation of methane concentrations on Mars.

Acknowledgements

This work is a part of a research series funded by the Czech Science Foundation (grant no. 17-05076S and 13-07724S) and ERDF/ESF “Centre of Advanced Applied Sciences” (No. CZ.02.1.01/0.0/0.0/16_019/0000778).

Reaching for the stars: Astronomy Outreach in South Africa

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Abstract

A clear night sky fascinates everyone, irrespective of cultural background. Hence astronomy is an excellent tool to convey scientific knowledge and inspire communities. The astronomy and space science outreach programs in South Africa achieve this by a wide variety of activities, such as a nationwide astroquiz for learners, astronomy and space science debates, stargazing, school-based astronomy and space clubs, astrotourism, and indigenous story telling. One of the key aims is to inspire students, and girls in particular, to get interested in astronomy and ultimately to pursue careers in STEM. The activities also enhance the public appreciation of science. The talk will provide an overview of some of the various outreach projects implemented for both public and students.

An introduction: Astroscience Education in sub-Saharan Africa—an Overview

Sohan Jheeta, found and Chairman of NoRCEL, Leeds, UK
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Abstract

From ancient times, astronomy has always fascinated human minds across the world. At the same time, our knowledge about outer space had profound impact on the development of civilisations. The cosmic neighbourhood of planet Earth has also become a laboratory for the natural sciences, first for physics, then for chemistry, and now for biology.

The value of astronomy for development is widely recognised. Africa is now co-hosting with Australia a scientific and technological mega project, the Square Kilometre Array (SKA), to become the largest radio telescope in the world. Eight African countries have already agreed to host telescope nodes, and a lot of capacity building is underway. This stretches as far as electrical and electronic engineering, mathematics, big data science, and turns advanced skills and technology into commercial benefits.

A key factor however is education. In many African countries, the sciences do not make popular subjects by the time students go on to university, often lagging far behind the arts and humanities. This is particularly true of astrophysics subjects, namely astrophysics, astrochemistry and astrobiology. Even where these subjects are taught at higher education levels, hands-on experimental work is somewhat limited and rudimentary. NoRCEL has been active on the continent since 2015, steadily delivering inspirational talks and workshops at ground level. Now NoRCEL has formulated an additional innovative initiative: Astroscience Exploration Network (ASEN). This network is leading the way forward from the bottom—up by designing an astroscience curriculum with practical experimental elements. This is because an advanced economy requires well-educated people, while well-educated people will only thrive if that economy provides suitable jobs. The direction is to move forward.... Onwards and upwards ASEN!

Investigation into the Cause of Time-Lags in the Arrival Times of Photons of Different Frequencies Emanating from Gamma-Ray Bursts

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Abstract

γ -ray Bursts (GRBs) are densely concentrated high-energy outbursts from hitherto unknown distant objects deep within space. In a few seconds of their emergence, they release as much energy as the Sun will release in its entire 10 billion years, thus, making them one of the most energetic and brightest known events in the Universe. In recent studies, it has been shown that photons emanating from these cataclysmic events and their afterglow experience time lags. When these time-lags are experienced, it causes a change in the frequency of the incoming radiation from the GRBs source thereby causing a delay in the arrival time of the photon when detected. In this research, we present a pilot study of time lags (Δt) in eight GRB Radio Afterglow emissions, i.e., delays in the arrival times of radio waves of different frequencies emanating from GRB Radio Afterglows. Unlike in most studies on this phenomenon, we do not assume that this time lags is due to the Photon being endowed with a non-zero mass, but that this may very well be due to the interstellar space being a cold rarefied cosmic plasma, which medium's electrons interact with the electric component of the Photon, thus generating tiny currents that lead to dispersion, hence, a frequency (ν) dependent speed of light (FDSL) where this speed scales off as ν^{-1} . The said interaction is such that, lower frequency Photons will propagate at lower speeds than higher frequency Photons thus leading to the observed time lags in the arrival times of Photons of different frequencies. In reasonable accord with our proposed FDSL model, we investigated eight of these events extracted from literature and found that for four of these GRB afterglows, there is a strong correlation between the observed time lags and the frequency ($\Delta t \propto \Delta \nu^{-1}$), thus justifying the prediction of our FDSL model. Further analysis of these four GRBs gives reasonable statistically significant results which are consistent. If this model can be corroborated by a large enough data set, there is hope that this same model can be used as a potent tool for finding independent distance estimates to not only GRBs locations, but to Fast Radio Bursts (FRBs) as-well.

