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Interplanetary Small Sats: Opportunities for Universities and Citizen Scientists

Dr. Mason A. Peck

Director, NY Space Grant Consortium

CubeSats

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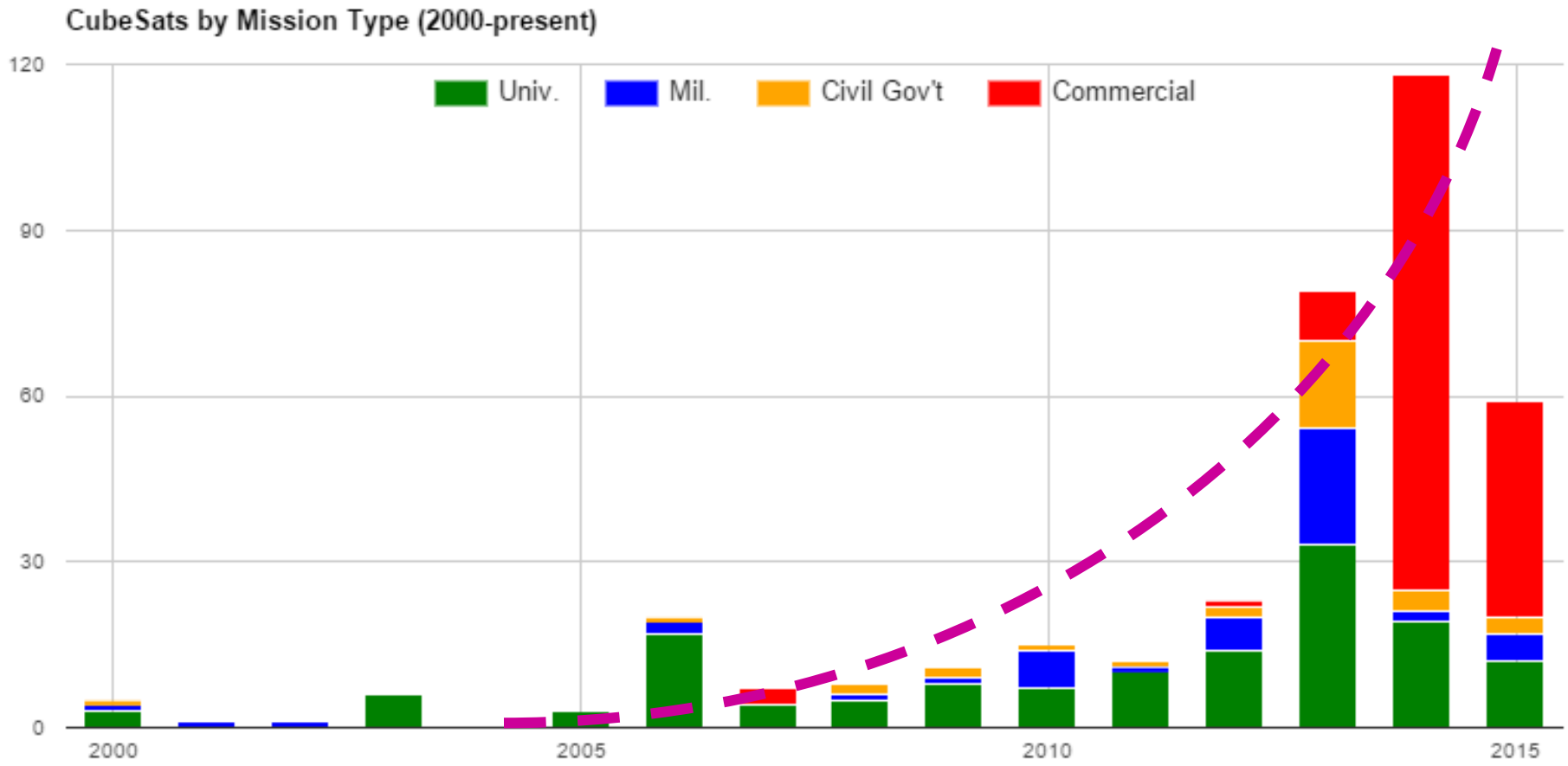
CubeSats are now the most commonly launched type of satellite



[Chart created on Mon Sep 28 2015 using data from M. Swartwout]

