SMD CubeSat Program Update

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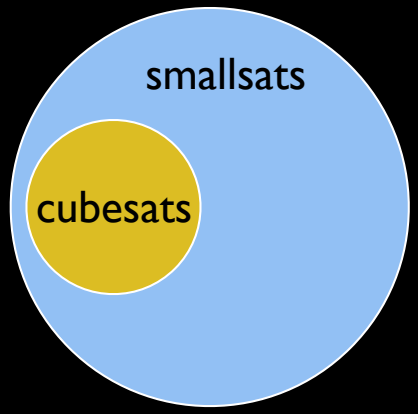
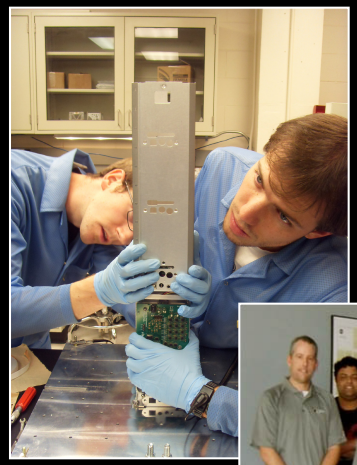
Smallsats as a tool for science



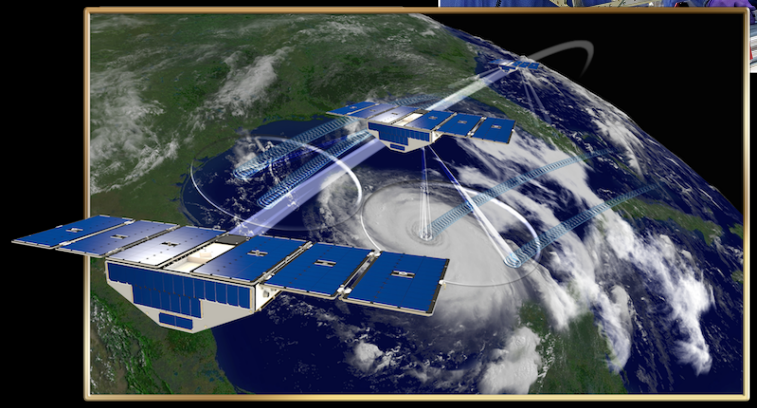
A "CubeSat" is a satellite launched from a canisterized dispenser
A "SmallSat" is a satellite smaller than ESPA class (~130 kg).

Smallsats have transitioned from being educational or demonstration platforms to a tool capable of 'big science' & increasing science/$



CSSWE, 3U NSF student cubesat ($900k)

CYGNSS - 8 30 kg s/c studying hurricane winds ($105M + LV)

