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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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Press Information Bureau  
Government of India

Ministry of Defence

Thu, 23 Sept 2021 5:54PM

# MoD places supply order for 118 Main Battle Tanks Arjun Mk-1A for Indian Army

*Big boost to 'Aatmanirbhar Bharat'*

### *Key Highlights:*

- *DRDO-developed new variant of MBT to enhance firepower, mobility & survivability*
- *Order worth Rs 7,523 crore*
- *72 new features & more indigenous content compared to Mk-1*
- *To open defence manufacturing avenue for 200 Indian vendors & create 8,000 jobs*

Ministry of Defence (MoD) placed an order with Heavy Vehicles Factory (HVF), Avadi, Chennai for supply of 118 Main Battle Tanks (MBTs) Arjun Mk-1A for the Indian Army on September 23, 2021. The order, worth Rs 7,523 crore, will provide further boost to the 'Make in India' initiative in defence sector and is a big step towards achieving 'Aatmanirbhar Bharat', envisioned by Prime Minister Shri Narendra Modi. It may be recalled that the Prime Minister had handed over the MBT Arjun Mk-1A to Chief of Army Staff General M M Naravane in Chennai on February 14, 2021.

The state-of-the-art MBT Mk-1A is a new variant of Arjun Tank designed to enhance fire power, mobility and survivability. Infused with 72 new features and more indigenous content from the Mk-1 variant, the tank would ensure effortless mobility in all terrains, besides precise target engagement during day and night. It has been designed and developed by Defence Research & Development Organisation (DRDO) by incorporating numerous upgrades on Arjun MBT, the in-service main battle tank with the Indian Army.

The MK-1A is equipped with accurate & superior firepower, all-terrain mobility and an invincible multi-layered protection provided by an array of advanced technology systems. It can take on the enemy during day & night conditions and in both static & dynamic modes. By virtue of these capabilities, this indigenous MBT proves to be at par with any contemporary in its class across the globe. This tank is particularly configured and designed for Indian conditions and hence it is suitable for deployment to protect the frontiers in an effective manner.

This production order to HVF, Avadi opens up a large avenue in defence manufacturing for over 200 Indian vendors including MSMEs, with employment opportunities to around 8,000 people. This will be a flagship project showcasing the indigenous capability in cutting edge defence technologies.

The MBT Arjun Mk-1A has been designed & developed by Combat Vehicles Research and Development Establishment (CVRDE), along with other laboratories of DRDO within two years (2010-12). The development activities commenced from June 2010 and the tank was fielded for user trials in June 2012. It took only two years to develop and field the MBT Arjun Mk-1A for user

trials from the user requirement. Extensive trial evaluation was conducted in various phases covering 7000+ kms (both in DRDO and user trials) of automotive and substantial firing of various ammunitions during 2012-2015.



<https://pib.gov.in/PressReleasePage.aspx?PRID=1757320>

## Business Standard

Fri, 24 Sept 2021

### Ministry of Defence orders 118 Arjun tanks for over Rs 7,000 crore

*'Atmanirbhar Bharat' boost, will benefit 200 Indian firms, create 8,000 jobs*

*By Ajai Shukla*

New Delhi: The Ministry of Defence (MoD) announced on Thursday that it has placed an order with the Ordnance Factory Board (OFB) for 118 indigenous Arjun Mark 1A main battle tanks (MBTs) for the army.

The Arjun Mark 1A has been developed by the Central Vehicles Research and Development Establishment (CVRDE) in Chennai — a Defence Research & Development Organisation (DRDO) laboratory — and will be manufactured in the OFB's Heavy Vehicles Factory (HVF), Avadi.

“This production order to HVF, Avadi opens up a large avenue in defence manufacturing for over 200 Indian vendors including MSMEs (micro, small and medium enterprises), with employment opportunities to around 8,000 people,” an MoD statement said.

“The order, worth Rs 7,523 crore, will provide a further boost to the ‘Make in India’ initiative in the defence sector and is a big step towards achieving ‘Aatmanirbhar Bharat’, envisioned by Prime Minister Narendra Modi,” said the MoD.

The army already operates 124 Arjun Mark 1 MBTs, which amounts to two tank regiments. It has stoutly resisted ordering more, arguing that the 62.5-tonne tank was too heavy to be transported over bridges and culverts near the border.

Eventually, in a tank-versus-tank face-off in the Rajasthan desert in March 2010, one squadron (14 tanks) of Arjuns was pitted against an equal number of Russian T-90 tanks, which the army wants to buy more of. Top army generals who witnessed the trial admitted the Arjun performed



The army already operates 124 Arjun Mark 1 MBTs, which amounts to two tank regiments

superbly. Whether driving cross-country over rugged sand dunes or accurately hitting targets with its powerful main gun, the Arjun matched and outdid the T-90.

Yet, the army refused to order more Arjuns, beyond the 124 already in service. At a meeting of the MoD-led Arjun Steering Committee in 2010, the army demanded 72 capability enhancements to improve the Arjun Mark 1 into what would be called the Arjun Mark 2.

Incredibly, given the army's complaint that the Arjun Mark 1 was too heavy, these 72 enhancements would make it 6 tonnes heavier. These included the fitment of mine ploughs (1.6 tonnes extra), explosive reactive armour (1.5 tonnes extra), suspension improvements (one tonne extra) and two more tonnes in other areas. The 62.5 tonne Arjun Mark 1 was to be translated into a 68.5 tonne Mark 2.

In June 2012, the DRDO offered the Arjun for trials with all the enhancements, except one: a cannon-launched guided missile (CLGM) that the army wanted to fire through the Arjun's main gun. The Israeli Lahat CLGM that equipped the Arjun could strike targets two-to-five km away. However, the army insisted the CLGM must strike targets as close as 1.2 km, even though the Arjun's powerful main gun was adequate to destroy such targets.

By 2015, a series of trials had validated the improvements the army demanded. However, the army dilly-dallied for three years, until March 2018, when it was agreed that the next batch of Arjuns, which would be supplied without missile firing capability. They would be designated Arjun Mark 1A.

After several months of delay, Arjun Mark 1A trials were held in December 2018 and the tank found fit in all respects. The army's trial team recommended the Arjun Mark 1A be inducted into service. Yet, it has taken almost three more years for an order to be placed.

"The state-of-the-art (Arjun Mark-1A)... is infused with 72 new features and more indigenous content from the Mark-1 variant... By virtue of these capabilities, this indigenous MBT proves to be at par with any contemporary in its class across the globe. This tank is particularly configured and designed for Indian conditions and hence it is suitable for deployment to protect the frontiers in an effective manner," said the MoD.

From the time the indent is placed, it would still take HVF 36 months to start delivering the first Arjun tanks. Since the DRDO is confident it would develop and prove the CLGM by then, the 118 Arjun Mark 1A tanks ordered today will actually be delivered as Arjun Mark 2, with full CLGM capability.

[https://www.business-standard.com/article/current-affairs/ministry-of-defence-orders-118-arjun-tanks-for-over-rs-7-000-crore-121092400028\\_1.html](https://www.business-standard.com/article/current-affairs/ministry-of-defence-orders-118-arjun-tanks-for-over-rs-7-000-crore-121092400028_1.html)

## Defence Ministry places ₹7,523-crore order for 118 indigenous Arjun Mk-1A tanks

*They would ensure effortless mobility in all terrains, besides precise target engagement during day and night*

*By Dinakar Peri*

New Delhi: The Defence Ministry on Thursday placed an order with the Heavy Vehicle Factory (HVF), Avadi, for the supply of 118 indigenous Arjun Mk-1A Main Battle Tanks for the Army at a cost of ₹7,523 crore.

“The state-of-the-art MBT Mk-1A is a new variant of Arjun tank designed to enhance fire power, mobility and survivability. Infused with 72 new features and more indigenous content from the Mk-1 variant, the tank would ensure effortless mobility in all terrains, besides precise target engagement during day and night,” the Defence Ministry said.



The MBT Arjun Mk-1A was designed and developed by the Combat Vehicles Research and Development Establishment (CVRDE) along with the other laboratories of the Defence Research and Development Organisation (DRDO).

### **Employment opportunities for 8,000 people**

In February, Prime Minister Narendra Modi had formally handed over Arjun Mk-1A to Army Chief Gen. Manoj Naravane in Chennai. The Army has two regiments of Arjun Mk1 tanks in service inducted between 2005 to 2010. “This production order to HVF, Avadi opens up a large avenue in defence manufacturing for over 200 Indian vendors including MSMEs, with employment opportunities to around 8,000 people,” the Ministry said.

As reported by *The Hindu* earlier, the Arjun Mk-1A has 14 major upgrades over the Mk1 variant which were formulated and approved in October 2018 and subsequently limited user validation trials were carried out of all the upgrades. The Mk1A will be without missile firing capability and will be incorporated as and when the development is complete, an official said. An Arjun hub has been set up in Jaisalmer where 248 rotables have been deposited to ensure quick support and maintenance for the fleet.

The DRDO has also taken up indigenisation of various assemblies and sub-assemblies including the Commander’s Panoramic Sight (CPS) and Gunner’s Main Sight (GMS). The CPS has already undergone various rounds of trials while the GMS is in the process of being integrated. Once the indigenous CPS and advanced GMS are incorporated, the indigenous content of the MBT Arjun Mk-1A will go up from 41% to 54.3% during production, officials said earlier.

The Mk-1A has been customised for missile firing and the advanced GMS has a built-in laser target designator. The missile is under development by the Armament Research and Development Establishment (ARDE), Pune.

<https://www.thehindu.com/news/national/defence-ministry-places-7523-crore-order-for-118-indigenous-arjun-mk-1a-tanks/article36632889.ece>

## Defence Ministry places order for 118 Arjun Mk-1A tanks at cost of Rs 7,523 crore

*The Defence Ministry has sealed a contract to procure 118 Main Battle Tanks (MBTs) which are a new variant of Arjun tanks designed with enhanced fire power, mobility and survivability*  
*Edited By Namrata Agrawal*

New Delhi: The Defence Ministry on Thursday sealed a contract to procure 118 Main Battle Tanks (MBTs) Arjun for the Indian Army at a cost of Rs 7,523 crore, in a major move to boost its combat capabilities. The defence ministry placed the order for the Arjuna Mk-1A tanks with the Heavy Vehicles Factory (HVF), Avadi, Chennai.

