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समाचार पत्रों से चयनित अंश
Newspapers Clippings

डीआरडीओ समुदाय को डीआरडीओ प्रौद्योगिकियों, रक्षा प्रौद्योगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौद्योगिकी की नूतन जानकारी से अवगत कराने हेतु दैनिक सेवा

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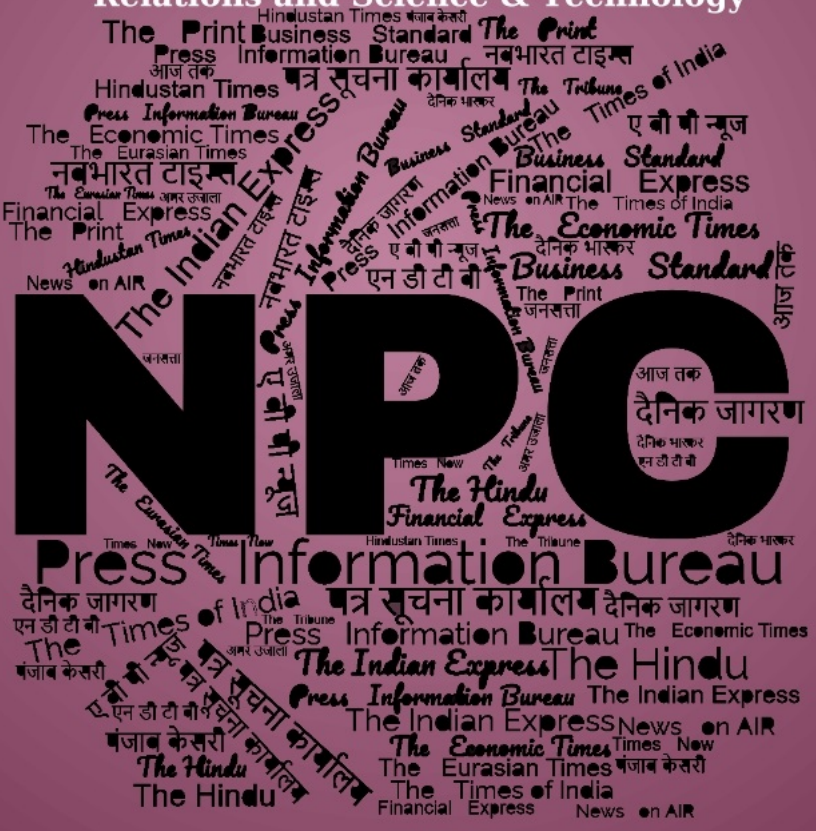

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ThePrint

Wed, 16 Oct 2024

As Navy beefs up its submarine arsenal, here's how VLF stations will provide secure communication

Defence Minister Rajnath Singh Tuesday laid the foundation stone of a 2,900-acre Very Low Frequency (VLF) station for the Navy at the Damagundam Reserve Forest site, Pudur Mandal, Vikarabad, Telangana. The defence minister said the station would help India secure its maritime interests. It will also ensure secure and real-time communication of Navy ships and submarines with the command centres of the forces, he added.

The VLF station will support the underwater operations of India's submarines, especially nuclear ones, by providing secure communication. VLF stations use wavelengths that penetrate deep into the salt water of oceans, reaching submarines that stay underwater. The need for VLF stations increased after India recently started operating two ballistic nuclear missile submarines (SSBNs), INS Arihant and INS Arighat. The Navy commissioned INS Arighat last month. Additionally, Aridhaman, a third nuclear submarine launched in 2021, will most likely be commissioned in 2025. India is also now pursuing a programme to build two nuclear powered submarines (SSNs). Eventually, India will operate a total of six SSNs. Nuclear submarines, which stay underwater, communicate differently than ships and conventional submarines.

In January this year, the Telangana government transferred 1.174 hectares of forest land for the project, which has taken approximately Rs 3,200 crore to complete.

How VLF stations help submarines communicate

A conventional submarine periodically comes to the periscope depth to charge batteries and get positional updates and information from the shore through the communication antenna. However, a submarine is a weapon of stealth and every time it comes to the periscope depth, it becomes vulnerable to detection by enemy radars or helicopters.

Submarines have no option but to come up for oxygen to charge their batteries, or if their navigation safety is damaged, to get a sense of the area. Submarines usually communicate their

positions to the shore authorities only when they come up for battery charging. A nuclear submarine uses nuclear propulsion, whereas a conventional submarine uses diesel. Unlike nuclear submarines, conventional submarines, if not fitted with Air Independent Propulsion (AIP), can be vulnerable since AIP prolongs the stay of conventional submarines underwater.

Communicating with an underwater nuclear submarine is more of a challenge. Unlike conventional submarines, nuclear-propelled submarines need not come up for charging batteries every day. Technically, it can stay underwater indefinitely. Considering this feature, nuclear submarines are the ultimate weapon of stealth. These stay underwater, cut off from the rest of the world. However, the VLF and ELF (Extremely Low Frequency) technologies become essential for communicating with these underwater submarines. VLF and ELF waves reach a certain depth below water from where the submarine can receive the communication.

Another advantage of ELF and VLF stations is that they travel widely. For instance, a station in India can send a message to submarines in the water near the US. However, the volume of information sent through ELF and VLF is far less when compared to High Frequency (HF) and Very High Frequency. However, ELF and VLF enable global communication and travel faster than HF/VHF.

ELF is considered far more advanced than the VLF technology, which India currently has. According to Army veterans ThePrint contacted, India's next step should be constructing ELF stations. Apart from the new station, India has a VLF facility in Tirunelveli. The VLF stations are specially for communicating with nuclear submarines, but such stations can also communicate with underwater conventional submarines.

A submarine communicates when on the surface, at periscope depth, or underwater. It either has a communication buoy or an antenna trailing it. The trail antenna receives the VLF/ELF communication that penetrates the water. Surface ships can also receive VLF and ELF communication but are more dependent and comfortable using HF/VHF.

https://theprint.in/defence/as-navy-beefs-up-its-submarine-arsenal-heres-how-vlf-stations-will-provide-secure-communication/2314091/

THE WEEK

Wed, 16 Oct 2024

A game-changer in the Pacific? US Navy's next-generation fighter jets set to contain China's naval ambitions

Even as China continues to upgrade its naval aviation abilities and ambitions, the US intends to maintain its dominance as the US Navy is expected to award a contract for its next-generation, carrier-based fighter soon. The Navy is set to decide between Lockheed Martin, Boeing, and Northrop Grumman for awarding the contract for the sixth-generation fighters, as Chief of Naval

Operations Adm. Lisa Franchetti said the three companies have proposals for that, and the Navy is in source selection right now.

The move comes even as China is developing its second fifth-generation fighter jet J-35, which will be deployed on its third aircraft carrier, the Fujian. The US intends to deploy the sixth generation aircraft by 2030, effectively making China a generation behind in its Navy's fighter capabilities.

The sixth-generation fighter jets are expected to operate alongside drones and fly missions at long ranges, giving the US Navy a much-required edge over China in a potential future war in the Pacific. “We expect that sixth-generation platform to be able to have advanced sensors, advanced lethality, advanced range, and being able to integrate with manned and unmanned capabilities together,” Chief of Naval Operations Adm. Lisa Franchetti was quoted as saying.

The sixth-generation fighter jets, currently being referred to as F/A-XX, is expected to replace Boeing's E/A-18 Growler electronic warfare attack aircraft and F/A-18 Super Hornet multi-role fighters.

The programme, part of the US Navy's broader Next Generation Air Dominance (NGAD) strategy, was first identified in June 2008. The F/A-XX is designed to perform a wide variety of missions, ground attack, surface warfare, air combat, and provide close air support, and aims to operate effectively in anti-access/area denial environments.

https://www.theweek.in/news/defence/2024/10/05/a-game-changer-in-the-pacific-us-navys-next-generation-fighter-jets-set-to-contain-chinas-naval-ambitions.html

अमर उजाला

Wed, 16 Oct 2024

Pralay Missiles: चीन–पाकिस्तान की सीमा पर 'प्रलय' मचाने को तैयार है ये मिसाइल, आर्मेनिया का भी आया दिल!