Astroscience Education and Outreach Activities in Zambia

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Abstract

In this paper we present the efforts made by the National Outreach Committee (NOC) in advancing astronomy and science education and communication in the country. We highlight training programmes, astronomy workshops and public outreach activities. Notable among these we have the Astrolab series of workshops, the Network for Astronomy School Education (NASE), GOLAB and the upcoming International Space Weather Initiative (ISWI) summer school.

Insights on Astro-science and Career Prospects for Zambians

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Abstract

The Zambian government, through a ministerial statement, has announced an indication to launch the country's first space satellite within two years and a group of experts to spearhead the process. Application of space science and technology by any government can foster socio-economic development as well as progress for the citizens and the rest of the world. A coordinated and robust educational outreach action is needed to popularise space related activities among Zambians. Many nationals in Zambia especially pupils and students do not have a clear picture of the attendant natural sciences and the associated applied sciences effected by space-faring nations to realise such an endeavour. The above-mentioned experts are tasked to outline and roll-out a national space science programme. Zambian youths are expected to have a crucial role leading into the future space activities. Therefore, we will discuss the pertinent astro-sciences including astrophysics and space science needed to achieve the set goal and programme plans. Furthermore, we will highlight some Zambian career scientists and engineers within and without the country's territory to motivate the local next generation to carry out the expected dynamics and unique programme. We will also present details required to ensure success at space related national projects using examples.

Dark Matter and its Fascinating Mysteries

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Abstract

Dark matter is one of the most fascinating and puzzling phenomena in modern astrophysics. It is believed to make up about 85% of matter in the universe, yet it cannot be directly observed or detected through conventional means. Despite its ubiquitous presence in the universe, its nature and properties remain elusive, and its detection and study represent some of the most pressing questions in the field. In this abstract, we describe an investigation into the nature of dark matter, including its properties, distribution, and role in shaping the evolution and dynamics of galaxies and large-scale structures in the universe.

We begin by providing an overview of the evidence for the existence of dark matter, including observations of galaxy rotation curves, gravitational lensing, and the cosmic microwave background radiation. We then discuss the various theoretical models proposed to explain dark matter, including weakly interacting massive particles (WIMPs), axions, and sterile neutrinos, among others. We explore the challenges and limitations of these models and describe the efforts underway to detect and study dark matter particles directly and indirectly.

Next, we focus on the distribution and properties of dark matter in galaxies and large-scale structures. We describe the current understanding of the relationship between dark matter and visible matter, including the formation and evolution of galaxies, the growth of cosmic structures, and the role of dark matter in shaping the cosmic web. We discuss the implications of recent observations and simulations, including the discovery of dark matter filaments and the impact of baryonic processes on dark matter distributions.

We then turn to the investigation of the properties of dark matter particles, including their mass, interaction strength, and other fundamental properties. We describe the various techniques used to study dark matter particles, including direct detection experiments, indirect detection through cosmic rays and gamma rays, and collider experiments. We discuss the challenges and limitations of each technique and the potential for future discoveries.

Finally, we discuss the broader implications of understanding dark matter, including its role in fundamental physics, the origins of the universe, and the search for new physics beyond the standard model. We explore the potential for new discoveries and breakthroughs in the field, including the possibility of detecting dark matter particles directly, studying the effects of dark matter on astrophysical phenomena, and using dark matter as a tool to probe the properties of the universe at large. In conclusion, our investigation into the nature of dark matter reveals the profound and far-reaching implications of understanding this mysterious substance. Through a combination of theoretical modeling, observational studies, and experimental techniques, we are working to unravel the mysteries of dark matter and unlock the secrets of the universe. The discoveries and breakthroughs that lie ahead have the potential to revolutionize our understanding of the cosmos and transform our view of the universe and our place within it.

