ANTHARIKSH

The Space...

DEPARTMENT OF AEROSPACE ENGINEERING

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

MYLAVARAM, ANDHRA PRADESH, INDIA.

Vision of the Department:

To achieve academic excellence and produce highly competent professionals in the field of Aerospace Engineering

Mission of the Department:

DM1: To impart high quality education in Aerospace Technology through class room teaching and laboratory practice

DM2: To develop indigenous Aerospace Technology by carrying out research in collaboration with industry and research organizations

DM3: To train and inspire the student community to possess effective communication and leadership skills with ethical values

DM4: To harness the technological development by being consistently aware of societal needs and challenges

Program Educational Objectives (PEOs)

PEOs	Statement
PEO1	To provide students with sound mathematical, engineering and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems
PEO2	To prepare students to excel in higher education programs and to succeed in industry/academia profession.
PEO3	To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigation of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design

PSO2: To prepare the students to work effectively in Aerospace and Allied Engineering organizations

FOCUS AND SCOPE

A department magazine bridges the gap between students and faculty. Typically, a department magazine consists of Technical articles, ideas, project outcomes, language skills, literary articles, technical updates, success stories, career tips, academic advice, the latest events and happenings related to campus. Cover-stories have to be written in an engaging format. We can also include interviews of former students who have achieved success through dedication and hard work.

PUBLICATION FREQUENCY:

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Send your articles to the following mail ID.

E-Mail: anthariksh.lbrce@gmail.com

Disclaimer

Some of the contents published in this magazine are from open sources. The contents of this magazine are for information purposes only, enabling the faculty and students to have easy and quick access to information and do not have any legal sanctity. This magazine is intended for circulation among students of the department of Aerospace Engineering of LBRCE only.

FROM HOD's DESK

Ethics is nothing but a code of conduct that helps a man to be a good citizen. We should be pure because purity is our real nature, our true divine Self. Similarly, we should love and serve our neighbours because we are all one in the Supreme Spirit.

Dr. P. Lovaraju

WHAT WOULD HAPPEN TO THE HUMAN BODY IN THE VACUUM OF SPACE?

G. ROSHITHA
198761A2111

Space is a vacuum devoid of air — meaning that, unlike on Earth, there's no atmosphere and no pressure exerted by air molecules. Atmospheric pressure determines the temperatures at which liquids boil and turn gaseous. If the pressure exerted by the air outside a liquid is high, as it is at sea level on Earth, it's harder for bubbles of gas to form, rise to the surface and escape. But because there is virtually no atmospheric pressure in space, the boiling point of liquids decreases significantly. "As you can imagine, given that 60% of the human body is made up of water, this is a serious problem," Dr. Kris Lehnhardt, an element scientist for the Human Research Program at NASA, told Live Science. In the absence of pressure, liquid water in our bodies would boil — changing immediately from a liquid to a gas. "In essence, all of your body tissues that contain water will start to expand," he said.

Some humans have actually been exposed to near-vacuums and survived to tell the tale. In 1966, an aerospace engineer at NASA, Jim LeBlanc, was helping to test the performance of spacesuit prototypes in a massive vacuum chamber. At some point in the test, the hose feeding pressurized air into his suit was disconnected. "As I stumbled backwards, I could feel the saliva on my tongue starting to bubble just before I went unconscious, and that's kind of the last thing I remember," he recalled in the 2008 "Moon Machines" documentary series episode "The Space Suit." The formation of gas bubbles in bodily fluids, known as an ebullism, also occurs in deep-water scuba divers who surface too quickly because they go from an underwater environment of high pressure to low pressure at the water's surface. For suit-less astronauts, the blood flowing through the veins boils less quickly than water in the tissues because the circulatory system has its own internal pressure, but massive ebullism in the body's tissues would result rapidly. A 2013 review in the journal Aerospace Medicine and Human Performance that looked at previous exposures to vacuums in animals and humans found that they lost consciousness within 10 seconds. Some of them then lost control of their bladders and bowel systems, and the swelling in their muscles constricted blood flow to their hearts and brains, as their expanded muscles acted as a vapor lock.. "No human can survive this — death is likely in less than two minutes," Lehnhardt said.

