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# समाचार पत्रों से चयित अंश Newspapers Clippings

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

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## India's Rustom-2 UAV gets massive upgrade, will soar to 27,000 feet in April

- *DRDO's hard push to Rustom-2 is seen in the context of the continuing efforts to indigenously produce cutting-edge military equipment.*

*By Shishir Gupta*

New Delhi: Rustom-2, India's medium-altitude long-endurance drone being developed by the Defence Research and Development Organisation, is targeted to achieve a huge milestone in April when it will take off from its test range in Karnataka's Chitradurga to fly for more than 18 hours at a height of over 27,000 feet, people familiar with the development said.

Rustom-2, also known as Tapas-BH (Tactical Airborne Platform for Aerial Surveillance-Beyond Horizon 201), successfully completed the last flight test in October last year when it successfully flew for eight hours at an altitude of 16,000 feet.

"This will be a huge step," said a senior government official about the indigenously-developed unmanned aerial vehicle (UAV) designed for strategic reconnaissance and surveillance operations. Rustom-1

India's previous efforts to develop military hardware hadn't been very successful in the past, forcing the country to import more than 60% of its military requirement. India is the world's third-biggest military spender in the world after the United States and China.

The drones, officials said, was one of the areas where India lagged behind and ended up relying on pricey imports from countries such as the USA and Israel.

China, which has invested heavily in military equipment over the years, has raced ahead in this sector also. According to the Stockholm International Peace Research Institute (SIPRI), which tracks global arms flows, China has not just built drones for the People's Liberation Army but also exported 163 large weapons-capable UAVs to 13 countries from 2008 to 2018. It even gave four Wing Loong II armed drones to Pakistan to protect the China-Pakistan Economic Corridor and Gwadar port.

The hard push to Rustom-2 is seen in the context of the continuing efforts to indigenously produce cutting-edge military equipment. Last year, the government unveiled plans to ban the import of 101 types of weapons and ammunition over the next five years ranging from artillery guns to conventional submarines and missiles.

On Sunday, Prime Minister Narendra Modi formally handed over the indigenous battle tank Arjun Mark 1A to the Indian Army as part of this renewed focus on achieving self-reliance in the defence sector. Less than a fortnight earlier, the Cabinet Committee on Security headed by PM



DRDO on Friday flight tested the Rustom-2 medium altitude long endurance indigenous prototype drone

Modi decided to award Hindustan Aeronautics Limited (HAL) a ₹48,000-crore contract to supply 83 LCA (light combat aircraft) Mk-1A jets to the Indian Air Force.

<https://www.hindustantimes.com/india-news/after-tejas-and-arjun-drdo-s-uav-mission-rustom-2-to-go-critical-in-april-101613386629726.html>

## पंजाब केसरी

Tue, 16 Feb 2021

# स्वदेशी रुस्तम-2 को डीआरडीओ ने बनाया और "घातक", अब 27 हजार फीट तक भर सकेगा उड़ान

नेशनल डेस्क: पिछले लंबे वक्त से चीन और पाकिस्तान के साथ भारत के रिश्ते काफी तनावपूर्ण रहे हैं। सेना लगातार मिसाइलों, हथियारों को और घातक बना रही है, जिससे किसी भी समय जरूरत पड़ने पर दुश्मन देशों के छक्के छुड़ाए जा सकें। अब डिफेंस रिसर्च एवं डेवलपमेंट ऑर्गेनाइजेशन (DRDO) द्वारा बनाए जा गए देसी ड्रोन रुस्तम-2 की तकनीक को भी अपग्रेड कर दिया गया है। इसके बाद ड्रोन पहले की तुलना में और अधिक मारक हो गया है।

अप्रैल महीने में इसकी कर्नाटक के चित्रदुर्ग में टेस्टिंग होने जा रही है, जिसके बाद यह एक नया रिकॉर्ड कायम करेगा। इस मामले से वाकिफ सूत्रों ने बताया कि डीआरडीओ रुस्तम-2 को अप्रैल महीने में 27 हजार फीट की ऊंचाई पर उड़ाने जा रहा है, जो कि 18 घंटे तक उड़ेगा।



रुस्तम-2 को तापस-बीएच (टैक्टिकल एयरबोर्न प्लेटफॉर्म फॉर एरियल सर्विलांस बियॉड होराइजन 201) भी कहते हैं और इसने पिछले साल अक्टूबर में सफलतापूर्वक 16 हजार फीट की ऊंचाई पर उड़ान भरी थी। डीआरडीओ ने इस ड्रोन को सटीक निशाना बनाने और दुश्मन के ठिकानों को भेदने के लिए बनाया है। रणनीतिक टोही और निगरानी कामों के लिए डिजाइन किए गए रुस्तम को लेकर सरकार के एक वरिष्ठ अधिकारी ने कहा कि यह बहुत बड़ा कदम होने जा रहा है।

सैन्य हार्डवेयर विकसित करने के लिए भारत के पिछले प्रयास बहुत सफल नहीं हुए और देश को अपनी सैन्य आवश्यकता का 60% से अधिक इम्पोर्ट करने के लिए मजबूर होना पड़ा है। भारत अमेरिका और चीन के बाद दुनिया का तीसरा सबसे बड़ा सैन्य खर्च करने वाला देश है। अधिकारियों का कहना है कि ड्रोन के मामले में भारत पिछड़ गया था और उसे अमेरिका और इजराइल जैसे देशों से महंगी कीमत पर इम्पोर्ट करना पड़ता था।

डीआरडीओ द्वारा बनाए गए रुस्तम-2 ड्रोन को देखें तो यह सेना के लिए बनने वाले हथियारों को देश में बनाने की भारत की प्राथमिकताओं को दिखाता है। इसी कड़ी में, पिछले साल केंद्र सरकार ने अगले पांच सालों में इम्पोर्ट किए जाने वाले 101 तरह के हथियारों और गोला-बारूदों पर बैन लगाने की बात कही थी। इसमें मिसाइलों से लेकर पनडुब्बी तक शामिल हैं।

प्रधानमंत्री नरेंद्र मोदी ने भी रविवार को डिफेंस सेक्टर में आत्मनिर्भरता हासिल करने पर फोकस करते हुए स्वदेशी युद्धक टैंक अर्जुन मार्क 1ए को सेना को सौंप दिया था। इससे पहले, प्रधानमंत्री मोदी के नेतृत्व वाली सुरक्षा मामलों की कैबिनेट कमेटी ने 83 हल्के लड़ाकू विमान एमके-1ए को सेना को देने के लिए एचएएल को 48 हजार करोड़ के कॉन्ट्रैक्ट की मंजूरी दी थी।

<https://m.punjabkesari.in/national/news/drdo-made-swadeshi-rustom-2-and--deadly--now-can-fly-up-to-27-thousand-feet-1333616>

## India developing 160 km-range Astra missile to get an edge over China, Pakistan

*Seeking to score a long edge over its adversaries - China and Pakistan, India is developing the Astra Mark 2 missile which will allow its fighter aircraft to destroy enemy planes from 160 kms in aerial combat*

*By Manjeet Negi*

New Delhi: Seeking to score a long edge over its adversaries - China and Pakistan, India is developing the Astra Mark 2 missile which will allow its fighter aircraft to destroy enemy planes from 160 kms in aerial combat, senior defence official said.

Astra is a beyond visual range air-to-air missile (BVRAAM), which flies over four times the speed of sound at Mach 4.5, and efforts are now on to integrate the over 100 km strike range missile on the indigenous fighter aircraft LCA Tejas, sources said.

The all-weather day and night capable Astra, which currently has a strike range of around 100-km, will eventually replace the expensive Russian, French and Israeli BVRAAMs that are currently imported to arm IAF fighters, sources added.



Astra missile being fired (ANI)

"The missile's trials are set to begin from September this year and will be completed by the next year. Astra Mark 2 would give India an edge over its adversaries - Pakistan and China. We are hoping to see the missile fully developed by 2022," senior defence officials told India Today.

The Indian Air Force and Navy have already given orders for Astra Mark-2 missiles.

The missile has also helped India join the ranks of the US, Russia, France and Israel in developing such complex BVRAAMs capable of detecting, tracking and destroying highly-agile hostile supersonic fighters packed with "counter-measures" at long ranges, sources said.

"Astra has excellent ECCM (electronic counter-counter measures) to tackle jamming by hostile aircraft, active radar terminal guidance and other features for high single-shot kill probability in both "head-on and tail-chase" modes," Defence Research & Development Organisation (DRDO) said.

