Consistent Funding of Outer Planets Activities in PSD ROSES Solicitations

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Limits on this Discussion

- I will speak about funding of Outer Planets-related research in PSD R&A

- Topics I will defer to others to discuss include:
  - Budget breakdowns not included in these slides
  - Future budgets
  - PSD policy

Instrumentation

- The instrument development programs are not included in the numbers presented here
- MatISSE and PICASSO, as well as their predecessors, support the development and maturation of flight hardware
- PSD has received funding and direction from Congress to support the development of instrumentation and spacecraft systems necessary for the exploration of the outer solar system

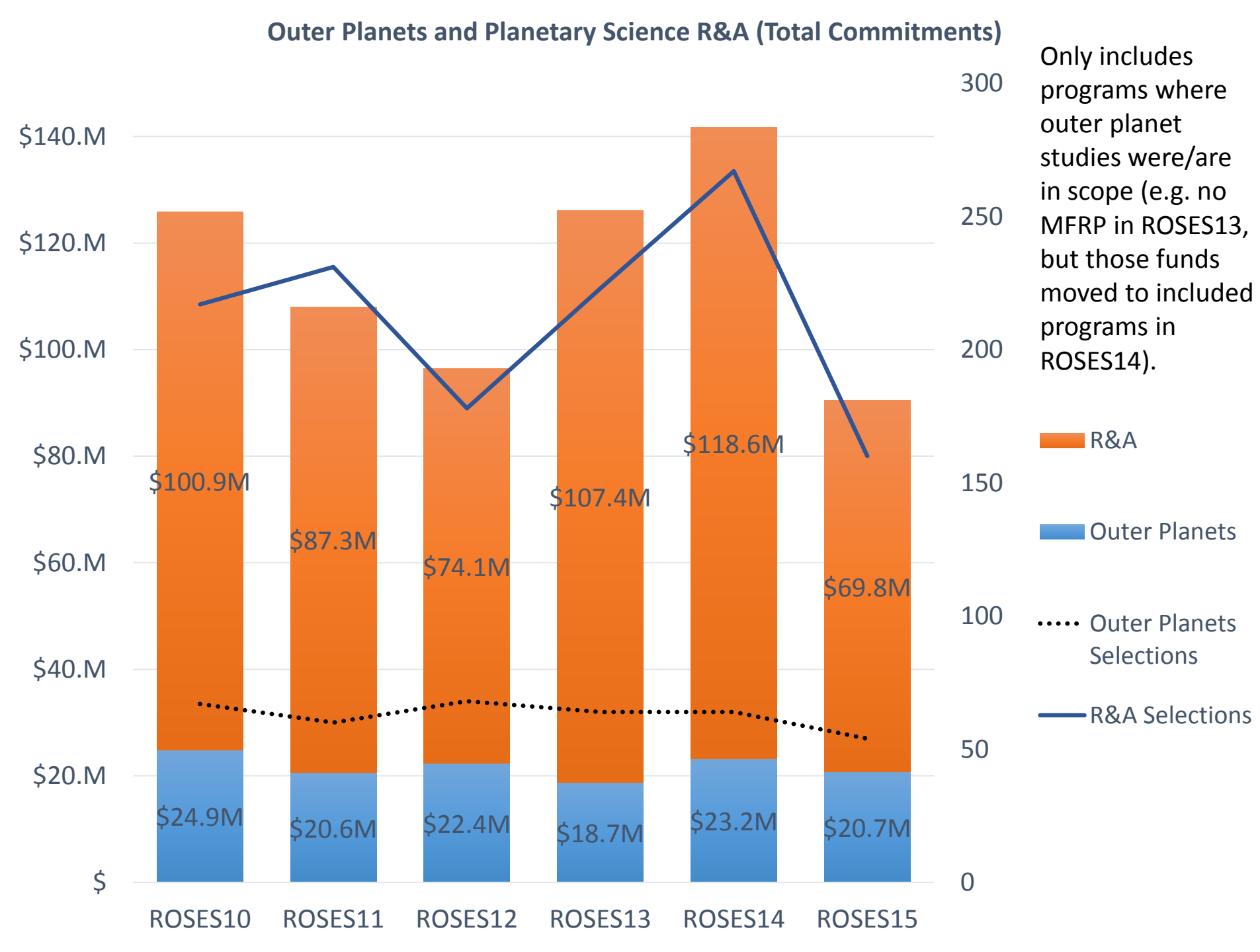
COLDTech

- Concepts for Ocean Worlds Life Detection Technology (COLDTech) is a program element solicited in ROSES15 for the explicit purpose of supporting “the development of spacecraft-based instruments and technology for surface and subsurface exploration of ocean worlds such as Europa, Enceladus, and Titan” and “instruments and technologies relevant to [a potential Europa lander].”