MarCO: Two 6U CubeSats (2016)

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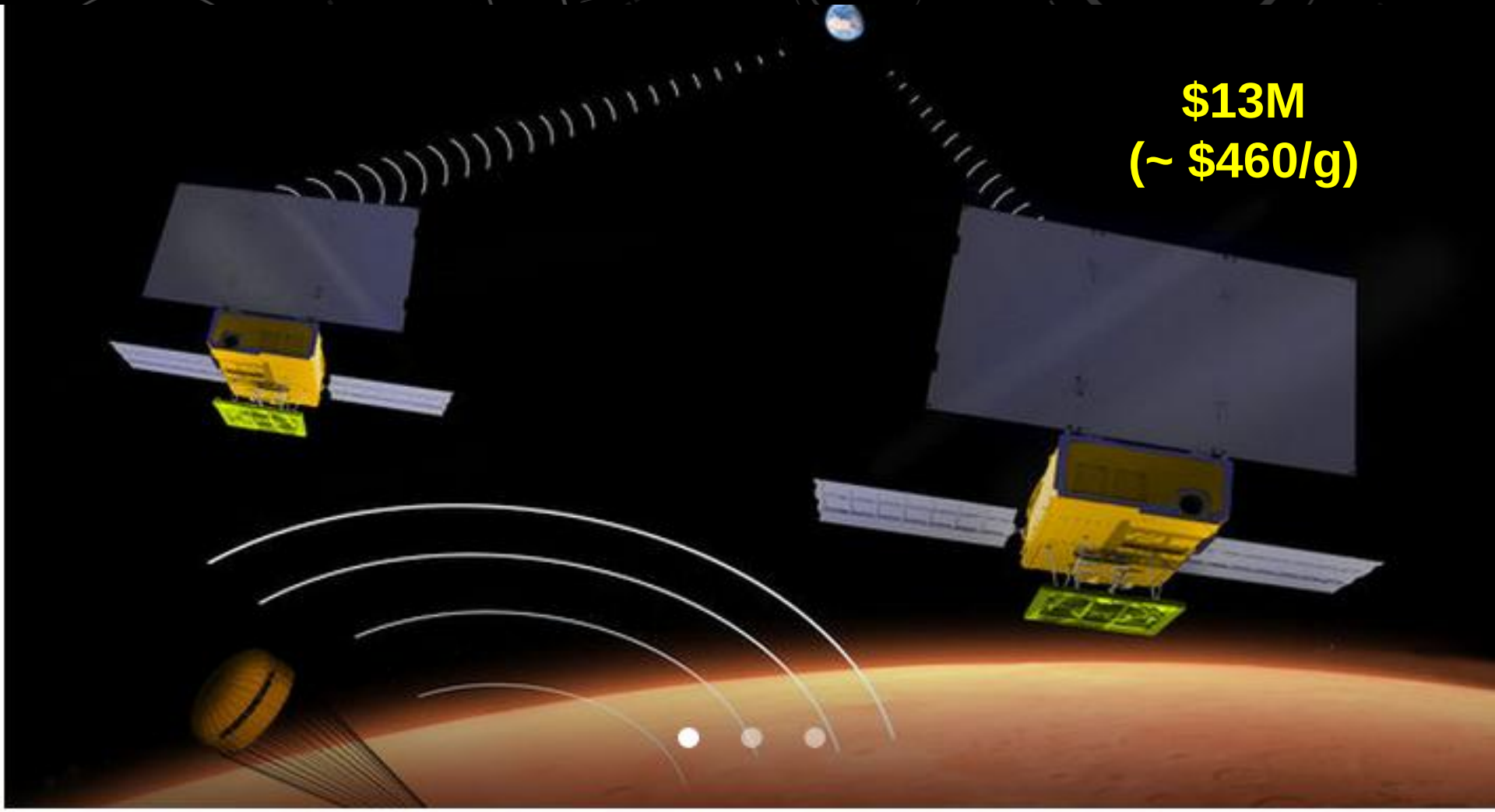

$13M
(~ $460/g)

NASA's two small MarCO CubeSats will be flying past Mars in 2016 just as NASA's next Mars lander, InSight, is descending through the Martian atmosphere and landing on the surface. MarCO, for Mars Cube One, will provide an experimental communications relay to inform Earth quickly about the landing. Image Credit: NASA/JPL-Caltech

