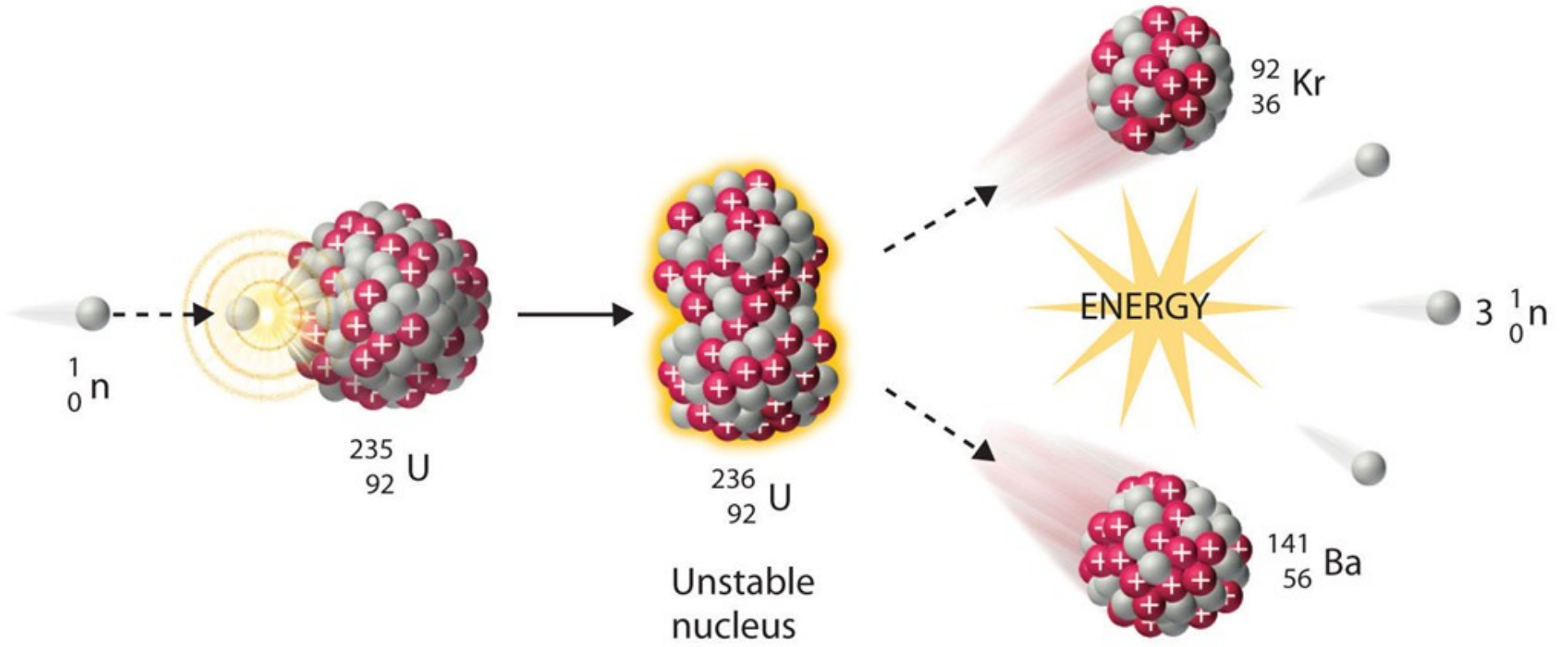
Modern Technologies and Conflicts

Nuclear, chemical weapons, PGS

10.10. 2018

JAKUB DRMOLA

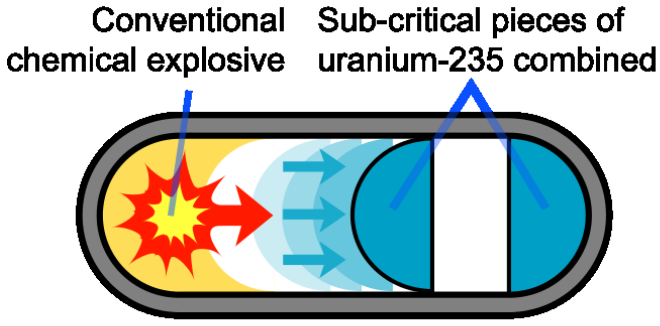
Basic fission



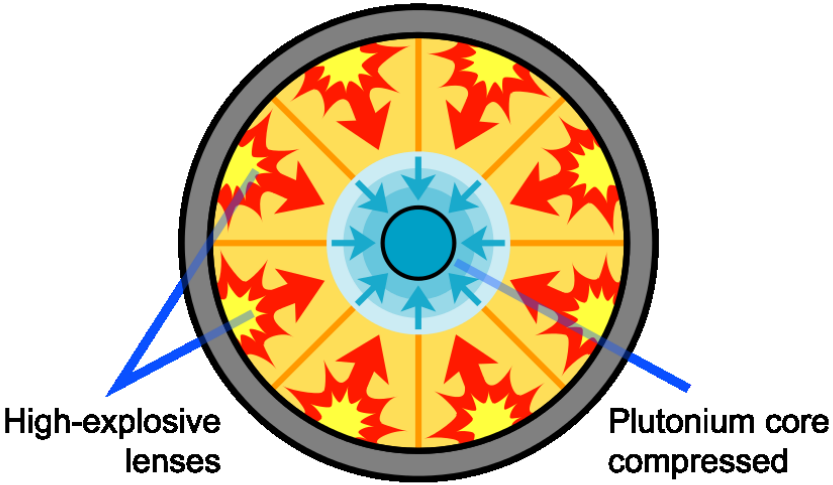
Types

- gun-type
  - first, less efficient and simpler design
  - assembly of 2 subcritical parts
  - Little Boy (Nagasaki, 6.8. 1945)

- implosion
  - newer, more efficient design
  - concentional explosion compresses the core
  - Trinity test (Nevada, 16.7. 1945)
  - Fat Man (Hirošima, 9.8. 1945)



