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### IISc best institution in the country

The Indian Institute of Science (IISc) has been declared as the best among all categories of institutions in the country for the second consecutive year. The government released the all India ranking of higher educational institutions for 2017. The elite science school, based in Bengaluru, has also grabbed the top slot in the list of 100 best universities in India followed by Jawaharlal Nehru University (JNU), New Delhi, and Banaras Hindu University (BHU) in Uttar Pradesh. University of Hyderabad climbed down to seventh position this year from fifth in last year's ranking. The IISc, established in 1909, was recently ranked eighth among the best small universities of the world by an international rating agency, Times Higher Education. The premier science institute had topped the list of the all India ranking of higher educational institutions, conducted under the Human Resource Development Ministry for the first time in 2015-16. The second edition of the exercise was conducted under six different categories — Engineering, Management, University, Colleges, Pharmacy and Overall. The institutions were ranked under five main parameters with each carrying a score of 100 — Teaching Learning and Resources; Research and Professional Practice; Graduation Outcomes: Outreach and Inclusivity; Perception. The first two parameters carried the highest ranking weightage of 0.30 each. "The educational institutions performing well in the annual ranking will be awarded with more funds and enhanced autonomy. We are formulating such policy," HRD Minister Mr Prakash Javadekar said, announcing the results. According to the ranking list for 2017, a total of eight higher educational institutions, including University of Mysore, from Karnataka figured in the list of 100 top institutions in India in the overall category. While a total of 81 engineering colleges participated from the state, just eight of them could make it to the list of top 100 engineering colleges. Of a total of 56 management schools from the state, only two secured a slot in the list of top 50 B-schools. As many as 19 (non-technical) colleges participated in the ranking from Karnataka, but only six could figure in the list of top 100. In the list of institutions ranked under overall category, the IISc was followed by Indian Institute of Technology (IIT) Madras and IIT-Bombay. Under the Engineering category, IIT-Madras grabbed the first slot, followed by IIT-Bombay and IIT-Kharagpur, IIT-Delhi, IIT-Kanpur, IIT-Roorkee and IIT-Guwahati. In the B-School category, while the Indian Institute of Management (IIM) Ahmedabad grabbed the top slot, IIM Bangalore was ranked second and IIM Calcutta third in the list of top 50. Delhi's Miranda House emerged as the best college as it was ranked first among the top 100 colleges in India. Chennai's Loyola College came second and Delhi's Sri Ram College third. A total of 3,551 higher educational institutions participated in the all India ranking while many other preferred not to join as they were required to submit "various data". The ranking of the medical colleges and law schools could not be done this year because of very low participation, a ministry official said.

Source: <http://www.deccanherald.com>

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## CURRENT AFFAIRS

**ISRO embraces private sector to outsource satellite manufacture For making a full multi-crore, heavy duty satellite — unable to keep pace with the bird's fabrication.**

In a highly secure, clean room of the Indian Space Research Organisation (ISRO) here, teams from the private sector are working shoulder-to-shoulder with government engineers to create a new bird that will soar in the sky very soon. The Indian space establishment has crossed a new threshold, engaging for the first time a private sector industry to make a full multi-crore, heavy duty and full navigation satellite. Having been unable to keep pace with satellite fabrication, the ISRO has now roped in the private industry to bridge the gap.

### Two for the Navy

A consortium led by Alpha Design Technologies, Bengaluru is tasked to make two full satellites for India's navigation system. After almost 150 missions and three decades of space faring, the ISRO is on a mission like never before. Towards that end, a high-tech defence equipment supplier from Bengaluru, Alpha Design Technologies has been chosen as the first private industry tasked with making not one but two full satellites for the ISRO. A team of 70 engineers is working hard to make a flight-ready satellite in the next six months. Colonel Mr H.S. Shankar, the man who helped India get its first bulk supply of electronic voting machines (EVMs), is leading the consortium and he is keeping a hawk's eye on the fabrication process.

### Challenging task

Col. Mr Shankar, Chairman-cum-Managing Director of Alpha Design Technologies, says, "It is a challenging task for any Indian company to undertake assembly, integration and testing of a satellite and that too for the first time in India." With seven satellites already in orbit, the NAVIC (Navigation with Indian Constellation) or the Swadeshi GPS system is today fully functional but to be on the safe side the ISRO needed two spare satellites on the ground for a quick launch in case something went wrong. It signed up with the Rs. 400-crore company to give India its first large private satellite. The ISRO also wants to seed an ecosystem where the private sector takes a lead in the future.

### Quantum jump: Annadurai

Mr M. Annadurai, Director of ISRO Satellite Centre in Bengaluru, said, "Basically there is a gap between what we are capable of doing now versus what we are supposed to make. There is a gap between the requirement and our capability. That gap we want to fill up with support from the industry." "...16 to 17 satellites we have to make every year. So it is a really-really quantum jump and to fill that gap..., we thought the industry could come in," he added. Satellite fabrication requires high precision as these birds cost hundreds of crores of rupees and after the launch they remain functional for up to 10 years with no scope for repair.

