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Fri, 19 March 2021

Indian Navy's Indigenisation Push Gets Boost with AIP System for Submarines

Indian Navy had embarked on a determined process of transitioning from a ship-buying force to a ship-building one by 2030. This goal, albeit delayed, is nearing fruition, with most recent vessels built in Indian shipyards.'

By D. Raghunandan

An innovative Air Independent Propulsion (AIP) system developed indigenously by the Defence Research & Development Organization (DRDO) in collaboration with a consortium of several private and public sector companies led by Larsen & Toubro (L&T) – the Lead System Integrator – passed a crucial test of its land-based prototype on March 8. The AIP power plant tests involved both, endurance mode – operation at low power for extended periods over 14 days – and maximum power mode over two days as required by the Indian Navy.

The 270kW Land-Based Prototype (LBP) was developed by DRDO's Naval Materials Research Laboratory (NMRL) at Ambarnath, about 50 kms from Mumbai. It came up under a project sanctioned in 2010 for Rs 191.6 crores at a marginal cost overrun of Rs 210 crores and is scheduled to close in June this year. Next, a Marinised Engineered AIP Energy Module (MAREEM), a pre-production version of an on-board AIP system, will be designed and installed on a test-bed submarine mock-up for a series of trials after which the production version would be developed and manufactured by industry partners for fitment on operational submarines. This AIP is designed as a modular unit that can be fitted into special hull sections in submarines, or even in other applications.



Under the once-classified Project 75(I), India is soon to manufacture six stealth diesel-electric submarines with Transfer of Technology (ToT) in collaboration with any one of five short-listed original equipment manufacturers from Russia, France, Germany, Spain and South Korea. These subs will be fitted with the indigenous AIP systems. Also, the production of six Scorpene class diesel-electric submarines is already underway under Project 75 at the public sector Mazagon Docks Shipbuilders Limited (MDL) under transfer of technology (ToT) from Naval Group of France, interestingly, also a PSU. Four of these have either already been delivered to the Navy or are nearing delivery, and it is expected that the last two Kalvari-class submarines would be with the DRDO AIP starting in 2023, while the earlier ones may also be retro-fitted with AIPs subsequently.

Significance of Aip

As the name suggests, AIP systems enable submarines to stay underwater for long periods of up to three weeks at low cruise speeds, without having to surface or snorkel (staying just below the

surface while extending a pipe up to inhale air required for the engine) at least every four days as is the case with diesel-electric submarines. Nuclear-powered submarines are able to stay underwater for an enormous length of time, often between 80 to 90 days or more for the larger subs, without having to surface, and excel at deep-water long-duration missions, even though their mechanical pumps that circulate much-needed coolant do make at least some noise. Nuclear power plants are of course extremely powerful and make oxygen, circulate air etc inside the sub. Modern diesel-electric subs too use lead-acid or Lithium-ion batteries while underwater, and are extremely silent for short periods, but must carry oxygen or air, and must surface frequently to run their engines to recharge the batteries, exposing themselves often to opposing forces. Subs with AIP, however, can stay underwater for much longer, since they carry power systems that do not require external air or oxygen. As such, they are deadly in near-coastal scenarios against land-based targets or other conventional submarines.

AIP power systems are therefore a hallmark of advanced submarine technology, currently possessed only by Russia, China, France, Germany, Sweden and Spain. Of these, China has supplied AIP systems for Pakistan Navy subs, while the other countries are major players in the international military equipment market for submarines.

India acquiring this capability indigenously is a significant development, since AIP systems are very expensive to import, and is a huge leap forward towards technological self-reliance in submarine technologies after having developed India's own nuclear-powered submarine. It is also one more feather in the cap of DRDO, with accolades multiplying in recent times since several indigenous technology development projects are fructifying after a decade or more of arduous R&D work.

Fuel Cells

As noted, AIP systems enhance the silent and low-detection capability of submarines by substantially reducing the interval between surfacing or snorkeling and fully submerged operations, called the "indiscretion ratio". This ability is enhanced even more by the use of fuel cells, which produce their own energy as long as fuel is supplied, and thus eliminate the need for conventional batteries that require recharging.