भारतीय सेना साल 2026 से प्रलय बैलिस्टिक मिसाइलों की तैनाती की तैयारी कर रही है। 150 से 500 किलोमीटर की दूरी तक मार करने वाली ये मिसाइलें चीन से सटी वास्तविक नियंत्रण रेखा पर तैनात की जाएंगी। इन मिसाइलों को खास भारत की उत्तरी सीमाओं पर चीन से मिल रहे खतरों का मुकाबला करने के लिए डिजाइन किया गया है। वहीं भारत इन मिसाइलों को अर्मेनिया को भी निर्यात कर सकता है। सूत्रों के मुताबिक आर्मेनिया ने इन मिसाइलों की खरीदारी में दिलचस्पी दिखाई है, जिस पर बातचीत जारी है।

सतह से सतह पर मार कर सकती है प्रलय मिसाइल

प्रलय मिसाइल कम दूरी की बैलिस्टिक मिसाइल यानी शॉर्ट रेंज बैलिस्टिक मिसाइल (SRBM) है। यह मिसाइल सतह से सतह पर मार कर सकती है, जिसे दुश्मन की इंटरसेप्टर मिसाइलों से बचने के लिए एडवांस टेक्नोलॉजी के साथ डेवलप किया गया है।

सैन्य सूत्रों ने बताया कि भारतीय वायु सेना ने 120 प्रलय मिसाइलों के लिए भी ऑर्डर दिए हैं, जिनकी डिलीवरी 2025 के अंत में शुरू होने की उम्मीद है। इन मिसाइलों का ऑर्डर 2022 में दिया गया था। इसके बाद वायुसेना को अप्रैल 2023 में और दो यूनिट यानी 250 मिसाइलों का अप्रूवल मिला। वहीं सितंबर 2023 में डिफेंस एक्विजिशन काउंसिल ने इस मिसाइलों के लिए एक आर्मी रेजिमेंट बनाने की अनुमति दी। जिसके बाद एक यूनिट में 120 मिसाइलें होंगी। कुल मिलाकर 370 मिसाइलें सेना में शामिल की जाएंगी। इन्हें भारतीय सेना की रॉकेट फोर्स बनने के बाद इसमें शामिल कर लिया जाएगा।

कई देशों ने प्रलय बैलिस्टिक मिसाइलों में दिखाई दिलचस्पी

सूत्रों ने बताया कि प्रलय बैलिस्टिक मिसाइलों को कई देशों दिलचस्पी दिखाई है। आर्मेनिया इन मिसाइलों को खरीदने का इच्छुक है औऱ इस पर बातचीत जारी है। दरअसल आर्मेनिया इन मिसाइलों के जरिए अजरबैजान की लोरा (लॉन्ग रेंज आर्टिलरी) बैलिस्टिक मिसाइलों से मुकाबला करना चाहता है, जिन्हें इस्राइल एयरोस्पेस इंडस्ट्रीज ने बनाया है।

लोरा एक थियेटर क्वॉसी बैलिस्टिक मिसाइल है, जिसकी रेंज 400 किलोमीटर है और जीपीएस के साथ इसकी सर्कुलर एरर प्रोबेबिलिटी (सीईपी) 10 मीटर है। वहीं सूत्रों ने बताया कि जल्द ही आर्मेनिया को प्रलय मिसाइलों की सप्लाई की जा सकती है। हालांकि बातचीत में जो कानूनी और तकनीकी पेंच सामने आ रहा है, उसमें भारत ने 300 किलोमीटर से अधिक की रेंज वाली मिसाइलों और 500 किलोग्राम से अधिक वजन वाले वॉरहेड का निर्यात नहीं करने की प्रतिबद्धता जताई है, जो अंतरराष्ट्रीय हथियार नियंत्रण समझौतों के तहत आता है। जिसके चलते हो सकता है कि अर्मेनिया को सप्लाई की जाने वाली मिसाइलें कम रेंज और कम वॉरहेड वजन वाली हों।

प्रलय बैलिस्टिक मिसाइल की खासियत

वहीं, प्रलय की मारक क्षमता 150-500 किलोमीटर है। प्रलय की रफ्तार 1200 किमी प्रति घंटा है, जिसे बढ़ाकर 2000 किमी प्रति घंटा किया जा सकता है। इसे डीआरडीओ के बीएमडी सिस्टम की पृथ्वी एडी मिसाइल से डेवलप किया गया है। प्रलय में टर्मिनल गाइडेंस के लिए रेडियो फ्रीक्वेंसी सीकर लगा है। वहीं यह मिसाइल में स्वदेश में विकसित फ्यूज्ड सिलिका रडार डोम से लैस है।

सूत्रों ने बताया कि प्रलय रूस की इस्कैंडर-एम मिसाइल का एक एनालॉग है, जो यूक्रेन में काफी कारगर साबित हुई है। वहीं प्रलय और इस्कैंडर की सटीकता लगभग 10 मीटर सीईपी के बराबर है। वहीं, प्रलय मिसाइल इस्केंडर-एम की तरह दुश्मन के एयर डिफेंस सिस्टम को चकमा भी दे सकती है। वहीं, क्वॉसी या अर्ध-बैलिस्टिक मिसाइलों को बैलिस्टिक मिसाइलों की तुलना में रोकना अधिक मुश्किल होता है।

वर्तमान में भारतीय वायु सेना और भारतीय सेना की मिसाइल यूनिट में तैनात पृथ्वी टैक्टिकल मिसाइल में यह फीचर है। सूत्रों का कहना है कि चीन और पाकिस्तान दोनों के पास इस तरह की मिसाइलें हैं। जहां चीन के पास डोंगफेंग-12 मिसाइल है, तो पाकिस्तान के पास चीन से मिली गजनवी एम-11 और शाहीन मिसाइल है।

दिसंबर 2021 में 24 घंटे के भीतर भारत ने इस मिसाइल का दो बार परीक्षण किया गया था। वहीं नवंबर 2023 में ओडिशा तट पर अब्दुल कलाम द्वीप से भी प्रलय का परीक्षण किया था। यह मिसाइल अपने परीक्षण में पूरी तरह से कामयाब रही थी। वहीं, चीन और पाकिस्तान सीमा पर इस मिसाइल की तैनाती से भारत की सामरिक क्षमता में जबरदस्त इजाफा होगा।

https://www.amarujala.com/india-news/indian-army-is-preparing-to-deploy-pralay-ballistic-missiles-along-the-lac-news-in-hindi-2024-10-16

Wed, 16 Oct 2024

Safran Data Systems Expands in Chennai to Drive Aerospace and Automotive Growth

Safran Data Systems (SDS) India has taken a significant step in enhancing its presence in India by opening a new state-of-the-art office in Chennai. This facility is set to become a key center for design and development in the aerospace, defence, and automotive sectors, aligning with the growing demand for advanced solutions. The inauguration was attended by notable figures such as B Krishnamoorthy, Special Secretary of the Government of Tamil Nadu, and JS Gavankar, CEO of Safran India.

Gavankar highlighted the strategic importance of the new facility, saying, “SDS is the niche which will assist the Indian Space Ecosystem to scale up with full support by Safran under Make in India.” This expansion aims to leverage Chennai’s strong engineering talent pool and contribute to India’s technological growth.

Krishnamoorthy expressed the local government’s commitment to supporting high-tech initiatives, stating, “Tamil Nadu is willing to support such a high technology initiative and will help Safran get the right talent, local support, and testing & certification ecosystem under TIDCO umbrella.”

Founded in 1999, Safran Data Systems India has become a key player in India’s space and defence sectors, actively supporting major projects like Chandrayaan and Aditya L1 with ISRO.

With over 200 professionals and a strong track record of delivering 1,500 projects globally, SDS India is poised to further drive innovation and growth in India’s aerospace and automotive sectors.

https://www.financialexpress.com/business/defence-safran-data-systems-expands-in-chennai-to-drive-aerospace-and-automotive-growth-3641056/

Wed, 16 Oct 2024

Only 5th-Gen Option For IAF: Russian Su-57 Remains One Of ‘Key Interim Choices’ For India As It Pushes AMCA

Western defense analysts have been highlighting that the Russian fifth-generation Sukhoi Su-57 “Felon” fighter jet’s development and production have been delayed due to a number of factors,

such as the Ukraine war and Western sanctions, which have restricted some critical micro-electronic components for major sensors and cockpit displays.

To compensate, Russia has been forced to ramp up production of the Su-30SM2 and Su-35S to make good numbers for the war effort. Others feel there are only minor delays. In June 2019, the Russian Ministry of Defence signed a contract for the production of 76 Su-57s. As per the plan, three full Aviation Regiments of Su-57 fighters will be in existence by 2028.

Meanwhile, the Russian government has stated that the order numbers are going up, and the production rate for the Su-57 will double in 2024. The target is to deliver more than 20 Su-57s in 2024. If Su-57 production begins to increase, could it be of interest to India?

New Su-57 Batch Deliveries

The Su-57, Russia's most advanced front-line aircraft, is produced at the Komsomolsk-on-Amur Aviation Plant in the Russian Far East. According to the Russian state-owned United Aircraft Corporation (UAC), a new batch of Su-57 fighter aircraft has been delivered and is already at their operational airbases. The pilots and engineers are reportedly very happy with the aircraft's performance.

Russia seems to have sorted out most technology development issues and supply chain bottlenecks. Meanwhile, the Sukhoi Design Bureau is continuously working on improving and expanding the aircraft's functionality and building infrastructure for further expanding production.

Su-57 Woes, As Per Western Reports

The Russo-Ukraine War is in its third year. Russia has been unable to dominate Ukrainian airspace for various reasons, including inadequate Suppression of Enemy Air Defences (SEAD).

