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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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## CONTENT

S. No.	TITLE	Page No.
<b>DRDO News</b>		<b>1-14</b>
<b>DRDO Technology News</b>		<b>1-14</b>
1.	DRDO successfully flight tests Hypersonic Technology Demonstrator Vehicle	1
2.	डीआरडीओ ने हाइपरसोनिक प्रौद्योगिकी वाहन का सफल परीक्षण किया	2
3.	హైపర్సోనిక్ టెక్నాలజీ డెమన్స్ట్రేటర్ వెహికల్ విమాన పరీక్షను విజయవంతంగా నిర్వహించిన డీఆర్డీవో	3
4.	India joins US, Russia, China hypersonic Missile club	4
5.	India is proud: Rajnath Singh after DRDO tests hypersonic technology demonstrator vehicle	5
6.	PM congratulates DRDO for successful HSTDV flight says very few nations have such capability	6
7.	डीआरडीओ की बड़ी कामयाबी, अब हमारी मिसाइलें दुश्मनों पर पड़ेगी और भारी	7
8.	India's defence inches closer to hypersonic tech	8
9.	DRDO successfully ight-tests hypersonic tech demonstrator vehicle	10
10.	Explained: Significance and capability of scramjet vehicle that DRDO tested today	12
11.	DRDO successfully tests Hypersonic Technology Demonstrator Vehicle	13
<b>Defence News</b>		<b>15-21</b>
<b>Defence Strategic National/International</b>		<b>15-21</b>
12.	Army starts process to make ICVs capable of operating in night	15
13.	How Indian Army foiled China's move to push 1,000 soldiers into Pangong Tso's south bank	16
14.	India-China Standoff: Gearing up for Ladkah's winter, Indian army gets ready to meet challenges of nature	17
15.	India has raised the costs for China to be adventurist. But is it enough?	19
<b>Science &amp; Technology News</b>		<b>21-33</b>
16.	ISRO set to launch Chandrayaan-3 early next year; Spacecraft to carry Lander and Rover	21
17.	Spacesuits for Gaganyaan Astronauts under production in Russia	22
18.	गगनयान अंतरिक्ष यात्रियों के लिए अंतरिक्ष सूट का रूस में हो रहा निर्माण	23
19.	Scientists predict new, hard, and superhard ternary compounds	23
20.	Superconductors are super resilient to magnetic fields	24
21.	A tiny instrument to measure the faintest magnetic fields	25
22.	Study identifies limits on the efficiency of techniques for reducing noise in quantum resources	27
23.	Scientists synthesize lead-free zirconium-based vacancy-ordered double perovskite nanocrystals	28
24.	MRI scans show brain reorganization during long space flights, but no neurodegeneration	29
<b>COVID-19 Research News</b>		<b>30-33</b>
25.	Study reveals long-term lung and heart damage in COVID-19 patients can improve with time	30
26.	New research: Post-Covid review in children finds severe heart damage	33



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*Mon, 07 Sept 2020 2:56PM*

## **DRDO successfully flight tests Hypersonic Technology Demonstrator Vehicle**

Defence Research and Development Organisation (DRDO) has successfully demonstrated the hypersonic air-breathing scramjet technology with the flight test of Hypersonic Technology Demonstration Vehicle (HSTDV) at 1103 hours from Dr APJ Abdul Kalam Launch Complex at Wheeler Island, off the coast of Odisha today.

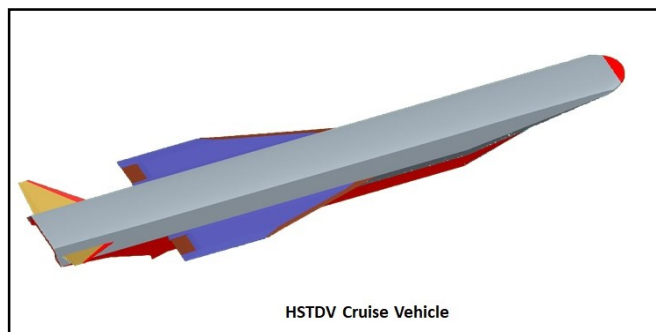
The hypersonic cruise vehicle was launched using a proven solid rocket motor, which took it to an altitude of 30 kilometres (km), where the aerodynamic heat shields were separated at hypersonic Mach number. The cruise vehicle separated from the launch vehicle and the air intake opened as planned. The hypersonic combustion sustained and the cruise vehicle continued on its desired flight path at a velocity of six times the speed of sound i.e., nearly 02 km/second for more than 20 seconds. The critical events like fuel injection and auto ignition of scramjet demonstrated technological maturity. The scramjet engine performed in a text book manner.

The parameters of launch and cruise vehicle, including scramjet engine was monitored by multiple tracking radars, electro-optical systems and Telemetry Stations. The scramjet engine worked at high dynamic pressure and at very high temperature. A Ship was also deployed in the Bay of Bengal to monitor the performance during the cruise phase of hypersonic vehicle. All the performance parameters have indicated a resounding success of the mission.

With this successful demonstration, many critical technologies such as aerodynamic configuration for hypersonic manoeuvres, use of scramjet propulsion for ignition and sustained combustion at hypersonic flow, thermo-structural characterisation of high temperature materials, separation mechanism at hypersonic velocities etc. were proven.

Raksha Mantri Shri Rajnath Singh congratulated DRDO on this landmark

achievement towards realising Prime Minister Narendra Modi's vision of Atmanirbhar Bharat. He



HSTDV Cruise Vehicle

also spoke to the scientists associated with the project and congratulated them on this great achievement. India is proud of them, he added.

Secretary Department of Defence R&D and Chairman DRDO Dr G Satheesh Reddy congratulated all the Scientists, Researchers and other personnel related with HSTDV mission for their resolute and unwavering efforts towards strengthening Nation's defence capabilities. On this successful demonstration, the country enters into the hypersonic regime paving way for advanced hypersonic Vehicles.

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=1651956>



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**रक्षा मंत्रालय**

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## **डीआरडीओ ने हाइपरसोनिक प्रौद्योगिकी वाहन का सफल परीक्षण किया**

रक्षा अनुसंधान और विकास संगठन (डीआरडीओ) ने आज हाइपरसोनिक प्रौद्योगिकी प्रदर्शन वाहन एचएसडीटीवी का ओडिशा के व्हीलर द्वीप स्थित डॉ. एपीजे अब्दुल कलाम प्रक्षेपण केन्द्र से सुबह 1103 बजे सफल प्रक्षेपण किया। इसके माध्यम से हाइपरसोनिक स्क्रेमजेट प्रौद्योगिकी का सफल प्रदर्शन किया गया।

हाइपरसोनिक क्रूज वाहन को एक ठोस रॉकेट मोटर का उपयोग करके प्रक्षेपित किया गया जो इसे 30 किलोमीटर (किमी) की ऊंचाई तक ले गया, जहां हाइपरसोनिक गति के अनुरूप इसके वायुगतिकीय ताप कवच को अलग किया गया। इसके बाद क्रूज वाहन प्रक्षेपण यान से अलग हो गया और इसके हवा को ग्रहण करने वाले हिस्से योजना के अनुसार खुल गए। इस दौरान ईंधन के रूप में हाइपरसोनिक दहन की प्रक्रिया निरंतर जारी रही जिससे यह अपने वांछित उड़ान पथ पर ध्वनि की गति से छह गुना यानी 2 किलोमीटर प्रति सेकेंड की गति से 20 सेकेंड से ज्यादा तक चलता रहा। इस दौरान ईंधन इंजेक्शन और स्क्रेमजेट के ऑटो इग्निशन जैसी महत्वपूर्ण घटनाओं ने तकनीकी परिपक्वता का प्रदर्शन किया। स्क्रेमजेट इंजन ने टेक्स्ट बुक तरीके से प्रदर्शन किया।

प्रक्षेपण, क्रूज वाहन और स्क्रेमजेट इंजन की कार्यप्रणाली मानकों के अनुरूप हुई या नहीं यह देखने के लिए इनपर बहुपथीय निगरानी वाले रडार, इलेक्ट्रोऑप्टिकल प्रणाली तथा टेलीमेट्री स्टेशनों की मदद से नजर रखी गई। स्क्रेमजेट इंजन हवा के अत्याधिक दबाव और बहुत अधिक तापमान पर काम करता रहा। हाइपरसोनिक वाहन के प्रदर्शन पर नजर रखने के लिए बंगाल की खाड़ी में एक जहाज भी तैनात किया गया था। वाहन का प्रक्षेपण सभी निर्धारित मानकों के अनुरूप हुआ जो कि इस अभियान की बड़ी सफलता रही।

इस सफल प्रदर्शन के साथ ही कई महत्वपूर्ण प्रौद्योगिकियां जैसे कि हाइपरसोनिक प्रौद्योगिकी के माध्यम से हवा में दक्ष परिचालन के साथ, प्रज्वलन के लिए स्क्रेमजेट प्रणोदन का उपयोग और हाइपरसोनिक प्रवाह में निरंतर दहन, उच्च तापमान सामग्री के थर्मो-संरचनात्मक लक्षण और हाइपरसोनिक वेग पर पृथक्करण प्रणाली की दक्षता साबित की गई।

रक्षामंत्री राजनाथ सिंह ने प्रधानमंत्री नरेन्द्र मोदी के आत्मनिर्भर भारत की परिकल्पना को साकार करने की दिशा में हासिल की गई इस ऐतिहासिक उपलब्धि के लिए डीआरडीओ को बधाई दी। उन्होंने इस परियोजना से जुड़े वैज्ञानिकों से बात की और उन्हें इस उपलब्धि के लिए बधाई दी। उन्होंने वैज्ञानिकों से कहा कि देश को उनपर गर्व पर है।

रक्षा विभाग के अनुसंधान और विकास विभाग के सचिव और डीआरडीओ के अध्यक्ष डॉ.सथीष रेड्डी ने भी एचएसटीडीवी अभियान से जुड़े सभी वैज्ञानिकों, अनुसंधानकर्ताओं और अन्य कर्मियों को देश की रक्षा क्षमताओं को मजबूत बनाने की दिशा में किए जा रहे उनके अथक प्रयासों के लिए बधाई दी। आज की सफलता के साथ ही भारत हाइपरसोनिक क्रूज मिसाइलों के प्रक्षेपण के लिए वांछित हाइपरसोनिक वाहन प्राप्त करने की दिशा में और आगे बढ़ गया है।

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**రక్షణ మంత్రిత్వ శాఖ**

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## **'హైపర్సోనిక్ టెక్నాలజీ డెమన్స్ట్రేటర్ వెహికల్' విమాన పరీక్షను**

### **విజయవంతంగా నిర్వహించిన డీఆర్డీఓ**

ఒడిశా తీరం వీలర్ ద్వీపంలోని డాక్టర్ ఏపీజే అబ్దుల్ కలాం లాంచ్ కాంప్లెక్స్ నుండి 'డిఫెన్స్ రీసెర్చ్ అండ్ డెవలప్ మెంట్ ఆర్గనైజేషన్' (డీఆర్డీఓ) ఈ రోజు ఉదయం 11.30 గంటలకు

