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Fri, 05 Nov 2021

India test fires aircraft-launched glide bombs capable of destroying enemy targets at 100Km

By Rishikesh Kumar

India has carried out a series of sophisticated weapon and missile tests, including the country's intercontinental ballistic Agni-5 missile in recent weeks. These tests are intended to validate war-preparedness amid the deployment of tens of thousands of new troops along the border with China.

The Indian Air Force and the Defence Research and Development Organisation (DRDO) test-fired a long-range stand-off precision air-to-surface munition Smart Anti-Airfield Weapon (SAAW), the Indian defence ministry said on Wednesday. The SAAW, belonging to the glide bomb category, was tested in two different configurations -- through the use of satellite navigation and also electro-optical sensors.



"Electro-optical seeker-based flight test of this class of bomb has been conducted for the first time in the country. The electro-optic sensor has been developed indigenously," the Indian defence ministry said.

The 120kg-category weapon can reportedly destroy enemy assets such as radars, bunkers, aircraft taxiing tracks and runways within a 100km range. Currently, the Indian Armed Forces purchase this form of weapon from Israel and Russia.

"This is a sort of guided bomb, and it will be much cheaper than a missile or rocket, the reason being that it is not having propulsion, it is making use of the aircraft's propulsion," the DRDO stated recently.

The Indian armed forces earlier tested the accuracy of its long-range guided bomb and several missiles in October.

In August 2020, China unveiled a 500kg "smart" glide dispenser bomb which "can release hundreds of submunitions" within seconds to "paralyze an airfield in one shot," while also performing "high-altitude long-range launch, autonomous all-weather attacks, and high-precision hits."

<https://sputniknews.com/20211103/india-test-fires-aircraft-launched-glide-bombs-capable-of-destroying-enemy-targets-at-100km-1090447993.html>

India tests Smart Anti-Airfield Weapon

By Joe Saballa

The Indian Air Force has tested an indigenously-developed smart weapon capable of targeting and destroying enemy airfield assets, including bunkers, radars, and runways.

Conducted at a firing range in Rajasthan on Wednesday, the test marked the second time in a week that the smart anti-airfield weapon demonstrated its capabilities when fired from a Jaguar fighter jet.

During the test, the newly adapted launcher smoothly deployed the weapon from the aircraft, utilizing advanced guidance and navigation algorithms to hit its intended targets from within 100 kilometers (62 miles) with high accuracy.

According to an official familiar with the weapon's development, the test was significant because it showed the capabilities of the embedded infrared seeker technology and GPS-based navigation and terminal guidance systems that improve the missile's accuracy.

"The two different configurations based on satellite navigation and electro optical (EO) sensors have been successfully tested. EO seeker-based flight test of this class of bomb was conducted for the first time in the country," the defense ministry said, as quoted by *The Times of India*.

Other Developments

Last week, the Indian Air Force and the Defence Research and Development Organisation (DRDO) conducted the first test of a long-range bomb designed to destroy enemy assets at around 100 kilometers (62 miles) away.

Mounted on a Sukhoi-30 warplane, the weapon struck a target using its laser guidance system.

The successful test of the weapon system reportedly will make India capable of staying well within its territory and hitting enemy targets from long range with high accuracy.

"The LRB, after release from the fighter, was guided to a land-based target at a long range with accuracy within specified limits. All the mission objectives were successfully met," a DRDO official remarked. "The flight of the bomb and the performance was monitored by a number of range sensors including electro-optical tracking systems, telemetry, and radar."

<https://www.thedefensepost.com/2021/11/04/india-anti-airfield-weapon/>



भारत का यह हथियार बढ़ा सकता है पाक-चीन की बेचैनी, खूबी सुन उड़ जाएंगे होश

पूर्वी लद्दाख में चीन के साथ एलएसी पर जारी तनातनी के बीच रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) और भारतीय वायुसेना (आईएएफ) की टीम ने स्वदेशी विकसित स्मार्ट 'एंटी-एयरफील्ड' हथियार के राजस्थान के जैसलमेर में संयुक्त रूप से दो सफल परीक्षण किए हैं

Edited By Mohit Sharma

नई दिल्ली: रक्षा अनुसंधान एवं विकास संगठन (DRDO) और भारतीय वायु सेना (IAF) ने स्वदेशी विकसित स्मार्ट 'एंटी-एयरफील्ड' हथियार के राजस्थान के जैसलमेर में संयुक्त रूप से दो सफल परीक्षण किए हैं। रक्षा मंत्रालय ने बुधवार को यह जानकारी दी। जैसलमेर की पोकरण फील्ड फायरिंग रेंज एक बार फिर भारत के ताकतवर बनने की साक्षी बनी है। यह वेपन एक तरह की मिसाइल ही है, जो जगुआर फाइटर प्लेन में लगता है। इससे पहले रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) और भारतीय वायुसेना (आईएएफ) की टीम ने शुक्रवार को संयुक्त रूप से एक एरियल प्लेटफॉर्म से स्वदेशी रूप से विकसित लॉन्ग-रेंज बम (एलआरबी) का सफलतापूर्वक परीक्षण किया था।



DRDO (Photo Credit: फाइल फोटो)

देश में पहली बार हुआ इस तकनीक का इस्तेमाल

रक्षा मंत्रालय ने बताया कि उपग्रह नेविगेशन और इलेक्ट्रो ऑप्टिकल सेंसर पर आधारित दो अलग-अलग उपकरणों का सफल परीक्षण किया गया है। इस तरह के बम का इलेक्ट्रो ऑप्टिकल सेंसर आधारित उड़ान परीक्षण देश में पहली बार किया गया है। इलेक्ट्रो ऑप्टिकल सेंसर को स्वदेशी रूप से विकसित किया गया है।