### It's tough up there

The space environment is very punishing and the untested fail miserably and space faring remains a high risk activity. Mr. Annadurai thinks the ISRO is not taking any risk by relying on the private sector, adding, "I do not think it is a risk. It is basically an incremental improvement over what we have already done. When you look at NAVIC satellite system, except for the first satellite, on all the other remaining satellites more than 95 per cent of the systems that were flown basically came from industry." "Similar thing is being done for this mission. For the first standby Indian Regional Navigation Satellite System (IRNSS) satellite, we will be handholding the private team. Some 70 young engineers are there and they will be watching what we are doing and then at the end of the first satellite fabrication, the private team will come out with a document of what they have understood and how they will make the second satellite, this document will be audited by the ISRO's quality assurance team," he said. And once the ISRO teams clears it and are convinced that the private team is really trained and they are equipped with the necessary skill sets, only then will they do the second satellite fabrication on their own.

### More birds to soar soon

"Hopefully, together we will be able to succeed because anyhow they are learning under our watch. So once they start to do one or two satellites like that, they will be able to take on making subsequent satellites totally on their own," he

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said. India recently launched 104 satellites on a single mission, creating such a global sensation that an intelligence officer from the U.S. expressed his “shock” at India’s singular achievement and this paved the way for India’s foray into the multi-billion dollar launch industry. By supporting the private industry to learn the processes of making satellites, India hopes to create a robust space industry in the private sector. In the past, the ISRO has designed and made a satellite for the Europeans and this new and bold move could in times pave the way for India being a global hub for the space sector. Towards that end, a high-tech space park is almost ready at one of ISRO’s newer satellite facilities in Bengaluru, and here the private sector could make the best of the best satellites. Mr. Annadurai has said once ready, this space park will be unique since from the smallest components to the flight-ready satellites — all will be made under one roof. No other facility like this exists anywhere in the world, he insists.

## **Reliable space power**

India is regarded as a low cost and reliable space power. Today for the first time a satellite is being fabricated in the private industry — a giant leap for the ISRO and a giant leap for the Indian space industry. So in the corner of an airtight room of India’s satellite fabrication unit where even the smallest speck of dust is not allowed to enter, a giant breathe of ‘private’ fresh air has been ushered in.

Source: <http://www.thehindu.com/>

## **Connected aircraft: 4 ways Honeywell is investing in the future of flight**

Connected cars are gaining investments from a host of tech companies around the world, but what about connected aircraft? At the 2017 Aircraft Interiors Expo conference in Germany, Honeywell showcased its latest efforts in the space and how it wants to change the future of air travel. Companies like Gogo, and others, have brought Wi-Fi connectivity to planes for passenger use. In addition to this connectivity, Honeywell is working on tech advancements that will more seriously affect the daily lives of pilots, mechanics, and the airline as a whole. “At Honeywell, we know the ultimate impact from connectivity will be felt beyond the cabin, unlocking critical data like weather information, engine usage, maintenance reporting and more that can be better shared and analyzed to help airlines improve efficiency and reduce costs,” Kristin Slyker, vice president for connected aircraft at Honeywell Aerospace, said in a press release.

### **SEE: Homeland Security ban will limit large electronics on some US-bound international flights**

According to the press release, Honeywell’s new connected aircraft tech will be impactful for “airlines, business jets, militaries, helicopters, and enthusiast owners.” Here are the four key investments Honeywell is making in the connected aircraft space.

#### **1. Weather information**

Honeywell said it hopes that its GoDirect Weather Information Service will help pilots better plan for their upcoming flights, and gain a clearer picture about the environment they’ll be flying in, the release said. It provides weather updates and connected flight management systems. “GoDirect Weather Information Service may save airlines from \$25,000 to \$100,000 per aircraft annually through avoiding hazardous conditions, reducing delays and diversions, lowering anti-ice usage, and decreasing maintenance costs and downtime,” the release said.

#### **2. Maintenance**

One of the biggest promises of connected machines including airplanes is that of predictive maintenance. Even before the airplane touches down, the release said, mechanics and maintenance crews will know what parts to repair or replace. Additionally, it will speed up the repair process, as the maintainers will know which parts to have ready before the flight comes in.

#### **3. In-flight Wi-Fi**

Honeywell is also making its own investment in high-speed, in-flight connectivity with its JetWave satellite communications system, the release noted. The system utilizes GX Aviation Ka-band service to give passengers Wi-Fi speeds similar to what they’d get at home or the office when they are flying, which could be good news for business travelers. The company has made 500 deliveries of the service, with 1,000 more planned, the release said.

#### **4. Fuel efficiency**

By accessing better data, Honeywell has been able to reduce the time of certain flights by 5% and also decrease the number of delays. The company’s GoDirect Fuel Efficiency software collects data from airline systems to lower emissions and could lead to up to 5% fuel savings every year as well.

Source: <http://www.techrepublic.com/>

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## **Jakkur: namma students to fly high at lower cost, in less time**