'హైపర్సోనిక్ టెక్నాలజీ డెమన్స్ట్రేటర్ వెహికల్'(హచ్ఎస్టీడీవీ) విమాన పరీక్షతో హైపర్సోనిక్ ఎయిర్-బ్రీటింగ్ స్క్రామ్జెట్ టెక్నాలజీని విజయవంతంగా ప్రదర్శించింది. హైపర్సోనిక్ క్రూయిజ్ వాహనం నిరూపితమైన ఘన రాకెట్ మోటారును ఉపయోగించి ప్రయోగించారు. దాదాపు 30 కిలో మీటర్ల (కి.మీ.) ఎత్తుకు తీసుకువెళ్ళింది. ఇక్కడ ఏరోడైనమిక్ పీచ్ పీల్స్ హైపర్సోనిక్ మాక్ నంబర్ వద్ద వేరు చేయబడ్డాయి. ప్రయోగ వాహనం నుండి వేరు చేయబడిన క్రూయిజ్ వాహనం ప్రణాళిక ప్రకారం గాలి తీసుకోవడం ప్రారంభించబడింది. హైపర్సోనిక్ విధానంలో దహనం కొనసాగింది మరియు క్రూయిజ్ వాహనం దాని నిర్దేశించిన విమాన మార్గంలో ధ్వని వేగం కంటే ఆరు రెట్లు వేగంతో దూసుకుపోయింది. అంటే సెకనుకు 02 కి.మీ. వేగంతో దాదాపు 20 సెకన్ల కంటే ఎక్కువగా సమయం ప్రయాణించింది. ఇంధన ఇంజెక్షన్ మరియు స్క్రామ్జెట్ యొక్క ఆటో జ్వలన వంటి క్లిష్టమైన సంఘటనలు సాంకేతిక పరిపక్వతను ప్రదర్శించాయి. స్క్రామ్జెట్ ఇంజిన్ టెక్స్ట్ బుక్ పద్ధతిలో ప్రదర్శించబడింది. స్క్రామ్జెట్ ఇంజిన్తో సహా క్రూయిజ్ వాహనానికి చెందిన వివిధ పారామితులను బహుళ ట్రాకింగ్ రాడార్లు, ఎలక్ట్రో-ఆప్టికల్ సిస్టమ్స్ మరియు టెలిమెట్రి స్ట్రెస్సు నుంచి పర్యవేక్షించారు. స్క్రామ్జెట్ ఇంజిన్ అధిక డైనమిక్ పీడనం వద్ద మరియు చాలా అధిక ఉష్ణోగ్రత వద్ద పనిచేసింది. హైపర్సోనిక్ వాహనం క్రూయిజ్ దశలో పనితీరును పర్యవేక్షించడానికి బంగాళాఖాతంలో ఒక ఓడను నియమించారు. అన్ని పనితీరు పారామితులు మిషన్ యొక్క అద్భుతమైన విజయాన్ని సూచించాయి. ఈ విజయవంతమైన ప్రదర్శనతో హైపర్సోనిక్ మాన్యవర్ణ కోసం ఏరోడైనమిక్ కాన్ఫిగరేషన్, జ్వలన కోసం స్క్రామ్జెట్ ప్రొఫైల్ వాడకం, హైపర్సోనిక్ ప్రవాహం వద్ద నిరంతర దహనం, అధిక ఉష్ణోగ్రత పదార్థాల ధర్మో-స్ట్రక్చరల్ క్యారెక్టరైజేషన్తో పాటు హైపర్సోనిక్ వేగాల్లో విభజన విధానం మొదలైన వంటి పలు రకాల క్లిష్టమైన సాంకేతికతలు నిరూపించబడ్డాయి. ప్రధానమంత్రి నరేంద్ర మోడీ 'ఆత్మనిర్భర్ భారత్' దృష్టిని సాకారం చేసేలా ఈ మైలురాయి సాధించినందుకు రక్షణ మంత్రి శ్రీ రాజనాథ్ సింగ్ డీఆర్డీఓను అభినందించారు. ఈ ప్రాజెక్టుకు సంబంధించిన శాస్త్రవేత్తలతో మాట్లాడిన ఆయన ఈ అరుదైన ఘనత సాధించినందుకు వారిని అభినందించారు. భారతదేశం



వారిని చూసి గర్వపడుతుందని అన్నారు. రక్షణ శాఖ ఆర్ అండ్ డీ కార్యదర్శి, డీఆర్డీఓ చైర్మన్ డాక్టర్ జి సతీష్ రెడ్డి హెచ్ఎస్టీడీవీ మిషన్కు సంబంధించిన శాస్త్రవేత్తలు, పరిశోధకులు మరియు ఇతర సిబ్బందిని అభినందించారు. ఈ విజయవంతమైన ప్రదర్శన దేశం హైపర్సోనిక్ పాలనలో అధునాతనమైన హైపర్సోనిక్ వాహనాలకు మార్గం సుగమం చేస్తుంది.

<https://pib.gov.in/PressReleasePage.aspx?PRID=1652166>

## hindustantimes

Tue, 08 Sept 2020

### India joins US, Russia, China hypersonic Missile club

*Government sources said that the DRDO will have the capacity to develop a hypersonic missile with scramjet engine in next five years*

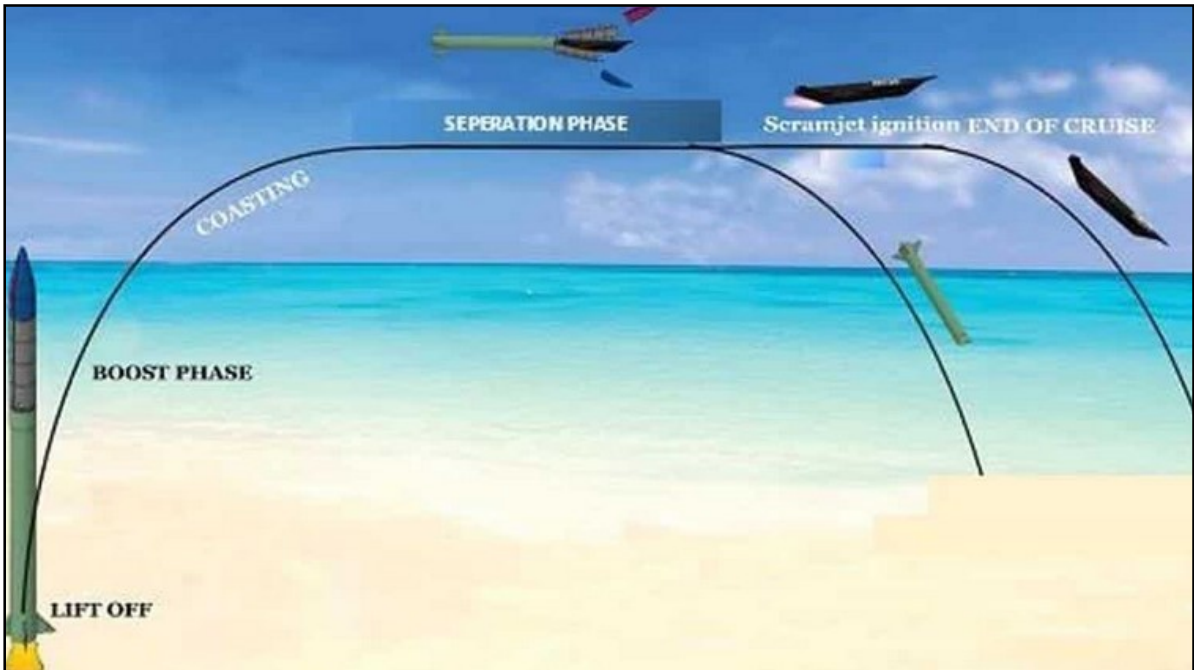
*By Shishir Gupta*

New Delhi: India on Monday became the fourth country after the United States, Russia and China to develop and successfully test hypersonic technology from APJ Abdul Kalam testing range (Wheeler Island) in Balasore, Odisha. This indigenous technology will pave the way towards development of missiles travelling at six times the speed of sound (Mach 6).



The HSTDV tested by India on Monday. (Pic: DRDO)

The test of Hypersonic Test Demonstrator Vehicle (HSTDV), developed by Defence Research and Development Organisation (DRDO) was conducted at 11.03 am today using the Agni missile booster and lasted for five minutes.



A graphic explaining the entire HSTDV flight maneuver. (Pic: DRDO)

People aware of the development said this test means that the DRDO will have the capacity to develop a hypersonic missile with scramjet engine in next five years, which will have the capacity to travel at more than two kilometres per second. The test was led by DRDO Chief Satheesh Reddy and his hypersonic missile team. The HSTDV performed on all parameters, including combustion chamber pressure, air intake and control guidance, the agency said.

At 11.03 am, the Agni missile booster took the hypersonic vehicle to height of 30 km after which the latter separated. Thereafter, the vehicle's air intake opened and that led to successfully firing of the test scramjet engine. The combustion lasted for more than 20 seconds with the vehicle achieving a speed of Mach 6. "The vehicle performed successfully on all the pre-determined parameters including the ability to handle combustion temperatures of over 2500 degrees Celsius as well as air speed," said a senior official.

Defence minister Rajnath Singh congratulated the DRDO immediately after the test and praised their efforts to indigenously build a scramjet engine.

He said that it is a landmark achievement towards realising the vision of 'Atmanirbhar Bharat' (self-reliant India).

"The @DRDO\_India has today successfully flight tested the Hypersonic Technology Demonstrator Vehicle using the indigenously developed scramjet propulsion system. With this success, all critical technologies are now established to progress to the next phase," Singh tweeted.

"I congratulate to DRDO on this landmark achievement towards realising the Prime Minister's vision of Atmanirbhar Bharat. I spoke to the scientists associated with the project and congratulated them on this great achievement. India is proud of them," the defence minister said in another tweet.

The HSTDV is an unmanned scramjet demonstration aircraft for hypersonic speed flight. Besides its utility for long-range cruise missiles of the future, the technology has multiple civilian applications also. It can be used for launching satellites at low cost too, according to government officials.

The HSTDV cruise vehicle is mounted on a solid rocket motor, which will take it to a required altitude, and once it attains certain mach numbers for speed, the cruise vehicle will be ejected out of the launch vehicle. Subsequently, the scramjet engine will be ignited automatically.

<https://www.hindustantimes.com/india-news/atmanirbhar-bharat-india-becomes-4th-country-to-test-hypersonic-technology-demonstrator-vehicle/story-UQ2bsvYDs95u0VGw62wfzJ.html>



*Tue, 08 Sept 2020*

## **India is proud: Rajnath Singh after DRDO tests hypersonic technology demonstrator vehicle**

*Calling it a "landmark achievement", Defence Minister Rajnath Singh congratulated the DRDO over the successful test flight of the HSTDV and said, "India is proud"*

*By Manjeet Singh Negi*

New Delhi: The Defence Research and Development Organisation (DRDO) on Monday successfully demonstrated the Hypersonic air-breathing scramjet technology with the flight test of Hypersonic Technology Demonstrator Vehicle (HSTDV) at 11:03 am from Dr APJ Abdul Kalam Launch Complex at Wheeler Island, off the coast of Odisha.

The hypersonic cruise vehicle was launched using a proven solid rocket motor, which took it to an altitude of 30 km, where the aerodynamic heat shields were separated at hypersonic Mach number. The cruise vehicle separated from the launch vehicle and the air intake opened as planned.

The hypersonic combustion sustained and the cruise vehicle continued its desired flight path at a velocity of six times the speed of sound i.e. nearly 2 km/s for more than 20 seconds. The critical events like fuel injection and auto ignition of scramjet demonstrated technological maturity and the scramjet engine performed in a textbook manner.

The parameters of launch and cruise vehicle, including the scramjet engine, was monitored by multiple tracking radars, electro-optical systems and telemetry stations.

"The scramjet engine worked at high dynamic pressure and at very high temperature. The ship was also deployed in the Bay of Bengal to monitor the performance during the cruise phase of hypersonic vehicle. All the performance parameters have indicated a resounding success of the mission," a DRDO official said.

With this successful demonstration, many critical technologies such as aerodynamic configuration for Hypersonic manoeuvres, use of scramjet propulsion for ignition and sustained combustion at hypersonic flow, thermo-structural characterisation of high-temperature materials, separation mechanism at hypersonic velocities etc were successfully tested.

Defence Minister Rajnath Singh congratulated the DRDO over the successful test flight of the HSTDV, calling it a "landmark achievement"

"I congratulate to DRDO on this landmark achievement towards realising PM's vision of Atmanirbhar Bharat. I spoke to the scientists associated with the project and congratulated them on this great achievement. India is proud of them," Rajnath Singh tweeted.

<https://www.indiatoday.in/india/story/rajnath-singh-drdo-hypersonic-technology-demonstrator-vehicle-1719421-2020-09-07>

## THE TIMES OF INDIA

Tue, 08 Sept 2020

### PM congratulates DRDO for successful HSTDV flight says very few nations have such capability

New Delhi: Prime Minister Narendra Modi on Monday lauded the Defence Research and Development Organisation (DRDO) for the successful flight of the hypersonic test demonstration vehicle, saying very few countries have such capability today.

In a tweet, Modi noted that the scramjet engine developed by scientists helped the flight achieve a speed six times the speed of sound.

"Congratulations to @DRDO\_India for successful flight of the Hypersonic Test Demonstration Vehicle today. The scramjet engine developed by our scientists helped the flight achieve a speed 6 times the speed of sound! Very few countries have such capability today," he said.



India on Monday successfully flight-tested the indigenously-developed hypersonic technology demonstration vehicle (HSTDV), joining a select group of countries having the capability to develop the next-generation hypersonic cruise missiles, officials said.

The HSTDV, based on hypersonic propulsion technologies and developed by the DRDO, will help India develop futuristic space assets like long-range missile systems and aerial platforms, they said.