The MBT Mk-1A is a new variant of Arjun Tank designed to enhance fire power, mobility and survivability, infused with 72 new features and more indigenous content from the Mk-1 variant. "The Ministry of Defence (MoD) placed an order with Heavy Vehicles Factory (HVF), Avadi, Chennai for supply of 118 Main Battle Tanks (MBTs) Arjun Mk-1A for the Indian Army on September 23," the ministry said in a statement.



Image used for representational purpose

"The order, worth Rs 7,523 crore, will provide further boost to the 'Make in India' initiative in defence sector and is a big step towards achieving 'Aatmanirbhar Bharat'," it said. The ministry said the tanks would ensure effortless mobility in all terrains, besides precise target engagement during day and night.

It has been designed and developed by the Defence Research & Development Organisation (DRDO) by incorporating numerous upgrades on Arjun MBT, the in-service main battle tank with the Indian Army.

"The MK-1A is equipped with accurate and superior firepower, all-terrain mobility and an invincible multi-layered protection provided by an array of advanced technology systems. It can take on the enemy during day and night conditions and in both static and dynamic modes," the ministry said.

It said the production order to Heavy Vehicles Factory will open up a large avenue in defence manufacturing for over 200 Indian vendors including MSMEs, with employment opportunities to around 8,000 people.

"This will be a flagship project showcasing the indigenous capability in cutting edge defence technologies," the ministry said.

It said the MBT Arjun Mk-1A has been designed and developed by Combat Vehicles Research and Development Establishment (CVRDE), along with other laboratories of DRDO within two years (2010-12).

"The development activities commenced from June 2010 and the tank was fielded for user trials in June 2012. It took only two years to develop and field the MBT Arjun Mk-1A for user trials from the user requirement," the ministry said.

"Extensive trial evaluation was conducted in various phases covering 7000 plus kms (both in DRDO and user trials) of automotive and substantial firing of various ammunition during 2012-2015," it said.

<https://zeenews.india.com/india/defence-ministry-places-order-for-118-arjun-mk-1a-tanks-at-cost-of-rs-7523-crore-2396506.html>

## Why India's order for 118 Arjun Mk-1A tanks for Rs 7,523 crore is a big deal

*The tank weighing 68.25 tonne, a new variant of the Arjun Tank infused with 72 new features, will be manufactured at the Heavy Vehicles Factory, Avadi, Chennai*

The Ministry of Defence on Thursday sealed a contract to procure 118 Main Battle Tanks Arjun for the Indian Army at a cost of Rs 7,523 crore, in a major move to boost its combat capabilities.

The defence ministry placed the order for the Arjuna Mk-1A tanks with the Heavy Vehicles Factory (HVF), Avadi, Chennai.

Speaking on the new order, the defence ministry said: "The order, worth Rs 7,523 crore, will provide further boost to the 'Make in India' initiative in defence sector and is a big step towards achieving 'Aatmanirbhar Bharat'.

### **Big deal over MBT Mk-1A**

The MBT Mk-1A is a new variant of Arjun Tank designed to enhance fire power, mobility and survivability, infused with 72 new features and more indigenous content from the Mk-1 variant.

Arjun has been a mainstay for the army for the last 15 years.

The Arjun Mk-1A has 54.3 percent indigenous content against the 41 percent in the earlier model.

Known as the "hunter killers", the latest version of the tank is equipped with a massive 120 mm rifled gun and Kanchan armour, making it the most potent armoured system in the inventory of the army.

The tank, which has been designed and developed by the Combat Vehicles Research and Development Establishment (CVRDE) along with the Defence Research and Development Organisation, can take on the enemy during day and night conditions and in both static and dynamic modes. The tank is particularly configured and designed for Indian conditions and hence it is suitable for deployment to protect the frontiers in an effective manner.

The Arjun Mk-1A also has a computer-controlled integrated fire control system with stabilised sighting that works in all lighting conditions. The secondary weapons include a co-axial 7.62-mm machine gun for anti-personnel and a 12.7-mm machine gun for anti-aircraft and ground targets.

The defence ministry stated that development activities commenced from June 2010 and the tank was fielded for user trials in June 2012.

The tank has undergone extensive trial evaluation in various phases covering 7000 plus km (both in DRDO and user trials) of automotive and substantial firing of various ammunition during 2012-2015.

Earlier in February, Prime Minister Narendra Modi handed over the Arjun Main Battle Tank (MK-1A) to the army at Chennai.

Speaking on the occasion, the prime minister had said, "I am proud to present Arjun Main Battle Tank (MK-1A). Tamil Nadu is already one of the largest automobile manufacturing states of the nation. I can now see the region becoming the largest tank manufacturing state of the nation."



The MBT Mk-1A is a new variant of Arjun Tank designed to enhance fire power, mobility and survivability, infused with 72 new features and more indigenous content from the Mk-1 variant. Image Courtesy: @DRDO\_India/Twitter



"The Made in Tamil Nadu tank shows India's ethos of courage. The armed forces have time and again shown that they are ready to protect the nation. They have also shown that India is committed to peace. We have shown courage and valour as well as restraint and commitment to protecting India's sovereignty," the prime minister further added.

### **Criticism of the Arjun Mk-1A**

However, the tank is not without its criticism. While the tank is commendable in multiple areas of firepower, mobility, protection and crew comfort. Its weight remains a contentious issue.

The tank today weighs 68.25 tonnes, making it among the world's heaviest. There are some experts who believe that the tank would remain limited largely to Rajasthan's desert region and that the MBT's bulk and weight excluded positioning it in Punjab or adjoining areas, as its cross-country mobility was restricted by the sizeable nominal ground pressure (NGP) it exerts.

Transportability of the tank owing to its weight is another issue.

When the Ladakh standoff began, India airlifted thousands of additional soldiers, tanks and armoured personnel carriers to the border. That cannot be done in the case of the Arjun tank. Moreover, one also needs a lighter tank in the mountains because the dynamics are different.

The Arjun Mk-1A can't easily be transported on trains as well, because this would require building dedicated Mobile Bogie Well Wagons used by the Railways to transport military equipment.

The entire Indian logistics support system is created and fine-tuned for medium-weight tanks and hence, it is a Herculean task to create a parallel network for just four regiments of Arjun MBT, which is more or less a desert theatre-specific system.

<https://www.firstpost.com/india/why-indias-order-for-118-arjun-mk-1a-tanks-for-rs-7523-crore-is-a-big-deal-9992961.html>



*Fri, 24 Sept 2021*

## **HELINA missile: Nag ATGM system completed all trials, ready to be inducted in the Indian Army**

*HELINA is a third-generation fire-and-forget class anti-tank guided missile (ATGM) system mounted on the Advanced Light Helicopter (ALH). With an all-weather day and night capability, Infrared Imaging Seeker (IIR), HELINA is one of the world's most advanced weapons*

*By Arfa Javaid*

Developed indigenously by DRDO, Nag anti-tank guided missile (ATGM), HELINA, has completed all the trials and the process for issuing of Acceptance of Necessity (AoN) by the Army has been initiated. Soon after its completion, a process for the Request for Proposal (RFP) will start off, according to Dr. Sachin Sood, Project Director of HELINA and DHRUVASTRA at DRDL Hyderabad.

He further stated that the launcher and missile are ready, but some Human Machine Interface (HMI) needs to be realised, which is underway.

The cost of each missile is yet to be finalized, however, the cost of a missile is expected to be under Rs. 1 crore. Initially, 500 missiles and 40 launchers will be needed.



**HELINA missile: Nag ATGM system completed all trials, ready to be inducted in the Indian Army**

### **About Nag ATGM, HELINA**

1. It is a third-generation fire-and-forget class anti-tank guided missile (ATGM) system mounted on the Advanced Light Helicopter (ALH).
2. The anti-tank guided missile (ATGM) system has a minimum range of 500 m and a maximum range of 7 km.
3. Guided by an Infrared Imaging Seeker (IIR), HELINA is one of the world's most advanced weapons.
4. With an all-weather day and night capability, the system can beat the enemy tanks through the conventional armour and can also destroy the explosive reactive armour.
5. The missile is capable of engaging the targets both in the direct hit mode and top attack mode.
6. Indian Air Force (IAF) has asked for the feasibility of integrating the HELINA on the soon-to-be inducted Light Combat Helicopter (LCH).

### **Background**

In February 2021, joint trials for HELINA (Army Version) and DHRUVASTRA (Air Force Version) missile systems were carried out aboard Advanced Light Helicopter (AHL) platform in Rajasthan.

In a bid to evaluate the mission capabilities in their minimum and maximum range, live firing of five missions was carried out. These were for the first time fired from a maximum forward speed and top angle against realistic static and moving targets.

While some of the missions were carried out with warheads against derelict tanks, others were against a moving target from a forward flying helicopter.

While the missile was developed by DRDO, the integration was done by Hindustan Aeronautics Limited (HAL). Bharat Dynamics Limited (BDL) is the production agency of the missile.

An Air Force version, DHRUVASTRA, is currently under development will have an Air to Ground role other than an anti-tank role. Some of its trials have already been conducted.

### **Integrated Guided Missile Development Program (IGMDP)**

The Integrated Guided Missile Development Program (IGMDP) was dreamed up by former President of India, Dr. A.P.J. Abdul Kalam, to help India attain self-sufficiency in the missile technology sector. The Government of India gave approval to the program in 1983 and it was completed in March 2012.

The missiles developed under this program are as follows:

1. **Prithvi:** It is a short-range surface-to-surface ballistic missile.
2. **Agni:** It has ballistic missiles with different ranges-- Agni-I, Agni-II, Agni-III, Agni-IV, Agni-V.
3. **Trishul:** It is a short-range low-level surface-to-air missile.
4. **Nag:** It is a third-generation anti-tank missile.
5. **Akash:** It is a medium-range surface-to-air missile.

<https://www.jagranjosh.com/general-knowledge/antitank-guided-missile-helina-completed-all-trials-ready-to-be-inducted-in-the-indian-army-1632378772-1>

# 'Matter of pride...' Agni V missile test: 'India has proved it can take on any challenge', Says DRDO Scientist

*Agni V missile will soon be conducted with a flight test with the first user trial of intercontinental-range ballistic missile (ICBM) to strengthen Defence*

*By Bhavyata Kagrana*

As India is all set to conduct a very significant flight test of the 5,000-km range Agni-V missile, Republic Media Network reached out to the nation's top scientist RK Gupta who explained the importance of the operation. According to the scientist, the reason why this is a significant development is that the missile is completely home-grown and no external country can put pressure on India.

