

Mar
2021

समाचार पत्रों से चयित अंश Newspapers Clippings

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence Technologies, Defence Policies, International Relations and Science & Technology

खंड : 46 अंक : 50 10 मार्च 2021

Vol.: 46 Issue : 50 10 March 2021



रक्षा विज्ञान पुस्तकालय
Defence Science Library
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Press Information Bureau
Government of India

Ministry of Defence

Tue, 09 March 2021 2:09PM

Fuel Cell based Air Independent Propulsion (AIP) system crosses important milestone of user specific tests

Defence Research and Development Organisation (DRDO) has achieved an important milestone in the development of Air Independent Propulsion (AIP) System by proving the land-based prototype on 8 March 2021. The plant was operated in endurance mode and max power mode as per the user requirements. The system is being developed by Naval Materials Research Laboratory (NMRL) of DRDO.

AIP has a force multiplier effect on lethality of a diesel electric submarine as it enhances the submerged endurance of the boat, several folds. Fuel cell-based AIP has merits in performance compared to other technologies.

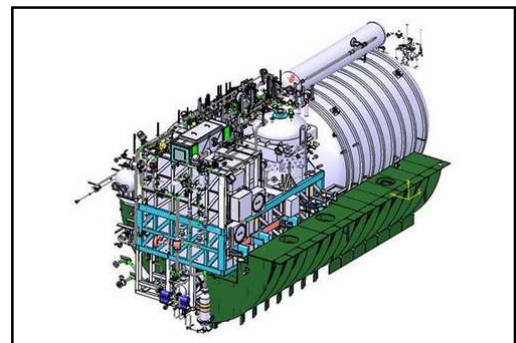
While there are different types of AIP systems being pursued internationally, fuel cell-based AIP of NMRL is unique as the hydrogen is generated onboard.

The technology has been successfully developed with the support of industry partners L&T and Thermax. It has now reached the stage of maturity for fitment into target vessels.

Raksha Mantri Shri Rajnath Singh congratulated DRDO, Indian Navy and Industry for the achievement.

Secretary DDR&D and Chairman DRDO, Dr G Satheesh Reddy appreciated the efforts of the teams involved in the successful development. He called upon the DRDO fraternity to come up with more such advanced technological achievements by putting extraordinary efforts.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1703456>





पत्र सूचना कार्यालय
भारत सरकार

रक्षा मंत्रालय

Tue, 09 March 2021 2:09PM

ईंधन सेल आधारित एयर इंडिपेंडेंट प्रोपल्शन (एआईपी) प्रणाली के विशिष्ट परीक्षणों में महत्वपूर्ण पड़ाव पार

रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) ने दिनांक 8 मार्च 2021 को भूमि आधारित प्रोटोटाइप को सफलतापूर्वक साबित करके एयर इंडिपेंडेंट प्रोपल्शन (एआईपी) प्रणाली के विकास में एक महत्वपूर्ण उपलब्धि हासिल की है। उपयोगकर्ता की आवश्यकताओं के अनुसार संयंत्र को एंड्योरेंस मोड और अधिकतम पावर मोड में संचालित किया गया था। इस प्रणाली को रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) की नौसेना सामग्री अनुसंधान प्रयोगशाला (एनएमआरएल) द्वारा विकसित किया गया है।

एयर इंडिपेंडेंट प्रोपल्शन (एआईपी) प्रणाली डीजल इलेक्ट्रिक पनडुब्बी की घातकता को काफी बढ़ा देती है। एआईपी तकनीक समंदर के अंदर पनडुब्बियों को ज्यादा देर तक रहने की इजाजत देता है। एनएमडीएल का ईंधन सेल आधारित है क्योंकि हाइड्रोजन जहाज पर उत्पन्न होता है।

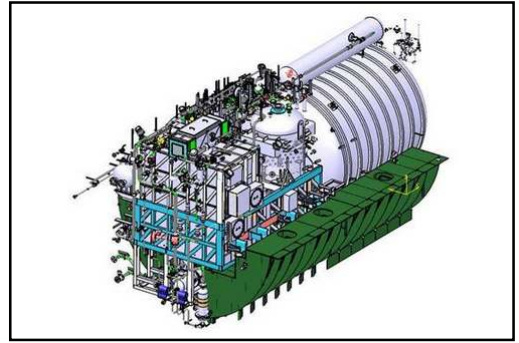
ऐसे समय जब अंतरराष्ट्रीय स्तर पर विभिन्न प्रकार की एयर इंडिपेंडेंट प्रोपल्शन (एआईपी) प्रणाली अपनाई जा रही हैं। हाइड्रोजन का उत्पादन जहाज पर होने के चलते नेवल मैटेरियल्स रिसर्च लेबोरेटरी (एनएमआरएल) की ईंधन सेल-आधारित एआईपी तकनीक अद्वितीय हैं।

इस तकनीक को उद्योग भागीदारों एलएंडटी और थर्मैक्स के सहयोग से सफलतापूर्वक विकसित किया गया है। यह अब पनडुब्बी में फिटमेंट के लिए पूरी तरह तैयार है।

रक्षा मंत्री श्री राजनाथ सिंह ने इस उपलब्धि के लिए रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ), भारतीय नौसेना और उद्योग को बधाई दी ।

रक्षा अनुसंधान एवं विकास विभाग (डीडीआरएंडडी) के सचिव और रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) के अध्यक्ष डॉ. जी सतीश रेड्डी ने इसके सफल विकास में शामिल टीमों के प्रयासों की सराहना की। उन्होंने डीआरडीओ बिरादरी से असाधारण प्रयास करते हुए ऐसी और उन्नत तकनीकी उपलब्धियां हासिल करने का आह्वान किया।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1703526>



DRDO's Light Tank will be power pack as "The highest altitude operable tank in the globe": G. Satheesh Reddy, Chairman DRDO

By Manish Kumar Jha

DRDO is tasked to empower India for building capability in defence –that not only limited to armed forces but it is now about technology for today and future which is foundational to growing defence economy. Last year, in the wake of precarious situation at LAC, despite the Covid 19, DRDO had some of the best moment of technological breakthrough with avant garde R&D, speedier trials and turnaround delivery so far. Besides such feat recently, It does get fair and unfair amount of criticism which it carries from the past record and legacy issues. In a first, Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO speaks with Manish Kumar Jha on the entire gamut of current and futuristic projects that will be definitive for India in the world of defence, security and aerospace.

DRDO has had some of the breakthrough moment in delivering and launching critical equipment for our Forces -- among the first few in technology space in the world? Could you talk about such DRDO project delivery under your leadership?

As the head of DRDO, the first big challenge undertaken was the Anti-Satellite (ASAT) mission and it was a great moment for the nation that we could successfully demonstrate ASAT capability during its maiden launch. India became the fourth nation in the world to showcase the direct hit of an (inactive) orbiting satellite.

In 2020, DRDO has conducted 12 trials within six weeks. This includes MRSAM, HSTDV, Dhruvastra, QRSAM, Rudram, SMART, BrahMos, SANT, Prithvi-2, Nirbhaya Cruise Missile and the like. Trials of the Nirbhaya cruise missile, Nag missile, man-portable anti-tank guided missile and other systems have been successfully conducted in the past one year.

We are in a phase of consolidation as well as expanding into futuristic technologies in defence research at DRDO. In last one year itself, five Astra missile systems were delivered to IAF, three sets of 10m Short Span Bridging system given to Indian Army, Indian Maritime Situational Awareness to Indian Navy, first Heavy Weight Torpedo Varunastra were handed over to Indian Navy while JVPC underwent the final phase of user trials. In addition, many systems have successfully undergone trials and are now ready to be inducted into the services.

At the same time, research and development has been initiated in areas of advanced technologies like quantum technologies, artificial intelligence, asymmetric technologies, advanced materials, sensors to make products with cutting-edge capabilities in defence. Defence technologies for space and cyber-security are other areas where we have started work in a big way. Work on indigenous air-independent propulsion systems is progressing well and is ready for deployment.



Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO



Dr G Satheesh Reddy, Secretary DDR&D & Chairman DRDO (R)

When are we ready for India's next gen fighter Jets - AMCA prototype and Tejas Mk 2 (Design and Development)?

Tejas MK-II program is in advance stages of development. After completion of aircraft PDR early last year, the detailed design activities are nearing completion. Manufacturing of long lead parts has already begun and the first prototype is on schedule for rollout in August 2022. Since there are very few unknowns in the programme, activities are moving rapidly.

The configuration of AMCA is frozen and PDR of the configuration is completed. The detailed design activities have commenced and rollout of the first prototype is planned in first half of 2024. The production of AMCA is planned through an SPV which will have large participation from private industries in addition to HAL.

Indian industries are already participating in many development activities like manufacturing of a full-scale model for stealth measurement experiments.