<https://www.theweek.in/wire-updates/national/2020/09/07/del81-pm-drdo.html>



## डीआरडीओ की बड़ी कामयाबी, अब हमारी मिसाइलें दुश्मनों पर पड़ेंगी और भारी

नई दिल्ली: रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) ने आज स्वदेशी रूप से विकसित स्क्रैमजेट प्रोपल्शन सिस्टम का प्रयोग करते हुए हाइपरसोनिक टेक्नोलॉजी डिमॉन्स्ट्रेटर व्हीकल का सफलतापूर्वक परीक्षण किया। रक्षा मंत्री राजनाथ सिंह ने इसकी जानकारी साझा की।

राजनाथ ने बताया कि इस सफलता के बाद अब अगले चरण की प्रगति शुरू हो गई है। वहीं, इस मौके पर रक्षा मंत्री ने डीआरडीओ और इसके वैज्ञानिकों को बधाई दी और कहा कि संस्थान प्रधानमंत्री नरेंद्र मोदी के आत्मनिर्भर भारत के सपने को साकार करने में जुटा है।

रक्षा मंत्री राजनाथ ने ट्वीट कर कहा, 'डीआरडीओ ने आज स्वदेशी रूप से विकसित स्क्रैमजेट प्रोपल्शन सिस्टम का उपयोग कर हाइपरसोनिक टेक्नोलॉजी डिमॉन्स्ट्रेटर व्हीकल का सफलतापूर्वक परीक्षण किया है। इस सफलता के साथ, सभी महत्वपूर्ण प्रौद्योगिकियां अब अगले चरण की प्रगति के लिए स्थापित हो गई हैं।

उन्होंने कहा, 'मैं डीआरडीओ को इस महान उपलब्धि के लिए बधाई देता हूँ जो पीएम मोदी के आत्मनिर्भर भारत के सपने को साकार करने की दिशा में है। मैंने परियोजना से जुड़े वैज्ञानिकों से बात की और उन्हें इस महान उपलब्धि पर बधाई दी। भारत को उन पर गर्व है।'

### देश की एक प्रमुख तकनीकी सफलता

डीआरडीओ के चेयरमैन डॉ जी सतीश रेड्डी ने कहा, यह देश की एक प्रमुख तकनीकी सफलता है। यह परीक्षण अधिक महत्वपूर्ण प्रौद्योगिकियों, सामग्रियों और हाइपरसोनिक वाहनों के विकास का मार्ग प्रशस्त करेगा। यह भारत को उन चुनिंदा देशों की श्रेणी में रखता है जिन्होंने इस तकनीक का प्रदर्शन किया है।

### क्या है हाइपरसोनिक टेक्नोलॉजी डिमॉन्स्ट्रेटर व्हीकल

भारत में हाइपरसोनिक टेक्नोलॉजी का सबसे पहला परीक्षण 2019 में किया गया था। इस तकनीक का इस्तेमाल हाइपरसोनिक क्रूज मिसाइल बनाने और काफी कम खर्च में सैटेलाइट लॉन्च करने में किया जाएगा। साथ ही हाइपरसोनिक और लंबी दूरी की क्रूज मिसाइलों के लिए यान के तौर पर भी इसका प्रयोग किया जाएगा।

हाइपरसोनिक टेक्नोलॉजी डिमॉन्स्ट्रेटर व्हीकल, हाइपरसोनिक क्रूज मिसाइल प्रणाली विकसित करने संबंधी भारत के महत्वाकांक्षी कार्यक्रम का हिस्सा है। भारत उन कुछ चुनिंदा देशों की श्रेणी में आ खड़ा हुआ है, जहां इस तकनीक का प्रयोग किया जाता है। फिलहाल, अमेरिका, रूस और चीन के पास ये तकनीक है।

<https://www.amarujala.com/india-news/rajnath-singh-congratulated-drdo-for-successfully-flight-tested-the-hypersonic-technology-demonstrator-vehicle>



Hypersonic air-breathing scramjet technology - फोटो: ANI


## India's defence inches closer to hypersonic tech

*Only the United States, Russia and China have developed technologies to field fast-maneuvring hypersonic missiles that fly at lower altitudes and are extremely hard to track and intercept. Mach 6 translates into a speed of 7,408kmph*

*By Rahul Singh*

India on Monday took the first steps towards developing a new class of ultra-modern weapons that can travel six times faster than the speed of sound (Mach 6) and penetrate any missile defence, with the Defence Research and Development Organisation (DRDO) carrying out a successful flight test of the hypersonic technology demonstrator vehicle (HSTDV) for the first time from a launch facility off the Odisha coast.

### Going hypersonic



India on Monday successfully flight-tested the indigenously developed hypersonic technology demonstrator vehicle that is expected to power long-range missile systems.

**WHY IS THE SUCCESSFUL FLIGHT TEST OF THE VEHICLE SIGNIFICANT?**  
It paves the way for India to develop hypersonic weapons that can travel six times faster than the speed of sound (Mach 6). The weapon will be integrated into the hypersonic vehicle.

**WHICH OTHER COUNTRIES HAVE DEVELOPED HYPERSONIC TECHNOLOGY?**  
Only the US, Russia and China have developed technologies to field hypersonic weapons that fly at lower altitudes and are extremely hard to track and intercept. India could develop hypersonic missiles in four years.

**WHAT WILL THE DEVELOPMENT OF HYPERSONIC MISSILES ENTAIL?**  
In Monday's test, the cruise vehicle continued on its flight path at Mach 6 speeds or nearly 2 km/second for more than 20 seconds. The next challenge for India will be to ensure the cruise vehicle can travel at those speeds for a few hundred seconds for the weapon to strike its target.

**WHAT ARE THE MAIN CHALLENGES FOR HYPERSONIC FLIGHTS?**  
Extremely high temperatures and aerodynamic forces make hypersonic flights tricky. The successful flight test proved several critical technologies including aerodynamic configuration for hypersonic maneuvers, use of scramjet propulsion for ignition and separation mechanism at speeds in excess of Mach 6.

**WHY ARE HYPERSONIC VEHICLES POWERED BY SCRAMJET ENGINES?**  
An improvement over the ramjet technology, the scramjet engine operates efficiently at hypersonic speeds and allows supersonic combustion. Ramjet engines are efficient at supersonic speeds of around Mach 3 but their performance drops when the vehicle hits hypersonic speeds.

Only the United States, Russia and China have developed technologies to field fast-maneuvring hypersonic missiles that fly at lower altitudes and are extremely hard to track and intercept. Mach 6 translates into a speed of 7,408kmph.

India could develop hypersonic cruise missiles powered by air-breathing scramjet engines in about four years, a top government officer said on condition of anonymity.

“The DRDO has successfully demonstrated the hypersonic air-breathing scramjet technology with the flight test of HSTDV at 1103 hours from Dr APJ Abdul Kalam launch complex at Wheeler Island off the coast of Odisha on Monday,” the defence ministry statement said.

An improvement over the ramjet technology, the scramjet engine operates efficiently at hypersonic speeds and allows supersonic combustion. Hypersonic missiles travel at speeds in excess of Mach 5.

Experts say that such vehicles are launched on rockets before they detach and move towards their target in the upper atmosphere. They can be steered to add unpredictability in an attack and because they follow a flat and low trajectory, it is hard to detect them early with radar.

“Congratulations to DRDO India for successful flight of the Hypersonic Test Demonstration Vehicle today. The scramjet engine developed by our scientists helped the flight achieve a speed 6 times the speed of sound! Very few countries have such capability today,” Prime Minister Narendra Modi tweeted.

The hypersonic cruise vehicle was launched using a proven solid rocket motor that took it to an altitude of 30km, where the aerodynamic heat shields were separated at a hypersonic Mach number, the statement said.

“The cruise vehicle separated from the launch vehicle and the air intake opened as planned. The hypersonic combustion sustained and the cruise vehicle continued on its desired flight path at a velocity of six times the speed of sound or nearly 2 km/second for more than 20 seconds,” the statement said. The first test of the HSTDV in June 2019 failed to meet mission parameters.

Developing hypersonic missiles will require the cruise vehicle to travel at speeds above Mach 6 for a few hundred seconds for the weapon to strike its target, said a second official, requesting anonymity.

“Critical events like fuel injection and auto ignition of scramjet demonstrated technological maturity. The scramjet engine performed in a textbook manner,” the statement said.

The parameters of launch and cruise vehicle, including the scramjet engine, were monitored by multiple tracking radars, electro-optical systems and telemetry stations, with the engine working efficiently at high dynamic pressure and very high temperature, it added.

A warship was deployed in the Bay of Bengal to monitor the performance during the cruise phase of the hypersonic vehicle. All the performance parameters indicated a “resounding success” of the mission, the statement said.

“This marks a technological breakthrough for the country. The successful mission will enable us to develop many more critical technologies and pave the way for hypersonic vehicle development,” DRDO chief G Satheesh Reddy told HT.

The flight test has proven a raft of critical technologies including aerodynamic configuration for hypersonic manoeuvres, use of scramjet propulsion for ignition and sustained combustion at hypersonic flow, thermo-structural characterisation of high temperature materials and separation mechanism at hypersonic velocities, the defence ministry said.

With hypersonic vehicles being key to defeating missile defences, the successful flight of the technology demonstrator vehicle is an important milestone, said Air Vice Marshal Manmohan Bahadur (retd), additional director general, Centre for Air Power Studies.

“This has been some time in the making and the challenge now is to make a time-bound transition to the prototype testing phase. China is quite ahead in hypersonics and India cannot afford to lag behind,” Bahadur said.

The dual-use hypersonic technology has non-military applications too – it can be used for launching satellites and developing commercial planes, experts said.

Defence minister Rajnath, who spoke with scientists associated with the critical project, congratulated the DRDO on the “landmark achievement” towards realising Prime Minister Narendra Modi’s vision of “Atmanirbhar Bharat”.

“The DRDO has today successfully flight tested the Hypersonic Technology Demonstrator Vehicle using the indigenously developed scramjet propulsion system. With this success, all critical technologies are now established to progress to the next phase,” the defence minister wrote on Twitter.

Reddy congratulated the scientists, researchers and other personnel associated with the mission for their “resolute and unwavering efforts” towards strengthening the country’s defence capabilities.

<https://www.hindustantimes.com/india-news/india-s-defence-inches-closer-to-hypersonic-tech/story-2XDxkfHhMiulSsdDfVNkbL.html>

## DRDO successfully ight-tests hypersonic tech demonstrator vehicle

By Anantha Krishnan M

Bengaluru: The Defence Research and Development Organisation (DRDO) said on Monday said that it had successfully flight tested the Hypersonic Technology Demonstrator Vehicle (HSTDV) using the indigenously developed scramjet propulsion system.

With the success of this hypersonic air-breathing scramjet technology, the DRDO said that it had established all critical technologies need to progress to the next phase.

“It is a giant leap in indigenous defence technologies and significant milestone towards a ‘Sashakt Bharat and Atmanirbhar Bharat. DRDO has now demonstrated capabilities for highly complex technology that will serve as the building block for next generation hypersonic vehicles in partnership with industry,” a DRDO spokesperson said.

Chairman DRDO Dr G Satheesh Reddy congratulated the scientists, researchers and other personnel related with HSTDV mission for their resolute and unwavering efforts towards strengthening nation’s defence capabilities.

It is a giant leap in indigenous defence technologies and significant milestone towards a Sashakt Bharat and Atmanirbhar Bharat, a DRDO spokesperson said. <https://t.co/kSxGU78RSP>  
<pic.twitter.com/DXj5CWboSM>



Defence Minister Rajnath Singh tweeted saying he spoke with the scientists associated with the project and congratulated them on this great achievement.

“India is proud of them,” he tweeted.

Today’s test was held from APJ Abdul Kalam Launch Complex at Wheeler Island, off the Odisha coast.

“The test was held around 11 am and it lasted for a few minutes,” an official said.

DRDO said the hypersonic cruise vehicle was launched using a proven solid rocket motor, which took it to an altitude of 30 km, where the aerodynamic heat shields were separated at hypersonic Mach number.

The @DRDO\_India has today successfully flight tested the Hypersonic Technology Demonstrator Vehicle using the indigenously developed scramjet propulsion system. With this success, all critical technologies are now established to progress to the next phase. — **Rajnath Singh** (@rajnathsingh) September 7, 2020



## **Launch Highlights**

- The cruise vehicle separated from the launch vehicle and the air intake opened as planned. •The hypersonic combustion sustained and the cruise vehicle continued on its desired flight path at a velocity of six times the
- The critical events like fuel injection and auto ignition of scramjet demonstrated technological maturity. The scramjet engine performed in a text book manner. It worked at high dynamic pressure and at very high temperature.
- The parameters of launch and cruise vehicle, including scramjet engine was monitored by multiple tracking radars, electro-optical systems and telemetry stations.
- A ship was also deployed in the Bay of Bengal to monitor the performance during the cruise phase of hypersonic vehicle.
- Many critical technologies such as aerodynamic congurtuation for hypersonic manoeuvres, use of scramjet propulsion for ignition and sustained combustion at hypersonic flow, thermo-structural characterisation of high temperature materials, separation mechanism at hypersonic velocities, etc.

