National Aeronautics and Space Administration

CBPSS
Fall 2022 Meeting: Research Resource Trends and Challenges

Diane C. Malarik
Deputy Director
Biological and Physical Sciences Division
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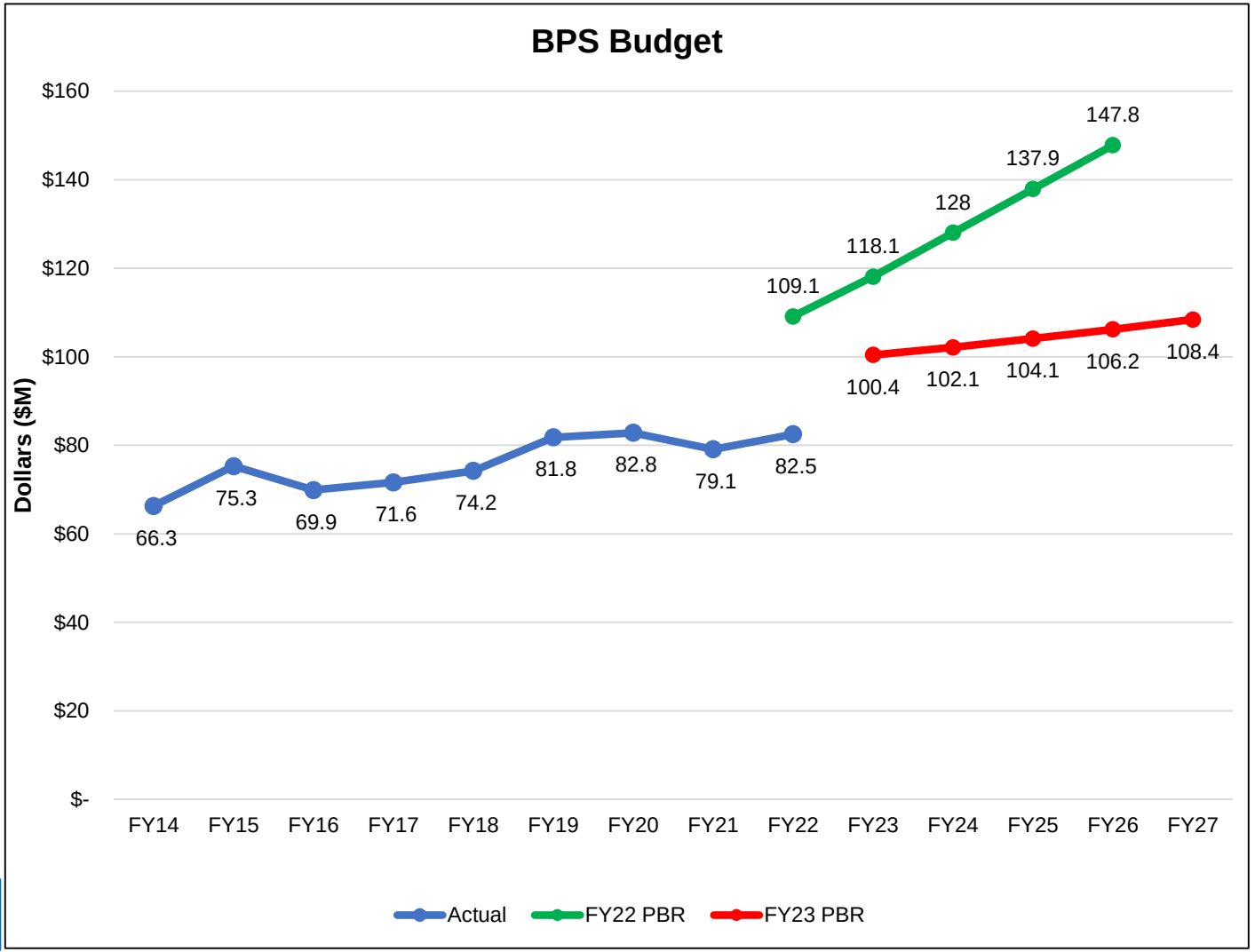
BPS Research Trends

BPS Budget

- **Moving from Human Exploration and Operations Mission Directorate (HEOMD) to Science Mission Directorate (SMD) has been beneficial to the BPS research community**
  - Advocacy within NASA HQ Senior Leadership
  - BPS has its own line in the congressional budget; no longer buried within the ISS budget in HEOMD
  - Decadal Survey will provide small number of highest priority transformational science
  - Small growth in appropriations but moderate growth in President's Budget Request (PBR) in Mar 2022

