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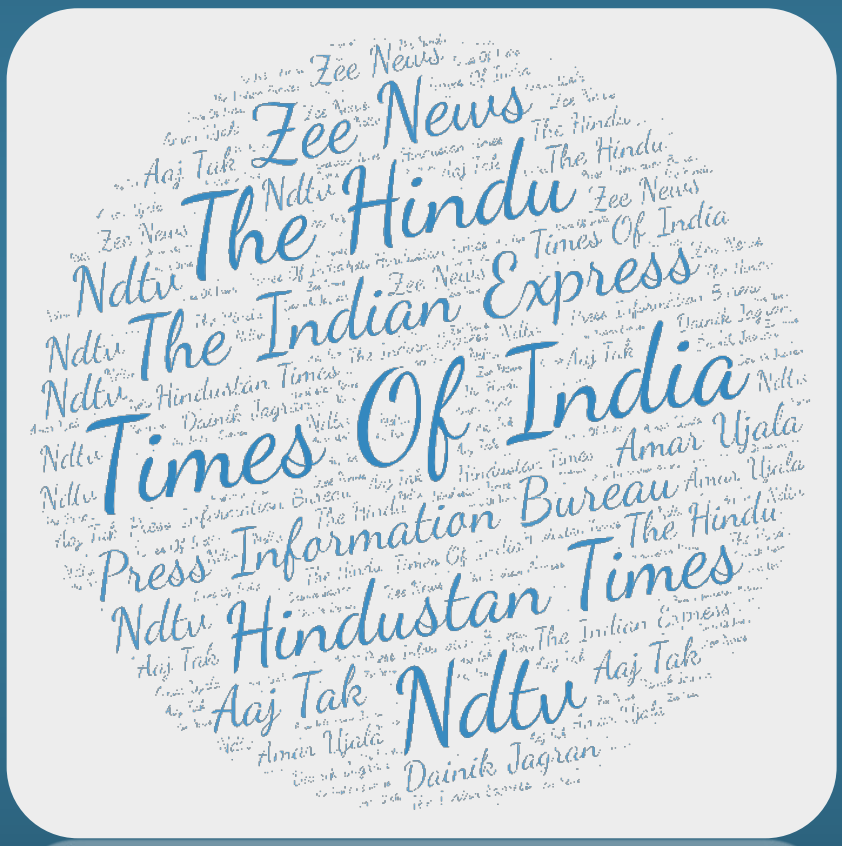

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THE ECONOMIC TIMES

Wed, 08 Jun 2022

Funding Under DRDO Scheme Enhanced to Rs 50 Crore Per Project

Defence Minister Rajnath Singh on Wednesday approved increasing financing under the Technology Development Fund of the Defence Ministry from Rs 10 crore per project to Rs 50 crore. The TDF scheme supports indigenous development of components, products, systems and technologies by MSMEs and start-ups. It is executed by the Defense Research & Development Organisation (DRDO). The Centre under the Union Budget 2022-23 allocated 25% of defence R&D budget to private business, startups, and academics. The enhanced funding is in line with the budget announcement and it will give further boost the vision of 'Aatmanirbharta in defence', the Defence Ministry said in a release.

The main goal of the TDF Program is to provide the defence manufacturing industry a huge boost by pushing the industry to innovate and develop defence technology in order to put India on the path to self-reliance. The programme provides funding for up to 90% of the project's total cost, allowing industry to collaborate with another industry. The industry and startups will be able to create more complex technologies for existing and future weapon systems and platforms thanks to increased investment. The TDF programme has approved 56 projects to date.

https://economictimes.indiatimes.com/news/defence/funding-under-drdo-scheme-enhanced-to-rs-50-crore-per-project/articleshow/92079627.cms

BusinessLine

Wed, 08 Jun 2022

Govt Strengthens DRDO's War Chest to Push for Developing Indigenous Technology

The Defence Research and Development Organisation can now afford to invite domestic industries to develop complex technologies and systems, with the Defence Ministry enhancing

funding under Technology Development Fund (TDF) scheme to ₹50 crore a project from ₹10 crore. Defence Minister Rajnath Singh, said the ministry, has approved scaling up of the funding under the DRDO's TDF scheme to widen support to indigenous development of components, products, systems and technologies by MSMEs and start-ups. First notable technology developed through the TDF route pertains to 'Video Processing & Switching Module' and 'Smart Multi-functional Display (SMFD)' developed for the Indian Air Force, said a senior DRDO officer.