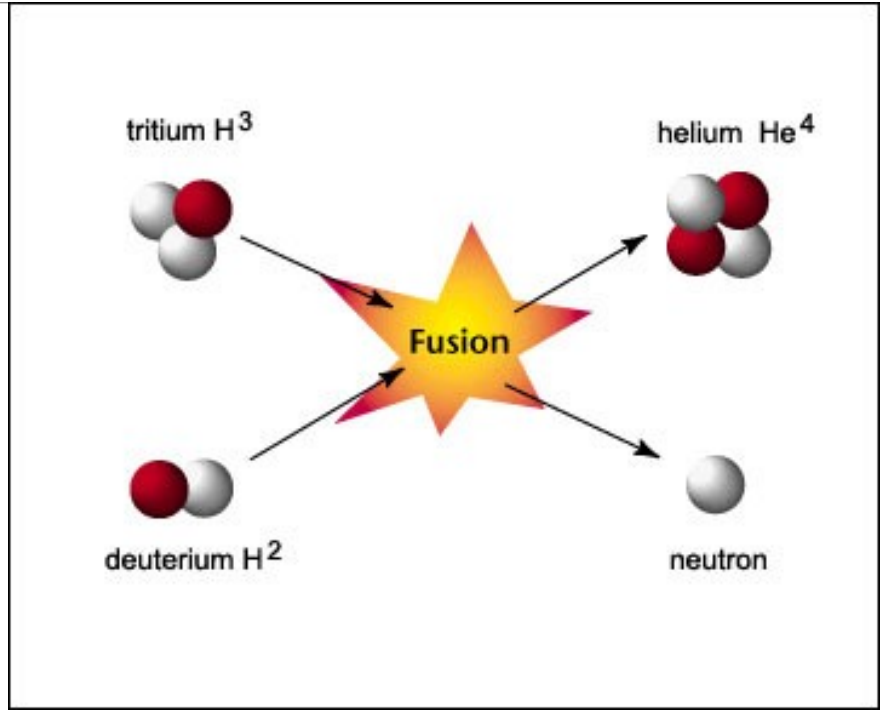
Gun-type assembly method



Implosion assembly method

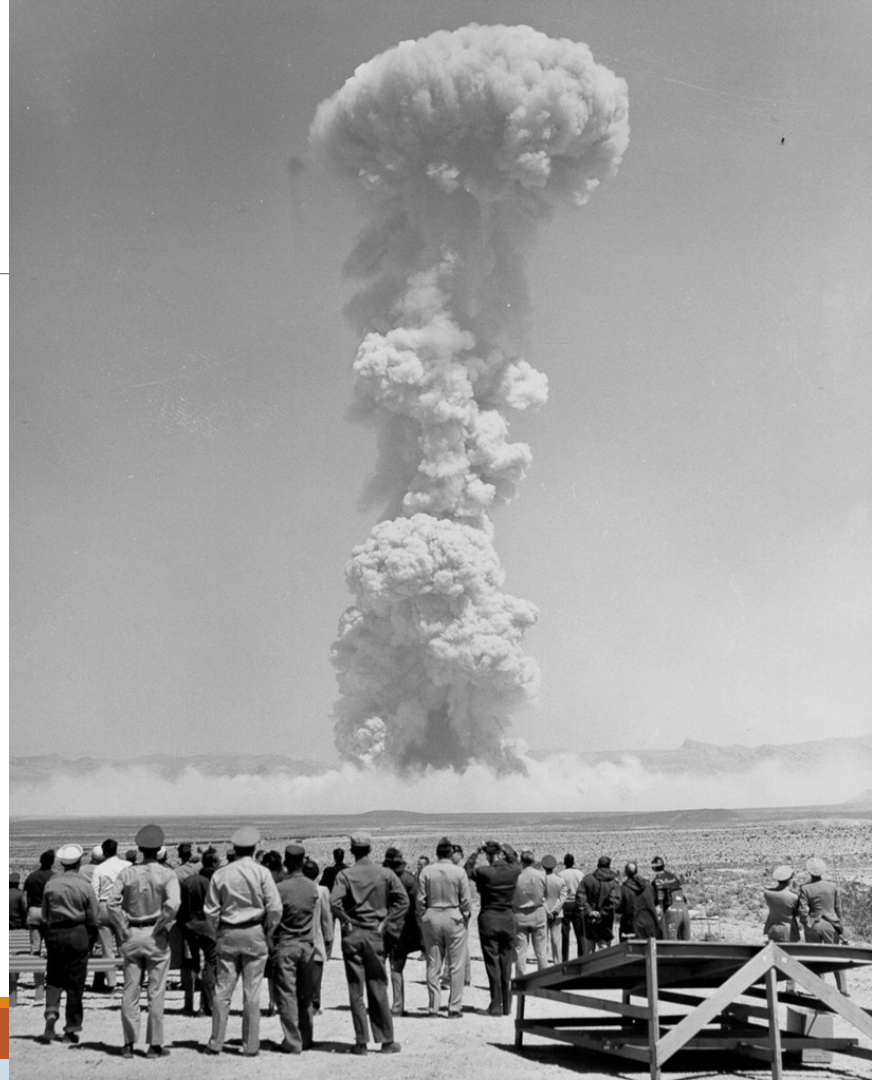
Nuclear fusion

- boosted fission
  - boosting yield of fission bombs by adding helium isotopes (1940s)
- thermonuclear/hydrogen bombs
  - hydrogen core compressed via fission bomb
  - developed in 50s
  - Castle Bravo, 1954, 15 MT
  - Tsar Bomb, 1961, 50 MT
  - roughly 1000x stronger than WW2 bombs
  - commonly used today on ballistic missiles



Other types

- Enhanced Radiation Weapon
  - optimized for neutron radiation
  - minimal physical destruction
  - “kills people, leaves buildings standing”
  - can be used on tactical or ABM missiles
- Electromagnetic Pulse
  - optimized for gamma and x-ray radiation
  - overloads and destroys electronics
  - non-nuclear variant also exist



Radiological weapons

- so called “dirty bomb”
  - spreading radiation through conventional explosion
  - tested as Denial-of-Access weapon
  - possibly attractive for terrorists
  - sounds scary but quite impractical
    - radiation too weak, temporary and can be cleaned up
    - primary threat is panic, not direct deaths

https://youtu.be/WD1BRE-DBsA?t=43m11s

- 2006, Litviněnko assassination

Depleted uranium

- by-product from uranium enrichment
- 50% heavier than lead, similar to tungsten
  - but cheaper and pyrophoric
- used in munitions, armoud, shielding, counterweights…
- lasting controversy regarding its effect on health and environment