Democratizing Access to Space

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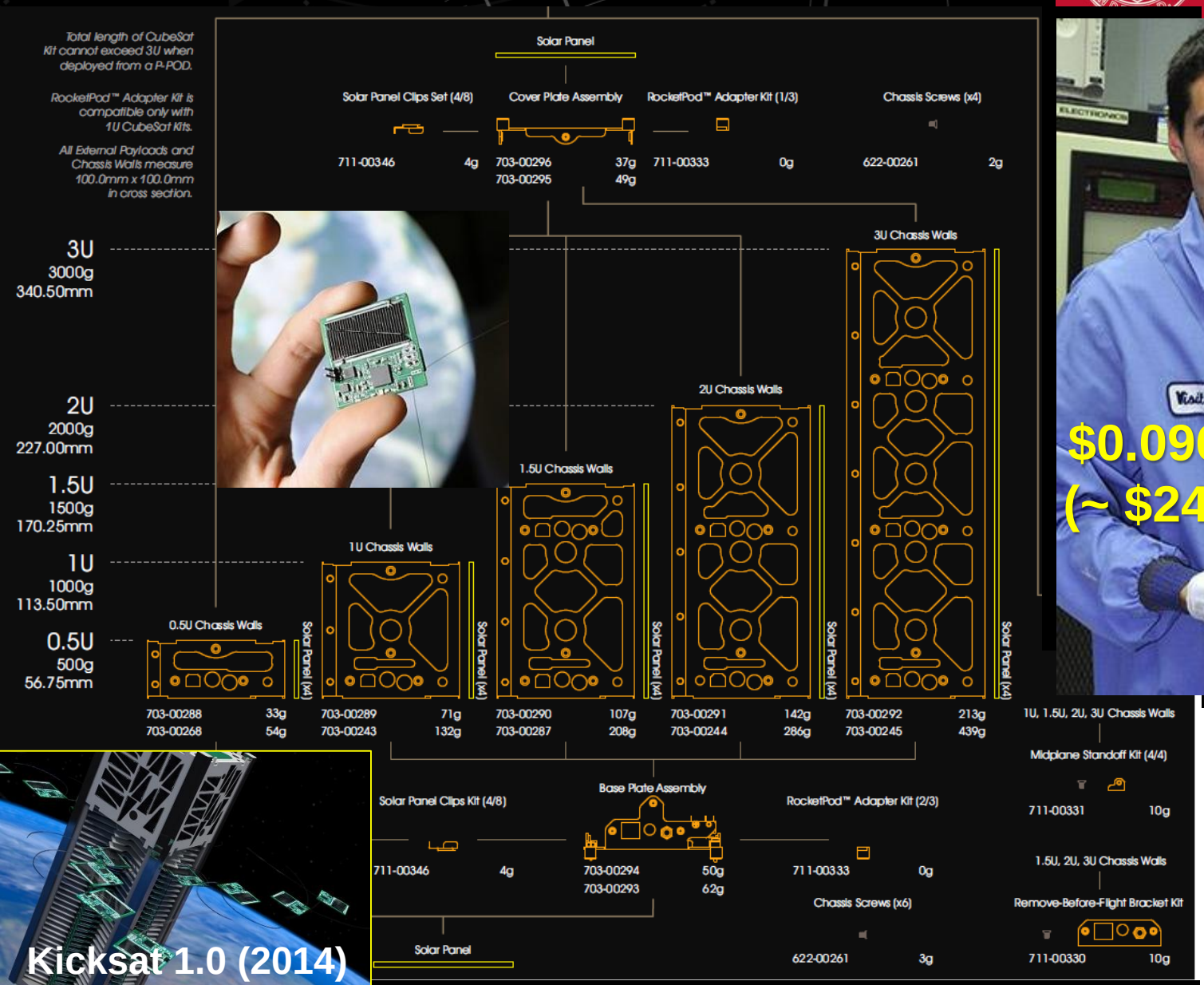

CUBE SAT KIT
www.cubesatkit.com
System Chart

Interplanetary CubeSats

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- CubeSats:
  - Access to space
  - Modularity
  - Fast turnaround
- Interplanetary CubeSats:
  - Science from the cutting-room floor
  - Redundancy
  - Distributed exploration
  - At least 15 to launch in the next 3 years
- Two biggest challenges
  - Propulsion
  - Communications