What is the status of jet engine/aero engine for such program? Are we exploring international collaboration with global OEMs for joint co-design and development?

For LCA Mk2, a bigger GE 414 engine is planned to be used and the test trials of the aircraft are expected to happen by 2022. While AMCA Mk-1 will have the same engine, the AMCA Mk-2 will have an indigenous engine. The LCA Mk-2 engine will be replaced with an indigenous one at a later stage.

The aircraft is being designed such that the indigenous engine will fit with minimal changes in the configuration. Kaveri engine design has given enormous experience in various aspects of engine design & development. We are working out the collaboration with engine houses having complementary capabilities for making the new engine with in the country. We are getting closer to achieving the desired technology. We are also expecting international collaboration.

The third new fighter jet that we are working on is the Twin-Engine Deck-Based Fighter (TEDBF) for the Navy. The TEDBF is being developed to replace the Russian-made MiG-29K fighters in service with the Indian Navy. The jet will operate from the current and future aircraft carriers of Indian Navy. TEDBFs is planned to be inducted in service by 2032.

The budget allocated to DRDO remains as per the last year. In comparison with many emerging and advanced countries with their budget spent ~15-20 % on R&D in defence, India puts as low as about 6% of total defence budget. How does it affect the big-ticket research projects underway? What is expected in terms of budgetary allocations?

The defence budget has been increased to 4.78 lakh crore for the Financial Year 2021-22 (FY21-22), which includes capital expenditure worth Rs 1.35 lakh crore. It is nearly 19 per cent increase in defence capital expenditure. This is the highest ever increase in capital outlay for defence in last 15 years.

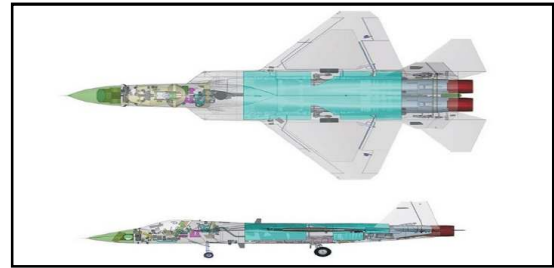
The Capital allocation for DRDO has been increased to Rs 11,375.50 crore. This is an increase of 8 per cent over 2020-21 and 8.5 per cent over 2019-20.

It was noted that 40% of DRDO's budget is spent on maintenance and manpower, leaving a lesser margin for buying critical equipment, testing platforms and project development? What is your take in this?

With an increase of 8% in our budget this year, there is less likelihood of major shortage of funds for critical equipment. As much as 20 per cent of resources of each laboratory should be



ABHYAS



AMCA -ADA

spent on research content of futuristic technologies and DRDO has been spending around 20-25 per cent of the budget on R&D. Human Resources are equally important.

What stage of development are we as far as AIP systems are concerned for Indian Navy's critical P75 project? This would be first such strategic partnership which MDL is responsible for submarine projects initiatives based upon AIP.

The DRDO developed indigenous AIP propulsion system is a modular system which can be easily configured for any conventional submarine platform. At present the system is configured for P75 submarines and has got the safety and interface acceptance and permission from the Submarine designer M/s NG France. The firm is to undertake the detailed design for its possible integration to the first available P75 platform.

Regarding P75I as per IN request, initial level of interactions have been done with four foreign designers and preliminary interface requirements are obtained from three designers. The preliminary design of DRDO AIP system is studied and feasibility is established for integration of the same in all the three platforms proposed by the designers.

Accordingly, the preliminary design of DRDO AIP is forwarded to the designers. Further action from IN is awaited for next course of action.

Today DRDO launched Fuel Cell based Air Independent Propulsion (AIP) System which crosses important milestone. AIP has a force multiplier effect on lethality of a diesel electric submarine as it enhances the submerged endurance of the boat, several folds. Fuel cell-based AIP has merits in performance compared to other technologies.

The system is being developed by Naval Materials Research Laboratory (NMRL) of DRDO.

While there are different types of AIP systems being pursued internationally, fuel cell-based AIP of NMRL is unique as the hydrogen is generated onboard. The technology has been successfully developed with the support of industry partners L&T and Thermax. It has now reached the stage of maturity for fitment into target vessels.

Could you throw light on India's next generation UAVs for our forces that might set benchmark capability?

DRDO has envisaged the need for a dedicated test range for testing and evaluation range to handle the fast-growing requirements of UAVs. Aeronautical Test Range has been established at Chitradurga, which is the only range for flight testing of UAVs in the country.

Aeronautical Development Establishment (ADE) is working on UAV configurations. Our laboratories CAIR and R&DE (E) are working on autonomous technologies and development of various kinds of robots for multiple applications. DRDO young scientist laboratories are also working on the technologies required for UAVs and robotics.

MALE UAV TAPAS BH-201 (Rustom II) programme has an operational range of 1000 km and payload capacity of 350 kg with an endurance of 24 hours at 30,000 ft altitude. It will carry variety of payloads such as Long Range Electro Optic (LREO) payload and Synthetic Aperture Radar (SAR) MPAR, ELINT, COMINT, IFF, TCAS, UCR etc. depending upon the ISR mission requirements.

Abhyas is an expandable aerial target for practice firing by Armed forces. It is being used for many SAM trials and has enormous potential for use for practice sessions.

What is the USP of DRDO's proposed light tank for the Indian Army and especially for the mountain corps? Any acceptance and delivery timeline if you could tell us?

The need of light weight tank is felt in today's scenario especially for the mountainous regions. The configuration is worked out.

The USP of DRDO's proposed light tank for the Indian Army is that it will be fitted with High Altitude Operable Power pack (Engine + Transmission) of 1000hp and will be capable of firing multiple ammunitions. This tank may be called as "highest altitude operable tank in the globe". The design work has commenced and we will bring out the timelines.

Saras (crane) Mk1 multi-purpose light civilian aircraft, designed by the National Aerospace Laboratories (NAL), which works closely with HAL, DRDO and the IAF--what is the case now?

This is not under the purview of DRDO, hence, I would not comment.

Artificial Intelligence is the now hugely used in unmanned reconnaissance aircraft, the unmanned ground combat vehicle, the unmanned submersible systems. How India is developing. Should not we lead in such technology with our strong Informational Technology base?

In fact, the artificial Intelligence is set up in all of DRDO divisions as they are working on set of systems as varied as land, air and naval. I agree with you that we could have led on this front.

Besides donning leadership role as DRDO's Chairman, foremost, you are India's leading aerospace scientist. I would like you to tell us your vision for DRDO as it is to play very vital role in India's development. Though credited, DRDO is also often criticised for being too large; deliberates and drags too much on unviable projects and sometimes too bureaucratic as a leading R&D organisation for 22nd century India? How do you bring change?

DRDO with its existing capabilities is poised to take up system development in the emerging dimensions of warfare and in the fields of artificial intelligence, quantum technology, photonics, cyber technology and the like. DRDO scientists are working in niche defence technology areas for building next generation systems, weapons and platforms and have chartered out paths to harness these technologies. Scientists are collaborating extensively with academia in the blue-sky research and with industry to develop defence systems in the shortest time frame.

A number of activities pertaining to various systems like AEW&C, AMCA, Guided Pinaka, Radar systems, Missile systems, Underwater Unmanned Systems are planned for 2021.

There are many other defence technologies and systems DRDO has taken up for development. DRDO will be responding ably to the future war fighting requirements of the tri-services with advanced technologies. Constructive criticism is welcome and we will continually strive to improve ourselves. Considering the number of systems and technologies that DRDO is working on, DRDO has optimally deployed its scientific manpower on important projects.

<http://www.businessworld.in/article/DRDO-s-Light-Tank-Will-Be-Power-Pack-As-The-Highest-Altitude-Operable-Tank-In-The-Globe-G-Satheesh-Reddy-Chairman-DRDO/09-03-2021-383371/>

Defence Minister Rajnath Singh lauds DRDO on development of Air Independent Propulsion System

Hyderabad: Defence Research and Development Organisation (DRDO) has achieved an important milestone in the development of an Air Independent Propulsion (AIP) System by proving the land-based prototype.

The plant was operated in endurance mode and max power mode as per the user requirements on March 9.

The system is being developed by the Naval Materials Research Laboratory (NMRL) of DRDO located in Maharashtra.

“AIP has a force multiplier effect on the lethality of a diesel-electric submarine as it enhances the submerged endurance of the boat, several folds. Fuel cell-based AIP has merits in performance compared to other technologies,” defence officials explained.

While there are different types of AIP systems being pursued internationally, fuel cell-based AIP of NMRL is unique as the hydrogen is generated onboard.