## **Challenging Mission**

The HSTDV was conceptualized for an autonomous flight of a scramjet-integrated hypersonic air-breathing vehicle for about 20 seconds.

Scientists at the Defence Research and Development Laboratory (DRDL) in Hyderabad, part of India's Missile Complex has been working on HSTDV for the last 15 years.

With today's mission, India joins a select few nations who have conducted autonomous flight of the hypersonic air-breathing vehicles, with United States, Russia and China already leading ahead.

Speaking to Onmanorama, DRDO Chairman Dr Reddy said: "It is a major technological breakthrough which paves the way for many critical technology development and realizing hypersonic vehicles."

National Aerospace Laboratories, a premier lab under CSIR in Bengaluru, too contributed to the HSTDV project developing a high temperature component that could withstand up to 3000°C temperature.

For the last several years, DRDL scientists have been developing high temperature materials for engine, airframe and other structural components.

The first aerodynamic wind-tunnel test for this mission was held in Israel in 2007 and two years later again in Russia (2009) as India then lacked hypersonic facility to test larger cross-section of platforms.

DRDO also set up new facilities under the command of Missile Complex in Hyderabad to undertake advanced tests of futuristic missions, including HSTDV.

<https://www.onmanorama.com/news/nation/2020/09/07/drdo-successfully-flight-tests-hypersonic-tech-demonstrator-vehicle.html>



## Explained: Significance and capability of scramjet vehicle that DRDO tested today

*Scientists believe that while the successful test is a major milestone, many more rounds of tests will have to be done to achieve the level of technology with countries like the US, Russia and China*

*By Sushant Kulkarni*

The Defence Research and Development Organisation (DRDO) on Monday successfully flight tested the Hypersonic Technology Demonstrator Vehicle (HSTDV) – an unmanned scramjet vehicle with a capability to travel at six times the speed of sound. A look at the vehicle and its development, and the importance of the test for defence and other sectors.

### Significance of the test

The DRDO said in a series of tweets, “In a historic mission today, India successfully flight tested Hypersonic Technology Demonstrator Vehicle, a giant leap in indigenous defence technologies and significant milestone towards a Sashakt Bharat and Atmanirbhar Bharat. DRDO with this mission, has demonstrated capabilities for highly complex technology that will serve as the building block for NextGen Hypersonic vehicles in partnership with industry.”

The test which was conducted from Dr APJ Abdul Kalam Launch Complex at Wheeler Island, off the coast of Odisha today, the Agni missile was used. A solid rocket motor of Agni missile was used to take to an altitude of 30 kilometers where the cruise vehicle separated from the launch vehicle and the air intake opened as planned. The parameters of the test were monitored by multiple tracking radars, electro-optical systems and telemetry stations and a ship was also deployed in the Bay of Bengal to monitor the performance during the cruise phase of hypersonic vehicle. All the performance parameters have indicated a resounding success of the mission, officials said.

A senior DRDO scientist said that though the system was tested for a very short duration, it has given scientists a large set of data points to work on for further development. The indigenous development of the technology will also boost the development of the systems built with hypersonic vehicles at its core, including both offensive and defensive hypersonic cruise missile systems and also in the space sector.

Scientists believe that while the successful test is a major milestone, many more rounds of tests will have to be done to achieve the level of technology with countries like the US, Russia and China. “This is certainly a milestone, but developers will have to look at it as a stepping stone.” A DRDO scientist, who was part of the project said.

### The hypersonic vehicle and its scramjet engine

The scramjets are a variant of a category of jet engines called the air breathing engines. The ability of engines to handle airflows of speeds in multiples of speed of sound, gives it a capability of operating at those speeds.

Hypersonic speeds are those which are five times or more than the speed of sound. The unit tested by the DRDO can achieve upto six times the speed of sound or Mach 6, which is well over 7000 kilometers per hour or around two kilometers per second.

For the test on Monday, the hypersonic combustion sustained and the cruise vehicle continued on its desired flight path at a velocity of Mach 6 for a period of 20 seconds. “The critical events



The scramjets are a variant of a category of jet engines called the air breathing engines. The ability of engines to handle airflows of speeds in multiples of speed of sound, gives it a capability of operating at those speeds.

like fuel injection and auto ignition of scramjet demonstrated technological maturity. The scramjet engine performed in a text book manner.” The DRDO said. While the technology helps achieve hypersonic speeds, it comes with its set of disadvantages, and the obvious one being its very high cost and high thrust-to-weight ratio.

### **Development of the technology**

The DRDO started on the development of the engine in early 2010s. The Indian Space Research Organisation (ISRO) has also worked on the development of the technology and has successfully tested a system in 2016. DRDO too has conducted a test of this system in June 2019.

The special project of the DRDO consisted of contributions from its multiple facilities including the Pune headquartered Armament and Combat Engineering Cluster. “At the hypersonic speeds, the system has to handle temperatures to the range of 2500 degrees celsius as well as the air speed, and thus development of the material is one of the main challenges.” said a DRDO scientist.

For this project, DRDO used many technologies already available with it. After the test on Monday, Defence Minister Rajnath Singh tweeted, “The DRDO has today successfully flight tested the Hypersonic Technology Demonstrator Vehicle using the indigenously developed scramjet propulsion system. With this success, all critical technologies are now established to progress to the next phase.”

<https://indianexpress.com/article/explained/explained-significance-and-capability-of-scramjet-vehicle-that-drdo-tested-6586748/>

## THE HINDU

*Tue, 08 Sept 2020*

# **DRDO successfully tests Hypersonic Technology Demonstrator Vehicle**

***DRDO says testing puts India in a select club of nations that have demonstrated this technology***  
***By Dinakar Peri***

New Delhi: The hypersonic air-breathing scramjet technology was successfully demonstrated by the Defence Research and Development Organisation (DRDO) on Monday with a flight test of the Hypersonic Technology Demonstrator Vehicle (HSTDV), which will lead to the development of hypersonic cruise missiles and vehicles in future.

“It’s a major technological breakthrough in the country. This testing paves the way for development of more critical technologies, materials and hypersonic vehicles. This puts India in a select club of nations that have demonstrated this technology,” DRDO Chairman G. Satheesh Reddy said.

A test of the technology demonstrator was conducted in June 2019.

“With this success, all critical technologies are now established to progress to the next phase,” Defence Minister Rajnath Singh said on Twitter.

The HSTDV took off at 11.03 a.m. on Monday from the Dr. APJ Abdul Kalam launch complex at Wheeler Island off the Odisha coast. “The hypersonic cruise vehicle was launched using a proven solid rocket motor, which took it to an altitude of 30 km, where the aerodynamic heat shields were separated at hypersonic speed,” the DRDO said in a statement.

The cruise vehicle separated from the launch vehicle and the air intake opened as planned. “The hypersonic combustion sustained and the cruise vehicle continued on its desired flight path at a velocity of six times the speed of sound, which is nearly 2 km/s for more than 20s,” the statement said.

### **‘Major breakthrough’**

With this technology, cruise missiles could now travel at hypersonic speeds, a defence source said. “Scramjet engine is a major breakthrough. Air goes inside the engine at supersonic speed and comes out at hypersonic speeds,” the source noted.

The vehicle reaches a certain altitude, then cruises and also reaches very high temperatures, up to 1,000-2,000 degrees Celsius, during re-entry. “After the Anti-Satellite Test, this is the biggest achievement recently,” the source pointed out.

Critical events such as fuel injection and auto ignition of the scramjet demonstrated technological maturity, the DRDO said. “The scramjet engine performed in a textbook manner. It worked at high dynamic pressure and at very high temperature.”

“The DRDO, with this mission, has demonstrated capabilities for highly complex technology that will serve as the building block for next generation hypersonic vehicles in partnership with the industry,” it stated.

### **Monitoring**

The parameters of the launch and cruise vehicles, including the scramjet engine, were monitored by multiple tracking radars, electro-optical systems and telemetry stations. A ship was also deployed in the Bay of Bengal to monitor the performance during the cruise phase of the hypersonic vehicle.

With this successful demonstration, many critical technologies such as aerodynamic configuration of hypersonic manoeuvres, use of scramjet propulsion for ignition and sustained combustion at hypersonic flow, thermo-structural characterisation of high-temperature materials and separation mechanism at hypersonic velocities have been validated, the DRDO said.

<https://www.thehindu.com/news/national/drdo-successfully-tests-hypersonic-technology-demonstrator-vehicle/article32541422.ece>

THE TIMES OF INDIA

Tue, 08 Sept 2020

## Army starts process to make ICVs capable of operating in night

New Delhi: The Indian Army has kick-started a process to make its infantry combat vehicles capable of operating in the night, a move that comes at a time it is engaged in a fierce border row with the Chinese military in eastern Ladakh, officials said on Monday.

The army has already invited expression of interest (EoI) from eligible domestic companies for the development of prototype and further procurement of armament for BMP-2/2K infantry combat vehicles.

The current fleet of BMP-2/2Ks was first inducted into the Army in 1985 and it has been the mainstay of the mechanised infantry since then.

The EoI said the armament system is "night blind" and needs to be upgraded with night-fighting capabilities.

"The terrain along our borders lends itself to conduct of large scale mechanised operations and the belligerence of our adversaries on the borders necessitate that our capabilities are adequately built up to match the threat," the Army said in the document.

It said the existing armament sighting system in use is based on image intensifier technology which has its limitations and is not fit for modern-day warfare.

"Present system is also deficient of modernised Fire Control System and Automatic Target Tracker which adversely affects the capability of BMP-2/2K to fight both during day and night," it said.

The Indian Army is engaged in a standoff in multiple locations in eastern Ladakh since early May.

Both sides held a series of diplomatic and military talks to resolve the row.

Tensions have further escalated since last week in the region after Indian troops foiled attempts by the Chinese PLA to occupy Indian territories in the Southern Bank of Pangong lake area on the intervening night of August 29 and 30.

Following the confrontation, India occupied a number of strategic heights in the Chushul sector overlooking crucial bases of the Chinese military. Since then, China has deployed additional troops, tanks and anti-tank guided missiles in the area.

India too has strengthened its combat capabilities following reinforcements by the People's Liberation Army (PLA).

In the aftermath of the row, the Indian Army has initiated a number of new programmes to bolster its combat capabilities.

<https://timesofindia.indiatimes.com/india/army-starts-process-to-make-icvs-capable-of-operating-in-night/articleshow/77984943.cms>

## How Indian Army foiled China's move to push 1,000 soldiers into Pangong Tso's south bank

*India's moves on night of 28 August were 'precautionary deployment', and its troops did not cross over to Chinese side of LAC*

*By Snehesh Alex Philip*

New Delhi: On the night of 28 August, China had attempted to move in over 1,000 soldiers to capture territory on the Indian side of the Line of Actual Control, near the southern bank of Pangong Tso, ThePrint has learnt.

However, the attempt was thwarted by a combination of an alert surveillance system and troops specialising in mountain warfare, who raced against time and managed to outflank the Chinese and dominate several heights, giving India strategic hold over Requin Pass and Spanggur Gap in the hills in the Chushul sector.

Sources in the defence and security establishment described the Indian move as a “precautionary deployment”, and underlined repeatedly that the forces had not crossed the LAC, even though inputs



Representational image of China's People's Liberation Army | Photo: Justin Chin | Bloomberg

said ‘Black Top’ across the LAC was also a scene of action.

ThePrint had reported earlier that Indian troops had to resort to “tactical warnings” to the incoming Chinese soldiers to dissuade them.

### How the events unfolded

Sources said at about 11 pm on 28 August, an Indian surveillance team first noticed the movement of some Chinese armoured personnel carriers (APCs) in Moldo.

This was followed by drone surveillance, and the People's Liberation Army troops' movement indicated they were going towards the LAC, and to a specific feature. Sources refused to identify the feature, citing operational reasons.

They said at this moment, specialised Indian units raced for the heights and dominated them — going even quicker than what had been worked out when multiple scenarios were being studied.

Then, it was noticed that the Chinese soldiers were carrying equipment meant to set up holding positions. This is when the Chinese were given the first tactical warning, and they stopped.