Fuel cells are electro-chemical devices that convert the chemical energy of a fuel (usually hydrogen), in combination with an oxidising agent (usually oxygen) mediated by an electrolyte, into electricity, through chemical reactions. When hydrogen and oxygen are used the only by-products are water and heat. For a future carbon-free world, hydrogen-based fuel cells are considered among the most promising non-polluting energy sources for use in a variety of applications such as automobiles and aircraft, where using solar power may be difficult. Like batteries, fuel cells can be added together in multiple units called a stack.

In submarine-based AIPs, the space limitation of having to carry oxygen and hydrogen is a major problem. The DRDO/NMRL AIP system has tackled this problem by producing hydrogen on board during operations. In this AIP, hydrogen is made from stored Sodium borohydride powder and stored oxygen with phosphoric acid as electrolyte, a so-called phosphoric acid fuel cell (PAFC). This makes the DRDO AIP one of the most advanced such systems currently in operation. While this method is not unique in the world, developing this technology indigenously is a major achievement by NMRL/DRDO, which will also have many other military as well as civilian applications down the line.

Sailing towards Self-Reliance

India's rapidly declining submarine fleet has been a matter of serious concern, that too at a time when the security environment on both flanks is seen to have deteriorated substantially, and when the Navy has projected security interests ranging from the Horn of Africa in the west to the Malacca Straits and beyond in the east. India's efforts at procurement from abroad have witnessed inordinate delays due to its notoriously shambolic procurement system, a bureaucracy bound up in red tape, and interference by vested interests. Even the P75I project underwent considerable delays due to persistent efforts by certain big corporate entities to enlist themselves among other serious

bidder, despite one being beset with serious financial and managerial issues and the other having no experience at all in ship-building.

The Indian Navy had embarked on a determined process of transitioning from a ship-buying force to a ship-building one by 2030. This goal, albeit delayed, is nearing fruition, with most recent vessels built in Indian shipyards.

Submarines posed serious challenges in terms of both technology and manufacturing capability. Having succeeded in developing and making the indigenous Arihant nuclear-powered submarine, and with the Project 75 Scorpene subs and Project 75I subs with AIP, the Indian Navy is close to the final stages of this journey towards indigenisation. It is believed that Project 75I involving ToT from a foreign OEM may well be the last ToT project for submarines, after which India would have established the full ecosystem for indigenous design and manufacture of different types of submarines.

The major role of L&T as system integrator in the AIP project, earlier in the construction of the Arihant nuclear sub and several other naval vessels, and as a potential bidder for the P75I project, are also noteworthy. L&T is emerging as a rare – emphasis on rare – example of a home-grown defence major in the private sector not dependent on imported technologies and willing to undertake the hard slog of indigenous development.

<https://www.newsclick.in/indian-navy-indigenisation-push-gets-boost-AIP-system-submarines>



Fri, 19 March 2021

India's HAL TEDBF, French Rafale or US' F-18 Super Hornet – Which Fighter jet will fly from the deck of INS Vikrant?

By Mansij sthana

The Indian Navy's first domestically-built aircraft carrier, INS Vikrant, could end up having HAL's upcoming fifth-generation Twin Engine Deck-Based Fighter (TEDBF) jet on her flight deck, if reports are to be believed.

And as things stand, the home-grown fighter could give stiff competition to Western aircraft such as Rafale and Super Hornet as the Navy is already on the lookout for a twin-engine fighter jet.

According to reports, the INS Vikrant will start sea trials soon, which could pave the way for her commissioning into the service later this year. The carrier is currently moored near a shipyard in Kochi in the southern India state of Kerala.



According to Naval News, the INS Vikrant will be equipped with the existing Russian-made MiG-29K Fulcrum fighter jets initially.

However, it is likely that the Hindustan Aeronautics Limited's (HAL) TEDBF aircraft will occupy the position whenever they are inducted into the Navy.

HAL's Upcoming Fighter Jet

The TEDBF fighter jet, which is currently under development, will replace the Indian Navy's MiG-29K fighter jets.