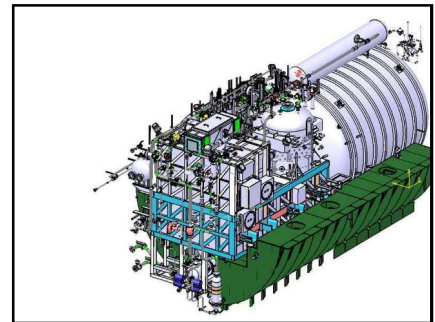
“The technology has been successfully developed with the support of industry partners L&T and Thermax. It has now reached the stage of maturity for fitment into target vessels,” defence officials said.

Union defence minister Rajnath Singh congratulated DRDO, Indian Navy and industry for the achievement.

Secretary DDR&D and Chairman DRDO, Dr G Satheesh Reddy appreciated the efforts of the teams involved in the successful development.

He called upon the DRDO fraternity to come up with more such advanced technological achievements by putting in extraordinary efforts.

<https://timesofindia.indiatimes.com/india/defence-minister-rajnath-singh-lauds-drdo-on-development-of-air-independent-propulsion-system/articleshow/81412293.cms>



DRDO tests new Air Independent Propulsion system to be fitted in Scorpene

The AIP system, once ready, will from 2024-25 onwards, be "retrofitted" into six Scorpene submarines that are being built in India under Project 75

By Ajai Shukla

New Delhi: The Defence Research and Development Organisation (DRDO) crossed an important milestone on Monday, when it demonstrated an Air Independent Propulsion (AIP) system that will allow Indian Navy submarines to operate for up to two weeks without having to surface to recharge its batteries.

“The (AIP) plant was operated in endurance mode and maximum power mode as per the user requirements. The system is being developed by Naval Materials Research Laboratory (NMRL) of DRDO,” announced the Ministry of Defence (MoD) on Tuesday.

Since NMRL’s is expected to operationally field its indigenous AIP only by 2023-24, this will come too late to power the six new submarines that the navy is tendering in a Rs 45,000-crore programme called Project 75-I.

Instead, the six Project-75I submarines will be powered by AIP systems that the foreign vendor must offer. The DRDO’s AIP system, once ready, will from 2024-25 onward, be “retrofitted” into six Scorpene submarines that are being built in India under Project 75, say naval sources.

Legacy, diesel-electric submarines can operate silently underwater for up to 48 hours, but they must surface after that to run a generator to recharge their batteries. When they surface, diesel-electric submarines become vulnerable to detection by enemy radar, which easily detects submarine masts or snorkels protruding out of the water. This vulnerability is reduced by powering a submarine with an AIP system, which allows for underwater operations for up to two weeks. However, submarines fitted with AIP must still surface every fortnight for battery charging. In that sense, they are not as difficult to detect as nuclear-powered subs, which can stay submerged indefinitely.

“AIP has a force multiplier effect on the lethality of a diesel-electric submarine as it raises the submerged endurance of the boat, several-fold. Fuel cell-based AIP has merits in performance compared to other technologies,” said the MoD.

Fuel cell technology-based AIP generates power through the reverse electrolysis of oxygen and hydrogen. In this process, the two elements chemically combine, thereby generating electricity to charge the submarine’s batteries. This process does not need air, but requires storage of highly inflammable hydrogen on board. This is not true of the DRDO’s AIP system, which relies on the innovative Phosphoric Acid Fuel Cell technology.

This process is more rugged, tolerant of fuel impurities, offers longer life and efficiency, and is much safer, since it does not require hazardous Hydrogen to be stored on board.

“While there are different types of AIP systems being pursued internationally, fuel cell-based AIP of NMRL is unique as the hydrogen is generated onboard. The technology has been successfully developed (by NMRL), with the support of industry partners Larsen & Toubro and Thermax. It has now reached the stage of maturity for fitment into target vessels,” said the MoD.



The six Project-75I submarines will be powered by AIP systems that the foreign vendor must offer

Having tested its AIP on a ‘land-based prototype’ (LBP), the DRDO will now evolve this into a “marinised” AIP system, which can fit into an actual submarine and operate underwater in live conditions.

The other type of AIP in service is a relatively untried, French system called “Module d’Energie Sous-Marine Autonome (MESMA). The navy had the option to fit the MESMA AIP systems into the six Scorpene submarines that were contracted in 2005 under Project 75.

However, sceptical about MESMA, the navy decided to put its faith in a conventional diesel-electric system for the Project 75 submarines. Once the DRDO developed an indigenous AIP, that would be fitted onto the Scorpene submarines.

https://www.business-standard.com/article/economy-policy/drdo-tests-new-air-independent-propulsion-system-to-be-fitted-in-scorpene-121030901685_1.html



Wed, 10 March 2021

DRDO develops AIP technology, Indian subs to be more silent and lethal

By Shishir Gupta

- ***A boost for Atma Nirbhar Bharat campaign, AIP-fitted submarines remain sub-surface for a longer period and are quieter than nuclear-powered submarines.***

A day before INS Karanj attack submarine is inducted into Indian Navy, the Defence Research and Development Organization (DRDO) conducted the final development test of Air Independent Propulsion (AIP) in Mumbai on Monday night, a major step that will make Indian submarines more lethal. AIP allows a submarine to be submerged for longer periods under water and makes the sub-surface platform more deadly by making it quieter than a nuclear submarine.

The Indian Navy now plans to retrofit all its Kalvari class non-nuclear attack with AIP during their first upgrade, expected around 2023. The 1615 tonne Kalvari class submarine is being built by Mazagon Dockyards Limited in collaboration with French Naval Group and is based on Scorpene design. INS Karanj, third of the class, is expected to be commissioned tomorrow.



The Indian Navy now plans to retrofit all its Kalvari class non-nuclear attack with AIP during their first upgrade, expected around 2023. (Photo: Indian Navy)

The development of AIP technology is a major boost for the Atma Nirbhar Bharat campaign since only the US, France, China, UK and Russia have this key technology. The DRDO’s AIP technology is based on a Phosphoric Acid Fuel Cell and the last two Kalvari class submarines will be powered by it. The AIP design was tested on land in Mumbai on Monday night, the last of a series of tests.

The AIP or marine propulsion technology allows non-nuclear submarines to operate without access to atmospheric oxygen (through snorkel or surfacing) and augments the diesel-electric propulsion system of attack submarines. This means that the AIP fitted submarine does not have to surface for charging its batteries and remains underwater for long periods. The AIP is retrofitted into existing submarine hulls by adding an additional hull section. The AIP equipped submarines are identified as SSP while classic diesel attack submarines carry the SSK classification.

While the nuclear submarine generates noise due to the ship’s reactor constantly pumping coolant to maintain temperatures of the engine, the AIP-equipped submarine maintains a lethal silence. The new technology will add to lethality of Indian submarines, which also take advantage

of internal refraction in equatorial waters due to differences in temperatures on the surface and within the ocean.

The DRDO's AIP technology has also got a pat in the back from the French, who were in touch with the Indians in the context of Kalvari class manufacturing. Despite urgent requests, the French have decided not to upgrade the Pakistani Agosta 90 B submarines with AIP technology, forcing Islamabad to either go to China or Turkey.

<https://www.hindustantimes.com/india-news/drdo-develops-technology-that-makes-indian-submarines-quieter-lethal-101615270359062.html>



Wed, 10 March 2021

Strategically important Air Independent Propulsion tech for Navy submarines achieves milestone: MoD

The Ministry said the technology has reached 'maturity' to be fitted on submarines

By Sushant Kulkarni

Pune: The strategically important Air Independent Propulsion (AIP) crucial for diesel electric submarines, being developed by the Defence Research and Development Organisation (DRDO), achieved a key milestone by undergoing further land-based tests in tune with requirements of the Indian Navy, the Defence Ministry said on Tuesday. The Ministry said the technology has reached 'maturity' to be fitted on submarines.

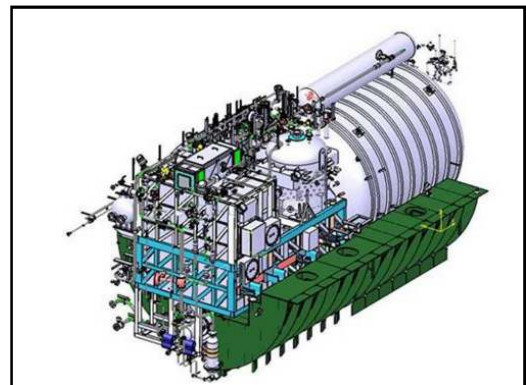
"DRDO has achieved an important milestone in the development of Air Independent Propulsion (AIP) System by proving the land-based prototype on March 8. The plant was operated in endurance mode and max power mode as per the user requirements." read a press statement from the Ministry of Defence. The system is being developed by DRDO's Naval Materials Research Laboratory (NMRL), located at Ambernath in Thane district of Maharashtra.