Both the technologies developed with the collaboration of indigenous industry partner, Logic Fruit Technologies from Gurugram will form the backbone of Su-30 avionics upgrade, explained the official . For logistic management at high altitude posts, DRDO funded Raphaemphibr Pvt Ltd, Noida, to manufacture a drone capable of carrying 20 kg payload at height greater than 1,500 feet. The high altitude drone developed in record time of 2 years under the same scheme has already received orders from the Army, stated DRO officials to cite another success story.

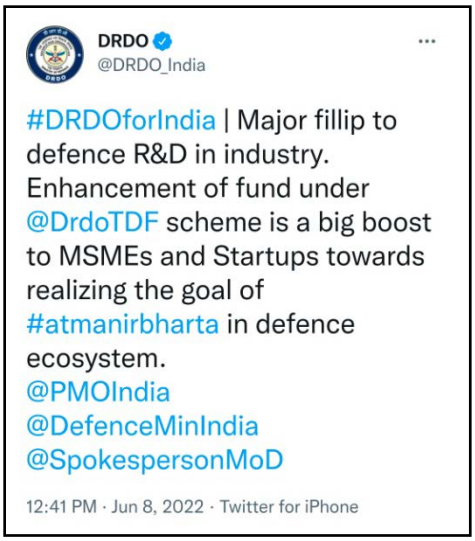
According to the DRDO, several other development projects including in aerospace and satellite, Mandarin to English translation software and sensors are in advance stages.

Under the scheme floated in 2016, the DRDO so far has funded 56 projects totalling ₹250 crores. The scheme facilitates up to 90 per cent of the total project cost and allows industry to work in consortium as well as academia. "With the enhanced funding, the industry and start-ups will be able to develop more complex technologies for existing and future weapon systems and platforms," said the ministry.

The graded enhancement of funding, believe DRDO officials, has helped the domestic defence industry to mature. Till now, the DRDO could aide development of products to specification that was just helping in supply chain for manufacturing of larger systems. The enhanced funding fulfils this year's union budget commitment and will further boost the vision of 'Aatmanirbharta' in defence, the ministry said. It may be recalled that 25 per cent of defence R&D budget was earmarked for private industry, start-ups and academia in the budget.

https://www.thehindubusinessline.com/news/national/govt-strengthens-drdos-war-chest-to-push-for-developing-indigenous-technology/article65507327.ece

DRDO On Twitter



Defence News

Defence Strategic: National/International

THE ECONOMIC TIMES

Wed, 08 Jun 2022

India, Vietnam INK Military Logistics Support Pact & Vision Document to Expand Defence Ties

India and Vietnam on Wednesday inked a vision document to further broad-base the "scope and scale" of defence ties by 2030 and sealed a logistics support pact to allow militaries of the two sides to use each other's bases for repair and replenishment of supplies. The signing of the two documents after Defence Minister Rajnath Singh's "fruitful" talks with his Vietnamese counterpart General Phan Van Giang in Hanoi, is seen as a major upswing in India-Vietnam strategic ties amid common concerns over China's increasing muscle-flexing in the South China Sea. The Memorandum of Understanding (MoU) on mutual logistics support is the first such major agreement that Vietnam has signed with any country. After the talks between Singh and General Giang, the defence ministry said India and Vietnam continue to have the "most trustworthy relations in contemporary times with broader convergence of interests and

common concerns." Singh said the close defence and security cooperation between India and Vietnam is an important factor for stability in the Indo-Pacific region.

"In these times of increasing cooperative engagements between the defence forces of the two countries, this (logistics pact) is a major step towards simplifying procedures for mutually beneficial logistic support and is the first such major agreement which Vietnam has signed with any country," it said in a statement. Singh, who arrived in Vietnam on Tuesday on a three-day visit, also called on Vietnamese President Nguyen Xuan Phuc and the discussions were focused on overall strategic ties between the two countries. The two defence ministers signed the 'Joint Vision Statement on India-Vietnam Defence Partnership towards 2030' that provides for expansion of defence and military ties in diverse areas, officials said.