The twin-engine, carrier-based, multirole TEDBF fighter is a canard twin-engine variant of the Tejas fighter jet. It is being jointly developed by HAL and Aeronautical Development Agency (ADA), an autonomous organization under India's Ministry of Defence.

The development of a new fighter was revealed by the DRDO in April last year, with the aircraft being showcased at the Aero India 2021 last month.

The upcoming fighter jet is expected to operate from the Indian Navy's short take-off but assisted recovery carriers — INS Vikramaditya and INS Vikrant.

TEDBF, Rafale and Super Hornet

With TEDBF expected to be ready for induction not before 2026, India is looking for a twin-engine carrier-based aircraft. It is believed the Navy has zeroed in on two names — the French Dassault Rafale and the US' Boeing F/A-18 Super Hornet. According to analysts, both are relatively mature designs and are considered low-risk options.

India has purchased 36 Dassault Rafale jets, of which 11 have already been delivered to the Indian Air Force. Although the IAF Rafales are land-based aircraft, they are not much different from the carrier-based version of the fighter jet.

And if the Indian Navy indeed decides to go with the Rafale, it will be based on IAF's first-hand experience of operating the fighter jets.

On the other hand, the twin-engine, multirole, carrier-capable Boeing F/A-18 Super Hornet fighter is another great option for the Indian Navy.

The Super Hornets are the advanced variants of the McDonnell Douglas F/A-18 Hornet, which according to Boeing, is among the most lethal, advanced, combat-proven, multi-role frontline fighters in service to date.

The Super Hornet fighter jets can carry air-to-air missiles and air-to-surface weapons. They also possess internal 20mm M61 rotary cannon.

Why TEDBF has an Edge over other two

Unlike the Rafale and the Super Hornet, which are both 4.5 generation fighter jets, India's upcoming indigenous TEDBF fighter is expected to be a fifth-generation aircraft.

As per reports, the TEDBF fighter will have a higher thrust and payload capacity, which would put them on a par with the French-made Dassault Rafales.

According to the latest figures provided by the ADA, the TEDBF fighters will be able to attain speeds of Mach 1.6. The aircraft, which will have a length of 16.2 meters (53ft in), is also expected to be a true multi-role fighter.

The TEDBF will be able to carry out combat air patrol (CAP), interception, ground attack, strike, maritime strike, reconnaissance, electronic warfare (EW), and buddy-refueling.

According to reports, the fighter jet will save some weight by having an internal weapons bay and will include the advanced short-range air-to-air (ASRAM) and Astra beyond-visual-range (BVR) air-air missiles.

It will also be able to carry Rudram-1 and Rudram-2 anti-radiation missiles. All these features make the HAL TEDBF a future fighter jet that could be the most suitable one for the INS Vikrant.

<https://eurasianimes.com/ins-vikrants-go-to-fighter-jet-indias-hal-tedbf-french-rafale-or-us-super-hornet/>



Press Information Bureau
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Thu, 18 March 2021 4:43PM

Indigenously built Indian Naval Landing Craft Utility L58 Commissioned at Port Blair; the ship adds fillip to Make in India & Atmanirbhar Bharat programme

Indian Naval Landing Craft Utility (LCU) L58, the eighth and last ship of the Landing Craft Utility (LCU) Mark IV Class, was commissioned into the Indian Navy at Port Blair, Andaman & Nicobar Islands on March 18, 2021. Commander-in-Chief, Andaman and Nicobar Command (CINCAN) Lieutenant General Manoj Pande was the Chief Guest and Chairman & Managing Director, Garden Reach Shipbuilders & Engineers Ltd (GRSE) Rear Admiral Vipin Kumar Saxena, IN (Retd) was present for the event.

Commander Krishan K Yadav read the Commissioning Warrant as the first Commanding Officer of the ship. The ship is manned by a motivated team of five officers and 50 sailors. Indigenously designed and built by GRSE, Kolkata, the ship's commissioning has added one more feather in the cap of the nation's 'Make in India' & 'Atmanirbhar Bharat' programme in the field of warship design and construction.