<https://www.indiatoday.in/india/story/india-developing-160-km-range-astra-missile-to-get-an-edge-over-china-pakistan-1769426-2021-02-15>

## PM Modi hands over 'Made in India' tank to Army: What makes the Arjun Main Battle Tank such a deadly threat?

*The upgraded Arjun Mark-1A Main Battle Tank is widely regarded as India's response to the Russian-made T-90S 'Bhishma' tanks that currently form the bulk of India's armoured vehicle regiments*

### Key Highlights

- *As per latest reports, the Defence Ministry had recently approved the induction of 118 Arjun Mark 1A tanks into the Indian Army at a cost of Rs 8,400 crore*
- *Compared to the earlier version, the Mark 1-A boasts an improved gunner sight, fitted with automated target tracking capabilities*
- *the DRDO has noted that it incorporates state-of-the-art battle tank technologies making it distinct from other contemporary MBTs while labelling it a “dependable warfighting machine”*

During his visit to Chennai to launch a swathe of new government programmes in Tamil Nadu, Prime Minister Narendra Modi, on Sunday, handed over the indigenously-developed Arjun Main Battle Tank (Mark 1A) vehicles to Army Chief General MM Naravane.

As per latest reports, the Defence Ministry had recently approved the induction of 118 Arjun Mark 1A tanks into the Indian Army at a cost of Rs 8,400 crore. The tanks were to be manufactured by the DRDO's Combat Vehicles Research and Development Establishment in Chennai, in collaboration with 15 academic institutions, eight laboratories and numerous other MSMEs.

The upgraded Arjun Mark-1A Main Battle Tank is widely regarded as India's response to the Russian-made T-90S 'Bhishma' tanks that currently form the bulk of India's armoured vehicle regiments. However, it is worth noting that, with the Indian Army placing a Rs 20,000 crore order in November 2019 for the manufacture of 464 T-90S tanks to add to the 1,191 Bhishma tanks already inducted, it does appear that it is being cautious in its thrust to overhaul its armoured vehicle arsenal.

Weighing 68 tonnes, the Mark 1-A is equipped with a 120mm main gun and stands as an upgraded version of the original Arjun Main Battle Tank. As per reports, the numerous improvements made to the tank based on the Army's recommendations have transformed it into one of the nation's most formidable self-protective tanks.

Compared to the earlier version, the Mark 1-A boasts an improved gunner sight, fitted with automated target tracking capabilities. This allows the tank's crew to locate and track mobile targets automatically, enabling attack even when the MBT is moving.

The MK-1A's gun is operated via a computerised integrated fire control that allows for high first-round kill capabilities. It also incorporates day-and-night stabilised sights. The Mark 1-A is also integrated with thermobaric and penetration-cum-blast ammunition, in addition to the conventional fin stabilised armour-piercing discarding sabot and high explosive squash head ammunition.



PM Modi handing over the indigenously-developed Arjun Main Battle Tank (Mark 1A) to the Indian Army in Chennai. | Photo Credit: PTI

The Arjun Main Battle Tank programme began in 1972 with the DRDO's CVRDE serving as its main laboratory. The project was not without controversy and delays but production of the tanks began in 1996 at the Indian Ordnance Factory's manufacturing facility located in Avadi, Tamil Nadu.

The first batch of 16 tanks was inducted into the 43 Armoured Regiment of the Indian Army. By 2009, the Army had the first Arjun regiment comprising 45 tanks, and by 2011, more than 100 tanks had been delivered.

However, a 2016 report from the Comptroller and Auditor General noted that the tanks had not been in operation since 2013 due to a lack of spare parts. The DRDO, in 2017, declared that it had imported spare parts to repair any faults that had, reportedly, sidelined 75 per cent of the nation's Arjun tanks.

As far as the Mark 1-A variant goes, the DRDO has noted that it incorporates state-of-the-art battle tank technologies making it distinct from other contemporary MBTs while labelling it a “dependable warfighting machine.”

<https://www.timesnownews.com/india/article/pm-modi-hands-over-made-in-india-tank-to-army-what-makes-the-arjun-main-battle-tank-such-a-deadly-threat/720417>



Tue, 16 Feb 2021

## Collins Aerospace looking to continue collaboration with HAL on LCA-MK1A

*Company is looking at expanding presence in the civil aviation industry, says MD*

*By Dinakar Peri*

Collins Aerospace, a unit of the Raytheon Technologies and one of the world's largest suppliers of aerospace and defence products, has been involved in the indigenous Light Combat Aircraft (LCA) Tejas programme and is interested in the avionics side of the business especially sensors and display systems, said Sunil Raina, MD, Customer & Account Management. He said the company is looking at expanding its presence in the civil aviation industry.

“In addition, we are also working with LCA for our mechanical, aerostructure and power control equipment on the aircraft. We are able to offer a complete solution on these platforms and have been in multiple discussions with Hindustan Aeronautics Limited (HAL) on these hi-tech products. This is also true for LCA-MK1A,” Mr. Raina told *The Hindu*.

At the Aero India early this month, HAL was awarded a ₹47,000-crore contract for 83 LCA — 73 of them higher capacity LCA-Mk1A variant — with deliveries scheduled to begin in early 2024. This takes the LCA jets on order to 123. The indigenous content is about 52% and HAL is looking at ways to increase it to 65%.

Collins serves a substantial customer base in India, including local and international governments, aerospace original equipment manufacturers (OEMs) and defence contractors, and is betting big on the civil aviation sector too.

Stating that Collins is the largest exporter of aerospace products, Mr. Raina said the Indian team has produced over 235 patents which cover inventions across all strategic business units and disciplines. “We helped India become a major aerospace manufacturing hub — with a thriving ecosystem within the region — by developing suppliers and offering better products and services.”



Visitors look at a model of a Light Combat Aircraft during the 13th edition of Aero India 2021, in Bengaluru. | Photo Credit: PTI

Mr. Raina said their Federal Aviation Administration (FAA) and Director General of Civil Aviation (DGCA) partnership enabled them to become one of the first Indian entities to domestically produce and export an aviation product to the U.S. “In addition, we successfully designed, developed and qualified the power door opening system for the A320neo and Bombardier C-series at our Bengaluru facility.”

At the Aero India, Defence Minister Rajnath Singh said the aero components sector is set to double to ₹60,000 crore by 2024.

With over 100 airports at the moment and projections of up to 300 airports in the future according to the government, Collins is actively participating to bid and implement the airport systems in the long term, particularly for contactless passenger processing systems, Mr. Raina said. “Our engineering and manufacturing centres in India have the capability of developing and customising solutions locally to meet customers’ requirements.”

Collins began operations in India in 1997 with a manufacturing facility in Bengaluru and has since expanded its footprint with India Design Center in Hyderabad and the Global Engineering Center in Bengaluru. Today, we have over 5,500 employees throughout four locations in India, and we are looking to expand into a new location in Bengaluru’s new aerospace park, Mr. Raina said.

<https://www.thehindu.com/news/national/collins-aerospace-looking-to-continue-collaboration-with-hal-on-lca-mk1a/article33835447.ece>



Tue, 16 Feb 2021

## List of 10 latest defence deals that India has signed in the last six months

*By Prabhjote Gill*

- *India is doubling down on the domestic manufacturing of defence equipment.*
- *The Modi administration has expressed its goal of wanting to turn India into a net exporter of defence items rather than be an importer.*
- *Here’s a list of 10 latest defence deals that show the trajectory of India’s defence procurement deals.*

India is on the road to turning itself into an exporter of defence equipment rather than an importer. The Modi administration has made no secret of it. It included the defence sector under its umbrella of Atma Nirbhar (self-reliance) schemes to boost the economy.

Some experts believe that while the impetus on domestic defence manufacturing is certainly a move in the right direction, imports are generally of better quality than domestic products.

Only time will tell if India’s switch in strategy will bear fruit, but the wheels of roping in more Indian firms to help out the Indian Armed Forces is already in motion.

**Here’s a list of the ten latest defence deals that India has signed in the last six months:**

### **1. India-made Israeli Tavor X 95 rifles**

Until now, India got its Tavor X 95 rifles from the Israel Weapons Industry (IWI). Now, these guns are being made in India and being supplied to the central and state forces, according to The Print.

### **2. ₹48,000 crore deal with Hindustan Aeronautics Limited to procure 83 new Tejas light combat aircraft**

On February 3, India’s Ministry of Defence awarded a ₹48,000 crore contract to Hindustan Aeronautics Limited to supply 83 light combat aircraft (LCA) Mk-1A jets — also called Tejas fighters — to the Indian Air Force.



The first Tejas LCA is scheduled to be delivered to the air force in three years. The rest will be supplied 2030.