Indian Navy has both conventional and nuclear submarines in its arsenal. The fleet of conventional submarines use diesel-electric engines, which require them to surface almost daily to get atmospheric oxygen for fuel combustion. With the Air Independent Propulsion (AIP) system on board, these submarines will be required to surface much less frequently, thus increasing their lethality and stealth multifold. Similar tests of the AIP prototype were conducted back in October 2019.

While nuclear-powered submarines are considered as key assets for deep sea operations, the conventional diesel electric ones are vital for coastal defence and operations close to the shore. The indigenously-developed AIP, which is one of the key missions of the NMRL, is considered one of the ambitious projects of the DRDO for the Navy. The project aims at fitting the technology on India's Scorpene class submarine INS Kalvari around 2023.

"While there are different types of AIP systems being pursued internationally, fuel cell-based AIP of NMRL is unique as the hydrogen is generated onboard," read the MoD statement.

"The technology has been successfully developed with the support of industry partners L&T and Thermax. It has now reached the stage of maturity for fitment into target vessels." The statement further said.



The system is being developed by DRDO's Naval Materials Research Laboratory (NMRL), located at Ambernath in Thane district of Maharashtra. (Express Photo)

“Defence Minister Rajnath Singh congratulated DRDO, Indian Navy and Industry for the achievement. DRDO Chairman Dr G Satheesh Reddy appreciated the efforts of the teams involved in the successful development. He called upon the DRDO fraternity to come up with more such advanced technological achievements by putting extraordinary efforts,” stated the MOD release.

<https://indianexpress.com/article/india/strategically-important-air-independent-propulsion-tech-for-navy-submarines-achieves-milestone-mod-7221496/>



Wed, 10 March 2021

भारतीय पनडुब्बियां अब अधिक समय तक पानी के नीचे लगा सकेंगी गश्त, DRDO ने विकसित की खास प्रणाली

रक्षा मंत्रालय ने कहा कि एआइपी प्रणाली से डीजल-विद्युत चालित पनडुब्बी की घातक क्षमता बहुत बढ़ जाती है। अन्य तकनीक की तुलना में ईंधन सेल आधारित एआइपी से समुद्र के अंदर पनडुब्बियां ज्यादा समय तक रह सकती हैं।

By Neel Rajput

नई दिल्ली: रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) ने डीजल से चलने वाली पनडुब्बियों के लिए एयर इंडिपेंडेंट प्रोपल्शन प्रणाली (एआइपी) के विकास में महत्वपूर्ण उपलब्धि हासिल की है। समुद्र से बाहर प्रोटोटाइप पर इसके प्रभाव का सफल परीक्षण किया गया है। रक्षा मंत्रालय ने मंगलवार को यह जानकारी दी।

मंत्रालय ने बताया कि आठ मार्च को उपयोगकर्ता की आवश्यकताओं के अनुसार एआइपी के प्रोटोटाइप को सहनशक्ति मोड (एंड्योरेंस मोड) और अधिकतम शक्ति मोड (पावर मोड) में संचालित किया गया था।

मंत्रालय ने कहा कि एआइपी प्रणाली से डीजल-विद्युत चालित पनडुब्बी की घातक क्षमता बहुत बढ़ जाती है। अन्य तकनीक की तुलना में ईंधन सेल आधारित एआइपी से समुद्र के अंदर पनडुब्बियां ज्यादा समय तक रह सकती हैं।

डीआरडीओ की नौसेना पदार्थ अनुसंधान प्रयोगशाला इस प्रणाली को विकसित कर रही है। मंत्रालय ने कहा कि अंतरराष्ट्रीय स्तर पर एआइपी के लिए अलग-अलग तकनीक अपनाई जाती है। लेकिन ईंधन सेल आधारित यह तकनीक इस मायने में अनूठी है क्योंकि इसके लिए जरूरी हाइड्रोजन जहाज पर उत्पन्न होता है।

निजी क्षेत्र का बड़ा योगदान

मंत्रालय के मुताबिक इस तकनीक को विकसित करने में निजी क्षेत्र का बड़ा योगदान है। इस तकनीक को उद्योग भागीदारों एलएंडटी और थर्मैक्स के सहयोग से सफलतापूर्वक विकसित किया गया है। यह अब पनडुब्बी में फिटमेंट के लिए पूरी तरह तैयार है।

रक्षा मंत्री ने दी बधाई

रक्षा मंत्री राजनाथ सिंह ने इस उपलब्धि के लिए रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ), भारतीय नौसेना और उद्योग जगत को बधाई दी।

क्यों खास है एआइपी तकनीक

पनडुब्बियां मुख्य रूप से दो तरह की होती हैं। एक पारंपरिक और दूसरी परमाणु संचालित। पारंपरिक पनडुब्बियां डीजल-विद्युत इंजन का उपयोग करती हैं। इन्हें अपने ईंधन को जलाने के लिए ऑक्सीजन की जरूरत होती है। इसके लिए ऐसी पनडुब्बियों को प्रतिदिन समुद्र की सतह पर ऑक्सीजन के लिए आना पड़ता है। वहीं, पनडुब्बी में एयर इंडिपेंडेंट प्रोपल्शन यानी एआइपी प्रणाली को लगा दिया जाता है तो उसे सप्ताह में केवल एक बार ऑक्सीजन लेने की आवश्यकता होती है।

<https://www.jagran.com/news/national-indian-submarines-will-now-be-able-to-patrol-underwater-for-longer-with-new-system-dveloped-by-drdo-21445114.html>



Wed, 10 March 2021

BrahMos ideal weapon for Navy missile project

By Priam Nepomuceno

Manila: The medium-range ramjet supersonic BrahMos cruise missile system is the ideal weapon for the planned shore-based anti-ship missile project of the Philippine Navy (PN), its Chief said Tuesday night.

"The BrahMos Missile and Launching System is the most promising alternative for the Shore-Based Anti-Ship Missile System as assessed by the PN Technical Working Group," Vice Adm. Giovanni Carlo Bacordo said in a text message to the Philippine News Agency (PNA) when asked whether the PN intends to acquire the Mach 3-capable BrahMos missile for its inventory.

Bacordo said the project is being pursued as part of the Navy's requirements for a credible defense posture as envisioned in its ongoing modernization program.

"The project proposal was already presented to the Senior Leaders, however (it is) still for further approval by the Commander-in-Chief and subsequent funding," he added.

Earlier, Defense Secretary Delfin Lorenzana said the acquisition program for the BrahMos would push through after his department and India's Defense Ministry signed on March 2 the implementing agreement concerning the procurement of defense material and equipment.

"As of now, it is a go. The implementing agreement recently signed will facilitate the G2G (government-to-government) mode of procurement," Lorenzana said.

When asked how many BrahMos batteries the country would procure, he answered only one would be acquired.

"One battery only. Three systems *na yan* (it will consist of three systems)," Lorenzana said.

A missile battery typically consists of three mobile autonomous launchers with two or three missile tubes each, along with the tracking systems.

The BrahMos cruise missile can be launched from a ship, aircraft, submarine, or land and has a top of Mach 3 and capable of carrying warheads weighing 200 kg. to 300 kg.

The acquisition of a land-based missile system is under Horizon Two of the Revised Armed Forces of the Philippines Modernization Program, which is slated for 2018 to 2022 and geared for the acquisition of equipment for external defense and has a budget of PHP300 billion. (PNA)

<https://www.pna.gov.ph/articles/1133128>



Philippine Navy chief, Vice Adm. Giovanni Carlo Bacordo. (File photo)



Press Information Bureau
Government of India

Ministry of Defence

Tue, 09 March 2021 3:56PM

Contract signing with M/s Suryadipta Projects Private Limited, Thane for acquisition of eleven ammunition cum torpedo cum missile barge for Indian Navy

A contract for construction & delivery of Eleven Ammunition Cum Torpedo Cum Missile (ACTCM) Barges has been concluded with M/s Suryadipta Projects Private Limited, Thane, an MSME on 05 March 2021. Delivery of Barges is scheduled to commence from May 22. The Ammunition Cum Torpedo Cum Missile Barges will be inducted in Indian Navy to undertake the mission needs for embarking/ disembarking Ammunition, Torpedo & Missile etc. These barges will be built under the Classification Rules of Indian Register of Shipping (IRS). The project adds another milestone to the Atmanirbhar Bharat & Make in India initiative of the Government of India.



