



NAWCAD Hypersonics Status

5 June 2023

Presented by: Steve Hynes
Presented to: MD Defense Forum

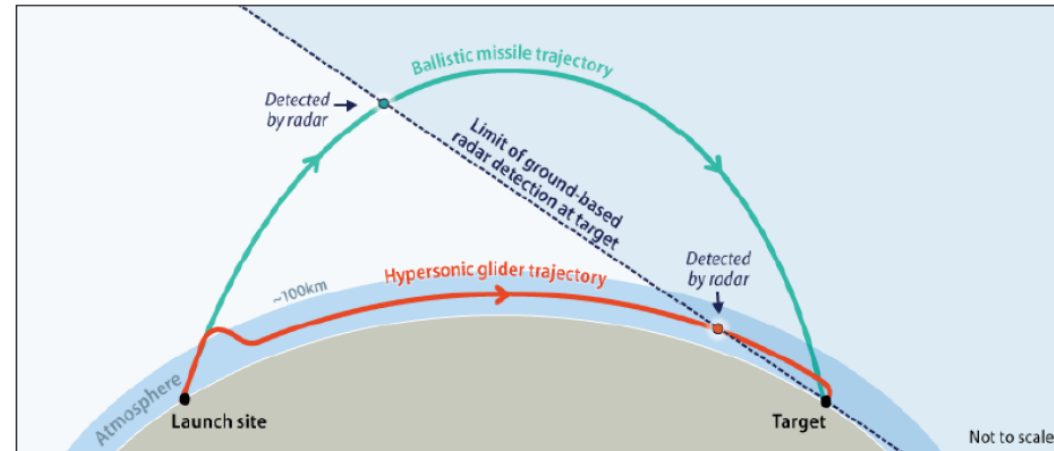


What/Why of Hypersonics

- Hypersonics generally means operating at speeds greater than Mach 5
- Faster weapons compresses decision and reaction time
- Extended range due to higher speeds
- Increased lethality with smaller warhead
- Faster speeds, ability to maneuver, and lower altitudes reduce weapon vulnerability
- China and Russia both reported to have Hypersonic Weapons
- Two primary weapon types: Boost-Glide, Cruise Missile; Most are Rocket Boosted
- Reusable Hypersonics looks at viable aircraft platforms