"Had an excellent meeting with General Phan Van Giang, the Defence Minister of Vietnam. We renewed interactions on expanding bilateral cooperation. Our close Defence and Security cooperation is an important factor of stability in the Indo-Pacific region," Singh tweeted. He said the "wide-ranging discussions" were focused on "effective and practical" initiatives to further expand bilateral engagements, adding regional and global issues also figured in the talks.

"After our fruitful deliberations, we signed the 'Joint Vision Statement on India-Vietnam Defence Partnership towards 2030', which will significantly enhance the scope and scale of our defence cooperation," he added The signing of the vision document to expand bilateral defence and security ties came amid growing congruence between the two countries in the maritime security domain amid China's increasing muscle-flexing in the region.

Singh and Gen Giang also agreed to the early finalisation of the USD 500 million defence Line of Credit (LoC) extended to Vietnam by India. The defence ministry, in a statement, said the implementation of the projects under the LoC will add substantially to Vietnam's defence capabilities and further Prime Minister Narendra Modi's vision of 'Make in India, Make for the World'. Singh also announced gifting of two simulators and monetary grants towards setting up a language and IT laboratory at the Air Force Officers Training School for capacity building of the Vietnamese armed forces. Hours later, the defence minister interacted with the Indian community in Hanoi during which he expressed appreciation for their achievements and contributions in promoting India-Vietnam relations. The defence minister began his visit by paying respects to late President Ho Chi Minh at his Mausoleum in Hanoi. He also visited Tran Quoc Pagoda, a revered Buddhist temple which reaffirmed the age-old civilisational and people-to-people linkages between the two countries.

Singh also paid a visit to the Military History Museum. Vietnam, an important country of the ASEAN (Association of Southeast Asian Nations), has territorial disputes with China in the South China Sea region. India has oil exploration projects in the Vietnamese waters in the South China Sea. India and Vietnam are boosting their maritime security cooperation in the last few years to protect common interests. The defence ministry described Vietnam as an important partner in India's Act East policy and the Indo-Pacific vision, adding both countries share a rich history of civilisational and cultural linkages spanning over 2,000 years. It said bilateral defence engagements have expanded over a period of time to include wide-ranging contacts between the two countries, including through defence policy dialogues, military-to-military exchanges, high-level visits, capacity building and training programmes and cooperation in the UN Peace Keeping and bilateral exercises.

Relations between the two countries were elevated to the level of 'strategic partnership' during the visit of Vietnam's then Prime Minister Nguyen Tan Dung to India in July 2007. In 2016, during Prime Minister Modi's visit to Vietnam, bilateral relations were further elevated to a 'comprehensive strategic partnership'. Vietnam has become an important partner in India's Act East policy and the Indo-Pacific vision.

https://m.economictimes.com/news/defence/rajnath-singh-meets-vietnamese-counterpart-signs-joint-vision-statement-to-significantly-enhance-defence-cooperation/amp_articleshow/92075508.cms

THE TIMES OF INDIA

Wed, 08 Jun 2022

Some Defence Infra Being Set up by China Near its Border with India Alarming: US Commander

The defence infrastructure being set up by China near its border with India is alarming and the level of activity there is eye-opening, US Army's Pacific Commanding General Charles A. Flynn said in New Delhi on Wednesday. Flynn arrived in India on Tuesday and had met Army chief General Manoj Pande to discuss bolstering of military cooperation. The US commander said that the "destabilising and corrosive" behaviour of China in the Indo-Pacific region is not helpful.

India and China have been engaged in a tense border standoff in eastern Ladakh since May 5, 2020, when there was a violent clash between the two sides in the Pangong lake area. Last month, it came to light that China is constructing a second bridge in eastern Ladakh and it could help its military quickly mobilise its troops in the region. China has also been establishing other infrastructure such as roads and residential areas in the border areas with India. China has maritime border disputes with various countries in the Indo-Pacific region such as Vietnam and Japan.