<https://pib.gov.in/PressReleasePage.aspx?PRID=1703502>



पत्र सूचना कार्यालय
भारत सरकार

रक्षा मंत्रालय

Tue, 09 March 2021 3:56PM

भारतीय नौसेना के लिए ग्यारह गोला बारूद/ टारपीडो/ मिसाइल बार्ज के अधिग्रहण के लिए मेसर्स सूर्यदीप्त प्रोजेक्ट्स प्राइवेट लिमिटेड, ठाणे के साथ अनुबंध पर हस्ताक्षर

दिनांक 05 मार्च 2021 को मेसर्स सूर्यदीप्त प्रोजेक्ट्स प्राइवेट लिमिटेड, ठाणे, जो एक एमएसएमई है, के साथ ग्यारह गोला बारूद/टारपीडो/ मिसाइल (एसीटीसीएम) बार्ज के निर्माण और वितरण के लिए एक अनुबंध किया गया है। दिनांक 22 मई से नौकाओं की डिलीवरी शुरू होनी है। गोलाबारूद कम टारपीडो कम मिसाइल बार्ज को भारतीय नौसेना में शामिल किया जाएगा ताकि गोला-बारूद, टारपीडो और मिसाइल आदि को तैयार करने/उतारने के लिए मिशनकी जरूरतों को पूरा किया जा सके। इन नौकाओं का निर्माण भारतीय जहाजरानी रजिस्टर (आईआरएस) के वर्गीकरण नियमों के तहत किया जाएगा। यह परियोजना भारत सरकार की आत्मनिर्भर भारत और मेक इन इंडिया पहल के लिए एक और मील का पत्थर है।



<https://pib.gov.in/PressReleasePage.aspx?PRID=1703604>

INS Karanj, third Scorpene-Class Submarine, commissioned into Indian Navy

Highlights:

- *INS Karanj, third Scorpene-Class Submarine, was commissioned into the Indian Navy on Wednesday*
- *The Scorpene-class submarine was commissioned into the Indian Navy in Mumbai in presence of Chief of Naval Staff Admiral Karambir Singh and Admiral (Retired) VS Shekhawat*

Mumbai: INS Karanj, India's third Scorpene-class diesel-electric submarine, was commissioned into the Indian Navy in Mumbai on Wednesday. The Scorpene-class submarine was commissioned into the Indian Navy in Mumbai in presence of Chief of Naval Staff Admiral Karambir Singh and Admiral (Retired) VS Shekhawat.

Speaking on the occasion, Navy Chief Admiral Karambir Singh said, "Indian Navy has been a strong proponent of indigenization & self-reliance in defence over past 7 decades. At present, out of 42 ships & submarines on order, 40 are being constructed in Indian shipyards."

"The impetuous to atmanirbharta or indigenization is a fundamental tenet of Indian Navy's growth story & future trajectory," the Navy Chief said.

Two submarines of this class, INS Kalvari and INS Khanderi, have already been commissioned into the Navy. A fourth of the class, INS Vela, has been undergoing trials at sea.

The fifth, INS Vagir, was launched in November 2020. The sixth boat of the class, named 'Vagsheer', is currently under construction. These submarines, which are one of the quietest conventional submarines currently in service around the world, have been designed by France's Naval Group and built in India by Mazagon Dock Limited under Project 75.

Scorpene-class submarines will be fitted with indigenous air-independent propulsion systems when they go for refit in a few years, according to the defence sources.

All these six Kalvari-class submarines have the same capabilities but they can be deployed in different roles which include guarding strategic points in the sea, laying mines, gathering intelligence, dropping marine commandos and engaging with enemy ships when required.

Kalvari-class submarines are being constructed by public sector shipbuilder Mazagon Dock Ltd (MDL). As per the contract with a French company, they would teach MDL and transfer the technology to India so it can make these ships indigenously.

<https://zeenews.india.com/india/ins-karanj-third-scorpene-class-submarine-commissioned-into-indian-navy-2346872.html>



Eye on China, India's plan for 6 nuclear-powered attack submarines back on track

Monday's significant test should be seen as part of the navy's overall capability-building plans, ranging from the ongoing plan to build six nuclear-powered attack submarines or SSNs to the commissioning of its second aircraft carrier, INS Vikrant, later this year

By Shishir Gupta

New Delhi: On March 8, the Defence Research Development Organization (DRDO) successfully carried out the final test of the land based prototype of the Air Independent Propulsion (AIP) system in Mumbai. The AIP system, retrofitted by expanding the hull area, ensures that diesel attack submarines can remain under surface for a longer period and become more silent than a nuclear-powered submarine. The AIP system will be retrofitted into Kalvari class submarines, the third of which (INS Karanj) will be commissioned on Wednesday March 10.

But analysts say that rather than being seen in isolation, Monday's significant test should be seen as part of the navy's overall capability-building plans, ranging from the ongoing plan to build six nuclear-powered attack submarines or SSNs – the project is back on track and was discussed at the Combined Commanders' Conference in Kevadia, Gujarat -- to the commissioning of its second aircraft carrier, INS Vikrant, later this year.

Overall, they add, the plans should also be seen as a concerted bid by the Indian Navy to counter the rise of China's navy – now larger than the US navy in terms of number of ships, although the US is still ahead in terms of tonnage and capability. In submarines for instance, India currently has only one Akula class SSN on lease from Russia; one more is expected to come on lease before 2025.

The analysts said the Indian Navy is all set to acquire big teeth and long legs this year. While South Block remains tight-lipped about the country's increasing naval capabilities, HT learns that the Chinese interlocutors during WMCC (working mechanism for consultation and coordination) meetings on disengagement in East Ladakh complained about Indian Navy warships being aggressive against the PLA Navy in the Indian Ocean. Thanks to Indian Navy full deployment in Indian Ocean and real time intelligence from the QUAD allies and France, the People's Liberation Army Navy's (PLAN) warships are only deployed around the Gulf of Aden as of now with no presence anywhere else in Indian Ocean.

India's national security planners are worried about the expanding PLAN and expect Chinese carrier strike force deployment in Indian Ocean by 2023 with Beijing expected to commission a third aircraft carrier this year. That's one reason the Indian Navy has embarked on its own capability-building drive. India will commission its second aircraft carrier INS Vikrant and second nuclear powered ballistic missile submarine (SSBN) INS Arighat this year. While INS Vikramaditya, the other carrier, will be home-based on the western seaboard of India, INS Vikrant will be on the eastern seaboard. Each will have one SSBN and SSN as part of its strike force.

Although the Indian Navy wants a third aircraft carrier with more tonnage than the two existing ones, the strategic planners of the Modi government are still to be convinced of the idea given the massive expenditure involved. The Vikramaditya's tonnage is 45,000 and the Vikrant's 37,500.



The plans should also be seen as a concerted bid by the Indian Navy to counter the rise of China's navy – now larger than the US navy in terms of number of ships, although the US is still ahead in terms of tonnage and capability. (Twitter/IndianNavy)

There's long been talk of a third carrier, INS Vishal, with a tonnage of 65,000, but this could set India back by at least \$15 billion.

Adding teeth to the Indian Navy are also its two leased Predator drones, which provide maritime domain awareness from Gulf of Aden to Sunda Straits with the unmanned aerial platform having endurance upwards of 30 hours and acquiring altitude of over 30,000 feet. Once the Indian military is trained to handle the Predator drones, currently based in the Arakkonam base in Tamil Nadu, the plan is to buy 10 armed Predator drones for each of the three services.

Vice Admiral (Retd) Madanjit Singh, former Western Naval Command Chief, said that New Delhi should be cured of its sea-blindness as this is the war theatre of future. "The Modi government must expand to blue water navy status if PLAN's expansion is to be checked."

<https://www.hindustantimes.com/india-news/eye-on-china-india-s-plan-for-6-nuclear-powered-attack-submarines-back-on-track-101615327826084.html>

THEWEEK

Wed, 10 March 2021

What type of 'Predator' armed drones will India get in \$3 billion deal?

*India will, reportedly, approve in April purchase of 30 drones from General Atomics
By Justin Paul George*

Talk of a large order of unmanned aerial vehicles from the US for the three Indian armed services have been in the news from early in the Donald Trump era. Last December, Indian Navy chief Admiral Karambir Singh revealed the Navy had leased two MQ-9B SeaGuardian drones from US Company General Atomics for surveillance in the Indian Ocean. He also announced that purchase of additional drones was high on the government's agenda.

On Tuesday, *Bloomberg* reported India will approve in April the purchase of up to 30 drones from General Atomics at a cost of \$3 billion. *Bloomberg* reported the drones "will give the Indian Navy the ability to better monitor Chinese warships in the southern Indian Ocean, and equip the army to engage targets along the disputed India-Pakistan border in the Himalayas".

Predator or Reaper?

General Atomics built the Predator drones that became legendary for their use as a weapon of choice for carrying out assassinations of terrorists using air-to-surface missiles. The original Predator was designated the MQ-1 and had a maximum takeoff weight of about 1 tonne. The US Air Force retired the MQ-1 Predator in 2018 and transitioned to a new system from General Atomics: The MQ-9A Reaper. The MQ-9A Reaper first flew in February 2001.

Confusingly, the MQ-9A Reaper has been referred to as the Predator-B. The Reaper was derived from and resembles the original MQ-1 Predator, which was used in the US conflicts in Afghanistan and Iraq. However, the Reaper is a totally different system.