- no nuclear reaction taking place
- minimal level of radioactivity (comparable to banana)
- but can be quite toxic (similar to other heavy metals)

History

- nucleus and radioactivity discovered before WW1 (Rutherford, Currie)
- first principles developed in 30s (Leo Szilard, Otto Hahn)
- 1942 project Manhattan started
  - UK lacked the industrial capacity
  - Germany focused on rocketry
- 1945 end of WW2
- USSR (1949), UK (1952), France (1960), China (1964), Israel (196?), India (1974), Pakistan (1998), DPRK (2016?)

Current arsenals

- permanent members of UN SC
- plus India, Pakistan and Israel
- ongoing efforts by DPRK and Iran
- issue of post-soviet countries
- former programs in Libya, Iraq, Syria, South Africa, Brazil, Taiwan, Sout Korea, Yugoslavia, ...

- https://www.ctbto.org/nuclear-testing/
- https://en.wikipedia.org/wiki/Nuclear_proliferation#/media/File:Nuclear_weapon_programs_worldwide_oct2006.png

WORLD NUCLEAR WEAPONS STOCKPILE

TOTAL NUCLEAR WEAPONS: 15,375

RUSSIA 7,300

USA 6,970

FRANCE 300

CHINA 260

UK 215

PAKISTAN 130

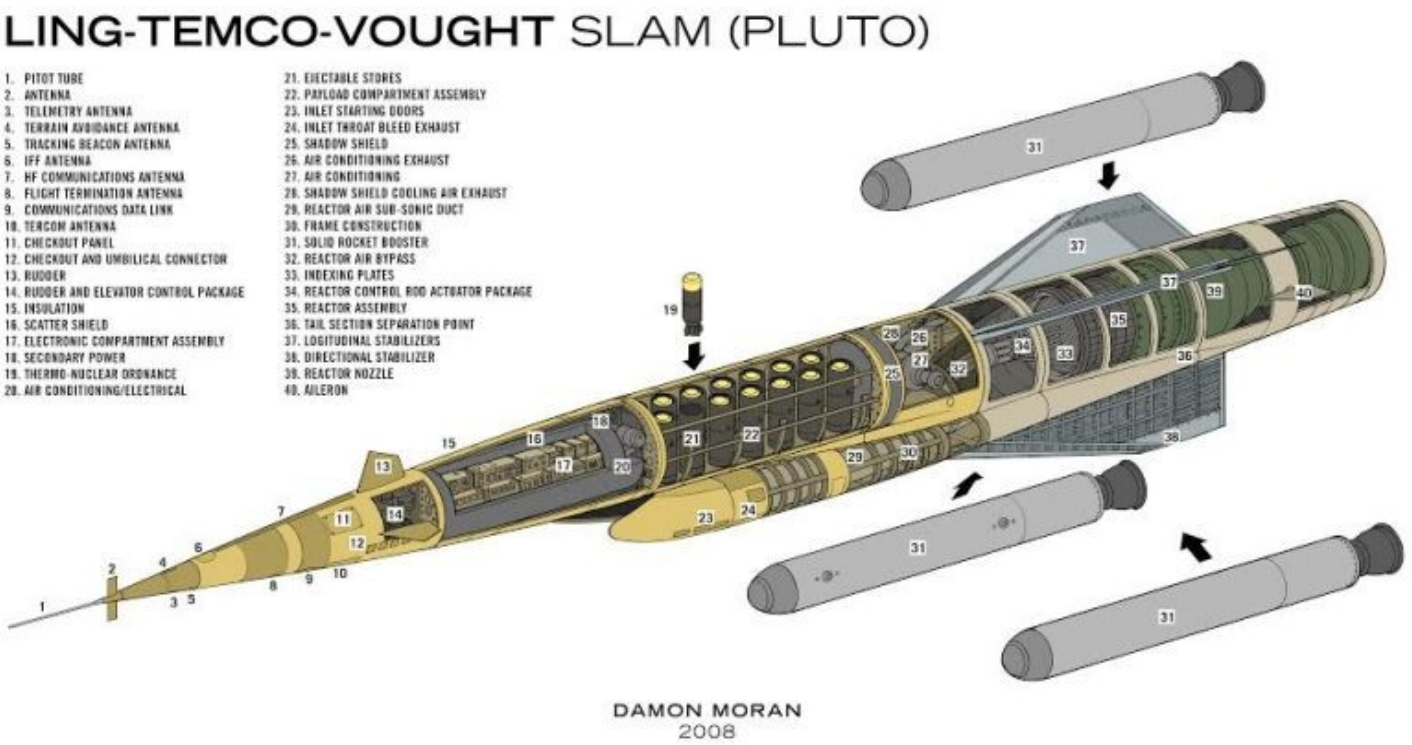
INDIA 120

ISRAEL 80

NORTH KOREA < 15

Some notable weapon systems

- SLAM (1955-1964) doomsday weapon



Terrorism

- ongoing speculations
  - esp. after collapse of USSR and 9/11
- regular news about efforts of terrorist grou
  procure nuclear weapons or dirty bombs, s
  without confirmation or results
- building a nuclear weapon from scratch
  impossible
- might steal it, buy it or attack a nuclear fac
- building dirty bomb is trivial, could be usec
  spread fear

Types of chemical weapons I.

- Nerve agents
  - block nerve signals > convulsions, paralysis of muscles > asphyxiation or heart failure
  - sarin, soman, tabun, VX, novichok