When asked about his assessment of the India-China border standoff in Ladakh, Flynn told reporters: "I believe that the activity level is eye-opening and I think the some of the infrastructure that is being created in the (Chinese Army's) Western theatre command is alarming." The western theatre command of the Chinese Army borders India. Flynn said when one sees China's military arsenal in all domains, one must ask the question why is it needed. "So, I do not have a crystal ball to tell you how it (India-China border standoff) is going to end or where we will be at. I will express to you that it is worthy of asking this question and try to get their response as to what are their intentions" he noted. He said the talks that are going on between India and China are helpful. "However, behaviour matters here as well. So, understanding what they are saying is one thing but the way they are acting and behaving by the way of build-up is concerning. It should be concerning to every one of us," he said. Flynn also talked about how the behaviour of China has changed between 2014 and 2022. "I was in this command from 2014 to 2018 as the commander of 25th infantry division and then the deputy commanding general of my current command (United States Army Pacific) as a two-star general. Then I left and went to the Pentagon to be the operations officer for the Army for three years and I came back a year ago," he said.

He added that when he looks back on what the CCP and the PRC (People's Republic of China) were doing then to what they are doing today, it can be said that they have taken an incremental and insidious path. The destablising and corrosive behaviour that they project into the Indo-Pacific region is simply not helpful, he said. "Our ability to strengthen the relationships in the region as a counterweight to those destablising activities and to strengthen the network of allies and partners and likeminded countries that care about the protection of their people, national sovereignty, land, resources, free and open Pacific Ocean and society," he said.

"I think it is worthy of us working together as a counterweight to some of those corrosive and corruptive behaviours that the Chinese do," he said. Indian Army Chief General Manoj Pande had on May 9 said China's intention has been to keep "alive" the boundary question with India though it remains the "basic" issue between the two countries. India and China have held 15 rounds of military talks so far to resolve the eastern Ladakh row. As a result of the talks, the two sides completed the disengagement process last year on the north and south banks of the Pangong lake and in the Gogra area. However, each side currently has around 50,000 to 60,000 troops along the Line of Actual Control (LAC) in the sensitive sector.

https://timesofindia.indiatimes.com/india/some-defence-infra-being-set-up-by-china-near-its-border-with-india-alarming-us-commander/articleshow/92082295.cms

INDIA TODAY

Wed, 08 Jun 2022

INS Satpura Visits Manila During Deployment to South China Sea

Enhancing military cooperation with the navies of friendly foreign countries, Indian Naval Ship (INS) Satpura, on a deployment to the South China Sea (SCS) and West Pacific, visited Manila from June 3 to 6.The visit was aimed at strengthening mutual working relationships and interoperability between the Indian Navy and the Philippines Navy. During the visit, the Commanding Officer, Captain Saket Khanna, met with Commodore Roy Vincent Trinidad, Deputy Commander of the Philippines Fleet.

INS Satpura was visited by officers and sailors from the Philippines Navy, who were briefed on the indigenous design and construction of the modern stealth frigate. Personnel from both navies also took part in friendly football and basketball matches. INS Satpura is an indigenously designed and built 6,000 tonne guided missile stealth frigate equipped to seek and destroy adversaries in the air, surface, and undersea. The ship is a part of the Eastern Fleet based at Visakhapatnam.

https://www.indiatoday.in/defence/story/ins-satpura-visits-manila-deployment-to-south-china-sea-1959656-2022-06-08

The Tribune

Thu, 09 Jun 2022

Quad Summit Resets Lens

Enunciates strategy to deal with an assertive China

By G Parthasarathy

The Tokyo Quad Summit has produced some far-reaching policy decisions, to the surprise of many. There has been a widespread belief that Quad is nothing but a talk-shop, confined to a few naval exercises by India, the US and Australia across the Straits of Malacca. Moreover, Quad was beset with serious differences on the Russia-Ukraine conflict. PM Modi made it clear that India would not be party to any resolution, or move, to voice criticism of Russian actions. The organisation, it was felt, would be well advised to focus on the Indo-Pacific Region. More importantly, Quad should have clear goals on issues like regional economic cooperation and climate change. New Delhi had wisely avoided joining the larger Asia-Pacific Free Trade Grouping. Its members include China, whose trade practices are mercantilist.