उच्च सटीकता के साथ लगाया टारगेट पर निशाना

रक्षा मंत्रालय ने बताया कि इस गाइडेड बम को सटीक नेविगेशन प्रणाली की मदद से जगुआर विमान के जरिए छोड़ा गया। यह बम 100 किलोमीटर की रेंज से आगे सटीक तौर पर पहुंचा। सिस्टम का इलेक्ट्रो ऑप्टिकल कॉन्फिगरेशन इमेजिंग इंफ्रारा-रेड सीकर तकनीक से लैस है। जो हथियार की सटीक मारक क्षमता को बढ़ाता है। दोनों परीक्षणों में टारगेट को सटीकता के साथ हिट कर मारा गया। सिस्टम को अधिकतम 100 किलोमीटर की दूरी के लिए डिजाइन किया गया है।

इससे पहले रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) और भारतीय वायुसेना (आईएएफ) की टीम ने शुक्रवार को संयुक्त रूप से एक एरियल प्लेटफॉर्म से स्वदेशी रूप से विकसित लॉन्ग-रेंज बम (एलआरबी) का सफलतापूर्वक परीक्षण किया था। डीआरडीओ की ओर से जारी एक बयान के अनुसार, "भारतीय वायुसेना के लड़ाकू विमान से दागे जाने के बाद बम को निर्दिष्ट सीमाओं के भीतर सटीकता के साथ लंबी दूरी पर स्थित भूमि-आधारित लक्ष्य के लिए निर्देशित किया गया।"

<https://www.newsnationtv.com/india/news/drdo-successfully-test-fires-anti-airfield-weapon-amid-tensions-with-china-223522.html>

India's Missile test not meant as a warning shot to Beijing, Experts Say

By J.M. Phelps

India's recent testing of a nuclear-capable intercontinental ballistic missile came on the heels of failed military and diplomatic talks between India and China, as well as reports of a hypersonic missile test by the Chinese regime.

But experts told The Epoch Times that India's test-fire was not a retaliatory response to the regime's recent actions

Agni-5 Capabilities

Animesh Roul, executive director of the New Delhi-based Society for the Study of Peace and Conflict, said this was not the first time India test-fired an Agni-5 surface-to-surface ballistic missile. In 2012, 2013, and 2018, the Agni-5 was tested several times.

"However, the Oct. 27 test at Odisha coast's Abdul Kalam Island was the first trial of the missile by the Strategic Forces Command that deploys India's nuclear arsenal," he said.

This confirms that Agni-5 nuclear-capable missiles could be quickly deployed from strategic locations in India, Roul added.

The missile test was also significant because it reaffirmed "India's official policy to have credible minimum deterrence and commitment to no first use, and it is also the first to be used by India's Strategic Force Command," said Mahesh Debata, an assistant professor at India's Jawaharlal Nehru University.

With a launch weight of nearly 100 thousand pounds, this nuclear-capable missile can carry a warhead of up to 3,000 pounds. India's Defence Research and Development Organisation (DRDO) reported that the Agni-5 missile has a maximum range of up to 3,600 miles.

Others, including Du Wenlong, a researcher at the People's Liberation Army's Academy of Military Sciences, have suggested a range of nearly 5,000 miles. If this is the case, the Agni-5 has the ability to strike nearly all of mainland China, reaching as far as the northernmost region of the country.

Continued Crisis

Border disputes between India and China have existed for many decades, and these unresolved territorial disputes have resulted in a number of conflicts through the years.

A violent clash between Indian and Chinese armed forces in the remote Himalayan region of eastern Ladakh in early May 2020 brought any chance of resolving disputes to a new low, Roul said. There were reportedly dozens of injuries and deaths on both sides.

In response to the deadly face-off, he said, "both sides have beefed up force deployment with tens of thousands of soldiers [and] weaponry ever since."

Following multiple rounds of military and diplomatic talks, Roul said signs of disengagement had begun. But he went on to note that the 13th round of military talks between India and China in October ended in a stalemate without further headway. "So, border issues between the two countries remain volatile," he said.



Army soldiers in a Pinaka multi-barrel rocket launcher march past during a ceremony to celebrate India's 73rd Army Day in New Delhi on Jan. 15, 2021. (Prakash Singh/AFP via Getty Images)

According to Roul, the ongoing tensions between the two countries could give reason for the Chinese regime to take the Agni-5 testing as a sign of aggressive military posturing by India.

Not a Warning Shot

Some experts have described the Agni-5 missile launch as a warning shot from India to China.

Roul disagreed, saying that it would not be sensible for any country to “display its missile muscle as a warning shot, or as part of any aggressive or defensive posturing.”

“India is very well aware of superior Chinese missile capabilities, and flexing [its own] muscles would be futile and counterproductive [to diplomatic and military talks],” he said.

Debata also said it is “not right to assume” that the successful test of Agni-5 missile from off the coast of Odisha was “a warning for any country or targeted at any particular country.”

Missile testing is not uncommon in India. Prior to the Agni-5, Roul said four other missiles have been operationally deployed with different ranges and payload capabilities. India could simply be showing China “its ongoing development in ground-based conventional missile and nuclear forces,” he said.

Debata said, “Since the inaugural test of Agni category missiles in 1989, it has been a potent force of India’s defense system and its present launching could be described as a right step to further spruce up India’s defense capabilities.”