The LCU 58 is an amphibious ship which can carry 160 troops, in addition to its crew. With a displacement of 900 tons, the ship is capable of carrying various types of combat vehicles such as Main Battle Tanks (MBTs), BMPs, Armoured Vehicles, trucks, etc. The ship measures 63 meters in length and is fitted with two MTA 4,000 series engines, which are capable of propelling the ship at speeds of up to 15 knots (28 kmph). The ship is also fitted with an advanced Electronic Support Measure (ESM) suite to intercept enemy radar transmissions, an advanced Integrated Bridge System (IBS) and a sophisticated Integrated Platform Management System (IPMS), which allow single station monitoring of the ship's navigational and machinery equipment respectively. The main armament of the ship includes two indigenously manufactured 30 mm CRN 91 guns which are controlled by a Stabilised Optronic Pedestal (SOP), an electronic day-night director sight manufactured by Bharat Electronics Limited (BEL). In addition, the ship is fitted with six Machine Gun Posts to neutralise air, surface and sub-conventional threats.

The LCU 58 would be based at Port Blair and will be deployed in a variety of roles such as Beaching, Search and Rescue, Disaster Relief, Coastal Patrol and Surveillance operations along the Andaman and Nicobar Group of Islands, Bay of Bengal and in the Indian Ocean.

It will augment the Indian Navy's mobility, reach and flexibility, furthering the Andaman and Nicobar Command's motto, 'Victory through Jointness'.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1705809>



पत्र सूचना कार्यालय
भारत सरकार

रक्षा मंत्रालय

Wed, 17 March 2021 3:41PM

पोर्ट ब्लेयर में स्वदेश निर्मित भारतीय नौसेना लैंडिंग क्राफ्ट युटिलिटी एल-58 की कमीशनिंग; यह जहाज मेक इन्डिया और आत्मनिर्भर भारत कार्यक्रम को प्रोत्साहित करेगा

लैंडिंग क्राफ्ट युटिलिटी (एलसीयू) मार्क चतुर्थ श्रेणी के आठवें और अंतिम जहाज इंडियन नेवल लैंडिंग क्राफ्ट युटिलिटी (एलसीयू) एल-58 को दिनांक 18 मार्च, 2021 को पोर्ट ब्लेयर, अंडमान एंड निकोबार द्वीप समूह में भारतीय नौसेना में कमीशन प्रदान किया गया। इस कार्यक्रम के लिए कमांडर-इन-चीफ, अंडमान एंड निकोबार कमांड (CINCAN) लेफ्टिनेंट जनरल मनोजपांडे मुख्य अतिथि तथा गार्डन रीच शिपबिल्डर्स एंड इंजीनियर्स लिमिटेड (जीआरएसई) के निदेशक सेवानिवृत्त नौसेना अधिकारी रीयर एडमिरल विपिन कुमारसक्सेना उपस्थित थे।



कमांडर कृष्ण के यादव ने जहाज के पहले कमांडिंग ऑफिसर के रूप में कमीशनिंग वारंट पढ़ा। इस जहाज में पांच अधिकारियों और 50 नाविकों की एक उत्साहित टीम तैनात है। जीआरएसई, कोलकाता द्वारा स्वदेश में डिजाइन और निर्मित जहाज की कमीशनिंग ने युद्धपोत डिजाइन और निर्माण के क्षेत्र में देश के 'मेक इन इंडिया' और 'आत्मनिर्भर भारत' अभियान की उपलब्धि में एक और अध्याय जोड़ दिया है।