One other issue was the limited production of Russia's fifth-generation stealth Su-57 fighters for penetration. It has been 14 years since its first flight in 2010, and less than 40 aircraft have been delivered. This is primarily due to design and development delays and the slow rate of production compounded by Western Sanctions. Actually, serious production didn't even begin until 2019, reflecting the industrial bottlenecks that have hampered Russia's war effort.

Western experts have estimated the aircraft's Radar Cross-Section (RCS) at around 0.5 square meters, which is about the same as a typical 4th-generation aircraft and certainly phenomenally more than the F-35 class fighters.

The aircraft is still forced to fire weapons into Ukraine from its own territory. A real stealthy aircraft should have been able to intrude deeper without being seen. Delays in the more advanced NPO Lyulka-Saturn AL-51 engines forced the designer to continue using the Al-41F1 engines, which are also used in the Su-35S. Western sanctions have affected the Su-57's sensor suite. Based on deliveries to date, the West feels that the UAC is unlikely to meet the production target of 2024.

Su-57: A Very Capable Fighter

The West acknowledges that the Su-57 is a highly maneuverable fighter like most others from the Sukhoi fighter stable. Its 360-degree thrust vectoring allows aerodynamics-defying combat manoeuvres. The Su-57's 'Integrated Modular Avionics Combat Systems' uses fiber optic

channels. It consists of the main nose-mounted N036-1-01 X band active electronically scanned array (AESA) radar with 1,514 T/R modules and two side-looking N036B-1-01 X-band AESA radars with 404 T/R modules embedded in the cheeks of the forward fuselage for increased angular coverage.

It also has an N036L-1-01 L-band array on the leading edges. Onboard computers process the X- and L-band signals, significantly enhancing the system's information. The aircraft's electro-optical system includes infrared search and track (IRST), directional infrared countermeasures (DIRCM), ultraviolet missile approach warning sensors (MAWS), a thermal imager for low-altitude flight and landing, and a navigation and targeting pod.

The aircraft is capable of deploying countermeasures such as flares and radar decoys, as well as single-use programmable ECM transmitters. The Su-57 would also serve as a test-bed for advanced AI and man-unmanned teaming technologies. Today, the Su-57 is one of the leading platforms, along with the Su-34 and Su-35, in Russia's combat inventory and operations in Ukraine. Russia is also working on continuous integration of new weapons into the aircraft.

Several new air-to-surface weapon systems have evolved based on the combat experience in Ukraine. As part of the Manned-Unmanned Teaming (MUM-T), the Su-57 will be able to launch and/or control the S-71M "Monochrome" combat UAV for deep penetration attacks. Similar to the British Shadow Storm, the drone is more like an "air-to-surface" cruise missile.

Work is on to integrate the Okhotnik UCAV as a 'loyal wingman' for uncrewed teaming. A carrier-based variant of the aircraft is also under development. Reportedly, a 'swarm' teaming experiment had been conducted with a group of Su-35s and a Su-57 acting as a command and control aircraft.

The delay in upgrading the Su-57 with AL-51 engines is undeniable, but all production Su-57 fighters transferred to the VKS in 2024 would feature second-stage AL-51 engines. The Stage 2 engines would feature serrated exhaust nozzles that improve thrust efficiency, stability, maneuverability, and performance while reducing engine Radar, IR, and noise signatures. The Stage 2 AL-51 will not only give the fighter super-cruise and longer range but also cut down operating costs because of better fuel consumption and longer engine life.

It is worth noting that the NPO Lyulka-Saturn AL-41F1 and AL-41F1S engines, which were developed from the AL-41F, simply did not fit into the Su-57 airframe. These smaller engines had had less thrust with 88.3 kN dry thrust, 142.2 kN in afterburner, and 147.1 kN in emergency power rating.

The AL-51F-1 has 107.9 kN dry thrust and 167 kN in afterburner. It is a two-shaft, low-bypass, after-burning turbofan engine. Unlike its AL-41F1 predecessor, the engine has glass-fiber plastic IGVs and convergent-divergent nozzles that use serrated flaps to reduce its signature. It also has a 19 percent higher thrust-to-weight ratio, 6.4 percent better specific thrust, and 9 percent lower specific fuel consumption.

The Russians have stated that the new engines allowed the plane to reach a maximum speed of 2,600 km/h and 2,100 km/h without using an afterburner. Russia has also developed a variety of specific armaments that can be carried in internal weapon bays. The aircraft can carry four beyond-

visual-range (BVR) missiles (R-37M) in its two main weapons bays and two short-range missiles (upgraded R-74) in the side bays.

It can carry bombs and surface-attack missiles on each station in the main bay. For missions that do not require stealth, the Su-57 can carry stores on its six external hardpoints, which could include the hypersonic Kh-47M2 Kinzhal air-launched ballistic missile. The aircraft has seen operational action in Syria and Ukraine, albeit in limited missions. Whether the aircraft will be able to compete with the American F-22 and F-35 aircraft remains a matter of conjecture. The F-35 aircraft has a large number of financially powerful Western partners and also has huge orders from over 20 countries.

A Reasonably Priced & Low Life-Cycle Costs

The Su-57's flyaway cost is reportedly around $35 million per aircraft. If true, it makes the Su-57 nearly half the price of the Chinese J-20 and even further cheaper than the much smaller single-engine F-35. Russians suggest that the Su-57's lifecycle costs are comparable to those of the Su-27, Su-30, and Su-35, which it was designed to replace. The Su-57 was intended to be the successor to the MiG-29 and Su-27. But it is clear that it will have to now operate in conjunction with the Su-35S and Su-30SM2.

Can India Acquire Su-57?

As India continues to slowly progress on its home-developed Advanced Medium Combat Aircraft (AMCA) fifth-generation fighter, Russia sees it as one of the few partnership or export options.

It has been making overtures. Russia also claims to be receiving requests from some (unnamed) foreign countries for the purchase of the Su-57 multi-role fighter. Until the production rates go up, the world has been at a wait-and-watch stage. India had earlier joined the Sukhoi/HAL Fifth Generation Fighter Aircraft (FGFA) project, which evolved the Su-57. However, India withdrew from the FGFA program in 2018 for technical and operational reasons, as well as unequal cost and work-sharing issues.

India paid its 50 percent share of $250 million toward the initial development cost. Despite India's exit, the two sides did leave a small window of hope for the future. With AMCA's squadron entry timelines slipping past 2035, the speculation has begun.

India's Urgency & Options For Fifth-Gen Aircraft

China has already produced 300 Chengdu J-20 "Mighty Dragon" fifth-generation fighters, and to match the US, it plans to induct 1,000 by 2035. Pakistan has already announced its intention to have a fifth-generation fighter by 2029. They are talking to China for the smaller but fairly versatile Shenyang J-31.

Nearly 200 Pakistan Aeronautical Complex (PAC) complex technicians are currently working with Turkish Aerospace Industries (TAI) on the TAI TF Kaan fifth-generation aircraft project. They are likely to exercise one of the options. The American Lockheed F-35 Lightning II aircraft is still not on offer, as India operates the Russian S-400 air defense system. While India pursues and accelerates the AMCA, the only global fifth-generation fighter option for New Delhi is the Russian Su-57.

But with 60 percent of the IAF still of Russian origin, is India ready to put more eggs in Russia's basket? Also, with the never-ending war in Ukraine, likely extended sanctions, and dollar-payment restrictions, Russia's ability to deliver will remain in question. India is thus stuck between the two ends of the Vice. But reviving the Indian connection with the Su-57 remains an option.

One school of thought is that the US could make an exception by selling a few F-35 squadrons to keep India away from Russia and in the American-led Western fold. India is crucial for the US' Indo-Pacific strategy. The technical hitches linked to the S-400 can be surmounted and secured through the already signed General Security of Military Information Agreement (GSOMIA) and Communications Compatibility and Security Agreement (COMCASA) agreements.

For the first time, the US brought the F-35 to Aero India in 2023. Over 1,000 F-35s are already flying in 17 air forces, and due to higher investments, they will continue to see upgrades at a much faster rate.

A Non-Stealthy Interim Option

The French Air and Space Force (FASF) has recently ordered 42 Rafale jets for around $5.5 billion. The purchase comes amidst French lawmakers' concerns about the serious delays in Franco-German-Spanish "Future Combat Air System" (FCAS) project which was to be the successor of Rafale. The FCAS is now predicted to enter full service no earlier than 2045 or 2050. The French defense procurement agency has notified Dassault Aviation and its major equipment suppliers, Thales, Safran, and MBDA, of the contract for the fifth round of Rafale production.

The Rafale is considered a 4.5-generation fighter. It has forward-hemisphere stealth and super-cruise capability. IAF Rafale aircraft are highly customized with some India-specific modifications. Essentially, they are of the F3-plus standard. The F3R standard was validated in 2018 and is currently in place on French Rafale.