## Scientist R K Gupta on flight-testing of Agni-V missile

Agni V missile is a very significant development. The first test fired by DRDO had taken place in April 2012 and that was a defining moment because that was the time when India reached a level where its technology in terms of missiles had advanced. All the technology that has been put into Agni V is homegrown and 100% made-in-India and therefore it is fully indigenous. It is an outcome of our scientists as these are the most advanced technology in terms of the control system, navigation, and everything related to this technology is superb." said R K Gupta.



### What has India achieved through Agni V development?

India has proved that it is ready to take any challenge that comes against the country. We have a declared policy of no first use, we don't want any kind of conflict, we want peace but there are countries that have been threatening us. Even after independence, there has been a history of attacks we had to suffer. We don't want to suffer anymore, India has proved its capabilities and in a political way has said that we can retaliate if someone tries to harm us"

### "Most appropriate time to have this development," said Major General (Retd) GD Bakshi

Adding to the insights provided by scientist RK Gupta, the Major General (Retd) also shared his expert opinion.

"This is the most appropriate time when India has developed the missile. The nation has developed this on its own which is most important. We have also proved that India requires no other country to protect it, we can do it on our own," added G D Bakshi.

### "It is a matter of pride," continued R K Gupta

"Definitely, it is a matter of great pride. When we got independence, there was nothing with us, no testing, no certification, everything started from scratch in a hostile environment. There were people who held us back acting on someone else's orders. Entire technology that has gone into the making of Agni V is home-grown and this is an answer to everyone who says India has been lagging behind, no it is most we have proved that we are capable of defending ourselves," concluded scientist R K Gupta.

<https://www.republicworld.com/india-news/general-news/agni-v-missile-test-india-has-proved-it-can-take-on-any-challenge-says-rk-gupta.html>

# Missiles of India - A comprehensive overview of India's deadly missile arsenal

*With an amalgamation of science, technology and human resource, India has set its foot in developing the most lethal and advanced missiles systems in the world*

*By Deepan Chattopadhyay*

India since gaining its sovereignty has amplified its stock of strategic and tactical missiles that caters to several defence strategies made by the Government of India. With an amalgamation of science, technology and human resource, India has set its foot in developing the most lethal and advanced missile systems in the world including anti-ship, air-defence, ballistic, cruise, air to air, anti-missile systems and even the capability to hit targets in space. India also marks itself among the seven countries possessing the Intercontinental Ballistic Missile (ICBM), which can travel a minimum distance of 5,500 km. India is also one of the four nations owning an Anti-Ballistic Missile (ABM) system.



India has a lethal stockpile of potent weapons, with the Indian Air Force (IAF) version of the BrahMos, Intercontinental ballistic missile Agni-5 and other pivotal missiles. Along with these, India incorporates the missile series of Prithvi, Dhanush and Nirbhay in its stockpile of ammunition.

Here is a list of some among India's missiles:

## **Surface-to-Air Missiles**

A surface-to-air missile (SAM), or ground-to-air missile (GTAM) is a weapon designed to be launched from the Earth to destroy enemy aircraft or other missiles and can be considered as an anti-aircraft defence system in modern armed forces.

- **Trishul**

Trishul missiles are short-range surface to air missiles with an operational range of 9km.

- **Akash Missile**

Presently, there are three variants at different stages of development, Akash-1S, Akash Mark-II, Akash-NG. The Akash -1S can travel up to a distance of 18 to 30 km, while the Akash Mk-II and Akash-NG can travel 35 to 40 km and more than 50 km, respectively.

- **Barak 8**

The long-range Indo-Israeli surface to Air Barak 8 Missile can travel up to a distance of 100 km to hit the target with Mach 2 speed, i.e, twice the speed of sound or 2470 km/hr.

## **Surface-to-Surface Missiles**

Surface-to-surface missiles are launched from the ground to strike land or sea targets. They may be fired from hand-held or vehicles, from a ship or ground installations. They are often enabled with a rocket engine or sometimes fired by an explosive charge since the launching platform is typically stationary or moving.

- **Agni-I**

A medium-range ballistic missile that can travel a distance of 700-1250 km to hit its target. The missile can reach Mach 7.5 speed. It is a single-stage missile that was developed after the Kargil War by the DRDO.

- **Agni-II**

It is the second strategic ballistic missile of the Agni family envisaged to be the mainstay of the Indian missile-based strategic nuclear deterrence. An Intermediate-range ballistic missile, Agni-II can reach a distance of 2,000–3,000 km while travelling at Mach 12 speed.

- **Agni-III**

It is an Intermediate-range ballistic missile that can travel a range of 3,000 km with a speed of 5–6 km/s, it was deployed to service in 2011 and can reach targets deep inside neighbouring countries including China.

- **Agni-IV**

Designed by the DRDO and inducted in service in 2013, The Agni-IV is an Intermediate-range ballistic missile that can reach a distance of around 4,000 km at Mach 7 speed.

- **Agni-V**

The Agni-V missile is an Indian nuclear-capable intercontinental ballistic missile developed by the DRDO and is India's only Intercontinental ballistic missile with a 5,000 km range that can reach an exceptional Mach 24 speed.

- **Prithvi II**

A Short-Range Ballistic Missile, Prithvi II can travel a distance of 350 km. The missile is developed by the DRDO

- **Shaurya**

The Shaurya missile is a canister launched hypersonic surface-to-surface tactical missile developed by the DRDO for use by the Indian Armed Forces. The missile can reach a distance of 750 to 1,900 km to destroy its target.

#### **Air-to-air Missiles**

Air to Air Missiles (AAM) is a missile fired from an aircraft with a motive to damage another aircraft or any airborne object. AAM is either solid fuelled or sometimes liquid-fuelled. It evolved from unguided air to air rockets used during World War-I.

- **MICA**

MICA is an anti-air multi-target, all-weather, fire-and-forget short and medium-range missile system encompassing a range of 500 m to 80 km reaching Mach 4 during its deployment.

- **Astra Missile**

Developed indigenously by the DRDO, Astra is an all-weather beyond-visual-range active radar homing air-to-air missile encompassing a range of 80-110 km reaching the Mach 4.5 + speed.

- **Novator K-100**

A Russian-made medium-Range air-to-air missile can be deployed to hit targets in the range of 300–400 km with a Mach 3.3 speed.

#### **Cruise Missiles**

A cruise missile is guided to its target by an onboard computer. It is a guided missile used against terrestrial targets, that remain in the atmosphere and flies the major portion of its flight path at an approximately constant speed. Cruise missiles are designed to deliver a target warhead over long distances with high precision.

- **BrahMos Supersonic Cruise Missile**

BrahMos missiles are designed developed and produced by BrahMos Aerospace, a joint venture company set up by the DRDO and Mashinostroyenia of Russia. The BrahMos supersonic cruise missile can cover a range of 290 km reaching the Mach 2.8 to 3 Mach speed.

- **BrahMos II**

Meanwhile, the BrahMos- II Hypersonic cruise missile can be deployed to hit the target within a range of 450 – 600 km in a Mach 7 velocity. The missile is currently under joint development by the DRDO and Russia's NPO Mashinostroyenia.

- **Nirbhay**

The Nirbhay subsonic cruise missile can reach a maximum range of 1,000 to 1500 km to destroy its target with a Mach 0.8 speed. The missile can be launched from multiple platforms and is capable of carrying conventional and nuclear warheads.

- **Submarine-launched ballistic missile**

A submarine-launched ballistic missile (SLBM) is a ballistic missile capable of being launched from submarines. Each missile carries a nuclear warhead and allows a single launched missile to strike several targets. Modern submarine-launched ballistic missiles are closely related to intercontinental ballistic missiles which can be deployed to reach a range of over 5,500 km.

- **Sagarika (K-15)**

Sagarika (K-15) is an Indian submarine-launched ballistic missile that can reach a range of 750 km that was designed for retaliatory nuclear strikes.

- **K-4 Ballistic Missile**

The K-4 Ballistic Missile is a nuclear-capable Intermediate-Range submarine-launched ballistic missile developed by the DRDO to arm the Arihant-class submarines. The missile has a maximum range of 3,500 km.

- **K-5 Missile**

The K-5 is a submarine-launched ballistic missile under development by the DRDO. The missile has a planned range of 5,000 km and will be equipped with Arihant-class submarines and is considered to be the fastest missile in its class.

- **Anti-Tank Missile**

An anti-tank guided missile (ATGM) is a guided missile primarily designed to hit and destroy heavily armoured military vehicles, which can be transported by a single soldier, to larger tripod-mounted weapons, which require a team to transport and fire, to vehicle and aircraft mounted missile systems.

- **Amogha-1**

The Amogha-1 is an ATGM with a range of up to 2.8km. It is under development by Bharat Dynamics at Hyderabad. It is the maiden missile designed and tested by Bharat Dynamics and will be produced in two versions. The land version has already been tested.

- **Nag Missile**

The Nag missile, also known as 'Prospina' for the land-attack version is an Indian third-generation, all-weather, fire and forget, an anti-tank guided missile with an operational range of 500m to 20km and ten-year maintenance-free shelf life.

- **Anti-ballistic missiles**

An Anti-ballistic missile is a surface to air missile designed and manufactured to counter ballistic missiles (Missile defence). Ballistic missiles are used to deliver nuclear, chemical, biological or conventional warheads in a ballistic attack.

- **Prithvi Air Defence (PAD)**

The Prithvi Air Defence (PAD) is a two-stage liquid and solid-fueled ballistic missile defence high altitude interceptor based on the Prithvi missile. The two-stage interceptor is 10 meters tall and is said to reach a maximum altitude of 80km.

- **Prithvi Defense Vehicle (PDV)**

The Prithvi Defense Vehicle (PDV) is an exo-atmospheric interceptor missile designed and manufactured to shoot down short-medium, and intermediate-range ballistic missiles in their terminal phase by intercepting with a hit-to-kill approach.

- **Anti-Satellite Missile**

- **A-SAT Missile**

In March 2019, India joined an exclusive club of countries that has the capability to hit a target in space as it tested the anti-satellite missile via 'Mission Shakti'. This test, which came just months

after India completed its fully operational nuclear triad (being able to launch nuclear warheads from air, land and sea), made India just the fourth country, after the US, Russia and China to be able to do so.