Public engagement with astronomy as a cornerstone for development in Qatar

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Abstract

While natural carbon resources provided the basis for an unprecedented economic growth in the State of Qatar, their finite availability has prompted an investment strategy focusing on education and research, given that these have been identified as the future core drivers of prosperity. With support from the Qatar National Research Fund (QNRF), we designed and carried out a programme "Fascination Astronomy" with the expressed goals to support the growth of talent towards a sustainable innovation system, to anchor science in modern Qatari society, and to make Qatar a well-respected partner in a culturally diverse world. The particular value of astronomy stems from it coming with an unparalleled intrinsic fascination and accessibility, as well as opportunities to get involved and take part, while we can connect to the rich Middle Eastern heritage and deep cultural rooting of this field. By first igniting the fascination and then taking it further to act as a driver to unleash human creativity, we are inspiring towards questioning and exploring, towards higher education, towards science careers, and towards understanding the value of science. Over two years, more than 100 teachers have been provided with training, more than 6,000 students were given an introduction to astronomy with practical demonstrations during visits to 168 schools, 500 students demonstrably developed both creative team skills and abilities of critical questioning and scientific enquiry through their active engagement as part of school teams in the projects of the Qatar National Astronomy Olympiads, and about 15,000 members of the general public got a glimpse of astronomy with demonstrations of the night sky in our mobile inflatable planetarium and live observing with our telescopes. Moreover, we sent a Qatari team to the International Olympiad in Astronomy and Astrophysics (IOAA), the first ever from an Arab country.

Emergence of Life: Importance of Formation of Organic Molecules of Life

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Abstract

It is believed that some of the necessary organic molecules may have been formed in specific areas of space (namely dark molecular clouds, eg Horsehead nebula) and delivered on to the Earth during the early heavy bombardment period of its history, approximately 4.3-4.0 billion years ago. These organic molecules may have played a pivotal role in the formation of life on Earth. In addition, it is believed that life on Earth was formed within a very short geological time frame of only 200-300 million years. So, it is not unreasonable to suppose that these molecules were initially made in space which in effect could be, metaphorically speaking, a huge chemical laboratory.

The research (drawn from my own experimental astrochemistry) highlighted during this oral presentation focuses on the formation of molecules under a variety of simulated space conditions (eg different temperatures, levels of radiation energies and types of impinging radiations). There are two sorts of chemistry that take place in space, solid and gas phase, and although only 25% of the chemistry in space occurs in the solid phase, this will be the focus of my oral presentation.

Day Two, 2nd June 2023

Infrared spectroscopy of ions, radicals and Rydberg atoms for Ariel astronomy

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Abstract

ARIEL is designed as a dedicated survey mission for transit and eclipse spectroscopy, capable of observing a large and well-defined planet sample within its 4-year mission lifetime. Transit, eclipse and phase-curve spectroscopy methods, whereby the signal from the star and planet are differentiated using knowledge of the planetary ephemerides, allow us to measure atmospheric signals from the planet at levels of 10-100 part per million (ppm) relative to the star and, given the bright nature of targets, also allows more sophisticated techniques, such as eclipse mapping, to give a deeper insight into the nature of the atmosphere. These types of observations require a specifically designed, stable payload and satellite platform with broad, instantaneous wavelength coverage to detect many molecular species, probe the thermal structure, identify clouds and monitor the stellar activity. The wavelength range proposed covers all the expected major atmospheric gases from e.g. H₂O, CO₂, CH₄, NH₃, HCN, H₂S through to the more exotic species such radicals CN, NH, CH, OH, CH, He₂, highly

vibrationally excited molecule of CO and many atoms in Rydberg (highly excited) states, which spectra appear in the 1.25-7.8 μm spectral range.

The Las Cumbres Observatory Global Telescope Network—at your service...

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Abstract

The Las Cumbres Observatory (LCO) is a world-spanning network of robotic telescopes of 0.4m, 1m, and 2m diameter at 7 sites that gives quasi-uninterrupted access to the whole sky. The 0.4m network is primarily used for educational purposes, and over 1,000 hours of observing time per year are made available for free to educational organisations from around the world following a competitive application to join the LCO “Global Sky Partners” programme. In contrast, the 1m and 2m networks are mostly for scientific research proposals. These telescopes are equipped with imagers and spectrographs, as well as with a large set of standard filters. Researchers in most African countries can get access to the LCO facilities through the ORP (Opticon RadioNet Pilot) transnational access programme, for which there are two calls per year. The University of St Andrews owns three of the LCO 1m telescopes and in exchange holds its dedicated share of observing time on the science network. We would be looking forward to exploring collaboration with African partners.

