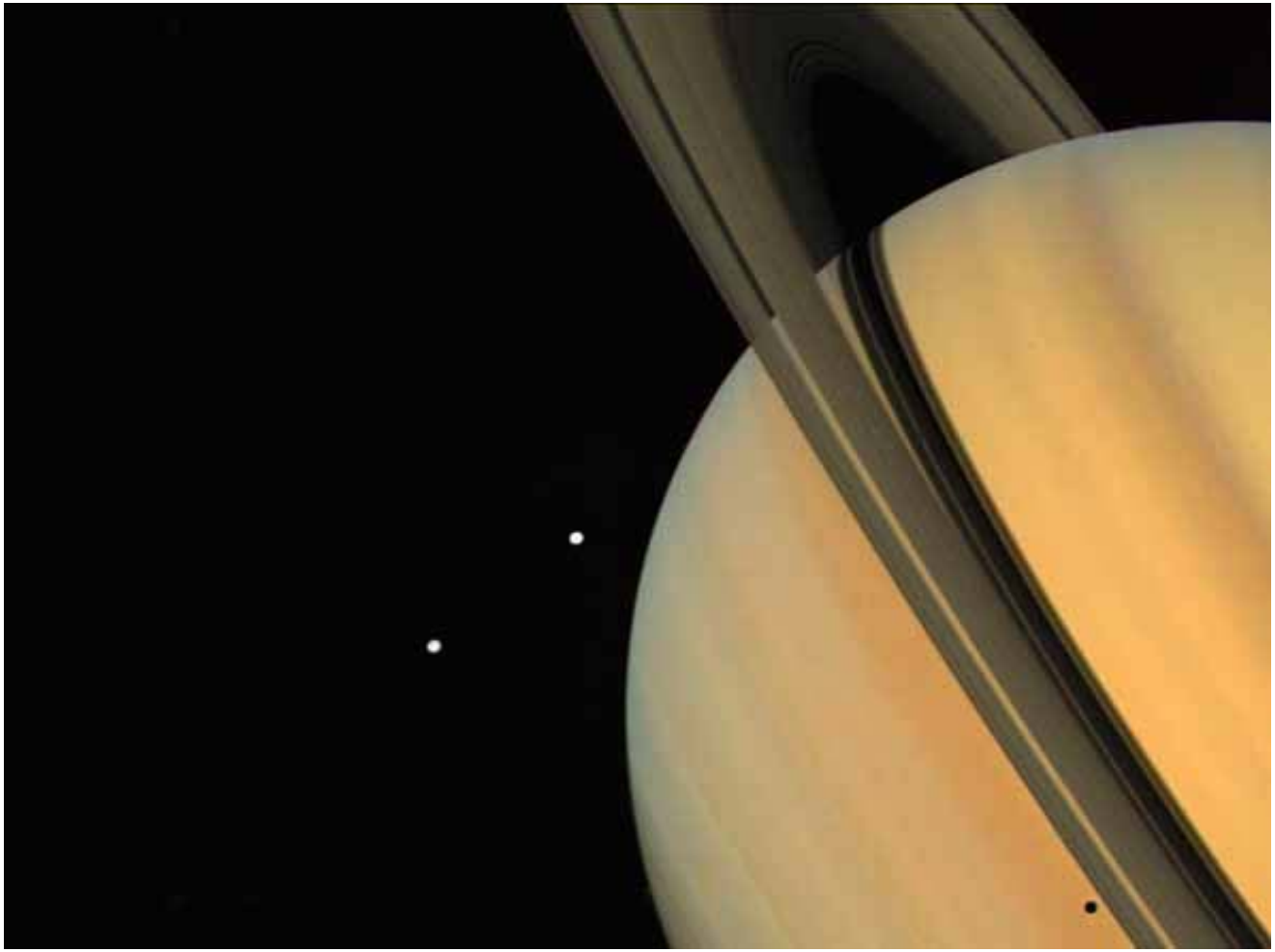
National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Science Mission Challenges for Propulsion Technology



Philip W. Garrison

Deputy Director,
Engineering and
Science Directorate

Jet Propulsion
Laboratory

August 3, 2009

Special Challenges of Science Missions

1. Easy missions (flybys, orbiters) have been done; future missions (landers, sample return) are hard
   - High energy (high delta V, high payload)
   - High thrust, variable thrust for landers
   - Very low Ibit for precision control
   - Long life, high throughput, many cycles, wide operating range
2. Requirements often exceed those for commercial satellite missions
3. Market too small to motivate commercial development

Special Challenges (Cont'd)

4. Planetary missions have no schedule flexibility; must make launch date established 4 to 5 years before project start
5. Competitive missions are cost capped
6. Unproven technology (any departure from flight qualified) is a serious threat to cost and schedule
7. Missions that promise the highest science return get funded
8. Reduced funding in NASA propulsion technology program

The Challenge

Must Win

- Maximum Science
  - Min S/C mass
  - Min capability LV
  - Low reserves
  - Low technical margins
  - Highly optimized design
  - Limited fall back options

Must Execute

- Low Risk
  - Flight qualified systems
  - Maximum heritage
  - Large reserves
  - Large technical margins
  - Fall back options available

Examples of Threats Caused by Less Than Fully Qualified Propulsion Technology

1. Galileo 10 N thrusters
2. MER and DAWN lightweight tanks
3. DAWN solar electric propulsion system

What To Do

1. Advocate for increased NASA and DoD investment in inspace propulsion technology and insure that these programs deliver TRL 6 products
2. Advocate for technology demonstration missions, e.g., New Millennium
3. NASA incentivize/indemnify use of new technology in competed mission AOs, e.g.,
   - New Frontier AO commits NASA to TRL 6 by PDR and augments the cost cap
     - NEXT - $15M
     - AMBR- $5M