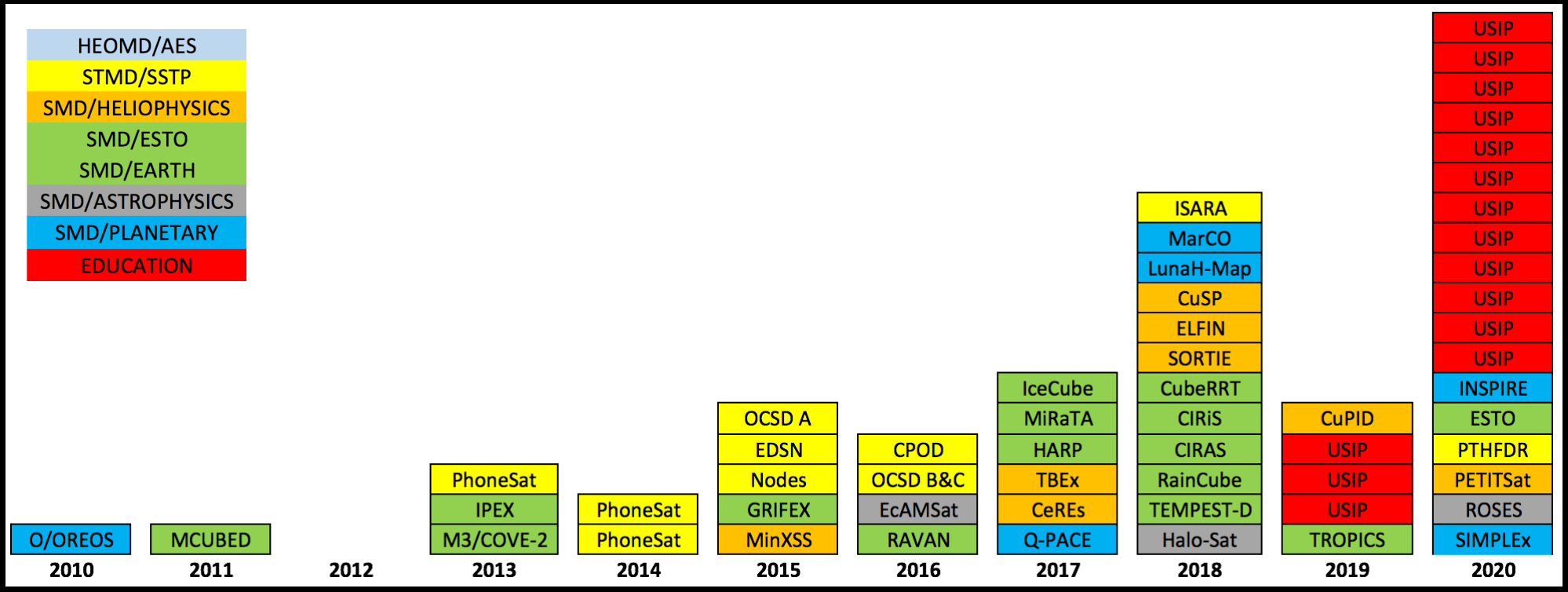


SMD has funded CubeSats across all science divisions

NASA has 71 CubeSat missions, comprised of 96 small spacecraft, launched or in development, supporting 27 science, 15 technology, 6 exploration and 23 STEM-related investigations.