Aiming to make flight training for aspirants of commercial pilot licences (CPLs) and private pilot licences (PPLs) significantly cheaper, the Government Flying Training School (GFTS), Jakkur, has procured a single engine simulator that would bring down trainee expenses by a whopping 50 per cent. The simulator – an FNPY-II single engine simulator – will be commissioned at the GFTS premises in Jakkur. “In the absence of a simulator, the trainees had to go to Hyderabad or Mumbai to get simulator training. The new single engine simulator (at GFTS) will not only be used by the pilots to meet the training requirements, but will also save their time and money,” said Wg Cdr (Retd) Amarjeet Singh Dange, chief flying instructor, GFTS. He said the simulator training expenses are borne by the students themselves; and to train for the mandatory 20 hours, a student normally shells out Rs 40,000 during his course. “Earlier, the students had to go to other flying schools for simulator training which charge Rs 2,000 per hour. Whereas the in-house simulator will charge only Rs 1,000 per hour. In addition, they have to spend on accommodation and other facilities, which is a burden to them,” Dange said. The simulator training does not include the course fee, which is about Rs 20 lakh for those studying to obtain CPL and Rs 6 lakh for PPL. There are currently 36 students pursuing flying training at the GFTS. To obtain a CPL, a student will have to clock 200 flying hours and the course duration is two years, while for the PPL the flying hours is 40 and the duration of the course is one year, as per guidelines of the Directorate General of Civil Aviation (DGCA). During the course, the students are introduced to theoretical courses in air regulation, air navigation, meteorology, aircraft general, technical specific aircraft and engines. The GFTS operates two Cessna 152 and two Cessna 172 aircraft to train the pilots. GFTS is also planning to procure a twin engine simulator in the future.

Source: <http://bangaloremirror.indiatimes.com>

## **HAL will be ready to launch IPO by end of August: MD**

The long-awaited initial public offering (IPO) of Hindustan Aeronautics Limited (HAL) could finally see the light of day by the end of August, said Chairman and Managing Director Mr T Suvarna Raju. Speaking to CNBC-TV18, Mr Raju said the IPO of the state-owned aerospace and defence company has been delayed as it required some concessions as far as putting data in the public domain was concerned. “We will have to wait till the results of the past financial year are audited,” said Mr Raju. “We should be ready (for the IPO) by July or August.” At the Aero India 2017 a couple of months ago, he had said progress that was made on identification of Book Running Lead Managers and preparation of draft red herring prospectus and that necessary documents were in place. Reports have long suggested that the company plans to divest 10% of its shareholding and go public, but it has been delayed for various reasons.

Source: <http://www.moneycontrol.com/>

## **Global interest in PSLV soars**

The Indian PSLV (Polar Satellite Launch Vehicle) space vehicle has received more than double its normal share of inquiries from prospective customers ever since it launched a record 104 satellites in a single flight in February. A world best, 101 small foreign commercial spacecraft were taken up at once in that feat, catapulting the PSLV's overall commercial tally to 180. “There has been a spurt in inquiries, almost double what we were getting. Globally, 500 satellites are expected to come up for launch every year from 2018 onwards. We are seeing how we can equip ourselves towards meeting this big opportunity,” said Mr Rakesh Sasibhushan, chairman and managing director of Antrix Corporation, ISRO's (Indian Space Research Organisation) business arm that markets its rocket and satellite services. “ISRO is also ramping up availability of the PSLVs. Antrix has asked for two dedicated PSLVs a year for doing fully commercial launches. They can mostly cater to the 5 kg to 100 kg small satellites,” he told. The PSLV, with a near impeccable 37 successes in 39 flights, he said, is a clear leader in the category of rockets that lift small satellites to low Earth orbits or LEOs. These satellites weigh up to 500 kg and must be placed in polar orbits 500 km from Earth. “Antrix has launch orders worth around 1 600 crore,” Mr. Sasibhushan said. Roughly 15% of its nearly 1 2,000-crore turnover comes from PSLV launch orders of foreign satellite operators. Similar 100-plus satellite contracts in a single flight would be uncommon; Mr. Sasibhushan said the next PSLV, C-38, due in May, would have 30 smallsats riding piggyback with the primary Cartosat-2 series satellite. But they are not a result of the February launch, he clarified. Mr Carolyn Belle, Senior Analyst at Northern Sky Research, a space industry consultancy based in Massachusetts, said in a response, “The PSLV is in an interesting position in the market. It has a strong technical track record and is an attractive vehicle for smallsat operators - especially if the launch [frequency] increases.” However, a limiting factor, in her view, is the waiver process that is needed to launch a US satellite, the US being the largest market.

Source: <http://www.thehindu.com/>

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## **ISRO, BHEL tie-up for lithium-ion batteries to have buyback agreements**

The Indian Space Research Organisation (ISRO) which is finalising a memorandum of understanding with BHEL to help develop low-cost lithium ion batteries for electric vehicles, also envisages a buyback commitment for such batteries. The move is expected to take care of concerns on managing the waste generated at the end of battery life. According to the MoU, BHEL will set up a production plant, while ISRO will provide support for scale-up, joint effort in cost optimisation, research and development for alternate chemistry and buyback commitment, according to sources. BHEL will develop the battery for commercial applications. This is part of India's plan to promote low-cost electric vehicles with the use of lithium-ion batteries. Thiruvananthapuram-based Vikram Sarabhai Space Centre (VSSC) has developed four types of lithium-ion batteries — 1.5 Ampere (Ah), 5Ah, 50 Ah and 100 Ah. Of these, 1.5 Ah and 50 Ah have been used for space applications and 5Ah and 100 Ah are ready for use in space applications.