At a time when the Chinese regime is putting its nuclear capabilities on full display, Roul said “the test may help India build a domestic consensus and reassurance about its military capabilities and overall morale of the armed forces.”

The Agni-5 missile is “clearly part of India’s strategic deterrence vis-à-vis China,” he added.

https://www.theepochtimes.com/indias-missile-test-not-meant-as-a-warning-shot-to-beijing-experts-say_4087158.html



Fri, 05 Nov 2021

China is enriching its nuclear arsenal faster than expected

China is enriching its nuclear arsenal faster than expected. It is closing the gap with the United States in terms of the number of weapons. The Pentagon said in a report released on Wednesday that the Pentagon had not been notified of the incident.

Last year, the number of nuclear warheads that could be used at any time in China’s arsenal was in the 200s, the report said. By 2026, the number of Chinese weapons could increase to 600. And in 2030 this number may stand at 1 thousand. China’s stockpile of nuclear weapons could be built in less than two and a half times less than the Pentagon estimates.

In addition to increasing the number of nuclear warheads, China has invested heavily in developing and expanding its nuclear arsenal, the report said. The U.S. Department of Defense has prepared this annual report on China’s military progress for submission to Congress.

In a similar report released last year, the Pentagon estimated that China’s stockpile of nuclear weapons could double by 2030. But long before that, China’s nuclear arsenal is getting bigger.



The United States and Russia are leading the world in stockpiling nuclear weapons. Now China is in fierce competition with these two countries. For this, Beijing is trying to increase the facilities for launching ballistic missiles with nuclear weapons from land, sea and air.

Beijing has built a new stockpile of nuclear missiles in western China, independent researchers say, after analyzing satellite images. The United States has expressed concern in response to the news. The Pentagon says it is concerned about the United States. Because, this action has raised questions about China's intentions. In this regard, Washington has called on Beijing to bring more transparency to the progress of the nuclear project.

China test-fired a hypersonic missile capable of carrying nuclear weapons, the UK-based Financial Times reported last month. However, China rejected this claim.

China, meanwhile, has called the Pentagon's report "biased." The State Department responded by saying that the report was intended to highlight Washington's potential risks. Chinese Foreign Ministry spokesman Wang Weibin said the US Defense Department had issued a similar report earlier. These biased reports did not paint a real picture. Not China but the United States itself is the biggest nuclear threat to the world.

India says it has successfully test-fired an Agni-5 missile in the ongoing conflict with China. According to the Times of India, quoting the country's foreign ministry, the successful launch of the missile also brought areas in the far north of China within India's missile range.

The missile was fired from APJ Abdul Kalam Island off the coast of Odisha state at 7.50 pm local time on Wednesday. Analysts see India's missile test as a warning to regional rival China.

According to Indian media NDTV, the Agni-5 surface-to-air missile has a range of 5,000 km. It belongs to the Intercontinental Ballistic Missile (ICBM) class. India claims that the missile can hit the target on the ground perfectly.

The Agni-1 to Agni-5 missiles have been designed and built by the Defense Research and Development Organization of India (DRDO). Among them, Agni-5 can hit a target at a distance of 600 km. And Agni-2 has the capacity to cover two thousand kilometers. On the other hand, India claims that Agni-3 and 4 can travel 2,500 to 3,500 kilometers.

Last June, India test-fired a nuclear-capable Agni Prime missile. This is a more sophisticated version of the Agni class of missiles. The missile was also launched from the coast of Odisha.

<https://www.stocknewsworld.com/china-is-enriching-its-nuclear-arsenal-faster-than-expected/>

The Tribune

Fri, 05 Nov 2021

India must enhance its military capabilities in line with changing world, modes of war: Modi

PM makes the remarks while addressing soldiers on Diwali at Nowshera sector in Rajouri district of Jammu and Kashmir

Nowshera: India must enhance its military capabilities in line with the changing world and modes of war, Prime Minister Narendra Modi said on Thursday and noted that modern border infrastructure had been built to augment connectivity and troop deployment.

Modi made the remarks while addressing soldiers on the occasion of Diwali at Nowshera sector in the border district of Rajouri in Jammu and Kashmir.

The prime minister lauded the role played by the brigade here in surgical strikes. India had conducted the surgical strike on September 29, 2016, across the Line of Control (LoC) as a response to a terrorist attack on an Army base in the Uri sector of Jammu and Kashmir.

Modi said many attempts were made to spread terrorism here after the surgical strike but they were given a befitting reply.

India must enhance its military capabilities in line with the changing world and modes of war, the prime minister said.

He said that connectivity in border areas had improved -- be it from Ladakh to Arunachal Pradesh, Jaisalmer to Andaman and Nicobar Islands.

Borders and coastal areas lacking normal connectivity now have roads and optical fibres, and this boosts deployment capabilities as well as facilities for soldiers, the prime minister said.

Modi said that earlier the country had to depend mostly on imports in the defence sector but with his government's attempts indigenous capabilities had got a boost.

He hailed the courage of soldiers and said their capability and strength had ensured peace and security for the country.

"I want to spend Diwali with family members, so I join you on this festival," he said.

Official sources shared photographs of him at an Army post in Nowshera. PTI

<https://www.tribuneindia.com/news/nation/india-must-enhance-its-military-capabilities-in-line-with-changing-world-modes-of-war-modi-334189>



Indian Navy strengthens anti-submarine capabilities

The Ministry of Defense (MoD) of India has signed an agreement with the US to acquire Mk-54 lightweight torpedoes to be fitted on P-8I MPA aircraft.