2005 Budget ~$450M = $686M in 2022 dollars

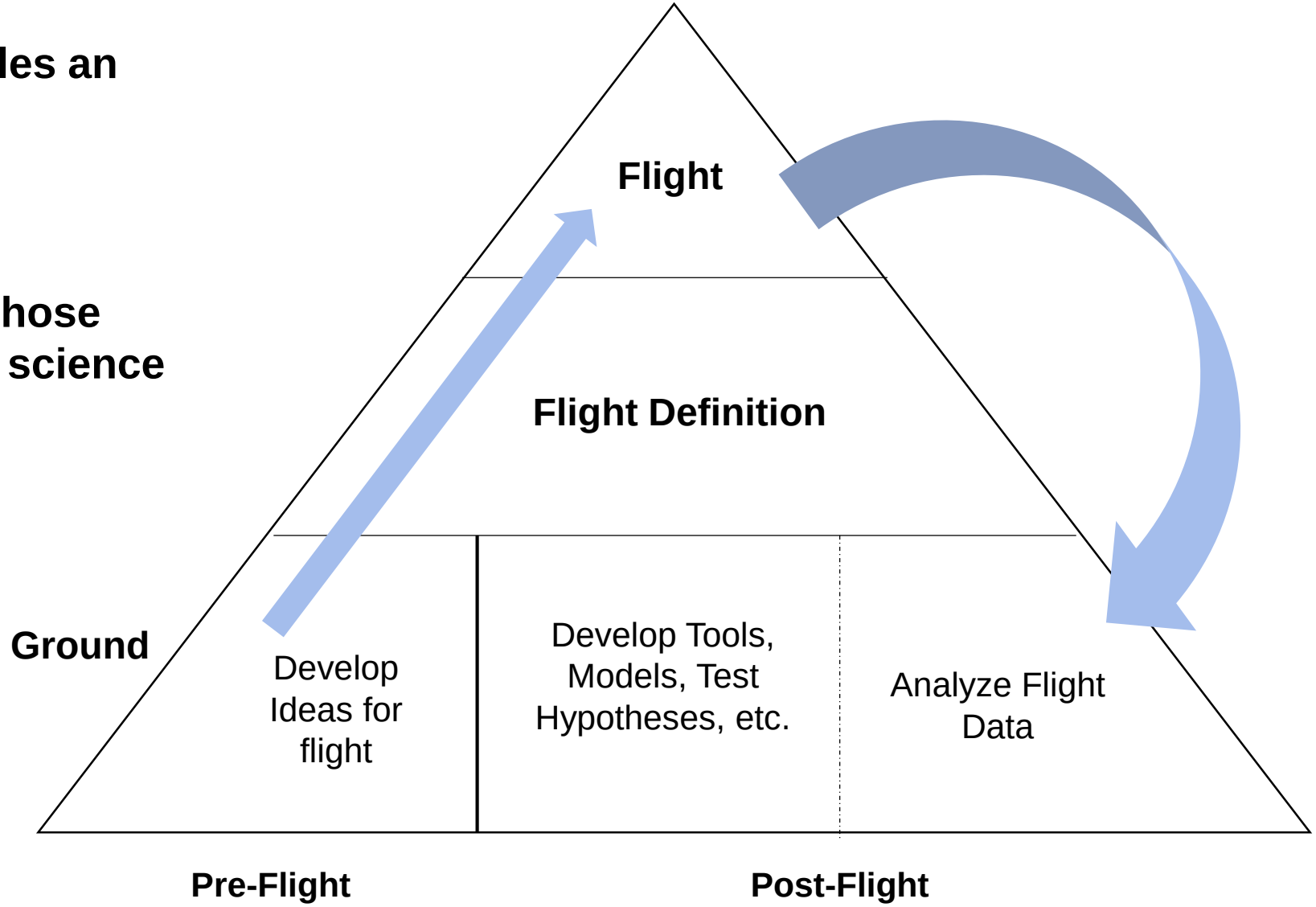


Historical Program Composition (Notional)

Healthy ground program enables an effective flight program

Select large number for flight definition and down select to those most feasible and with largest science return for the planned budget

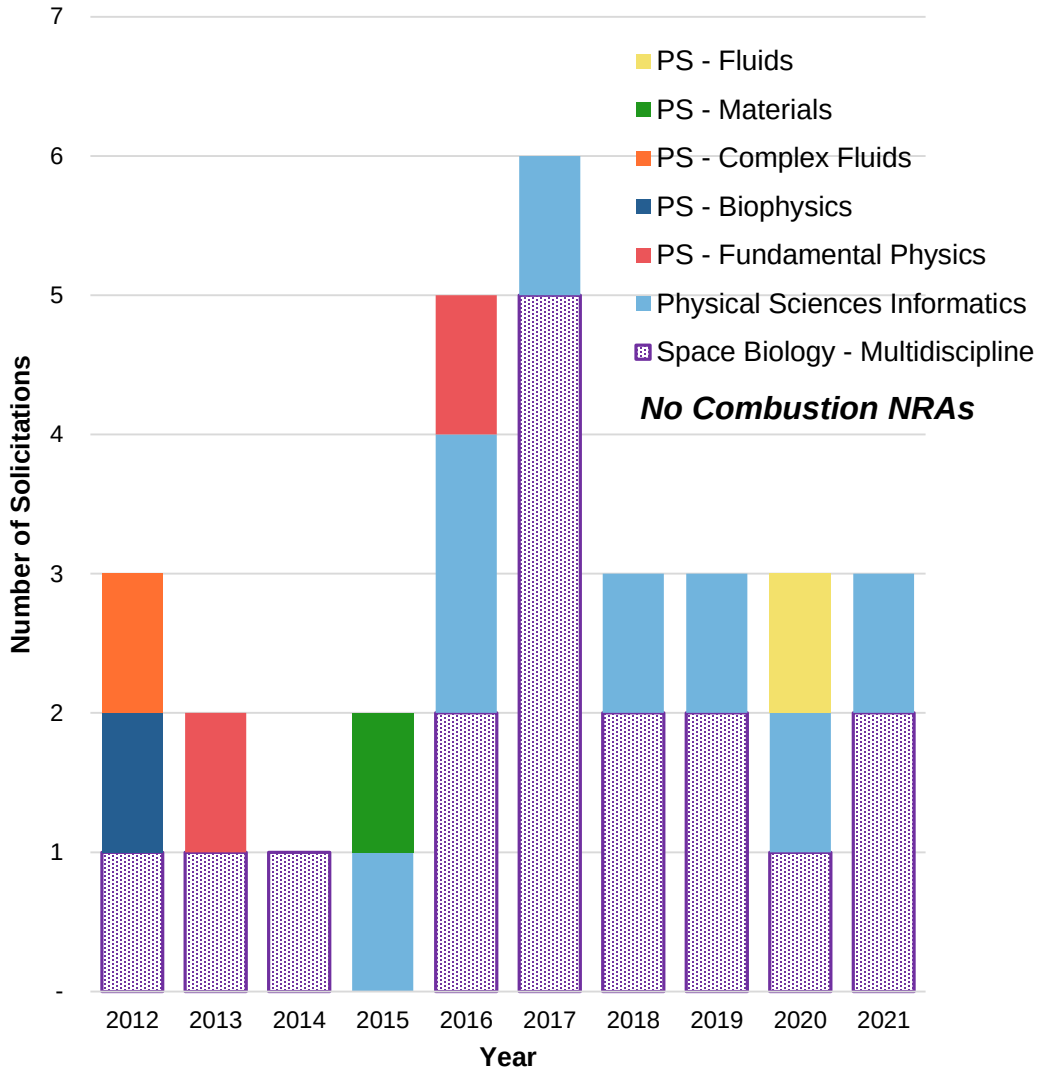
No ground program in PS to develop ideas for flight



