What Proton, Angara and Baikal have in common

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Outline

Launching elephants into space

- Mankind needs heavy-class rockets
- Delivering large payload to low Earth orbit (LEO)
  From 160 to 2 000 km
- Launching spacecrafts to geostationary orbit (GSO)
  36 000 km

Proton

- Created in the 60's at OKB-52 (now NPOM)
- Originally designed as a heavy ICBM capable of delivering a 100-megaton warhead to the United States
- Several modifications have been developed
- In service for more than 40 years
- Nearly 300 launches with 97% success rate

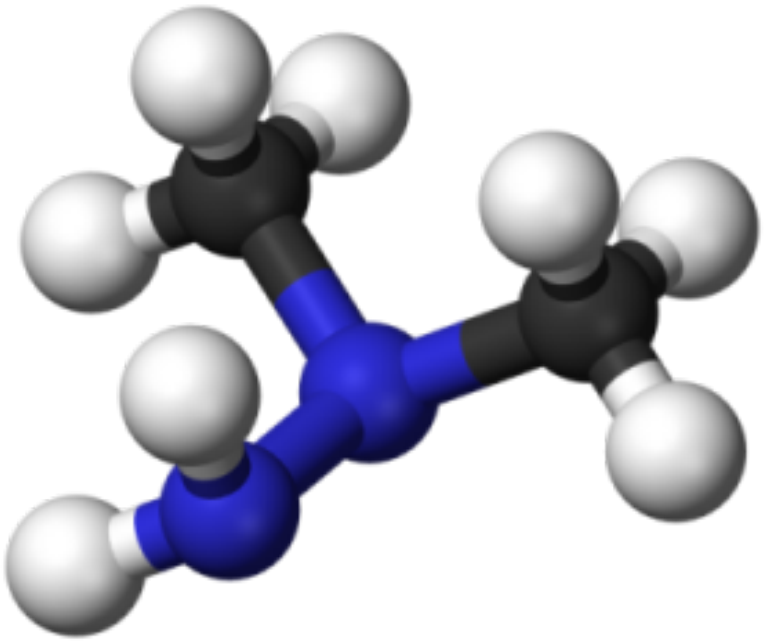
Proton achievements

- Launches of hundreds of communication and military satellites (since 1970)
- Launches of unmanned interplanetary stations
  to Moon, Venus and Mars (1969–1983)
- Flights of Almaz and Salyut manned space stations (1971–1991)
- Delivery of modules of Mir station (1986–1996)
- Estiblishing of key segments of the ISS on orbit (since 1998)

Proton-M

- Modern modification of original Proton launch vehicle developed by Khrunichev space centre
- Features a new control system and Briz-M upper stage booster
- Capable of launching up to 22 tonnes to LEO and up to 4 tonnes to GSO

The evil Proton fuel

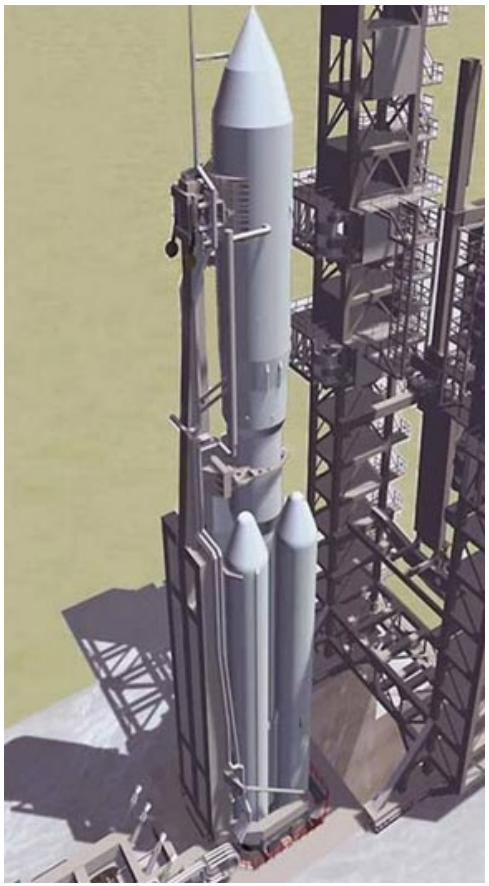


- Proton uses unsymmetrical dimethylhydrazine (UDMH) as a fuel, which is highly toxic
- Falling rocket stages pollute ground areas
- Ecological impact increases in case of launch failures

Geopolitical issues

- Proton can be launched only from Baikonur, which is a foreign territory (Kazakhstan)
- Russia pays 115 million dollars every year for rent of Baikonur

Angara



- A family of versatile modular launch vehicles developed by Khrunichev space centre
- No UDMH for fuel
- Can be launched from Plesetsk cosmodrome in northern Russia

Angara modularity

- Rocket is built from universal common core boosters (CCB) which are connected together
- Each CCB has fuel tanks and one modern RD-191 rocket engine
- Modular approach allows to use the same parts to produce a wide range of rockets, from lightweight and intermediate variants to heavy-duty ones

Angara 1.1

- Kid version of Angara system
- Uses just one CCB and a simple upper stage booster
- Can deliver up to 2 tons to low Earth orbit

Angara-A5

- The most powerful flavor of Angara
- Built from 5 common core boosters and several upper stage boosters
- Launches 24.5 tons to LEO and 4.5 tons to GSO

Green rocket

- Angara uses liquid oxygen and kerosene as a fuel
- No UDMH means no serious environmental damage

Space Independence

- Plesetsk is planned to become a primary launch base for Angara rockets
- Angara system will secure Russia's independent access to space regardless of any trends in foreign relations
- Facilities for Angara launches will be built at Baikonur, too

Baikal

- Shuttle booster planned for use with Angara
- Based on Angara's common core booster
- Has wings and an additional engine from MiG-29 fighter
- Boosts the rocket on the first stage
  and returns back to ground like an airplane
- Utilises technologies used in Buran
- Can be used up to 25 times (planned 200)

Baikal embrace

- Baikals replace one or several of the first stage boosters
- Use of shuttle boosters will allow to lower launch cost by 25–50%
- Baikal safely returns to runway instead of falling

Great expectations

- Currently Angara modules undergo testing procedures
- First launch is scheduled for 2011
- Baikal is under development but without direct government support (unlike Angara)