Defense News

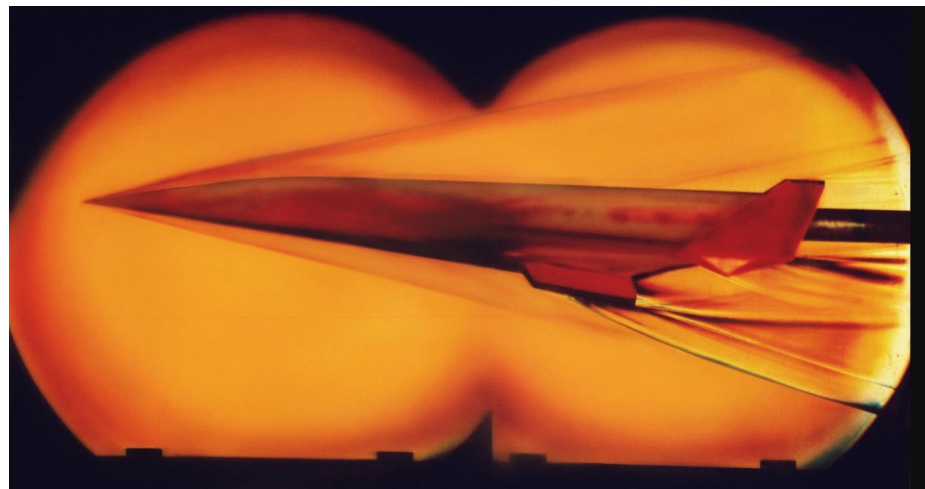


The Economist

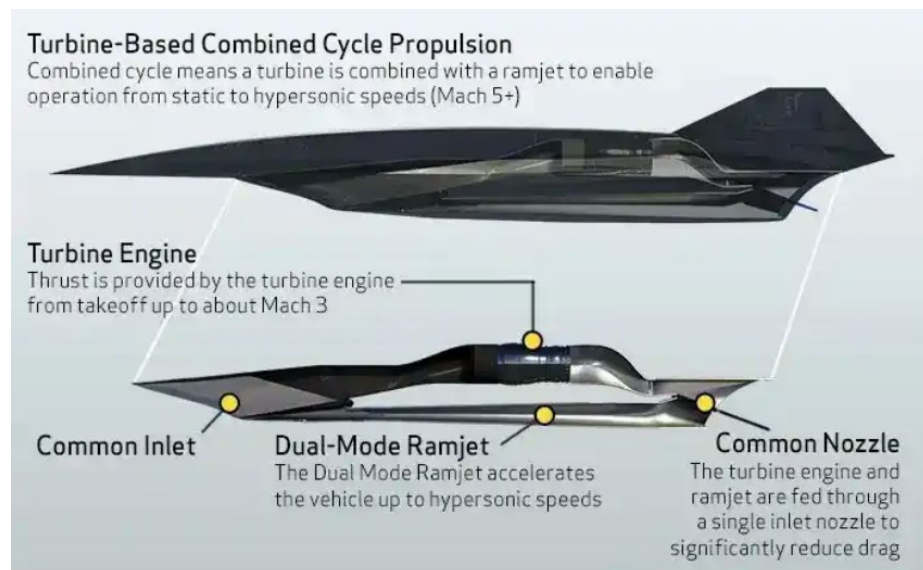


Hypersonics is Challenging

- Aerodynamic heating immense
- Difficulty replicating flight environment and high cost of testing will drive heavier reliance on digital M&S
- Manufacturing and lifing of high temperature materials
- Cruise missile propulsion and combined cycle technology not mature
- Alternate methods for Positioning, Navigation, and Timing
- Thermal loads
- Sensor window performance
- Reliable communications in plasma
- Business case for hypersonics not settled
 - Expensive to produce



NASA

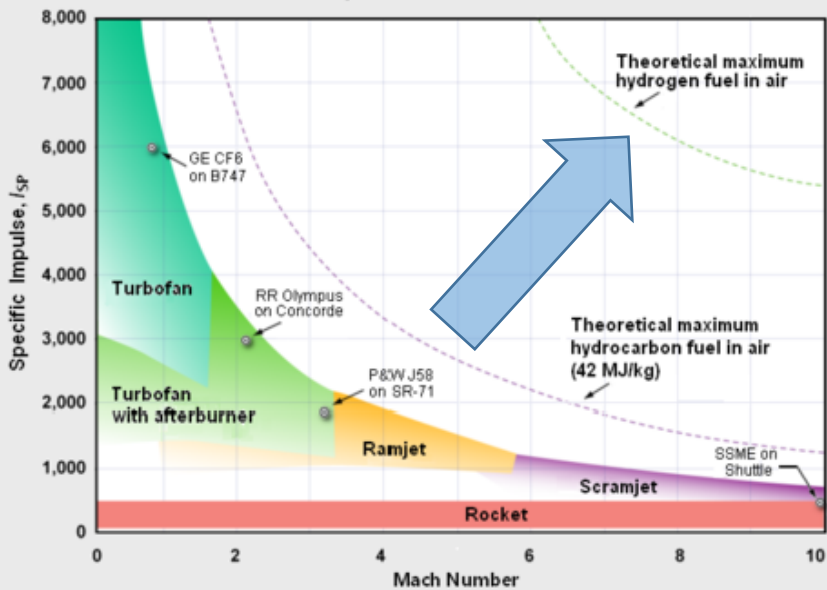




Propulsion and Materials

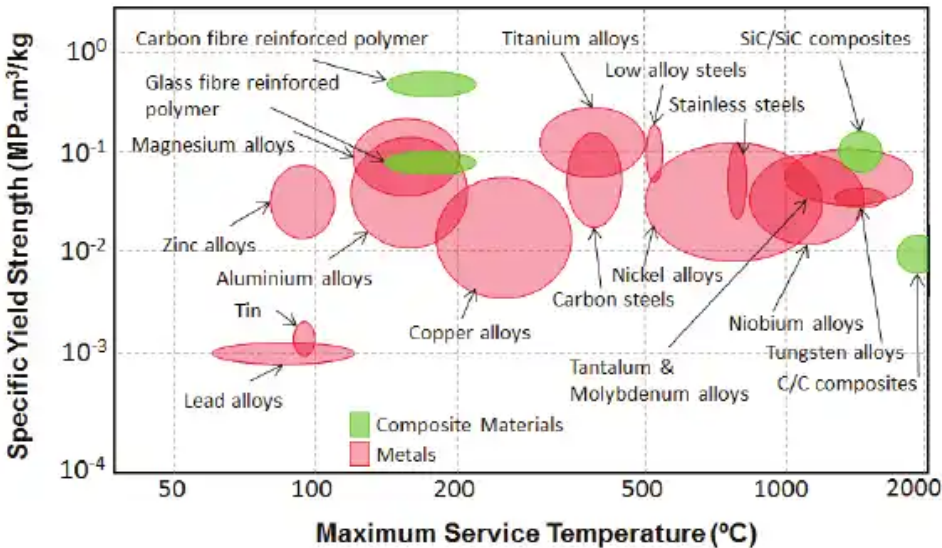
High Mach thrust is limited based on current technologies. Alternate fuel chemistries have potential but there are other issues

Propulsion Performance



Wikipedia

- Exotic materials not well understood
- Producibility in mass difficult and expensive
- Goal is high strength, light-weight, low cost



