Hypersonic plane design tested in wind tunnel, discussed in journal

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Earlier this month a tantalizing thought from Boeing was presented, as "an aircraft that can fly more than five times the speed of sound, jetting across world in one to three hours. If Boeing has any say, it'll be a reality

in 10-20 years."

Reports said Boeing was looking at a future Mach 5-plus strike-and-reconnaissance aircraft.
Jeffrey Lin and P.W. Singer report now in *Popular Science* that there is hypersonic news from China. "A team of researchers at the Chinese Academy of Sciences have tested a hypersonic plane in a wind tunnel to speeds of Mach 7, or 5,600 miles per hour."

The researchers have written a paper about their work, which appears in the Chinese journal *Physics, Mechanics and Astronomy*.

The researchers have dubbed the hypersonic vehicle the "I-plane."

"Beijing to New York in 2 hours? Chinese team reveal hypersonic plane ambition," ran the headline in the *South China Morning Post*. Stephen Chen reported on the "ultra-fast plane." He said it would travel at hypersonic speed "meaning at more than 6,000km/h (3,700mph), faster than five times the speed of sound – according to the team."

The paper is titled "Hypersonic Ishaped aerodynamic configurations" and author affiliations are Key Laboratory of HighTemperature Gas Dynamics of Institute of Mechanics, Chinese Academy of Sciences, Beijing; School of Engineering Science, University of Chinese Academy of Sciences, Beijing.

Cui Kai, who's part of the Key Laboratory of High Temperature Gas Dynamics at the Chinese Academy of Sciences, heads the project.

The authors are proposing "a new family of hypersonic I-shaped aerodynamic configurations," and they said these are "derived from the high-pressure capturing wing concept."

Reporting on the design, Cheng said the I-plane name was related to "the shadow cast by the aircraft on the ground – in the shape of a capital "I" – when it is bearing down like a dive-bomber."

The I-plane design calls for two layers of wings; Cheng noted it resembled the biplanes used during the first world war.

At hypersonic speed, a machine would make New York from Beijing in just a couple of hours.

Chen talked about a potential of seven times the speed of sound.

Cui and his team at the Chinese Academy of Sciences in Beijing tested a scaled-down model of the plane in a wind tunnel, said Chen. "They pushed the model plane to seven times the speed of sound – which works out to more than 8,600km/h – and found it performed surprisingly well, with low drag and high lift."

What's special this time:

"China's latest hypersonic vehicle features lower wings that reach out from the middle of the fuselage like a pair of embracing arms. A third flat, bat-shaped wing meanwhile extends over the back of the aircraft," Chen wrote.

The advantage is that "this biplane design means the aircraft will be able to handle significantly heavier payload than existing hypersonic vehicles that have a streamlined shape and delta wings."

Rafi Letzter in *Live Science* also discussed their design in terms of what kinds of problems are addressed by the design, namely, drag and lift. "This design solves the basic problem of hypersonic planes, the researchers wrote: It's very difficult to build a Mach 5-plus plane with

enough room inside for passengers or cargo that it doesn't knock itself out of the air."

He added, "The waverider-HCW combination is all about turning the pressure waves of hypersonic travel from drag and downward force into additional lift."

While the paper talks about the plane's potential in long-distance travel, the *Popular Science* article pondered over what their work might mean in a military context.

In that military context, the term hypersonic vehicle means more than machines to carry people across the globe for same-day weddings. They are "considered potential strategic game-changers. The speed would allow for greater global reach, but also could nullify current air defenses."

A researcher not directly involved in the I-plane but who has been informed about the project, meanwhile, was quoted in the *South China Morning Post*. He said "the hypersonic vehicle could potentially be used to transport anything from flowers to bombs, and likewise, passengers could be tourists or military special forces."

He added, "We're talking about something like a hypersonic heavy bomber."

More information: Kai Cui et al. Hypersonic I-shaped aerodynamic configurations, *Science China Physics, Mechanics & Astronomy* (2017). DOI: 10.1007/s11433-017-9117-8