<https://www.republicworld.com/india-news/general-news/missiles-of-india-a-comprehensive-overview-of-indias-deadly-missile-arsenal.html>



Fri, 24 Sept 2021

## No test of nuclear-capable Agni-V missile being conducted: DRDO

*India has already conducted seven trials of the missile, which has a range of over 5,000 kilometres*

New Delhi: The Defence Research and Development Organisation (DRDO) on Thursday denied reports of a possible test-flight of the Intercontinental Ballistic Missile Agni-V. DRDO Chief G Satheesh Reddy told India Today that no test of the nuclear-capable missile is being conducted.

The latest development comes weeks after the DRDO handed over Medium Range Surface to Air Missile (MRSAM) System to the Indian Air Force (IAF). The Agni-V test in the coming days could indicate an early induction of the system into the armed forces.

The test, which could be conducted in October, has already been delayed. It was supposed to take place in 2020 but was deferred due to Covid-19. The missile will be tested with Multiple Independently Targetable Re-entry Vehicles (MIRV).

The Agni-V ICBM has been developed by DRDO and Bharat Dynamics Limited. It weighs close to 50,000 kilograms. The missile is 1.75 meters tall with a diameter of 2 metres. A 1,500-kilogram warhead will be placed on top of the three-stage rocket boosters that are powered by solid fuel.

Scientists have said that at its fastest the ICBM will be 24 times faster than the speed of sound travelling 8.16 kilometres per second, achieving a high speed of 29,401 kilometres per hour.

The missile is equipped with a ring laser gyroscope inertial navigation system (NavIC) that works with satellite guidance. The missile is capable of hitting its target with pinpoint precision. It can be launched from mobile launchers.

The missile is programmed in such a way that after reaching the peak of its trajectory, it turns towards the earth to continue its journey to the target with an increased speed, due to the earth's gravitational pull.

Its path is precisely directed by the advanced onboard computer and inertial navigation system. As the missile enters the earth's atmosphere, the atmospheric air rubbing its outer surface skin raises the temperature to beyond 4,000 degrees Celsius.

However, the indigenously designed and developed heat shield maintains the inside temperature at less than 50 degrees Celsius.

India has already conducted seven trials of the missile, which has a range of over 5,000 kilometres — with China raising concern over the tests. The first successful test of the Agni-V was conducted on April 19, 2012. Successive tests were conducted on September 15, 2003, January 31, 2015, December 26, 2016, January 18, 2018, June 3 2018, and December 10, 2018.



Agni-V is an Intercontinental Ballistic Missile. (Photo: Twitter/Rajnath Singh)

The first two flights of Agni-5 in 2012 and 2013 were in an open configuration. The third, fourth and fifth launches were from a canister integrated with a mobile launcher, which enables the launch of the missile in a shorter time as compared to an open launch.

During the last trial in 2018, the flight performance of the missile was tracked and monitored by radars, tracking instruments and observation stations.

<https://www.indiatoday.in/india/story/agni-v-missile-test-icbm-drdo-defence-ministry-indian-army-1856257-2021-09-23>

# अमर उजाला

Fri, 24 Sept 2021

## खंडन: डीआरडीओ प्रमुख ने कहा- अभी अग्नि-5 मिसाइल का कोई परीक्षण नहीं किया जा रहा

सार

पहले परीक्षण अक्टूबर 2020 में होने वाला था, इसे कोविड-19 के कारण स्थगित कर दिया गया था। मिसाइल का परीक्षण मल्टीपल इंडिपेंडेंटली टारगेटेबल री-एंट्री व्हीकल्स से किया जाएगा।

विस्तार

नई दिल्ली: रक्षा अनुसंधान और विकास संगठन ने गुरुवार को इंटरकांटिनेंटल बैलिस्टिक मिसाइल अग्नि-5 के संभावित परीक्षण की खबरों का खंडन किया है। डीआरडीओ प्रमुख जी सतीश रेड्डी ने बताया कि परमाणु सक्षम मिसाइल का कोई परीक्षण नहीं किया जा रहा है।

अग्नि श्रृंखला की इंटरकांटिनेंटल बैलिस्टिक मिसाइल को रक्षा अनुसंधान और विकास संगठन और भारत डायनेमिक्स लिमिटेड द्वारा विकसित किया गया है। माना जा रहा है कि इस नई मिसाइल की मारक क्षमता 5,000 से 8,000 किमी है। हालांकि, सटीक सीमा अभी स्पष्ट नहीं है। चीन समेत कुछ देशों का कहना है कि भारत अग्नि-5 की सही रेंज का खुलासा नहीं कर रहा है।



अग्नि-वी - फोटो : social media

अक्टूबर में होने वाले परीक्षण में पहले ही देरी हो चुकी है। यह 2020 में होना था, लेकिन कोविड-19 के कारण स्थगित कर दिया गया था। मिसाइल का परीक्षण मल्टीपल इंडिपेंडेंटली टारगेटेबल री-एंट्री व्हीकल्स से किया जाएगा। अग्नि-5 भारत की पहली और एकमात्र इंटर कॉन्टिनेंटल बैलिस्टिक मिसाइल है, जिसे रक्षा अनुसंधान एवं विकास संगठन ने बनाया है। ये भारत के पास मौजूद लंबी दूरी की मिसाइलों में से एक है।

वैज्ञानिकों ने कहा है कि आईसीबीएम अपने सबसे तेज गति से 8.16 किलोमीटर प्रति सेकंड की यात्रा करने वाली ध्वनि की गति से 24 गुना तेज होगी, जो 29,401 किलोमीटर प्रति घंटे की उच्च गति प्राप्त करेगी।

मिसाइल रिंग लेजर गायरोस्कोप इनर्टियल नेविगेशन सिस्टम (नाविक) से लैस है जो उपग्रह के मार्गदर्शन के साथ काम करता है। मिसाइल सटीक निशाना लगाने में सक्षम है। इसे मोबाइल लॉन्चर से लॉन्च किया जा सकता है।

<https://www.amarujala.com/india-news/no-plans-to-conduct-test-nuclear-capable-ballistic-missile-agni-v>



## Key trial of 5,000-km ICBM Agni-V in October

By Rajat Pandit

New Delhi: India will soon conduct another test of its most formidable strategic missile, the over 5,000-km Agni-V, even as work is still in progress to develop multiple-warhead capability for ballistic missiles.

The “user-trial in full operational configuration” of the Agni-V missile, which carries a single 1.5-tonne warhead, will be conducted by the tri-Service Strategic Forces Command (SFC) in October, said sources on Thursday.

It will be the first user-trial of the three-stage intercontinental ballistic missile (ICBM), which is now gradually being inducted into the SFC, since the military confrontation with China in eastern Ladakh erupted in April-May last year.

The operational deployment of the over 50-tonne Agni-V will enhance the deterrence posture against China, which has missiles like the Dong Feng-41 (12,000-15,000-km) that can hit any Indian city. China has also recently gone in for a huge expansion in new missile silo fields for launching nuclear-tipped ICBMs.

Agni-V, which will bring even the northernmost part of China within its strike envelope, is operationally better than the earlier Agni variants because it is a canister-launch missile to ensure lesser maintenance as well as swifter transportation and firing.

The Agni-V test will come soon after a new-generation two-stage missile called Agni-Prime, with a strike range of 1,500-km, was tested on June 28. The Agni-Prime, also a canister-launch missile, will eventually replace the Agni-I (700-km) missiles in the arsenal of the SFC, which also has the Prithvi-II (350-km), Agni-II (2,000-km) and Agni-III (3,000-km) missile units.

DRDO is simultaneously working to develop ‘multiple independently targetable reentry vehicles’ (MIRVs) for the Agni missiles. An MIRV payload will have a single missile carrying four to six nuclear warheads, each programmed to hit a separate target.

“It will take another two years for a MIRVed missile to be flight-tested to prove the core technologies. With warheads meant to hit targets hundreds of kilometre apart with different trajectories, such a missile involves complex technologies. The test of the highly-miniaturised Agni-Prime in June included decoys, not an MIRV payload,” said a source.

India has also for long modified some Sukhoi-30MKI, Mirage-2000 and Jaguar fighters to deliver nuclear gravity bombs. The new French-origin Rafale fighters being inducted by the IAF are also capable of doing it.

But the third leg of India’s nuclear triad is still far away from becoming robust, represented as it is by the solitary nuclear ballistic missile submarine (SSBN) INS Arihant armed with only 750-km range K-15 missiles as of now.

Countries like the US, Russia and China have SSBNs with well over 5,000-km range submarine-launched ballistic missiles (SLBMs). India has three more SSBNs under development, with INS Arighat now slated for commissioning next year after some delay. The K-4 missiles, with a strike range of 3,500-km, in turn, will take at least one more year to be ready for induction.

<https://timesofindia.indiatimes.com/india/key-trial-of-5000-km-icbm-agni-v-in-october/articleshow/86468298.cms>



## Agni-V: First user trial of nuclear-capable Intercontinental Ballistic Missile soon

*The Agni-V missile has a strike range of 5,000 kms and can hit targets deep inside China, entire Asia and Europe and parts of Africa*

### Key Highlights

- *China spooked by India's nuclear-capable 'Agni V' missile test*
- *India likely to receive first shipment of S-400 missile system by 2021 end*
- *DRDO successfully tested new generation nuclear capable missile Agni-P in June 2021*

New Delhi: In what is sure to ring in alarm bells in the Chinese and Pakistani establishment, India is expected to undertake the first user trial of its indigenous nuclear-rich Intercontinental Ballistic Missile Agni-V soon. The missile has a strike range of 5,000 kms and can hit targets deep inside China, entire Asia and Europe and parts of Africa. Reports suggest that the Strategic Forces Command of the Indian Army has made elaborate preparation at a defence facility off the Odisha coast for the mission.

Defence Research and Development Organization (DRDO) and Bharat Dynamics Limited (BDL) have developed the Agni-V Intercontinental Ballistic Missile. The Agni V missile can carry a nuclear payload of 1,500 kg.



The country had planned to induct Intercontinental Ballistic Missile Agni-V in 2020 after the hat-trick pre-induction trials in 2018, however, the COVID-19 pandemic forced India to postpone the induction

Besides India, only seven countries, including the US, UK, Russia, China, France, Israel and North Korea possess Intercontinental Ballistic Missiles in their defence arsenal.

Meanwhile, China questioned India's plan to conduct the trial of an intercontinental-range ballistic missile, citing the United Nations Security Council Resolution 1172.