Courtesy of a more powerful engine, the MQ-9A Reaper has a maximum takeoff weight of about 4.7 tonnes, over four times that of the MQ-1 Predator. In addition, while the original Predator could carry only two Hellfire anti-tank missiles, the Reaper has an external payload limit of over 1 tonne, giving it a massive firepower boost. This gives it the capability to carry up to four Hellfire missiles and two 227kg bombs on the same mission. Both the Predator and Reaper are



A US Air Force MQ-9 Reaper armed with bombs and air-to-ground missiles | General Atomics

controlled by personnel on the ground using satellite datalinks. General Atomics claims the MQ-9A Reaper can remain airborne for over 27 hours.

The MQ-9B SeaGuardian is a variant of the Reaper optimised for maritime missions. According to General Atomics, the MQ-9B SeaGuardian can carry out roles such as anti-submarine warfare and maritime surveillance. The company has also talked of developing it for use as a platform to detect naval mines. The MQ-9B is equipped with a powerful radar to scan the ocean surface and can carry sonobuoys to detect submarines. According to General Atomics, the MQ-9B SeaGuardian has a maximum takeoff weight of over 5.6 tonnes and can remain airborne for over 40 hours.

The Reaper and Predator can remain airborne for several hours at a time, relying back data to operators and planners. The Reaper can also use its missiles to hit 'targets of opportunities' such as terrorists on the move or missile systems.

The *Bloomberg* report said India would be buying the 'MQ-9B Predator'; however, it is likely both the Reaper and SeaGuardian will be purchased given differing service requirements. Interestingly, in 2019, *Breaking Defense*, a US publication, reported India and the US were in talks to customise the Reaper for Indian military requirements. This included modifying the weapon systems and communications equipment.

If confirmed, the deal for 30 drones will make India one of the largest operators of the MQ-9A Reaper family. The expected deal with the US comes as Pakistan is expecting delivery of Chinese-built drones that can carry missiles.

<https://www.theweek.in/news/india/2021/03/10/what-type-of-predator-armed-drones-will-india-get-in-3-billion-deal.html>



Wed, 10 March 2021

NASA and ISRO's NISAR space mission launch by January 2023, Dr Sivan tells Zee Media

The Indian Space Research Organization (ISRO) has shipped its satellite components to NASA's Jet Propulsion Laboratory for a joint satellite mission known as NASA-ISRO Synthetic Aperture Radar (NISAR). This joint mission, which is under development aims to provide earth observation data, that would help in the better management of natural resources and hazards. It is also meant to help scientists study the extent and pace of climate change

By Siddharth MP, Edited By Namrata Agarwal

Chennai: The Indian Space Research Organization (ISRO) has shipped its satellite components to NASA's Jet Propulsion Laboratory for a joint satellite mission known as NASA-ISRO Synthetic Aperture Radar (NISAR). This joint mission, which is under development aims to provide earth observation data, that would help in the better management of natural resources and hazards. It is also meant to help scientists study the extent and pace of climate change.



According to ISRO, NISAR is a collaboration for a dual-frequency S-Band and L-Band Synthetic Aperture Radar for earth observation. On March 4, ISRO Chairman Dr K Sivan virtually flagged off the Indian-made S-Band payload from the Space Applications Centre, Ahmedabad. At the NASA facility, this S-Band radar will be integrated with the American L-Band radar, following which it would be sent to India, for further assembly, integration and launch.

"Once ready, NASA would send the payload to India and it will be entirely assembled as a satellite at the UR Rao Space Center in Bengaluru. We have not finalized the launch date, but it is likely to be around end of 2022 or early 2023, on board a GSLV Mark II rocket from Satish Dhawan Space Center" Dr K Sivan told Zee Media.

NASA says that the NISAR mission will use advanced radar imaging that will provide an unprecedented, detailed view of Earth. "The satellite is designed to observe and take measurements of some of the planet's most complex processes. These include ecosystem disturbances, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides", read NASA's NISAR page.

It also adds that the project data would reveal information about the evolution and state of Earth's crust.

It was on September 30, 2014, that NASA and ISRO signed a partnership to collaborate on and launch NISAR. NASA is providing the mission's L-band synthetic aperture radar, a high-rate communication subsystem for science data, GPS receivers, a solid-state recorder and payload data subsystem. ISRO is providing the spacecraft bus, the S-band radar, the launch vehicle and associated launch services.

NASA adds that NISAR will be the first satellite mission to use two different radar frequencies (L-band and S-band) to measure changes in our planet's surface less than a centimeter across.

<https://zeenews.india.com/space/nasa-and-isros-nisar-space-mission-launch-by-january-2023-dr-sivan-tells-zee-media-2346741.html>

ISRO develops joint earth observation satellite mission radar with NASA

ISRO has developed a radar for the joint earth observation satellite mission with the US space agency Nasa. The radar is capable of producing extremely high-resolution images

New Delhi: The Indian Space Research Organisation (Isro) has completed the development of a radar for the joint earth observation satellite mission with the US space agency National Aeronautics and Space Administration (NASA). Isro has developed a Synthetic Aperture Radar (SAR), capable of producing extremely high-resolution images for the mission.

Nasa-Isro SAR (NISAR) is a joint collaboration for a dual-frequency L and S-band SAR for earth observation. "NISAR will be the first satellite mission to use two different radar frequencies (L-band and S-band) to measure changes in our planet's surface less than a centimeter across," NASA said.

NASA and Isro had signed a partnership on September 30, 2014, to collaborate on and launch NISAR which is targeted to launch in early 2022 from Sriharikota spaceport in Andhra Pradesh.

Nasa providing the mission's L-band SAR, a high-rate communication subsystem for science data, GPS receivers, a solid-state recorder and payload data subsystem.

Isro is providing the spacecraft bus, the S-band radar, the launch vehicle and associated launch services for the mission, whose goal is to make global

measurements of the causes and consequences of land surface changes using advanced radar imaging. The S-band SAR payload of NISAR satellite mission was flagged off by the Secretary in the Department of Space and ISRO Chairman K Sivan on March 4 through virtual mode.

The payload has been shipped from ISRO's Ahmedabad-based Space Applications Centre (SAC) to NASA's Jet Propulsion Laboratory (JPL) at Pasadena in the US for integration with the latter's L-band SAR payload, an ISRO statement said.

"NISAR would provide a means of disentangling highly spatial and temporally complex processes ranging from ecosystem disturbances to ice sheet collapses and natural hazards including earthquakes, tsunamis, volcanoes and landslides", ISRO said.

NASA added that the mission will measure Earth's changing ecosystems, dynamic surfaces and ice masses, providing information about biomass, natural hazards, sea level rise and groundwater, and will support a host of other applications.

"NISAR will observe Earth's land and ice-covered surfaces globally with 12-day regularity on ascending and descending passes, sampling Earth on average every six days for a baseline three-year mission", NASA said on the mission's website. "This allows the mission to observe a wide range of Earth processes, from the flow rates of glaciers and ice sheets to the dynamics of earthquakes and volcanoes".

Over the course of multiple orbits, the radar images will allow users to track changes in croplands and hazard sites, as well as to monitor ongoing crises such as volcanic eruptions. The images will be detailed enough to show local changes and broad enough to measure regional trends.

<https://www.indiatoday.in/science/story/isro-develops-joint-earth-observation-satellite-mission-radar-with-nasa-1777244-2021-03-09>

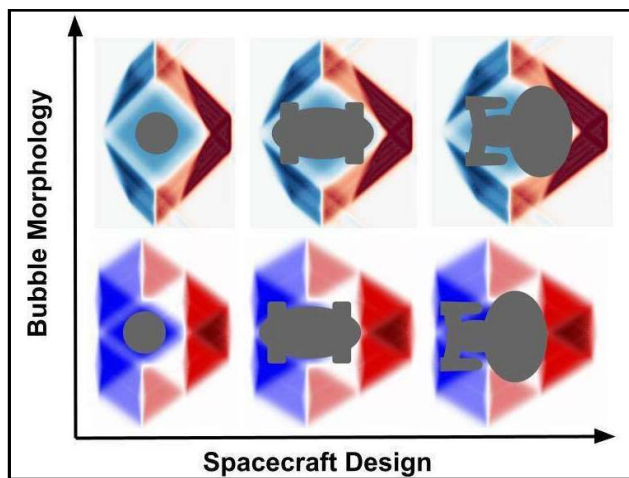


ISRO has completed development of a Synthetic Aperture Radar (SAR) capable of producing extremely high-resolution images for a joint earth observation satellite mission (PTI)

Breaking the warp barrier for faster-than-light travel

If travel to distant stars within an individual's lifetime is going to be possible, a means of faster-than-light propulsion will have to be found. To date, even recent research about superluminal (faster-than-light) transport based on Einstein's theory of general relativity would require vast amounts of hypothetical particles and states of matter that have 'exotic' physical properties such as negative energy density. This type of matter either cannot currently be found or cannot be manufactured in viable quantities. In contrast, new research carried out at the University of Göttingen gets around this problem by constructing a new class of hyper-fast 'solitons' using sources with only positive energies that can enable travel at any speed. This reignites debate about the possibility of faster-than-light travel based on conventional physics. The research is published in the journal *Classical and Quantum Gravity*.