These Chinese practices have led India into a growing trade deficit with China, which rose from $72.91 billion to 94.16 billion in the last two years. Moreover, even with ASEAN, India's initial expectations of having a Free Trade Agreement that would include IT services have not been fulfilled. It was only appropriate, in this background, that India joined the 13-member Indo-Pacific Economic Framework Agreement, put together by the US, during the summit. This agreement includes Quad members, together with ASEAN members Brunei, Indonesia, Malaysia, Singapore, the Philippines, Thailand and Vietnam, apart from New Zealand and South Korea. Strategically important ASEAN members are in the group, including notably, the Philippines and Vietnam, which have, for long, borne challenges of Chinese intrusions.

While India has endeavoured to promote maritime cooperation with its neighbours across the Bay of Bengal, such efforts will be strengthened when all Quad members plan future joint exercises in the Bay of Bengal. This effort should include participation by Indonesia, Vietnam and others. The summit took place at an interesting time, with global attention primarily focused on dealing with Russia's military intervention. Despite all the rhetoric and sabre-rattling, this is an issue which will have to be settled politically, with Russia being fully satisfied that its southern lines of communication to the sea are secure. It is perhaps time to remind the US of the Nixon-Mao honeymoon during the Bangladesh conflict, and, thereafter, their efforts to 'cap, roll back and eliminate' India's nuclear autonomy, particularly by the Carter and Clinton administrations.

The emergence of a growingly assertive and aggressive China has changed strategic equations in the Asia-Pacific. Beijing's actions have violated international law across virtually all its land and maritime boundaries with sixteen countries. It would, therefore, be useful for ASEAN countries to participate in military exercises across the Straits of Malacca by Quad.

The most important factor which emerged in the Quad meeting was, however, recognition by the US that Quad has to look beyond military power to economic cooperation to promote prosperity and meet challenges posed by China. The summit was accompanied by India joining the US-

sponsored Indo-Pacific Economic Framework (IPEF), together with other Quad members. The IPEF now has 13 members, including the Quad members, together with Asia-Pacific countries like Indonesia, Malaysia, New Zealand, the Philippines, Singapore, Thailand and Vietnam. The main economic priorities would include supply chain resilience, clean energy and infrastructure. Modi has stated that the IPEF was a 'declaration of our collective will to make the region an engine of global economic growth'. Substantive discussions are required to make the IPEF a meaningful grouping.

While India, Japan and ASEAN members will focus on China's moves across the Indian and Pacific Oceans, Australia and New Zealand would now have to focus attention on Chinese moves in the small Pacific island states. China's foreign minister Wang Yi met leaders of a dozen small island states in the South Pacific, offering to provide Chinese infrastructure projects and modernisation of cyber security and training, evidently in return for receiving military bases there. The effort drew a blank. Australia played a key role in undermining this effort by the visit of its recently appointed foreign minister Penny Wong to the Pacific Islands. The visit was timed to coincide with Wang Yi's visit. Tensions may well arise in an emerging maritime boundary dispute on Pacific waters between China and Japan.

China cannot be pleased with what is happening in the Indo-Pacific Region. Beijing has thus far sulked at providing any significant assistance to Sri Lanka to deal with the most serious economic crisis the island has ever faced. China is not pleased with port facilities India has acquired, with Japanese financing, in Colombo Port. Shortly thereafter, India and Sri Lanka signed a pact on installing three hydel projects off the coast of Jaffna, located close to Tamil Nadu. This was done after Sri Lanka rescinded an earlier decision awarding the projects to China. In the meantime, the Chinese-built Hambantota Port and airport in the constituency of the Rajapaksa family remain virtually unused, and serve as yet another example of Chinese 'debt trap diplomacy'.