"As to whether India can develop ballistic missiles capable of carrying nuclear weapons, the UN Security Council Resolution 1172 has made clear provisions. Maintaining peace, security and stability in South Asia is in the common interest of all parties, and China hopes all parties will make constructive efforts to this end," Zhao Lijian, a spokesperson of Chinese Foreign Ministry, said on September 16, 2021.

India has a series of Agni missiles in its armoury. Agni-1 has a range of 700 km, Agni-2 with a range of 2,000 km, Agni-3 and Agni-4 can strike targets between 2,500 km and 3,500 km.

### **New generation Agni P Ballistic Missile successfully flight tested**

Notably, DRDO successfully flight tested the new generation Agni P Ballistic Missile on June 28, 2021. Agni P is a new generation advanced variant of Agni class of missiles. It is a canisterised missile with a range capability between 1,000 and 2,000 kms.

<https://www.timesnownews.com/india/article/agni-v-first-user-trial-of-nuclear-capable-intercontinental-ballistic-missile-soon/815839>

# Pakistan, China rattled as India set to conduct first user trial of nuclear-capable Agni-V missile

*Experts believe that if India fires this missile, it can attack the whole of Asia, Europe, parts of Africa*

*Edited By Abhishek Sharma*

India may test nuclear-rich Intercontinental Ballistic Missile Agni-V on Thursday. Countries like China and Pakistan are trembling with fear about the test of this missile because they have an idea of its power. However, it is a different matter that India has already successfully tested the Agni-5 missile seven times.

According to experts, the fear of China is also justified because its entire country is coming in the range of Agni-V missile.

The Agni-V Intercontinental Ballistic Missile has been developed by the Defence Research and Development Organization (DRDO) and Bharat Dynamics Limited (BDL). It is believed that the range of this missile is 5,000 to 8,000 km. However, the exact range is not yet clear. Some countries including China say that India is not disclosing the correct range of Agni-V.



The Agni-V missile weighs 50,000 kgs. It is 17.5 meters long and has a diameter of 6.7 feet. On top of this, a nuclear weapon weighing 1,500 kg can be installed. The missile has three-stage rocket boosters, which fly on solid fuel. The speed of Agni-V is 24 times more than the speed of sound. That is, it covers a distance of 8.16 kilometres in one second. According to the information, the missile is capable of attacking the enemy at a speed of 29,401 kilometres per hour. It is fitted with Ring Laser Gyroscope Inertial Navigation System, GPS, NavIC Satellite Guidance System.

The missile hits its target perfectly. If there is a difference in accuracy due to any reason, then it will be just 10 to 80 meters. However, this difference does not reduce the lethal strikes of the missile. A ground mobile launcher is used to launch Agni-V. It can be loaded on the truck and transported to any place by road. Scientist M Natarajan had planned about Agni for the first time in the year 2007.

Experts believe that if India fires this missile, it can attack the whole of Asia, Europe, parts of Africa. In other words, half the world is in its range. The most striking feature of the Agni-V is its MIRV (Multiple Independently Targetable Re-entry Vehicles) technology. In this technique, multiple weapons can be installed instead of one in the warhead mounted on the missile. That is, a missile can hit multiple targets simultaneously.

The first successful test of Agni-V took place on 19 April 2012. This was followed by successful trials on 15 September 2013, 31 January 2015, 26 December 2016, 18 January 2018, 3 June 2018 and 10 December 2018. Altogether there have been 7 successful tests of the Agni-V missile, this missile was tested on different parameters in different tests, from which it came to the fore that the missile is the best weapon to destroy the enemy.

Due to MIRV technology in this missile, two to 10 weapons can be installed. That is, the same missile can simultaneously target 2 to 10 different targets spread over several hundred kilometres. Chinese expert Du Wenlong said some time ago that the Agni-V missile has a range of 8,000 km, but the Indian government is not disclosing this range. So that countries around the world do not object to it. The Agni-V missile is controlled by a control and guidance system of 200 grams.

Apart from China and Pakistan, England and America have praised India for this missile. Media organizations in England have said that India will join the list of countries like China, Russia, France, America, England and probably Israel after the successful test of Agni-V. America has also spoken in support of India. Whereas NATO said that India's missile test poses no threat to the world. India is making its technology more state-of-the-art and no one should have any problem with this.

<https://www.dnaindia.com/india/report-pakistan-china-rattled-as-india-set-to-conduct-first-user-trial-of-nuclear-capable-agni-v-missile-2912517>



*Fri, 24 Sept 2021*

## **Pune: C-DAC collaborates with DRDO Young Scientist's Laboratory**

Pune: Promoting the research in Quantum Technologies, Centre for Development of Advanced Computing (C-DAC) Pune and DRDO Young Scientist Laboratory- Quantum Technologies (DYSL-QT) has signed a memorandum of Understanding (MoU) recently.

“The collaboration would strengthen innovations and promote excellence in shared research, harnessing the potential of Quantum Technologies. Both the organizations will demonstrate pilot projects for the realization of a comprehensive program on Quantum Computing, which would immensely benefit the country”, said the press statement issued by C-DAC.



“This tool will be useful for students to learn the practical aspects of Quantum simulation, algorithms and programming. C-DAC along with DYSL-QT shall co-develop various Quantum algorithms in the strategic areas of Defence applications. This collaboration shall lead to the development of innovative solutions for the country's advancement”, it added.

The MoU was signed by Col. Asheet Kumar Nath (Retd.), Director General (I/C), C- DAC and Santu Sardar, Director, DYSL-QT, in the virtual presence of Sudhir Kamath, Director General, Micro Electronic Devices, Computational Systems and Cyber Systems (MED & CoS) and eminent scientists in the field of Quantum Computing. DYSL- QT is one of the five YSLs (Young Scientist Laboratories) of the DRDO dedicated to the nation by the Prime Minister, Narendra Modi.

C-DAC is an Autonomous Scientific Society under the Ministry of Electronics and Information Technology (MeitY).

<https://www.punekarnews.in/pune-c-dac-collaborates-with-drdo-young-scientists-laboratory/>

## MoRTH issues draft notification to introduce fire alarm system in buses' passenger compartments

New Delhi: The Ministry of Road Transport and Highways (MoRTH) has issued a draft notification to introduce a fire alarm and protection system in the passenger compartments in buses, through an amendment in the Automotive Industry Standard (AIS), an official statement said on Thursday.

Currently, fire detection, alarm and suppression systems are notified for fires originating from the engine compartment only.

According to the statement, the draft notification is intended for fire detection and protection in the passenger compartment for type-III buses (type-III buses are those designed and constructed for long-distance seated passenger transport) and school buses.

The statement noted that studies on fire incidents indicate that injuries to passengers are mainly due to heat and smoke in the passenger compartment.

These injuries can be prevented if the heat and smoke in the passenger compartment are controlled by providing an additional evacuation time (of at least three minutes) to the occupants by thermal management during fire incidents, it added.

The statement said a technical solution to this problem has been developed by the ministry in consultation with various stakeholders, including DRDO.

A water mist-based active fire protection system has been designed and developed along with a fire alarm system.

The statement pointed out that simulation studies have demonstrated that the designed system is able to manage the temperature in the passenger compartment within 50 degrees centigrade in less than 30 seconds of mist operation.

Comments have been sought on this notification from stakeholders within 30 days.

*(Disclaimer: This story has not been edited by Outlook staff and is auto-generated from news agency feeds. Source: PTI)*

<https://www.outlookindia.com/newscroll/morth-issues-draft-notification-to-introduce-fire-alarm-system-in-buses-passenger-compartments/2165769>

# Defence Strategic: National/International



Press Information Bureau  
Government of India

Ministry of Defence

Thu, 23 Sept 2021 3:11PM

## MoD promulgates framework for increased utilisation of simulators by the three Services & Indian Coast Guard

### *Key Highlights:*

- *Aim is to transform to simulation-based training across all military domains*
- *To achieve cost effective, safe and smart training*
- *Emphasis on indigenous design & development*
- *Outsourcing of operation & maintenance of simulators to Indian companies*
- *Applicable to all types of in use/to be procured simulators*

Ministry of Defence (MoD) has promulgated the framework for enhanced and synergised utilisation of simulators by the three Services and the Indian Coast Guard (ICG). The overarching vision is to transform to simulation-based training across all military domains for combatants, leaders, maintainers, administrators, life science experts, procurement and financial agencies and thus achieve cost effective, efficient, safe, fast-paced and smart training.

The framework lays emphasis on indigenous design & development as well as outsourcing of operation and maintenance of simulators to the Indian companies. The framework has the following goals and objectives:

- To reduce live equipment utilisation.
- To ensure capability plans cater for phased induction of simulators.
- To duly factor requirement of simulators at the planning stage of procurement.
- To coordinate among various agencies of the Government and factor combined requirements of simulators during procurement.

The policy will be applicable to all types of simulators in use/to be procured in the future by the Armed Forces. Avenues of application of simulation technology will be constantly explored to achieve a high level of op preparedness while reducing expenditure on training and preserving the life of equipment.