- The solicitation specifies the expected budget of ~$20M/year for these two-year, Outer Planets-only awards

Introduction to the Conclusions

- The data used are
  - All outer planets selection and funding across select ROSES programs, by year
  - All selections and funding for all programs, by year, for which outer planets studies was/is in their scope (even if they never received outer planets proposals)
  - Expressed in total funding commitment for all task years (a 3-yr $100k/yr and a 2-yr $150k/yr award will both add $300k to the ROSES year they were selected in)
- These data
  - Reflect outer planets funding but not all PSD ROSES funding
  - Can not be used to compare outer planets funding or selection numbers to those of the more-general R&A programs
  - Can not be used to look at changes across the ROSES13/-14 boundary
  - May undercount the outer planets-applicable funding (~5% level) in any year; it may be slightly more for ROSES15, which is being finalized now


Outer Planets and Planetary Science R&A (Total Commitments)
$140.M
$120.M
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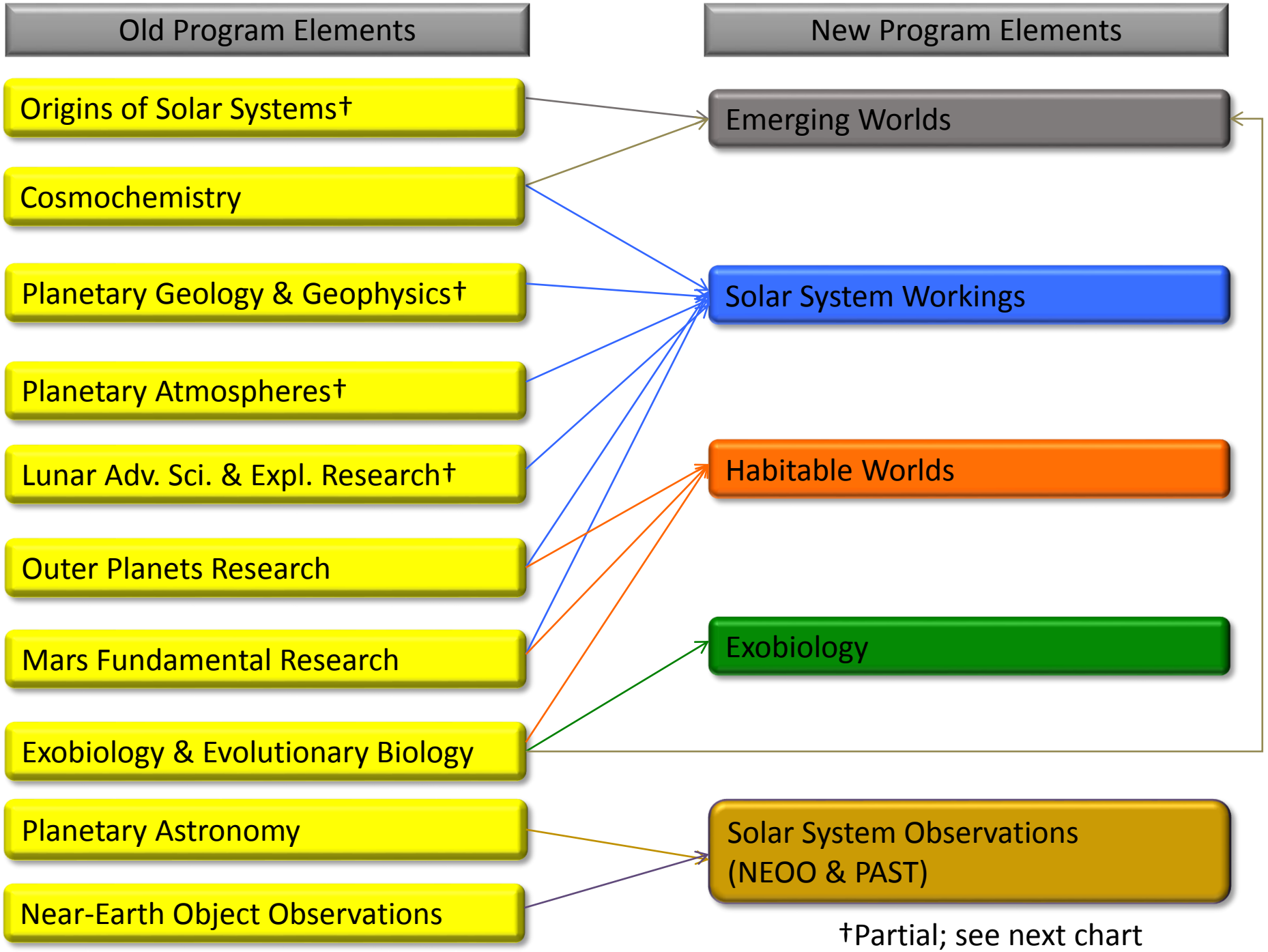
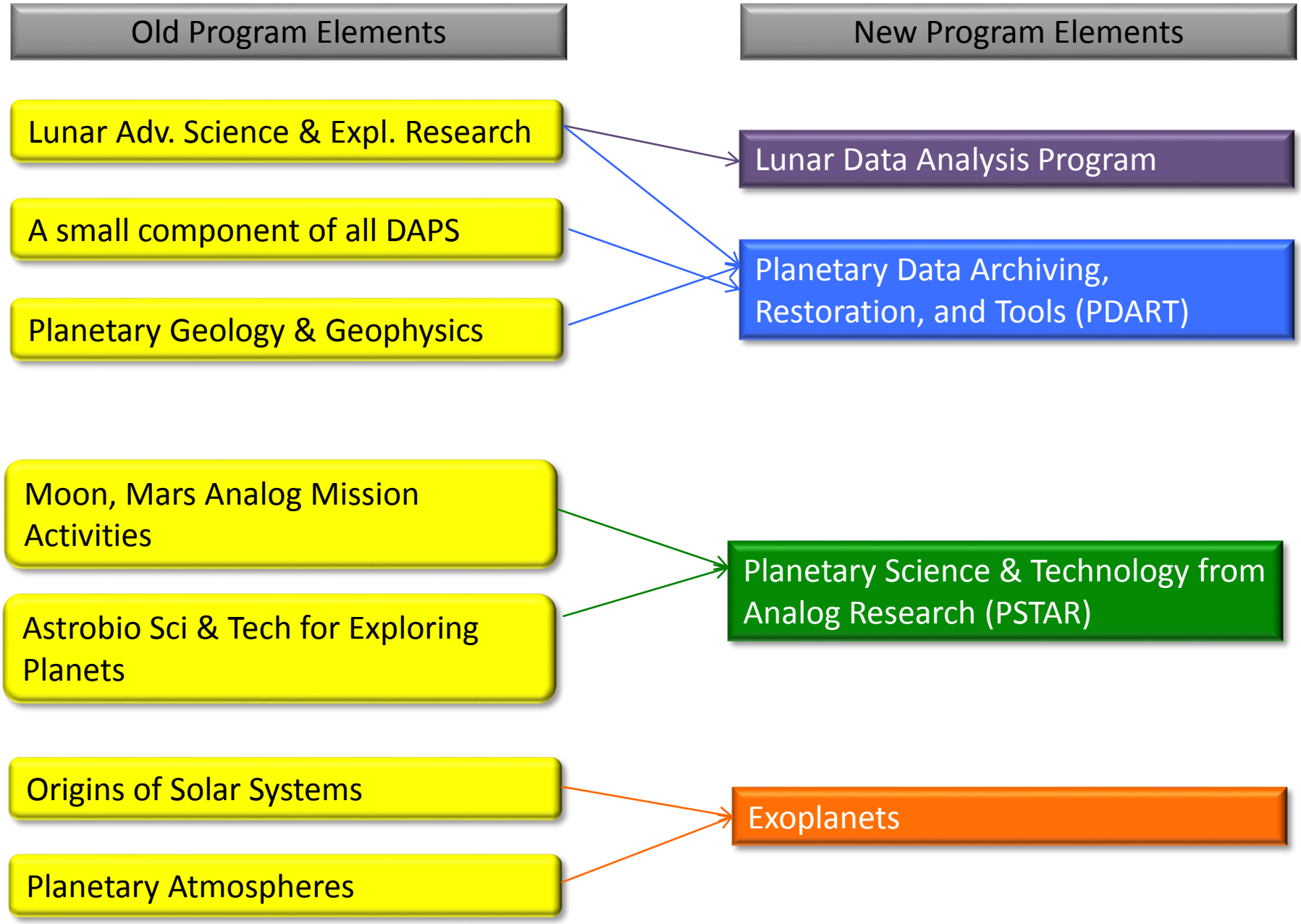
$23.2M
$20.7M
ROSES10
ROSES11
ROSES12
ROSES13
ROSES14
ROSES15
Only includes programs where outer planet studies were/are in scope (e.g. no MFRP in ROSES13, but those funds moved to included programs in ROSES14).
R&A
Outer Planets
Outer Planets Selections
R&A Selections