India has the opportunity to balance China's economic and military power across its Indian Ocean neighbourhood. Concerns about the Indian Ocean Region becoming a virtual 'Chinese lake' are being addressed by timely diplomacy. Developments at the summit clear the way for greater maritime defence cooperation with ASEAN neighbours, apart from areas like supply chains, clean energy and infrastructure. The foundation stone has just been laid to expand the role of Quad across the Indo-Pacific Region.

https://www.tribuneindia.com/news/comment/quad-summit-resets-lens-402163

Wed, 08 Jun 2022

New Improved Lithium-Ion Batteries That Last Longer in Extreme Cold

If you have an electric car and drive in the cold, you're likely well aware of the reduced performance and range when temperatures drop below freezing. Even if you live somewhere warm, you might have seen the same effect in your cell phone during a ski trip, finding your percentage charge quickly waning despite minimal usage. Fortunately, scientists are hard at work improving battery technology, looking to increase capacity, speed up charging, enhance endurance, boost safety, and yes, upgrade the performance in very cold temperatures.

When temperatures fall below freezing, cell phones need to be recharged frequently, and electric cars have shorter driving ranges. This is because their lithium-ion batteries' anodes get sluggish, holding less charge and draining energy quickly. To improve electrical performance in the extreme cold, researchers reporting in ACS Central Science have replaced the traditional graphite anode in a lithium-ion battery with a bumpy carbon-based material, which maintains its rechargeable storage capacity down to -31°F (-35°C). As the name implies, a lithium-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge and back when charging.

Lithium-ion batteries are great for powering rechargeable electronics because they can store a lot of energy and have long lifespans. But when temps fall below freezing, these energy sources' electrical performance declines, and when conditions are cold enough, they can fail to transfer any charge. It's why some people living in the U.S. Midwest have trouble with their electric cars in the dead of winter, and why it's risky to use these batteries in space explorations. Recently, scientists determined that the flat orientation of graphite in the anode is responsible for the drop in a lithium-ion battery's energy storage capacity in the cold. So, Xi Wang, Jiannian Yao, and colleagues wanted to modify the surface structure of a carbon-based material to improve the anode's charge transfer process.

To create the new material, the researchers heated a cobalt-containing zeolite imidazolate framework (known as ZIF-67) at high temperatures. The resulting 12-sided carbon nanospheres had bumpy surfaces that demonstrated excellent electrical charge transfer capabilities. Then the team tested the material's electrical performance as the anode, with lithium metal as the cathode, inside a coin-shaped battery. The anode demonstrated stable charging and discharging at temperatures from 77°F to -4°F (25°C to -20°C) and maintained 85.9% of the room temperature energy storage capacity just below freezing.

In comparison, lithium-ion batteries made with other carbon-based anodes, including graphite and carbon nanotubes, held almost no charge at freezing temperatures. When the researchers dropped the air temperature to -31°F (-35°C), the anode made with bumpy nanospheres was still rechargeable, and during discharge, released nearly 100% of the charge put into the battery. Incorporating the bumpy nanosphere material into lithium-ion batteries could open up the possibilities for using these energy sources at extremely low temperatures, the researchers say.

Reference: "Riemannian Surface on Carbon Anode Enables Li-ion Storage at -35 °C" 8 June 2022, 10.1021/acscentsci.2c00411. *DOI: 10.1021/acscentsci.2c00411*

https://scitechdaily.com/new-improved-lithium-ion-batteries-that-last-longer-in-extreme-cold/amp/

Wed, 08 Jun 2022

Experiments in Twisted, Layered Quantum Materials Offer New Picture of How Electrons Behave

A recent experiment detailed in the journal Nature is challenging our picture of how electrons behave in quantum materials. Using stacked layers of a material called tungsten ditelluride, researchers have observed electrons in two-dimensions behaving as if they were in a single dimension—and in the process have created what the researchers assert is a new electronic state of matter. "This is really a whole new horizon," said Sanfeng Wu, assistant professor of physics at Princeton University and the senior author of the paper. "We were able to create a new electronic phase with this experiment—basically, a new type of metallic state."

Our current understanding of the behavior of interacting electrons in metals can be described by a theory that works well with two- and three-dimensional systems, but breaks down when describing the interaction of electrons in a single dimension. "This theory describes the majority of the metals that we know," said Wu. "It states that electrons in metal, though strongly interacting, should behave like free electrons, except that they may have different values in some characteristic quantities, such as the mass and magnetic moment."