एलसीयू 58 एक उभयचर जहाज है जो अपने चालक दल के अलावा 160 सैनिकों को ले जा सकता है। 900 टन की भारवहन क्षमता के साथ यह जहाज विभिन्न प्रकार के लड़ाकू वाहनों जैसे मुख्य युद्धक टैंक (एमबीटी), बीएमएसपी, बख्तरबंद वाहन और ट्रक आदि ले जाने में सक्षम है। जहाज की लंबाई 63 मीटर है और इसमें दो एमटीए 4000 सीरीज इंजन लगे हैं जो जहाज को 15 नॉट (28 किमी प्रति घंटे) तक की गति से पहुंचाने में सक्षम हैं। इस जहाज में दुश्मन के रडार ट्रांसमिशन को भेदने में सक्षम आत्याधुनिक इलेक्ट्रॉनिकसपोर्ट मेजर लगा है, साथ ही आत्याधुनिक एकीकृत ब्रिज प्रणाली (आईबीएस) और एक परिष्कृत एकीकृत प्लेटफार्म मैनेजमेंट सिस्टम (आईपीएमएस) लगा है जो क्रमशः जहाज के नौवहन व मशीनरी उपकरणों की एकल स्टेशन निगरानी की सुविधा प्रदान करता है। जहाज के मुख्य आयुध में दो स्वदेश निर्मित 30 मिमी सीआरएन 91 गन शामिल हैं जो एक स्थिर ऑप्टिकल पेडस्टल (एसओपी) द्वारा नियंत्रित की जाती हैं- जो कि भारत इलेक्ट्रॉनिक्स लिमिटेड (बीईएल) द्वारा निर्मित एक इलेक्ट्रॉनिक डे-नाइट डायरेक्टर साइट है। इसके अतिरिक्त जहाज में हवा, सतह और उप-पारंपरिक खतरों को बेअसर करने के लिए छह मशीनगन पोस्ट भी लगे हैं।

एलसीयू 58 पोर्ट ब्लेयर पर रखा जाएगा तथा इसे अंडमान औरनिकोबार समूह, बंगाल की खाड़ी और हिंद महासागर में समुद्र तट, खोज और बचाव, आपदा राहत, तटीय गश्ती और निगरानी अभियानों जैसी विभिन्न भूमिकाओं में तैनात किया जाएगा।

यह अंडमान निकोबार कमान के आदर्श वाक्य 'विक्ट्री थ्रो जॉइंटनेस/ संयुक्तताके माध्यम से जीत' को आगे बढ़ाते हुए भारतीय नौसेना की गतिशीलता, पहुंच और लचीलेपन को बढ़ाएगा।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1705857>

Science & Technology News



Fri, 19 March 2021

ISRO Gaganyaan: Indian private firm delivers component for crew module

The crucial component, delivered to the Indian Space Research Organization (ISRO), is meant to perform health checks of the various cable harness assemblies used in the Crew Module, which houses the astronauts

By Sidharth MP, Edited By Namrata Agarwal

Chennai: Data Patterns, a Chennai-based firm delivered a crucial component that is meant to be used in Gaganyaan, which is India's ambitious human spaceflight programme. The checkout system, which was delivered to the Indian Space Research Organization (ISRO), is meant to perform health checks of the various cable harness assemblies used in the Crew Module, which houses the astronauts.

Simply put, a cable/wire harness assembly is a grouping of wires that are designed to carry power or signals. When fully extended, the wiring in aircraft and spacecraft measure several kilometers, so the wires are bound in a harness, rather than being let loose. By being bound into a harness, the wires are protected from adverse conditions that may occur during operation and are much more compact.

The health checks of wiring harnesses such as high voltage insulation, continuity, isolation, current carrying capacity and other electrical parameters play a vital role in the safety of the Crew Module. This crew module is required to withstand the various forces exerted upon on during launch and also serve as an orbiting home for Indian astronauts, who will be circling the earth in Low Earth Orbit. The handing over ceremony took place on Wednesday, March 17 at Data Patterns' facility near Chennai, in the presence of Dr S Unnikrishnan Nair, Director, Human Space Flight Centre(HSFC) among others. According to the private firm, the component was delivered within four months, against the typical schedule of twelve months.



Located at the ISRO Headquarters in Bengaluru, HSFC is responsible for implementation of Gaganyaan Project which involves end-to-end mission planning, development of Engineering systems for crew survival in space, crew selection & training and also to pursue activities for sustained human space flight missions.

During its three decade-long association with ISRO, Data Patterns has supplied the 14000 point count down checkout system for the second launch pad, upgraded the launch vehicle tracking radars, supplied the X-Band and C-Band weather radars, the company said.