Development of the F4 standard began in 2019. The standard improved onboard processing, external connectivity, MBDA's MICA medium-range air-to-air missile, and upgrade of the Thales Spectra self-defense system. The radar and sensor upgrades facilitate the detection of airborne stealth targets at long range. The helmet-mounted display also has improved capabilities.

With improved communications equipment, it is also more effective in network-centric warfare. Flight tests began in 2021, and the first F4-standard aircraft was delivered in 2023. All FASF aircraft are planned to be will be upgraded to this standard. UAE is the first foreign customer of F4.

The "Super Rafale" F5 standard will have cutting-edge capabilities. Dassault and its partners are already working on the standard, which will be ready by around 2030. The F5 standard will have next-generation new sensors, armaments, and a faster and more secure ability to communicate and collaborate. The Rafale F5 will also act as a sensor truck with data fusion and processing abilities that allow it a tactical flying command post role, a role that is evolving in the USA's Next Generation Air Dominance (NGAD).

The F5 will also be modified to carry the Anglo-French Future Cruise Missile (FCM) and Future Anti-Ship Missile (FASM). Thales RBE2 XG radar is planned for F5. The "Super Rafale" will also

be modified to carry hypersonic nuclear-guided missiles known as “ASN4G,” which will replace the nuclear-guided ASMPA missile as France’s deterrence capability.

It is planned to integrate a loyal unmanned wingman on the lines being evolved in the European nEUROn combat drone program. Most major countries, including India, are developing the loyal wingman concept. The Rafale has seen action in Afghanistan, Libya, Mali, Iraq, and Syria. The number built to date is around 260. The new order will bring the total number of Rafale in the French armed forces to 234.

Rafale export orders currently stand at 297, including India (36), Egypt (55), Qatar (36), Greece (24), the United Arab Emirates (80), Indonesia (42), and Croatia (24) as current foreign customers. The FASF new order will keep Dassault Aviation Rafale’s production line active for the next 10 years. If the IAF were to acquire 114 Rafale as a one-time import measure, all these could be made in India. India could choose to have the F5 variant, which will have many traits of the fifth-generation fighter.

To Summarize

The Indian Air Force (IAF) is considered the fourth largest and fourth most powerful air force. Its fighter squadrons are down to an all-time low of 31, and the IAF does not have a fifth-generation fighter. Chinese J-20 numbers are growing rapidly, and the aircraft has been operating at airfields across the LAC (Line of Actual Control) in Xinjiang (Hotan) and Tibet (Shigatse).

While India must invest more and take a task force approach to developing the LCA Mk2 and AMCA, it needs an interim solution to make good numbers and reduce the capability gap with China. The choices are far and few. The time to exercise is now, lest we get left far behind.

https://www.eurasiantimes.com/only-5th-gen-option-for-iaf-russian-su-57/

The EurAsian Times

Wed, 16 Oct 2024

China ‘Unleashes’ World’s First 6-Metric-Ton Tiltrotor Drone; Can Carry Men & Material At Unprecedented Speeds & Altitudes

China has once again grabbed global attention with the debut of its latest aviation innovation—the Zhang Ying R6000 (also known as UR6000). R6000, a 6-metric-ton tiltrotor drone produced by Chinese OEM United Aircraft Wuhu Aviation Industrial Park in China’s eastern Anhui province, showcases China’s cutting-edge advancements in aerospace.

Designed for civilian missions like cargo and passenger transport, the R6000 underscores China's growing ambitions in aviation technology and its strategic push toward civil-military integration. A photo shared by United Aircraft on October 11 reveals what is said to be the first completed UR6000 prototype on the production line. A placard proudly declares it "the first machine delivered off the line."

What Is Tiltrotor Technology?

A tiltrotor drone combines helicopter and airplane technology. It's an unmanned aerial vehicle (UAV) that can take off and land vertically like a helicopter but also fly forward like a plane. During take-off and landing, its rotors point straight up, allowing it to hover like a helicopter. Once airborne, the rotors tilt horizontally, enabling it to transition into forward flight.

This means it doesn't need a runway to take off or land, yet it can still cover long distances quickly and efficiently. It's often called a 'hybrid VTOL drone' because it switches between vertical and forward flight by adjusting the position of its rotors.

Features of the R6000

The R6000 is hailed as the world's first 6-ton-class tiltrotor, marking China's initial venture into the large tiltrotor segment. This innovative aircraft features a high-wing configuration with constant-chord wings and tiltable rotors mounted on fixed engine pods at the tips of the wings. Each engine is equipped with three-blade rotors, while the forward section of the fuselage incorporates canard surfaces.

A large cargo door is positioned on the port side toward the rear of the fuselage, and the AAV boasts a U-shaped empennage configuration with two horizontal and two vertical stabilizers. Designed to accommodate ten passengers, this revolutionary tiltrotor targets civilian applications such as cargo and passenger transport.

According to the company, the R6000 boasts a maximum take-off weight of 6,100 kg and a commercial payload capacity of 2,000 kg. It offers an impressive cruising speed of 550 km/h, a service ceiling of 7,620 m, and a maximum flight distance of 1,500 km. With its substantial payload capacity and advanced autonomous systems, the R6000 sets new benchmarks in UAV technology. Although the specifics of its engines remain undisclosed, the R6000 is expected to be powered by turboshaft engines.

According to a Janes report, each engine is anticipated to be rated between 1,500 and 2,000 horsepower, and a variable-speed gearbox will be employed to manage the varying power needs for vertical and horizontal flight modes. Its cutting-edge technical specifications distinguish it from traditional aircraft, positioning the R6000 to redefine long-range UAV standards. It is capable of transporting passengers or cargo at unprecedented speeds and altitudes for an uncrewed aircraft of this size.

United Aircraft: The Innovators

While Chinese private aerospace firm United Aircraft may not be among the largest in the country, it boasts significant experience in designing and building rotary-wing drones. The company has

developed both smaller quadcopters and larger drones with coaxial rotor arrangements, primarily aimed at logistics, surveillance, firefighting, and emergency response.

The R6000 project builds on United Aircraft's previous successes in developing uncrewed coaxial helicopters for firefighting and emergency operations. Models like the 600-kg TD550 and the 350-kg TD220 have established the company as a leader in autonomous systems. A decade ago, the TD220's flight tests, conducted under the guidance of founder Tian Gangyin, enabled United Aircraft to secure a major military contract, enhancing its reputation in the Chinese aviation industry.

This expertise in autonomous systems has been crucial in the R6000's development, which incorporates innovative design elements to optimize both vertical and horizontal flight.

From Concept To Reality

Development of United Aircraft's UR6000 tiltrotor Autonomous Aerial Vehicle (AAV) reportedly began in 2021. China first showcased the concept at the Singapore Airshow in February 2024. By the third quarter of 2024, the R6000 rolled off the assembly line.

According to reports, a full-scale prototype is expected to be formally unveiled at the Zhuhai Air Show later in 2024, with full certification anticipated by 2027.

China's Civil-Military Integration

The tiltrotor's innovative design, coupled with China's civil-military integration policy, highlights its dual-use potential for both civilian and military missions. In an interview with 'Janes,' a United Aircraft official stated that "the R6000 AAV is a fully autonomous platform designed for cargo and passenger transport applications." While the tiltrotor drone is currently marketed for civilian use, its military applications are undeniably apparent.

In fact, one image on United Aircraft's website features the UR6000 adorned with People's Liberation Army (PLA) markings, signaling the company's commitment to a military-civil integration strategy. Although the R6000 was initially intended for civilian missions, it possesses clear military potential. Its capabilities have drawn the attention of defense analysts worldwide, especially given the company's recent successes in the military sector.

It can easily adapt for military purposes such as troop transport, supply delivery, or reconnaissance missions. The R6000's potential to blur the lines between civilian and military uses underscores China's broader strategy of leveraging dual-use technologies to strengthen both sectors.

Through this innovation, China not only showcases its technological prowess in civil aviation but also expands the boundaries of how these technologies can be applied in military contexts. As a forward-looking tiltrotor model, the R6000 epitomizes United Aircraft's vision of merging military and civilian technology, setting the stage for a new era in dual-use aviation.

Strategic Implications

The tiltrotor is poised to join an expanding family of fixed-wing Chinese transport drones designed for dual civilian and military applications. It is well-suited for various missions, especially in the Indo-Pacific theater, where access to conventional airstrips may be restricted during wartime. This

capability is crucial for delivering cargo to remote locations, such as Chinese island outposts in the South China Sea.

