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

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Tue, 09 March 2021

Lightweight torpedo test-fired successfully

The anti-submarine missile is indigenously developed by NSTL

By Sumit Bhattacharjee

Visakhapatnam: The indigenously-instrumented Advanced Light Torpedo (TAL), developed by the Naval Science and Technological Laboratory (NSTL), successfully cleared its maiden flight trial with a parachute system from the Indian Navy's Ilyushin Il-38 maritime patrol aircraft on Monday.

This was the Country's first such trial where the indigenous lightweight torpedo was fired from a fixed-wing aircraft.

The lightweight torpedo was designed, developed, produced and inducted into services a decade ago and is used against underwater platforms as part of anti-submarine warfare (ASW).

To enhance the range of quick acquisition of the target, the Navy scheduled the launch of TAL from fixed-wing aircraft of the Navy, for precise attacks at desired locations.

The torpedo, along with Torpedo Release Mechanism and Fire Control System, are designed and developed by the NSTL.

The torpedo, on safe separation from the aircraft, descends with the help of a parachute and the TRM detaches the parachute, enabling the torpedo to continue its operation in waters. The parachute is designed by ADRDE, Agra. The TAL can track multiple targets simultaneously using state-of-the-art processor-based signal processing algorithms.

The trial team, led by Principal Project Director R.V.S. Subrahmanyam and other members from NSTL and ADRDE Agra, participated in the trial along with the Indian Navy.

NSTL Director Dr O.R. Nandagopan congratulated the team and acknowledged the participation of the Indian Navy and other DRDO establishments such as ADRDE, ADE, and CEMILAC.

<https://www.thehindu.com/news/national/andhra-pradesh/lightweight-torpedo-test-fired-successfully/article34022882.ece>

India is set to become a competitive exporter in the global defence market

Prime Minister Narendra Modi set a target for Indian defence exports: \$5 billion by 2024. Recently, the Union cabinet cleared the export of Akash missile systems and formed a high-powered panel to grant swift approval to export military hardware.

Besides Akash, surface-to-air missile systems, the BrahMos supersonic cruise missile and larger weapon systems can now be sold to “friendly foreign” nations that have a robust system to manage these assets. It will also help improve strategic ties with them. Until now, India has only exported ordnance and smaller armaments.

Experts believe that apart from Akash and BrahMos, other missiles like Prahaar and the air-to-air Astra have huge export potential. Astra, which has a range of 100km, is now entering the production stage after completing successful trials from the Sukhoi Su-30MKI jet.



Two things hampered the sale of indigenously developed missiles: the lack of effort to sell and a strong lobby of First-World nations that dominates defence markets. India also lacked the policy to push defence exports, despite defence scientists seeking export permission since 2005.

Interestingly, from 2015 to 2019, India was the world’s second-largest importer of weapons, after Saudi Arabia. India imported 9.2 per cent of the arms produced globally. India did though manage to export defence equipment worth Rs10,745 crore in 2018-19, seven times the figure in 2016-17.

According to an observer in South Block, efforts are on to fast-track the long-promised sale of BrahMos and Akash to Vietnam. This deal with China’s neighbour is also a clear message to Beijing.

India’s missile programme took off in 1982 when Prime Minister Indira Gandhi decided to develop indigenous missile systems. She formed a Missile Study Team with A.P.J. Abdul Kalam as its head. The team recommended the phased development of five missiles—Trishul and Akash surface-to-air missiles, Nag anti-tank missile, Prithvi short-range ballistic missile and Agni.

Four decades on, the Philippines, Indonesia, Vietnam, the UAE, Bahrain, Saudi Arabia, Egypt, Kenya and Algeria have expressed their interest in the Akash, which is capable of targeting aerial assets within a range of 25km. The missile was inducted into the Indian Air Force in 2014 and the Army in 2015.

Defence officials claim that Akash is around 50 per cent cheaper than its competitors. Other Indian systems like radars and sonars, too, cost only a quarter to one-fifth of similar systems available in the global market. All export versions will be different from the ones inducted into the Indian armed forces, as no country sells the best variant.

The 290-km range BrahMos, which has a range of 290km, is being eyed by Indonesia, the UAE, Saudi Arabia, South Africa, Vietnam and the Philippines. All formalities have been completed with the Philippines—including a green light from Russia, as the missile development project was a joint venture—and the matter is awaiting final approval from the cabinet committee for security.

William Selvamurthy, a scientist who served as chief controller of research and development at the Defence Research and Development Organisation, says that India was running First World industries because it has the world’s fourth-largest air force and its requirements are huge.

“There was a lot of pressure on India to not develop missile systems,” said Selvamurthy. “Countries dominating the field of missile technology do not want any other player in the global market. They had put restrictions under non-proliferation treaties.” He said India is now strong enough to make a decision. “With selling missiles, we will be competing with the US, Russia and other European nations,” he said.

Retired Air Vice-Marshal P.K. Srivastava, who served in Bharat Dynamics Limited (BDL), the manufacturer of the Akash, says that it took close to 20 years for the missile to reach this stage. It took a lot of time to progress from design drawing to production drawing, he said, followed by about 1,000 corrections and modifications before it was finally inducted into the armed forces. So far, the armed forces have ordered Akashes worth Rs24,000 crore; an Rs10,000-crore contract is in the works.

“Initially, we (BDL) wanted to set up the whole supply chain by involving private players and go for bigger numbers later,” said Srivastava. “I feel the time is now ripe for us to (export). We must pitch Akash as the cheapest in its category. We can give Israel a good fight, which also sells cheap military platforms in the segment.”

He added that there was no policy to export as India never intended to sell. “We always had the capacity, but never thought of exploiting it,” he said. As talks are on about upgrading the Akash to the Mk-II variant, the Mk-I can be safely sold.

On the export potential of BrahMos, India is considering multiple options. A. Sivathanu Pillai, the architect of the BrahMos missile, said that the priority was to first meet the requirement of Indian defence forces. During his tenure as chief of BrahMos, nearly 14 countries expressed interest in the missile.

Pillai said that as India is now a member of the Missile Technology Control Regime (MTCR), it can sell missiles with a range beyond 300km. “We are definitely interested in exporting, but not the best systems,” said Pillai. “In the case of exporting the Akash, of which other versions are available, there should not be an issue. But while exporting a BrahMos-type missile, which is a ‘winning weapon’, we need to be careful.”

BrahMos NG, which has a limited range, can be exported, he said. The BrahMos’s range is now being extended to over 400km; efforts are underway to test an 800km variant by the end of this year. The Indian armed forces have placed a Rs 36,000-crore order for the BrahMos.

Pillai also highlighted an additional issue: “If we go in for exports, our priority may be shifted because of multiple government-to-government agreements. Our mind will be diverted if the focus is on selling.”

Former DRDO Scientist Ravi Gupta partly blames the armed forces for preventing exports. He said unless a weapons system is inducted in significant numbers at home, external buyers will not trust the platform. “Sadly, we were the only country in the world which was working against its own national interest,” said Gupta. “In India, the induction of a military platform takes more time than its development.” He added that because of huge kickbacks in defence deals, the indigenous sector did not get the desired attention.

The situation is changing fast as many indigenous platforms, including the recently approved Tejas light combat aircraft, have been ordered for the armed forces. There is an effort to cut imports and bring the indigenous defence industries together to meet the demand at home.