Almost all the electronics of the Launch vehicle are checked out using Data Patterns' indigenous test system solutions. With the guidance of ISRO, Data Patterns is also regularly building Avionics packages for both Launch vehicles and satellites, the company added.

About a week ago, DR K Sivan, Chairman, ISRO had said that Gaganyaan design is in the final stages and project realization has started, all efforts are on for first unmanned mission trial by this year end. Gaganyaan is expected to witness two unmanned trials, before the manned mission which is scheuled for 2022-23.

<https://zeenews.india.com/india/isro-gaganyaan-indian-pvt-firm-delivers-component-for-crew-module-2348781.html>



Fri, 19 March 2021

Scientists take step towards quantum supremacy

A Russian-German research team has created a quantum sensor that grants access to measurement and manipulation of individual two-level defects in qubits. The study by NUST MISIS, Russian Quantum Center and the Karlsruhe Institute of Technology, published in *npj Quantum Information*, may pave the way for quantum computing.

In quantum computing the information is encoded in qubits. Qubits (or quantum bits), the quantum mechanical analog of a classical bit, are coherent two-level systems. A leading qubit modality today is superconducting qubits based on the Josephson junction. That is the kind of qubit IBM and Google use in their quantum processors. However, scientists are still searching for the perfect qubit—one that can be precisely measured and controlled, while remaining unaffected by its environment.

The key element of a superconducting qubit is the nanoscale superconductor-insulator-superconductor Josephson junction. A Josephson junction is a tunnel junction made of two pieces of superconducting metal separated by a very thin insulating barrier. The most commonly used insulator is aluminum oxide.



Qubit production process. Credit: Sergey Gnuskov/NUST MISIS

Modern techniques do not allow to build a qubit with 100% precision, resulting in so-called tunneling two-level defects that limit the performance of superconducting quantum devices and cause computational errors. Those defects contribute to a qubit's extremely short life span, or decoherence.

Tunneling defects in aluminum oxide and at surfaces of superconductors are an important source of fluctuations and energy losses in superconducting qubits, ultimately limiting the computer runtime. The more material defects occur, the more they affect the cubit's performance, causing more computational errors, the researchers noted.

The new quantum sensor grants access to measurement and manipulation of individual two-level defects in quantum systems. According to Prof. Alexey Ustinov, Head of the Laboratory for Superconducting Metamaterials at NUST MISIS and Group Head at Russian Quantum Center, who co-authored the study, the sensor itself is a superconducting qubit, and it allows the detection and manipulation of individual defects. Traditional techniques for studying material structure, such as small-angle X-ray scattering (SAXS), are not sensitive enough to spot small individual defects,

therefore using those techniques won't help to build the best qubit. The study may open avenues for quantum material spectroscopy to investigate the structure of tunneling defects and to develop low-loss dielectrics that are urgently required for the advancement of superconducting quantum computers, the researchers believe.

More information: Alexander Bilmes et al, Quantum sensors for microscopic tunneling systems, *npj Quantum Information* (2021). DOI: [10.1038/s41534-020-00359-x](https://doi.org/10.1038/s41534-020-00359-x)
<https://phys.org/news/2021-03-scientists-quantum-supremacy.html>



Fri, 19 March 2021

How deep is a mirror? It depends, but the calculations are more precise now

Light reflects from a mirror, but where exactly does this reflection happen? Well, it depends, Martin van Exter and Corné Koks discovered. Their precise calculations, published in *Optics Express*, are important for designing optical cavities for quantum communication.

"To tell you the truth, many researchers have been a bit sloppy," says Martin van Exter. "We have dotted some i's and crossed some t's." Van Exter is talking about Distributed Bragg Reflectors (DBRs), "the standard type of mirror in physics." They are made of stacked layers of glass with alternating refractive indexes. Van Exter: "They work very well. By just stacking enough layers, you can attain up to 99.99 percent reflection."

But a consequence of using glass is that light penetrates the mirror partly. How deep does this penetration go? Van Exter and Ph.D. student Corné Koks wondered.