According to NASA's bioastronautics data book, the vacuum of space would also pull air out of your lungs, causing you to suffocate within minutes. After an initial rush of air surged out, the vacuum would continue to pull gas and water vapor from your body through your airways. The continuous boiling of water would also produce a cooling effect — the evaporation of water molecules would absorb heat energy from your body and would cause the parts near your nose and mouth to nearly freeze. The remainder of your body would also cool, but it would do so more slowly because not as much evaporation would take place. As astrophysicist Paul Sutter told Forbes, temperature is a measure of how much energy atoms and molecules have to move about — and because space is almost empty, there's not much to move at all, making it "cold." This also means that there isn't matter in space to transfer heat to. However, a person could freeze from the evaporation of their body's water and the slow loss of heat via the radiation emanating from their body.

THE KARGIL GIRL

K. ROSHINI
20761A5620

Flight lieutenant GUNJAN SAXENA born in 1975 is an Indian Air Force (IAF) officer and former helicopter pilot. She joined the IAF in 1994 and is a 1999 Kargil war veteran. She is one of the two women IAF officers to be part of kargil war, making her the second woman IAF officers after Srividya Rajan, her colleague, to go to war (also listed as "one of the first woman to fly in combat zone").She is the first of two women along with flight lieutenant Srividya Rajan from the IAF to enter a war Zone flying cheetah helicopters. One of her main roles during the kargil war was to evacuate the wounded from kargil, transport supplies and assist in surveillance. She Would go on to be part of operations to evacuate over 900 troops, both injured and decreased, from kargil .In 2004, after serving as a pilot for 8 years,her career as a helicopter pilot ended; permanent commissions for women were not available during her time. Saxena was born into an army family. Her father, Lt Col anup kumar saxena and brother Lt. Col. Anshuman both served in the India Army. Saxena graduated with a Bachelor of science degree in physics from Hansraj college , univesity of Delhi in New Delhi . She Was one of the six women who joined the Indian Air Force as pilot in 1996.This was the 4th batch of women Air Force trainees for the IAF. Among the six female trainees was Flt. Lt. Srividya Rajan who would also go on to fly a Cheetah in combat zone.

Flying officer Saxena was 24 years old when she flew during the kargil war and stationed in srinagar. In the kargil War, as part of Operation vijay, apart from evacuating the wounded, she helped transport supplies to troops in the forward areas of Dras and Batalik. She also was assigned surveillance roles such as mapping ebemy positions. She had to deal with makeshift landing grounds, heights of 13,000 to 18,000feet and enemy fire. She was one of the ten piolts, and the only female piolt, based in srinagar that flew hundreds of sorties during the war, evacuating over 900 casualties, wounded and killed saxena was the only women in the Indian Armed Forces who flew into war zones in the kargil war.

As the role of women in the Indian military has always been a subject of discourse; es-

pecially in combat zone, their service has often been cut-short as compared to those of men .For her outstanding service in the war zone, she was honoured with the Shaurya Chakra Award (a gallantry award presidented for valour courageous action of self-sacrifice while not engaged in direct action with the enemy) by the army and become the first woman to receive this honour.

It's an honour to pen down my thoughts on the kargil girl.

India will ever be proud of giving birth to women like GUNJAN SAXENA

ARTISTIC VIEW OF HYPERSONIC MISSILES

KARL SCHWARZSCHILD'S LETTER TO ALBERT EINSTEIN

BHUVANESWARI M
Assistant Professor

Albert Einstein received a letter on the 22nd of December, 1915, from the trenches of the first world war. The shabby and wrinkled envelope which carried the letter was totally covered in mud and the name of the sender was cloaked by a huge speck of bloodstain. He opened it and what he saw was the name of a true prodigy, Karl Schwarzschild. He was totally shaken by the letter he just received. It contained the first exact solution to the field equations of general relativity which could perfectly describe the geometry or distortion of spacetime surrounding a massive object.

WHO IS KARL SCHWARZSCHILD?

Karl Schwarzschild was born in Frankfurt, Germany on the 9th of October, 1873, to a Jewish family.

He developed an interest in astronomy as a child along with other subjects like music and art. His precocious abilities made him write his first research papers on **the theory of orbits of binary stars** at a very young age of sixteen. Those were published in *Astronomische Nachrichten* - the oldest astronomical journal, in 1890.