Defence scientists have maintained that India is considerably self-reliant and that once we start exporting, a market will be formed outside and private players can also join. “Not only Defence PSUs but private sectors of the Indian Defence Industry, too, have grown,” said Selvamurthy. “The ecosystem has changed and it is time to go in for exports.”

<https://www.eletimes.com/india-is-set-to-become-a-competitive-exporter-in-the-global-defence-market>

As Indian DRDO aims for hypersonic missiles, expert predicts three complications in the new-gen missiles

India has joined the global race in developing hypersonic weapons, which can hit the target without being intercepted. Countries are going for hypersonic missiles essentially to protect themselves from ballistic missile defense systems, according to an Indian missile expert.

China became the first country to publicly announce the deployment of hypersonic weapons when its DF-17 missile was on display during the National Day military parade on October 1, 2019.

Then, in December 2019, Russia announced the deployment of its Avangard missile. According to Russian media, the Avangard is a strategic intercontinental ballistic missile system equipped with a hypersonic boost-glide vehicle and is capable of flying at over 20 times the speed of sound in the dense layers of the atmosphere.

While India too had set its sights on possessing hypersonic technology for some time and even had to go through some failures, it finally made a breakthrough last year.

In September 2020, India's Defense Research and Development Organisation (DRDO) successfully test-fired the Hypersonic Technology Demonstrator Vehicle (HSTDV), joining the elite hypersonic club.

The tests also laid the foundation for the development of a hypersonic cruise missiles system in the future, which would be a significant addition to India's military might.

Hypersonic weapons belong to the class of weapons that can travel at a speed faster than Mach 5 or can travel five times the speed of sound.

The supremely fast weapons possess the ability of maneuvering between varying altitudes and azimuths, making them harder to detect.

They are deadly weapons as they have the speed of a ballistic missile and the maneuverability of a cruise missile.

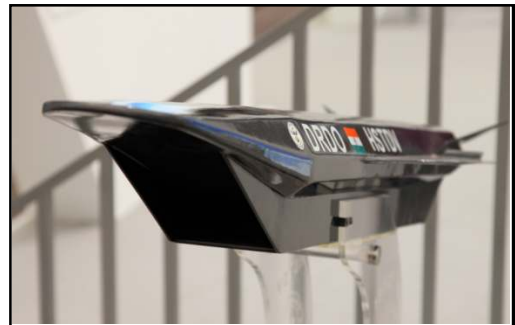
The hypersonic weapons have been specially designed to counter modern ballistic missile defense systems and to deliver conventional and nuclear payload at high velocities over long ranges, making them a huge threat.

According to Dr. Manpreet Sethi, a distinguished fellow at the Centre of Air Power Studies (CAPS), hypersonic missiles are being inducted by countries, which already possess nuclear weapons.

However, there is still ambiguity over whether these missiles will carry conventional or nuclear warheads, she says, although Russia has indicated that its hypersonic missile, most probably, the Avangard, is a nuclear delivery system.

In an interview published on the CAPS website, Sethi predicts three immediate complications, which could arise with the arrival of hypersonic weapons.

"In nuclear-possessing countries, this kind of ambiguity (whether they could carry nuclear or conventional warheads) could be problematic for their strategic stability. The tendency would be to assume the worst. Once the early warning system picks up a missile coming in, you are not sure



where it is headed, you could then assume that it is going for your nuclear assets. Therefore, there would be a tendency among countries to lower the alert-level postures they have.”

“The second problem could arise in the offense-defense spiral because you are going to counter ballistic missile defense system with hypersonic missiles. But countries like the US are already strengthening their ballistic missile defense or bringing up counter-measures to hypersonic weapons.”

“The third complication — this will get us into the weaponization of space very quickly. Interceptors to hypersonic missiles will have to have both interceptors and sensors in space,” she says, indicating that future wars may be fought in space.

Moscow has reportedly stepped up the development of its Avangard intercontinental ballistic missiles (ICBMs), which could pose a significant threat to Washington as the relations between the two nuclear-armed nations are far from smooth.

First mentioned by President Vladimir Putin in March of 2018, the Avangard is a hypersonic glide vehicle (HGV).

According to reports, it can be carried as a MIRV (Multiple independently targetable reentry vehicle) payloads by the UR-100UTTKh, R-36M2, and RS-28 Sarmat heavy ICBMs.

The US Army is already on course of delivering its first hypersonic weapon capability to one of its units, which could be done before the end of this current year.

India too has stepped on the gas. After the successful launch of the indigenously-developed Hypersonic Technology Demonstrator Vehicle (HSTDV), the DRDO is now looking to develop a complete hypersonic cruise missile system in the next four to five years.

Such a capability will boost the ability of the military in targeting speeds two times that of the BrahMos supersonic cruise missile, enabling India to have a significant advantage in future strike capabilities.

<https://eurasianimes.com/indian-missile-expert-predicts-three-complications-from-hypersonic-weapons/>



Tue, 09 March 2021

Philippines and India sign deal paving the way for BrahMos missile procurement

By Xavier Vavasseur

On March 2, 2021, the Philippines and India signed a government-to-government agreement on defense equipment procurement, paving the way for the sale of the Brahmos missile to the Philippines.

The main content of the agreement is the intention of the Philippines to acquire the BrahMos coastal defense system with supersonic missiles produced by the Russian-Indian joint venture BrahMos Aerospace. However, the agreement itself is not a contract.

In 2020, local media reported that India offered the Philippines a \$ 100 million credit line for the purchase of Indian weapons systems, most notably BrahMos missiles, but now a Filipino government source involved in the deal said the amount of the Indian loan could be higher. In January 2020, the CEO of BrahMos Aerospace, Sudhir Mishra, visited the Philippines to discuss the sale of the BrahMos missile system.



Prototype of the Russian-Indian coastal mobile missile system Brahmos demonstrated during the Technology Day of the Philippine Army in 2019. Picture via MaxDefense PH.

For the record, the Philippines have shown interest in the purchase of the BrahMos since 2016. It was reported that negotiations were underway since 2019 regarding the procurement of two mobile batteries for the Philippine army under the Land-Based Missile System (LBMS) program. A mock-up of the Philippine army version of the launcher was shown. The missiles were fitted on a semi-trailer towed by a South Korean KIA KM500 truck. In addition, in the spring of 2020, there were reports of the Philippine Navy's intention to purchase three batteries of the BrahMos system. However, in early December 2020, the Philippine government decided to postpone the plan, for financial reasons (linked to the ongoing coronavirus pandemic).

Keeping the Chinese Navy at bay

The Philippines are worried about the rise of the People's Liberation Army Navy (PLAN or Chinese Navy). The PLAN already controls many islets such as the Spratly Islands and the Scarborough Shoal. The recent discovery of a Chinese submarine drone on the nearby Selayar Island and a new law allowing Chinese coast guard to open fire on foreign ships in waters claimed by China continue to fuel tensions in the region.

The Brahmos procurement would offer the Philippines a way to deter China's expansionism and somewhat restore the military balance between the two countries. Should the Philippines go ahead with the Brahmos procurement plan, it would become the first export customer of the system.

About Brahmos

The BrahMos is a medium-range ramjet supersonic cruise missile that can target ship and land targets and can be launched from submarine, ships, aircraft, or land. It is designed by Brahmos Aerospace, a joint venture between the Russian Federation's NPO Mashinostroyeniya and India's Defence Research and Development Organisation (DRDO).