### **Use in two-wheelers**

On use in vehicles, the Automotive Research Association of India (ARAI) has successfully tried using these batteries in two- and -four wheelers, sources said. It has demonstrated use of 50 Ah cells in two-wheelers that can run up to 98 km with a two-hour charge, with speeds of up to 40-50 kmph. It is now trying the feasibility of 100 Ah batteries to demonstrate electric vehicle operations, which use lower-cost indigenous material. Initial tests show that the 100 Ah batteries are more efficient at lower temperatures. BHEL has expressed interest in the transfer of technology from VSSC to produce lithium-ion batteries to meet the requirements of ISRO as well as electric vehicles. ISRO, on its part, has identified areas for cost reduction, which can be transferred to BHEL for production of low-cost Li-ion batteries. They include bulk procurement of raw material. There is scope to indigenise components of the fuel cell by using graphite (from Himadri Chemical), aluminium foil from Hindalco or Nalco, copper foil or sheet from Cubex. These companies have expressed interest in lithium-ion batteries. VSSC has initiated in-house development of the 50 Ah and 100 Ah cells. "While BHEL is interested, the technology should also be transferred to private, public and other joint venture firms for commercial production," said a source. Other corporate majors that have expressed interest include Mahindra Renault, Hyundai, Nissan, Tata Motors, High Energy Batteries (India) Ltd, BHEL and Indian Oil Corporation. Representatives of the companies participated in a meeting chaired by the Road Transport and Highways Minister Mr Nitin Gadkari on promoting commercial production of lithium-ion batteries for use in electric motor vehicles. India needs to promote commercial production of lithium ion batteries for use in electric motor vehicles. The meeting was also attended by the Cabinet Secretary, Secretary-Road Transport and Highways, Director from Vikram Sarabhai Space Centre (VSSC) and Director, ARAI. The Cabinet Secretary pointed out the need to bring all issues related to non-polluting vehicles under one roof. Last week, Suzuki Motor Corporation, Toshiba Corporation and Denso Corporation entered into an agreement to manufacture lithium-ion battery packs in India.

Source: <http://www.thehindubusinessline.com/>

## **After Mars, ISRO decides it's time to probe Venus**

It's official. The Indian Space Research Organisation (ISRO) has invited scientists to suggest studies for a potential orbiter mission to Venus - somewhat similar to the one that landed in Mars in 2013. ISRO plans to send a spacecraft that will initially go around Venus in an elliptical orbit before getting closer to the 'Yellow Planet'. It will carry instruments weighing 175 kg and using 500W of power. The scientific community has been told to suggest space-based studies by May 19. "The Announcement of Opportunity [AO] is just the beginning. The studies must be finalised, a project report would have to be presented and approved. A formal mission may not happen before 2020," a senior ISRO official told. A mission must be approved by ISRO's Advisory Committee on Space Sciences, then the Space Commission and later by the government. Venus, the second planet from the Sun, comes closest to Earth roughly every 583 days, or about 19 months. Venus, our closest planetary neighbour, is similar to Earth in many aspects. However, it takes only 225 days to revolve around the Sun. Secondly, the surface is very hot due to nearness to the Sun. India's previous and second planetary outing, the record-setting Rs. 450-crore Mars Orbiter Mission (MOM) of 2013, continues to impress. The orbiter is going round the Red Planet even as you read this — well beyond its planned life of six months. An orbiter sent to the Moon in 2008 was delivering data until about three months before its estimated life span. A second Moon landing mission is planned in early 2018.

Source: <http://www.thehindu.com/>

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## How are India's private aerospace firms faring?

The emphasis on "Make in India", centred on indigenous aerospace and defence production, has focused the limelight on private-sector companies. Unlike the public-sector companies, (see article in DNA, April 3), these are much smaller, often family-owned, and are fairly recent entrants. They are keen to make their mark, hungry for orders, and willing to work hard to win them. Apart from their well-trained and highly motivated staff and their well-equipped facilities, their private-sector corporate culture is their greatest asset. A former HAL Chairman had once said that he was very satisfied with their quality of work, as well as their avoidance of cost and time overruns. The finest tributes to these small companies are paid by the giants of the industry — the original equipment manufacturers they serve. Airbus had a full-page advertisement in a Show Daily at Aero India 2017. "We congratulate Aequs. Together, we are giving wings to Make in India". Aequs had won Airbus' Innovation Award for aerostructures and materials. Similarly, Boeing had honoured Russell Techsys as the "Supplier of the Year 2015". Marshall Aerospace & Defence Group has said that Maini Precision Products have been a key supplier for complex structural parts and subassemblies, and have achieved the status of top-rated supplier. They have been awarded that contract for the entire life of the programme. Some companies have won multiple awards. Once these small companies start operations, they generally grow rapidly. Adani Aerospace & Defence is setting up a modern aerospace "ecosystem" at Mundra. It includes a well-equipped airfield with night-landing facilities and hangars for manufacturing work. Among Maini's main products are landing gear components for Safran, to equip the very new Airbus A350. Maini had expanded their aerospace facilities from just four CNC (Computer Numerical Control) machines in 2005 to 40 today. Russell Techsys, after setting up an 87,000 sq ft engineering facility at Whitefield, are now constructing a 200,000 sq ft plant at the Devanahalli Aerospace Park. What type of work do these companies do? Entry-level companies usually set up a small number of CNC machines to produce small and fairly simple components, as displayed at their stands at Aero India 2017. Among the largest and most complex components was a nose undercarriage leg machined from the solid. They soon graduate to multi-axis CNC milling machines for the machining of fairly sophisticated components. These form parts of airframes, engines, landing gears, and the like. Further up the supply chain, Airbus has formed a partnership with Tata Advanced Systems Ltd. (TASL) for the final assembly of the C295W military transport in India, should it be ordered. Similarly, Airbus has set up a partnership with Mahindra Defence for the production in India of a number of Airbus military helicopters. Should India order the AS565 Panther helicopter (above), Airbus will not only set up a final assembly line, but will also make India a global hub for it. Larsen & Toubro have teamed up with European missile manufacturer MBDA. They initially plan to develop and manufacture a fifth-generation anti-tank guided missile. If selected, it would be the most advanced such weapon in India's armoury. Israel Aerospace Industries (IAI) and Kalyani Strategic Systems have formed a joint venture to manufacture and market the former's air defence systems as well as special-purpose munitions. Adani Aerospace & Defence had displayed at Aero India 2017 a full-scale mock-up of the Elbit Hanes 900 UAV. Should India wish to order it, Elbit will transfer the technology to Adani for its local manufacture. Among the "big boys" is Tata Power SED. Their wide-ranging products include launcher-transporters for Akash surface-to-air missiles, Pinaka artillery rockets and the Medium Range Surface to Air Missiles. The company is setting up a very modern new plant on a 50-acre site at Vemagal, Karnataka. No Indian private company is able to currently manufacture complete military aircraft of its own design. It would need capabilities like prime contractorship and systems integration to do that. The first such aircraft could possibly be made some day by the Tata Group, as a number of Tata companies have already acquired wide-ranging aerospace manufacturing capabilities. Private manufacturers will then have finally "arrived".