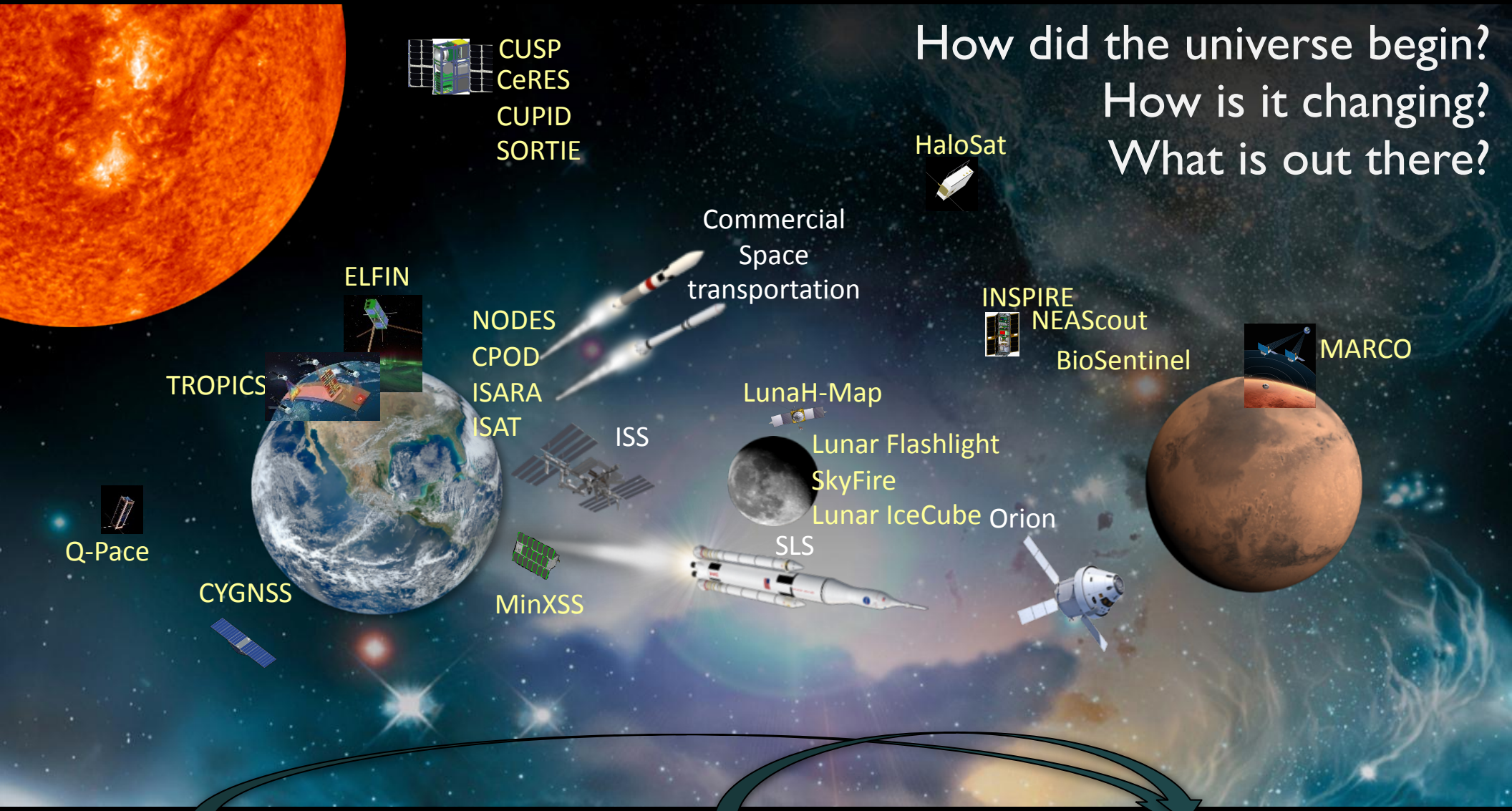
NASA
71 missions
96 spacecraft

- **SMD**: 27 missions, 41 spacecraft
- **STMD**: 15 missions, 26 spacecraft
- **HEOMD**: 6 missions, 6 spacecraft
- **OE**: 23 missions, 23 spacecraft



Launch Year

CubeSats throughout the solar system



NASA Technology:

SSTP technology investments

- Formation Flight, Propulsion
- Communications, ACS systems

NASA Exploration:

Access to Space, SKGs

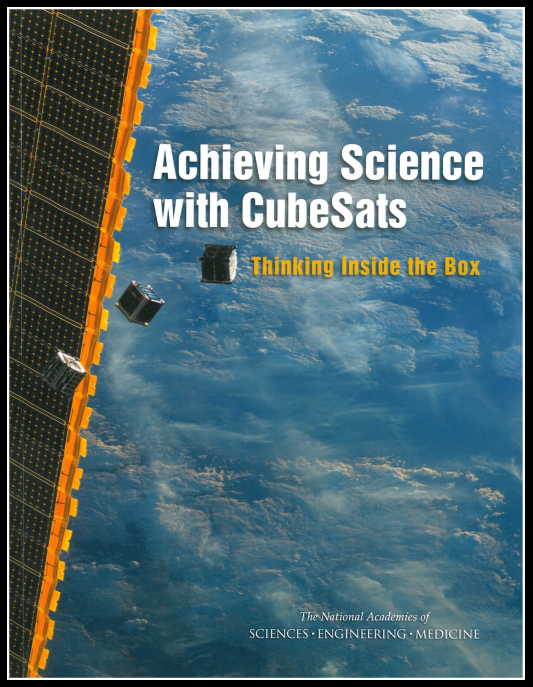
- CubeSat Launch Initiative
- SLS/Orion/Commercial

NASA Science:

- SmallSats in all solicitations
- Leveraging STMD technologies
- Augmenting Larger Missions

SMD CubeSat/SmallSat Approach

- A National Academies Report (2016) concluded that CubeSats have proven their ability to produce high-value science.
- In particular, CubeSats are useful as targeted investigations to augment the capabilities of larger missions or to make a highly-specific measurement.
- Constellations of 10-100 CubeSat/SmallSat spacecraft have the potential to enable transformational science.