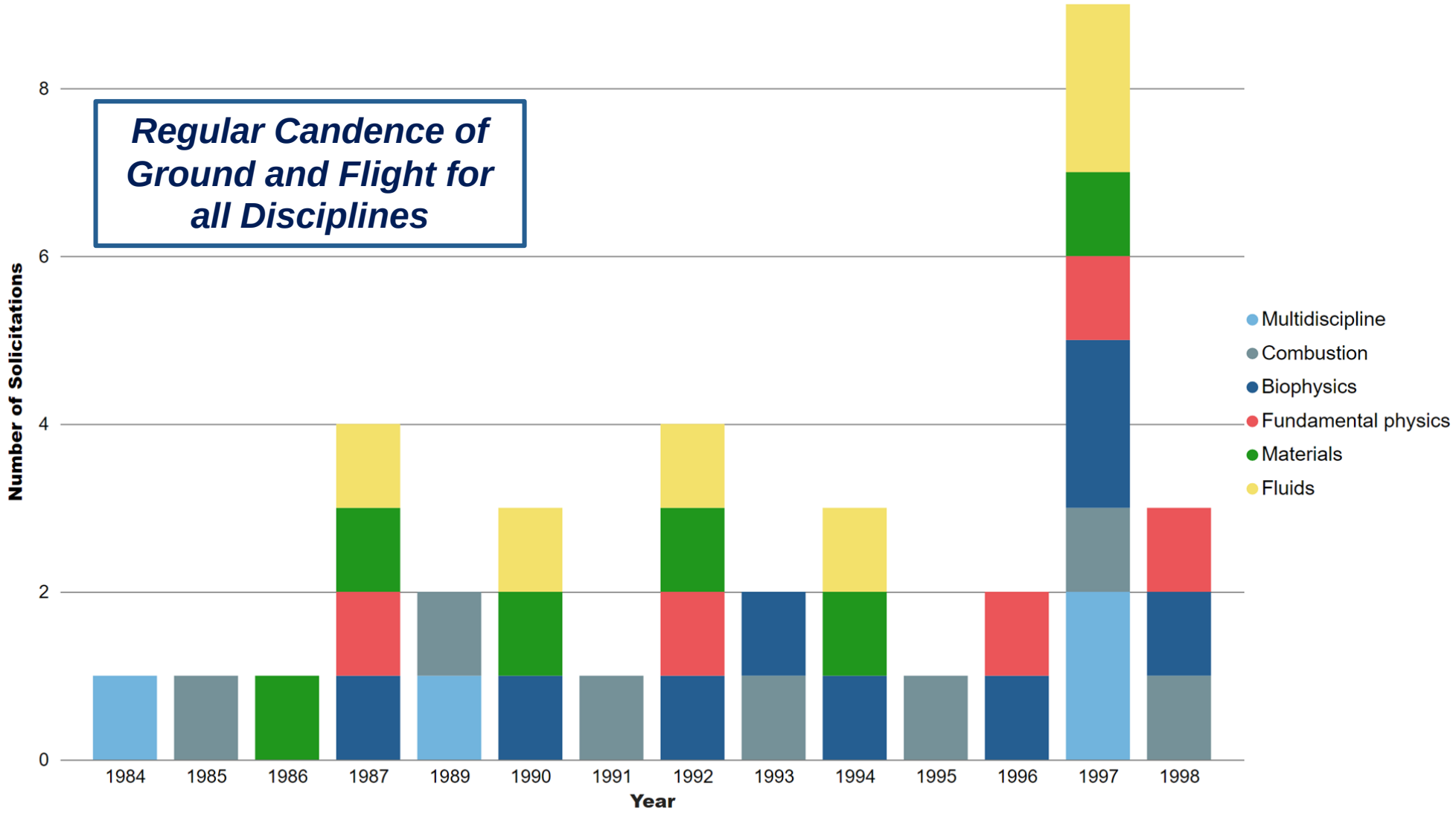
BPS Solicitations: 2012-2021

NASA Research Announcements (NRAs) cadence has been limited by budget constraints, as compared to historical levels

- **Space Biology has maintained an annual cadence of solicitations (multi-discipline flight and ground), resulting in a more robust research community. However, total available $ to make grants have reduced**
  - Less new hardware due to ability to re-use (rodents, plants, etc.)
- **Physical Sciences had very few solicitations, resulting in a less robust research community**
  - Due to relative high cost of unique Physical Science hardware, research has limited depth in any given discipline
  - Small number of flight selections, with no ground development program
  - Uses large amount international hardware (EML, ELF, MSRR, DECLIC, BECCAL, SMD)