Realising that the Indians had understood their tactics, the Chinese called in additional vehicles as back up, so the Indian side issued additional warnings to dissuade them. “They realised the Indians meant business,” a source said.

“In total, 40 to 50 vehicles were there, including APCs. Each vehicle is believed to have 30-40 PLA personnel. So, the Chinese were easily over 1,000 strong,” the source said.

India then decided to dominate more hill tops in the area, and ended up doing just that over 50 km of unoccupied territory. Soldiers of the Mountain Strike Corps and a specialised elite unit raced for the passes, and dominated them with back up provided by certain other fighting arms.

Sources said specialised teams had already been deployed in the area in wake of the crisis that began in May, and were acclimatised and aware of the terrain and different routes to be taken. These troops specialise in carrying out covert operations behind enemy lines.



Around the same time, Nyima Tenzin, a Tibetan-Indian from the elite covert paramilitary unit Special Frontier Force (SFF), stepped on a 1962-vintage anti-personnel mine and was killed in action. His last rites were conducted Monday.

<https://theprint.in/defence/how-indian-army-foiled-chinas-move-to-push-1000-soldiers-into-pangong-tsos-south-bank/497804/>



Tue, 08 Sept 2020

## India-China Standoff: Gearing up for Ladkah's winter, Indian army gets ready to meet challenges of nature

*The Indian Army has time tested procedures and systems in place to ensure that front line troops are never left wanting for any item for whatever the reason*

*By Maj Gen Jagatbir Singh (Retd.)*

Operational Logistics is a science, it requires the highest calibre of a staff officer who has to painstakingly look into the finest of small print to ensure that the troops are equipped, housed, maintained, well-fed and properly clothed at all times. The permutations and combinations are mind-boggling and there is no room for the slightest amount of error.

In the present context of Eastern Ladakh, logistics, of course, involves not only transporting men and material but thereafter maintaining them in some of the most inhospitable places in the world. Deployment is difficult but sustenance is many times more challenging. At these temperatures and altitudes, there are not only issues of the enemy but also weather and health. Hence, adequate reserves to cater for unforeseen disruptions also need to be catered for at various locations.

The first step, of course, is the induction of men and material. Unfortunately, there are presently only two axes available, one from Jammu, Srinagar, through the Zoji La pass, Kargil and Leh and the other the Pathankot, Manali, road through Rohtang Pass on to Leh. The average turnaround is about ten days. From Leh of, course routes lead to Eastern Ladakh over the Changla Pass.

The other, method is by air and in this case, the aircraft takes off from Chandigarh and land at Leh. The capacity of loads varies depending on the type of aircraft used, whether, IL -76, C-130 or C - 17 and of course the weather.

Induction of troops have their own challenges as you need transit halts en route at various transit camps and acclimatization at various stages depending on where the troops are being deployed. Convoys need to be planned, these involve their security, road space management which is the speed of the convoy, timings, number of vehicles to the kilometre, repairs and recovery en route, and timings of halts and rests. Apart from this, you need to have transit halts en route. All this is being done round the clock in a meticulous manner once the roads open up. Of course with the induction of additional troops and equipment, it only increases in scope and implementation.

As the road space is only open from May to October after which the passes are blocked, movement takes place by a combination of Service and Civil Hired vehicles, with an average load of ten tons per vehicle for the latter. The focus is on carrying out Advance Winter Stocking which is what is presently in progress. All major movement of troops also takes place by road. Beyond



Fuel is a lifeline at these altitudes as this is also used for warming. (Representational image: PTI)

Leh, the movement takes place mainly through Service Transport in the form of the ALS or Stallion unless of course, a post is air maintained in which case supplies are dropped by aircraft or by helicopters. The average figures roughly translate into two lakh tons for Advanced Winter Stocking that is without the incremental build-up that we are witnessing hence the number of vehicles and aircraft involved are phenomenal.

To coordinate this move and implement it, the Q Staff at various Headquarters from Army, Command, Corps, Area, Division and Brigade are involved. They have the responsibility of ensuring that the troops occupying the further most locations are well equipped, adequately housed properly clothed and fed and kept warm in the harsh winter. Apart from this, they have to ensure that spares are available.

One of the first things required is habitat; it is no secret that with temperatures plummeting down to minus 40 degrees at night, troops cannot stay in the open. Apart from that is the challenge of lack of local resources for construction, hence, amongst the first things that need to be done on induction is to create adequate habitat be it pitching up special tents, creating defences and construction of shelters, cookhouses and toilets. Tracks need to be improved and routes identified and marked. Engineers are closely involved in carrying out these tasks especially at the level of Headquarters. There, of course, exists a certain amount of defences which already prepared and can house additional troops being inducted but incase unoccupied areas are being held these have to be created.

Apart from that is storage, the vast amount of spares, supplies, ammunition and fuel that has been dumped needs to be stored. You need to have adequate shelters for protecting this from the elements. All this is being coordinated and ensured with the aim being that the turnaround time for the item to reach the further most troops is reduced.

Management of each commodity has its own set of challenges be it ammunition, supplies, fuel or stores. For example, ammunition varies from small arms to tank and artillery ammunition, each having its own weight and rules for carriage and storage. The responsibility, of course, lies with the Army Ordnance Corps (AOC) and this, in turn, is divided into on weapon scale and first line and second line ammunition. Missiles are of course stored and transported as per their own laid down guidelines.

Fuel is a lifeline at these altitudes as this is also used for warming. The scales are laid down and though it is carried up in bulk petroleum vehicles it needs to be stored in barrels and jerricans. The responsibility of supplying petroleum and its products rests with the Army Service Corps (ASC), who are also responsible for supplies. Of course, the types of fuel, oils and lubricants also vary depending on the equipment being used. The spectrum is wide from aviation fuels to kerosene for heating.

Supplies or rations are the next major issue, scales of rations are laid down and there are special food items which are authorized for high altitude areas. Troops have to be given their meals. In some cases hot food is delivered in most cases it is cooked in situ and there are also those troops who survive on tinned food. This includes dry rations such as atta, rice, daal, and sugar to fresh items which include vegetables, meat and milk and then tinned food or tetra packs of milk. The ASC is responsible for these supplies and most of the procurement is done in the plains. Of course in the winter months supply of fresh vegetables gets disrupted for long periods of time.

Apart from the above, clothing is the next major issue. Troops need to be properly clothed to protect them from the elements. The procurement and issue of Extreme Cold Climate Clothing has to be done. This includes sleeping bags, coats, boots, and woollen trousers and of course goggles and gloves. Being exposed to the elements can lead to frostbite and chilblains, hence clothing has been catered for and issued to all troops. The responsibility of clothing lies with the AOC.

Repair and recovery of equipment also forms part of being able to withstand operations in this terrain. Spares need to be catered for and repairs are carried out as far forward as possible to ensure that all equipment is fully serviceable at all times. The responsibility mainly lies with the

Electronics & Mechanical Engineers (EME), who establish Repair Posts and Workshops and have the ability to replace tank engines and repair the most sophisticated computers.

In the end what is essential is medical facilities, be it in the form of Medical Aid Posts, Advanced Dressing Stations and of course Field Hospitals. There are medical personnel posted and attached with units and forward posts and there is a system of treatment and evacuation of casualties which is coordinated and controlled by both the Medical Staff and the A Branch at various intermediate headquarters that ensures that all medical requirements are catered for.

The essence of logistics is that whatever is required is made available at the time required, in the quantity required and at the place required. The Indian Army has time tested procedures and systems in place to ensure that front line troops are never left wanting for any item for whatever the reason.

*(The author has commanded the prestigious 1 Armoured Division and 18 Cavalry one of the oldest Regiment in the Indian Army. He has been an instructor at Defence Services Staff College several times and has held prestigious staff appointments. Views expressed are personal.)*

<https://www.financialexpress.com/defence/india-china-standoff-gearing-up-for-ladkajs-winter-indian-army-gets-ready-to-meet-challenges-of-nature/2076737/>

## THE ECONOMIC TIMES

Tue, 08 Sept 2020

# India has raised the costs for China to be adventurist. But is it enough?

By Pranab Dhal Samanta

### Synopsis

***Having already mobilised, one significant part of that political call has already been made. Both sides are prepared to brave the harsh winter.***

New Delhi: The military power play between India and China has reached a politically crucial point, with forces on both sides fully deployed in Ladakh, prepared for any eventuality. So, how far does China want to escalate matters, given that the stakes have gone up considerably since it first moved troops in April?

The prospect of two large armies, armed and fully mobilised, facing off each other in the height of winter on the upper reaches of the Himalayas is as bewildering as it's unnerving. Which is why any reassessment has to be over the next few weeks.

It was around this time of the year in 1962 that China took the call to end months of eyeball-to-eyeball deployment and press ahead with an assault in October, which was already early winter.

A 1964 CIA staff study, 'The Sino-Indian Border Dispute 1961-62' ([bit.ly/327BVyB](https://bit.ly/327BVyB)), stated that China chose the date only when it was certain that 'their opponents would fight alone'. Politically, the situation now is quite different. But militarily, the winter question is still relevant.

Having already mobilised, one significant part of that political call has already been made. Both sides are prepared to brave the harsh winter.



For Delhi, matters have moved beyond the border dispute and into the economic sphere, especially the digital arena, where India has found willing allies.

But what happened on the southern banks of Pangong Tso just a week back tells us that such deployment is fraught with the danger of escalation — and in quick time. It's clear now that disengagement without larger de-escalation serves little purpose.

But for some reason — which has evoked considerable suspicion on the Indian side — China is keen to continue with the military conversation on disengagement despite displaying less convergence and expressing more belligerence at these talks.

This was also a key agenda point by China at the two defence ministers' meeting over the last weekend in Moscow on the sidelines of the Shanghai Cooperation Organisation (SCO) meeting. India's position is clear — the ground situation must return to status quo ante as on April 15.

Which effectively means that China withdraws forces it has amassed in the area, and not just tinker with deployments to create distance among Indian and Chinese troops. That approach had a specific utility in averting clashes after the June 15 incident at Galwan, but it's not a sustainable solution.

### **Before the Trail Turns Cold**

The onset of winter provides that window of opportunity for China to reassess the political fallout of continuing with this aggressive deployment for the coming months. If a diplomatic conversation is to be had, then it would have to be now, so that the threat subsides, and doesn't perpetuate through the winter.

Much will depend on the impact all the rallying against China has had on Beijing, especially on its actions against India. The India-China stand-off has not got dovetailed with the US-China conflict.

Instead, it has acquired a narrative of its own in which most countries are willing to give the Indian script a shot. The launch of the India-Japan-Australia Supply Chain Resilience Initiative (SCRI) is a case in point.

For Delhi, matters have moved beyond the border dispute and into the economic sphere, especially the digital arena, where India has found willing allies, because China has used economic coercion on countries much worse than what India has so far done to China on account of its border aggression.

Beijing took some 40-plus retaliatory measures against South Korea, when along with US help, Seoul had decided to deploy the sophisticated THAAD anti-ballistic missile system as a defence against North Korean missiles in 2016-17.

China had even launched investigations in Shanghai and Chengdu against South Korean company Lotte, which had provided its golf course to be used as a THAAD-deploying site. So, when India bans apps, the playbook is very much Chinese. China resorted to economic coercion against Canada when it arrested a top Huawei executive there; against Australia over Manus Island, and a host of other countries.

Which is why other countries seem to want to mirror Indian measures, at least on the digital side. Did the Chinese Communist Party (CCP) anticipate any of this when it gave the People's Liberation Army (PLA) the green signal? Unlikely. India, until now, has not let developments on the border permeate into other aspects of the relationship.

So, what does China stand to achieve in political terms from this aggressive deployment? It is highly improbable that PLA may have acted on its own. It is deployed to strictly pursue political objectives. In Ladakh, however, this political objective is not fully clear.

Also, PLA is speaking an aggressive language — both on ground and in military conversations — compared to what China's diplomats are parroting to their Indian counterparts.

### **Multitasking at Hand**

What's clear in this complication is that the point of confluence is the party, not the State.

Which means India will have to devise a strategy to deal with all elements separately — one with PLA on the military side, another with the Chinese State machinery through the foreign

affairs department so as to nurse the relationship and keep communication channel open; and yet another to pressurise CCP by taking strategic measures, including economic ones.

Has enough already happened on all these fronts for China to yield? It's difficult to say. What's certain is that India has managed to raise the political and strategic cost for China to be adventurist. The test is whether it's sufficient for China to negotiate for peace.