He completed his doctorate at the University of Munich for the work on the applications of Henri Poincaré's theory of stable configurations of rotating bodies and tidal deformation of moons. He got a chance to work with some renowned physicists Felix Christian Klein, David Hilbert, and Hermann Minkowski while serving as a professor at a reputable institute in Göttingen, from 1901 to 1909. He then moved to Potsdam where he worked as a director of the Astronomical Observatory and contributed to the field of spectroscopy as well. He also volunteered for military services at the outbreak of world war 1 in 1914, despite being 40. He was put In-charge of the weather station in Belgium while in France he served in an artillery unit and helped with calculating the trajectories of the ballistic missiles. He got his hands on the copy of the issue of the *Proceedings of the Royal Prussian Academy of Sciences* while being on the Eastern front. He was then introduced to Einstein's general theory of relativity. While serving in Russia he wrote papers on Einstein's theory and Planck's quantum theory. The latter involved the explanation of the Stark effect (shifting of spectral lines of the hydrogen atom by an external electric field) and its proof from the postulates of quantum theory. Einstein was dumbfounded because he published his theory just a month ago and in such a short span of time Schwarzschild was able to find such a precise solution to these complex and highly non-linear partial differential equations. While, he himself, the maker of the theory, was only capable of finding the mathematical techniques to identify the approximate solutions. It was no less than a miracle to think of what Schwarzschild had done while being in a war field surrounded by explosions and poisonous gases.

Minor adjustments to his results provided us with a very popular solution that now bears his name — **the Schwarzschild metric**. Today, physicists and mathematicians often employ the help of powerful computers and numerical techniques to solve these notoriously grinding equations. Finally, Einstein was happy because he knew this result is so powerful that it will trigger the interest of the scientific community towards the general theory of relativity, which until then had gathered a little enthusiasm. He responded to the letter and promised to present this work at a meeting of the Prussian academy:-

"I have read your paper with the utmost interest. I had not expected that one could formulate the exact solution of the problem in such a simple way. I liked very much your mathematical treatment of the subject."

"Often I have been unfaithful to the heavens. My interest has never been limited to things situated in space, beyond the moon, but has rather followed those threads woven between them and the darkest zones of the human soul, as it is there that the new light of science must be shone."

—Karl Schwarzschild

THE GLASS-PAPER MAGIC

K. RUBY
20761A5629

Most of us in our childhood must have played turning up side down a water filled tumbler covered with a sheet of paper and must have enjoyed the magic of paper being held firmly by the glass not knowing what the reason behind it exactly is.

This very small play involves much fluid science we often ignore. According to the hydrostatic principle, the pressure exerted by the water in the glass on the upper surface of the paper when it is upside down is **density of water × g × height of water column.** The force due to this pressure and the self weight of the water in the glass are the forces that act downwards on the upper surface of the paper. On the other hand it is the force due to atmospheric pressure that acts upwards beneath the paper.

Taking height of liquid column h = 9.4 cm and diameter of tumbler, d = 6.5 cm

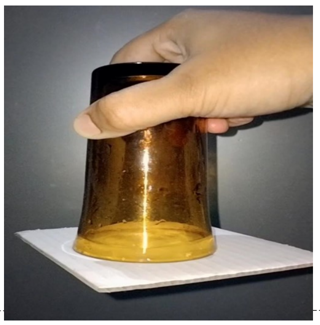
Forces acting downwards upon the paper :

$F_{down} = (P_{water} \times area) + W_{water}$

$$= \rho g h A + mg$$

$$= \rho g h A + \rho v g$$

$$= \rho g h A + \rho g h A = 2\rho g h A = 6.119 \text{ N}$$



And force acting upward beneath the paper:

$$F_{up} = P_{atm} \times A = 336.22 \text{ N}$$

So ,

$$\mathbf{F_{up} > F_{down}}$$

Hence, at any cost the net upward force is far greater than the net downward force which ultimately holds the paper firm to the glass .

SABRE ROCKET ENGINE

(SYNERGETIC AIR BREATHING ROCKET ENGINE)

C.NAVEEN KUMAR
20765A2101

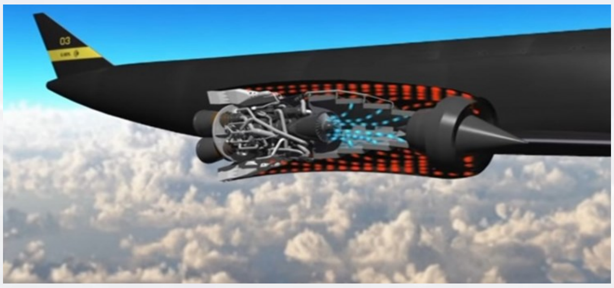
The revolutionary SABRE air-breathing rocket engine, has the potential to transform access to Space. This will explore the unique characteristics of the SABRE engine and the prospects it offers for a single-stage-to-orbit launch vehicle with aircraft SABRE is at heart a rocket engine designed to power aircraft directly into space (single-stage to orbit) to allow reliable, responsive and cost-effective space access, and in a different configuration to allow aircraft to cruise at high speeds (five times the speed of sound) within the atmosphere.