Properties of giant molecular clouds in the nearby galaxy M33

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Abstract

Investigating Giant Molecular Clouds (GMCs) in external galaxies presents the opportunity to examine how the distribution, density structure and dynamical state of star forming clouds depends on galactic environment. With ALMA, these GMCs in the nearby galaxies can now be resolved for the first time. I am working with ALMA data from M33, where three GMCs at different evolutionary stages have been mapped with CO isotopes at an angular resolution of 0.44×0.27 arcsecs ($\sim 2\text{pc} \times 1\text{pc}$). In this talk, I will present the background of my research, preliminary results and future work as it is still an ongoing research

Space Ethics

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Abstract

Space ethics was officially born in the early 2000s. The accidents of the two American shuttles, the increase in the number of debris in circum-terrestrial space, the demands of the actors of NewSpace have made the ethical questioning necessary. Questioning the *raison d'être*, the resources committed, the positive and negative effects of our space activities has gradually become a requirement for space actors but also for our civil societies. In addition to the initiatives of space agencies in the field of ethics, there is now an interest in the subject of space in the academic world of the humanities. This reading therefore proposes to introduce the notion of space ethics and to evoke the main issues that animate it (exploration, exploitation).

Zambia Space Explorers: Promoting Space Exploration and Astronomy Education in Zambia

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Abstract

Zambia Space Explorers is an Astronomy-based STEM organisation founded in September 2021 with the mission to promote and bring to light the idea of space exploration amongst young people in Zambia. Our aim is to educate the public, particularly young people, about different aspects and ideas related to space exploration and astronomy. We strive to inspire the next generation of scientists and explorers from within the country.

Since our founding, we have participated in various STEM events around the country. In 2022, we collaborated with the Pan-African Citizen Science E-lab and the International Astronomical Search Collaboration to bring Citizen Science programs to Zambia. We were able to make 6 asteroid detections which have been submitted for further analysis.

In the upcoming year, we plan to do outreach events in all learning institutions to reach more people. We intend to collaborate with other countries to promote astronomy on a larger scale. Our slogan, "PROMOTING THE SPACE SIDE OF STEM," reflects our approach, which takes a more practical orientation to offer everyone the opportunity to participate in Citizen Science programs to make real astronomy discoveries and participate on a global scale with other countries. Our presentation will provide an overview of our mission and objectives, our accomplishments to date, and our plans for the future. We will share our experiences and insights to inspire others to get involved in space exploration and astronomy education.

Space: Exploring the Unknown.

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Abstract

“We choose to go to the moon! We choose to go to the moon ... not because it is easy, but because it is hard, because that goal will serve to organize and measure the best of our energies and skills...”- JFK, moon speech.

Our will to know beyond what we know drives us. What is so interesting about relearning what you already know? In 2015, a Japanese man named Satoru Anzaki reportedly died of boredom at his own retirement party, where he felt out of place and unimportant. Always interesting to challenge yourself and achieve the ‘coolest’ thing you can do with the tools available.

It is only after we master our environment that we are then best positioned to control it to our benefit. JFK hardly understood the full benefits space exploration would bring today, e.g Google Maps.

My interest in space was birthed from tales my brother would tell me about space, and about the unique properties of light, this interest was later invigorated in my second year in Uni when I engaged in a deep conversation with a love interest on the intricacies of space and how the possibility of higher dimensions perfectly describes the spiritual realm the Christian religion portrays, an odd conversation with a girl you are interested in, right? Lol.

My goal in the field is to make a contribution from the electrical engineering standpoint in this fight of space exploration, a fight waged by Galileo Galilei through the ages of Katherine Johnson, the lady whom the movie “Hidden Figures” is based on, through to today where we have the James Webb telescope staring at the unknown and SpaceX making tremendous strides in space exploration.

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The End of Forum

Thanks for attending and safe journey home