Source: <http://www.dnaindia.com/>

## TECHNOLOGY

### 'Fuzzy fibres' may help gen-next rockets stand extreme heat

Scientists, including those of Indian origin, have developed "fuzzy fibres" that act like Velcro and could stand up to the heat and pressure of next-generation rocket engines. The fibres made of silicon carbide strengthen composites used in advanced rocket engines that have to withstand temperatures up to 1,600 degrees Celsius. Ceramic composites in rockets now being developed use silicon carbide fibres to strengthen the material, but they can crack or become brittle when exposed to oxygen. The researchers from Rice University in the US embedded silicon carbide nanotubes and nanowires into the surface of NASA's fibres. The exposed parts of the fibres are curly and act like the hooks and loops that make Velcro so valuable - but on the nanoscale. The result creates very strong interlocking connections where the fibres tangle; this not only makes the composite less prone to cracking but also seals it to prevent oxygen from changing the fibre's chemical composition. The researchers grew hooks and loops on nanotubes by first bathing silicon carbide fibre in an iron catalyst and then using water-assisted chemical vapour deposition to embed a carpet of

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carbon nanotubes directly into the surface. These become the template for the final product. The fibres were then heated in silicon nanopowder at high temperature, which converts the carbon nanotubes to silicon carbide 'fuzz'. The researchers, including Mr Pulickel Ajayan from Rice University, hope their fuzzy fibres will upgrade the strong, light and heat-resistant silicon carbide fibres that, when put in ceramic composites, are being tested for robust nozzles and other parts in rocket engines. "The silicon carbide fibre they already use is stable to 1,600 degree Celsius," said Mr Chandra Sekhar Tiwary, a postdoctoral associate at Rice University in the US. "So we are confident that attaching silicon carbide nanotubes and wires to add strength will make it even more cutting-edge," he said. The new materials should also make entire turbo engines significantly lighter, said graduate student Amelia Hart. "Before they used silicon carbide composites, many engine parts were made of nickel superalloys that had to incorporate a cooling system, which added weight to the whole thing," Hart said. "By switching to ceramic matrix composites, they could take out the cooling system and go to higher temperatures," she said. "Our material will allow the creation of larger, longer-lasting turbo jet engines that go to higher temperatures than ever before," she added. The research was published in the journal Applied Materials and Interfaces.

Source: <http://www.deccanherald.com/>

## Scientists develop 'Grassoline' to power airplanes of the future

In the quest of more sustainable energy sources, scientists have developed 'grassoline' – a biofuel derived from grass that could one day power aircraft. Researchers investigated methods that can disintegrate and treat grass until it can be used as a fuel. "Until now, grass has mainly served as feed for animals. But apart from that, grass can also be used as biofuel. Due to its vast abundance, grass is the perfect source of energy," said Mr Way Cern Khor from Ghent University in Belgium. To improve its biodegradability, the grass is pre-treated at first. Then bacteria are added which convert the sugars in the grass into lactic acid and its derivatives, researchers said. This lactic acid can serve as an intermediate chemical to produce other compounds such as biodegradable plastics (PLA) or fuels. The lactic acid was then converted into caproic acid, which was further converted into decane. Decane can be used in aviation fuel, researchers said. "Right now the amount of biofuel that can be made from grass is still limited to a few drops. The current process is very expensive, and engines should be adapted to this new kind of fuel," they said. "If we can keep working on optimising this process in cooperation with the business world, we can come down on the price. And maybe in a few years we can all fly on grass!" Mr Khor said.