To increase its anti-submarine and anti-surface warfare capabilities, India is investing heavily in the procurement of advanced airborne platforms such as Boeing P-8I Multi-mission Maritime Patrol Aircraft (MPA) and MH-60R Seahawk maritime helicopters.

These acquisitions are expected to drive the procurement of several cutting-edge weapon systems, including torpedoes, anti-ship and land-attack missiles.



An Indian P-8I. (Credit: IN)

According to GlobalData's estimates, India is expected to spend about US\$263m on procuring Varunastra, Mk-54 lightweight torpedoes and heavyweight torpedoes between 2021-2031.

"This procurement is independent of the recent Sino-Russian joint patrol in the Tsugaru Strait and warming ties between China and Russia. However, this procurement is an example of India moving closer to the US and western equipment than its traditional ally," Chandan Kumar Nayak, Defence Analyst at GlobalData, said.

Additionally, the sale of MK-54 torpedoes will provide the Indian Navy (IN) the ability to strike Chinese threats in the Indian Ocean.

"India will seek to maintain its military supremacy in the Indian Ocean and therefore, we expect that the IN will procure further capabilities to counter not just overt naval activity, but any covert designs from its neighbors," Nayak said.

<https://www.australiandefence.com.au/news/indian-navy-strengthens-anti-submarine-capabilities>

China could have 1,000 nuclear warheads by 2030, says Pentagon

China is expanding its nuclear arsenal faster than anticipated, narrowing the gap with the United States, says Pentagon

Washington: Beijing is expanding its nuclear arsenal faster than anticipated, narrowing the gap with the United States, the Pentagon said, adding that China could have 1,000 deliverable nuclear warheads by 2030.

In a report, Pentagon said Wednesday that China could have 700 deliverable nuclear warheads by 2027, and could top 1,000 by 2030 -- an arsenal two-and-a-half times the size of what the Pentagon predicted only a year ago, according to the report.

The People's Republic of China (PRC) "is investing in, and expanding, the number of its land-, sea-, and air-based nuclear delivery platforms and building the infrastructure necessary to support this major expansion of its nuclear forces.

The assessment came in the US Department of Defense's annual report to Congress on Chinese military developments.

Like the United States and Russia, the two leading nuclear powers, China is building a "nuclear triad," with capabilities to deliver nuclear weapons from land-based ballistic missiles, from missiles launched from the air, and from submarines, it said.

The report said China is likely not seeking a capability to launch an unprovoked nuclear strike on a nuclear-armed adversary -- primarily the United States -- but wanted to deter attacks from others by maintaining a credible threat of nuclear retaliation.

A year ago, the Pentagon's China report said the country had about 200 deliverable warheads and would double that by 2030.

Independent researchers have in recent months published satellite photographs of new nuclear missile silos in western China.

The acceleration "is very concerning to us," a US defense official said.

It "raises questions about their intentions," the official said, calling for more transparency from Beijing over its nuclear force development.

- Main US rival -

The Pentagon has declared China its principal security concern for the future, as Beijing undertakes to build the People's Liberation Army into "world-class forces" by 2049, according to its official plan.

China is expanding its air, space and sea forces with the aim of projecting its power globally, much as the United States military has for decades.

The rivalry has increased concerns about a possible clash between the US and China, especially over Taiwan, which China claims as its territory but which is closely supported by the United States.

The new US report said China's swift military modernization aims to have the capability by 2027 to overcome any pushback to an effort to reclaim Taiwan, by pressure or military force.



A guide explains the models of China's first atomic bomb (R) and hydrogen bomb (L) at an exhibition hall in Zitong County of Mianyang. Photo: Xinhua/Liu Kun

By 2027, the report says, China aims to have "the capabilities to counter the US military in the Indo-Pacific region, and compel Taiwan's leadership to the negotiation table on Beijing's terms."

- October 2020 crisis -

The report confirmed news stories in recent months saying that in October 2020 Pentagon officials were forced to quell real concerns in Beijing that the United States, driven by domestic political tensions related to the presidential election, intended to instigate a conflict with China in the South China Sea.

Underscoring its fears, the PLA had issued intensified warnings in state-controlled media, launched large scale military exercises, expanded deployments and put troops on heightened readiness, the report said.

After senior Pentagon officials moved to directly speak to Chinese counterparts, the concerns eased and a Chinese defense spokesman announced publicly that the United States in fact did not plan to trigger a crisis.

"These events highlighted the potential for misunderstanding and miscalculation, and underscored the importance of effective and timely communication," the report said.

The report also questioned the PLA's intent in biological research into substances that potentially have both medical and military uses.

"Studies conducted at PRC military medical institutions discussed identifying, testing, and characterizing diverse families of potent toxins with dual-use applications," the report said, raising concerns over compliance with global biological and chemical weapons treaties.

Such concerns have echoed since early 2020 after the Covid-19 pandemic erupted first in the area of a Chinese biological research laboratory with PLA connections in Hunan.

The Chinese have denied the lab had anything to do with the Covid outbreak, but have limited access to it from investigators.

- Instability -

Meanwhile the Pentagon's top general warned Wednesday that the Chinese military's stunning technological advances, signified by its recent globe-circling hypersonic missile test, left the world poised to enter an era of increased strategic instability.

"We are witnessing one of the largest shifts in global geostrategic power that the world has witnessed," Joint Chiefs Chairman General Mark Milley told the Aspen Security Forum.

"That means that we're going to have to put a premium, in my view, on maintaining great power peace," he said.