As China continues to merge civilian and military technologies, the R6000 is set to become a vital asset in the country's aviation portfolio, pushing the limits of what unmanned aerial systems can achieve. This innovative approach not only enhances operational flexibility but also underscores China's commitment to advancing its capabilities in both civilian and military aviation.

https://www.eurasiantimes.com/china-unleashes-worlds-first-6-metric/

The EurAsian Times

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Disrupting Enemy Defenses, Leonardo Unveils 'Lethal' EW System Capable Of Generating Fleet Of 'Ghost' Aircraft

Italy's Leonardo has unveiled its latest electronic warfare (EW) innovation, the BriteStorm system, designed to transform the way armed forces engage in electronic combat. BriteStorm offers an advanced solution for "stand-in jamming," allowing both crewed and uncrewed platforms to operate more safely by creating fleets of 'ghost' jets to confuse enemy radar systems.

Unlike traditional stand-off jammers, which are mounted on large aircraft positioned far from the battlefield, Leonardo's stand-in jammer is lightweight, small enough to fit on a drone, and inexpensive enough to be expendable.

The company revealed that the BriteStorm system represents a departure from conventional jamming methods, which typically involve long-range, high-power systems placed well outside the range of enemy threats. Instead, BriteStorm is designed for closer-range operations. It provides an effective means of disrupting enemy air defense systems before they can pose a danger to friendly forces.

Developed at Leonardo's renowned electronic warfare facility in Luton, UK, BriteStorm has already undergone successful live trials. The system can be integrated into a variety of platforms, including drones and loitering munitions, further extending its versatility for both current and future military missions. BriteStorm builds on Leonardo's earlier technology, BriteCloud, an Expendable Active Decoy (EAD) designed to disrupt radio frequency-guided missiles.

While BriteCloud is primarily used as a last-resort defense, BriteStorm operates earlier in the mission, jamming enemy radars and integrated air defense systems (IADS) to prevent the detection of friendly assets.

According to Mark Randall, Campaign Manager for Electronic Warfare at Leonardo, "Platforms installed with a BriteStorm payload can deploy ahead to create confusion so that enemy IADS are unable to detect, track, and attempt to engage friendly assets. Due to the evolution of near-peer

IADS capabilities, it is critical that friendly forces use BriteStorm to ensure they remain protected."

Andrew Ingram, Head of Capability for Electronic Warfare at Leonardo, added that the stand-in jamming approach reduces the need for high-power systems, making it more suitable for operations in closer proximity to enemy defenses. This not only increases operational flexibility but also lowers the risks for larger, more vulnerable platforms that would otherwise need to engage from a distance.

Diagram showing the components of a BriteStorm payload – the Miniature Techniques Generator (MTG), Transmit Receive Modules (TRMs), and high/medium/low band antennas.

The Royal Air Force (RAF) has already received several BriteStorm payloads through its Rapid Capabilities Office (RCO) and has begun flight testing to assess their capabilities.

BriteStorm Capable Of Generating Ghost Formations

The manufacturer said that the BriteStorm system distinguishes itself as the first stand-in jammer on the market equipped with advanced digital radio frequency memory (DRFM) technology, regardless of the platform it's installed on. DRFM is regarded as the gold standard in electronic warfare because it allows BriteStorm to capture and replicate an enemy radar system's pulse with precise accuracy.

Upon detecting an enemy radar signal, BriteStorm uses Leonardo's cutting-edge DRFM technology to digitally record the radar pulse, analyze it, and respond with either electronic jamming or sophisticated spoofing techniques.

This manipulation can create an array of false targets, such as dozens of "ghost" fighter jets, making it difficult for enemy radars to distinguish between real and fake threats. This technology is similar to that used in Leonardo's earlier BriteCloud system, an expendable decoy designed to protect aircraft by disrupting radar-guided missiles.

BriteStorm's jammers, when deployed on drones or other uncrewed platforms, can enter a target zone from multiple vectors at once. This further complicates the enemy's defenses by forcing them to divide and misallocate resources.

Leonardo has also incorporated more traditional jamming techniques into BriteStorm, allowing it to disrupt enemy radar by bombarding it with electronic noise. This capability can shield friendly manned and unmanned aircraft during military operations, ensuring their protection by clouding the enemy's targeting systems.

BriteStorm 55 is deployed by a Eurofighter Typhoon to defeat an incoming RF missile threat.

"BriteStorm is highly effective against radars in the NATO A to J bands," Leonardo said. "This means that BriteStorm is effective against all types of… surveillance, target acquisition, and tracking radars."

Moreover, Leonardo views the BriteStorm system as a major advancement over Raytheon's Miniature Air-Launched Decoy (MALD), an expendable jamming missile that has reportedly also seen action in Ukraine. While both systems serve to disrupt enemy defenses, Leonardo believes BriteStorm offers enhanced capabilities and greater versatility for modern warfare scenarios.

Leonardo has specifically pointed to several key military programs as potential avenues for integrating the BriteStorm system. These include the US Army's Air Launch Effects (ALE) and Future Tactical Uncrewed Aircraft System (FTUAS) programs, the US Air Force's Collaborative Combat Aircraft (CCA) initiative, and the United Kingdom's Autonomous Collaborative Platforms (ACP) drone program.

Leonardo sees these programs as prime opportunities for BriteStorm, given the growing focus on uncrewed and collaborative systems in modern defense strategies.

https://www.eurasiantimes.com/leonardos-latest-electronic-warfare-system/

The EurAsian Times

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China Has Constructed 22 Villages In Bhutan; Eyes Doklam For Strategic Supremacy Over India: New Report

A research report reveals that China has built 22 villages and settlements within Bhutan's traditional borders, including 19 villages and three small settlements. Three of the villages are set to be upgraded to towns. Notably, seven of these cross-border constructions have emerged since early 2023, indicating a significant acceleration in development in the annexed areas.

In 2016, China began constructing a village in a territory widely recognized as part of Bhutan. It took five years for foreign observers and governments to discover this. By then, China had already built two more villages within Bhutan's borders, all in remote Himalayan regions.

China's Expanding Footprint

A recent report highlights a startling development in the geopolitical landscape of the Himalayas. According to a report by 'Turquoise Roof' – a network of Tibetan analysts, there are now 22 such villages and settlements. Satellite imagery shows around 752 residential blocks, housing an estimated 2,284 family-sized units.

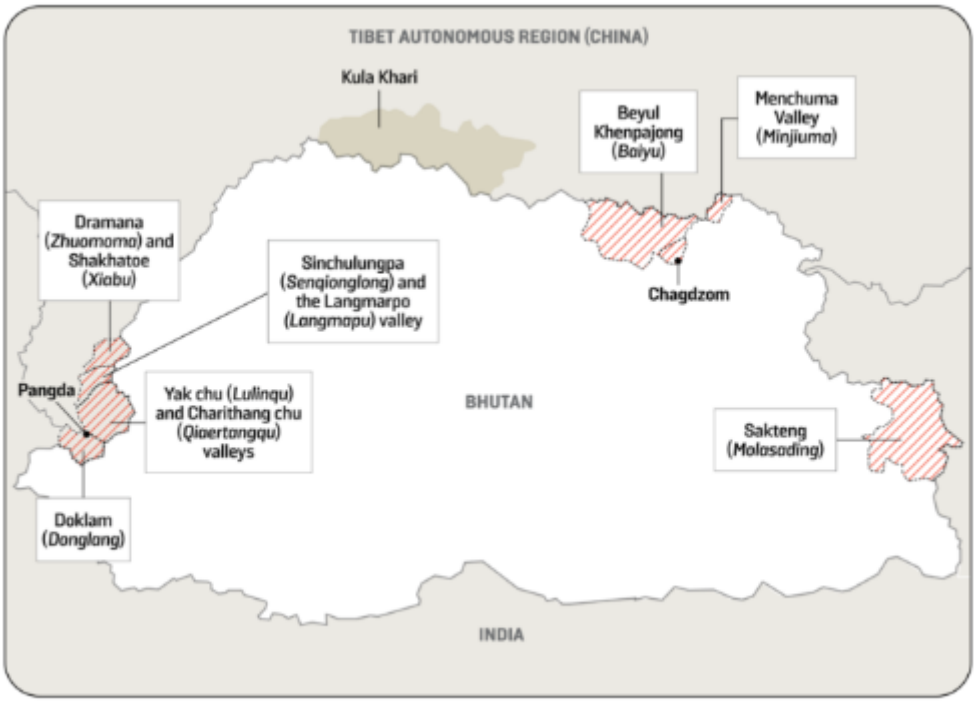
Approximately 7,000 people, along with an unknown number of officials, construction workers, border police, and military, are being relocated to these previously unpopulated areas. These newly constructed villages are situated in high-altitude valleys and on steep ridges. They average an altitude of 3,832 meters above sea level, with ten villages perched over 4,000 meters. Menchuma, the highest village, sits precariously at an elevation of 4,670 meters above sea level.

A significant aspect of these constructions is their connectivity; all are linked by roads to Chinese towns yet remain isolated from Bhutanese urban centers. As China strengthens its foothold in Bhutan, the latter's military capabilities are limited. It comprises only about 8,000 personnel, primarily serving a symbolic and defensive role. This stark power imbalance raises serious concerns for Bhutan's sovereignty amid ongoing tensions with its powerful neighbor.