<https://economictimes.indiatimes.com/news/defence/india-has-raised-the-costs-for-china-to-be-adventurist-but-is-it-enough/articleshow/77985185.cms?from=mdr>

## Science & Technology News

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Tue, 08 Sept 2020

# ISRO set to launch Chandrayaan-3 early next year; Spacecraft to carry Lander and Rover

### *At a Glance*

- *Chandrayaan 3 will not carry an orbiter—but will include a lander and a rover to study the lunar surface.*
- *Despite the apparent hard landing of the lander, the Chandrayaan-2 mission is believed to be 95-98% successful.*
- *The Chandrayaan 1 mission had provided conclusive evidence for the presence of ice water on the poles.*

India's Moon mission successor—Chandrayaan-3—may be launched somewhere in early 2021, as per the announcement from the Minister of State for the Department of Space, Jitendra Singh on Sunday.

The third lunar mission was earlier scheduled for 2020, but the ongoing pandemic and the lockdown imposed to contain the spread of coronavirus has stalled many of Indian Space Research Organisation's (ISRO) preparations for Chandrayaan 3. Earlier in June, the ISRO had pushed the uncrewed Gaganyaan mission also to a later date.



In its second attempt, the Indian space agency is aiming to achieve a soft landing on the south pole of the lunar surface, which is least explored to date. Unlike its predecessor, Chandrayaan 3 will not carry an orbiter—but will include a lander and a rover to study the lunar surface.

In one of the earlier announcements this year by ISRO, K Sivan had said, "The Chandrayaan-2 Orbiter will be used for communicating with the lander and rover of Chandrayaan-3 during their mission on the moon."

Moreover, reports suggest ISRO scientists will also be considering incorporating improvements that experts have suggested after analysing what went wrong in the previous mission. One such priority could be 'strengthening the legs of the lander' so as to improve its chances of survival in the event of another crash.

On September 7, 2019, the lander Vikram crashed on the surface while attempting a soft-land on the Earth's only natural satellite Moon. As per ISRO, the lander's trajectory began to deviate at



about 2.1 km above the lunar surface, and the mission control subsequently lost all communication with the lander. The agency failed to re-establish the contact despite persistent efforts for several weeks.

Despite the apparent hard landing of the lander, the Chandrayaan-2 mission is believed to be 95-98% successful as all the instruments onboard the orbiter are functioning well and sending back data to ISRO. The mission has helped scientists to study the lunar atmosphere, topography, composition and other details.

A decade ago, the Chandrayaan 1 mission had provided conclusive evidence for the presence of ice water on the poles, which is devoid of sunlight. Moreover, recently the data from the mission was also used to examine the presence of rust or hematite on the lunar surface.

On the other hand, ISRO continues to rigorously work on one of its most anticipated missions, Gaganyaan—the first-ever human space mission. The training of astronauts has been going on in Russia and a couple of uncrewed precursor missions are likely to take off next year.

<https://weather.com/en-IN/india/space/news/2020-09-07-isro-set-to-launch-chandrayaan-3-early-next-year>



Tue, 08 Sept 2020

## Spacesuits for Gaganyaan Astronauts under production in Russia

*Research, Development and Production Enterprise Zvezda, a subsidiary of Russian space organisation Roscosmos, has started manufacturing personal flight equipment for the Indian cosmonauts*

Bengaluru: Russian research and development enterprise "Zvezda" has started manufacturing of space suits for the Indian astronauts, who are likely to be part of India's first manned space mission "Gaganyaan", a Russian organisation said on Monday.

Research, Development and Production Enterprise Zvezda, a subsidiary of Russian space organisation Roscosmos, has started manufacturing personal flight equipment for the Indian cosmonauts undergoing training in Russia, Glavkosmos said on Monday.



Glavkosmos is a subsidiary of Roscosmos with which the Human Spaceflight Center (HSC) of the city-based Indian Space Research Organisation (ISRO) has signed a contract to train the Indian astronauts.

"On September 3, Indian cosmonauts who have been training for a spaceflight in Russia under the contract of Glavkosmos, visited Zvezda, where their anthropometric parameters were measured for the subsequent production of spacesuits," Glavkosmos CEO Dmitry Loskutov said.

The contract also provides for the production of individual seats and custom-made couch liners, he added.

The contract for the production and delivery of individual equipment kits for Indian astronauts was signed by Glavkosmos and the HSC on March 11.

Four Indian Air Force fighter pilots are currently under training in Russia since February 10, and likely to be the potential candidates for Gaganyaan project.

Gaganyaan, India's first manned mission to space, was planned around 2022. However, the ISRO has indicated that it may be delayed due to COVID-19 pandemic and the lockdown induced by it.

<https://www.ndtv.com/india-news/spacesuits-for-gaganyaan-astronauts-under-production-in-russia-2291917>

## गगनयान अंतरिक्ष यात्रियों के लिए अंतरिक्ष सूट का रूस में हो रहा निर्माण

नई दिल्ली: रूसी अनुसंधान और विकास उद्यम 'वेजदा' ने भारतीय अंतरिक्ष यात्रियों के लिए अंतरिक्ष सूट का निर्माण शुरू कर दिया है जोकि अंतरिक्ष में मानव को भेजने के भारत के प्रथम अभियान 'गगनयान' का हिस्सा हो सकते हैं। रूस की एक संस्था ने सोमवार को यह जानकारी दी।

ग्लेवकोसमोस ने कहा कि रूस में प्रशिक्षण प्राप्त कर रहे भारतीय अंतरिक्ष यात्रियों के लिए व्यक्तिगत उड़ान उपकरण का निर्माण शुरू कर दिया गया है।

ग्लेवकोसमोस के मुख्य कार्यकारी अधिकारी (सीईओ) दिमित्री लॉस्कृतोव ने कहा कि रूस में प्रशिक्षण प्राप्त कर रहे अंतरिक्ष यात्री तीन सितंबर को वेजदा आए और अंतरिक्ष सूट के लिए उनकी नाप ली गई।



गगनयान मिशन

<https://www.amarujala.com/india-news/space-suits-for-gaganyaan-astronauts-under-production-in-russia>

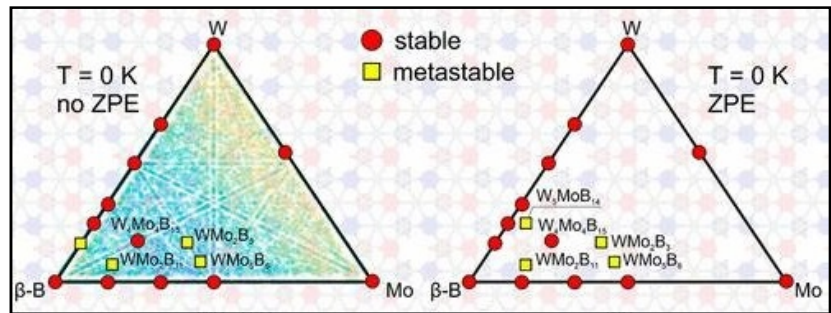


Tue, 08 Sept 2020

## Scientists predict new, hard, and superhard ternary compounds

Scientists from the Skolkovo Institute of Science and Technology (Skoltech), Institute of Solid State Chemistry and Mechanochemistry (ISSC SB RAS), Pirogov Medical University and Yerevan State University have predicted new hard and superhard ternary compounds in the tungsten-molybdenum-boron system using computational methods. Their research was published in the journal *Chemistry of Materials*.

According to Alexander Kvashnin, a senior research scientist at Skoltech and a co-author of the paper, the study is a natural follow-on to previous extensive research into binary systems. In pursuit of new materials, the scientists had to create a more complex system by adding a third element, which resulted in strongly altered properties and new compounds. These changes were the focus of interest for the scientists.



Ternary phase diagram of the W-Mo-B system at 0 K. Credit: A. Kvashnin et al./Chemistry of Materials

The team predicted the structure of potentially superhard ternary compounds in the W-Mo-B system using the USPEX evolutionary algorithm developed by Artem Oganov, a Skoltech professor and a co-author of the paper, and his students.

"We planned to predict a series of ternary compounds that would display better mechanical properties, such as hardness and fracture resistance, as compared to binary compounds. We did

predict several ternary compounds which turned out to be high-entropy alloys. The mixing of tungsten and molybdenum atoms produced compounds that were disordered and, therefore, had varying stability depending on temperature," explains Alexander Kvashnin.

Carbides—four- or five-component compounds—are typically classified as high-entropy compounds. Scientists believe that their study is the first step toward finding such compounds among boride systems.

"Obvious prospects of this research may translate into new hard materials outperforming their existing counterparts and withstanding higher temperatures or pressures. Companies such as Gazpromneft may use those materials for drilling or other purposes," says Christian Tantardini, one of the authors of the paper and an employee of ISSC and Skoltech.

The scientists intend to pursue their research effort. They are eager to find out what happens to even more complex compounds in response to temperature and pressure changes.

**More information:** Alexander G. Kvashnin et al, Computational Search for New W–Mo–B Compounds, *Chemistry of Materials* (2020). DOI: [10.1021/acs.chemmater.0c02440](https://doi.org/10.1021/acs.chemmater.0c02440)

**Journal information:** [Chemistry of Materials](https://pubs.acs.org/doi/10.1021/acs.chemmater.0c02440)  
<https://phys.org/news/2020-09-scientists-hard-superhard-ternary-compounds.html>



Tue, 08 Sept 2020

## Superconductors are super resilient to magnetic fields

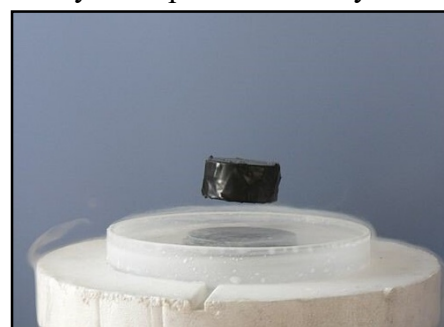
A researcher at the University of Tsukuba has offered a new explanation for how superconductors exposed to a magnetic field can recover, without loss of energy, to their previous state after the field is removed. This work may lead to a new theory of superconductivity and a more eco-friendly electrical distribution system.

Superconductors are a class of materials with the amazing property of being able to conduct electricity with zero resistance. In fact, an electrical current can circle around a loop of superconducting wire indefinitely. The catch is that these materials must be kept very cold, and even so, a strong magnetic field can cause a superconductor to revert back to normal.

It was once assumed that the superconducting-to-normal transition caused by a magnetic field could not be reversed easily, since the energy would be dissipated by the usual process of Joule heating. This mechanism, by which the resistance in normal wires converts electrical energy into heat, is what allows us to use an electric stovetop or space heater.

"Joule heating is usually considered negatively, because it wastes energy and can even cause overloaded wires to melt," explains Professor Hiroyasu Koizumi of the Division of Quantum Condensed Matter Physics, the Center for Computational Sciences at the University of Tsukuba. "However, it has been known for a long time from experiments that, if you remove the magnetic field, a current-carrying superconductor can, in fact, be returned to its previous state without loss of energy,"

Now, Professor Koizumi has proposed a new explanation for this phenomenon. In the superconducting state, electrons pair up and move in sync, but the true cause of this synchronized motion is the presence of so-called "Berry connection," characterized by the topological quantum



Credit: University of Tsukuba

number. It is an integer and if it is nonzero, current flows. Thus, this supercurrent can be switched off abruptly by changing this number to zero without Joule heating.

The founder of modern electromagnetic theory, James Clerk Maxwell, once postulated a similar molecular vortex model that imagined space being filled with the rotation of currents in tiny circles. Since everything was spinning the same way, it reminded Maxwell of "idle wheels," which were gears used in machines for this purpose.

"The surprising thing is that a model from the early days of electromagnetism, like Maxwell's idle wheels, can help us resolve questions arising today," Professor Koizumi says. "This research may help lead to a future in which energy can be delivered from power plants to homes with perfect efficiency."

**More information:** Hiroyasu Koizumi. Reversible superconducting-normal phase transition in a magnetic field and the existence of topologically protected loop currents that appear and disappear without Joule heating, *EPL (Europhysics Letters)* (2020). DOI: [10.1209/0295-5075/131/37001](https://doi.org/10.1209/0295-5075/131/37001)  
<https://phys.org/news/2020-09-superconductors-super-resilient-magnetic-fields.html>



Tue, 08 Sept 2020

## A tiny instrument to measure the faintest magnetic fields

Physicists at the University of Basel have developed a minuscule instrument able to detect extremely faint magnetic fields. At the heart of the superconducting quantum interference device are two atomically thin layers of graphene, which the researchers combined with boron nitride. Instruments like this one have applications in areas such as medicine, besides being used to research new materials.