<https://www.thenews.com.pk/latest/905917-china-could-have-1000-nuclear-warheads-by-2030-says-pentagon>



Fri, 05 Nov 2021

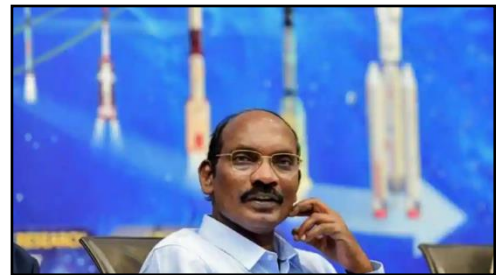
Exclusive: What is ISRO's 'Solar Power Calculator' that is to be offered to the world?

By Sidharth MP

Story highlights

Earlier this week, addressing his counterparts at the COP26 Global Climate Summit at Glasgow, Indian Prime Minister Narendra Modi had announced that ISRO would offer the world a 'Solar Power Calculator'

The Indian Space Research Organization (ISRO) has demonstrated the method of identifying the best suited locations for installing upcoming solar power generation farms, across the globe. India's state-run space agency has done so using data obtained from its own earth observation satellites that are continuously monitoring the planet, from Geostationary orbit (36,000 kms above the earth's equator). WION spoke to Dr. K. Sivan, Chairman, ISRO for more on this project.



Earlier this week, addressing his counterparts at the COP26 Global Climate Summit at Glasgow, Indian Prime Minister Narendra Modi had announced that ISRO would offer the world a 'Solar Power Calculator'. He said that it would help decide the location of solar energy projects across the globe. He added that it would strengthen the 'One Sun, One World, One Grid' initiative.

When requested to elaborate on the project, Dr. K. Sivan said, it was a technology demonstration proposal that was made using data from Earth Observation satellites. "It is about using satellite data and identifying potential areas where maximum solar energy is available per year, across the globe. We will be collecting this data, analysing, mapping it and sharing it online and via a mobile application. Mapping this data and sharing it would help countries decide their upcoming solar power projects" he told WION.

Talking about if ISRO was also developing some hardware for this purpose, he replied that ISRO was only using data, mapping and analysing it and not working on any hardware aspect, for this project.

According to ISRO's description of the solar calculator mobile application, computation of solar energy potential is essential to select the locations for solar photovoltaic (PV) power plants. "An android app for the computation of solar energy potential has been developed by Space Applications Centre (SAC), ISRO, Ahmedabad at the behest of Ministry of New and Renewable Energy, Govt. of India. It is a very useful tool for installation of PV solar panels for tapping solar energy," it reads.

ISRO's website says the mobile app allows users to obtain the 'solar energy potential' data in (kWh/m²), when the location is keyed or is designated according to GPS. It gives monthly and yearly solar potential processed using Indian Geostationary Satellite data (Kalpana-1, INSAT-3D and INSAT-3DR). It also offers monthly minimum and maximum temperature to calculate realistic solar potential.

Additionally, the app also offers monthly and yearly solar potential (in kWh/m²) and minimum-maximum temperature at any location. It also displays the location on the satellite image and

provides azimuth / elevation angles as well as day length over different time periods in a year. ISRO adds, Wind, solar and wave energy resources can be assessed with the help of Earth Observation data, sourced from satellites that are in the geostationary orbit (roughly 36,000kms) above earth's equator.

Asked about when this particular 'Solar calculator' would be made fully available across the globe, Dr. Sivan said that the technology behind it had been demonstrated and that further work was required. Regarding the much anticipated rocket launch schedule of ISRO in November and December 2021 and the possible launch of India's Small Satellite launch Vehicle (SSLV rocket), he said, it was being worked out.

<https://www.wionews.com/india-news/exclusive-what-is-isros-solar-power-calculator-that-is-to-be-offered-to-the-world-426660>



Fri, 05 Nov 2021

Study: Machine learning a useful tool for quantum control

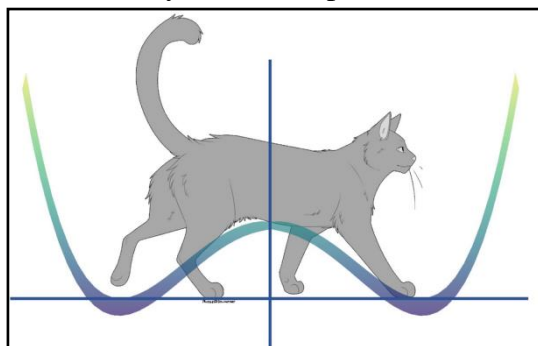
By Lucy Dickie

In the everyday world, we can perform measurements with nearly unlimited precision. But in the quantum world—the realm of atoms, electrons, photons, and other tiny particles—this becomes much harder. Every measurement made disturbs the object and results in measurement errors. In fact, everything from the instruments used to the system's properties might impact the outcome, which scientists call noise. Using noisy measurements to control quantum systems, particularly in real-time, is problematic. So, finding the means for accurate measurement-based control is essential for use in quantum technologies like powerful quantum computers and devices for healthcare imaging.

Now, an international group of researchers from the Quantum Machines Unit at the Okinawa Institute of Science and Technology Graduate University (OIST), Japan, and the University of Queensland, Australia, has shown, through simulations, that reinforcement learning, a type of machine learning, can be used to produce accurate quantum control even with noisy measurements. Their research was recently published in *Physical Review Letters*.

Dr. Sangkha Borah, postdoctoral scholar within the unit and lead author of the paper, explained the idea using a simple example. "Imagine a ball on top of a hill. The ball can easily roll to the left or the right, but the aim is to keep it in the same place. To achieve this, one needs to see which way it is going to roll. If it is inclined to go to the left, force needs to be applied on the right and vice versa. Now, imagine that a machine is applying that force, and, using reinforcement learning, the machine can be taught how much force to apply and when."