Source: <http://indianexpress.com/>

## SpaceX makes aerospace history with successful launch and landing of a used rocket

After more than two years of landing its rockets after launch, SpaceX finally sent one of its used Falcon 9s back into space. The rocket took off from Cape Canaveral, Florida, this evening, sending a communications satellite into orbit, and then landed on one of SpaceX's drone ships floating in the Atlantic Ocean. It was round two for this particular rocket, which already launched and landed during a mission in April of last year. But the Falcon 9's relaunch marks the first time an orbital rocket has launched to space for a second time. SpaceX CEO Elon Musk appeared on the company's live stream shortly after the landing and spoke about the accomplishment. "It means you can fly and reflly an orbital class booster, which is the most expensive part of the rocket. This is going to be, ultimately, a huge revolution in spaceflight," he said. This evening's mission was a critical milestone for SpaceX, which has been working to make its rockets partially reusable since as early as 2011. Up until now, practically all orbital rockets have been expendable, so they're basically thrown away once they launch into space. That means an entirely new rocket — which can cost tens to hundreds of millions of dollars to make — has to be built for each mission to orbit. SpaceX's strategy has been to land its rockets after launch in an effort to fly them again and again. That way the company can partially save on manufacturing costs for each mission. SpaceX doesn't save the entire Falcon 9 rocket after each launch though. It saves the first stage — the 14-story core of the Falcon 9 that contains the main engines and most of the fuel needed for launch. About a few minutes after takeoff, the first stage separates from the top of the rocket and makes a controlled descent back to Earth — either landing on solid ground or on one of the company's autonomous drone ships in the ocean. Prior to tonight's launch, SpaceX had attempted 13 of these rocket landings and eight vehicles had successfully stuck the touchdown. But as SpaceX slowly acquired a growing stockpile of recovered rockets these last two years, the company had yet to actually reuse one of these vehicles. Now with today's launch, SpaceX has proven that part of a used Falcon 9 can successfully launch to space again. And the fact that the vehicle successfully returned to Earth in one piece means that the rocket is poised to launch for a third time. Now SpaceX can boast nine successful rocket landings, as well as a Falcon 9 that has gone to and from space two times now. "It's

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been 15 years to get to this point, it's taken us a long time," Mr Musk said. "A lot of difficult steps along the way, but I'm just incredibly proud of the SpaceX for being able to achieve this incredible milestone in the history of space." The rocket used for today's launch was the second Falcon 9 that SpaceX ever recovered. It was the vehicle used for CRS-8, the company's eighth cargo resupply mission to the International Space Station. On April 8th, the rocket sent nearly 7,000 pounds of supplies — including an inflatable habitat module called the BEAM — to the station for NASA. After launch, the rocket then landed on SpaceX's drone ship, titled Of Course I Still Love You. SpaceX decided to launch this Falcon 9 again first, since the company wanted to save the first rocket it ever landed — a vehicle that sent 11 satellites into orbit for the company ORBCOMM in December 2015. That stage is now on display at SpaceX's headquarters in Hawthorne, California. Though today's launch was historic for the aerospace industry, it was otherwise routine for SpaceX. The Falcon 9 help to loft a communications satellite for the company SES, which is based out of Luxembourg. The satellite, called SES-10, will eventually sit in a high orbit 22,000 miles up and deliver communications services exclusively to Latin America. SpaceX confirmed that SES-10 was successfully deployed shortly after the launch. SES had been very vocal about its desire to be the first company to launch on a used rocket. And there is certainly financial incentive for customers. SpaceX president Gwynne Shotwell has said that customers that fly on a used Falcon 9 could eventually get discounts of up to 30 percent. Since the cost to launch a Falcon 9 starts at around \$60 million, launching on a used rocket could start at around \$40 million. For the first few relaunches, though, Shotwell told *Space News* that the discounts will be more in the order of 10 percent. Neither SpaceX nor SES disclosed how much money was saved for this flight. "We did receive a discount. Obviously to fly this there was some interest and there was some incentive to do so," Mr Martin Halliwell, CTO of SES, said in a press conference prior to the launch. "But it is not just the money in this particular case. It's really, 'let's get this proof-of-concept moving.' Someone has to go first here and SES has a long history of doing this." If SpaceX wants to maximize the economic benefits of its reusable rockets, the best method is to launch these vehicles as frequently as possible. But before a rocket can launch again, it has to be inspected, refurbished, and tested a few times to ensure that it's ready for spaceflight. It took SpaceX up to four months to get this rocket ready for flight today, according to Shotwell, but the company is working to trim down that turnaround time. SpaceX could have a lot of practice on that front soon, as it expects to launch up to six pre-flown Falcon 9s this year.

Source: <http://www.theverge.com/>

## **NASA designs device to protect astronauts from neutron beams**

NASA scientists have developed a new device to monitor harmful radiation exposure, which may help keep astronauts safe during deep-space missions such as the manned mission to Mars. To be launched on the fifth re-supply mission undertaken by Orbital ATK — an American aerospace and defence manufacturer — to the International Space Station (ISS), the Fast Neutron Spectrometer is designed to detect and measure the energy of neutrons, which are known to be specifically harmful to humans. "While there are already advanced instruments to detect gamma rays produced by supernovas or black holes, X-rays and other charged particles, we needed a way to detect and measure neutron radiation to quantify the impact on human biology," said Mr Mark Christl, from the NASA's Marshall Space Flight Centre in the US. "Neutron detection techniques have not seen the same leap in technology advancement," Christl added. Neutron radiation is created when the high-energy neutron particles from the sun and outside our solar system interact with other particles or matter, such as a spacecraft or a planetary surface. However, they are only viable for about 13 minutes before they decay into charged particles. The Fast Neutron Spectrometer is comprised of an aluminum housing with a plastic scintillator that slows down a neutron when it hits the device and re-emits the energy in the form of light. NASA astronaut Shane Kimbrough installed the device on the space station in December last year. Since then, it has been moved to different locations around the interior of the station. The device will monitor neutrons for six months, sending data for any neutron strikes to a laptop computer on the station. Even though the space station's radiation environment is not considered "deep space," the spectrometer is a new capability ready for validation in a space environment. "These radiation detectors may force missions to change mid-stream, but it will help keep our astronauts safe," Christl said.