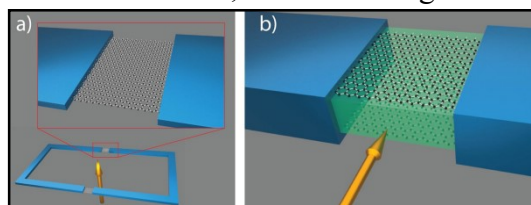
To measure very small magnetic fields, researchers often use superconducting quantum interference devices, or SQUIDs. In medicine, their uses include monitoring brain or heart activity, for example, while in the earth sciences researchers use SQUIDs to characterize the composition of rocks or detect groundwater flows. The devices also have a broad range of uses in other applied fields and basic research.

The team led by Professor Christian Schönberger of the University of Basel's Department of Physics and the Swiss Nanoscience Institute has now succeeded in creating one of the smallest SQUIDs ever built. The researchers described their achievement in the scientific journal *Nano Letters*.

### A superconducting ring with weak links

A typical SQUID consists of a superconducting ring interrupted at two points by an extremely thin film with normal conducting or insulating properties. These points, known as weak links, must be so thin that the electron pairs responsible for superconductivity are able to tunnel through them. Researchers recently also began using nanomaterials such as nanotubes, nanowires or graphene to fashion the weak links connecting the two superconductors.

As a result of their configuration, SQUIDs have a critical current threshold above which the resistance-free superconductor becomes a conductor with ordinary resistance. This critical threshold is determined by the magnetic flux passing through the ring. By measuring this critical current precisely, the researchers can draw conclusions about the strength of the magnetic field.



(a) A conventional superconducting quantum interference device (SQUID) consists of a superconducting ring interrupted at two points by weak links (in this case a graphene layer). (b) The new SQUID is made up of a stack of two-dimensional materials, including two graphene layers separated by a thin film of boron nitride. (University of Basel, Department of Physics)



## SQUIDs with six layers

"Our novel SQUID consists of a complex, six-layer stack of individual two-dimensional materials," explains lead author David Indolese. Inside it are two graphene monolayers separated by a very thin layer of insulating boron nitride. "If two superconducting contacts are connected to this sandwich, it behaves like a SQUID—meaning it can be used to detect extremely weak magnetic fields."

a) A conventional superconducting quantum interference device (SQUID) consists of a superconducting ring interrupted at two points by weak links (in this case a graphene layer). b) The new SQUID is made up of a stack of two-dimensional materials, including two graphene layers separated by a thin film of boron nitride. (University of Basel, Department of Physics)

In this setup, the graphene layers are the weak links, although in contrast to a regular SQUID they are not positioned next to each other, but one on top of the other, aligned horizontally. "As a result, our SQUID has a very small surface area, limited only by the constraints of nanofabrication technology," explains Dr. Paritosh Karnatak from Schönenberger's team.

The tiny device for measuring magnetic fields is only around 10 nanometers high—roughly a thousandth of the thickness of a human hair. The instrument can trigger supercurrents that flow in minuscule spaces. Moreover, its sensitivity can be adjusted by changing the distance between the graphene layers. With the help of electrical fields, the researchers are also able to increase the signal strength, further enhancing the measurement accuracy.

### Analyzing topological insulators

The Basel research team's primary goal in developing the novel SQUIDs was to analyze the edge currents of topological insulators. Topological insulators are currently a focus of countless research groups all over the world. On the inside, they behave like insulators, while on the outside—or along the edges—they conduct current almost losslessly, making them possible candidates for a broad range of applications in the field of electronics.

"With the new SQUID, we can determine whether these lossless supercurrents are due to a material's topological properties, and thereby tell them apart from non-topological materials. This is very important for the study of topological insulators," remarked Schönenberger of the project. In future, SQUIDs could also be used as low-noise amplifiers for high-frequency electrical signals, or for instance to detect local brainwaves (magnetoencephalography), as their compact design means a large number of the devices can be connected in series.

**More information:** David I. Indolese et al. Compact SQUID Realized in a Double-Layer Graphene Heterostructure, *Nano Letters* (2020). DOI: [10.1021/acs.nanolett.0c02412](https://doi.org/10.1021/acs.nanolett.0c02412)

**Journal information:** [Nano Letters](https://doi.org/10.1021/acs.nanolett.0c02412)

<https://phys.org/news/2020-09-tiny-instrument-faintest-magnetic-fields.html>



# Study identifies limits on the efficiency of techniques for reducing noise in quantum resources

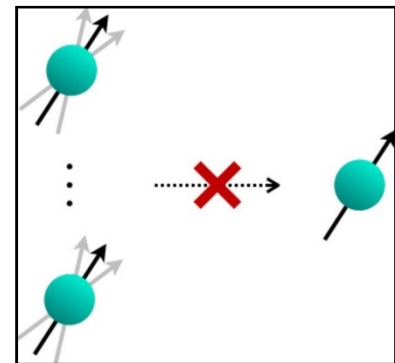
By Ingrid Fadelli

Quantum technologies, such as quantum computers, quantum sensing devices and quantum memory, have often been found to outperform traditional electronics in speed and performance, and could thus soon help humans to tackle a variety of problems more efficiently. Despite their huge potential, most quantum systems are inherently susceptible to errors and noise, which poses a serious challenge to implementing and using them in real-world settings.

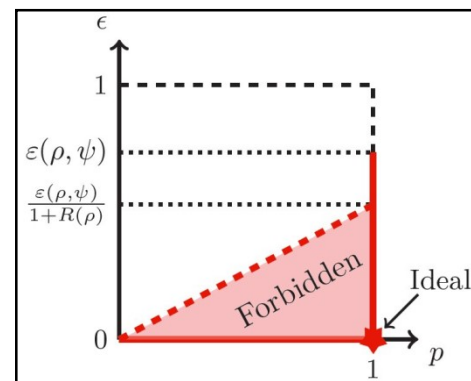
To enable the large-scale implementation of quantum technologies, researchers have been trying to develop techniques that could make them more resilient to noise and less prone to errors. While some of these methods, such as quantum error correction and fault tolerance, have proved to be useful and are now cornerstones of quantum information science, the factors that limit the performance of quantum systems in real-world applications are still poorly understood.

Researchers at University of Cambridge in the U.K. and Perimeter Institute for Theoretical Physics in Canada have recently tried to gain a theoretical understanding of the limitations of techniques for "purifying" noisy quantum resources. In a paper published in *Physical Review Letters*, they mathematically proved the existence of a series of universal limits on the accuracy and efficiency of methods to purify different types of quantum resources associated with practical applications, which play a key role in the functioning of quantum technologies.

"The ideas and techniques discussed in our paper originate from the general 'one-shot quantum resource theory,' which we outlined in one of our earlier PRL papers,"



A drawing representing distillation--a fundamental subroutine for quantum technologies. Credit: Fang & Liu.



Credit: Fang & Liu.

Zi-Wen Liu, one of the researchers who carried out the study, told Phys.org. "The key idea is to analyze an information-theoretic quantity called the quantum hypothesis testing relative entropy, which is shown to induce universal limitations on noisy-state to pure-state transformations."

Using mathematical theorems, Liu and his colleagues proved a series of fundamental limitations on the extent to which generic noisy resources can be purified, which stem from the laws of quantum mechanics. The calculations they carried out apply to virtually all types of quantum resources.

"More explicitly, we derive nontrivial lower bounds on the error of converting any full-rank noisy state to any target pure-resource state by any free protocol (including probabilistic ones)—and find that it is impossible to achieve perfect resource purification, even probabilistically," Liu explained. "In particular, there is a nontrivial tradeoff bound between the success probability and the accuracy of the protocol, which is akin to an 'uncertainty relation.'"

The mathematical theorems introduced by this team of researchers imply the existence of strong limits to the efficiency of distillation, a technique to purify quantum resources that underpins a wide variety of blueprinted quantum technologies. More specifically, these theorems introduce the first explicit lower bounds on the costs of magic state distillation, which is considered to be a leading scheme for realizing scalable and fault-tolerant quantum computation.

"Remarkably, our theorems allowed us to establish the first rigorous understanding of the necessary resource costs of large-scale quantum computing and other quantum technologies," Liu said. "We expect that our results will serve as important guidelines and find wide-ranging applications in practical scenarios. Moreover, we are writing a follow-up work on extending the no-purification theorems to quantum channels, which are directly applicable to important dynamical scenarios like quantum channel simulation and circuit synthesis, to make the theory more complete."

In addition to shedding light on the costs and limitations of quantum technologies, the findings improve the understanding of the fundamental principles of quantum mechanics. Like the celebrated no-go theorems, the no-cloning theorem and the uncertainty principle, the new "no-purification" theorems they have introduced are expected to play critical roles in the scientific and practical development of quantum physics. In the future, they could spark further research into how well these limits can be achieved, ultimately paving the way to more efficient quantum technologies for practical real-world applications.

**More information:** Kun Fang et al. No-Go Theorems for Quantum Resource Purification, *Physical Review Letters* (2020). DOI: [10.1103/PhysRevLett.125.060405](https://doi.org/10.1103/PhysRevLett.125.060405)

Zi-Wen Liu et al. One-Shot Operational Quantum Resource Theory, *Physical Review Letters* (2019). DOI: [10.1103/PhysRevLett.123.020401](https://doi.org/10.1103/PhysRevLett.123.020401)

**Journal information:** *Physical Review Letters*  
<https://phys.org/news/2020-09-limits-efficiency-techniques-noise-quantum.html>



Tue, 08 Sept 2020

## Scientists synthesize lead-free zirconium-based vacancy-ordered double perovskite nanocrystals

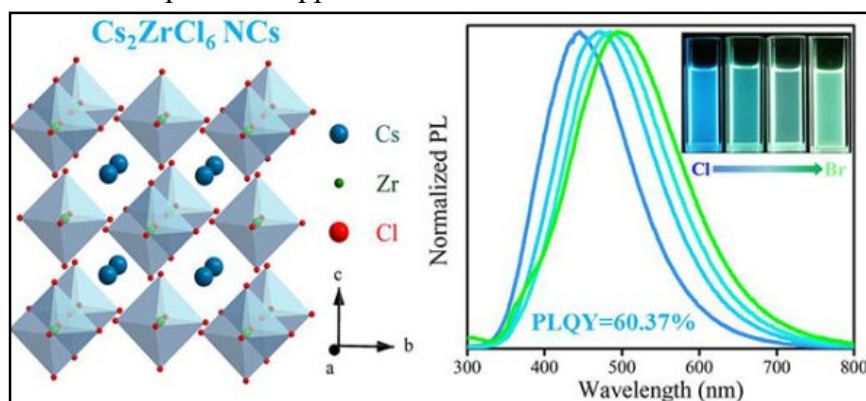
By Li Yuan

In recent years, all-inorganic  $\text{CsPbX}_3$  ( $X = \text{Cl}, \text{Br}, \text{I}$ ) perovskite nanocrystals have attracted extensive research attention due to their excellent photoelectric properties. However, the problems of Pb toxicity and poor stability hinder their practical application.

A research group led by Prof. Han Keli from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) synthesized vacancy ordered  $\text{Cs}_2\text{ZrCl}_{6-x}$  ( $0 \leq x \leq 1.5$ ) double perovskite nanocrystals (NCs) for the first time via hot injection

method.

This study was published in *Angewandte Chemie International Edition* on August 22.



Lead-free perovskite  $\text{Cs}_2\text{ZrCl}_6$  NCs with a PLQY up to 60.37% is synthesized. Credit: LIU Siping and YANG Bin

The Cs<sub>2</sub>ZrCl<sub>6</sub> NCs exhibited long-lived triplet excited state, featuring highly efficient photoluminescence (PL) quantum efficiency due to thermally activated delayed fluorescence.

The scientists also revealed the mechanism of TADF by detailed experimental characterizations including temperature-dependent photoluminescence spectra, temperature-dependent time-resolved photoluminescence spectra, nanosecond transient emission spectra, and pump-probe femtosecond time-resolved spectra.

TADF is promising luminescence mechanism for obtaining high exciton utilization. It is common in solid organic molecules or metal-organic complexes, but rarely reported in all-inorganic colloidal nanocrystals.

The study provides a unique strategy for the development of new inorganic phosphors.