Reinforcement learning is often used in robotics where a robot might learn to walk through a trial-and-error approach. But such applications within the realm of quantum physics are rare.



Schrödinger's cat illustrates the paradox of superposition. In this scenario, a cat was placed in a closed box with a flask of poison. After a while, the cat could be considered simultaneously alive and dead. In analogy to quantum mechanics, this refers to a quantum particle simultaneously being in the two wells. If someone were to open the box fully, they would find out whether the cat is either alive or dead, so the rules of the ordinary, classical world would resume. However, if one were to open the box just a little, they might see just a small part of the cat, perhaps the tail, and if they were to see the tail twitch, they might assume, without certainty, that the cat was still alive. This refers to the weak measurements that the machine was giving the researchers as data points. Credit: Okinawa Institute of Science and Technology

Although the ball-atop-a-hill is a tangible example, the system that the researchers were simulating was on a much smaller scale. Instead of a ball, the object was a small particle moving in a double-well which Dr. Borah and his colleagues were trying to control using real-time measurements.

"The bottom of the two wells is called the quantum ground state," said Dr. Bijita Sarma, postdoctoral scholar within the unit and co-author of the paper. "That's where we wanted the particle to eventually be located. For that we need to perform measurements continuously to extract information about the particle's state and depending on that, apply some force to push it to the ground state. However, the measurements typically used in quantum mechanics do not allow us to do that. Hence, we need to have a smarter way to control the system."

Interestingly, when in ground state, the particle will be in both wells simultaneously. This is called quantum superposition, and it's a necessary state for the system to be in, given its importance in various quantum technologies. To detect the location (or locations) of the particle in the well, the machine agent is given the measurement records from continuous weak measurements in real time that it uses as data points for learning. And because this used a reinforcement loop, any information that the machine learned from the system would be used to make its future measurements more accurate.

Adding to the complexity of this system was the fact that it is nonlinear, meaning that the change in its output was not related to the changes in its input. These systems are confusing and chaotic when compared to so-called linear systems. For such nonlinear systems, there is no standard method of quantum control, but this research has shown that with reinforcement learning, the machine can learn to control the quantum system completely autonomously.

"As we gradually move towards a future largely dominated by artificial intelligence, the time is ripe to explore the utility of artificial intelligence, such as machine learning, in solving some problems that cannot be solved by conventional means," concluded Dr. Borah. "This is especially applicable to controlling particle dynamics at the quantum level, where everything is dramatically counterintuitive."

Prof. Jason Twamley, who leads the OIST unit, added: "For nonlinear systems, there is no known method of efficient feedback control. In this work, we have shown that reinforcement learning can indeed be effective for such control, which is amazing and futuristic."

More information: Sangkha Borah et al, Measurement-Based Feedback Quantum Control with Deep Reinforcement Learning for a Double-Well Nonlinear Potential, *Physical Review Letters* (2021). [DOI: 10.1103/PhysRevLett.127.190403](https://doi.org/10.1103/PhysRevLett.127.190403)

Journal information: [Physical Review Letters](https://phys.org/news/2021-11-machine-tool-quantum.html)
<https://phys.org/news/2021-11-machine-tool-quantum.html>

Revising a generalized spin current theory for the magnetoelectric effect in multiferroics

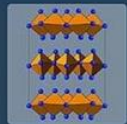
Microscopic aspects of ferroelectricity are canonically related to polar atomic displacements that break inversion symmetry of the crystal, leading to a non-zero net electric dipole moment. However, there is a special class of magnetic materials called multiferroics where inversion symmetry breaking occurs by a magnetic order stabilized in an otherwise crystallographically centrosymmetric lattice. The magnetically induced electric polarization can display complex forms of magnetoelectric coupling to the underlying magnetic texture, and its practical realization is one of the key directions towards achieving the cross-control of ferroelectric properties and magnetism in new generation electronic devices. Thus, understanding the microscopic origin of multiferroicity is a foremost goal of both fundamental and practical importance.

Proposed almost two decades ago, the phenomenological spin current theory of magnetically induced electric polarization has been a big step advancing our insights about multiferroic activity in spiral magnets. However, this theory remains largely phenomenological and often fails to account for various possible multiferroic scenarios that are realized in real materials, causing in some cases severe misinterpretations of their microscopic origin.


The team of researchers from Tokyo Institute of Technology (Tokyo Tech) collaborated with National Institute for Materials Science and Chiba University resolved the problem related to the emergence of electric polarization in centrosymmetric materials within a much broader theoretical perspective. Starting from the electronic Hubbard model, which captures the essential physics of magnetic insulators, the authors formulated a transparent toy theory for electric polarization uncovering its generic coupling to the material's magnetic structure. Based on general symmetry arguments, they considered the spin-orbit coupled Kramers pair of electronic states residing at each magnetic site of a single bond and derived an invariant which couples to the spin current and remains finite even when the bond is centrosymmetric, thus permitting finite polarization for noncollinear spins (Figure 1). "Similar to the spin lattice models relating the energy of the system to the directions of magnetic moments, our study shows a rigorous mapping of the electronic model onto the counterpart model for electric polarization, whose properties are eventually dictated by the symmetry of the underlying electronic states," explains Dr. Sergey Nikolaev from Tokyo Tech.