A detailed action plan with assigned responsibility to all the constituents of MoD and industrial association will be followed to revitalise the exploitation of simulators by the three Services and the ICG. The Indian agencies involved in development, production and maintenance would be engaged by the Services to ensure highest level of indigenisation for production, deployment and maintenance of the military simulators.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1757253>



## रक्षा मंत्रालय द्वारा तीनों सेवाओं और भारतीय तटरक्षक बल द्वारा सिमुलेटरों के उपयोग में बढ़ोतरी करने से संबंधित रूपरेखा की घोषणा

### मुख्य विशेषताएं-

- इसका उद्देश्य सभी सैन्य क्षेत्रों में सिमुलेशन-आधारित प्रशिक्षण संबंधी बदलाव लाना है।
- लागत प्रभावी, सुरक्षित और स्मार्ट प्रशिक्षण प्राप्त करना।
- स्वदेशी डिजाइन और विकास पर जोर देना।
- भारतीय कंपनियों को सिमुलेटरों के संचालन और रखरखाव की आउटसोर्सिंग।
- सभी प्रकार के उपयोग किए जा रहे/खरीदे जाने वाले सिमुलेटर पर लागू।

रक्षा मंत्रालय ने तीनों सेवाओं और भारतीय तटरक्षक द्वारा सिमुलेटर के अधिक और समावेशी उपयोग संबंधी रूपरेखा की घोषणा की है। इसका व्यापक विजन योद्धाओं, नेताओं, अनुरक्षकों, प्रशासकों, जीव विज्ञान विशेषज्ञों, खरीदार और वित्तीय एजेंसियों के लिए सभी सैन्य क्षेत्रों में सिमुलेशन-आधारित प्रशिक्षण के लिए बदलना लाना है। इस प्रकार लागत प्रभावी, निपुण, सुरक्षित, त्वरित और स्मार्ट प्रशिक्षण प्राप्त करना है।

इस रूपरेखा में स्वदेशी डिजाइन और विकास पर जोर देने के साथ-साथ भारतीय कंपनियों को सिमुलेटरों के परिचालन और रखरखाव की आउटसोर्सिंग पर भी जोर दिया गया है। इस रूपरेखा में निम्नलिखित लक्ष्यों और उद्देश्यों को शामिल किया गया है-

- लाइव उपकरण उपयोग को कम करना-
- सिमुलेटरों को चरणबद्ध तरीके से शामिल करने के लिए क्षमता योजना पूर्ति सुनिश्चित करना।
- खरीदारी की योजना चरण में सिमुलेटरों की फेक्टर जरूरत को विधिवत रूप से पूरा करना।
- खरीदारी के दौरान सरकार की विभिन्न एजेंसियों और सिमुलेटरों की फेक्टरयुक्त आवश्यकताओं के बीच समन्वय स्थापित करना।

यह नीति सशस्त्र बलों द्वारा उपयोग किए जा रहे और भविष्य में खरीदे जाने वाले सभी प्रकार के सिमुलेटरों पर लागू होगी। प्रशिक्षण पर खर्च को कम करते हुए और उपकरणों के जीवन को संरक्षित करते हुए उच्चस्तर की तैयारी हासिल करने के लिए सिमुलेशन प्रौद्योगिकी के अनुप्रयोग के मार्ग लगातार तलाशे जाएंगे।

तीनों सेनाओं और भारतीय तटरक्षक द्वारा सिमुलेटरों के अधिक उपयोग के नवसंचार के लिए रक्षा मंत्रालय औद्योगिक संघ के सभी घटकों को सौंपी गई जिम्मेदारियों के साथ एक विस्तृत कार्य योजना का अनुपालन किया जाएगा। विकास, उत्पादन और रखरखाव के कार्य में लगी भारतीय एजेंसियों को सेना द्वारा सैन्य सिमुलेटरों के उत्पादन, तैनाती और रखरखाव के लिए उच्चतम स्तर के स्वदेशीकरण को सुनिश्चित करने के लिए नियोजित किया जाएगा।

<https://pib.gov.in/PressReleasePage.aspx?PRID=1757304>

# Indian military's new workhorse: MQ-9 Reaper drones

*By Pradip R Sagar*

On January 3, 2020, US president Donald Trump took a brief break from his Christmas vacation at the Mar-a-Lago resort in Florida to make a dramatic announcement. He told journalists that the US military had “successfully executed a flawless precision strike” that killed Qasim Soleimani, the head of Iran’s Quds Force that had allegedly injured or killed hundreds of American civilians and military personnel. “He was a monster, but he is no longer a monster,” Trump said. “He is dead.”



Apparently, the operation was as dramatic as the announcement. Two MQ-9 Reaper drones had taken off from an airbase in Kuwait, travelled 600km to hover over Baghdad International Airport. When the green light came, the drones launched the missiles which took out two cars that were leaving the airport. The attack killed Soleimani and Abu Mahdi al-Muhandis, head of al-Hashd al-Shaabi (popular mobilisation forces), an Iran-backed militia in Iraq. The Reapers’ precision stunned the world.

“ The Reapers, say strategists, will give India the ability to remotely launch cross-border strikes and engage border targets. ”

Months earlier, Trump had cleared the sale of MQ-9 Reapers to India, making it the first non-NATO country to get the clearance. Now, India is concluding the acquisition process. The drones, also called Predator B, would be distributed among the three services—10 each for the Army, the Navy and the Air Force. The Reapers come fitted with smart bombs and Hellfire missiles, and will form part of India’s response to the Chinese combat drone Wing Loong II, which Pakistan is buying.



The \$3-billion deal will sharpen India’s offensive capabilities. At present, the Indian military operates drones only for surveillance and reconnaissance missions. The weaponised Reapers, say strategists, will give India the ability to remotely launch cross-border strikes and engage border targets. It will also help the Navy keep an eye on Chinese warships in the Indian Ocean.

Last year, videos of Armenian tanks and artillery positions being decimated by Azerbaijan’s drones showed the world the changing character of new-age wars. It is estimated that around 2,000 attack drones and more than 80,000 surveillance drones will be sold around the world in the next 10 years. According to Lt Gen (retd) D.S. Hooda, the architect of the Army’s 2016 surgical strike across the Line of Control, it is now an essential capability for a modern military to take out targets deep behind the enemy lines with “minimal” risk. “It is a much more convenient option to send armed drones [instead of fighter



aircraft] to hit the target,” he told THE WEEK. “Cross-border strikes and Balakot-type airstrikes can be done without risking lives and aircraft.”

Under Project Cheetah, the Air Force is looking to upgrade its existing fleet of Heron drones for offensive missions. The medium-altitude, long-endurance Israeli drones, which serve all three services of the Indian military, are being fitted with laser-guided bombs and air-to-ground and air-launched anti-tank missiles. The Air Force, which is the lead agency for the project, will spend Rs5,000 crore on upgrades. India is among the few modern militaries that do not have armed drones. Even smaller countries like Nigeria, Somalia, Pakistan and South Africa have been using weaponised drones.

Manufactured by San Diego-based General Atomics, the Reaper has an endurance of 48 hours, and can carry a 1,700kg payload for more than 6,000 nautical miles. It comes with nine “hardpoints”—slots on an airframe designed to carry loads—that are capable of carrying sensors, missiles and laser-guided bombs. It can operate in adverse weather and is designed to survive lightning strikes.

According to Vivek Lall, chief executive of General Atomics Global Corporation, India-US defence ties are the result of decades of dedicated efforts by both countries to overcome traditional mindsets and align on common goals. “This is validated by the volume of trade and technology transfer existing today between the two largest democracies in the world,” he told THE WEEK. “We fully expect this trend to continue, and the fact that defence cooperation remains high on the list of priorities for bilateral relationship is a sign of these mutual security objectives.”

The Reaper platform has been a workhorse of the US military, producing models that have flown more than seven million hours, most of them in combat situations. The platform currently accounts for 11 per cent of all US air force missions, but only 2.6 per cent of total costs. The USAF drone fleet accumulates around three lakh flight hours a year, making it a favourite of military commanders around the world.

“No other family of platforms comes close to providing the capability, response, interoperability and utility of these aircraft, and we believe India will receive the same high value for investment that the US and other nations currently receive,” said Lall.

India had acquired its first unmanned vehicle in 1996—the Israeli Searcher Mk-I. Even now, drones India has are mainly Israel-made. The Defence Research and Development Organisation’s Nishant and Rustom drones are also used for surveillance and intelligence-gathering. India recently signed multiple contracts together worth Rs500 crore to buy Israeli “kamikaze drones”, which are essentially munitions that can search for and destroy targets.

Last year, the Navy had leased two Reapers for surveillance operations in the Indian Ocean. With its capacity to remain in the air for long, said Hooda, the Reapers can monitor and defend the China border. “It brings enormous offensive capabilities,” he said. “It is not going to replace manned fighter jets, but it brings advanced and additional capabilities.”

<https://www.theweek.in/theweek/current/2021/09/23/indian-militarys-new-workhorse-mq-9-reaper-drones.html>

## Govt likely to seal Rs 22,000-cr deal to buy 56 C-295 military transport planes

*The defence ministry is likely to finalise in the next few days the nearly Rs 20,000 crore Airbus-Tata deal to procure 56 C-295 medium transport aircraft to replace the Avro-748 planes of the Indian Air Force, people familiar with the development said on Thursday*

*Edited By Namrata Agrawal*

New Delhi: The defence ministry is likely to finalise in the next few days the nearly Rs 20,000 crore Airbus-Tata deal to procure 56 C-295 medium transport aircraft to replace the Avro-748 planes of the Indian Air Force, people familiar with the development said on Thursday.

The long-pending procurement was cleared by the Cabinet Committee on Security two weeks ago.

Under the deal, 16 aircraft will be delivered in a flyaway condition by the Airbus Defence and Space of Spain within 48 months of the signing of the contract.



The remaining 40 planes will be manufactured in India by a consortium of the Airbus Defence and Space and the Tata Advanced Systems Limited (TASL) within 10 years of the signing of the contract, officials said.

The C-295MW aircraft is a transport plane of 5-10 tonne capacity.

This is the first project of its kind in which a military aircraft will be manufactured in India by a private company.

"All 56 aircraft will be installed with indigenous electronic warfare suite," the defence ministry had said on September 8 after the procurement was cleared by the Cabinet Committee on Security.

The in-principle approval for the Avro replacement programme was accorded around nine years ago.

A large number of detail parts, sub-assemblies and major component assemblies of aerostructure are scheduled to be manufactured in India.

The ministry had said that before the completion of the deliveries, a servicing facility for the C-295MW aircraft is scheduled to be set up in India.

"It is expected that this facility will act as a regional MRO (maintenance, repair and overhaul) hub for various variants of the C-295 aircraft," it had said.

<https://zeenews.india.com/india/govt-likely-to-seal-rs-22000-cr-deal-to-buy-56-c-295-military-transport-planes-2396584.html>



Fri, 24 Sept 2021

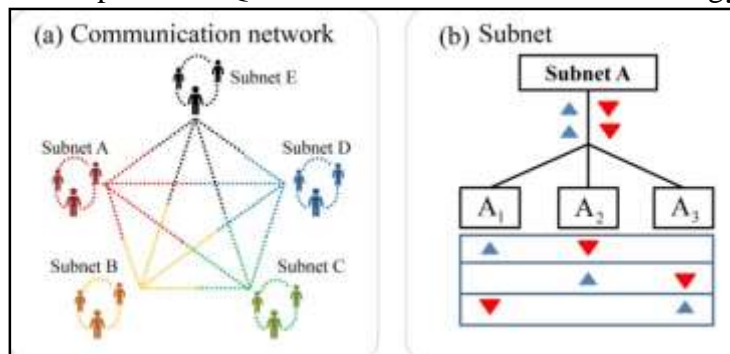
## A 15-user quantum secure direct communication network

Quantum secure direct communication (QSDC) based on entanglement can directly transmit confidential information. Scientist in China explored a QSDC network based on time-energy entanglement and sum-frequency generation. The results show that when any two users are performing QSDC over 40 kilometers of optical fiber, and the rate of information transmission can be maintained at 1Kbp/s. Our result lays the foundation for the realization of satellite-based long-distance and global QSDC in the future.

