16.512, Rocket Propulsion
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Lecture 37: Future Developments

Some (dangerous) Forecasts on the Future of High Thrust Rockets (Chemical or Nuclear)

Looking ahead in Rocketry

Liquid Rockets :

- No increase in I_{sp} to be expected.
- Gradual reliability increase through:
  - Better Health Monitoring, diagnostics, control, auto-reconfiguration
  - Added redundancy
  - Better materials, simplified designs
- Shorter, less expensive design cycle by
  - Heavy use of computation
  - Active stability enforcement
- Potential replacement of propellants → "green" propellants (H_2O_2 + HC ? instead of Hydrazine + N_2O_4)

Solid Rockets :

- Stronger, lighter casings
- Active stability controls
- Less expensive manufacturing
- Basic combustion physics → "designer propellants"

Hybrid Rockets : Potential to replace solids (similar I_{sp}, re-start, control, safety)
Need better sliver control techniques

Nuclear Rockets : Needed for interplanetary flight. Political issue. Phoebus 2A, 12 min (1968) 119 Kg/s, H_2 P_{th} = 4 GW, 2280 K, 47 atm, 9500 Kg mass

$$F/w \simeq 10$$

$$F \simeq 119 \times 8000 \approx 10^6 \text{ N} \simeq 100 \text{ Ton}$$

Open cycle, cannot (should not) operate from ground.

Can be launched chemically to orbit (inactive), then be used as upper stage. Shielding only “shadow”, will require large exclusion zone about vehicle ($\sim$ 10 Km, except in protected cone)

New design by Carlo Rubbia claims scalability to small size. A thin films surrounding H_2 channels, says can build critical engine for 30 KW H.