The author of the paper, Dr. Erik Lentz, analyzed existing research and discovered gaps in previous 'warp drive' studies. Lentz noticed that there existed yet-to-be explored configurations of space-time curvature organized into 'solitons' that have the potential to solve the puzzle while being physically viable. A soliton—in this context also informally referred to as a 'warp bubble'—is a compact wave that maintains its shape and moves at constant velocity. Lentz derived the Einstein equations for unexplored soliton configurations (where the space-time metric's shift vector components obey a hyperbolic relation), finding that the altered space-time geometries could be formed in a way that worked even with conventional energy sources. In essence, the new method uses the very structure of space and time arranged in a soliton to provide a solution to faster-than-light travel, which—unlike other research—would only need sources with positive energy densities. No exotic negative energy densities needed.



Artistic impression of different spacecraft designs considering theoretical shapes of different kinds of 'warp bubbles.' Credit: E Lentz

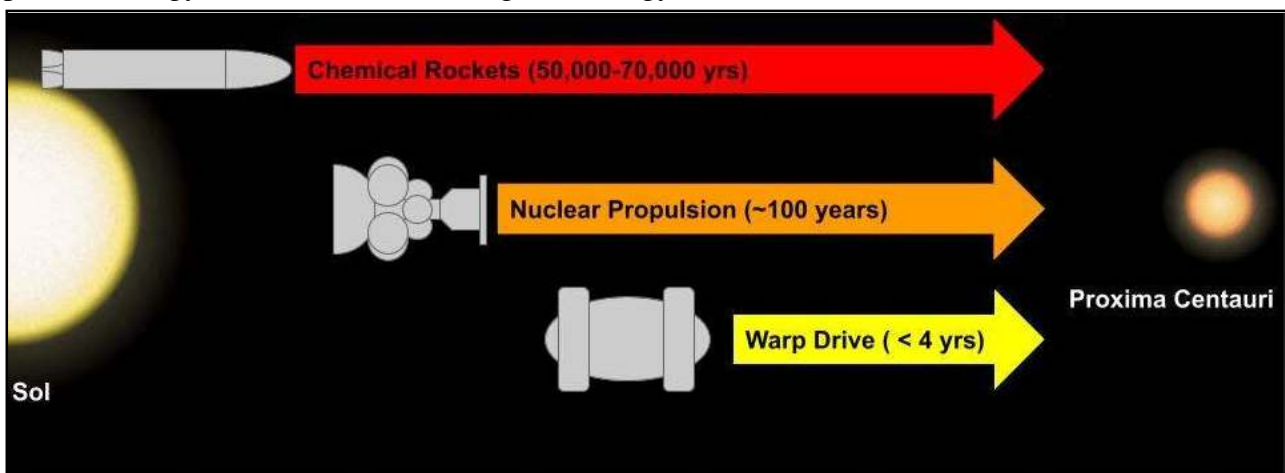


Image to show how long it would take different types of spacecraft to travel from our solar system to Proxima Centauri (the nearest known star). Currently, the only option would be to use a chemical rocket meaning a journey time of over 50,000 years. Credit: E Lentz

If sufficient energy could be generated, the equations used in this research would allow space travel to Proxima Centauri, our nearest star, and back to Earth in years instead of decades or millennia. That means an individual could travel there and back within their lifetime. In comparison, the current rocket technology would take more than 50,000 years for a one-way journey. In addition, the solitons (warp bubbles) were configured to contain a region with minimal tidal forces such that the passing of time inside the soliton matches the time outside: an ideal environment for a spacecraft. This means there would not be the complications of the so-called 'twin paradox' whereby one twin traveling near the speed of light would age much more slowly than the other twin who stayed on Earth: in fact, according to the recent equations both twins would be the same age when reunited.

"This work has moved the problem of faster-than-light travel one step away from theoretical research in fundamental physics and closer to engineering. The next step is to figure out how to bring down the astronomical amount of energy needed to within the range of today's technologies, such as a large modern nuclear fission power plant. Then we can talk about building the first prototypes," says Lentz.

Currently, the amount of energy required for this new type of space propulsion drive is still immense. Lentz explains, "The energy required for this drive traveling at light speed encompassing a spacecraft of 100 meters in radius is on the order of hundreds of times of the mass of the planet Jupiter. The energy savings would need to be drastic, of approximately 30 orders of magnitude to be in range of modern nuclear fission reactors." He goes on to say: "Fortunately, several energy-saving mechanisms have been proposed in earlier research that can potentially lower the energy required by nearly 60 orders of magnitude." Lentz is currently in the early-stages of determining if these methods can be modified, or if new mechanisms are needed to bring the energy required down to what is currently possible.

More information: Erik W Lentz, Breaking the warp barrier: hyper-fast solitons in Einstein–Maxwell-plasma theory, *Classical and Quantum Gravity* (2021). DOI: [10.1088/1361-6382/abe692](https://doi.org/10.1088/1361-6382/abe692)
<https://phys.org/news/2021-03-warp-barrier-faster-than-light.html>



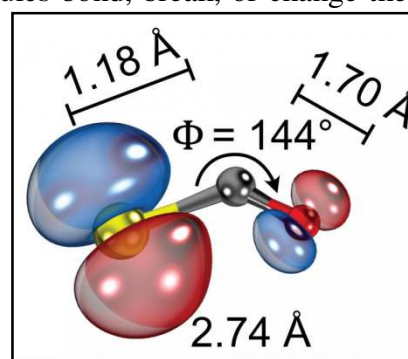
Wed, 10 March 2021

Determining the structure of a molecule with laser-induced electron diffraction

Light microscopes have revolutionized our understanding of the microcosmos, but their resolution is limited to about 100 nanometers. To see how molecules bond, break, or change their structure, we need at least 1000 times better resolution.

Laser induced electron diffraction (LIED) is a technique which allows to pinpoint the individual atoms inside a single molecule, and to see where each atom moves when the molecule undergoes a reaction. This technique proved to be an amazing tool for the imaging molecules, such as water, carbonyl sulfide or carbon disulfide. However, using a strong laser field to generate the electron diffraction presented challenges in retrieving the exact structure, since the structural resolution depended on exact knowledge of the laser field itself.

In a study recently published in *Nature Communications*, ICFO researchers Aurelien Sanchez, Kasra Amini, Tobias Steinle, Xinyao Liu, led by ICREA Prof. at ICFO Jens Biegert, in collaboration with researchers from Kansas State University,



Schematic illustration of the molecular structure of ionized Carbonyl Sulfide (OCS+) showing its bent and asymmetrical configuration and the bond lengths between atoms. Credit: ICFO

Max-Planck-Institut für Kernphysik, Physikalisch-Technische Bundesanstalt, and Friedrich-Schiller-Universität Jena, have reported on an alternative and novel approach that retrieves accurate and precise information about the atomic structure without exact knowledge over the laser field. They successfully applied the method to imaging gas-phased molecule carbonyl sulfide (OCS), in particular on the bond lengths between the constituent atoms, showing a significant bent and asymmetrically stretched configuration of the ionized OCS⁺ structure.

Determining the atomic bonds of Carbonyl Sulfide

In their experiment, the scientists took a gas mixture of 1% OCS in helium and expanded it supersonically to create a molecular beam of the gas with a temperature below 90K. They then took a 3.2μm laser and exposed the molecule to the strong laser field. The interaction between the laser and the molecule produced an accelerated electron, which was released from the molecule, accelerated into the laser field and returned back to the target ion by the electric field of the laser; the re-collision of the electron with the ion structure generated a molecular imprint of the structure and, by extracting this information from the electron interference pattern and the scattering angle analysis, the scientists were capable of determining the proper structure of the molecule.

Novelty of the approach

Named ZCP-LIED, the novelty of this approach resides in the fact that the scientists came up with a very clever way to retrieve the atomic information by using the full 2D electron scattering information, mainly the energy and scattering angle spectra of the electron in the laboratory frame instead of the laser frame, which drastically improved the statistics of the results. Alongside to using 2D data instead of 1D information, they also identified a distinctive feature in spectra related to what they called the zero crossing point (ZCP) positions (where the interference signal showed a null value). By carrying out the analysis over these critical points, the scientists were able to obtain from a much smaller data set more precise information on the bond lengths of the atoms that make up the molecule, reducing quite considerably the calculation time.