In one-dimensional systems, however, this "Fermi liquid theory" gives way to another theory, "the Luttinger liquid theory," to describe the interaction between electrons. "Luttinger liquid theory provides a basic starting point to understand interacting electrons in one dimension," said Wu. "Electrons in a one-dimensional lattice are so strongly correlated with one another that, in a sense, they begin not to act like free electrons." The Fermi liquid theory was first put forward by the Nobel Prize winner L.D. Landau. Luttinger's theory went through a long process of refinement before it became widely accepted by physicists. A theoretical model was first proposed by Japanese Nobel Prize winner Shinichiro Tomonaga in the 1950s, said Wu, and was independently formulated by J.M. Luttinger later in 1963.

Luttinger, however, provided an inadequate solution and so Princeton mathematician and physicist Elliott Lieb, today the Eugene Higgins Professor of Physics, Emeritus, took up the challenge in 1965, eventually providing a correct solution. Another physicist and Nobel Prize

laureate, F. Duncan Haldane, Princeton's Sherman Fairchild University Professor of Physics, then used the model in 1981 to understand the interaction effects of one-dimensional metals. Haldane coined the term "Luttinger liquids" and laid the foundation for the modern theory of Luttinger liquids as a general description for one-dimensional metals.

For a long time, these two theories—the Fermi liquid theory and the Luttinger liquid theory — have been central to our understanding of the behavior of electrons in condensed matter physics, according to their dimensionality. But there have been hints that the interactions of electrons are much more complex than this simple classification. Philip Anderson, another Nobel Prize winner and Princeton physicist, proposed in the 1990s that there might be certain "exotic" cases in which the behavior of electrons in two-dimensional systems, on rare occasions, could also follow the predictions of Luttinger liquid theory. In other words, although the electrons in two-dimensional systems are typically explained by the Fermi liquid theory, Anderson wondered if those electrons counterintuitively could behave as a Luttinger liquid, as if they were in a one-dimensional system.

This was largely hypothetical. There were no experiments that could be connected to these exotic cases, Wu said. Through experimentation, Wu and his team discovered that electrons in a specially created two-dimensional material structure, when cooled to very low temperatures, suddenly began to behave as predicted by Luttinger liquid theory. In other words, they were acting like correlated electrons in a one-dimensional state.

The researchers carried out their experiment using a material called tungsten ditelluride (WTe_2), a layered semimetal. A semimetal is a compound that has intermediate properties that place it between metals and insulators. Princeton researchers Leslie Schoop, assistant professor of chemistry, and Robert Cava, the Russell Wellman Moore Professor of Chemistry, and their teams created tungsten ditelluride crystals of the highest quality. Wu's team then created single atomic layers of this material, and stacked two of them together vertically for the study.

"We stacked monolayers of tungsten ditelluride on top of one another and used an angle twist of either 5 or 6 degrees," said Pengjie Wang, co-first author of the paper and a postdoctoral research associate. This created a large rectangular lattice called a moiré pattern, which resembles a common French textile design. The team had originally intended to observe how the twist angle would affect the other types of quantum phenomena in the tungsten ditelluride. But what they found astonished them.

"At first, we were confused by the results," Wang said. "But it turned out to be right." The researchers observed that the electrons, instead of acting freely, began to congregate strongly into a linear array indicative of electrons in a one-dimensional system. "What you have here is really a two-dimensional metallic state that is not described by the standard Fermi liquid theory," said Wu. "For the first time, we find a completely new electronic phase of matter in two dimensions described by the Luttinger liquid theory." Guo Yu, co-first author on the paper and a graduate student in electrical and computer engineering, described the properties of the material as remarkably switchable between either uniform in all directions (isotropic) or varying strongly in physical properties when measured in different directions (anisotropic).

"What is unique for our twisted bilayer tungsten ditelluride system is that, unlike most of the other monolayer materials and their moiré superlattices which are isotropic, the moiré pattern in our sample is highly anisotropic, crucial to hosting the one-dimensional physics," Yu said.

A new metallic phase might sound like it would have numerous practical applications, but Wu cautioned that this is preliminary research. Before such applications can be realized, he said, additional work needs to be carried out. Nonetheless Wu is optimistic about the future. "This might help open up a whole new window to look at novel quantum phases of matter," he said. "In the coming years, we will see a lot of new findings coming out of this research."