- Blood agents
  - absorbed into blood by inhalation or consumption > block oxygen
  - cyanide, arsenic, oxygen monoxide
- Choking agents
  - stings and destroys cells in lungs and membranes > lungs flood with liquid > asphyxiation
  - phosgene, chlorine

Types of chemical weapons II.

- Blistering agents
  - up to 24 hours after contact, chemical burns for days, extremely painful, necrotic
  - yperite (mustard gas), lewisite
- Psychoactive
  - temporary loss of consciousness, confusion, hallucinations
  - LSD-25, BZ, Kolokol-1
- Incapacitating
  - cause vomiting, burning in eyes, coughing, tears
  - chloracetophenon, CS, CR, adamsite


IWM

History I.

- use of smoke since time immemorial
- da Vinci's proposal for chemical grenade
- boom of chemistry since 19th century
- largest use in history during First World War
  - 1914 – tear gas, first use by France, unsuccessful
  - 1915 - chlorine, phosgene
  - 1917 - yperite (mustard gas)
  - over 1 million soldiers impacted, 100 thousand killed (primarily by phosgene)
  - all major powers used chemical weapons
- nerve gases discovered in Germanny in 1930s

History II.

- very limited combat use during WW2 – why?
  - Germany did not know nobody else discovered nerve gas, worried about escalation
  - used a lot by Japan
  - planned use for defense of Great Britain
  - Zyklon B in extermination camps
- “gas race” during Cold War
- used in smaller conflicts in Middle East, Africa, etc.

Technology used

- methods of dispersion
  - wind, artillery, air bombs, spraying, binary munitions
- methods of protection
  - detection by sight and smells, damp cloth over face
  - later gas masks, continually improved, full suits
  - neutralizing chemical agents, antidotes, electronic detection