Importantly, the authors showed that the phenomenological spin-current theory, commonly used for the analysis of spiral multiferroics, can be regarded as the special case of a more general spin-

Beyond Phenomenology: Electric Polarization from Magnetic Order




Multiferroic materials possess both magnetic order and electric polarisation




However, the microscopic theory of multiferroicity is lacking

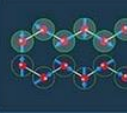
A theory of magnetically induced electric polarization for multiferroics



Magnetoelectric (ME) coupling in spiral magnets



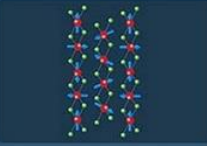
This study presents a generalised "spin-current" theory for ME coupling



The phenomenological law by Katsura, Nagaosa, and Balatsky

$$\vec{P} \sim \epsilon_j \times [e_j \times e_j]$$


The phenomenological model fails to describe ME coupling in a number of multiferroics



- ✔ Combines with density functional theory
- ✔ Reveals the fundamental origin of ME coupling
- ✔ Validates multiferroic properties in spiral magnets

The proposed microscopic theory of multiferroicity goes beyond the phenomenological model and deepens our understanding of ME coupling

Magnetically induced polarization in centrosymmetric bonds
Solovyev et al. (2021) | *Physical Review Letters* | DOI: 10.1103/PhysRevLett.127.187601



Credit: Tokyo Institute of Technology

current theory proposed in this study and is only correct for certain symmetries of the Kramers states. "We explicitly showed that the material specific symmetry properties can lead to different forms of magnetoelectric coupling, thus providing compelling alternatives for the analysis of multiferroics," says Dr. Igor Solovyev from National Institute for Materials Science.

The main findings of the study were combined with first-principles calculations and applied to a series of spiral magnets in order to demonstrate how the generalized spin-current theory can effectively help to rationalize the properties of multiferroic materials.

More information: Igor Solovyev et al, Magnetically Induced Polarization in Centrosymmetric Bonds, *Physical Review Letters* (2021). DOI: [10.1103/PhysRevLett.127.187601](https://doi.org/10.1103/PhysRevLett.127.187601)

Journal information: [Physical Review Letters](https://phys.org/news/2021-11-current-theory-magnetoelectric-effect-multiferroics.html)
<https://phys.org/news/2021-11-current-theory-magnetoelectric-effect-multiferroics.html>



Fri, 05 Nov 2021

Graphene research sounds out new possibilities for electronic technologies

A team of researchers has revealed that sonic boom and Doppler-shifted sound waves can be created in a graphene transistor, giving new insights into this world-famous material and its potential for use in nanoscale electronic technologies.

When a police car speeds towards you and passes by with its siren blaring, you can hear a distinct change in the frequency of the siren's noise. This is the Doppler effect. When a jet aircraft's speed exceeds the speed of sound (about 760 mph), the pressure it exerts upon the air produces a shock wave which can be heard as a loud supersonic boom or thunderclap; this is the Mach effect.

Scientists from Loughborough, Nottingham, Manchester, Lancaster and Kansas universities have discovered that a quantum mechanical version of these phenomena occurs in an electronic transistor made from high purity graphene. Their new publication, Graphene's non-equilibrium fermions reveal Doppler-shifted magnetophonon resonances accompanied by Mach supersonic and Landau velocity effects, has been published today in *Nature Communications*.

Graphene is over 100 times stronger than steel while being extremely light, over 100 times more conductive than silicon, and has the lowest electrical resistivity at room temperature of all known materials. These properties make graphene well suited for a range of applications, including coatings to improve touch screens in phones and tablets and to enhance the speed of electronic circuits.

The research team used strong electric and magnetic fields to accelerate a stream of electrons in an atomically-thin graphene monolayer composed of a hexagonal lattice of carbon atoms.

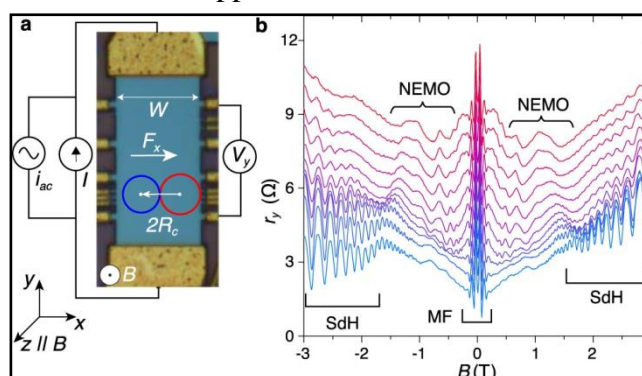


Fig. 1: Current dependence of magnetoresistance oscillations in monolayer graphene Hall bars. a Optical micrograph image of the graphene Hall bar ($W = 15 \mu\text{m}$) and a schematic diagram of the measurement configuration. b Plots of differential resistance $r_y = dV_y/dI$ at $T = 5 \text{ K}$ as a function of B for DC currents, I , between 0 (blue) and $140 \mu\text{A}$ (red) in $14 \mu\text{A}$ intervals, curves are offset by 0.7Ω for clarity. Curly brackets indicate the emergence of additional non-equilibrium magneto-oscillations (NEMOs) examined in detail in Figs. 2 and 3. Square brackets labeled SdH indicate Shubnikov-de Haas oscillations and square brackets labeled MF indicate the magnetic focussing peaks. Credit: DOI: [10.1038/s41467-021-26663-4](https://doi.org/10.1038/s41467-021-26663-4)

At a sufficiently high current density, equivalent to around 100 billion amps per square meter passing through the single atomic layer of carbon, the electron stream reaches a speed of 14 kilometers per second (around 30,000 mph) and starts to shake the carbon atoms, thus emitting quantised bundles of sound energy called acoustic phonons. This phonon emission is detected as a resonant increase in the electrical resistance of the transistor; a supersonic boom is observed in graphene.