More information: Pengjie Wang et al, One-dimensional Luttinger liquids in a two-dimensional moiré lattice, *Nature* (2022). *DOI: 10.1038/s41586-022-04514-6*

https://phys.org/news/2022-06-layered-quantum-materials-picture-electrons.html

Business Standard

Thu, 09 Jun 2022

QS University Rankings 2023: IISc Ranked World's Best Research Varsity

Regaining the pole position among public and private institutions from the country, the Indian Institute of Science (IISc) Bangalore was ranked at 155th place in the latest QS World University Rankings. The premier institute also continued to prove its mettle in quality research, as it emerged as the global leader in the citations per faculty (CpF) indicator in the latest rankings. According to the indicator, when universities are adjusted for faculty size, IISc is the world's best research university. It achieved a perfect score of 100/100 on this metric. Further, as the fastest rising South Asian university on the QS rankings' top 200 list, IISc gained 31 places year-on-year (YoY), up from 186th position last year. The nineteenth edition of the international university rankings by global higher education analysts QS (Quacquarelli Symonds) featured 41 Indian universities, of which 12 improved their rankings, 12 remained stable, 10 saw a decline and seven were new entrants. This year's QS World University Rankings is the largest ever, with 1,418 institutions across 100 locations, up from 1,300 last year. Massachusetts Institute of Technology (MIT) finished a record-extending 11th consecutive year as world number one. The University of Cambridge rose to second place, while Stanford University remained in the third position.

Following IISc were some of the leading Indian Institutes of Technology (IITs), all of whom improved their standing, while IIT Indore debuted at 396th rank (see box). Among declared public institutions of eminence, while IISc, IIT Bombay, IIT Delhi, IIT Madras and IIT Kharagpur attained a higher rank, University of Delhi and University of Hyderabad saw a decline while Banaras Hindu University's rank remained unchanged. On the other hand, two of the declared private institutions of eminence maintained the same rank — Manipal Academy of Higher Education and Birla Institute of Technology and Science (BITS) — while O. P. Jindal Global University (JGU) rose to the next band of 651-700.

JGU is not only India's top ranked university with a focus solely on social sciences, arts and humanities but also the only Indian non-STEM (science, technology, engineering and mathematics) and non-medicine university to find a place in the QS World University Rankings 2023.

INDIA'S BEST

Top Indian institutes in QS World University Rankings 2023

2023	Institute	2022
155	IISc Bangalore	186
172	IIT Bombay	177
174	IIT Delhi	185
250	IIT Madras	255
264	IIT Kanpur	277
270	IIT Kharagpur	280
369	IIT Roorkee	400
384	IIT Guwahati	395

Source: QS (https://www.TopUniversities.com/)

Among new entrants, University of Madras debuted in the 541-550 band, while Chandigarh University debuted in the 801-1,000 bracket as the youngest varsity, having been established less than 10 years ago. IIT Guwahati (37th for CpF), IIT Roorkee (47th for CpF) and the University of Madras (48th for CpF) are also among the global top 50 research institutions.

In terms of other indicators, the University of Calcutta (801-1,000) recorded the highest percentage of female students (63 per cent), followed by the University of Mumbai (1,001-1,200) with 57 per cent. Amity University (1,001-1,200), on the other hand, employed the highest percentage of female faculty (58 per cent), followed by the University of Mumbai (56 per cent).

However, India continues to struggle in indicators such as institutional teaching capacity and QS' internationalisation metrics. Thirty of India's 41 ranked universities have suffered decline in its Faculty/Student Ratio (FSR) indicator, with only four recording improvements. Amrita Vishwa Vidyapeetham (1,001-1,200) is the best-performing local institution for the proportion of international faculty, ranking 411th globally, while Amity University (1,001-1,200) is the national leader for the proportion of international students as it ranked 542nd globally. According to QS Senior Vice President Ben Sowter, while the latest edition of the rankings reflects the excellent work that several Indian varsities are doing to improve their research footprint, the dataset also suggests that the Indian higher education sector still struggles to provide adequate teaching capacity.

https://www.business-standard.com/article/education/qs-university-rankings-2023-iisc-ranked-world-s-best-research-varsity-122060801282_1.html