Strategic and tactical aspect

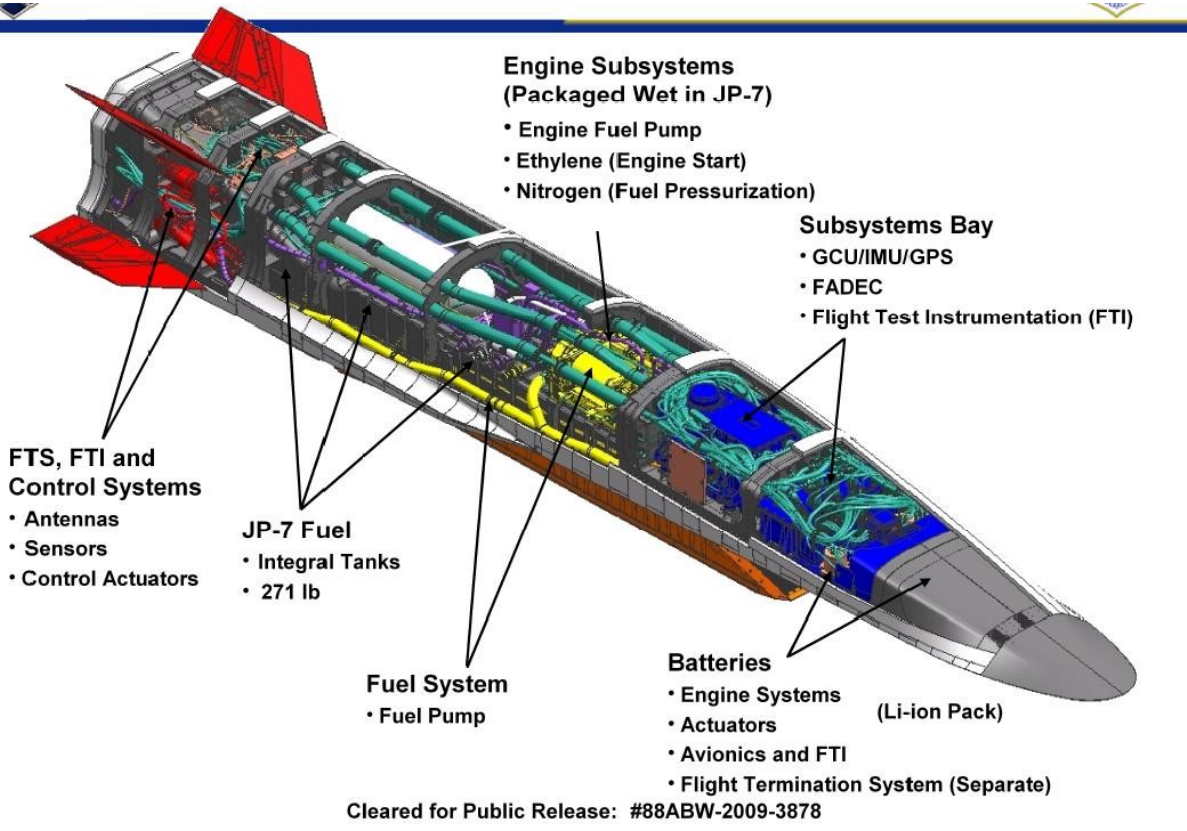
- highly dependent on weather
  - temperature, wind and humidity can limit the effect or even hit friendly forces
- contamination
- quite cheap and simple to produce
- very bad for PR
- not very effective when the armies are protected
- can escalate quickly

Terrorism etc.

- chemical weapons are relatively easily procurable
- sometimes used to enhance conventional attacks
  - not effective
- Aum Shinrikyo
  - 1990-5: 10 attempts for chemical attack
    - (4x sarin, 4x VX, 1x phosgene and cyanide)
  - 2x successful, 14 killed, 4000 injured
- Moscow theater siege, kolokol-1 used by police, 2002
- attacks on chlorine tanks in Iraq, 2007
- use in Syria since 2012, multiple sides
  - (chlorine, sarin, yperite, tear gas)
- assassination of Kim Jong Nam, 13/2/2017, VX
- Sainsbury attack on Skripals, 04/04/2018, novichok

Some notable weapon systems

- scramjet
- goal is fastest possible reaction when ballistic missiles cannot be used and cruise missiles are too slow
- hypersonic (mach5+)
- flight across pacific in 1-2h
- theoretical basics known since WW2
- mixed success in tests



Some notable weapon systems

- Mach7+, range up to 200 km
- electromagnetic force instead of chemical combustion
- small “cheap” munition, less risky to store
- purely kinetic energy kill
- 11 kilograms @ Mach7 ≈ 87t @ 100 km/h (locomotive)
- targets at land, sea and air
- first deployments “soon”

https://www.youtube.com/watch?v=O2QqOvFMG_A&feature=youtu.be&t=8s

- problems:
  - gun wear and durability
  - power demands