Of these 83 new aircraft, 73 are Mk-1A fighter jets and 10 are LCA Mk-1 trainer aircraft.

### **3. Over ₹1,000 crore defence procurement contract with Bharat Electronics for modern radio systems**

The Indian Ministry of Defence signed a contract, worth over ₹1,000 crore, with Bharat Electronics Limited (BEL) for procuring Software Defined Radio Tactical (SDR-Tac) on February 8.

The design and development SDR-Tac is a joint venture between the Defence Research and Development Organisation's (DRDO), Weapons and Electronics Systems Engineering Establishment (WESEE), BEL, Centre for Artificial Intelligence & Robotics (CAIR) and the Indian Navy.

The radio system itself is a four channel multi-mode, multi-band, 19 rack mountable, and ship borne design.

### **4. The Indian Army is going get 118 Arjun Mark-1A tanks worth ₹8,400**

In December 2020, the Defence Ministry recently cleared the induction of 118 Arjun Mark-1A tanks into the Indian Army. Their cumulative value is around ₹8,400 crores.

The tanks are indigenously made by the Defence Research & Development Organisation (DRDO). This tank is a third-generation main battle tank. This means it has composite armour and computer stabilized fire control systems, which allow firing on the move as well as very high first hit probability on targets up to 2,000 meters away.

It has 72 more features as compared to its older version.

These 118 new tanks will be joining the fleet of the first batch of 124 Arjun tanks, which are already with the Indian Army and deployed in the western desert along the border which India shares with Pakistan.

### **5. A \$200 million deal for Israeli SPICE bombs**

While most of the new defence procurement deals in India's kitty are focused on keeping manufacturing in-house, some equipment is still being imported. While India tried to brush reports under the rug, the country has signed a \$200 million contract with Israel's Rafael Advanced Defence System.

This deal includes the procurement of bomb guidance kits, anti-tank guided missiles, and software-enabled radios.

The company has declined to identify the 'Asian country' which is its customer — as per its press release in December 2020 — but Jane's Defence Weekly reported that the tactical radios are specific to the Indian Army. And, Indian military officials have earlier divulged that the Indian Air Force employed SPICE kits during the Balakot air strike.

### **6. Indian firm bags Army's ₹ 140 crore deal for high altitude UAVs**

The Indian Army ordered an advanced version of SWITCH tactical drones from ideaForge, an Indian company on January 14. These are specialised drones which are made to operate in high altitude areas like Ladakh.

The exact number of drones has not been disclosed but the deal is worth \$20 million (around ₹140 crore) and the delivery will take around one year.

IdeaForge won out over other well known companies like Israel's top UAV manufacturer Elbit, the Tata Group, Dynamatic Technologies Ltd, and VTOL Aviation.



Chief of Defence Staff Bipin Rawat with Chief of Naval Staff Admiral Karambir Singh during the valedictory function of the 13th edition of Aero India 2021, at Yelahanka air base in Bengaluru BCCL

## **7. Indian Army on the hunt for new carbines**

The Indian Army has issued a fresh request to fast track the procurement of 93,895 carbines after the last process with the United Arab Emirates (UAE) Caracal was scrapped in September last year.

The Request for Information (RFI) has been issued to all major foreign small arms manufacturers, including Caracal, SiG Sauer, Beretta and Kalashnikov. The primary difference this time is that the RFIs have also been issued to Indian firms like the Ordnance Factory Board (OFB), Reliance Defence, SSS Defence, Bharat Forge, and PLR Systems among others.

## **8. Government sanctions six new ‘eyes in the sky’ worth ₹10,994 crore**

In another boost to ‘Make in India’, the Defence Acquisition Council gave its go-head for the DRDO to develop six new Airborne Early Warning and Control (AEW&C) planes in September last year.. With a budget of ₹10,994 crore, these new planes will act as the “eyes in the sky” for the Indian Air Force.

They will also bridge a critical gap in India’s defence preparedness.

## **9. The Indian Navy will be getting new UAVs to strengthen maritime surveillance**

In September 2020, the Defence Acquisition Council, chaired by Union Minister Rajnath Singh, also approved the Navy’s proposal to acquire ship-launched, unmanned aerial systems for ₹1,000 crore which will allow the force to have a better maritime knowledge while on the move.

## **10. Hindustan Aeronautics Limited (HAL) received a request for proposal (RFP) for its HTT- 40 trainer aircraft from India’s Ministry of Defence (MoD)**

In addition to the Tejas aircraft, the Ministry of Defence is also looking into procuring HTT-40 trainer aircraft from HAL. The company showcased the prototype back in 2016 and its manufacturing will be a big boost of domestic production in India, according to Venkatesh Kandlikar, an analyst with GlobalData.

<https://www.businessinsider.in/defense/news/list-of-10-latest-defence-deals-that-india-has-signed-in-the-last-six-months/slidelist/80926534.cms#slideid=80927142>

# बराक-8 मिसाइल नौसेना में हुआ शामिल, DRDO ने इजरायल एयरोस्पेस इंडस्ट्रीज की मदद से किया तैयार

By Shashio Kumar Jha

नई दिल्ली: पानी के अंदर दुश्मनों को माकूल जवाब देने के लिए भारतीय नौसेना के बेड़े में अब बराक-8 मिसाइल भी शामिल हो गया है। डीआरडीओ और इजरायल एयरोस्पेस इंडस्ट्रीज के सहयोग से तैयार किया गया बराक-8 मिसाइल डिफेंस सिस्टम भारतीय नौसेना को सौंप दिया गया है। डीआरडीओ के अध्यक्ष डॉ जी सतीश रेड्डी ने एलआरएसएएम मिसाइलों के अंतिम उत्पादन बैच को रविवार को एपीजे अब्दुल कलाम मिसाइल कॉम्प्लेक्स, हैदराबाद में झंडी दिखाकर रवाना किया।

## 2018 में हुई थी डील

दरअसल भारत ने साल 2018 में इजरायल की एयरोस्पेस इंडस्ट्रीज (आईएआई) से बराक-8 मिसाइल डिफेंस सिस्टम की खरीद के लिए 777 मिलियन डॉलर (करीब 5,687 करोड़ रुपये) का सौदा किया था। यह मिसाइल एलआरएसएएम श्रेणी के तहत काम करती है। इस अनुबंध के तहत इजरायल की कंपनी को भारतीय नौसेना के 7 जहाजों को एलआरएसएएम एयर और मिसाइल डिफेंस सिस्टम्स की आपूर्ति करना था। बराक-8 को इजरायल एयरोस्पेस इंडस्ट्रीज (आईएआई) और रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) ने संयुक्त रूप से विकसित किया है। इजरायल ने हथियारों और तकनीकी अवसंरचना, एल्टा सिस्टम्स दिया है जबकि भारत डायनामिक्स लिमिटेड (बीडीएल) ने मिसाइलों का उत्पादन किया है।



## बराक-8 मिसाइल की विशेषताएं

- बराक-8 एक भारतीय-इजरायली लंबी दूरी वाली सतह से हवा में मार करने वाली मिसाइल है।
- बराक 8 को विमान, हेलीकॉप्टर, एंटी शिप मिसाइल और यूएवी के साथ-साथ क्रूज मिसाइलों और लड़ाकू जेट विमानों के किसी भी प्रकार के हवाई खतरा से बचाव के लिए डिजाइन किया गया।
- इस तरह के सिस्टम का इस्तेमाल इजरायली नौसेना के अलावा भारतीय नौसेना, वायु सेना और थल सेना करती हैं।
- परमाणु हथियार ले जाने में सक्षम लंबी दूरी की मिसाइल बराक-8 की मारक क्षमता 70 से 90 किमी है।
- साढ़े चार मीटर लंबी मिसाइल का वजन करीब तीन टन है और यह 70 किलोग्राम भार ले जाने में सक्षम है।
- बराक-8 मिसाइल बहुउद्देशीय निगरानी और खतरे का पता लगाने वाली राडार प्रणाली से सुसज्जित है।

## लंबी दूरी की जमीन से हवा में मार करने वाली मिसाइल

दरअसल यह मिसाइल कई श्रेणियों में आती हैं जैसे कुछ जमीन या सतह से हवा में मार करने वाली तो कोई हवा से हवा में मार करने वाली मिसाइल होती हैं। इसके अलावा इनमें लंबी दूरी, मध्यम दूरी और छोटी दूरी की मिसाइल होती हैं। नौसेना को आपूर्ति की गई मिसाइल लंबी दूरी की जमीन से हवा में मार करने वाली श्रेणी की है। शिप पर इसका इस्तेमाल एंटी मिसाइल डिफेंस सिस्टम के रूप में किया जाता है। इसका इस्तेमाल भारत और इजरायल की सेनाएं करती हैं। भारतीय सेना भी बराक श्रेणी की कई मिसाइलों का पहले से ही इस्तेमाल कर रही है। साल 2017 में भारत और इजरायल ने इस मिसाइल के जमीनी संस्करण के लिए करीब 2 अरब डॉलर का सौदा किया था जिसे एमआरएसएएम के नाम से जाना जाता है।