For validation of their approach, they used various methods, compared them to quantum chemistry theoretical simulations and prove that their ZCP-LIED technique could obtain inter-nuclear distances with a much higher precision, could measure bond distances of similar length (something rather impossible to do with previous methods), that it avoided converting frames of reference, and was able to determine the molecular structure in environments where the background noise could be considerable. Taking all this into account, they reported obtaining the molecular information of 10-atom molecules, and in particular, for the carbonyl sulfide, where they saw that the molecule OCS⁺ had a significantly bent and asymmetrically stretched structure, different to what previous studies had determined for this molecule.

The results obtained by this study have demonstrated that the ZCP-LIED technique could be a very powerful tool to determine the molecular structure of large and more complex molecules. It could also be extended to ultrafast electron diffraction (UED) and even ultrafast X-ray diffraction (UXD) to track the geometric structure molecules in a transient phase.

More information: A. Sanchez et al, Molecular structure retrieval directly from laboratory-frame photoelectron spectra in laser-induced electron diffraction, *Nature Communications* (2021). DOI: [10.1038/s41467-021-21855-4](https://doi.org/10.1038/s41467-021-21855-4)

Journal information: [Nature Communications](https://www.nature.com/articles/s41467-021-21855-4)
<https://phys.org/news/2021-03-molecule-laser-induced-electron-diffraction.html>

Combined technique using diamond probes enables nanoscale imaging of magnetic vortex structures

Obtaining a precise understanding of magnetic structures is one of the main objectives of solid-state physics. Significant research is currently being undertaken in this field, the aim being to develop future data processing applications that use tiny magnetic structures as information carriers. Physicists at Johannes Gutenberg University Mainz (JGU) and the Helmholtz Institute Mainz (HIM) recently presented a new method for investigating magnetic structures combining two different techniques. This allows to measure and map the magnetization as well as the magnetic fields of the sample. Involved in the project were atomic physicists from the work group led by Professor Dmitry Budker and the team of experimental solid-state physicists led by Professor Mathias Kläui. The findings have been published in *Physical Review Applied*.

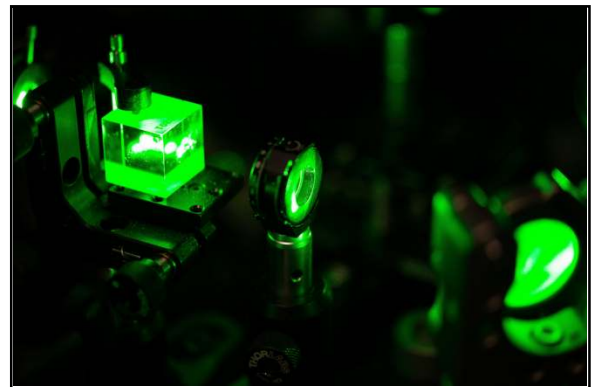
"In this project we combined two quantum sensing techniques which never before had been used together to analyze a sample," explained Till Lenz, first author of the article and a doctoral candidate in Budker's group. One well-known method employed in solid-state physics uses the magneto-optic Kerr effect (MOKE) in order to detect magnetic fields and magnetization. "But this gives us only a limited amount of information," said Lenz. For this reason, the researchers decided to combine the Kerr effect with magnetometry methods that utilize so-called diamond color centers in order to also enable the mapping of magnetic fields. "We hope that this will lead to new insights when it comes to solid-state physics and ferromagnetic structures," stated Georgios Chatzidrosos, also a doctoral student in the Budker group. Professor Mathias Kläui is excited about the new measuring capabilities: "The use of diamond probes provides a sensitivity that opens up entirely new options with regard to measurement potentials."

New combined measurement methods can be used in a wide range of different ambient conditions

Diamond is not only a precious stone but is also used to make cutting and grinding tools. Specific defects in the diamond crystal lattice result in properties that can be used to examine magnetic structures. These color centers, also known as nitrogen-vacancy centers, are point defects in the carbon lattice structure of diamond. The research group led by Professor Dmitry Budker uses these color centers in diamond as probes to measure magnetic phenomena.

Diamond-based magnetometers can function at very low temperatures as well at temperatures above room temperature, while the distances required between sample and probe can be miniscule, in the range of just a few nanometers. "We have a thin layer of nitrogen defects in a diamond crystal and with this we can map magnetic structures and take photos of magnetic fields," explained Dr. Arne Wickenbrock from the Budker group. And co-author Dr. Lykourgos Bougas added: "By mapping all the components of a magnetic field, we can complement and extend the possibilities offered by magneto-optic measurements."

"The probe that functions with the help of diamond color centers is much more sensitive than conventional tools and provides us with extremely good results. We are able to access some



Diamond magnetometer with nitrogen-vacancy defects being optically initialized using green laser light. Credit: Arne Wickenbrock, JGU

fascinating samples, which results in unique opportunities for cooperation," emphasized Professor Mathias Kläui, describing the advantage of the collaboration between the two research groups. "Combining our complementary measurement techniques enables the complete reconstruction of the magnetic properties of our samples." The recently published article is the product of teamwork within the Dynamics and Topology (TopDyn) Top-level Research Area at JGU, which is funded by the state of Rhineland-Palatinate. In addition, the work was also undertaken under the umbrella of the 3D MAGiC project, which was launched in collaboration with Forschungszentrum Jülich and Radboud University Nijmegen in the Netherlands and has been awarded an ERC Synergy Grant.

To quote the paper published in *Physical Review Applied*: "Our concept represents a novel platform for wide-field imaging of the magnetization and resultant magnetic fields of magnetic structures using engineered diamond magnetic sensors and an optical setup that allows for both measurement modalities." In addition to the two JGU and HIM work groups, also involved was Professor Yannick Dumeige of Université de Rennes 1 in France, who as a recipient of a Friedrich Wilhelm Bessel Research Award of the Alexander von Humboldt Foundation in 2018 also worked with the Budker group. Professor Kai-Mei Fu, physicist at the University of Washington, also participated in the project as a HIM Distinguished Visitor.

Looking to the future, the cooperation partners plan to employ the new technique to analyze various multidisciplinary aspects that are of particular interest to the respective groups. These include investigating two-dimensional magnetic materials, the magnetic effects of molecular chirality, and high-temperature superconductivity.

More information: Till Lenz et al. Imaging Topological Spin Structures Using Light-Polarization and Magnetic Microscopy, *Physical Review Applied* (2021). DOI: [10.1103/PhysRevApplied.15.024040](https://doi.org/10.1103/PhysRevApplied.15.024040)
<https://phys.org/news/2021-03-combined-technique-diamond-probes-enables.html>

Women more likely to become Covid-19 ‘long-haulers’, US study shows

In a preprint paper published last week, researchers from US said the group in which symptoms had persisted for more than 61 days consisted of 58.9% females

By Angana Chakrabarti, Edited By Sanghamitra Mazumdar

New Delhi: A new study has found that women are more likely to become Covid-19 ‘long haulers’, who are individuals that show persistent symptoms even after being cured of the infection.

The study drew a model based on 1,407 records of Covid-19 patients with symptoms. In a preprint paper published last week, researchers from the US found that the group in which symptoms had persisted for 61 days and more consisted of 58.9 per cent females.

“Although our study supported a potential association with female sex and higher likelihood of becoming a long-hauler, race appeared to be less predictive for both Caucasian and Hispanic ethnicity,” the researchers noted.

The method

For the study, the researchers obtained 1,407 records — from the University of California Covid Research Data Set (UC CORDS) — of symptomatic Covid-19 patients who had never been hospitalised. Nonnegative matrix factorization, a group of algorithms in a multivariate analysis that extracts “interpretable components” from data, was used to determine relationships between symptoms at each stage.

“In order to identify factors leading to the development of persistent symptoms we developed a predictive model that inputs multiple potential key factors to predict if a subject with SARS-CoV-2 infection will become a long-hauler,” the study said.

Data on the patients’ socio-demographics and symptoms experienced by them in the first 11 days, whether they were asymptomatic in the initial days, were also included in the model.

The long-haulers

According to the results, in the first 10 days, 68 per cent of the total group showed symptoms and 32 per cent were asymptomatic.

“Prevalent symptoms during this time include (in descending order) dyspnea, cough, fever, chest pain, diarrhoea, anxiety, and fatigue,” the study states.

This group consisted of 52 per cent females and 47.1 per cent males with those aged 50-59 years contributing to the most number of cases.

The group with sustained symptoms for above 61 days, indicative of long haulers, consisted of 58.9 per cent females.

“Symptoms that are prevalent among long-haulers include (descending order): chest pain, dyspnea, anxiety, abdominal pain, cough, low back pain, and fatigue,” the study found.

The study, however, said further research is needed to understand “the underlying pathophysiology” to understand the immune responses to the Covid-19 infection.

<https://theprint.in/health/women-more-likely-to-become-covid-19-long-haulers-us-study-shows/618394/>