In the past, attempts to design single stage to orbit propulsion systems have been unsuccessful largely due to the weight of an on-board oxidizer such as liquid oxygen, needed by conventional rocket engines. One possible solution to reduce the quantity of on-board oxidizer required is by using oxygen already present in the atmosphere in the combustion process just like an ordinary jet engine. This weight saving would enable the transition from single-use multi-stage launch vehicles to multi-use single stage launch vehicles.

They are two modes of working of engine:

1) Air breathing mode – the rocket engine sucks in atmospheric air as a source of oxygen (as in a typical jet engine) to burn with its liquid hydrogen fuel in the rocket combustion chamber.
2) Conventional rocket mode – the engine is above the atmosphere and transitions to using conventional on-board liquid oxygen.

** SABRE is the first engine to achieve this goal by operating in two rocket modes. Working of engine: The design comprises a



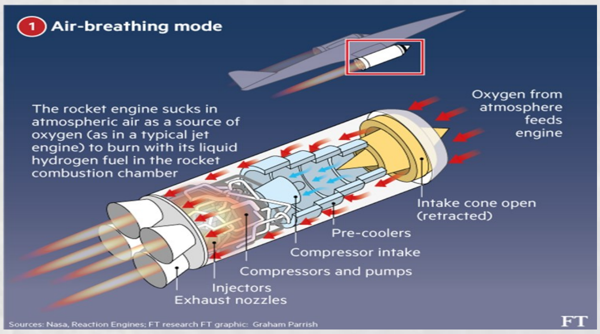
single combined cycle rocket engine with two modes of operation. The air-breathing mode combines a turbo-compressor with a lightweight air precooler positioned just behind the inlet cone.

At high speeds this precooler cools the hot, ram-compressed air, which would otherwise reach a temperature that the engine parts could not withstand. leading to a very high-pressure ratio within the engine The compressed air is subsequently fed into the rocket combustion chamber where it is ignited along with stored liquid hydrogen. The high -pressure ratio allows the engine to provide high thrust at very high speeds and low altitudes. Inserts a helium loop to prevent the ice formation and removes the water vapour in air. After shutting the inlet cone off at Mach 5.14, and at an altitude of 28.5 km.

IS IT POSSIBLE TO GENERATE ELECTRICITY EVEN IN SPACE?

KRISHNA LIKHIL CHEKKA
21ASE035

Scientists have found that sunlight beyond the Earth's is about 5 times more powerful than sunlight touching the ground. Thus, if



solar power could be generated in space and brought to the ground in some form, the electricity needs could be met efficiently. At the same time, scientists believe that it can also prevent air pollution. In this regard, Japanese scientists have taken another step forward and embarked on a great project called O Space Solar Power System in space. As part of this project, 'photovoltaic dishes' will be set up at a specific location in geostationary orbit, spanning several square miles across the Earth's atmosphere. Like the satellites in that orbit, these dishes also rotate at a speed equal to the speed at which the earth revolves around itself, always from the ground. Seems to be at the same place as seen. These dishes in space absorb the vast amount of available solar energy and send it to the ground in the form of laser beams or microwaves. Scientists believe that these rays or waves could generate and use large amounts of electricity on Earth. If the project is successful maybe other countries will be prepared for such innovative methods. Potential advantages of collecting solar energy in space include a higher collection rate and a longer collection period due to the lack of a diffusing atmosphere and the possibility of placing a solar collector in an orbiting location where there is no night. A considerable fraction of incoming solar energy (55–60%) is lost on its way through the Earth's atmosphere by the effects of reflection and absorption. Space-based solar power systems convert sunlight to microwaves outside the atmosphere, avoiding these losses and the downtime due to the Earth's rotation, but at great cost due to the expense of launching material into orbit. SBSP is considered a form of sustainable or green energy, renewable energy, and is occasionally considered among climate engineering proposals.