"We use these mirrors to make optical cavities. Two small mirrors opposite each other, with the light reflecting back and forth. Pretty small mirrors, too," says Van Exter. The distance between the mirrors is only 2 or 3 micrometers, about a 50th the thickness of a hair. This is only a little larger than the wavelength of the light. "So for us, it matters how far the light penetrates the mirror."

Penetration depth

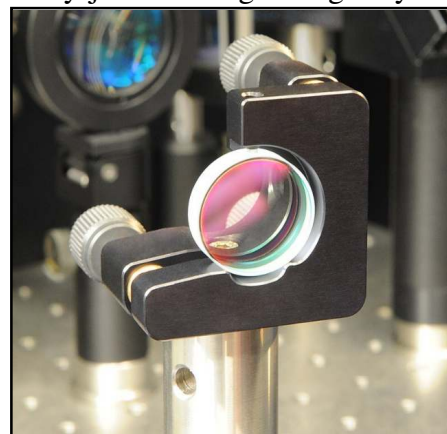
Koks and Van Exter carried out a thorough mathematical analysis of the behavior of electromagnetic radiation in DBRs, and concluded that there are three different penetration depths, depending on what exactly one would like to measure.

Light within a cavity can be a standing electromagnetic wave, with nodes (where the amplitude is zero) and antinodes (where the amplitude is maximal). The point in the mirror where the node is located, was dubbed the phase penetration depth by Van Exter and Koks. "This penetration depth is not very deep, typically almost on the surface of the mirror," says Van Exter, 'this holds for light of one wavelength."

"But sometimes, you don't use single wavelength, but a pulse," says Van Exter, "but a pulse. When you calculate how fast this pulse returns, and therefore from what depth, the penetration depth turns out to be larger. This, we call the frequency penetration depth." Next to that, the physicists define a third modal penetration depth, applicable for sharply focused beam of light.

Sloppy calculations

The conclusion is that there are three different penetration depths. Which one one should use, depends on exactly what you want to measure. "These are no revolutionary changes," says Van



A DBR, aka a Bragg mirror. Credit: Wikimedia Commons

Exter, "but we do show this for the first time, and we note that physicists are often sloppy when calculating their optical setups."

The difference are important for optical cavities made by Van Exter's research group, which can possibly be used for quantum communication in the future. Van Exter says: "One of the holy grails is to transfer the quantum state of a photon to a single atom or molecule, or vice versa. You might be able to do that by reflecting the light back and forth in an optical cavity holding one atom. But then you must be able to calculate the exact size of your cavity, and therefore the depth of your mirror."

More information: C. Koks et al. Microcavity resonance condition, quality factor, and mode volume are determined by different penetration depths, *Optics Express* (2021). [DOI: 10.1364/OE.412346](https://doi.org/10.1364/OE.412346)

Journal information: [Optics Express](https://phys.org/news/2021-03-deep-mirror-precise.html)
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Mystery of the nanobubbles solved

Water containing suspended nanobubbles is utilized in many biological and medical applications. For example, nanobubbles increase the efficiency of drug and gene delivery. Water containing oxygen nanobubbles is used in wastewater treatment, to promote the growth of plants and animals, and as a cure for diseases caused by anaerobic bacteria. The observed lifetime of suspended nanobubbles is up to several weeks. However, according to the classical theory of bubble stability, a nanosized bubble should dissolve within microseconds. This controversy between experiments and theory is known as the nanobubble paradox.

Now, researchers of VTT Technical Research Centre of Finland, Tapio Vehmas and Lasse Makkonen, have solved this paradox. According to their thermodynamic analysis, nanoscale bubbles indeed dissolve rapidly, but when the bubble is sufficiently small already upon its formation, the dissolving process does not begin. This is because when a very small bubble shrinks, the energy that is required to create the supersaturation necessary to transfer gas from the bubble boundary to the liquid, is more than the corresponding reduction in the surface energy of the bubble. According to Vehmas and Makkonen, the bubble diameter, below which dissolving does not begin in saturated water at room temperature, is 180 nanometers.