Source: <http://www.thehindubusinessline.com/>

## **New material may double solar cell efficiency**

In a breakthrough, scientists have identified a new crystalline material that could replace silicon and double the efficiency of solar cells without a significant cost increase. Conventional solar cells are at most one-third efficient, a limit known to scientists as the Shockley-Queisser Limit. The new material, a crystalline structure that contains both inorganic materials (iodine and lead) and an organic material (methyl-ammonium), boosts the efficiency so that it can



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carry two-thirds of the energy from light without losing as much energy to heat. This material identified by researchers at Purdue University and the National Renewable Energy Laboratory in the US could double the amount of electricity produced without a significant cost increase. Enough solar energy reaches the Earth to supply all of the planet's energy needs multiple times over, but capturing that energy has been difficult – as of 2013, only about one per cent of the world's grid electricity was produced from solar panels. Mr Libai Huang, assistant professor of chemistry at Purdue, said the new material, called a hybrid perovskites, would create solar cells thinner than conventional silicon solar cells, and is also flexible, cheap and easy to make. The most common solar cells use silicon as a semiconductor, which can transmit only one-third of the energy because of the band gap, which is the amount of energy needed to boost an electron from a bound state to a conducting state, in which the electrons are able to move, creating electricity. Incoming photons can have more energy than the band gap, and for a very short time – so short it is difficult to imagine – the electrons exist with extra energy. These electrons are called “hot carriers,” and in silicon they exist for only one picosecond (which is 10<sup>-12</sup> seconds) and only travel a maximum distance of 10 nanometres. At this point the hot carrier electrons give up their energy as heat. This is one of the main reasons for the inefficiency of solar cells. Huang and her colleagues have developed a new technique that can track the range of the motion and the speed of the hot carriers by using fast lasers and microscopes. “The distance hot carriers need to migrate is at least the thickness of a solar cell, or about 200 nanometres, which this new perovskite material can achieve,” Mr Huang said. “Also these carriers can live for about 100 picoseconds, two orders of magnitude longer than silicon,” he said. Mr Kai Zhu, senior scientist at the National Renewable Energy Laboratory in Colorado, said that these are critical factors for creating a commercial hot-carrier solar cell. “This study demonstrated that hot carriers in a standard polycrystalline perovskite thin film can travel for a distance that is similar to or longer than the film thickness required to build an efficient perovskite solar cell,” he said. “This indicates that the potential for developing hot carrier perovskite solar cell is good,” Mr Zhu added. The research was published in the journal Science.

Source: <http://indianexpress.com/>

## **CSIR-NIO develops robotic platform to track oceanic processes**

Researchers at the Dona Paula based CSIR-National Institute of Oceanography (NIO) have developed a robotic platform that can be stationed at any depth from 0 to 200 meters to track the oceanic processes. “Scientists at Marine Instrumentation Group of CSIR - National Institute of Oceanography (CSIR-NIO) have developed a robotic platform, Seabed Resident Event Profiler (SREP), that can be stationed at any water depth down to 200 meters along the Indian coast,” NIO spokesman said today. “SREP is designed to track oceanic processes such as upwelling that occurs regularly during June to September along the west coast of India and are important for the ecosystem sustenance and fishery,” he said. “Several sensors that can detect the conditions associated with upwelling such as low temperature, low oxygen, high nutrients, and changes in density patterns are placed on this platform,” the spokesman said. NIO has said “this robot records the water column information regularly as programmed at every 10 to 25cm during every profile four times a day, stores the data and communicates the same to users at the institute.” “The robot in its final configuration will be able to sit on the seabed for 100 days continuously,” he said. During the recent voyage of Mrs RV Sindhu Sadhana, the latest state of the art research vessel of institute, SREP was tested along the coast. “The robot autonomously profiles the water column from as deep as 200 meters to surface of the sea. Underwater photograph of SREP at 26 meters below the sea surface shows the system ready for profiling,” the spokesman added. The SREP is particularly targeted at studies related to monsoon, global climate and upwelling. Southwest monsoon being the backbone of this country's economy, knowing the conditions related to onset of monsoon is one of the major goals. “Upwelling is another phenomenon associated with the monsoon during which migration of deep sea oxygen minimum zone (OMZ) towards the coast as shallow as 30 meters occurs, apart from bringing the nutrient rich water to the surface and increasing the biological productivity of the region. “The figure shows a salinity temperature profile collected during the deployment,” he said. “SREP is being prepared for deployment for duration of about 100 days during upcoming monsoon season,” the spokesman added.