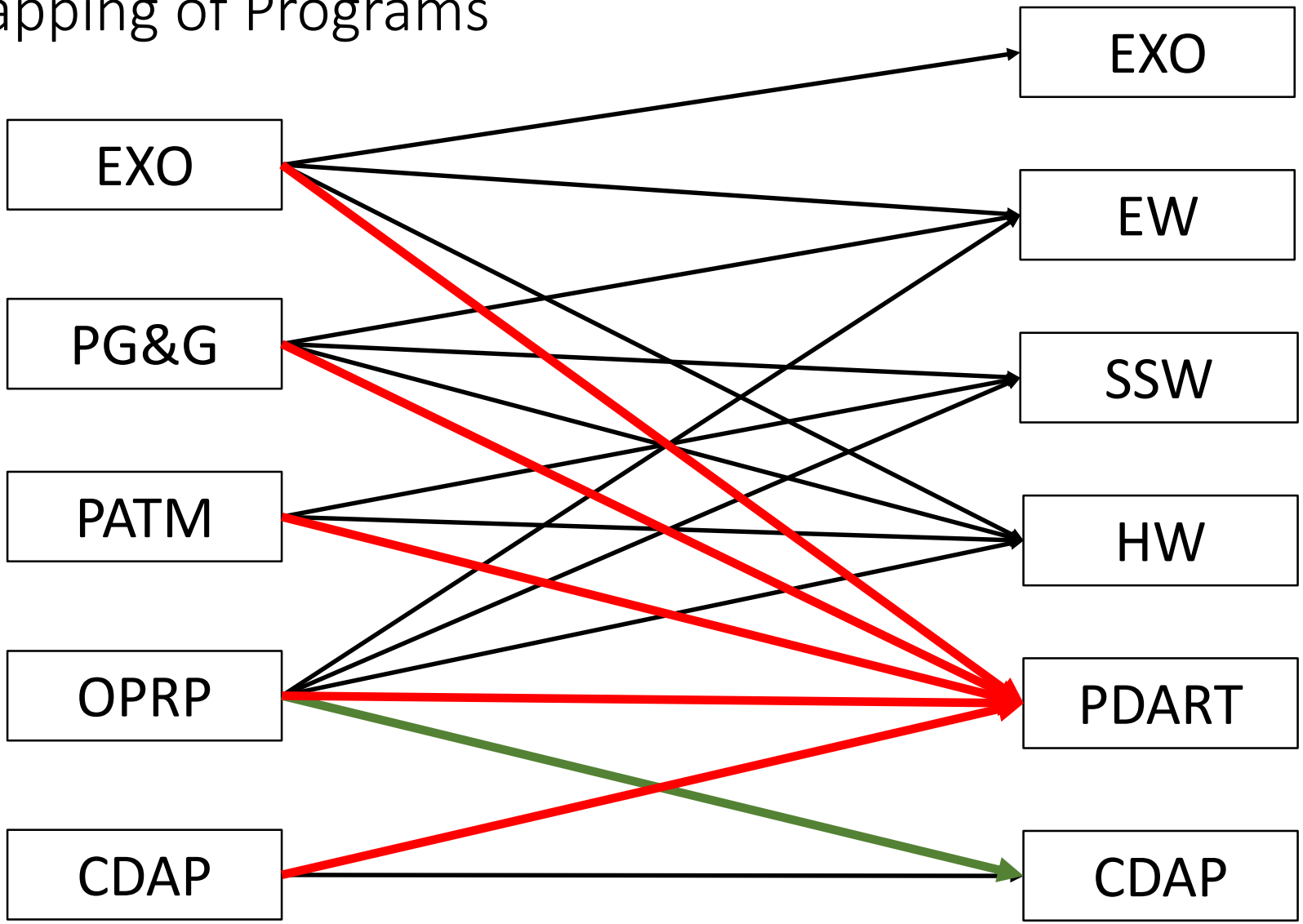
Funding of Outer Planets in PSD R&A

- Consideration of all relevant programs
  - CDAP, EW, EXO, HW, OPRP, PAST, PATM, PGG, PDART, SSO, SSW
- Consistent treatment of PDART-type proposals
  - Don’t count pre-ROSES2014 selections or count PDART selections
- Account for transfer of OPRP Cassini studies to CDAP
  - Reduce OPRP portfolio by 1/3 or count CDAP pre- and post-ROSES2014
- Account for differences in budget requests, descopes and pilot studies, etc.
  - Look at money released by a program, not just number of selections