A Chinese Village In Indian-Claimed Territory

China inherited Tibet's border with Bhutan in 1951 when the Tibetan government signed a surrender agreement with Beijing, effectively ceding its territory to China. This resulted in a border of approximately 477 km between Bhutan and China. Since then, China and Bhutan have not reached an agreement on this border, making Bhutan one of only two countries (the other being India) among China's 14 neighbors with an undemarcated border.

China's territorial ambitions are not confined to Bhutan. In 2021, China constructed a village in territory claimed by India, naming it "Luoba (Lhoba) New Village." This village is located in an area that was seized from Indian control by Chinese troops in 1959, just before the 1962 Indo-Chinese War. Since then, China has maintained full control over that territory.



Bhutan Map

China Seeks Possession Of Doklam

China is constructing cross-border villages in two primary regions of Bhutan: western and northeastern. Eight of these villages are located in western Bhutan, an area that historian Tsering Shakya notes was ceded to Bhutan in 1913 by the 13th Dalai Lama, the then-ruler of Tibet. These villages serve strategic purposes for China, as they aim to gain control over the western region, which includes the 89-sq km plateau of Doklam.

Gaining control of the Doklam plateau would provide China with a significant strategic advantage in its ongoing tensions with India. The southern ridge (Zompelri) at Doklam overlooks the strategically vital Siliguri Corridor, which connects mainland India to its northeastern provinces. If China gains access to this ridge, it could create a serious vulnerability for India.

India-China 2017 Doklam Standoff

Doklam, or Donglang in Chinese, is a less than 100 sq km area comprising a plateau and valley at the trijunction of India, Bhutan, and China. It lies between China's Yadong County to the north, Bhutan's Ha District to the east, and India's Sikkim State to the west. China gained control of the Doklam plateau in 1988.

China claims Doklam as part of its Donglang region, but India and Bhutan recognize it as Bhutanese territory. Despite Bhutan's condemnation, China proceeded with its construction activities near the India-Bhutan-China trijunction in Doklam,

In June 2017, Indian and Chinese troops were engaged in a two-month standoff triggered by China's proceeding with its construction activities near the India-Bhutan-China trijunction in Doklam despite Bhutan's condemnation. When China attempted to extend a road southward on the plateau, Indian troops intervened to halt the construction, leading to a tense two-month border

standoff. On August 28, both sides withdrew their troops, but China has since maintained control over most of the Doklam area and built a village called Pangda there.

China's Proposed 'Package Deal'

China's 14 cross-border villages and settlements are located in northeastern Bhutan, specifically in areas known as Beyul Khenpajong (including the Pagsamlung and Jakarlung valleys) and Menchuma. China has only claimed these regions since the 1980s, having marked them as part of Bhutan on official maps until at least the early 1990s.

Unlike western Bhutan, these northeastern regions hold little military or strategic value for China. So, why is China annexing north-eastern Bhutan?

China's intent is to use these areas as leverage in exchange for territories in Bhutan's west, particularly the Doklam plateau. This was made clear in 1990 when China proposed the "package deal," offering to drop its claims on the northeastern areas in return for Bhutan conceding the western regions China desires, including Doklam.

The motive seems to be a bargaining strategy: China intends to exchange these territories for the desired land in western Bhutan.

China's Six-Step Strategy To Undermine Indo-Bhutanese Treaties

However, Bhutan cannot transfer the Doklam area to China without India's consent due to Indo-Bhutanese treaties, which require Bhutan to consider India's security concerns. Consequently, since the mid-1990s, Bhutan has postponed agreeing to China's proposed territorial exchange.

According to the 'Turquoise Roof' report, China's reaction to Bhutan's failure to accept the package deal has unfolded in a six-stage strategy.

First Stage: In the early 1990s, China deployed local herders into disputed areas, leading to interactions that displaced Bhutanese pastoralists.

Second Stage: Tibetan herders established huts or shelters in these contested areas.

Third Stage: Military foot patrols were sent to support the herders in these regions.

Fourth Stage: Improvised structures were built as military outposts, which were later upgraded to permanent facilities.

Fifth Stage: From around 2004, roads were constructed to connect these outposts to towns within Tibet (China).

Final Stage: In 2016, the construction of villages commenced in the claimed territories.

If Bhutan Accepts China's Demands…

In March 2023, the Bhutanese government, seemingly left with little choice, indicated that it was nearing a deal with China involving a territorial exchange. However, China's construction of cross-border villages has not only continued but accelerated; since early 2023, seven more villages or settlements have been built in north-eastern Bhutan, significantly increasing the housing stock in the region.

It appears increasingly unlikely that China will fulfill its original offer to return land in north-eastern Bhutan, where it has constructed villages. Bhutan is likely to regain only those areas that China has claimed or annexed primarily as leverage to create the appearance of concessions. Analysis of China's construction surge in 2023-24 suggests that China is now very unlikely to return areas where it has built villages, encompassing about 80% of the disputed territory it has annexed.

"China is expected to argue that it is not obligated to return these areas because Bhutan, constrained by India's security concerns, is unlikely to yield the Doklam region," according to the report.

If Bhutan, as anticipated, concedes the non-Doklam areas along its western border to China, the latter is likely to relinquish its claims only to areas it has claimed but not annexed, totaling approximately 353 sq km in the Upper Langmarpo, Charitang, and Yak Chu regions in the west, and about 78 sq km in the Chagdzom area in the northeast. China is also likely to return an area of about 147 sq km that it has occupied but has not developed with villages or relocated settlers, specifically in the Pagsamlung Valley.

The report also says that, given Bhutan's limited defense resources and India's historical role as Bhutan's security guarantor, there has been little interest from India regarding Bhutan's border issues beyond Doklam. Very little, if anything, is known about discussions between India and Bhutan concerning the Bhutan-China border dispute since 2017, and India's position on Bhutan's border issues, other than Doklam, remains unclear.

The Challenge For Small Nations

China's cross-border village strategy raises significant concerns not only for Bhutan and India but also for the international community, as it sets a troubling precedent for how major powers can exploit territorial claims to expand their influence at the expense of smaller states.

Bhutan's struggle to effectively respond to China's opportunistic annexation efforts underscores the challenges smaller nations face when confronting powerful adversaries. This issue is similarly evident in the situations involving China and Taiwan, as well as China and the Philippines in Asia.

The current situation emphasizes the need for enhanced diplomatic support and a robust framework to safeguard the sovereignty of small nations and ensure they are not left vulnerable to the encroachments of larger powers.

https://www.eurasiantimes.com/header-china-has-already-constructed-22/

THE HINDU

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Inside the underground lab in China tasked with solving a physics mystery

A giant sphere 700 m (2,300 ft) underground with thousands of light-detecting tubes will be sealed in a 12-storey cylindrical pool of water in coming months for an experiment that will shine new light on elusive subatomic particles known as neutrinos.

After years of construction, the $300 million Jiangmen Underground Neutrino Observatory (JUNO) in China's southern Guangdong province will soon start gathering data on neutrinos, a product of nuclear reactions, to help solve one of the biggest mysteries in particle physics.

Every second, trillions of extremely small neutrinos pass through matter, including the human body. In mid-flight, a neutrino, of which there are three known varieties, could transform into other types. Determining which types are the lightest and the heaviest would offer clues to subatomic processes during the early days of the universe and to explaining why matter is the way it is.

To that end, Chinese physicists and collaborating scientists from all over the world will analyse the data on neutrinos emitted by two nearby Guangdong nuclear power plants for up to six years. JUNO would also be able to observe neutrinos from the sun, gaining a real-time view of solar processes. It could also study neutrinos given off by the radioactive decay of uranium and thorium in the Earth to better understand mantle convection driving tectonic plates.

Due to go operational in the latter half of 2025, JUNO will outpace the far larger Deep Underground Neutrino Experiment (DUNE) under construction in the United States. DUNE, backed by the Long-Baseline Neutrino Facility (LBNF) under the U.S. Department of Energy's (DOE) top particle physics laboratory, Fermilab, will come online around 2030.

The race to understand neutrinos and advance the study of particle physics, which has transformed medical imaging technologies and developed new energy sources, intensified when the DOE abruptly cut funding for U.S. institutes collaborating on JUNO. It instead focused on building DUNE, which has since been plagued by delays and budget overruns, with costs skyrocketing to more than $3 billion.

"China had supported Fermilab's LBNF at the time, but later the cooperation could not continue," Wang Yifang, chief scientist and project manager of JUNO, told Reuters during a recent government-backed media tour of the facility. "Around 2018-2019, the U.S. DOE asked all national laboratories not to cooperate with China, so Fermilab was forced to stop working with us."

The DOE, the largest U.S. funding agency for particle physics, did not respond to Reuters' request for comment. Sino-U.S. tensions have risen sharply over the past decade. A trade war erupted during the Trump administration and President Joe Biden later cracked down on the sale of advanced technology to China.