The baseline Brahmos ground launched cruise missile (GLCM) has a launch range of approximately 290 km (180 miles) and speed of Mach 2.8-3.0. In 2016, India joined the Missile Technology Control Regime (MTCR) and got the right to develop cruise missiles with extended launch ranges for the national armed forces. In March 2017, the Indian defense industry tested an extended-range variant of the missile known as Brahmos-ER (ER for Extended Range), which was reported to be able to hit targets at a distance of approximately 400 km. BrahMos-II is a hypersonic cruise missile currently under development and is estimated to have a range of 600 km and a speed of Mach 8. BrahMos-NG (Next Generation) is a mini version based on the existing BrahMos. While it has similar 290 km range and mach 3.5 speed, it is much smaller to be able to be deployed from Indian Air Force aircraft such as Mig-29K, HAL Tejas or Dassault Rafale.

According to Brahmos Aerospace, Brahmos is a two-stage missile with a solid propellant booster engine as its first stage which brings it to supersonic speed and then gets separated. The liquid ramjet or the second stage then takes the missile closer to 3 Mach speed in cruise phase. Stealth technology and guidance system with advanced embedded software provides the missile with special features.

<https://www.navalnews.com/naval-news/2021/03/philippines-and-india-sign-deal-paving-the-way-for-brahmos-missile-procurement/>

All about DRDO Skill development centre for fire safety training

Rajnath Singh, the Defence Minister of India has inaugurated a DRDO Skill Development Centre for Fire Safety Training at Pilkhuwa in UP. Know all about the facility, the technical availability and the significance of its presence

By Tulika Tandon

Why in News?

Rajnath Singh recently inaugurated Skill Development Centre (SDC) for Fire Safety Training of DRDO at Pilkhuwa in the state of Uttar Pradesh (UP).

About DRDO SDC

1. The SDC DRDO facility would be helpful in developing trained human resources along with fire safety technology and products that can be used to save life and assets.
2. The facility would be utilised for imparting fire prevention and fire-fighting training to the Fire Service personnel of Indian Armed Forces, DRDO, Ordnance Factories, Coast Guard and defence undertakings.
3. **First of its Kind:** The facility is first of its kind developed by a Delhi based DRDO Lab called the Centre for Fire, Explosive and Environment Safety. The facility was established in 1992.
4. Armaments Directorate of DRDO manages and administers CFEES
5. The Skill development facility is spread in a 24 acres area at Pilkhuwa.
6. As per the Govt of India, various trainees from Bhutan, Sri Lanka and other neighbouring countries would also be imparted training at the Centre.



Technical Facilities at DRDO SDC:

1. The facility has been created by the adoption of state of the art technology which involved various simulation systems validating fireside at a sensible scale.
2. It has been specially designed to meet the challenges and enhance the skills of Defence Fire Service Personnel and Combatants from the armed forces.
3. SDC has four bays with fire-fighting and rescue appliances.
4. The appliances include hydraulic platform, air crash fire tender and emergency rescue tender.
5. These would be used for imparting practical/hands-on training.
6. They would also provide for important life-saving personal protective equipment for the fire fighters.
7. The Centre has a Fire Drill Tower.
8. It also has an emergency escape chute that is to be used for simulation of fire in high rise buildings, Breathing Apparatus Training Facility, a Model Fire Station that has specialised fire-fighting and rescue appliances, LPG Petroleum Tank Farm Simulator, Fire Suit Test and Evaluation facility, a Hostel and Transit Facility and Administrative and Training Facility.
9. The SDC is to be managed and maintained by CFEES. It is the organization that carries out safety audits, training activities and R&D activities in the area of fire, explosive & environment safety.
10. CFEES trains almost 500 personnel every year in modules customised to the needs of Ministry of Defence (MoD) establishments.

Significance:

1. The high standard facilities to be used in this SDC would result in enhanced levels of fire safety awareness.
2. It would also lead to the implementation of safety provisions in defence establishments which in turn would minimise the loss of life and property due to fire accidents.
3. As per the National Crime Records Bureau, every fifth death in the world is due to that in India caused by fire. As many as 13000 fire accidents occurred in the country in 2018 which need enhanced mechanisms to be saved.
4. India loses as many as 35 people per day due to fire and two thirds of people facing fire accidents belong to the age group of 18-40, maximum of them being women.

<https://www.jagranjosh.com/general-knowledge/all-about-drdo-skill-development-centre-for-fire-safety-training-inaugurated-by-rajnath-singh-1615208119-1>

Defence News

Defence Strategic: National/International



Press Information Bureau
Government of India

Ministry of Defence

Mon, 08 March 2021 4:30PM

Government spending on military modernisation

Modernisation of Armed Forces is a systematic process carried out as per the Defence Procurement Procedure (DPP)/ Defence Acquisition Procedure (DAP). The modernisation process aims at keeping the Indian Armed Forces in state of operational readiness and optimally equipped with modern weapon systems. The budget allocation for modernisation of defence equipment is utilized to meet the operational requirement of the Armed Forces and for acquisitions of contemporary systems based on the planned priorities of the Defence Forces. DPP/DAP accords highest priority to Buy Indian (Indigenously Designed, Developed and Manufactured) (IDDM). Government has put in place enablers to achieve higher level of the indigenization and self-reliance in the defence sector by harnessing the capabilities of the public and private sector industries in the country.

The Details of Budget Estimates 2020-21, Revised Estimate 2020-21 and Budget Estimate 2021-22 on the Modernisation (Capital Acquisition) of Armed Forces, under Defence Service Estimate (DSE) is as under:

	Budget Estimates 2020-21	Revised Estimates 2020-21	Budget Estimates 2021-22
Capital Acquisition (Modernisation)	90,047.80	1,14,320.30	1,11,463

During last five financial year (2015-16 to 2019-20) and current year (upto January 2021), 304 contracts were signed. Out of total 304 contracts, 190 contracts have been signed with Indian vendors for capital procurement of defence equipment for Armed Forces.

In May, 2001, the Defence Industry sector, which was hitherto reserved for the public sector, was opened up to 100% for Indian private sector participation, with Foreign Direct Investment (FDI) up to 26% both subject to licensing. Further, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry vide Press Note No. 4 (2020 Series), has allowed FDI under automatic route upto 74% and above 74% through government route wherever it is likely to result in access to modern technology or for other reasons to be recorded. In addition, 44 FDI proposals / Joint Ventures have been approved so far in defence sector for manufacturing of various defence equipments. FDI inflows of over Rs. 4191 crores have been reported by the defence and aerospace sector till January, 2021.