Quantum communication has presented a revolutionary step in secure communication due to its high security of the quantum information, and many communication protocols have been proposed, such as the quantum secure direct communication (QSDC) protocol. QSDC based on entanglement can

directly transmit confidential information. Any attack of QSDC results to only random number, and cannot obtain any useful information from it. Therefore, QSDC has simple communication steps and reduces potential security loopholes, and offers high security guarantees, which guarantees the security and the value propositions of quantum communications in general. However, the inability to simultaneously distinguish the four sets of encoded orthogonal entangled states in entanglement-based QSDC protocols limits its practical application. Furthermore, it is important to construct quantum network in order to make wide applications of quantum secure direct communication. Experimental demonstration of QSDC is badly required.

In a new paper published in *Light Science & Application*, a team of scientists, led by Professor Xianfeng Chen from State Key Laboratory of Advanced Optical Communication Systems and Networks, School of Physics and Astronomy, Shanghai Jiao Tong University, China and Professor Yuanhua Li from Department of Physics, Jiangxi Normal University, China have explored a QSDC network based on time-energy entanglement and sum-frequency generation (SFG). They present a fully connected entanglement-based QSDC network including five subnets, with 15 users. Using the frequency correlations of the fifteen photon pairs via time division multiplexing and dense wavelength division multiplexing (DWDM), they perform a 40-kilometer fiber QSDC experiment by implying two-step transmission between each user. In this process, the network processor divides the spectrum of the single-photon source into 30 International Telecommunication Union (ITU) channels. With these channels, there will be a coincidence event between each user by performing a Bell-state measurement based on the SFG. This allows the four sets of encoded entangled states to be identified simultaneously without post-selection.



(a) The quantum network is fully connected by five subnets (A, B, C, D and E are represented by red, orange, green, blue, and black, respectively). The dotted lines between the subnets (10 links with different colors) are the correlated time-energy photon pairs between the subnets. (b) Every subnet (such as subnet A) is equipped with a 1×3 beam splitter and a delay controlling module, which splits a frequency-correlated entangled photon pair (red and blue signs) and sends them to three users randomly. Credit: Zhantong Qi, Yuanhua Li, Yiwen Huang, Juan Feng, Yuanlin Zheng, and Xianfeng Chen

It is well known that the security and reliability of the information transmission for QSDC is an essential part in the quantum network. Therefore, they implemented block transmission and step-by-step transmission methods in QSDC with estimating the secrecy capacity of the quantum channel. After confirming the security of the quantum channel, the legitimate user performs encoding or decoding operations within these schemes reliably.

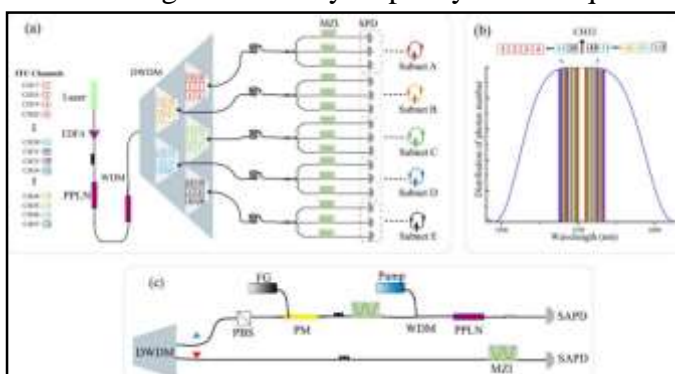
These scientists summarize the experiment results of their network scheme:

"The results show that when any two users are performing QSDC over 40 kilometers of optical fiber, the fidelity of the entangled state shared by them is still greater than 95%, and the rate of information transmission can be maintained at 1 Kbp/s. Our result demonstrates the feasibility of a proposed QSDC network, and hence lays the foundation for the realization of satellite-based long-distance and global QSDC in the future."

"With this scheme, each user interconnects with any others through shared pairs of entangled photons in different wavelength. Moreover, it is possible to improve the information transmission rate greater than 100 Kbp/s in the case of the high-performance detectors, as well as high-speed control in modulator being used" they added.

"It is worth noting the present-work, which offers long-distance point-to-point QSDC connection, combined with the recently proposed secure-repeater quantum network of QSDC, which offers secure end-to-end communication throughout the quantum Internet, will enable the construction of secure quantum network using present-day technology, realizing the great potential of QSDC in future communication." the scientists forecast.

<https://phys.org/news/2021-09-user-quantum-network.html>



(a) The physical structure of the quantum network. The spectrum is split into 30 ITU grid channels via a 100 GHz-DWDM. CH17 to CH31 are numbered from 1 to 15 respectively, and the numbers with opposite sign denote corresponding to channels CH33-CH47. The architecture of wavelength allocation is omitted in the small trapezoid multiplex blocks. Each small block with colored digital symbols constructs a wavelength group distributed by the network processor. (b) Each pair of signal photon and idler photon is indicated by the same colored bars with and without opposite digital sign. (c) Illustration of SFG progress. Photons generated in pairs by spontaneous parametric down-conversion process are multiplexed into the SFG experiment to realize encoding and quantum communication. Credit: Zhantong Qi, Yuanhua Li, Yiwen Huang, Juan Feng, Yuanlin Zheng, and Xianfeng Chen

## Grabbing magic tin by the tail

Atomic nuclei have only two ingredients, protons and neutrons, but the relative number of these ingredients makes a radical difference in their properties. Certain configurations of protons and neutrons, with "magic numbers" of protons or neutrons arranged into filled shells within the nucleus, are more strongly bound than others. The rare nuclei with complete proton and neutron shells, which are termed doubly magic, exhibit particularly enhanced binding energy and are excellent test cases for studies of nuclear properties.



The ISOLDE facility seen from above. Credit: CERN

In a paper just published in *Nature Physics*, Maxime Mougeot of CERN and colleagues describe theoretical calculations and experimental results from CERN's ISOLDE facility that shed new light on one of the most iconic doubly magic nuclei: tin-100.

With 50 protons and 50 neutrons, tin-100 is of particular interest for studies of nuclear properties because, in addition to being doubly magic, it is the heaviest nucleus comprising protons and neutrons in equal number—a feature that gives it one of the strongest beta decays, in which a positron (the antiparticle of an electron) is emitted to produce a daughter nucleus.

Studies of the beta decay of tin-100 suffer from difficulties in producing it. Moreover, the two most recent such studies, at RIKEN in Japan by Lubos and colleagues and at GSI in Germany by Hinke and colleagues, yield different values for the energy released in the decay, resulting in discrepant values for the mass of tin-100.

Recent developments at the ISOLDE facility have enabled production of the neighboring nuclei indium-101, indium-100 and indium-99, a mere proton below tin-100. In their new study, Mougeot and colleagues used all of the experimental armament of the facility's ISOLTRAP set-up to measure the masses of these new members of the ISOLDE family, notably the mass of indium-100.

"The mass of tin-100 can be derived from that of indium-100 and the energy released in the beta decay of tin-100 into indium-100," says Mougeot, "So our indium-100 mass measurement grabbed this iconic doubly magic nucleus by the tail."

The ISOLTRAP mass measurement of indium-100 is ninety times more precise than the previous one, magnifying the discrepancy in the values of the tin-100 mass deduced from the most recent beta-decay studies.

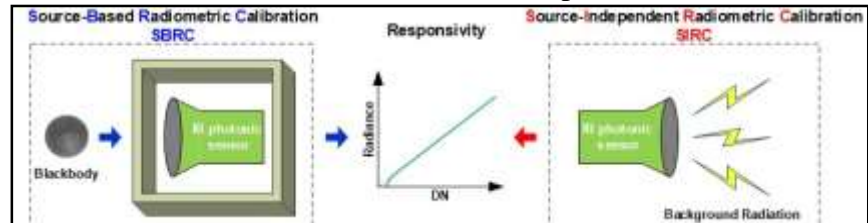
The researchers then made comparisons between the measured masses of the indium nuclei and new sophisticated "ab initio" theoretical calculations that attempt to describe nuclei from first principles. These comparisons favor the beta-decay energy result of Hinke and colleagues over that of Lubos and colleagues. Moreover, they show excellent agreement between the measurements and the calculations, giving the researchers great confidence that the calculations capture the intricate nuclear physics of tin-100 and its indium neighbors.

**More information:** Mougeot, M., Atanasov, D., Karthein, J. et al. Mass measurements of <sup>99–101</sup>In challenge ab initio nuclear theory of the nuclide <sup>100</sup>Sn. *Nat. Phys.* (2021). [doi.org/10.1038/s41567-021-01326-9](https://doi.org/10.1038/s41567-021-01326-9), [www.nature.com/articles/s41567-021-01326-9](https://www.nature.com/articles/s41567-021-01326-9)

**Journal information:** *Nature Physics*  
<https://phys.org/news/2021-09-magic-tin-tail.html>

# Source-independent radiometric calibration (SIRC) for high-accuracy infrared remote sensing

Radiometric calibration (RC) guarantees measurements from infrared photonic sensors with certain accuracy, where a traditional radiation source will introduce unexpected uncertainties for degradation. To overcome such a limitation, Scientist in China proposed an original source independent RC (SIRC) principle by modeling the incident background radiation to both photoconductive and photovoltaic HgCdTe detectors, respectively. SIRC will ensure a long-term stable service of Chinese geostationary meteorological satellites and benefit the future infrared micro-satellite constellation for climate applications.