The study by Vehmas and Makkonen clarifies why nanobubbles can exist, and what is the basis of producing them. This will assist in developing more efficient nanobubble generators. The new theory can be applied also to nanobubbles attached to surfaces. Surface nanobubbles are utilized, for example, in cleaning, and in reducing friction of objects moving in water.

The study "Metastable nanobubbles" by Makkonen and Tikanmäki was published in American Chemical Society's journal *ACS Omega*.

More information: Tapio Vehmas et al. Metastable Nanobubbles, *ACS Omega* (2021). [DOI: 10.1021/acsomega.0c05384](https://doi.org/10.1021/acsomega.0c05384)

Journal information: [ACS Omega](https://phys.org/news/2021-03-mystery-nanobubbles.html)
<https://phys.org/news/2021-03-mystery-nanobubbles.html>



Sample in the middle scatters coherent laser light which indicates presence of nanosized bubbles. Scattering of the laser light indicates presence of surfaces. In daylight, all samples are transparent which presents that the surfaces are in nanoscale. Credit: Tapio Vehmas

Links between COVID-19 and skin rashes

- *A new study investigates the relationship between COVID-19 and skin rashes.*
- *The authors found a significant association between skin rashes and a positive SARS-CoV-2 test.*
- *More than 1 in 5 people with a SARS-CoV-2 infection reported skin changes as the only symptom of infection.*

As we pass the 1-year mark of the COVID-19 pandemic, scientists are still discovering the specific characteristics of this new disease.

Perhaps the most obvious physical impact of COVID-19 is on the lungs, but doctors and researchers have also found links between COVID-19 and various other organs and systems, including the heart, brain, and kidneys.

SARS-CoV-2 infection also appears to affect the largest organ of the body — the skin.

In a recent study, which appears in the *British Journal of Dermatology*, a group of researchers teamed up with the British Association of Dermatologists to develop a better understanding of the skin manifestations associated with COVID-19.

COVID-19 and the skin

The first mention of a link between COVID-19 and skin changes came from China in the early phase of the outbreak.

Initially, it seemed that skin changes were relatively uncommon. In one analysis from February 2020, for instance, researchers reported rashes in fewer than 0.2% of 1,099 people with laboratory-confirmed COVID-19 across 552 hospitals.

Shortly after, in March, a study identified “cutaneous manifestations” in 18 out of 88 patients, or 20.4%, who were receiving treatment for COVID-19 at one hospital in Italy.

Since then, a number of other studies have identified skin changes associated with COVID-19. However, some of these reports only included limited numbers of participants. To date, scientists have not identified the full extent and variety of skin changes related to SARS-CoV-2 infection.

The most recent study investigates the issue in a large sample of participants.

A fresh look

The authors of the recent study took data from the COVID Symptom Study app. This collects a wealth of data, including information about participants’ age, sex, ethnicity, weight, height, general health, and use of medications, as well as whether the person is a healthcare worker.

Since May 2020, the app has prompted users to report any SARS-CoV-2 testing and results. A person can also report any symptoms.

In all, the researchers had access to data from 336,847 app users, 17,407 of whom had undergone a SARS-CoV-2 test, either positive or negative. The scientists also included data from 54,652 people who had registered at least one symptom of COVID-19 but had not taken a test. The authors refer to this group as “symptomatic untested users.”

Additionally, the researchers sent out a survey, which was advertised on social media. This was not targeted at users of the app. It asked for information about when a rash appeared, how long it lasted, and what other symptoms were present.

From this survey, the researchers extracted usable data from 11,544 people. Of this group, 2,328 had provided a photo of their rash and gave permission to share it. The team selected a subset of these photos, which they whittled down to 260 images.

The images were “blindly assessed and independently categorized by four experienced dermatologists.” Among the 260 photographs, 52 were discarded by at least one dermatologist, and 208 images were analyzed.

Stay informed about COVID-19

Get the latest updates and research-backed information on the novel coronavirus direct to your inbox.

<https://www.medicalnewstoday.com/articles/links-between-covid-19-and-skin-rashes#A-fresh-look>