In addition, following provisions have been made in Defence Acquisition Procedure(DAP) - 2020 for tie-ups with foreign companies for manufacture of defence equipment in the country:-

- i. Under Buy and Make (Indian) category, Indian vendor(s) can tie-up with a foreign Original Equipment Manufacturer (OEM), for indigenous production involving transfer of technology of critical technologies.
- ii. Buy(Global-Manufacture in India) category refers to an outright purchase of equipment from foreign vendors, in quantities as considered necessary, followed by indigenous manufacture of the entire/part of the equipment and spares/assemblies/sub-assemblies/maintenance along with repair and overhaul (MRO) facility(only in cases where these are part of the main contract) for the equipment, through its subsidiary in India/through a Joint Venture/through an Indian Production Agency(PA)(with ToT of critical technologies to the Indian PA), meeting a minimum of 50 % Indigenous Content (IC) on cost basis of the Base Contract price.
- iii. Government has notified the 'Strategic Partnership (SP)' Model in May 2017, which envisages establishment of long-term strategic partnerships with Indian entities through a transparent and competitive process, wherein they would tie up with global Original Equipment Manufacturers (OEMs) to seek technology transfers to set up domestic manufacturing infrastructure and supply chains.
- iv. Under the offset guidelines of DAP-2020, following avenues have been made available for discharge of offset obligations: -
 - Investment in defence manufacturing: This could be through FDI or direct investment or joint ventures or through the non-equity route for co-production, co-development and production or licensed production of defence products.
 - Investment in ToT to Indian enterprises for manufacture of eligible products.
 - Acquisition of technology through ToT to Government institutions and establishments engaged in the manufacture and/or maintenance of eligible products as listed in DAP-2020.

In order to encourage discharge of Offset obligation in investment of defence manufacturing and Transfer of Technology, higher multipliers have been assigned in the revised Offset policy under DAP-2020.

Following initiatives have been taken to facilitate Defence Public Sector Enterprises (DPSUs), Ordnance Factory Board (OFB) and Private Defence Players to explore business opportunities abroad:

- i. Export Promotion cell has been constituted to co-ordinate and follow-up on export related action including enquiries received from various countries and facilitate private sector and public sector companies for export promotion.
- ii. Defence Attaches in Indian Missions abroad, have been mandated for export promotion of Indigenous defence products of both public and private sector. A scheme for Export promotion of Indian Defence Equipment manufactured in India has also been rolled out wherein Defence Attachés are provided financial support to promote export of indigenous defence equipment abroad.
- iii. Subject to strategic and diplomatic considerations, domestically manufactured defence products are promoted through Lines of Credit/Gratis. Defence Lines of Credit (LOCs)/Gratis are

extended to identified Friendly Foreign Countries (FFCs) to enable them to import Defence goods and services from India on attractive terms.

- iv. Geographical countries/regions have been allocated to DPSUs/OFB for establishment of their offices in various countries to promote export of Indigenous defence platforms/equipment.
- v. An online portal has been created through which export leads received from various countries are disseminated directly to the Indian Defence Exporters who are registered on the portal.
- vi. Webinars in coordination with Indian Missions abroad, DPSUs/OFB and Private Industry Associations have been organised with 15 Foreign Friendly Countries during the year 2020-21 to promote defence exports.

This information was tabled in a written reply by Raksha Rajya Mantri Shri Shripad Naik to a question asked by Shri P Bhattacharya and Smt Priyanka Chaturvedi in Rajya Sabha today.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1703203>



**Press Information Bureau
Government of India**

Ministry of Defence

Mon, 08 March 2021 4:31PM

Defence budget

Details of total projections and allocations made to Armed Forces {Army, Navy (including Jt. Staff), and Air Force} covering both Revenue (Net) and Capital Heads are as under:-

Year	BE	
	Projected	Allocated
2014-15	2,84,079.55	2,10,403.60
2015-16	2,62,335.84	2,27,874.05
2016-17	2,69,242.84	2,33,551.93
2017-18	3,37,238.49	2,41,381.70
2018-19	3,68,786.05	2,58,887.19
2019-20	3,71,033.22	2,84,226.76
2020-21	4,03,219.61	3,01,115.86
2021-22	4,49,508.45	3,24,657.56

Details of projections and allocations made to Armed Forces {Army, Navy (including Jt. Staff), and Air Force} under Capital Head are as under:-

Year	BE	
	Projected	Allocated
2014-15	1,32,597.69	84,076.95
2015-16	1,04,398.76	86,032.41
2016-17	1,09,449.90	78,731.32
2017-18	1,33,126.34	78,124.04
2018-19	1,57,962.78	83,434.04
2019-20	1,56,776.11	92,014.87
2020-21	1,61,849.20	1,02,432.57
2021-22	1,99,553.44	1,23,000.22

It may be observed from the above tables that the allocations received from Ministry of Finance are not as per projections made, however, based on pace of expenditure, pending committed liabilities etc., additional funds are sought during the course of the financial year at appropriate stages. It is further submitted that, if necessary, re-prioritization is undertaken to ensure that urgent and critical capabilities are acquired without any compromise to operational preparedness of the Defence Services.

This information was tabled in a written reply by Raksha Rajya Mantri Shri Shripad Naik to a question asked by Shri K C Venugopal and Shri Mallikarjun Kharge in Rajya Sabha today.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1703205>



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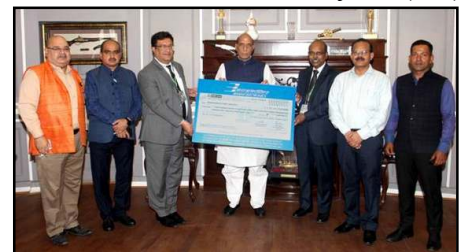
Ministry of Defence

Mon, 08 March 2021 2:43PM

BEL pays Rs 174.43 crore interim dividend to Government

Navratna Defence Public Sector Undertaking (DPSU) Bharat Electronics Ltd (BEL) has paid interim dividend of 140 per cent on its paid-up capital to the Government for financial year (FY) 2020-21.

Chairman & Managing Director of BEL Shri M V Gowtama presented the Interim Dividend cheque of Rs 174,43,63,569.20/- (Rupees one hundred seventy-four crore forty-three lakh sixty-three thousand five hundred sixty-nine and twenty paise only), payable on the shares held by the President of India, to the Raksha Mantri Shri Rajnath Singh in New Delhi on March 08, 2021. The BEL has declared 140 per cent as interim dividend (Rs 1.40/- per share) to its shareholders for the FY 2020-21.



This is the 18th consecutive year that BEL is paying interim dividend. It had paid a total dividend of 280 per cent on its paid-up capital for the FY 2019-20.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1703166>



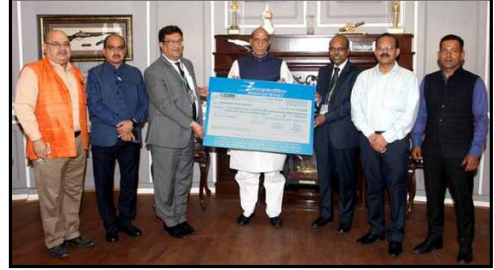
पत्र सूचना कार्यालय
भारत सरकार
रक्षा मंत्रालय

Mon, 08 March 2021 2:43PM

बीईएल ने सरकार को 174.43 करोड़ रुपये का अंतरिम लाभांश दिया

नवरत्न डिफेंस पब्लिक सेक्टर अंडरटेकिंग (डीपीएसयू) भारत इलेक्ट्रॉनिक्स लिमिटेड (बीईएल) ने वित्त वर्ष 2020-21 के लिए सरकार को अपनी पेड-अप कैपिटल पर 140 फीसदी का अंतरिम लाभांश दिया है।

बीईएल के अध्यक्ष एवं प्रबंध निदेशक श्री एम वी गौतम ने दिनांक 8 मार्च, 2021 को नई दिल्ली में रक्षा मंत्री श्री राजनाथ सिंह को भारत के राष्ट्रपति द्वारा रखे गए शेयरों पर देय 174,43,63,569.20 रुपये (एक सौ चौहत्तर करोड़ तियांलीस लाख तिरसठ हजार पांच सौ उनहत्तर रुपये बीस पैसे) का अंतरिम लाभांश चेक भेंट किया। बीईएल ने वित्त वर्ष 2020-21 के लिए अपने शेयरधारकों को अंतरिम लाभांश (1.40/- रुपये प्रति शेयर) के रूप में 140 प्रतिशत घोषित किया है।



यह लगातार 18वां साल है कि बीईएल अंतरिम लाभांश दे रहा है। इसने वित्त वर्ष 2019-20 के लिए अपनी पेड-अप पूंजी पर कुल 280 प्रतिशत का लाभांश दिया था।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1703214>

THE TIMES OF INDIA

Tue, 09 March 2021

Armed forces got Rs 1.24 lakh crore less than their projection in defence budget

By Rajat Pandit

New Delhi: The armed forces got as much as Rs 1.24 lakh crore less than what they had asked for in the 2021-2022 budget, the defence ministry told Parliament on Monday.