इस बारे में डीआरडीओ अध्यक्ष रेड्डी ने स्वदेशी उत्पादन प्रयासों के महत्व पर प्रकाश डालते हुए मिसाइल सिस्टम क्वालिटी एश्योरेंस एजेंसी के प्रयासों की सराहना की, जिससे भारत भर के विभिन्न उद्योगों में उत्पादन गतिविधियों को व्यवस्थित करके एयरोस्पेस के गुणवत्ता मानकों वाली मिसाइलों की समय से आपूर्ति हो सकी। इस दौरान भारतीय नौसेना के वीएसएम रियर एडमिरल वी राजशेखर ने भारतीय नौसेना की वायु रक्षा क्षमता को मजबूत करने के लिए डीआरडीओ के प्रयासों की सराहना की। उन्होंने डीआरडीओ से भविष्य के युद्ध के लिहाज से उन्नत हथियार प्रणालियों को डिजाइन और विकसित करने का आग्रह किया।

<https://www.rakshaknews.com/others-news/barak-8-missile-joins-navy-drdo-prepared-with-the-help-of-israeli-aerospace-industries>



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Ministry of Defence

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### Inter service affiliation of the Assam regiment and Arunachal scouts with 106 air force squadron

The historic affiliation of Assam Regiment and Arunachal Scouts of Indian Army with 106 Air Force Squadron was formally signed at a solemn ceremony at Tezpur (Assam) on 15 Feb 2021. The ceremony commenced with inspection of the Guard of Honour by Maj Gen PS Behl, Colonel of The Assam Regiment & Arunachal Scouts. Thereafter the 'Charter of Affiliation' was signed by Maj Gen PS Behl and Gp Capt Varun Slaria, Commanding Officer, 106 Squadron.

The affiliation of the Regiment with the SU-30 Squadron of Eastern Air Command will assist them in development of mutual understanding of joint ethos, capability, limitations and core competencies of other service through common understanding of military tactical doctrines and concepts in the contemporary conflict environment.

The Assam Regiment was raised on 15 Jun 1941 and stood its ground to turn defeat into victory winning six Battle Honours in the Second World War. The contribution of The Regiment in Burma Campaign and in 1971 Indo-Pak war in changing the course of the battle is well documented in history. Drawing troops from the seven sister states of the North-East India, the regiment is decorated with One Ashok Chakra, nine Param Vishishth Seva Medals, two Maha Vir Chakras, eight Kirti Chakras, four Padma Shrees, four Uttam Yudh Seva Medals, four Ati Vishisth Seva Medals, five Veer Chakras, 20 Shourya Chakras, 13 Yudh Seva Medals, 180 Sena Medals, 35 Vishisth Seva Medals, 66 Mention-in-Despatches and numerous Commendation Cards.

106 Squadron, IAF, was raised on 11 Dec 1959 and currently operates the air dominance fighter Sukhoi 30 MKI. It is the most decorated squadron of the Indian Air Force with three Mahavir Chakras and seven Vir Chakras. The Squadron has been awarded with the prestigious President's Standard.

The contribution of the Air Force Squadron and the Assam Regiment in the 1971 War and the combined war waging efforts of the Regiment and Eastern Air Command in the Burma campaign speaks volume of their martial ardour, resoluteness and dauntless courage.

The gathering was addressed by Maj Gen PS Behl in which he spoke of the importance of affiliation and its far reaching impact in the present day. The General Officer highlighted that the idea behind the affiliation was aimed at greater understanding of each other's operational ethos, building camaraderie and *esprit-de-corps*. This enhanced synergy and understating of each other's strengths will act as a 'Force Multiplier' within our armed forces.

Later, Maj Gen PS Behl flew a familiarisation sortie on Sukhoi 30 MKI to acquaint himself with its capabilities. The ceremony was also marked by aerobatics display by the formidable Sukhoi 30 MKI.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1698125>

## Third Scorpene class submarine delivered to Indian Navy

*The submarine was launched in January 2018 for sea trials and will be commissioned as INS Karanj, said a naval officer*

*By Manish K Pathak*

The Mazagaon Dock Limited (MDL) on Monday delivered the third Scorpene-class submarine to the navy after two years of sea trials. The submarine was launched in January 2018 for sea trials and will be commissioned as INS Karanj, said a naval officer.

MDL chairman and managing director Vice Admiral Narayan Prasad (retired) and Rear Admiral B Sivakumar, Western Naval Command's chief of staff officer (technical), signed the acceptance document.

INS Karanj is India's third of the six Scorpene-class submarines with superior stealth and combat capabilities. The diesel-electric attack submarine has been built under MDL's Project-75 in collaboration with a French firm.

The first such submarine INS Kalvari was launched in October 2015 and commissioned in December 2017, five years behind the schedule. The second, INS Khanderi, was launched in January 2017 for sea trials and commissioned in September 2019.

INS Vela was launched in May 2019 and is undergoing sea trials. INS Vagir was launched in November 2020 and is also undergoing sea trials. The sixth submarine INS Vagsheer is at the stage of outfitting.

Scorpene submarines can undertake multifarious missions like anti-surface and anti-submarine warfare as well as intelligence gathering, mine laying, area surveillance, etc.

They are designed to operate in all theatres, with means provided to ensure interoperability.

The state-of-the-art technology utilised for the construction of Scorpene class submarines has ensured superior stealth features such as advanced acoustic silencing techniques, low radiated noise levels, hydro-dynamically optimized shape, and the ability to launch an attack on the enemy using precision-guided weapons. The attack can be mounted with both torpedoes and tube-launched anti-ship missiles, at the same time as underwater or on the surface.

The stealth of this strong platform is enhanced by the special attention given to various signatures. These stealth features give it invulnerability, unmatched by most submarines.

"Two SSK submarines built by MDL in 1992 and 1994 are still in service after more than 25 years, a clear testimony of MDL's quality of construction. MDL has also achieved expertise in submarine refits by successfully executing the medium Refit-cum-Upgradation of all the four SSK class submarines of the Indian Navy. It is presently carrying out the Medium Refit and Life Certification of INS Shishumar, the first SSK submarine," said an MDL statement.

"MDL has always been at the forefront of the nation's progressive indigenous warship building programme. With the construction of the Leander and Godavari class frigates, Khukri class Corvettes, Missile Boats, Delhi and Kolkata class destroyers, Shivalik class Stealth Frigates, the SSK submarines and the Scorpene submarine under its belt, the history of modern day MDL almost maps the history of indigenous warship building in India."

<https://www.hindustantimes.com/india-news/third-scorpene-class-submarine-delivered-to-indian-navy-101613446494802.html>



The submarine will be commissioned as INS Karanj. (Sourced)

## Indian Army leases 4 Unmanned Aerial Vehicles from Israel under emergency procurement programme

*The contract is pegged at \$200 million and is reportedly valid for three years*

New Delhi: The Indian Army has leased four Heron TP medium-altitude, long-endurance (MALE) unmanned aerial vehicles (UAVs) from Israel as a part of its emergency procurement programme. The development comes at a time when India and China have just begun disengagement from one of the most prolonged stand-off along the Line of Actual Control (LAC).

This is the second significant contract under the provisions of the Defence Acquisition Procedure 2020 (DAP 2020). The Indian Navy had, under the same provisions, contracted Sea Guardian MALE UAVs from the United States.

According to a report in Janes, the contract is pegged at \$200 million. The report cited that the lease is valid for three years and extendable up to two years.

### **Contract signed at a time when tensions along LAC were still ongoing**

The lease for the UAVs was granted in mid-January when the LAC standoff was still ongoing. The standoff ended just last week when India and China decided to mutually disengage from the northern banks of Pangong Tso. Speaking in the Parliament, Defence Minister Rajnath Singh had said that his government will not allow anyone to take even one inch of land.

Underlining the importance of modernisation and the procedural challenges, Army Chief General MM Naravane had recently said that the latest changes in the DAP 2020 were aligned to empower the domestic industry.

"While all these initiatives are quite appreciable, there is a lot of work that still needs to be done... There are certain inherent procedural lacunae that have crept into the acquisition process which primarily arises due to the overbearing nature of our rules, regulations and guidelines in trying to ensure zero error," Naravane had said at a seminar.