SMD is developing a directorate-wide approach that has five objectives:

1. **Identify** high-priority science objectives in each discipline that can be addressed with CubeSats/SmallSats
2. **Establish** a multi-discipline approach and collaboration that helps science teams learn from experiences and grow capability, while avoiding unnecessary duplication
3. **Manage** program with appropriate cost and risk
4. **Coordinate** technology investments across NASA mission directorates and other government agencies
5. **Leverage** and partner with a growing commercial sector to collaboratively drive instrument and sensor innovation

National Academy Recommendations for NASA

- **Programmatic Recommendations**
  - Coordinate the directorates
  - Provide clearinghouse for technology, vendor information, lessons learned
  - Efficient and tailored development processes
  - Maintain variety of CubeSat programs with appropriate cost & risk postures
- **Education and training**
  - Use CubeSats for hands-on training
- **Constellations**
  - Develop implementation capability
- **Technology Investments**
  - Invest in high payoff technology
  - Analyze commercial capability on ongoing basis; partner when applicable
- **Policy**
  - Review policies to maximize return (tracking, deorbit, spectrum licensing, launch)

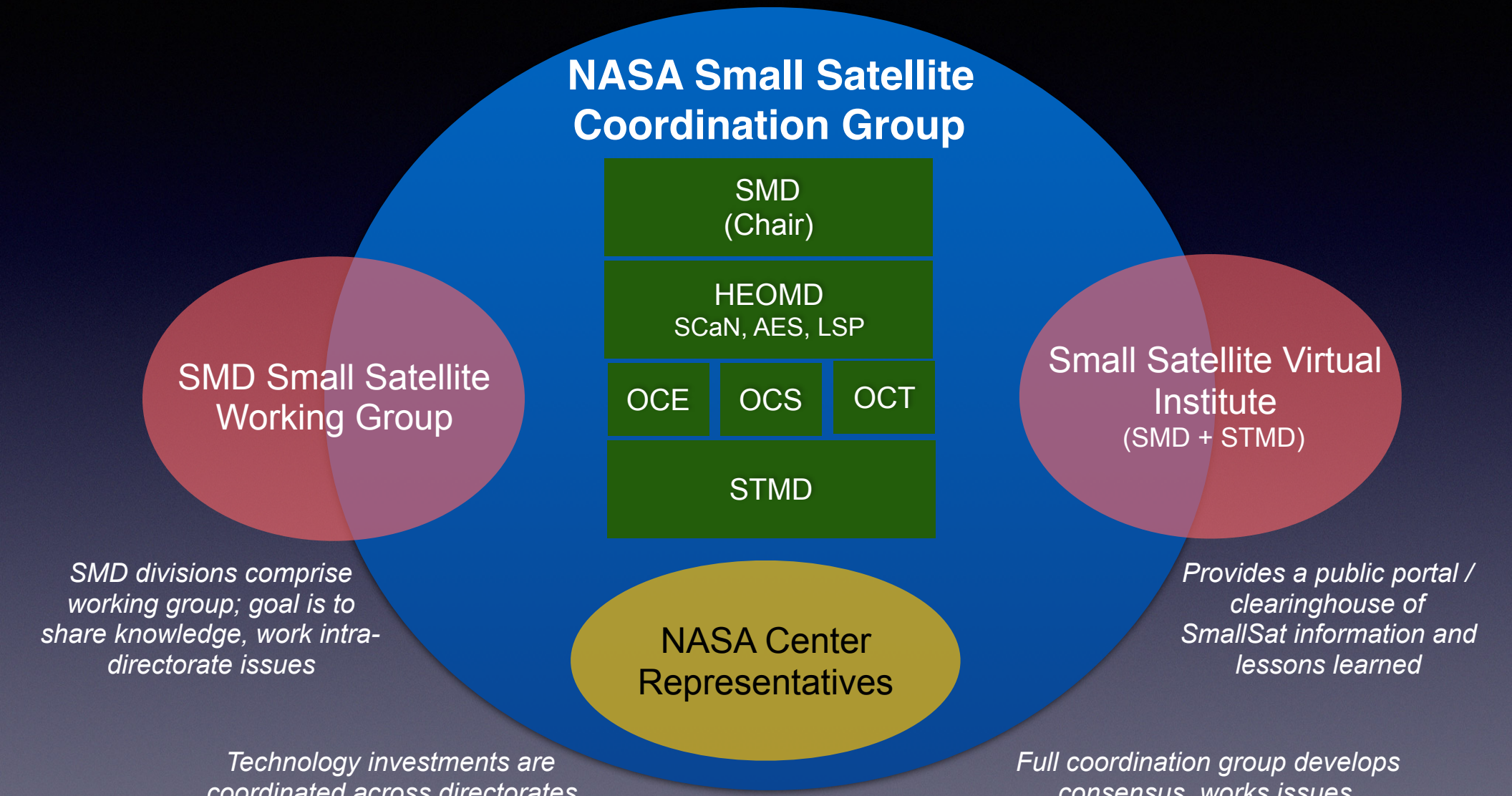
Most issues & topics have readily available actions (not starting from scratch). Need a forum for stakeholder discussion and concurrence to move out on actions.