In August, a bilateral science and technology cooperation pact signed in 1979 lapsed, potentially pushing more scientists to seek alternative partners, creating duplication in research and missing out on collaboration that otherwise might have led to beneficial discoveries. In the 2010s, the countries jointly produced a nuclear reactor that could use low-enriched uranium, minimising the risk of any fuel being weaponised. China's foreign ministry said Beijing was "in communication" with Washington about the lapsed science agreement. The U.S. State Department did not comment.

Sole U.S. Collaborator

Institutions collaborating on JUNO hail from locations including France, Germany, Italy, Russia and the U.S., and even self-governed Taiwan, which China claims as part of its territory. Neutrino observatories are also being constructed in other places. "The one in the U.S. will be six years behind us. And the one in the France and in Japan, they will be two or three years later than us. So we believe that we can get the result of mass hierarchy (of neutrinos) ahead of everybody," Wang said.

So far, real-life neutrino applications remain a distant prospect. Some scientists have mulled the possibility of relaying long-distance messages via neutrinos, which pass through solid matter such as the Earth at near light speed. Researchers are keeping their distance from politics to focus on the science, although they remain at the mercy of governments providing the funding.

One U.S. group remains in JUNO, backed by the National Science Foundation, which recently renewed its funding for its collaboration for another three years, the group's leading physicist told Reuters. In contrast, more than a dozen U.S. institutes participated in the predecessor to JUNO, the Daya Bay experiment, also in Guangdong.

"Despite any political differences, I believe that through our collaboration on this scientific endeavour, we are setting a positive example that may contribute, even in a small way, to bringing our countries closer together," said J. Pedro Ochoa-Ricoux of the University of California, Irvine.

Data integrity

The passage of neutrinos from the two power stations will be logged by JUNO's 600 metric ton spherical detector, which will immediately transmit the data to Beijing electronically. The data will be simultaneously relayed to Russia, France and Italy, where it can be accessed by all of the collaborating institutions, said Cao Jun, JUNO's deputy manager.

Data integrity has been a concern among foreign companies in China since a law was enacted in 2021 on the use, storage and transfer of data in the name of safeguarding national security. "We have a protocol to make sure that no data is missing," Cao said.

For data on the more crucial aspects of the experiment, at least two independent teams will conduct analyses, with their results cross-checked. "When these two groups get a consistent result, we can publish it," Cao said. U.S.-based Ochoa-Ricoux, who previously collaborated on China's Daya Bay

experiment, will lead the data analysis for JUNO. He will also be involved in the DUNE data analysis. "We welcome the Americans," said Wang, also director of the Institute of High Energy Physics, the Chinese counterpart of Fermilab.

https://www.thehindu.com/sci-tech/science/inside-the-underground-lab-in-china-tasked-with-solving-a-physics-mystery/article68759736.ece

THE HINDU

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Nobel Prize for microRNA find underscores RNA's primacy in biology

In 1993, two post-doctoral researchers named Victor Ambros and Gary Ruvkun independently published back-to-back papers in the December 3 issue of the journal *Cell*. In their papers, they described how the roundworm *Caenorhabditis elegans* uses a small RNA molecule to control the production of a protein.

While the work was certainly novel, it did not receive much attention at the time because other scientists thought the phenomenon was unique to worms and of no practical relevance to understanding its role in other life-forms, including humans.

It was not until seven years later that Ruvkun found a similar mechanism existed in nearly all of the animal kingdom. The paper created waves in the scientific community since it represented a whole new paradigm in molecular biology, with potentially far-reaching implications on human health and disease. Last week, Ambros and Ruvkun were awarded the Nobel Prize in Physiology or Medicine for their discovery of microRNA and the latter's role in gene regulation, a process universal to all cells.

What, when, where, why

Every cell in an organism contains a copy of its DNA, the blueprint for how to build and maintain that organism. The building and maintenance activities are achieved by molecules called proteins; the DNA contains instructions on how cells can make these proteins. Every protein has a specific function.

For instance, haemoglobin is responsible for carrying oxygen from the air we breathe to the cells in the body. Each set of instructions to make a given protein from the organism's total DNA is called a gene. The DNA of humans has between 19,000 and 20,000 genes. While all cells in the body contain all these genes, and thus the information on how to make all the proteins, no cell makes all 20,000 proteins.

Gene expression — the process of reading the information in a gene to make a protein — is specific to cell types. A given cell will only make those proteins it needs for its function. Thus the red blood cells make haemoglobin but not the cells that make up the stomach. When a cell wants to

make a protein, it first makes a transient copy of the gene called the messenger RNA (mRNA). The information in the mRNA is then used to make the protein. This process of making an mRNA copy of the information in the gene is called transcription.

A gene is transcribed to mRNA to make a protein only in those cells where that protein is required. Once the mRNA is made, the cell will continue to make proteins until it is stopped. The protein production process must be stopped when enough proteins have been made because if it isn't controlled, excess protein, apart from being a waste of resources, can be harmful to the cell.

For a long time, this halting of protein production, called post-transcriptional gene regulation, was thought to occur when the mRNA degrades — either on its own (due to its low stability) or aided by special enzymes that the cell makes. Ambros and Ruvkun essentially identified a new way in which cells regulate protein production. They discovered the existence of tiny RNA molecules, called microRNA (miRNA) that bind to mRNAs and prevent protein synthesis.

A vital cellular process

Chemically, a miRNA is made of the same material that makes up mRNA. The difference lies in their sizes: RNA is composed of a combination of four chemical bases arranged on a sugarphosphate backbone, rather like a long bead of strings made of four coloured beads arranged at random. Their length is therefore measured in how many beads, or bases, they contain. Thus, mRNAs range from hundreds to lakhs of bases while the average miRNA is just 22 bases long.

The composition of these 22 bases — or the order of arrangement of the beads on the string — depends on which mRNA a given miRNA is going to target. Usually, the sequence of bases of an miRNA is complementary to a stretch of bases on the target mRNA, making it specific to that mRNA. Once the miRNA binds to its target, the target mRNA is either marked for destruction or is unable to serve as a template to produce protein, thus switching protein production off.

This way, if needed, miRNAs can inhibit the synthesis of a given protein even before it begins. Since Ruvkun's report of the first human miRNA in 2000, researchers have discovered thousands of new miRNAs, playing roles in regulating almost 60% of all human genes. Switching off protein production at the right time is a vital cellular process.

Therefore it was no surprise when researchers found miRNAs to play pivotal roles in animal development, the differentiation of cells into their correct types, cell division, cell death, and — importantly — response to stress and disease, especially in various cancers. The high specificity of miRNAs made them ideal candidates for targeted therapies for conditions like cancer, which involve abnormal protein production. But despite their potential, the story of the research on the clinical utility of miRNAs does not have a very happy beginning.

RNA is important

The rapid academic progress on miRNAs prompted scientists to test the therapeutic potential of miRNAs. Early experiments in mice gave encouraging results, where researchers were able to inhibit the formation of lung tumours using miRNAs.

The first clinical trial of a human miRNA, called miRNA-34a, soon followed in 2013. But the technology to deliver the mRNA to the target cells was not as well developed then as it is now; as a

result scientists had to administer extremely high doses of the molecule to ensure a small amount would reach the target site. This had the unfortunate consequence of triggering an immune response. When four patients died, the investigators immediately stopped the trial.

Scientists later made significant advances in packaging and delivering miRNA, allowing others to test multiple other miRNAs against various diseases — including hepatitis C, multiple cancers, and cardiovascular diseases. When Ambros and Ruvkun won the Nobel Prize last week, 581 clinical trials involving miRNAs had been registered in the U.S. Of these, 215 had been completed and 20 had been terminated over safety concerns.

Since other alternatives are available for most of these conditions, miRNA's time in medicine has yet to come. Hopefully the Nobel Prize will change this field's fortunes: despite the challenges it faces in therapy, miRNAs' relevance to physiology and medicine is unquestionable. This is why Ambros and Ruvkun were awarded the Nobel Prize despite the absence of therapeutic applications.

This is also the fifth instance of a Nobel Prize being awarded for RNA research: mRNA vaccines won in 2023; RNA interference in 2006; RNA's role as enzymes in 1989; the discovery of mRNA in 1965. Indeed, scientists are slowly understanding that RNA, not DNA, is at the core of the delicate balance cells must maintain.

https://www.thehindu.com/sci-tech/science/nobel-prize-microrna-discovery-underscores-rna-primacy-biology/article68755707.ece

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AI & other lessons from the Nobels

ONE technology that is linked to both the physics and chemistry Nobel prizes this year is artificial intelligence (AI). The physics laureates — John Hopfield and Geoffrey Hinton — applied principles and tools of physics to develop methods that have facilitated machine learning.

Hopfield used the principle of atomic spin to create a structure that can store and reconstruct information, while Hinton invented a method that can independently discover properties in data forming the basis for the large artificial neural networks now in use. These discoveries, over the decades, have helped powerful computers mimic human functions like memory and learning.