Beyond the Planned Air Force Series, Hallen and Spencer, BPAF Paper 1



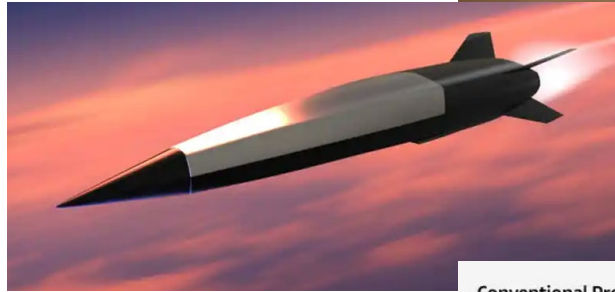
Current DOD Efforts

Numerous Technology and Acquisition Programs

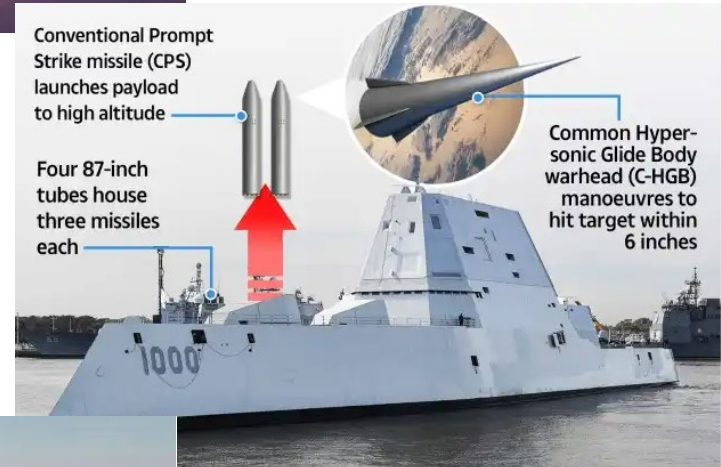
- HAWC / HACM / SCIFIRE (TD/A) – AF/DARPA two successful flight demonstrations by Lockheed and Northrop in 21/22. AUS Demo to follow (CM)
- CPS/LRHW (A) – Navy/Army vertical launch missile, built by Lockheed Martin, Boost Glide
- HALO (A) – Navy next generation air-launched precision weapon for Navy, contracts recently awarded (LM and Raytheon)
- MAYHEM (TD) – AF reusable hypersonic combined cycle ISRT/Strike aircraft, expendable – contract to Leidos



Northrop Grumman



Raytheon



Leidos



Approved for Public Release

The U.S. Sun



Where is NAWCAD?

- NAWCAD is more focused on Reusable Hypersonics
- Developing the workforce for the aircraft of tomorrow
- Difficult challenges balancing design for carrier suitability and really high speed
- Navy developing HALO – next generation anti-ship weapon
 - Follow-on to LRASM
 - Recent contracts to Raytheon and Lockheed Martin
 - Mid-tier rapid acquisition



Lockheed Martin



The subsonic LRASM (pictured) will be replaced by the hypersonic HALO. (Photo: Lockheed Martin)



NAWCAD Future Investment

- Develop Critical Skills
 - Focused technology Efforts
 - Active Training / Hiring
 - SBIRs
- Assess viability of a Carrier-based hypersonic fighter
- Connect with partners looking for opportunities for collaboration: Air Force, UMD, JHTO
- Contribute to technology advancement – roadmaps in development
 - Materials manufacturing
 - Rotation Detonation Engine
 - Digital Modeling and Tools
- Collaborate with other Navy partners (NAWCWD, NSWC, NRL)



Lockheed Martin



Concept art of a Hermeus Corp hypersonic design the Air Force wants to test. (Hermeus)



Backup



Acronyms

- M&S – modeling and simulation
- NAWCAD – Naval Air Warfare Center – Aircraft Division
- HAWC – Hypersonic Air-Breathing Weapon Concept
- HACM – Hypersonic Attack Cruise Missile
- SCIFIRE – Southern Cross Integrated Flight Research Experiment
- AF – Air Force
- DARPA – Defense Advanced Research Projects Agency
- CPS – Conventional Prompt Strike
- LRHW – Long Range Hypersonic Weapon
- HALO – Hypersonic Air Launched Offensive Anti-Surface Weapon
- UMD – University of Maryland
- JHTO – Joint Hypersonic Transition Office
- NAWCWD – Naval Air Warfare Center – Weapons Division
- NSWC – Naval Surface Warfare Center
- NRL – Naval Research Laboratory
- SBIR – Small Business Innovation Research



Hypersonic Vehicle History



- X-15 (late 1960s)
 - Built by North American
 - Liquid fuel, Rocket Powered
 - Max Mach 6.7, 200 flights

- NASP (mid 80s to mid 90s)
 - Single stage to orbit, Reusable
 - Manned, never got beyond paper design

- X-43 (1998 – 2004)
 - 12 Ft long, ~3000 lb
 - Dropped from B-52, Rocket boosted
 - Unmanned, unrecoverable
 - 3 flights, Max Mach 9.64

- Different configurations possible for weapons
 - **Boost Glide**
 - **Cruise Missile**