Physical Sciences Solicitations: 1984 - 1998

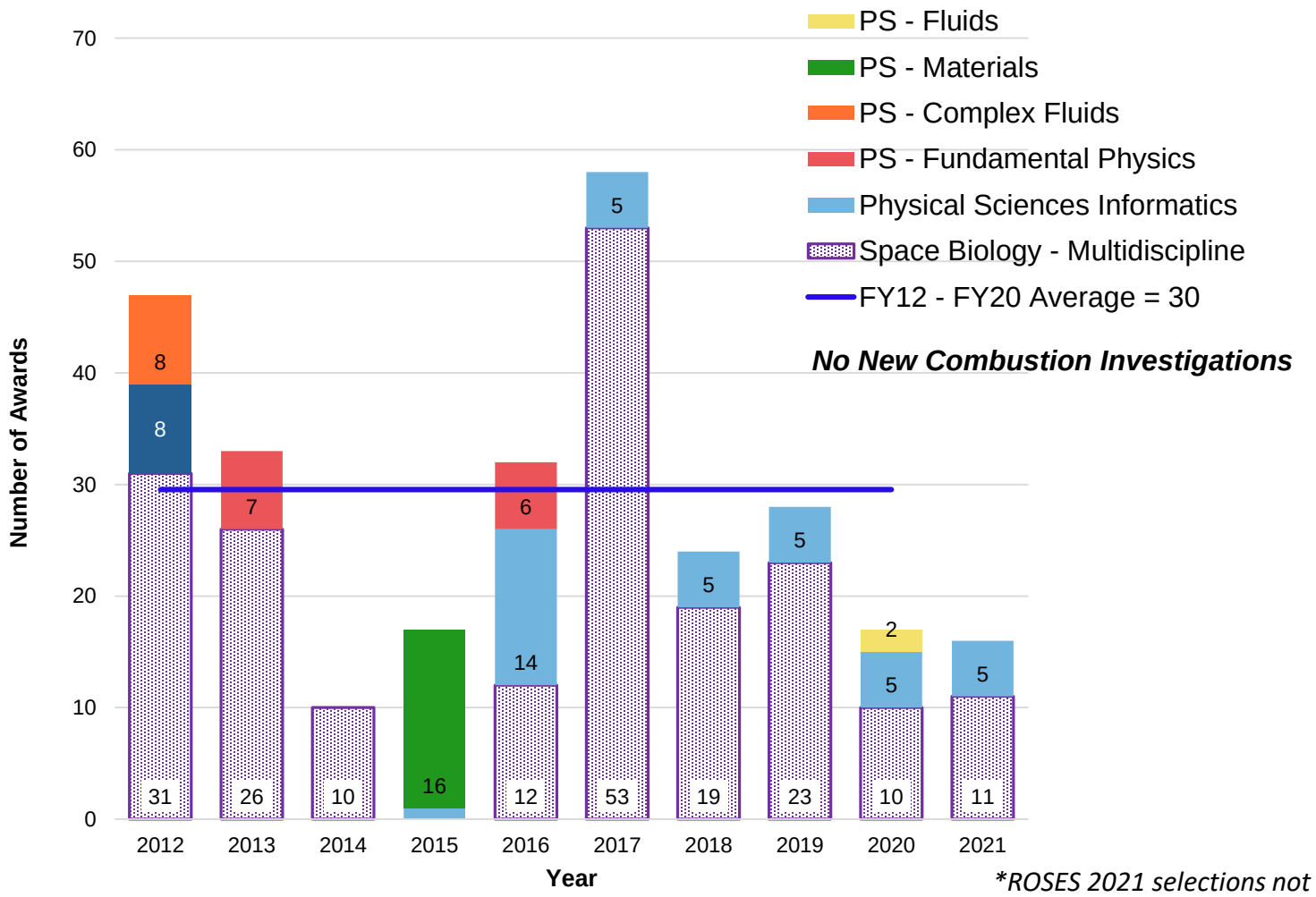


BPS Selections: 2012-2021

Low number of NRAs directly correlates with fewer selections

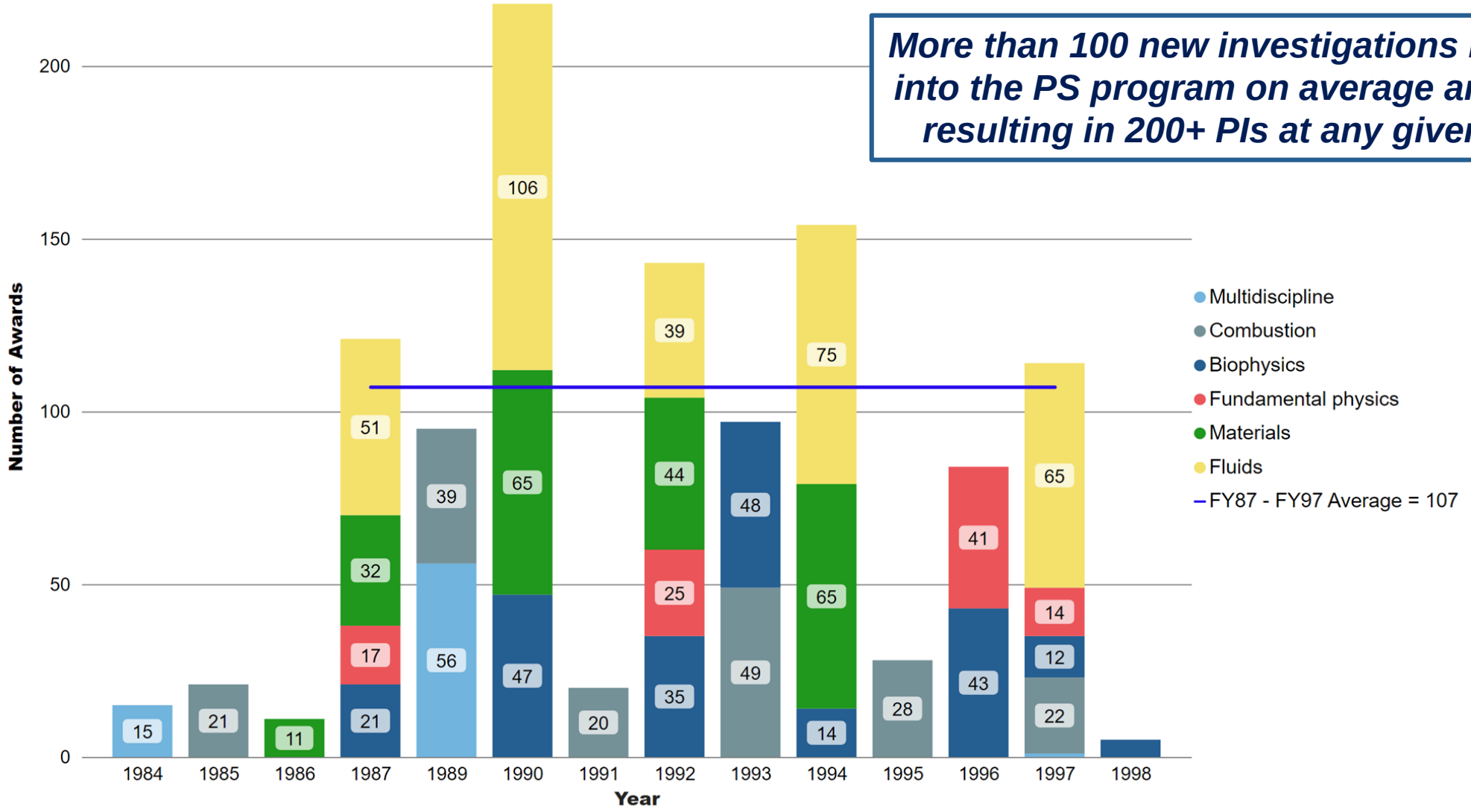
Due to high cost of unique Physical Science hardware, research has limited depth in any given discipline in PS