The Army, Navy and IAF, including joint staff, had projected an overall budgetary requirement of Rs 4,49,508 crore but were allocated only Rs 3,24,657 crore, said minister of state for defence Shripad Naik, in a written answer in Rajya Sabha.

Within this amount, the 15-lakh strong armed forces were allocated Rs 1,23,000 crore under the capital outlay, which is primarily meant for military modernization, when they had projected a requirement of Rs 1,99,553 crore.

Listing out similar shortfalls since 2014-15, Naik said that while finance ministry's allocations are not as per the projections made by the armed forces, additional funds "are sought during the course of the financial year based on the pace of expenditure, pending committed liabilities (instalments for deals inked earlier)" and the like.



"If necessary, re-prioritization is undertaken to ensure that urgent and critical capabilities are acquired without any compromise to operational preparedness of the defence services," added Naik.

India spent an additional unbudgeted Rs 20,776 crore on emergency arms procurements and committed liabilities in the 2020-2021 fiscal in face of China's belligerence on the northern borders.

Though India and China carried out troop disengagement on both sides of Pangong Tso in eastern Ladakh last month, the deadlock in the other "friction points" of Gogra, Hot Springs, Demchok and Depsang Plains is still to be resolved.

The overall defence budget for 2021-2022 was increased by a paltry sum to Rs 4,78,196 crore from last year's budgetary allocation of Rs 4,71,378 crore, which amounts to a mere 1.4% hike. But the silver lining is that the capital outlay has been hiked by almost 19% to Rs 1,35,061 crore from last year's budgeted Rs 1,13,734 crore.

<https://timesofindia.indiatimes.com/india/armed-forces-got-rs-1-24-lakh-crore-less-than-their-projection-in-defence-budget/articleshow/81397613.cms>

THE ECONOMIC TIMES

Tue, 09 March 2021

GRSE lays Keel of third advanced stealth frigate ship under Project 17A

Synopsis

"GRSE achieved a major milestone with the 'laying of the Keel' of Yard 3024, a ship of the Advanced Stealth Frigate Project, P 17A," an official said.

The keel of the third advanced stealth frigate ship under Project 17A, being built by Defence PSU Garden Reach Shipbuilders and Engineers Limited (GRSE) for the Indian Navy, has been laid, an official said here on Monday. GRSE NSE -1.04 %, which was awarded its biggest contract for building the three ships, has already launched the first advanced stealth frigate 'Himgiri' in December.

"GRSE achieved a major milestone with the 'laying of the Keel' of Yard 3024, a ship of the Advanced Stealth Frigate Project, P 17A," the official said.

He said that despite huge challenges amid the COVID19 pandemic, the shipyard launched its first ship of P 17A, 'Himgiri' ahead of schedule on December 14, 2020.

"The keel laying of Yard 3024 has also been achieved ahead of schedule," he said.

The keel for the second ship was laid on January 24, 2020, he said.

The official said that the keel was laid by a senior operative, Mithailal Pasi, structural fitter of shipbuilding shop at the main works unit of GRSE on Friday, in the presence of Vice-Admiral



The contract for construction of the three stealth frigates under Project 17A is the largest ever order awarded to the shipyard by the Ministry of Defence with a value of over Rs 19,293 crore

Sandeep Naithani, controller of Warship Production and Acquisition, Indian Navy and Rear Admiral G K Harish, Director General of Naval Design and Rear Admiral V K Saxena, (ret'd), chairman and managing director, GRSE.

The contract for construction of the three stealth frigates under Project 17A is the largest ever order awarded to the shipyard by the Ministry of Defence with a value of over Rs 19,293 crore, the GRSE official said.

The official said that the important milestones of ship building involve the process of cutting of steel which is called the 'start production' stage followed by 'keel laying', subsequent to which, the other blocks are built around the keel block.

In the next phase, the ship is launched in water for the first time, following which the ship is outfitted with equipment and systems, followed by trials of equipment, he said.

On completion of all trials and once the compartments are ready, the ship is delivered to the customer, the official said.

The P17A ships, the most advanced state-of-the-art guided missile frigates, are equipped with a powerful weapon and sensor package capable of neutralising threats in all three dimensions of air, surface and sub-surface, he said.

<https://economictimes.indiatimes.com/news/defence/grse-lays-keel-of-third-advanced-stealth-frigate-ship-under-project-17a/articleshow/81396083.cms>

mint

Tue, 09 March 2021

Indian Army leases four Heron UAVs from Israel

By Elizabeth Roche

- ***The lease agreement for the four UAVs was signed mid-January using the emergency powers given to the armed forces to speed up military purchases***

New Delhi: The Indian Army has leased four Heron unmanned aerial vehicles (UAVs) made by Israel Aerospace Industries (IAI) for possible deployment along the 3,488-km India-China border.

The medium-altitude long endurance UAVs are expected to be delivered between August and December, a person familiar with the matter said on Monday.

The lease agreement was signed in mid-January using the emergency powers given to the armed forces to speed up purchases, a second person aware of the matter said. The lease period is for three years, this person added.

Senior military commanders of India and China and diplomats are expected to meet soon to discuss pulling back troops from contentious areas along the LAC. Against this backdrop, monitoring the whole of the LAC—from Ladakh to Arunachal Pradesh — would have to be done with a mix of technology, like UAVs, and soldiers being deployed at critical areas seen as vulnerable to incursions. According to former diplomats and Indian Army officers, there are 23 such points across the LAC.



The four medium-altitude long endurance UAVs are expected to be delivered to the Indian Army between August and December. File photo: Reuters

<https://www.livemint.com/news/india/indian-army-leases-4-heron-unmanned-aerial-vehicles-from-israel-11615180737809.html>

After initial refusal, India to buy 30 Armed MQ-9B Sea Guardian Drones from the US – Reports

By Manjiv Asthana

The Indian Air Force (IAF), the Army, and the Navy are set to acquire a total of 30 armed versions of the US-made MQ-9B Sea Guardian drones in a deal estimated to be worth \$3 billion, ThePrint reports. Last year, India had refused the offer.

The decision to procure the advanced drones comes ahead of US Secretary of Defense Lloyd Austin's visit to India later this month.

According to the report, Austin's visit could pave the way for the forthcoming meeting of the Quadrilateral Security Dialogue between the US, India, Japan, and Australia.

The news of the procurement of the modern drones comes after the Indian Navy had leased two MQ-9B Sea Guardian UAVs (a variant of Predator B) from the US last year.