In 2008, Japan passed its Basic Space Law which established space solar power as a national goal and JAXA has a roadmap to commercial SBSP. In 2015, the China Academy for Space Technology (CAST) showcased their roadmap at the International Space Development Conference. In February 2019, *Science and Technology Daily*, the official newspaper of the Ministry of Science and Technology of the People's Republic of China, reported that construction of a testing base had started in Chongqing's Bishan District. CAST vice-president Li Ming was quoted as saying China expects to be the first nation to build a working space solar power station with practical value. Chinese scientists were reported as planning to launch several small- and medium-sized space power stations between 2021 and 2025. In December 2019, Xinhua News Agency reported that China plans to launch a 200-tonne SBSP station capable of generating megawatts (MW) of electricity to Earth by 2035. In May 2020 the US Naval Research Laboratory conducted its first test of solar power generation in a satellite. In August 2021, the California Institute of Technology (Caltech) announced that it planned to launch a SBSP test array by 2023, and at the same time revealed that Donald Bren and his wife Brigitte, both Caltech trustees, had been since 2013 funding the Institute's Space-based Solar Power Project, donating over $100 million. Much of the material launched need not be delivered to its eventual orbit immediately,

which raises the possibility that high efficiency (but slower) engines could move SPS material from LEO to GEO at an acceptable cost.

Advantages:

The SBSP concept is attractive because space has several major advantages over the Earth's surface for the collection of solar power:

It is always solar noon in space and full sun.

A satellite could be illuminated over 99% of the time, and be in Earth's shadow a maximum of only 72 minutes per night at the spring and fall equinoxes at local midnight. Orbiting satellites can be exposed to a consistently high degree of solar radiation, generally for 24 hours per day, whereas earth surface solar panels currently collect power for an average of 29% of the day.

Power could be relatively quickly redirected directly to areas that need it most. A collecting satellite could possibly direct power on demand to different surface locations based on geographical baseload or peak load power needs. Reduced plant and wildlife interference.

Disadvantages:

The SBSP concept also has a number of problems:

The large cost of launching a satellite into space. For 6.5 kg/kW, the cost to place a power satellite in GEO cannot exceed $200/kg if the power cost is to be competitive.

Microwave optic requires GW scale due to Airy disk beam spreading. Typically a 1 km transmitting disk at 2.45 GHz spreads out to 10 km at Earth distance.

The space environment is hostile; PV panels (if used) suffer about eight times the degradation they would on Earth (except at orbits that are protected by the magnetosphere)

Space debris is a major hazard to large objects in space, particularly for large structures such as SBSP systems in transit through the debris below 2000 km. Collision risk is much reduced in GEO since all the satellites are moving in the same direction at very close to the same speed.

The large size and corresponding cost of the receiving station on the ground. The cost has been estimated at a billion dollars for 5 GW by SBSP researcher Keith Henson.

Energy losses during several phases of conversion from photons to electrons to photons back to electrons.

Waste heat disposal in space power systems is difficult to begin with, but becomes intractable when the entire spacecraft is designed to absorb as much solar radiation as possible. Traditional spacecraft thermal control systems such as radiative vanes may interfere with solar panel occlusion or power transmitters.

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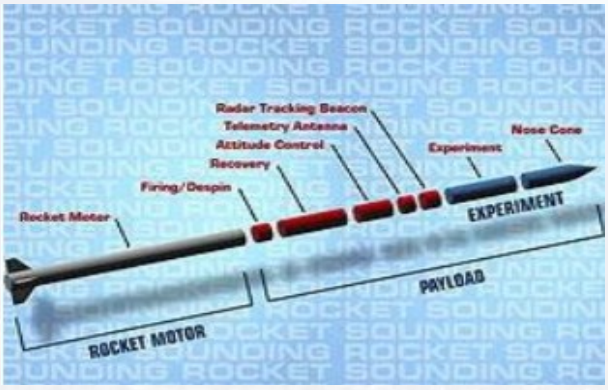

Student placements :

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D. JOBIN	18761A2115
P. MANOJ KUMAR	18761A2139
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LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
(AUTONOMOUS)
Department of Aerospace Engineering
CONGRATULATIONS
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Mercedes-Benz Research and Development India
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We are Proud of you
Dept. of Aerospace Engineering, LBRCE


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THE SPACE...

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