The chemistry Nobel has gone to David Baker of the University of Washington; Demis Hassabis and John M Jumper of Google DeepMind. Baker has been awarded for his work on computational protein design and the DeepMind researchers get the other half of the prize for developments in protein structure prediction.

Proteins are essential for cellular functions in living bodies. They are intricately folded, depending on their atomic structure and water molecules surrounding them. In a single protein, there could be trillions of potential interactions, creating countless possible shapes. Baker developed

computational tools for designing new proteins, which, in turn, has opened the door for new therapies and treatments. The Google DeepMind researchers have developed an AI system called AlphaFold that predicts the three-dimensional structure of proteins from their amino acid sequences.

The physics, chemistry and medicine Nobel prizes again demonstrate that fundamental research is vital for knowledge creation and there is no substitute for basic research. This point has to be re-emphasised in the Indian context because every time, we bemoan that no Indian has got a Nobel for scientific research done in India after CV Raman. Hargobind Khorana, S Chandrasekhar and Venki Ramakrishnan won their Nobels for research conducted in foreign universities. Along with applied research and technology development, sustained investments are needed in fundamental research for breakthroughs.

The Nobel is usually given for pathbreaking work that leads to transformative tools and technologies. Hopfield, who is 91, began working on what came to be known as the 'Hopfield network' and associative memory in the 1980s. So did Hinton, with his 'Boltzmann machine' method. Their methods enabled the machine learning revolution decades later, in 2010. And finally, we have consumer products like ChatGPT. Similarly, chemistry laureate Baker has been working on protein structures for decades. He came up with the first tool for protein structure prediction, Rosetta, in 1998.

The edifice of AI is based on many building blocks created over the decades. Not many know that Indian scientists have also contributed to this process. At a time when AI was just emerging as a possibility and engaging the attention of scientists along with the development of digital computers in the 1950s, physicist-turned-statistician Prasanta Chandra Mahalanobis developed a concept which came to be known as the Mahalanobis Distance. It helps detect outliers in data and measure dissimilarities in data points. Subsequently, Mahalanobis Distance found wide applications in computer science and AI. At the Indian Statistical Institute (ISI) founded by him, Mahalanobis recognised the importance of cybernetics and invited its pioneer Norbert Wiener to spend time in the institute as a visiting professor in 1955. Wiener initiated ISI researchers like Dwijesh Datta Majumder to work in pattern recognition, fuzzy logic and neural networks.

In 1966, Raj Reddy, a young Indian doctoral student in America, pioneered the development of systems for recognising continuous speech. He developed a new system called Hearsay I for continuous speech recognition. Along with giving computers the capability to memorise and learn like humans, making them capable of recognising human speech was a critical step towards achieving AI. Reddy later developed Hearsay II, Harpy and Dragon systems, which are the basis of commercial speech recognition technology used in computers as well as robots.

Reddy's fundamental discovery was the 'blackboard model' for coordinating multiple knowledge sources and it has found wide applications in AI, like voice control of robots and speaker-independent speech recognition. For his contributions, Reddy was given the Turing Award — considered the Nobel of computer science — in 1994. His contribution to the building blocks of AI is as seminal as that of 2024 Nobel winners.

The Nobel for AI-related discoveries comes with warnings about the potential danger of the technology from the two pioneers. Hinton has called AI chatbots 'quite scary' after he quit the

position he held in Google's AI division. He also fears that the widespread use of AI could widen economic disparities in society as the increased productivity and wealth due to AI would only help the rich. AI could gobble up a lot of mundane jobs.

To redress such impacts of AI on inequality, Hinton has said that the governments should consider a system of universal basic income for those impacted. Similarly, Hopfield has signed petitions calling for strong controls of technology and risk and benefit analysis of AI. He fears new applications of AI could lead to a dystopian society imagined by George Orwell.

Coming back to India's Nobel drought, we need to introspect. The Central government has finally operationalised a new mechanism to fund research, the Anusandhan National Research Foundation, but the funding pathways are still unclear. If India aspires to make a mark in the world of science, basic research in universities and labs should get adequate and continuous support. This is a long-term game. The focus on applied research, incremental innovation and technology development helps meet immediate societal and industrial needs.

So, we will have to strike a balance between basic research and technology while allocating resources. The private sector, too, should draw lessons from this year's Nobel. The chemistry Nobel has been shared by researchers from Google, reflecting the deep investments the company has made in basic research. Whichever way one looks, there is no magic wand or recipe for getting a Nobel other than sustained investments in basic research.

https://www.tribuneindia.com/news/comment/ai-other-lessons-from-the-nobels/

Wed, 16 Oct 2024

AI is Shaping Science's Future – Resistance is Futile

Last week, the Nobel Prize in Natural Sciences for 2024 was announced. The Chemistry prize went to David Baker, Demis Hassabis and John Jumper for using Artificial Intelligence to tackle a long-standing problem in biochemistry, accurately predicting how proteins will fold. The Physics honour went to John Hopfield and Geoffrey Hinton for using the concepts of physics to develop the neural networks that underpin the artificial intelligence technologies in widespread use today.

Everyone and their grandmothers were surprised by decision to award the prizes to AI. The announcement even managed to surprise and flabbergast Geoffrey Hinton, the Godfather of AI, who in a press conference said, "My message is this: if you believe in something, don't give up on it until you understand why that belief is wrong."

The Nobel Prize can only be split three ways at most, but the frontiers of modern science are pushed by massive international collaborations of thousands of scientists from hundreds of universities.

Hinton acknowledged this by saying, “I think of the prize as a recognition of a large community of people who worked on artificial neural networks for many years. I’d particularly like to acknowledge my two main mentors: David Rumelhart, with whom I worked on the backpropagation algorithm … and my colleague Terry Sejnowsky, who I worked with a lot in the 1980s on Boltzmann machines and who taught me a lot about the brain.” Hinton also went on to acknowledge his colleagues and even his students.

AI’s impact on science is only beginning

What modern scientists are achieving would be impossible without the assistance of AI. Proteins can be made up of chains of thousands of amino acids, which would be impossible for any scientist to figure out. Mapping all the 140,000 neurons in the brain of an adult fruit-fly, along with the 50 million connections between them is a staggeringly impossible task to achieve manually.

AI is absolutely needed to model particle interactions in accelerators, statistically derive the most plausible visual representations of black holes, and understanding climate change, let alone tackling it. AI promises to revolutionise science with the dawn of the intelligence age, and humans can either sit and whinge or wholeheartedly embrace the change.

https://www.news9live.com/science/ai-is-shaping-sciences-future-resistance-is-futile-2724376

Wed, 16 Oct 2024

Lunar Network Launched! ESA’s Moonlight to Power 400+ Missions

The Moonlight program, a ground-breaking project to create a satellite constellation for navigation and communication services around the Moon, was formally launched by the European Space Agency (ESA) on October 15, 2024. As a significant step towards sustainable lunar exploration and a growing lunar economy, this project intends to finance the more than 400 lunar missions that space agencies and private firms have planned over the next 20 years.

For upcoming robotic and human missions, Moonlight’s Lunar Communications and Navigation Services (LCNS) program will supply vital infrastructure. The system’s ability to provide surface mobility and accurate, autonomous landing capabilities will make lunar exploration more effective and economical. It will enable low-latency, high-speed communication between the Moon and Earth, increasing the effectiveness of lunar operations.

In addition to providing new business opportunities for European industry in the growing space economy, this infrastructure is essential to humanity’s long-term presence on the Moon. Additionally, moonlight will be essential to missions involving deeper space exploration.

Constellation of Satellites to Target the Lunar South Pole

Five satellites—four for navigation and one for communications—will make up Moonlight, which will be connected to Earth via three ground stations. The 400,000-kilometer constellation will concentrate on the lunar south pole, which is important for upcoming missions because of its ice-containing “craters of eternal darkness” and solar-powered “peaks of eternal light,” which might supply oxygen, water, and rocket fuel.

Phased Implementation and Cooperation with Global Partners

The Lunar Pathfinder communications satellite will launch Moonlight in 2026, followed by the first Moonlight services in 2028 and complete operations by 2030. To make sure Moonlight complies with LunaNet, a framework for lunar communication and navigation standards, ESA is collaborating closely with NASA and JAXA. Global compatibility with upcoming lunar infrastructures will be made possible by this partnership.

ESA Celebrates Milestone at International Astronautical Congress

At a contract signing ceremony held during the International Astronautical Congress in Milan, the program was formally introduced. In addition to providing hitherto unheard-of business prospects, ESA leadership stressed the significance of Moonlight in establishing a stable, secure presence on the Moon. As major investors, the UK and Italy reaffirmed their commitment to the initiative and its potential to propel the lunar economy in the future.

https://www.news9live.com/science/lunar-network-launched-esas-moonlight-to-power-400-missions-2724063