Source: <http://economictimes.indiatimes.com/>

## **ISRO plans Joint Venture with industries for rocket-building**

The Indian Space Research Organisation (ISRO) plans to forge a joint venture with an industrial consortium to build rockets. “We are (currently) using significant amount of things from the industry. If you take launch vehicles (space rockets), 80 per cent of our work, we do with the industry (which are making space-related equipment) today,” the agency's Chairman Mr A S Kiran Kumar told PTI in an interview. The space agency is looking to form a joint venture

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with an industry consortium (to build polar satellite launch vehicle or PSLV), with the first launch planned for 2020-21 under this proposed entity, Mr Kiran Kumar said. “We are now going through the process of establishing those mechanisms and getting the necessary approvals,” he said. According to the ISRO Chairman, the consortium would have less than half-a-dozen companies from the industry, which would, however, have many sub-contractors under them. In the area of satellites, the ISRO has given a contract to a company for assembly, integration and testing of spacecraft. “We are getting many of the sub-systems done through the industry across the country,” he said. Asked if he sees the ISRO as a pure R&D player outsourcing all other work to the industry, Mr Kiran Kumar said, “It should be an ideal thing to happen in the long run because if the industry is able to do what is required, then definitely it’s a better opportunity for us (ISRO).”

Source: <http://economictimes.indiatimes.com/>

## **ISRO readying for test flight of heavyweight rockets**

Indian Space Research Organisation plans to undertake next month the first developmental flight of a “game-changer” rocket capable of launching four-ton class of satellites from Sriharikota spaceport, says its Chairman Mr A S Kiran Kumar. ISRO rockets (launch vehicles) at present have the capability to launch satellites up to 2.2 tons; it depends on international launchers to orbit satellites heavier than that. “Next month, we have scheduled the launch of GSLV-Mk III-D1”, Mr Kiran Kumar told PTI. The Bengaluru-headquartered space agency plans to undertake the second developmental flight within a year. “By the time two developmental flights are over, we will be working towards making more launches so that it (GSLV-Mk III) becomes operational”, he said. ISRO views operationalisation of this rocket as a “game-changer” for it, he said. “Once we build our own four tonne capacity, we will be able to significantly reduce our launch from outside; then we are also looking at building satellites within that four-tonne capacity, so that you can do all the launches within the country,” Mr Kiran Kumar said. The GSLV-Mk III-D1 launcher would carry GSAT-19 satellite which has a mass of 3200 kg. The satellite would carry Ka and Ku band payload along with a Geostationary Radiation Spectrometer (GRASP) payload to monitor and study the nature of the charged particles and influence of space radiation on spacecraft and electronic components. The satellite would employ advanced spacecraft technologies including bus subsystem experiments in electrical propulsion system, indigenous Li ion battery and indigenous bus bars for power distribution, among others.

Source: <http://www.thehindubusinessline.com/>

## **BUSINESS**

### **HAL turnover at ₹ 17,400 crore**

Hindustan Aeronautics Ltd has achieved a turnover of ₹ 17,406 crore for the financial year ended March 31, 2017, 4% higher than the year before. Profit before tax was ₹ 3,294 crore, barely above last year’s PBT. “The company is doing well on expected lines. We contributed around ₹ 800 crore to the government exchequer by way of interim dividend. This is in addition to ₹ 162 crore paid as dividend tax,” a release quoted HAL CMD Mr T. Suvarna Raju as saying. For the previous year, the audited turnover was ₹ 16,736 crore and pre-tax profit ₹ 3,288 crore. During fiscal 2016-17 the company received orders worth 21,000 crore that included 12 Dornier-228 aircraft for the Indian Navy; 32 ALH light helicopters for the Navy and the Coast Guard; and AL-31 FP engines for the fighter Sukhoi-30 MkI. The year also saw the first flight of two HAL-designed aircraft—basic trainer HTT-40 and the Light Utility Helicopter LUH, besides carriage trials of the indigenous light fighter LCA fixed with a mid-air refuelling probe. On the aeroengines front, HAL launched the metal cutting for its 1200-kW HTSE 1200 turboshaft engine.

Source: <http://www.thehindu.com/>

### **HAL to aggressively market Advanced Hawk to foreign buyers**

Government-controlled Hindustan Aeronautics Limited (HAL) is looking to aggressively market the upgraded Advanced Hawk trainer jets — jointly developed by HAL and BAE Systems of the UK — to foreign buyers, given the “rather tepid response” from the Indian Air Force for which the jets were initially intended. “We are looking to target friendly countries of both India and the UK, with India (HAL) priming the orders,” official sources said. Sources indicated that both parties were of the opinion that there existed a potential market for the Advanced Hawk, which made its debut at Aero India 2017 in Bengaluru. A recent bribery scandal involving Rolls-Royce, which makes engines for the Hawk aircraft, has placed any “fresh orders from the Indian forces under a shadow”. India is the largest operator of the Hawk in the world.

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## Surya Kiran

HAL is also said to be “priming a RFP (Request For Procurement) of 20 Hawks for the Surya Kiran aerobatic team of the IAF.” Sources said: “BAE is the supplier to HAL in the RFP. The Surya Kiran team has flown the Hawk utilising aircraft from the existing fleet of the IAF. HAL is priming, and BAE has submitted its proposal for the supply of equipment and services to HAL.” Currently, the IAF operates around 123 Hawk Mk132 jets that provide Stage-III training before pilot’s progress to operational fighters such as Mirage 2000, MiG-29, Su-30MKI or Jaguar. The IAF and the Indian Navy have been flying the Hawk Mk132 variants for training, with over 1 lakh flying hours.

Source: <http://www.thehindubusinessline.com/>

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