<https://www.timesnownews.com/india/article/indian-army-leases-4-unmanned-aerial-vehicles-from-israel-under-emergency-procurement-programme/720714>



Tue, 16 Feb 2021

# Move over Gaganyaan, India plans sustained human presence in space: What's more in store

*Move over Gaganyaan, India is planning to have a sustained human presence in space. The Department of Space has envisaged a national effort to meet the goal of successful demonstration of human spaceflight capability and to achieve the vision of sustained human presence in space*

New Delhi: Move over Gaganyaan, India is planning to have a sustained human presence in space. The Department of Space has envisaged a national effort to meet the goal of successful demonstration of human spaceflight capability and to achieve the vision of sustained human presence in space. Union Minister Jitendra Singh had said that India's maiden human spaceflight module 'Gaganyaan' will be launched after the second unmanned mission planned in 2022-23.

### More in store

- The Department of Space has put up for public consultation on the website of the Indian Space Research Organisation (ISRO), the draft "Humans in Space Policy for India -- 2021" and guidelines and procedures for its implementation. DoS believes that given the collaborative nature of human spaceflight due to its multi-disciplinary nature, it is essential to have a policy-framework, which not only fosters partnerships but also addresses proliferation concerns and compliance to existing policies, laws and treaties.
- According to the draft, human-spaceflight programme needs to be sustained over longer periods to deliver tangible benefits. Hence, it is essential that the policy enables sustained presence in low earth orbit and beyond through reliable, robust, safe and affordable means by undertaking appropriate capacity building measures like collaborations, infrastructure development, facilities modernisation, technology development and human resource development. This would also encourage new industries, create high technology jobs, enable socio-economic growth and further enhance India's stature and role in space.
- "The Humans in Space Policy aims for sustained human presence in space as an instrument for development, innovation and foster collaborations in alignment with national interests," the draft read.
- Various technological elements such as development of human rated launch vehicle, environmental control and life support system, crew escape system, deceleration system, crew selection and training, crew recovery operations, development of human centric products, and micro gravity experiments shall be undertaken by department utilising expertise of ISRO, national research institutions, academia, industry and other organisations.
- As part of demonstration of human space flight capability, department shall
- undertake developmental unmanned missions prior to manned mission. A standardised approach towards safety and reliability shall be adopted for
- mission assurance and success
- Indian human space program envisages undertaking the demonstration of human spaceflight to LEO in the short-term and will lay the foundation for a sustained Indian human space exploration programme in the long run. DoS with mandate to carry out space activities in India shall define a roadmap with regard to human space activities.

- In order to pursue the objectives as stipulated in Humans in space policy, the necessary technology and gap areas shall be identified. The thrust areas thus identified shall become part of technology roadmap of ISRO. The thrust areas will include key technology elements e.g. Regenerative life support systems, development of Rendezvous and docking systems, Inflatable habitats, extravehicular activity suits etc.
- Indian human space programme involves various national institutions, organisations and stakeholders. A suitable mechanism shall be constituted to ensure effective coordination and seamless execution among various agencies involved. Announcement of opportunities shall be floated for encouraging the participation of national research institutes/academia/industries.

<https://www.indiatvnews.com/science/space-human-presence-india-isro-big-project-gaganyaan-human-spaceflight-latest-news-685064>

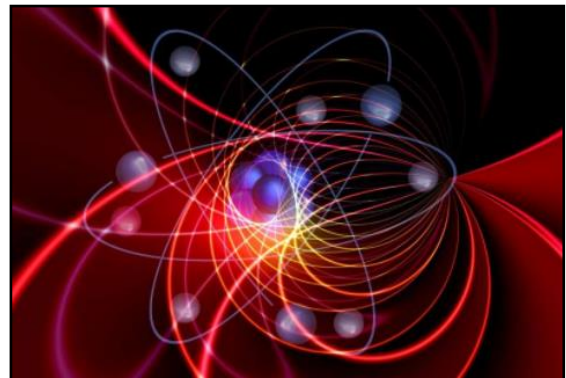


Tue, 16 Feb 2021

## Light used to detect quantum information stored in 100,000 nuclear quantum bits

Researchers have found a way to use light and a single electron to communicate with a cloud of quantum bits and sense their behavior, making it possible to detect a single quantum bit in a dense cloud.

The researchers, from the University of Cambridge, were able to inject a 'needle' of highly fragile quantum information in a 'haystack' of 100,000 nuclei. Using lasers to control an electron, the researchers could then use that electron to control the behavior of the haystack, making it easier to find the needle. They were able to detect the 'needle' with a precision of 1.9 parts per million: high enough to detect a single quantum bit in this large ensemble.



Credit: CC0 Public Domain

The technique makes it possible to send highly fragile quantum information optically to a nuclear system for storage, and to verify its imprint with minimal disturbance, an important step in the development of a quantum internet based on quantum light sources. The results are reported in the journal *Nature Physics*.

The first quantum computers—which will harness the strange behavior of subatomic particles to far outperform even the most powerful supercomputers—are on the horizon. However, leveraging their full potential will require a way to network them: a quantum internet. Channels of light that transmit quantum information are promising candidates for a quantum internet, and currently there is no better quantum light source than the semiconductor quantum dot: tiny crystals that are essentially artificial atoms.

However, one thing stands in the way of quantum dots and a quantum internet: the ability to store quantum information temporarily at staging posts along the network.

"The solution to this problem is to store the fragile quantum information by hiding it in the cloud of 100,000 atomic nuclei that each quantum dot contains, like a needle in a haystack," said Professor Mete Atatüre from Cambridge's Cavendish Laboratory, who led the research. "But if we try to communicate with these nuclei like we communicate with bits, they tend to 'flip' randomly, creating a noisy system."



The cloud of quantum bits contained in a quantum dot don't normally act in a collective state, making it a challenge to get information in or out of them. However, Atatüre and his colleagues showed in 2019 that when cooled to ultra-low temperatures also using light, these nuclei can be made to do 'quantum dances' in unison, significantly reducing the amount of noise in the system.

Now, they have shown another fundamental step towards storing and retrieving quantum information in the nuclei. By controlling the collective state of the 100,000 nuclei, they were able to detect the existence of the quantum information as a 'flipped quantum bit' at an ultra-high precision of 1.9 parts per million: enough to see a single bit flip in the cloud of nuclei.

"Technically this is extremely demanding," said Atatüre, who is also a Fellow of St John's College. "We don't have a way of 'talking' to the cloud and the cloud doesn't have a way of talking to us. But what we can talk to is an electron: we can communicate with it sort of like a dog that herds sheep."

Using the light from a laser, the researchers are able to communicate with an electron, which then communicates with the spins, or inherent angular momentum, of the nuclei.

By talking to the electron, the chaotic ensemble of spins starts to cool down and rally around the shepherding electron; out of this more ordered state, the electron can create spin waves in the nuclei.

"If we imagine our cloud of spins as a herd of 100,000 sheep moving randomly, one sheep suddenly changing direction is hard to see," said Atatüre. "But if the entire herd is moving as a well-defined wave, then a single sheep changing direction becomes highly noticeable."

In other words, injecting a spin wave made of a single nuclear spin flip into the ensemble makes it easier to detect a single nuclear spin flip among 100,000 nuclear spins.

Using this technique, the researchers are able to send information to the quantum bit and 'listen in' on what the spins are saying with minimal disturbance, down to the fundamental limit set by quantum mechanics.

"Having harnessed this control and sensing capability over this large ensemble of nuclei, our next step will be to demonstrate the storage and retrieval of an arbitrary quantum bit from the nuclear spin register," said co-first author Daniel Jackson, a Ph.D. student at the Cavendish Laboratory.

"This step will complete a quantum memory connected to light—a major building block on the road to realizing the quantum internet," said co-first author Dorian Gangloff, a Research Fellow at St John's College.

Besides its potential usage for a future quantum internet, the technique could also be useful in the development of solid-state quantum computing.

**More information:** Quantum sensing of a coherent single spin excitation in a nuclear ensemble, *Nature Physics* (2021). DOI: [10.1038/s41567-020-01161-4](https://doi.org/10.1038/s41567-020-01161-4), <https://dx.doi.org/10.1038/s41567-020-01161-4>

**Journal information:** [Nature Physics](https://phys.org/news/2021-02-quantum-nuclear-bits.html)  
<https://phys.org/news/2021-02-quantum-nuclear-bits.html>

# Random twists of place: How quiet is quantum space-time at the Planck scale?

By Craig Hogan

Fermilab scientists have been conducting experiments to look for quantum fluctuations of space and time at the smallest scale imaginable according to known physics. At this limit, the Planck length, our classical notions of space and time break down.