University of Michigan CubeSat Ambipolar Thruster (CAT, a 5kg 3U CubeSat)

$0.096M (~ $24/g)

CisLunar Explorer (2018)

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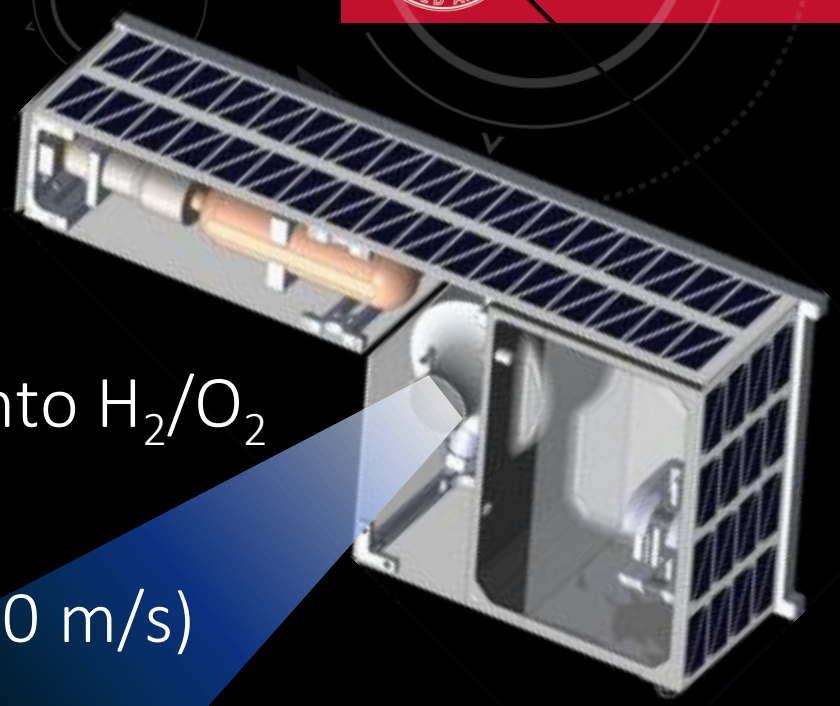
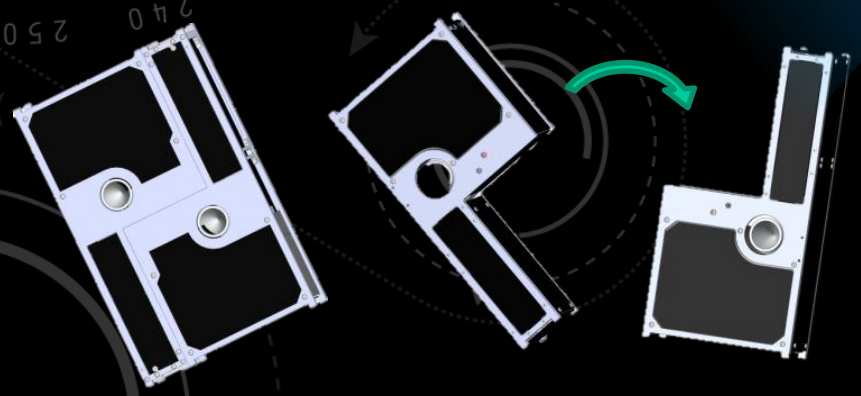
- Low cost
- Two 3U CubeSats
- Non-toxic propellant
- Launch water; electrolyze into H_2/O_2
- No need for batteries
- High ΔV capability (900-1300 m/s)
- Competitive I_{sp}: 300-370 sec



$0.1M
(~ $10/g)