SB solicits largely in areas where hardware exists, limiting its breadth



*ROSES 2021 selections not completed

Physical Sciences Awards: 1984 - 1998

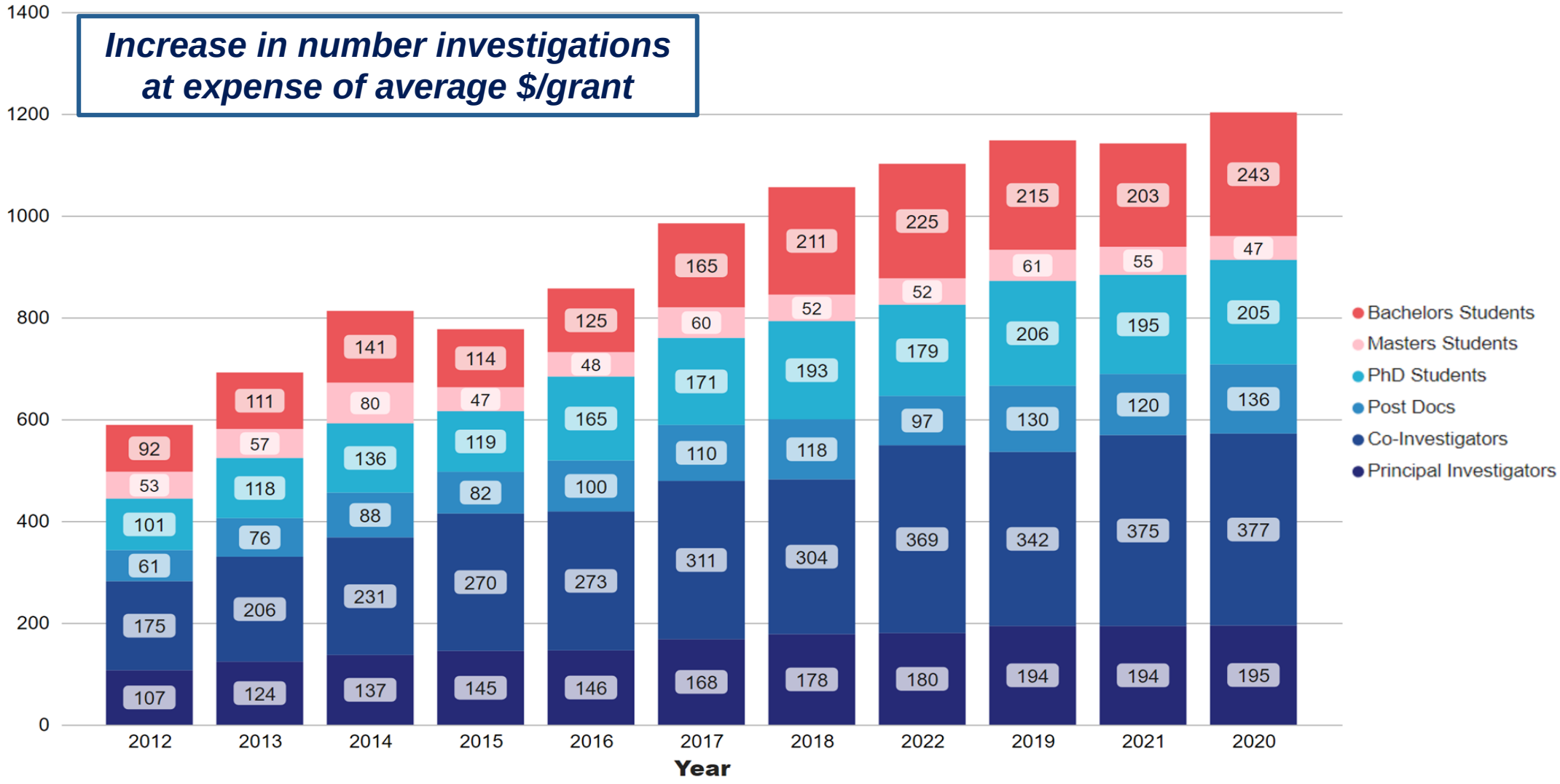


BPS Solicitation Changes Last 10 Years

- **Award length**
  - Typical grants are three-year awards, but some are shorter
    - One year for Space Biology Early Career Investigations
    - Two years for Physical Science Informatics
  - Flight project awards can be as long as ten years or more
- **Brisk flow of new PIs into BPS Space Biology**
  - The last three large Space Biology annual solicitations saw new PIs as 60%, 47%, and 40% of the total selected awardees;
  - GeneLab Analytical Investigation and Early Career Investigation selections at a relative low cost of up to $100K for one year to conduct pilot studies.
  - Lower turnover in Physical Sciences than in Space Biology
    - Most Physical Sciences PIs are on flight projects with long development times and execution schedules

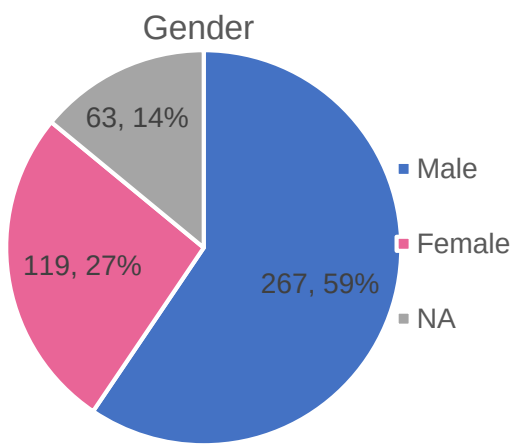
Principal Investigators and Students

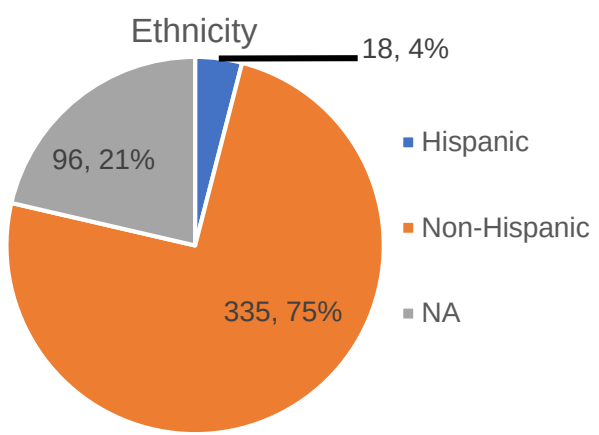
Increase in number investigations at expense of average $/grant

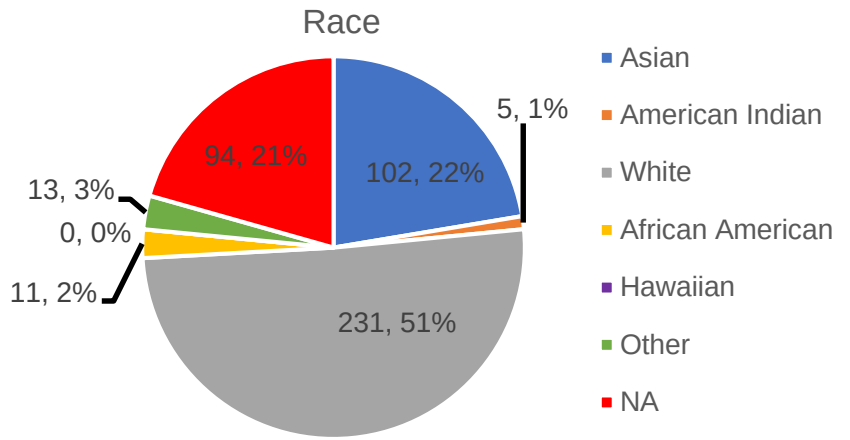


Diversity of BPS Principal Investigators (2016 – 2018)