The Navy had taken the drones for a period of a year to boost its intelligence, surveillance, and reconnaissance capabilities amid the border standoff with China in eastern Ladakh.

It is believed under the deal to procure 30 MQ-9 Reaper drones, the Indian Air Force, Army and Navy will all acquire 10 drones each.

Earlier, the deal for the 30 drones was on the cards under the Trump Administration, however, India refused to succumb to the US' constant push of concluding the deal.

Developed by American defense firm General Atomics, the MQ-9 Sea Guardian is an unmanned aerial vehicle (UAV) capable of remotely controlled or autonomous flight operations.

The drones are reported to have an endurance of 48 hours and a range of over 6,000 nautical miles.

As reported by The Eurasian Times, India had previously rejected the deal citing high costs and vulnerability in well-defended airspace.

<https://eurasianimes.com/after-initial-refusal-india-to-buy-30-armed-mq-9b-sea-guardian-drones-from-the-us-reports/>



MQ-9 Reaper drone

Quad, France and UAE join hands in 2 naval exercises to dominate Indo-Pacific

By Shishir Gupta

- **French foreign minister Jean-Yves Le Drian and finance minister Bruno Le Maire will be in Delhi next month while IAF chief Air Chief Marshal RKS Bhadauria will be in France. At least 8 Rafale fighters will leave for India through mid-air refuelling by UAE between April 19 and April 23**

The Indian Navy, its partners in the QUAD grouping, and, its strategic allies France and the United Arab Emirates (UAE) will be part of complex interoperability exercises involving carrier strike groups, anti-submarine warfare aircraft and attack submarines in April— a move aimed at projecting their dominance from the Persian Gulf to the Malacca Straits.

The UAE will be joining India and France for the first time in a trilateral naval exercise in the strategically important Persian Gulf and the Gulf of Oman in late April under the Varuna banner. This is scheduled between April 25 and 27.

While dates of the QUAD-plus France naval exercise has to be firmed up on paper, India, the US, Australia, and Japan (the members of QUAD), with France will showcase their naval strength and commitment to freedom of navigation in the Bay of Bengal from April 4 to 7 with missile-guided destroyers, frigates, submarines and surveillance aircraft practising complex manoeuvres under the La Perouse banner.



Analysts say Indo-French naval cooperation will further deepen when French navy ships pay a visit to Kochi port in March. Photo courtesy: French ministry of armed forces (Photo courtesy: French ministry of armed forces)

Both La Perouse and Varuna last took place in 2019, but were cancelled due to global pandemic last year. UAE's naval chief confirmed his country's participation in the Varuna trilateral exercises.

Analysts say Indo-French naval cooperation will further deepen when French navy ships pay a visit to Kochi port in March. This will be followed by La Perouse. Then, in late April, the French Carrier Strike Group led by aircraft carrier Charles de Gaulle will enlarge its footprint in the Persian Gulf with an Indian Kolkata-class destroyer and UAE naval forces under the Varuna banner.

As India's sole aircraft carrier INS Vikramaditya is under maintenance after a long deployment arising from India's stand-off with China in East Ladakh, Indian destroyers, P-8I aircraft and a submarine will participate in the QUAD-plus exercise. During the naval drills, the warships will practise formation sailing, live firing, communications, search, rescue, damage control and personnel transfers. The US is also not sending its aircraft carrier to La Perouse; at least three of its carrier strike groups have been deployed throughout the year in South China Sea and Indo-Pacific.

According to a former Indian Navy western commander who asked not to be named, La Perouse shows that the QUAD-plus maritime force can work together anywhere in the Indo-Pacific as there is convergence on shared values, democracy, freedom of navigation and cooperation. The aim of the QUAD-plus navies is to project dominance in the Indo-Pacific from the Gulf of Aden to the north and far Pacific, touching the western coast of US.

The political substance to these exercises will be given by the meeting of QUAD leaders in a virtual summit this month followed by the visit of the US Defence Secretary Lloyd Austin to India

later this month to renew close defence cooperation under the Biden Administration. Indian Prime Minister Narendra Modi is expected to meet French President Emmanuel Macron around EU summit in Portugal in May.

According to analysts, QUAD-plus' primary emphasis is a free Indo-Pacific – something that has become increasingly important in light of Beijing's expansionist plans for the region.

After the on-going stand-off with PLA in East Ladakh, the Indian Navy along with its partners including UAE and France has clear objectives in the Indo-Pacific. While the formidable US navy will hold the fort beyond Malacca Straits, the Indian Navy along with its key allies will be first responders in the Indian Ocean. The visit of External Affairs Minister S Jaishankar to Maldives, Seychelles and Mauritius this month was to ensure that Indian navy ships can call in at naval ports in these countries, thereby increasing their range.

<https://www.hindustantimes.com/india-news/quad-france-and-uae-join-hands-in-2-naval-exercises-to-dominate-indopacific-101615248156836.html>

Science & Technology News

THE  HINDU

Tue, 09 March 2021

ISRO to handle projects of security, advanced technology

Bulk of commercial activities would be handled by New Space India Limited

By Jacob Koshy

New Delhi: The India Space Research Organisation (ISRO) has said it would be in charge of projects linked to “national security and advanced technology” — like the forthcoming Chandrayaan2 missions and the Gaganyaan mission, that plans to send Indian cosmonauts into space. However, the bulk of commercial activities would increasingly be handled by the newly formed New Space India Limited.

The comments were in response to a query by the Standing Committee on Science and Technology, led by Rajya Sabha MP Jairam Ramesh on whether the NSIL would “replace” ISRO.

The NSIL most recently coordinated the launch of the Amazonia satellite by Brazil on February 28 — its first fully commercial mission — that also saw 18 other satellites being launched.

It was incorporated in March 2019 and in June 2020 “enhanced” its scope. Its mandate, according to a standing committee report on space laid in the Rajya Sabha on Monday, would include owning satellites for earth observation and communication applications; (ii) providing space-based earth observation and communication service; (iii) building satellites and launching them as per demand; (iv) building launching vehicles through Indian industry and launch as per requirements; (v) providing launch services; and (vi) technology transfer to Indian industry. It would act as the aggregator of user requirements and obtain commitments.

Several of these activities were being handled by the Antrix Corporation, considered the commercial arm of ISRO. However, it is involved in a fractious dispute with the U.S.-based Devas Multimedia, because of which the government of India owes nearly \$1.2 billion going by an order of a tribunal of the International Chamber of Commerce and upheld by a U.S. federal court last year. The NSIL, it is said, is also a move by India's space establishment to insulate space-products marketing efforts and international business development prospects from any financial liability due to the Antrix-Devas issue.