Addressed by establishing:

- Small Spacecraft Coordination Group (SSCG)
- SMD SmallSat Working Group (SSWG)

With SMD SPE chairing both groups

SMD SMALLSAT STRATEGY - IMPROVING COORDINATION



SMD divisions comprise working group; goal is to share knowledge, work intra-directorate issues

Provides a public portal / clearinghouse of SmallSat information and lessons learned

Technology investments are coordinated across directorates and field centers

Full coordination group develops consensus, works issues, recommends actions

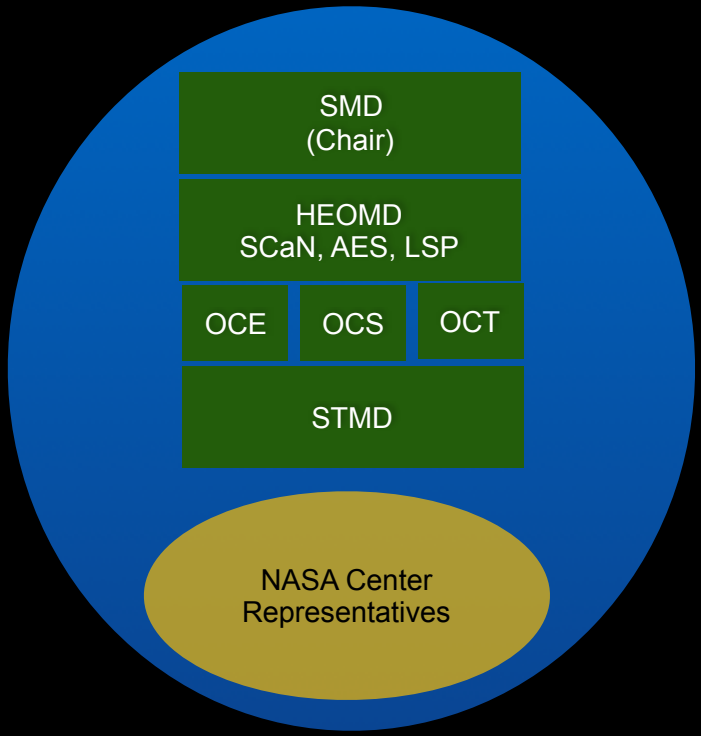
Implementation: Fall 2017

SSWG task list

- Review and make recommendations for the management and oversight of CubeSat and SmallSat programs
- Review TMC weaknesses for issues specifically affecting the implementation of CS/SS missions
- Standardize the AO process and language for CubeSats
- Address access to space issues, from CubeSats to ESPA-class rideshares
- Identify and maintain science objectives achievable with SmallSat platforms, mapped to technology developments, to create a SmallSat focus for cross-cutting technology investments for STMD.