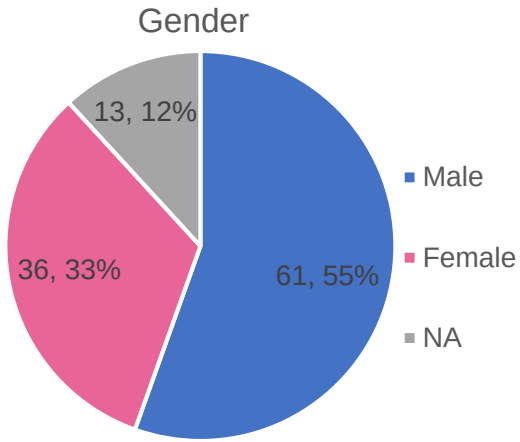
Total Proposals Submitted

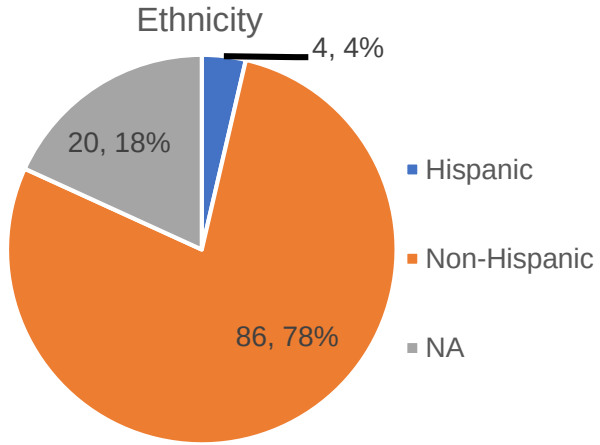


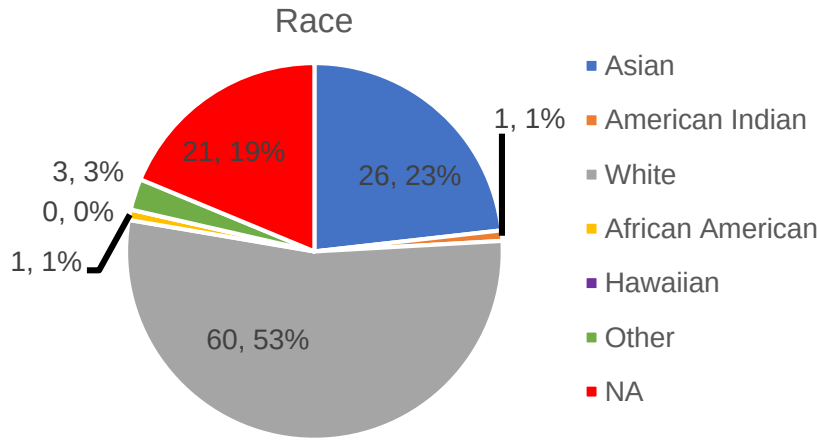




Proposals Selected



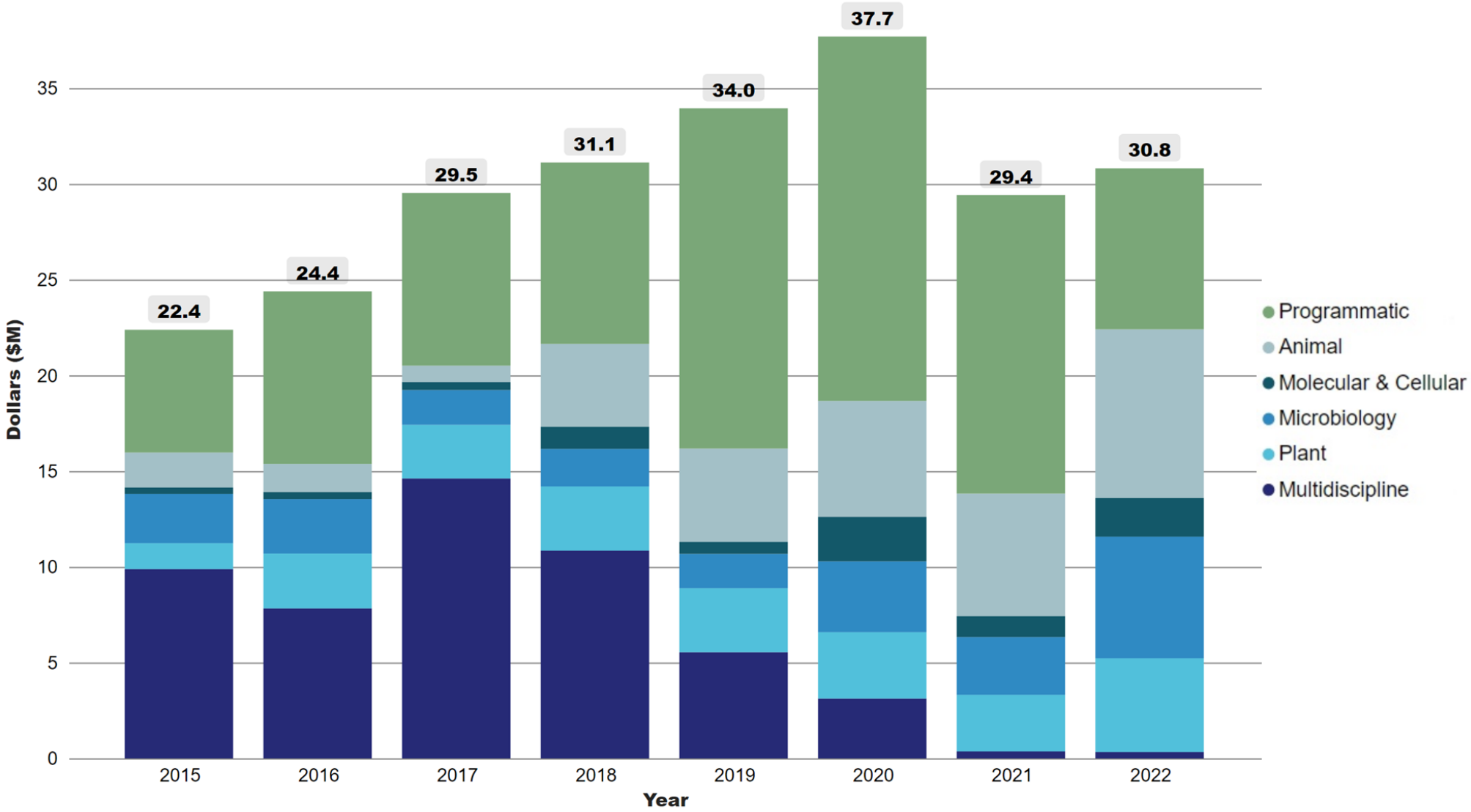




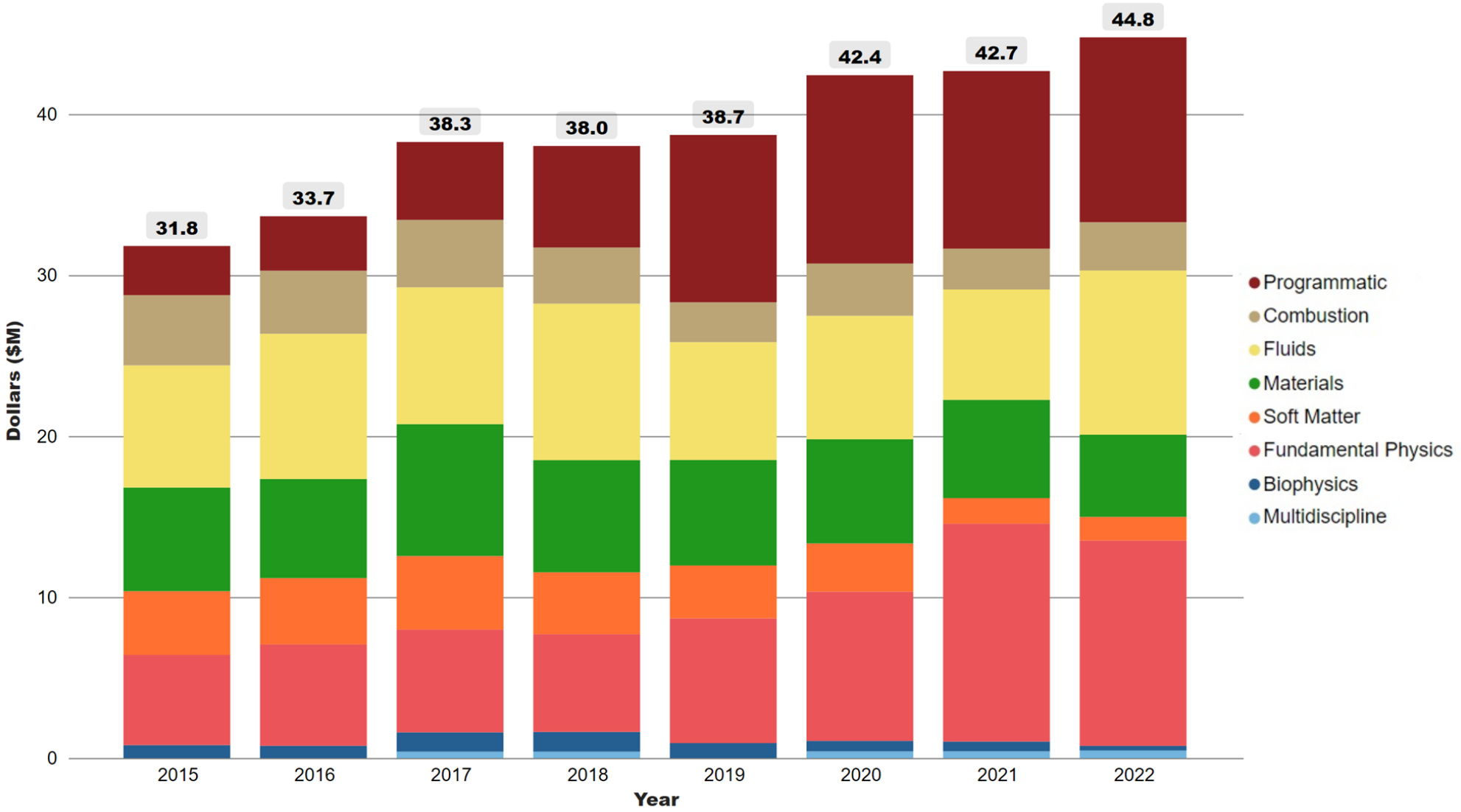
BPS participates in SMD's initiatives to address Diversity, Equity, Inclusion and Access (DEIA)

**2016 to 2018;Voluntary diversity data collection began in 2016*

Space Biology Funding by Research Area



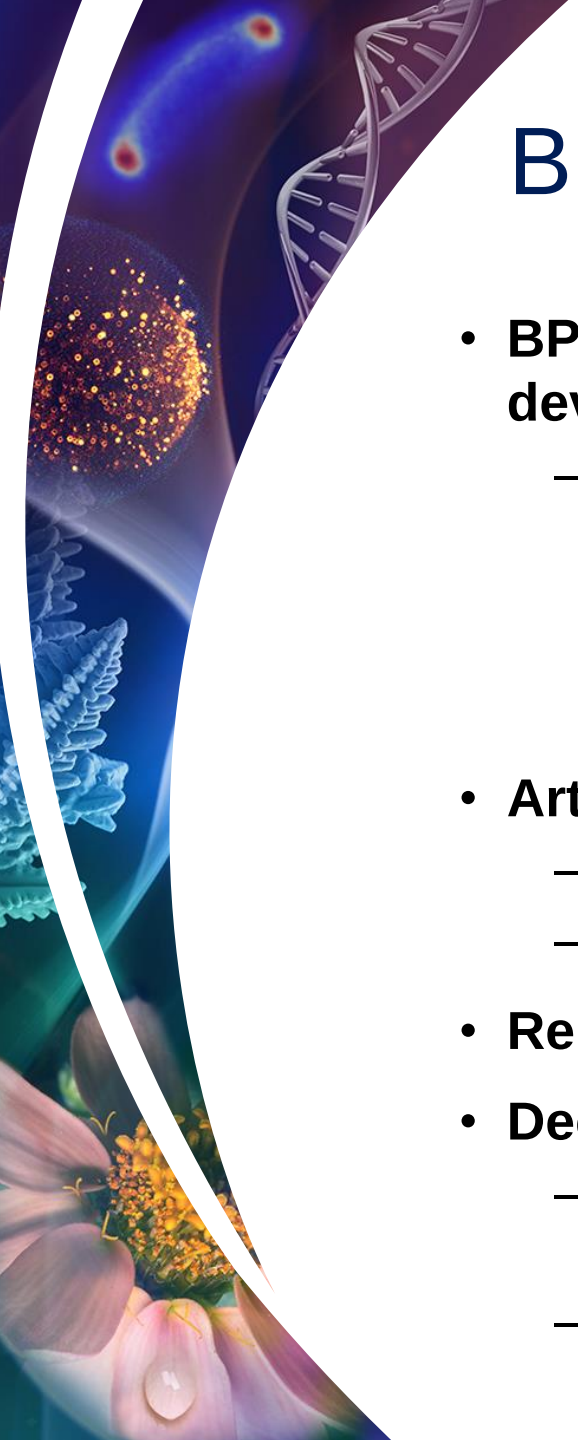
Physical Sciences Funding by Research Area



BPS Solicitations Future

- **Future of BPS research solicitations is dependent on our budget and Decadal recommendations**
- **Within current budget FY22-27, BPS NRA plans are:**
  - Annual multi-discipline Space Biology research (ground and flight)
  - Annual Physical Sciences Informatics (PSI) Database-based research (ground)
  - Annual Quantum Science (ground)
  - Bi-annual Quantum Science (flight)
  - One in each of Fluids, Materials and Soft Matter (flight)
- **If BPS budget grows beyond the President's Budget Request (PBR)**
  - Develop robust ground program to complement the flight program
  - Develop new hardware for Beyond LEO and solicit for its use
  - Develop new hardware for ISS that can be transitioned to CLDs and solicit for itsuse