Imagine the ratio of the size of the universe compared to a speck of dust. That's about how big the speck of dust is compared to the Planck length,  $10^{-33}$  centimeters. The Planck time is how long it takes light to travel that distance.

Quantum mechanics tells us that everything is constantly fluctuating on small scales, but Planck-scale jitters of space and time themselves are so small that they've never been measured in the laboratory. Better understanding movement at the Planck scale may help physicists answer a basic and important question: Why do things appear to happen at definite times and places?

This space-time property, sometimes called simply "locality," is indeed pretty basic. Definite places and times are supposed to be what space-time is made of—the very fabric of reality.

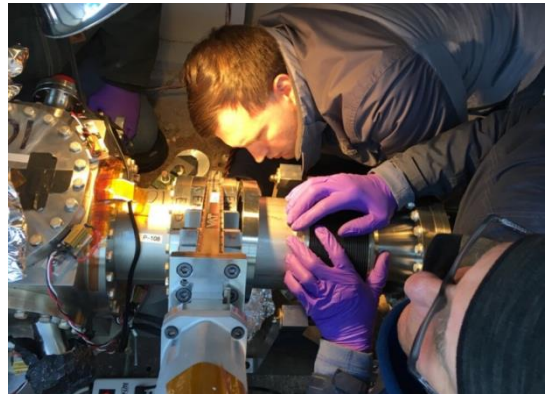
It has long been thought that the Planck scale is too small to study in any experiment, but about 10 years ago we decided to try it anyway. It's possible that Planck-scale quantum uncertainties of space-time add up over the time it takes light to cross an experiment, so an impossibly small effect becomes merely very hard—rather than impossible—to detect. So, we built an apparatus called the Fermilab Holometer to look for very small fluctuations in widely separated locations.

## Quantum matter and space-time: two world-systems sharing one unexplained reality

A quantum system is anything made of matter and energy, and nothing in it happens at a definite place and time until it is measured. Space-time seems to be just the opposite: Everything happens locally at a definite place, but its properties can be measured only nonlocally, that is, by comparing what happens in different places.

Somehow, these two different world-systems—quantum matter and space-time—share and interact in the same real physical world. Local absolute space directly affects matter, as anyone can see by spinning a top or experience by getting dizzy on a merry-go-round. Because matter is the source of gravity, it obviously affects space and time. Gravitational waves, which are made of pure space-time, carry energy and information, even through "empty" space, and matter can turn into pure space-time, in the form of black holes. But nobody understands exactly how quantum stuff relates to space and time.

The reason it's easy to forget about quantum space-time in everyday life, and even in most Fermilab experiments, is that it doesn't affect anything we actually measure. Although there must be some quantum uncertainty to space-time itself, it becomes fatal to standard theory only below the length where single quantum particles form black holes. This is the tiny scale we call the Planck length.



On Dec. 20, 2016, University of Chicago scientists Jonathan Richardson and Stephan Meyer work on the final assembly of the newly reconfigured Holometer vacuum system, which is inside an rough enclosure made of plywood, on a platform made of a steel slab recycled from Fermilab's boneyard. The steel cube at the left holds the end mirror of one of the Holometer interferometers. Credit: Craig Hogan, Fermilab

## The Holometer's success in measuring nothing

On a modest, 40-meter scale, the Holometer resembles giant detectors, such as the Laser Interferometer Gravitational-Wave Observatory in Hanford, Washington, and Livingston, Louisiana, that are used to detect gravitational waves from distant objects. Like LIGO, it uses mirrors and light—laser interferometers—to measure the shaking of space and time. In the Holometer, the laser light and mirrors, taken together as a system, become a nonlocal quantum object 40 meters long in one direction and 40 meters in another. They create an output signal that depends on quantum differences in the mirror positions. We can measure fluctuations from random changes of relative position of only one Planck length every Planck time if they are coherently correlated on the scale of the apparatus.

We published the results of our first experiment several years ago. In one sense the experiment was a big success, since we succeeded in measuring nothing with an unprecedented precision: With some kinds of Planck-scale jitters, we would have seen a big effect. But we found no such shaking. It was quiet.

However, that experiment did not rule out all kinds of fluctuating motion in space-time. For example, because the arms of its interferometers were straight, the laser light would not be affected if the apparatus shook with a purely rotational motion: The mirrors would move sideways relative to the beam instead of along it.

### Searching for Planck-scale twists in space-time

In general relativity, rotating matter drags space-time along with it. In the presence of a rotating mass, the local nonrotating frame, as measured by a gyroscope, rotates relative to the distant universe, as measured by distant stars. It could well be that quantum space-time has a Planck-scale uncertainty of the local frame, which would lead to random rotational fluctuations or twists that we would not have detected in our first experiment, and much too small to detect in any normal gyroscope.

So, we did a new experiment. We rebuilt the apparatus in a new shape. We added extra mirrors to steer some of the laser light in different direction, so the signal would respond to coherent rotational jitters or twists.

The new instrument is an incredibly sensitive gyroscope for very short durations, able to detect very small rotational twists over the fraction of a microsecond it takes light to cross it. We can detect shaking that changes direction randomly a million times a second, but that moves the opposite sides of the apparatus by only a billionth of a billionth of a meter—a speed much slower than continental drift. In our apparatus, that corresponds to randomly fluctuating twists of about one Planck length every Planck time.

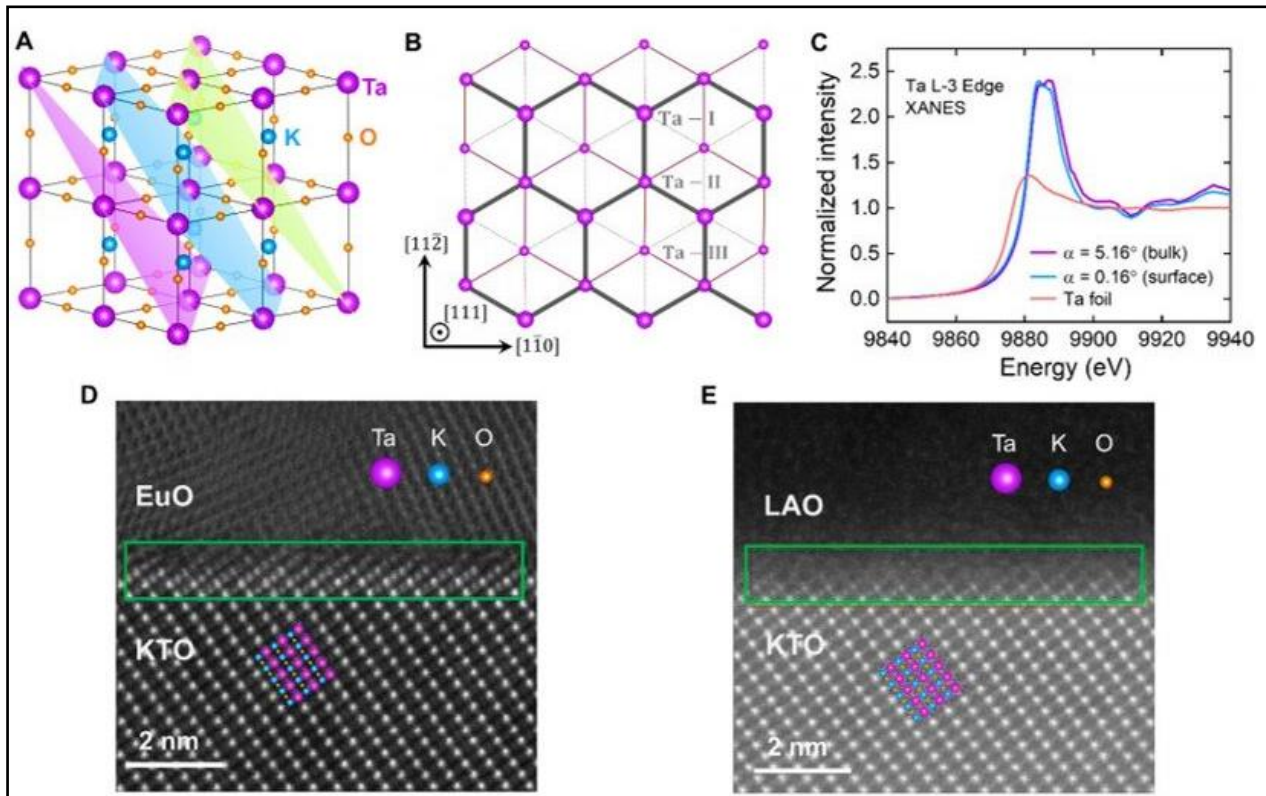
We recently completed our final experiment with this reconfigured Holometer. Our final result is again no jitters, which can be interpreted as no Planck-scale twists, of a certain kind, in the fabric of space-time. It seems space-time at the Planck scale is very quiet indeed.