Participatory Space

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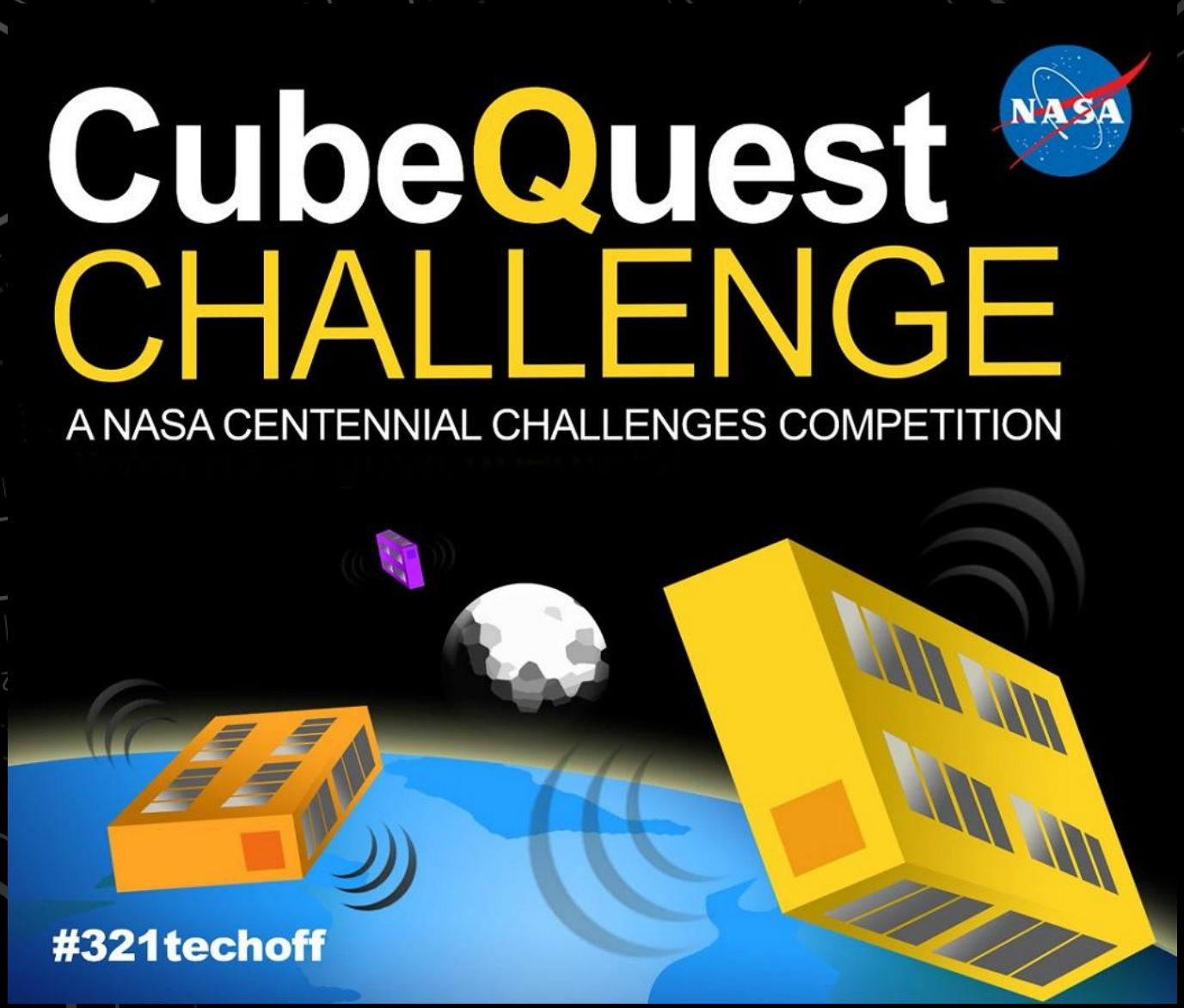