BPS Challenges



BPS Challenges

- **BPS must develop new research capabilities while vehicles are in development**
  - Commercial LEO Destinations (CLD) are the future for LEO
    - BPS research is highly subsidized in ISS era (launch, crew time, facility rack hardware, Mission Integration and Operations, etc.)
    - Uncertainty in availability facility rack hardware (Veggie, APH, animal habitats, FIR, CIR, MSRR, LSG, MSG, EXPRESS, etc.) and who will pay to develop or rent it)
- **Artemis Era: Critical research to enable humans to go farther and stay longer**
  - Resources (crew, mass, volume, power, thermal) are uncertain
  - Current budget does not support developing new hardware for Artemis research
- **Rebuilding the Physical Sciences research community**
- **Decadal Survey**
  - Decadal Survey will recommend new transformative research requiring new capabilities
  - Current BPS budget projection does not support a decadal wedge

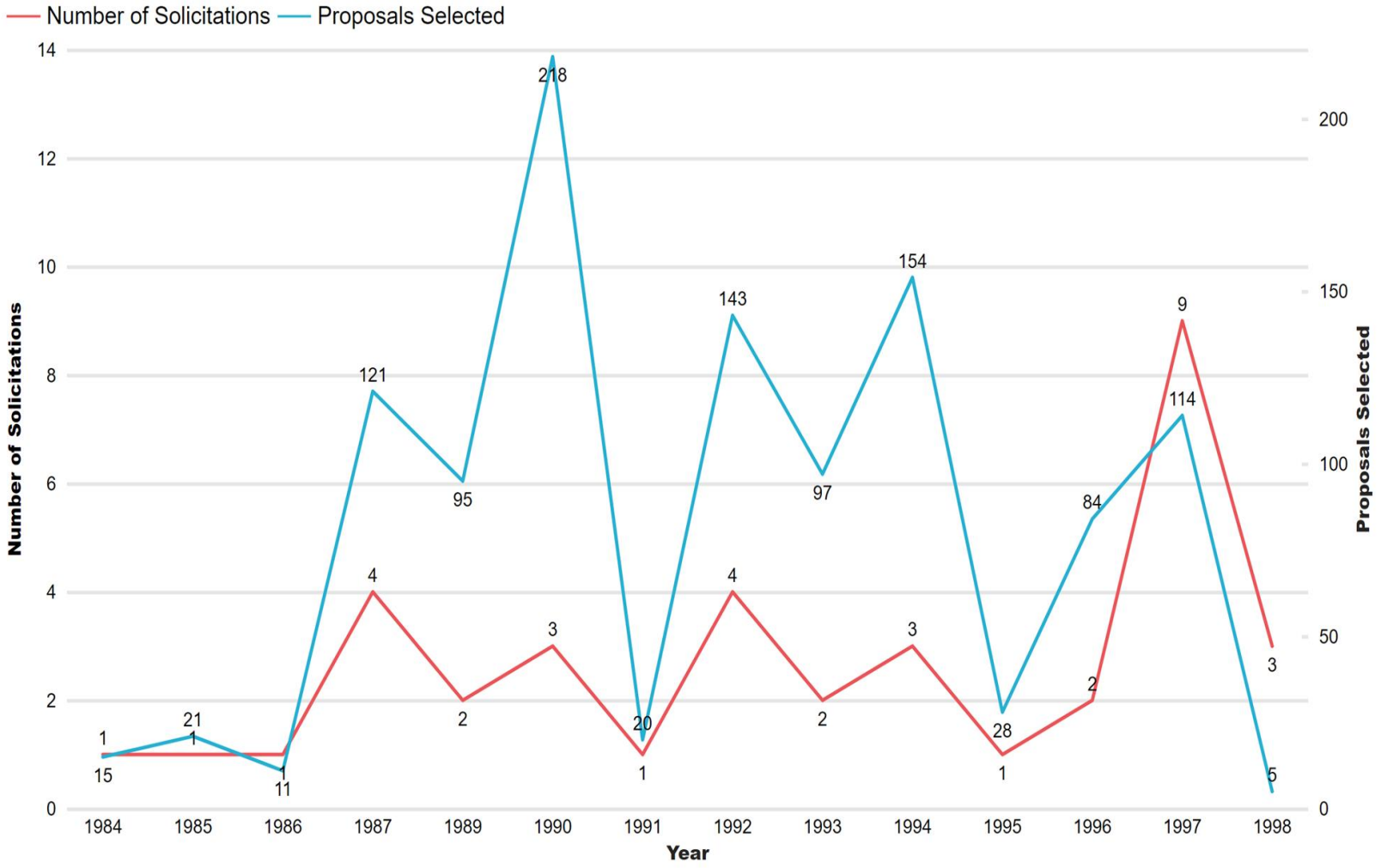
Conclusions

- **BPS is better positioned to perform transformational science in the next decade**
- **BPS has staff and plans to transition to CLD era**
- **BPS is anxiously awaiting the delivery of the Decadal Survey NET Jun 2023**

Backup

Acronyms

BPS Resources: Acronyms			
APH	Advanced Plant Habitat	BECCAL	Bose-Einstein Condensate and Cold Atom Lab
BPS	Biological and Physical Sciences Division	CBPSS	Committee on Biological and Physical Sciences in Space
CIR	Combustion Integrated Rack	CLD	Commercial LEO Destinations
DECLIC	Device for the Study of Critical Liquids and Crystallization	DEIA	Diversity, Equity, Inclusion, and Access
ELF	JAXA's Electrostatic Levitation Furnace	EML	NASA Kennedy Space Center's Electromagnetic Lab
EXPRESS	EXpedite The PRocessing of Experiments to Space Station	FIR	
HEOMD	Human Exploration and Operations Mission Directorate	LEO	Low Earth Orbit
MSG	Meteosat Second Generation	MSRR	Materials Science Research Rack
NASA	National Aeronautics and Space Administration	NET	NASA Employee Team
NRA	NASA Research Announcements	PBR	Presidential Budget Request
PI	Principle Investigators	PS	Physical Sciences
PSI	Physical Sciences Informatics	SB	Space Biology
SMD	Science Mission Directorate	Veggie	The Vegetable Production System

Historical Perspective: Physical Sciences 1984 - 1998

BPS Predecessor Organizations: Hundreds of new investigations in Physical Sciences Annually