<https://www.thehindu.com/news/national/isro-to-handle-projects-of-security-advanced-technology/article34022322.ece>

Novel hydrogen fuel purification membrane paves the way for greener future

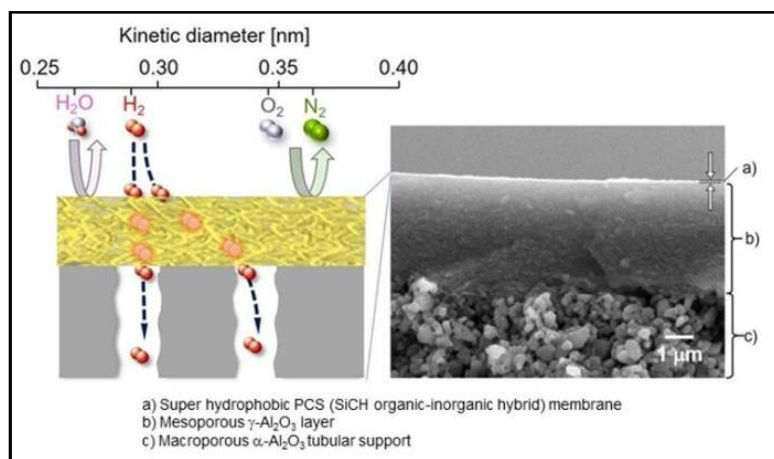
Hydrogen has been hailed as the 'fuel of the future' owing to several reasons. First, compared to the conventionally used hydrocarbons, hydrogen exhibits higher energy yield. Second, the commercial use of hydrogen fuel, which yields only water as a byproduct, would help mitigate the imminent global warming crisis by reducing the use of exhaustible and polluting fossil fuels. Thus, ongoing research has been focusing on efficient and environment-friendly ways to produce hydrogen fuel.

Solar hydrogen production through a photoelectrochemical (PEC) water-splitting reaction is an attractive 'green' method of hydrogen fuel production, owing to its potential for high conversion efficiency, low operating temperatures, and cost-effectiveness. However, efficient separation of hydrogen gas from a mixture of gases (called syngas) under different environmental conditions, has proven to be a challenge. A recent paper published in the journal *Separation and Purification Technology* seeks to address this challenge. In this study, a group of researchers from Nagoya Institute of Technology, Japan, led by Professor Yuji Iwamoto, in collaboration with researchers in France, successfully characterized a novel membrane that allows highly selective separation of hydrogen gas generated from the PEC reaction. Prof. Iwamoto says, "Membrane separation is attractive as a low-cost hydrogen gas purification technology. However, current techniques face several challenges, for example, water-induced swelling with polymer membranes and lower hydrogen permeance with metal, polymer, and supported liquid membranes. "

The researchers first developed an organic-inorganic hybrid polymeric membrane, primarily consisting of a polymer called polycarbosilane (PCS) formed on an aluminum oxide (Al_2O_3)-based porous support. Prof. Iwamoto further explains, "By using high-molecular-weight PCSs with a melting point above 200°C , we showed that a superhydrophobic PCS membrane could be deposited on a mesoporous $\gamma\text{-Al}_2\text{O}_3$ -modified macroporous $\alpha\text{-Al}_2\text{O}_3$ tubular support. "

After successfully developing the PCS membrane, the researchers tested it under PEC reaction conditions. As hypothesized, the PCS membrane showed high hydrophobicity. Moreover, under the flow of a simulated highly humid gas mixture at 50°C , the PCS membrane exhibited excellent hydrogen selectivity. Further analysis revealed that the preferential hydrogen permeation through the PCS membrane was governed by the "solid state diffusion" mechanism. Overall, irrespective of the ambient environmental conditions provided, the PCS membrane exhibited efficient hydrogen gas separation.

With the development and characterization of this new PCS membrane, it is inevitable that its commercial adoption will not just facilitate the use of hydrogen fuel for energy needs but also curb the use of non-renewable fossil fuels. Prof. Iwamoto concludes, "With this technological development, we expect great progress in environmental-friendly and sustainable hydrogen production."



A cross-sectional image of selective hydrogen gas permeation in a super hydrophobic membrane formed on a porous tubular support. Credit: Yuji Iwamoto from Nagoya Institute of Technology

Let's hope that the use of PCS membrane is a step towards a hydrogen-based society.

More information: Miwako Kubo et al, Superhydrophobic polycarbosilane membranes for purification of solar hydrogen, *Separation and Purification Technology* (2020). DOI: [10.1016/j.seppur.2020.117998](https://doi.org/10.1016/j.seppur.2020.117998)
<https://phys.org/news/2021-03-hydrogen-fuel-purification-membrane-paves.html>



Tue, 09 March 2021

Innovative flat optics will usher the next technological revolution

In a new paper published in *Light: Science & Applications*, a group led by Professor Andrea Fratalocchi from Primalight Laboratory of the Computer, Electrical and Mathematical Sciences and Engineering (CEMSE) Division, King Abdullah University of Science and Technology (KAUST), Saudi Arabia, introduced a new patented, scalable flat-optics technology manufactured with inexpensive semiconductors.

The KAUST-designed technology leverages on a previously unrecognized aspect of optical nanoresonators, which are demonstrated to possess a physical layer that is completely equivalent to a feed-forward deep neural network.

"What we have achieved," explains Fratalocchi, "is a technological process to cover flat surfaces, which in optical jargon are called 'flat optics,' with 'physical' neural units that are able to process light as a neural network does with an electrical signal."

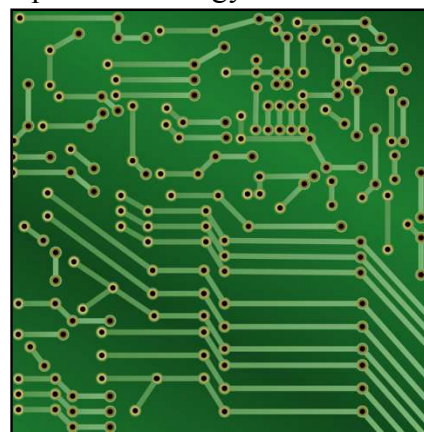
These innovative flat optics achieve near unity efficiencies (up to 99%) in the visible range in ultrathin surfaces, which provides broadband and vectorial light control in both transmission and reflection with the desired wavefront shape. Moreover, the nanoshape silicon surface is ultrathin (60 nanometers thick, 1 nm=1/1000000 of 1mm) and can be customized on flexible surfaces.

The program used to design the nanosurface runs on KAUST's Shaheen-II supercomputer, a Cray XC40 delivering over 7.2 Pflop/s of theoretical peak performance, and is carried out with the Autonomous Learning Framework for Rule-based Evolutionary Design software developed by Fratalocchi and his team.

"We have developed a program that uses artificial intelligence to design the nanoresonators. The algorithm works using evolutionary techniques: in simple terms, the algorithm is able to train itself and improves its results after every cycle to produce surfaces of increasing efficiency every time that it is run. In our article, we showed experimental components with better performance than the current state of the art in flat-optics or from commercial devices available from leading companies, such as Thorlabs and Newport."

The KAUST research team is currently planning to use flat optics to develop new flat devices that could revolutionize older technologies based on bulk optics. Among the innovations, Fratalocchi and his team are building a human-eye camera, a bio-sensor able to 'read' cells infected with malaria and new types of displays.

"There are really endless applications," explains Fratalocchi, "because almost all existing measurement systems, in principle, could be substituted by their cost-effective, compact flat-optics versions. We are developing a statistical learning approach that, for any given measurement task, designs a corresponding flat-surface that encodes the measure into a single optical image, or



Credit: CC0 Public Domain

logogram. With this approach, the entire field of sensing and metrology could become natural language processing based on nonlinear logograms."

"One of our current projects is a flat camera that can see even better than the human eye, which is limited by using only three primary receptors for color vision. We can also miniaturize any component, no matter how bulky," adds Fratalocchi. "The key concept here is that a neural network is a universal approximator that can learn any function. For this reason, we can train our flat optics to perform any task, or a sequence of tasks currently performed by electronic systems, just in less space and at the speed of light."