**More information:** Siping Liu et al. Efficient Thermally Activated Delayed Fluorescence from All-Inorganic Cesium Zirconium Halide Perovskite Nanocrystals, *Angewandte Chemie International Edition* (2020). DOI: [10.1002/anie.202009101](https://doi.org/10.1002/anie.202009101)

**Journal information:** [Angewandte Chemie International Edition](https://www.angewandte-chemie.com)  
<https://phys.org/news/2020-09-scientists-lead-free-zirconium-based-vacancy-ordered-perovskite.html>



Tue, 08 Sept 2020

## MRI scans show brain reorganization during long space flights, but no neurodegeneration

By Bob Yirka

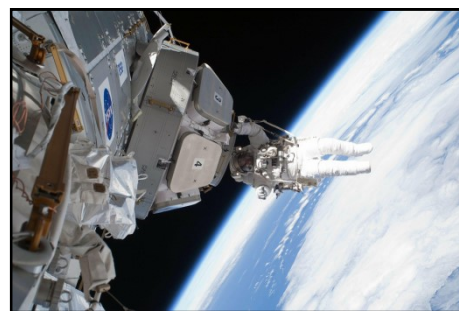
An international team of researchers has found that long space flights can lead to some minor brain reorganization but no neurodegeneration. In their paper published in the journal *Science Advances*, the group describes their study of the brains of cosmonauts returning from long-term missions aboard the International Space Station, and what they found.

Prior research has shown that long-term space missions can lead to bone and muscle degeneration due to the impact of extended freefall on the body. Some studies have also shown that it can lead to minor loss of visual acuity due to fluid buildup in the eyes. In this new effort, the researchers wanted to know what effects such missions might have on the brains of those who remain in space for long periods of time.

To find out, the researchers conducted a special type of MRI scan on 11 male Russian cosmonauts who had together averaged six months in space aboard the ISS—before and after they returned from their missions—and then again seven months later.

The researchers scanned the cosmonauts' brains with diffusion MRI, a process that involves taking multiple scans at once. In this case, they took 153 scans during a single session. Each of the scans has slightly different parameters, which allows for creating images in multiple ways. As an example, one of the scans had a parameter called the b value, where a certain signal is lowered during scanning to record decay of the material being scanned—in this case, brain matter.

The researchers found that the brain reorients itself during long space missions, essentially floating into different parts of the skull. This resulted in slight reorganization of the brain itself in response to the reorientation. The cosmonauts brains also responded in other ways to the unusual living environment—they acquired new motor skills and had better balance and coordination. The researchers also found that the reorientation did not result in neurodegeneration and that normal



Credit: Pixabay/CC0 Public Domain

orientation was nearly restored seven months after the cosmonauts returned to Earth. They also confirmed fluid build-up behind the eyes as the reason for the loss of visual acuity during long space flights.

**More information:** Steven Jillings et al. Macro- and microstructural changes in cosmonauts' brains after long-duration spaceflight, *Science Advances* (2020). DOI: [10.1126/sciadv.aaz9488](https://doi.org/10.1126/sciadv.aaz9488)

**Journal information:** [Science Advances](https://www.science.org)

<https://phys.org/news/2020-09-mri-scans-brain-space-flights.html>

## COVID-19 Research News

hindustantimes

Tue, 08 Sept 2020

### Study reveals long-term lung and heart damage in COVID-19 patients can improve with time

*Patients with severe COVID-19 infection can spend weeks in intensive care on ventilators which can lead them to suffer long-term lung and heart damage but recent study reveals that it can improve with time*

Washington: COVID-19 patients can suffer long-term lung and heart damage but, for many, this tends to improve over time, according to the first, prospective follow-up of patients infected with the coronavirus, presented at the European Respiratory Society International Congress.

Researchers in the COVID-19 'hot spot' in the Tyrolean region of Austria recruited consecutive coronavirus patients to their study, who were hospitalised at the University Clinic of Internal Medicine in Innsbruck, the St Vinzenz Hospital in Zams or the cardio-pulmonary rehabilitation centre in Munster, Austria. In their presentation to the virtual congress, they reported on the first 86 patients enrolled between 29 April and 9 June, although now they have over 150 patients participating.

The patients were scheduled to return for evaluation six, 12 and 24 weeks after their discharge from hospital. During these visits, clinical examinations, laboratory tests, analysis of the amounts of oxygen and carbon dioxide in arterial blood, lung function tests, computed tomography (CT) scans and echocardiograms were carried out.

At the time of their first visit, more than half of the patients had at least one persistent symptom, predominantly breathlessness and coughing, and CT scans still showed lung damage in 88% of patients. However, by the time of their next visit 12 weeks after discharge, the symptoms had improved and lung damage was reduced to 56%. At this stage, it is too early to have resulted from the evaluations at 24 weeks.

"The bad news is that people show lung impairment from COVID-19 weeks after discharge; the good news is that the impairment tends to ameliorate over time, which suggests the lungs have a mechanism for repairing themselves," said Dr Sabina Sahanic, who is a clinical PhD student at the University Clinic in Innsbruck and part of the team that carried out the study, which includes Associate Professor Ivan Tancevski, Professor Judith Loffler-Ragg and Dr Thomas Sonnweber in Innsbruck.

The average age of the 86 patients included in this presentation was 61 and 65% of them were male. Nearly half of them were current or former smokers and 65% of hospitalised COVID-19 patients were overweight or obese. Eighteen (21%) had been in an intensive care unit (ICU), 16 (19%) had had invasive mechanical ventilation, and the average length of stay in hospital was 13 days.

A total of 56 patients (65%) showed persistent symptoms at the time of their six-week visit; breathlessness (dyspnoea) was the most common symptom (40 patients, 47%), followed by coughing (13 patients, 15%). By the 12-week visit, breathlessness had improved and was present in 31 patients (39%); however, 13 patients (15%) were still coughing.

Tests of lung function included FEV1 (the amount of air that can be expelled forcibly in one second), FVC (the total volume of air expelled forcibly), and DLCO (a test to measure how well oxygen passes from the lungs into the blood). These measurements also improved between the visits at six and 12 weeks. At six weeks, 20 patients (23%) showed FEV1 as less than 80% of normal, improving to 18 patients (21%) at 12 weeks, 24 patients (28%) showed FVC as less than 80% of normal, improving to 16 patients (19%) at 12 weeks, and 28 patients (33%) showed DLCO as less than 80% of normal, improving to 19 patients (22%) at 12 weeks.

The CT scans showed that the score that defines the severity of overall lung damage decreased from eight points at six weeks to four points at twelve weeks. Damage from inflammation and fluid in the lungs caused by the coronavirus, which shows up on CT scans as white patches known as 'ground-glass', also improved; it was present in 74 patients (88%) at six weeks and 48 patients (56%) at 12 weeks.

At the six-week visit, the echocardiograms showed that 48 patients (58.5%) had dysfunction of the left ventricle of the heart at the point when it is relaxing and dilating (diastole). Biological indicators of heart damage, blood clots and inflammation were all significantly elevated.

Dr Sahanic said: "We do not believe left ventricular diastolic dysfunction is specific to COVID-19, but more a sign of the severity of the disease in general. Fortunately, in the Innsbruck cohort, we did not observe any severe coronavirus-associated heart dysfunction in the post-acute phase. The diastolic dysfunction that we observed also tended to improve with time."

She concluded: "The findings from this study show the importance of implementing structured follow-up care for patients with severe COVID-19 infection. Importantly, CT unveiled lung damage in this patient group that was not identified by lung function tests. Knowing how patients have been affected long-term by the coronavirus might enable symptoms and lung damage to be treated much earlier and might have a significant impact on further medical recommendations and advice."

In a second poster presentation to the Congress, Ms Yara Al Chikhanie, a PhD student at the Dieulefit Sante clinic for pulmonary rehabilitation and the Hp2 Lab at the Grenoble Alps University, France, said that the sooner COVID-19 patients started a pulmonary rehabilitation programme after coming off ventilators, the better and faster their recovery.

Patients with severe COVID-19 can spend weeks in intensive care on ventilators. The lack of physical movement, on top of the severe infection and inflammation, leads to severe muscle loss. The muscles for breathing are also affected, which weakens the breathing capacity. Pulmonary rehabilitation, which involves physical exercises and advice on managing symptoms, including shortness of breath and post-traumatic stress disorder, is crucial for helping patients to recover fully.

Ms Al Chikhanie used a walking test to evaluate the weekly progress of 19 patients [4] who had spent an average of three weeks in intensive care and two weeks in a pulmonary ward before being transferred to the Dieulefit Sante clinic for pulmonary rehabilitation. Most were still unable to walk when they arrived, and they spent an average of three weeks in rehabilitation. The walking test measured how far the patients could walk in six minutes. In the beginning, they were able to walk an average of 16% of the distance that, in theory, they should be able to walk normally if healthy. After three weeks of pulmonary rehabilitation, this increased to an average of 43%, which was a significant gain but still a serious impairment.

Ms Al Chikhanie said: "The most important finding was that patients who were admitted to pulmonary rehabilitation shortly after leaving intensive care, progressed faster than those who spent a longer period in the pulmonary ward where they remained inactive. The sooner rehabilitation started and the longer it lasted, the faster and better was the improvement in patients'



walking and breathing capacities and muscle gain. Patients who started rehabilitation in the week after coming off their ventilators progressed faster than those who were admitted after two weeks. But how soon they can start rehabilitation depends on the patients being judged medically stable by their doctors. Despite the significant improvement, the average period of three weeks in rehabilitation wasn't enough for them to recover completely.

“These findings suggest that doctors should start rehabilitation as soon as possible, that patients should try to spend as little time as possible being inactive and that they should enrol with motivation in the pulmonary rehabilitation programme. If their doctors judge it to be safe, patients should start physical therapy exercises while still in the hospital's pulmonary ward.”

Thierry Troosters, who was not involved in the study, is President of the European Respiratory Society and Professor in Rehabilitation Sciences at KU Leuven, Belgium. He said: “Anecdotal evidence has been emerging since the start of the COVID-19 pandemic that many patients suffer debilitating long-term after-effects from the coronavirus. Dr Sahanic's presentation is important because it is one of the first, comprehensive prospective follow-ups of these patients and shows the serious, long-term impact of COVID-19 on the lungs and heart. It is sobering to hear that more than half of the patients in this study showed damage to their lungs and hearts 12 weeks after hospital discharge, and that nearly 40% were still suffering from symptoms such as breathlessness. The good news, however, is that patients do improve and this surely will help the rehabilitation process, as discussed in the second presentation.

“Ms Al Chikhanie's research complements this information and shows how essential it is for patients to start pulmonary rehabilitation as soon as they are physically able to do so. This is why rehabilitation can also be started in the ward if programmes are adapted to the capabilities of the patient. This is perfectly in line with a recent statement of our Society where we also advocate for tailored rehabilitation. It is clear from both these studies that rehabilitation, including physical and psychologic components, should be available for patients as soon as possible and it should continue for weeks if not months after they have been discharged from hospital in order to give patients the best chances of a good recovery. Governments, national health services and employers should be made aware of these findings and plan accordingly.” *(This story has been published from a wire agency feed without modifications to the text. Only the headline has been changed.)*

<https://www.hindustantimes.com/fitness/study-reveals-long-term-lung-and-heart-damage-in-covid-19-patients-can-improve-with-time/story-oQN1mpg3qjTM5psXSr0ZSL.html>

## **New research: Post-Covid review in children finds severe heart damage**

*The heart damage is so severe that some children will need lifelong monitoring and interventions, according to senior author Dr Alvaro Moreira of The University of Texas Health Science Center at San Antonio*

New Delhi: Multisystem inflammatory syndrome in children (MIS-C), believed to be linked to Covid-19, damages the heart, says a medical literature review published in *EClinicalMedicine*, a journal of *The Lancet*.

The heart damage is so severe that some children will need lifelong monitoring and interventions, according to senior author Dr Alvaro Moreira of The University of Texas Health Science Center at San Antonio.

“According to the literature, children did not need to exhibit the classic upper respiratory symptoms of Covid-19 to develop MIS-C, which is frightening. Children might have no symptoms, no one knew they had the disease, and a few weeks later, they may develop this exaggerated inflammation in the body,” Moreira said in a statement.

The team reviewed 662 MIS-C cases reported worldwide between January 1 and July 25. Eleven of the children died. Ninety per cent had an ECG test and 54% of the results were abnormal. The heart damage included:

- Dilation of coronary blood vessels, a phenomenon also seen in Kawasaki disease.
- Depressed ejection fraction, indicating a reduced ability for the heart to pump oxygenated blood to tissues.

<https://indianexpress.com/article/explained/explained-post-covid-review-in-children-finds-severe-heart-damage-6585794/>