The researchers also observed a quantum mechanical analog of the Doppler effect at lower currents when energetic electrons jump between quantised cyclotron orbits and emit acoustic phonons with a Doppler-like up-shift or down-shift of their frequencies, depending on the direction of the sound waves relative to that of the speeding electrons.

By cooling their graphene transistor to liquid helium temperature, the team detected a third phenomenon in which the electrons interact with each other through their electrical charge and make "phononless" jumps between quantised energy levels at a critical speed, the so-called Landau velocity.

Loughborough's Dr. Mark Greenway, one of the authors of the paper, said: "It is fantastic to observe all of these effects simultaneously in a graphene monolayer. It is due to graphene's excellent electronic properties that allow us to investigate these out-of-equilibrium quantum processes in detail and understand how electrons in graphene, accelerated by a strong electric field, scatter and lose their energy. The Landau velocity is a quantum property of superconductors and superfluid helium. So it was particularly exciting to detect a similar effect in the dissipative resonant magnetoresistance of graphene."

The devices were fabricated at the National Graphene Institute, University of Manchester.

Dr. Piranavan Kumaravadeivel, who led device design and development notes, "the large size and high quality of our devices are key for observing these phenomena. Our devices are sufficiently large and pure that electrons interact almost exclusively with phonons and other electrons. We expect that these results will inspire similar studies of non-equilibrium phenomena in other 2D materials. Our measurements also demonstrate that high-quality graphene layers can carry very high continuous current densities which approach those achievable in superconductors. High purity graphene transistors could find future applications in nanoscale power electronic technologies."

More information: M. T. Greenaway et al, Graphene's non-equilibrium fermions reveal Doppler-shifted magnetophonon resonances accompanied by Mach supersonic and Landau velocity effects, *Nature Communications* (2021). DOI: [10.1038/s41467-021-26663-4](https://doi.org/10.1038/s41467-021-26663-4)

Journal information: [*Nature Communications*](#)

<https://phys.org/news/2021-11-graphene-possibilities-electronic-technologies.html>

Deer may be spreading Covid-19 Coronavirus, study found 33% have been infected

By Bruce Y. Lee

You can say, “don’t go deer,” all you want to the Covid-19 coronavirus. But apparently the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) ain’t going to listen. A preprint posted November 1 on the *bioRxiv* website detailed how a research team found SARS-CoV-2 in a third of the White-tailed deer sampled in Iowa from September 2020 through January of 2021.

The team from Penn State, University of Cambridge, University of Chicago, and Houston Methodist Hospital examined samples of retropharyngeal lymph nodes from a total of 283 deer, 151 of whom were free-living and 132 were in captivity. Of course, you may not know what retropharyngeal lymph nodes are because you may not say, “check out his or her retropharyngeal lymph nodes” when scrolling through Tinder dating profiles. In this case, “retro” means situated behind rather anything with the word “disco” in it. Your pharynx is essentially your throat. So retropharyngeal lymph nodes are lymph nodes behind your throat. The researchers searched the lymph node samples for evidence of SARS-CoV-2 genetic material (i.e., RNA) using RT-PCR.

The results may cause you to go oh deer. A little over a a third (33.2%) of all samples from September 2020 through January of 2021 were positive for SARS-CoV-2 RNA. Narrowing the time window to Nov 23, 2020 through January 10, 2021, pushed this number even higher up to 82.5% with 80 of 97 having detectable SARS-CoV-2 RNA.

Keep in mind that this is still just a preprint. That means that it hasn’t yet gone through peer-review and been published in a reputable scientific journal. Anyone with decent Wifi, a computer, and opposable thumbs can upload a pre-print. So take any results from this study with a fanny pack full of salt.

Nevertheless, finding the virus in deer shouldn’t have been too surprising. There already have been cases of lions, tigers, cats, dogs, minks, and other animals getting infected with the Covid-19 coronavirus. In fact, evidence suggests that the viruses may be circulating among bats before eventually making their way into humans. So you shouldn’t bat your eye with the news that the virus is being found in various mammals. Nonetheless, what may be striking is the percentage of deer that have been infected.

The research team found that many of the cases were clustered together geographically. This suggested that once infected with SARS-CoV-2, the buck did not stop there. Neither did the doe. The deer in many cases probably spread the virus to other deer.

Before you say, “how deer your spread the SARS-CoV-2,” consider what species probably originally passed the virus along to them. Here’s a hint. This species tends to take a lot of selfies. Yes, since there were different clusters of deer infected in separate parts of Iowa over time, different humans probably passed the virus to different deer on different occasions.



Oh deer, a study suggested that the Covid-19 coronavirus is already fairly widespread among Whitetail deer. (Photo by: Jeffrey Greenberg/Universal Images Group via Getty Images)

Now, even if you don't give a buck about what happens to deer, these study findings should be important to you. White-tailed deer (*Odocoileus virginianus*) are fairly common in North America. They could serve a reservoir for the SARS-CoV-2 that's part of cycle of the virus. The virus may be able to go back and forth between humans, deer, and potentially other animals. Therefore, any approach to controlling the spread of the virus should include other animals like deer.

In other words, when designing strategies and interventions to try to contain the virus and end this pandemic, make sure that you hold other animals and deer to our hearts. But not too close. Because animals like deer are not yet vaccinated and they are not great at wearing face masks.

<https://www.forbes.com/sites/brucelee/2021/11/04/deer-may-be-spreading-covid-19-coronavirus-study-found-33-have-been-infected/?sh=6c4c747d6d90>