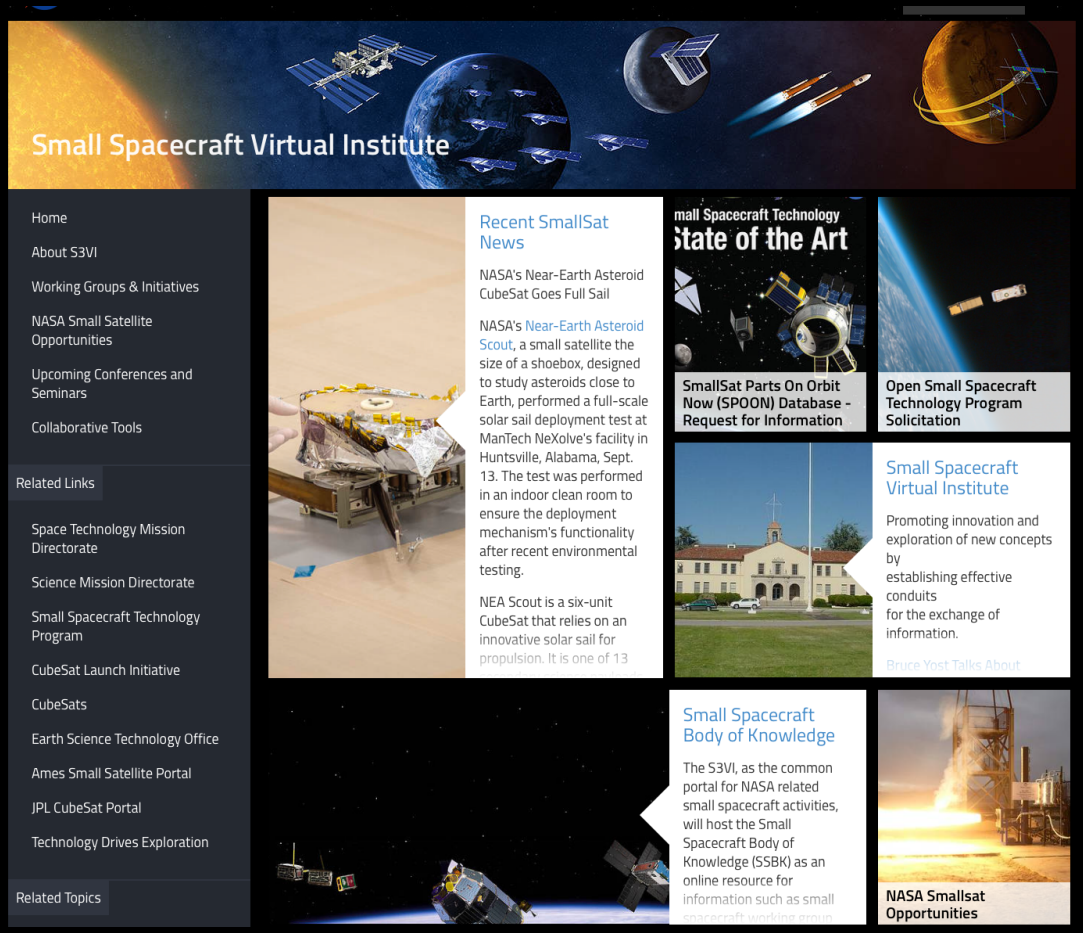
SSCG task list

- Policy related activities/issues
  - Providing advice to the Agency on small spacecraft and secondary payload matters
  - Formulate and review draft policy affecting effective management of small spacecraft, secondary payloads and rideshare initiatives
  - Mission Assurance, spectrum, orbital debris, etc
- Awareness of the small spacecraft activities in respective organizations
- Coordination of Roadmap and Small Spacecraft Implementation Plans
- Information on small spacecraft/secondary payload activities external to NASA
- Coordination of conference, workshops and other meetings



Small Spacecraft Systems Virtual Institue

https://www.nasa.gov/smallsat-institute



- **Small Spacecraft State of the Art (SoA) Report**
  - Current State of the Art Report available: https://sst-soa.arc.nasa.gov
  - Formulate and review draft policy affecting effective management of small spacecraft, secondary payloads and rideshare initiatives
  - Mission Assurance, spectrum, orbital debris, etc
- **Smallsat Parts on Orbit Now (SPOON) database**
  - Space Dynamics Laboratory / S3VI supported database architecture and process development
  - Dialog established with The Aerospace Corporation to federate SmallSatDB and LaunchLog (2018 activity)

CS/SS for astrophysics

Astrophysics driven by need to capture photons. We know that.

- Current opportunities for CubeSats and Smallsats:
  - APRA, <~$4M
  - Mission of Opportunity ($35-75M)
- Request for Information - Due November 30, 2017
  - Looking for concepts that fall between APRA and MoO (Topic 1)
  - ALSO looking for advanced concepts to guide technology investments (Topic 2).
  - Planetary RFI yielded **lots** of useful information (and 102 responses!), particularly wrt needed technologies.