The reason to keep looking for these effects is that we may never understand how quantum space-time works without some measurement to guide theory. The Holometer program is exploratory. Our experiment started with only rough theories to guide its design, and we still do not have a unique way to interpret our null results, since there is no rigorous theory of what we are looking for. Are the jitters just a bit smaller than we thought they might be, or do they have a symmetry that creates a pattern in space that we haven't measured? New technology will enable future experiments better than ours and possibly give us some clues to how space and time emerge from a deeper quantum system. We recently published a paper on our findings in the arXiv.

**More information:** Interferometric Constraints on Spacelike Coherent Rotational Fluctuations. arXiv:2012.06939v1 [gr-qc] [arxiv.org/abs/2012.06939](https://arxiv.org/abs/2012.06939)  
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# Two-dimensional superconductivity and anisotropic transport at potassium tantalate interfaces

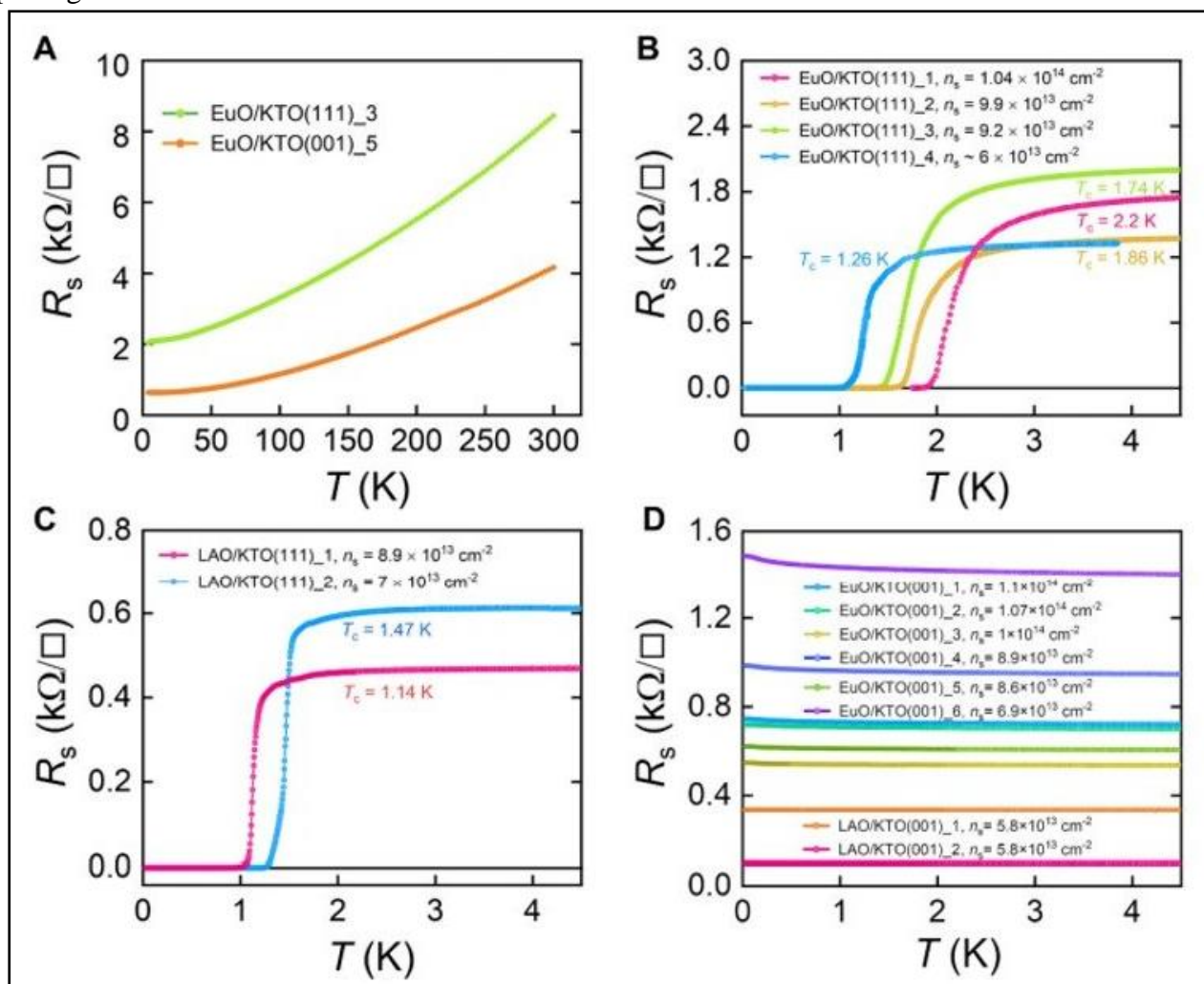
Unique electronic structures found at materials interfaces can allow unconventional quantum states to emerge. In a new report on *Science*, Changjiang Liu and a research team at the Argonne National Laboratory, University of Illinois and the Chinese Academy of Sciences detailed the discovery of superconductivity in electron gases formed at the interfaces between potassium tantalate (KTaO<sub>3</sub>) and insulating overlayers of either Europium-II oxide (EuO) or lanthanum aluminate (LaAlO<sub>3</sub>). The superconducting transition temperature approaching 2.2 K observed in this work was an order of magnitude higher than previous systems of lanthanum aluminate/strontium titanate. The critical field and current-voltage measurements indicated the two-dimensional (2-D) character of superconductivity. The team noted a spontaneous in-plane transport [anisotropy](#) in the EuO/ KTaO<sub>3</sub> samples prior to the onset of superconductivity to suggest the emergence of a distinct 'stripe' like phase near the critical field.



Schematics of KTO (111) surface, XANES and STEM characterizations. (A) KTaO<sub>3</sub> lattice structure. The relative sizes of the ions are chosen to emphasize the Ta atoms. The three adjacent (111) planes containing Ta<sup>5+</sup> ions are colored in light purple, blue and green, respectively. (B) Distribution of Ta<sup>5+</sup> ions viewed along the [111] crystal axis. Ta<sup>5+</sup> ions are shown with progressively smaller sizes in the three adjacent (111) planes, which are labeled as Ta - I, Ta - II and Ta - III, respectively. Solid lines between Ta<sup>5+</sup> ions indicate the relative distance or coupling strength – with thicker lines representing stronger couplings, giving rise to a buckled honeycomb lattice for the first bilayer comprising Ta - I and Ta - II sites. (C) XANES data from sample EuO/KTO(111)\_4 at the Ta Ledge. The KTO near the surface is only slightly reduced, with Ta valence close to its bulk value (5+). XANES data for pure Ta is also shown for comparison. STEM images of the (D) EuO/KTO (111) and (E) LAO/KTO (111) interfaces, looking down the [110] direction. Green box indicates the region near the interface. Credit: *Science*, doi: 10.1126/science.aba5511

## Superconductivity in 2-D

Liu et al. described 2-D superconductivity in electron gases formed at oxide-insulator/potassium tantalate oxide interfaces. Superconductivity in two-dimensions is a central theme in condensed matter physics and materials science. In 2-D surfaces, the electron-electron and electron-lattice interactions that mediate pairing can give rise to states that compete with superconductivity. As a result, only a small fraction of 2-D electron gas (2-DEG) and ultrathin metallic films are superconducting. Researchers had previously conducted most of the foundational work in 2-D superconductivity using amorphous thin films to gather deep insights to the nature of classical and quantum phase transitions. The 2-D superconductivity can be realized in crystalline materials and interfaces between crystalline materials to allow scientists to realize and break symmetries to tailor electronic structures in ways hitherto impossible in amorphous and disordered thin films. For instance, in a 2-D superconductor with strong spin-orbit coupling and broken inversion symmetry, a Rashba interaction can lead to a candidate platform to realize Majorana modes. Three of the most prominent examples of 2-D superconductors at crystalline interfaces involve transition metal oxides with strong electron-electron and electron-lattice interactions to mediate superconducting pairing.