"With proper funding and resources," concludes Fratalocchi, "in five to 10 years' time, most of today's bulky technology will have shrunk to pocket size, with a similar revolution that electronics experienced at the end of the last century."

More information: F. Getman et al, Broadband vectorial ultrathin optics with experimental efficiency up to 99% in the visible region via universal approximators, *Light: Science & Applications* (2021). DOI: [10.1038/s41377-021-00489-7](https://doi.org/10.1038/s41377-021-00489-7)

Journal information: [Light: Science & Applications](https://phys.org/news/2021-03-flat-optics-usher-technological-revolution.html)
<https://phys.org/news/2021-03-flat-optics-usher-technological-revolution.html>



Tue, 09 March 2021

New mechanism found for generating giant vortices in quantum fluids of light

By Sarah Collins

Anyone who has drained a bathtub or stirred cream into coffee has seen a vortex, a ubiquitous formation that appears when fluid circulates. But unlike water, fluids governed by the strange rules of quantum mechanics have a special restriction: as was first predicted in 1945 by future Nobel winner Lars Onsager, a vortex in a quantum fluid can only twist by whole-number units.

These rotating structures are predicted to be widely useful for studying everything from quantum systems to black holes. But while the smallest possible quantum vortex, with a single unit of rotation, has been seen in many systems, larger vortices are not stable. While scientists have attempted to force larger vortices to hold themselves together, the results have been mixed: when the vortices have been formed, the severity of the methods used have generally destroyed their usefulness.

Now, Samuel Alperin and Professor Natalia Berloff from the University of Cambridge have discovered a theoretical mechanism through which giant quantum vortices are not only stable but form by themselves in otherwise near-uniform fluids. The findings, published in the journal *Optica*, could pave the way for experiments that might provide insight into the nature of rotating black holes that have similarities with giant quantum vortices.

To do this, the researchers used a quantum hybrid of light and matter, called a polariton. These particles are formed by shining laser light onto specially layered materials. "When the light gets trapped in the layers, the light and the matter become inseparable, and it becomes more practical to look at the resulting substance as something that is distinct from either light or matter, while inheriting properties of both," said Alperin, a Ph.D. student at Cambridge's Department of Applied Mathematics and Theoretical Physics.

One of the most significant properties of polaritons comes from the simple fact that light can't be trapped forever. A fluid of polaritons, which requires a high density of the exotic particles, is constantly expelling light, and needs to be fed with fresh light from the laser to survive. "The result," said Alperin, "is a fluid which is never allowed to settle, and which doesn't need to obey

what are usually basic restrictions in physics, like the conservation of energy. Here the energy can change as a part of the dynamics of the fluid."

It was exactly these constant flows of liquid light that the researchers exploited to allow the elusive giant vortex to form. Instead of shining the laser on the polariton fluid itself, the new proposal has the light shaped like a ring, causing a constant inward flow similarly to how water flows to a bathtub drain. According to the theory, this flow is enough to concentrate any rotation into a single giant vortex.

"That the giant vortex really can exist under conditions that are amenable to their study and technical use was quite surprising," Alperin said, "but really it just goes to show how utterly distinct the hydrodynamics of polaritons are from more well-studied quantum fluids. It's exciting territory."

The researchers say that they are just at the beginning of their work on giant quantum vortices. They were able to simulate the collision of several quantum vortices as they dance around each other with ever increasing speed until they collide to form a single giant vortex analogous to the collision of black holes. They also explained the instabilities that limit the maximum vortex size while exploring intricate physics of the vortex behavior.

"These structures have some interesting acoustic properties: they have acoustic resonances that depend on their rotation, so they sort of sing information about themselves," said Alperin. "Mathematically, it's quite analogous to the way that rotating black holes radiate information about their own properties."

The researchers hope that the similarity could lead to new insights into the theory of quantum fluid dynamics, but they also say that polaritons might be a useful tool to study the behavior of black holes.

More information: Samuel N. Alperin et al. Multiply charged vortex states of polariton condensates, *Optica* (2021). DOI: [10.1364/OPTICA.418377](https://doi.org/10.1364/OPTICA.418377)

Journal information: [Optica](https://doi.org/10.1364/OPTICA.418377)

<https://phys.org/news/2021-03-mechanism-giant-vortices-quantum-fluids.html>

Tue, 09 March 2021

India leads global fight against COVID-19 with research: M Venkaiah Naidu

Vice President M Venkaiah Naidu lauded the efforts, ingenuity of Indian researchers and scientists for finding technological solutions to the problem

New Delhi: Vice President M Venkaiah Naidu on Sunday said resilience, research and re-invention have helped India become a torch-bearer in the global fight against COVID-19. He also appreciated the efforts and ingenuity of Indian researchers and scientists for finding technological solutions to the challenges thrown by the pandemic.

Addressing the first Graduation Day ceremony of the Employees' State Insurance Corporation Medical College (Faridabad) held in New Delhi, Naidu praised doctors, scientists and policymakers for the fight against the virus. "I salute the entire medical fraternity from doctors to nurses, para-medical staff and sanitary workers, technicians and ASHA workers in villages, who, as team India came together as one to fight the pandemic," he said. Naidu also lauded the Indian industry for ramping up the production of essential items such as PPE kits, surgical gloves, face masks, ventilators and vaccines.



He also appreciated the medical and paramedical institutes being run by the ESIC for their role in the fight against the COVID-19 pandemic. During the ceremony, the vice president was glad to see that all the medal winners were girls. He congratulated them and underlined the need to provide equal opportunities to women in every field.

"I have always believed that if you serve humanity with a spirit of selfless dedication, you will derive boundless satisfaction," he told the passing out students. Referring to the largest vaccination drive in the world against COVID-19 being undertaken in India, the vice president said the worst phase of the pandemic appears to be over. However, he cautioned people to remain vigilant and continue to take all the necessary precautions till the country defeats the virus decisively.

Challenges to be addressed

In his address, Naidu also referred to several other health challenges that need to be addressed such as low doctor-patient ratio, shortage of medical colleges, inadequate infrastructure in rural areas, and low adoption of health insurance. Expressing concern over high out-of-pocket expenditure on health in India, Naidu called for ensuring quality healthcare for all at affordable rates.

The vice president praised ESIC for running India's largest social security programme covering roughly 10 per cent of the country's population. Naidu also appreciated ESIC for several new initiatives such as MoU with the National Health Authority (NHA) wherein the beneficiaries of the ESI scheme in selected districts can access services at Ayushman Bharat-empanelled hospitals. He also appreciated the ESIC's initiative to open its underutilised hospitals to the general public on a nominal user charge basis.

Naidu also expressed satisfaction over India emerging as an attractive medical tourism hub in the region due to its state-of-the-art facilities and highly skilled professionals. On this occasion, Labour Minister Santosh Gangwar said, "A historic task of amalgamating 44 labour laws into four

codes. After the implementation of the Code on Social Security 2020, which is one of those codes, Employees State Insurance Corporation (ESIC) services would be expanded to all districts in the country."

Labour Secretary Apurva Chandra said the ESIC would cover unorganised workers including gig and platform workers under its social security ambit. Gig and platform workers are those workers that work outside of traditional employers and employees relationship. The platform workers are attached to an online platform to provide their services like Ola, Uber, Zomato or Swiggy.

<https://news.careers360.com/india-lead-fight-against-covid-19-research-re-invention-naidu>