Participatory Space

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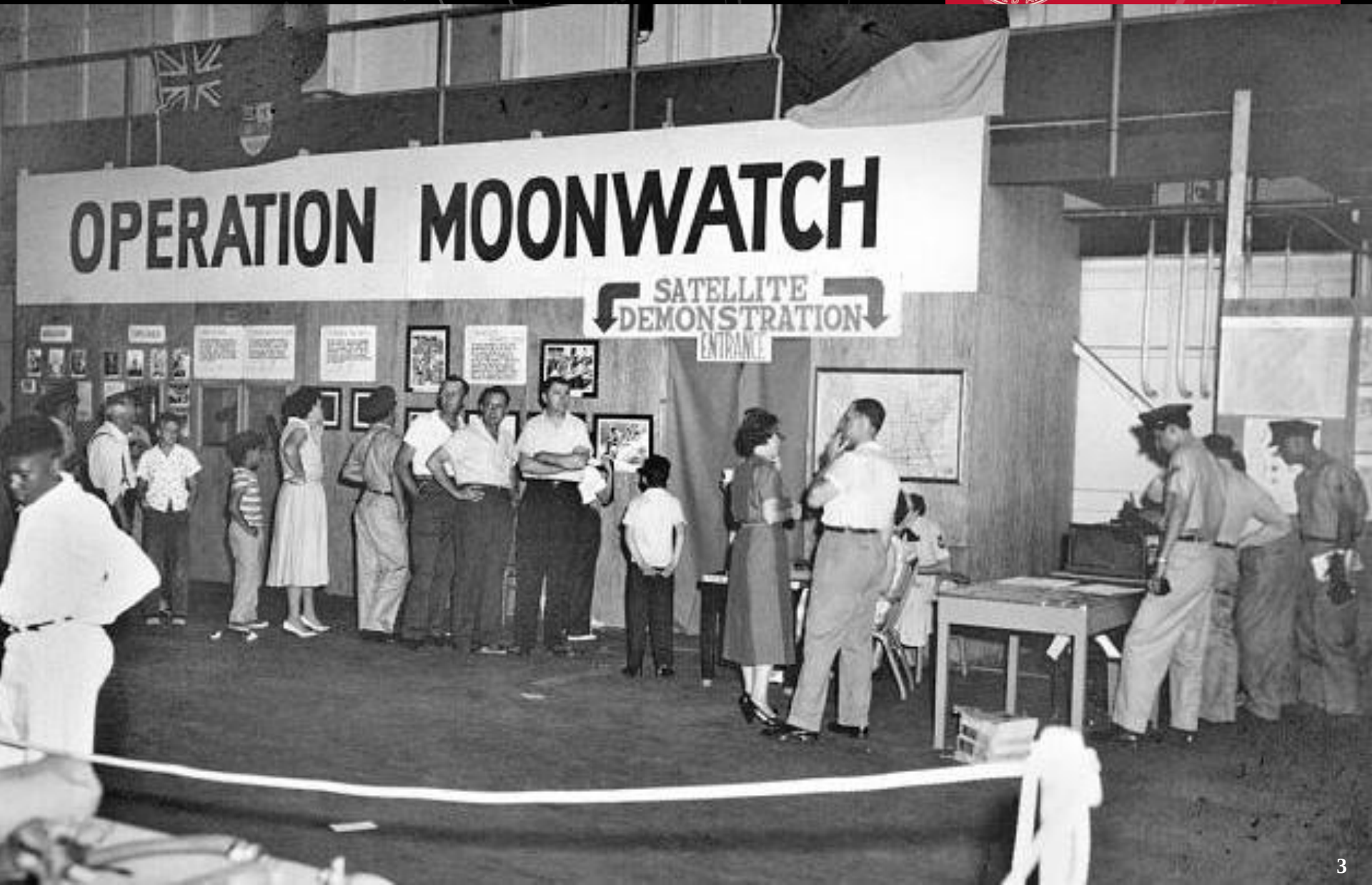

CubeSat Science Fiction Prize

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- HS Students are asked to design a CubeSat that implements an idea from *science fiction*
  - The winner's CubeSat will be built at a US University and proposed for launch via NASA's CubeSat Launch Initiative
  - High School Students will be invited to join the university team during the summer for experiential learning
  - Judges: technologists, science fiction authors, educators

CubeSat Science Fiction Prize

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- Examples
  - Antimatter propulsion (medical isotopes)
  - Tractor beam (electromagnetic docking)
  - Terraforming (grow biological samples on lunar simulant in space to produce O2)
  - Von Neumann Probes (reenter tiny sensors from orbit)
  - Clarke's Seedships (replicate DNA in zero gravity)
  - Space Elevator (deployable tether and a vehicle that climbs it)
  - Time Machine (demonstrate relativity with an atomic clock)

Join Us!

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- The more universities that can build spacecraft for the winners, the more HS winners the competition can support
- Let me know if your university will build a CubeSat as the prize for a winning HS team
- There will be a high-profile public announcement of the competition and all collaborators in mid-October!

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