Transport measurements of 2DEGs formed at different KTO interfaces. (A) Metallic temperature dependence of the sheet resistance of EuO/KTO (111) and (001) samples measured from 300 K to 4 K. (B) Measurement at lower temperatures shows superconducting transitions in EuO/KTO (111) samples (current along [11 2  $\bar{1}$ ]) with varying carrier densities, which are determined from Hall measurement at  $T = 10$  K for samples EuO/KTO(111)\_1, 2 and 3. The carrier density in EuO/KTO(111)\_4 is estimated from growth condition. (C) Similar measurements on LAO/KTO (111) samples also show superconductivity. (D) No superconductivity is observed in samples with (001) oriented KTO interfaces with overlayers of either EuO or LAO down to 25 mK. The range of the carrier density is similar to those of the (111) oriented samples shown in (B) and (C). Credit: Science, doi: 10.1126/science.aba5511

## **Observing 2-D superconductivity with potassium tantalate.**

Potassium tantalate ( $\text{KTaO}_3$  or KTO) is an insulator with a cubic perovskite structure and a dielectric constant that exceeds 4500 upon cooling to low temperatures. The KTO material is a 'quantum paraelectric' substrate due to quantum fluctuations at low temperatures during ferroelectric transition. Researchers can use ionic liquid gating to tune the KTO surface into a weak superconducting state. To realize 2-D electron gas (2-DEG) at the KTO interfaces, they introduced vacuum cleaving, followed by exposure to UV or synchrotron radiation. Using angle-resolved photoemission spectroscopy (ARPES) studies on the KTO surface, Liu et al. found a distinct Fermi surface with a six-fold symmetry derived from the lattice architecture. They measured a transition temperature as high as 2.2 K, which they tuned by varying carrier density during sample growth. They also noted an emergent stripe-phase which broke the rotational symmetry in the KTO surface.

The team next prepared the 2-D electron gas (2-DEG) on potassium tantalate (KTO) by growing a layer of europium oxide (EUO) via molecular beam epitaxy or lanthanum aluminate (LAO) using pulsed laser deposition, which they confirmed using X-ray diffraction measurements. Using aberration-corrected high-resolution transmission electron microscopy and scanning transmission electron microscopy, they detected oxygen vacancies near the EUO/KTO interface. When they lowered the temperature, the interface displayed superconductivity. Liu et al. grew the samples at different temperatures and oxygen pressures to obtain different carrier densities and mobilities. They noted the observed crystallographic orientation dependent interfacial 2-D superconductivity at the KTO interface to be in sharp contrast with the 2-DEGs observed at strontium titanate (STO) interfaces, where superconductivity occurred for all orientations.

### **Current-voltage behavior and Van der Pauw geometry**

The superconductivity in the EUO/KTO sample also showed a robust critical-current behavior. As the team raised the temperature close to the transition temperature, they noted a gradual onset of a resistive state at low currents. They interpreted the evolution of superconductivity in a 2-D superconductor relative to a Berezinskii–Kosterlitz–Thouless (BKT) transition. Accordingly, current driven unbinding of vortex anti-vortex pairs created by thermal fluctuations at finite temperatures caused the onset of a non-linear current-voltage (I-V) in the superconducting state. The results further suggested 2-D superconductivity to be inhomogeneous (diverse), where weak links joined the superconducting regions.

The team then noted the appearance of a distinct phase near the superconducting state in low carrier density EUO/KTO samples and conducted measurements of resistance in a van der Pauw geometry; i.e., a simple analytical technique to determine electrical resistivity and sheet resistance. When they decreased the temperature below 2.2 K, the resistance increased by almost 50 percent for current along the crystal axis, while it decreased by 50 percent for current flowing in a different crystallographic direction. The van der Pauw method amplified the transport anisotropy in high-mobility 2-DEGs suggesting the emergence of a distinct phase that broke rotational symmetry across macroscopic length scales, which persisted across a broad temperature range from 2.2 K down to about 0.7 K. At even lower temperatures, the resistance in crystallographic directions reduced rapidly to zero to obtain a superconducting state.

### **Characteristics of 2-D superconductivity**

After lowering the temperature in the setup, Liu et al. noted increased resistance due to superconducting puddles that inhibited transport between weakly coupled superconducting regions. They restored global superconductivity at lower temperatures via Josephson coupling between these regions. The results indicated the underlying superconductivity to be anisotropic, allowing the superconducting regions to organize themselves into stripes with coherent alignment across macroscopic length scales. The magnetic field dependence of sheet resistance provided further evidence for an anisotropic stripe like phase. As the magnetic field increased, Liu et al. observed a sharp increase in resistance that suppressed global superconductivity along both directions of current. In this way, as the scientists suppressed the global superconductivity using temperature or magnetic fields, the transport measurements revealed a stripe phase to produce large anisotropic

transport oriented along similar crystal axes in KTO and STO (potassium tantalate and strontium titanate) interfaces. The research team propose to conduct further experiments, including those that probe the spatial structure of superconductivity to understand the nature of the observed superconductivity and resistance anisotropy.

**More information:** Liu C. et al. Two-dimensional superconductivity and anisotropic transport at KTaO<sub>3</sub> (111) interfaces, *Science*, [DOI: 10.1126/science.aba5511](https://doi.org/10.1126/science.aba5511)

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## COVID-19 Research News

mint

Tue, 16 Feb 2021

### Coronavirus survives longer on glass, plastic than on cloth, paper: IIT study

- *Researchers found that a droplet remains liquid for a much shorter time on a porous surface, making it less favourable to the survival of the virus*
- *Researchers said the Coronavirus can survive for 4 days on glass, 7 days on plastic, stainless steel. However, only 3 hours on paper and 2 days on cloths*

New Delhi: The novel coronavirus may survive for far lesser time on porous surfaces such as paper and clothes than on impermeable surfaces like glass and plastic, a study by researchers from the Indian Institute of Technology (IIT) Bombay suggests.

Covid-19, caused by the SARS-CoV-2 virus, is transmitted through respiratory droplets. The virus-laden droplets also form fomite upon falling on a surface, which serves as a source for infection spread.

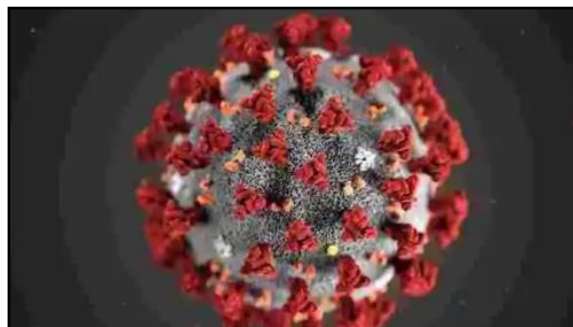
In the study, published in the journal *Physics of Fluids*, the researchers analysed the drying of droplets on impermeable and porous surfaces.

They found that a droplet remains liquid for a much shorter time on a porous surface, making it less favourable to the survival of the virus.

The research suggests that the virus can survive for four days on glass, and seven days on plastic and stainless steel.

However, the virus survived for only three hours and two days on paper and cloth, respectively, the researchers said.

"Based on our study, we recommend that furniture in hospitals and offices, made of impermeable material, such as glass, stainless steel, or laminated wood, be covered with porous material, such as cloth, to reduce the risk of infection upon touch," said study author Sanghamitro Chatterjee from IIT Bombay.



The study also suggests that seats in public places, such as parks, shopping malls, restaurants, and railway or airport waiting halls, could be covered with cloth to reduce the risk of disease spread.

According to the researchers, 99.9 per cent of the droplet's liquid content for both impermeable and porous surfaces is evaporated within the first few minutes.

They noted that after this initial state, a microscopic thin residual liquid film remains on the exposed solid parts, where the virus can still survive.

The team, including Janani Srree Murallidharan, Amit Agrawal and Rajneesh Bhardwaj, also from IIT Bombay, discovered the evaporation of this remnant thin film is much faster in the case of porous surfaces as compared to impermeable surfaces.

The droplets spread due to capillary action between the liquid near the contact line and the horizontally oriented fibres on the porous surface and the void spaces in porous materials, which accelerates evaporation, the researchers said.

"The fact that just the geometric features rather than the chemical details of the porous material make the thin-film lifetime significantly less was surprising," Bhardwaj explained.

The researchers said that the study findings, such as the droplet's liquid phase lifetime of approximately six hours on paper, will be particularly relevant in certain contexts, like schools.

While this timescale is shorter than that of any permeable material, such as glass with a liquid phase lifetime of around four days, it would impact the exchange of notebooks, they said.

For example, the researchers said, it could come handy when policymakers evaluate safe measures for reopening schools or the exchange of currency note transactions in retail banks.

Similarly, they said the cardboard boxes, used commonly by e-commerce companies around the world, could be deemed relatively safe, since they would inhibit the virus survival.

<https://www.livemint.com/science/news/coronavirus-survives-longer-on-glass-plastic-than-on-cloth-paper-iit-study-11613379432184.html>