In SBRC, the responsivity of an IR sensor is measured as a black-box to obtain its whole output when viewing the radiation from a source (i.e. blackbody). Conversely, in SIRC, The responsivity of a full or at least closely-approached BLIP sensor, which can be satisfied by most onboard sensors, is calculated by modeling the relationship between the incident background radiation and its responsivity. In essence, SBRC is a measurement-based method while SIRC is a modeling-based one. Particularly, the responsivity here merely refers to the linear component of the whole relationship between DN and radiance illustrated above. Credit: Qiang Guo, Fuchun Chen, Xiangyang Li, Boyang Chen, Xin Wang, Guilin Chen, and Caiying Wei

In SBRC, the responsivity of an IR sensor is measured as a black-box to obtain its whole output when viewing the radiation from a source (i.e. blackbody). Conversely, in SIRC, The responsivity of a full or at least closely-approached BLIP sensor, which can be satisfied by most onboard sensors, is calculated by modeling the relationship between the incident background radiation and its responsivity. In essence, SBRC is a measurement-based method while SIRC is a modeling-based one. Particularly, the responsivity here merely refers to the linear component of the whole relationship between DN and radiance illustrated above. Credit: Qiang Guo, Fuchun Chen, Xiangyang Li, Boyang Chen, Xin Wang, Guilin Chen, and Caiying Wei

To guarantee measurements from infrared (IR) photonic sensors with certain accuracy, radiometric calibration (RC) is implemented to determine the radiometric responsivity of sensor and usually be solved by comparing with some radiation source (i.e. blackbody), called source based RC (SBRC). SBRC method provides a reasonable calibration way, where the targeted sensor is measured as a black-box to obtain its whole output when viewing the incident radiation from a source. However, there are three main intrinsic limitations in design, manufacture and application aspects for SBRC respectively. Firstly, since some non-ideal characteristics of a source (i.e. the emissivity of an available blackbody is absolutely less than unit) exist in nature, the additional uncertainty from such a source to the ultimate calibration results is inevitable. Secondly, it is hardly to be guaranteed that a well-qualified blackbody together with some relevant assembly are equipped for all IR sensors, particularly for those onboard the popular micro-satellite platforms. Finally, diverse sources will bring extra difficulties to unify the costs of traceability for different sensors, which is unacceptable for the current climate and climate change researches.

In a new paper published in *Light: Science & Applications*, a team of scientists, led by Professor Qiang Guo from National Satellite Meteorological Center, China Meteorological Administration, China, and co-workers from Shanghai Institute of Technical Physics, Chinese Academy of Sciences have proposed an original source independent RC (SIRC) principle based on modeling instead of comparing for SBRC, where the incident background radiation to detector, as a dominated factor influencing the responsivity characteristics of a photonic sensor, is modeled to implement RC for both two fundamental types (photoconductive and photovoltaic) of HgCdTe photonic detectors. The SIRC merely requires the temperature information of main components of a sensor other than some complex source and its assembly, and provides a traceable way at lower uncertainty costs relative to the traditional SBRC.

In essence, the characteristics of the sensor's calibrated response are independent of such a known and controlled source (e.g. blackbody for an IR sensor), which implies that we may obtain them in other ways, e.g. modeling with the dominant impact factors, instead of the traditional one

by using measurement with a source. These scientists summarize the operational principle of SIRC:

"We propose the SIRC principle which establishes a new methodology to calibrate an infrared photonic sensor by modeling the relationship between the incident background radiation and its responsivity for the available IR photonic detectors, particularly for space utilization. The main defects and limitations of SBRC are completely overcome in SIRC, e.g. without additional uncertainty from source, without a complex source or its assembly to be equipped, and easy to be traceable with some measured temperature information to provide more reliable measurements from a sensor."

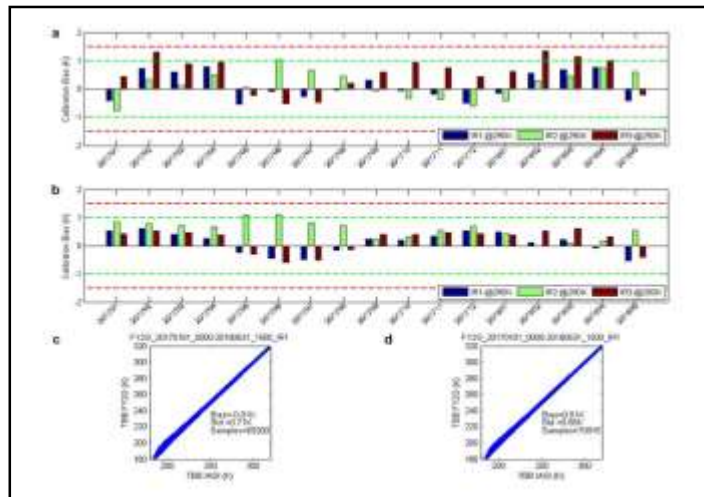
"The proposed SIRC principle is expected to set up a whole new solution for both design and development of a spaceborne IR photonic sensor as well as its corresponding radiometric calibration processing on ground, and particularly benefit the IR measurement accuracy of micro-satellite constellation in a more applicable way."

"The SIRC is being implemented in Fengyun-2 satellites (FY-2G and FY-2F) since 2019, which ensures a long-term stable service of Chinese geostationary meteorological satellites for the global observation system under the framework of World Meteorological Organization. Moreover, a 20-year-period traceable Fengyun-2 dataset to be re-calibrated with SIRC will benefit the further climate applications."

**More information:** Qiang Guo et al, High-accuracy source-independent radiometric calibration with low complexity for infrared photonic sensors, *Light: Science & Applications* (2021). DOI: [10.1038/s41377-021-00597-4](https://doi.org/10.1038/s41377-021-00597-4)

**Journal information:** [Light: Science & Applications](https://www.nature.com/journal/41377)

<https://phys.org/news/2021-09-source-independent-radiometric-calibration-sirc-high-accuracy.html>



a, Monthly biases of FY-2G VISSR IR1-IR3 bands with IBBC method. b, Monthly biases of FY-2G VISSR IR1-IR3 bands with SIRC method. c, Scatter plots of the collocated observations between FY-2G IR1 band and IASI with IBBC method. d, Scatter plots of the collocated observations between FY-2G IR1 band and IASI with SIRC method. Credit: Qiang Guo, Fuchun Chen, Xiangyang Li, Boyang Chen, Xin Wang, Guilin Chen, and Caiying Wei



Fri, 24 Sept 2021

## How severe is one's Covid-19 infection?

By Aishwarya Viswamitra

Mumbai: India's Covid-19 cases saw a massive surge in March and April 2021. The second wave of the Covid-19 pandemic put a lot of pressure on the medical infrastructure. Appropriate medical facilities were at times not available to those who needed them most—the ones who had severe symptoms. There was no way to predict how severe the symptoms of an infected person could become. The golden test to check for Covid-19, the RT-PCR test can only tell whether a person is infected or not. Unfortunately, the test cannot determine the severity of the infection.



Image Credit: IIT Bombay

Researchers from the Indian Institute for Technology Bombay (IIT Bombay) and Kasturba Hospital for Infectious Diseases, Mumbai, led by Prof Sanjeeva Srivastava of IIT Bombay, have found that levels of specific proteins in the nasopharyngeal samples of a person can differentiate between low and high severity of infection. This information would help hospitals distribute healthcare resources on time and ensure that those who require critical care could be identified with relative ease. The study was published in *iScience*, an open-access journal from Cell Press. The study was funded by the Council of Scientific & Industrial Research (CSIR) and by IIT Bombay.

The commonly used RT-PCR test uses a reverse transcription-polymerase chain reaction to detect the virus's nucleic acid. But specific viral or host proteins, released at different stages of infection, have stories to tell. By identifying which protein is released at which stage, we can determine the severity of the disease. Mass spectrometry is a tool that can find if a particular protein is present and in what percentage in a sample.

But first, the researchers needed to check if mass spectrometry could be used as a primary diagnostic test to confirm Covid-19 infection. Separate tests for detecting and measuring the severity of Covid-19 would only increase the work of the already burdened medical staff. The researchers collected nasopharyngeal samples from three groups of patients; Covid-19 positive, Covid-19 negative and Covid-19 recovered. They used mass spectrometry to determine which proteins were present in each of the groups' samples.

The researchers compared the protein profiles of Covid-19 positive and Covid-19 negative samples. They identified 25 proteins that were upregulated or present in higher quantities in Covid positive patients. They verified the 25 proteins' identities and quantities using a mass spectrometry technique called the Selected Reaction Monitoring (SRM) assay. While mass spectrometry can identify any biomolecule, an SRM assay is targeted at just proteins. Therefore, SRM is a highly sensitive and selective method for the identification of proteins and the precise measurement of their quantities.

These 25 proteins could potentially be used to determine whether a sample is Covid positive or Covid negative. A quantitative clinical study on a larger cohort needs to be done to determine the



cutoff percentages of the identified proteins. It would allow mass spectrometry to be used as a diagnostic test.

The researchers used Covid-19 recovered samples to identify whether these proteins also indicated progression towards severity or recovery. Thus, Covid-19 recovered patients were used as another control to narrow down the list of significant proteins that were altered only in the positive patients.

The second step was to find proteins that differentiated severe cases from non-severe ones. The 24 Covid-19 positive samples consisted of 11 non-severe and 13 severe patient samples. A patient is said to have high severity if they have acute respiratory distress syndrome, pneumonia or an oxygen saturation level below 87%. The researchers analysed the samples of the severe and non-severe groups separately. They identified six significant proteins that could differentiate severe Covid-19 patients from non-severe ones.

Proteins take part in cellular activities through step-by-step processes. Each step of a process may require particular proteins. The researchers studied the role that the six identified proteins played in the cellular processes in humans. A Covid-19 infection alters these processes, leading to higher levels of the six identified proteins. Thus, creating drugs that inhibit the significant proteins would lower the severity of the infection.

The researchers wanted to check if any existing drugs could be used to target the identified proteins rather than waiting for a new drug to be designed. The advantage of using existing drugs is that they are verified for safety. In the lab, the researchers investigated the binding efficiency of current drugs (29 FDA-approved, nine clinical, and 20 pre-clinical trial drugs) to the proteins involved in altered cellular processes in the infected host. By doing this, the researchers identified several drug candidates and small molecules, which could potentially bind to and inhibit the significant proteins.

“Drug development is a costly and time-consuming process. Thus it is important to find an alternative therapeutic approach for dealing with Covid-19,” explains Dr Kruthi, one of the authors of the study. “Most of these drugs are FDA approved and are in use for combating other groups of diseases. Thus, these drugs have the potential for Covid-19 therapy.”

Mass spectrometry could potentially be used as a diagnostic and prognostic test. Further studies on a large cohort of Covid-19 positive and Covid-19 negative samples in order to validate these results need to be done. A quantitative analysis of the identified proteins needs to be conducted. Further tests inside human cells need to be done to validate these small molecules and drug candidates.

<https://researchmatters.in/news/how-severe-one%E2%80%99s-covid-19-infection>