Old Program Elements
New Program Elements
Origins of Solar Systems†
Cosmochemistry
Planetary Geology & Geophysics†
Planetary Atmospheres†
Lunar Adv. Sci. & Expl. Research†
Outer Planets Research
Mars Fundamental Research
Exobiology & Evolutionary Biology
Planetary Astronomy
Near-Earth Object Observations
Emerging Worlds
Solar System Workings
Habitable Worlds
Exobiology
Solar System Observations
(NEOO & PAST)
†Partial; see next chart


Old Program Elements
New Program Elements
Lunar Adv. Science & Expl. Research
A small component of all DAPS
Planetary Geology & Geophysics
Lunar Data Analysis Program
Planetary Data Archiving, Restoration, and Tools (PDART)
Moon, Mars Analog Mission Activities
Astrobio Sci & Tech for Exploring Planets
Planetary Science & Technology from Analog Research (PSTAR)
Origins of Solar Systems
Planetary Atmospheres
Exoplanets

More Accurate (and a busier) Mapping of Programs



Mapping of scope, not proposals or budget;
except for OPRP->CDAP, which is budget.

PDART-type Proposals

- PDART (Planetary Data Archiving, Restoration, and Tools) is a program first solicited in ROSES 2014
- PDART does not fund science investigations, the term PSD uses to refer to those efforts that would answer science questions or test science hypotheses
- PDART funds efforts that would produce or otherwise make available data sets, higher-order data products (including USGS geologic maps), databases, or software tools that would enable or enhance science investigations

PDART-type Proposals

- Although the PDART program is new, PSD has been funding these PDART-type efforts in previous ROSES years through the Core Programs and the Data Analysis Programs
  - "Types of research solicited by this program include, but are not limited to: …Development and production of cartographic products from planetary datasets; Generation of new data in a laboratory or field environment…" **[PGG13]**
  - "The scope of the Planetary Atmospheres activity also includes laboratory investigations that supply basic physical measurements that are currently needed to interpret planetary data, including measurements and calculations of spectroscopic, optical, and thermodynamic properties of materials found in planetary atmospheres." **[PATM13]**
  - "Investigators may propose tasks that involve one or more of the following activities that support the program goals above: Development of…laboratory studies…relevant to the interpretation of mission data listed above or the evolution and dynamics of giant planets, their satellites, and other small bodies in the outer Solar System…" **[OPR13]**
  - "Proposals to produce a higher order data product that enhances the science return from the mission; investigations that incorporate theory, modeling, laboratory studies, correlative analyses; and/or other research that would greatly increase the use of, or significantly facilitate the interpretation of, data from the mission are also eligible for CDAPS. Such proposals that don't directly analyze data but are intended to amplify its interpretation will be judged upon the perceived impact of the proposed work on the interpretation of Cassini data." **[CDAPS13]**

PDART-type Proposals

- A Global Geologic Map of Enceladus
- Infrared Molecular Spectroscopy of Hydrocarbons for Planetary Atmospheres
- Electron Impact Induced Oxygen and Sulfur Emission Studies Important to the Jovian Satellites
- Spectral Characterization of Planetary Surface Materials: Extended Temperature and Wavelength Coverage
- Benzene and Ammonia Infrared Spectroscopy
- Infrared Absorption Cross Sections for the Outer Planets
- A Laboratory Study of the Chemistry, Spectra, and Optical Constants of Pluto and Charon Ices
- UV Emission Processes in Planetary Atmospheres by Electron and Proton Impact
- Photodesorption of Planetary Ices
- Thermal Reactions in Ices Relevant to Satellites of the Outer Solar System

PDART-type Proposals

- Cassini Data Analysis Program (CDAP)
  - 3-5 (0.75-1.25/yr)
- Outer Planets Research Program (OPRP)
  - 11-14 (2.75-3.5/year)
- Planetary Atmospheres (PATM)
  - 10-12 (2.5-3/year)
- Planetary Geology and Geophysics (PGG)
  - 5-6 (0.75-1.5/year)

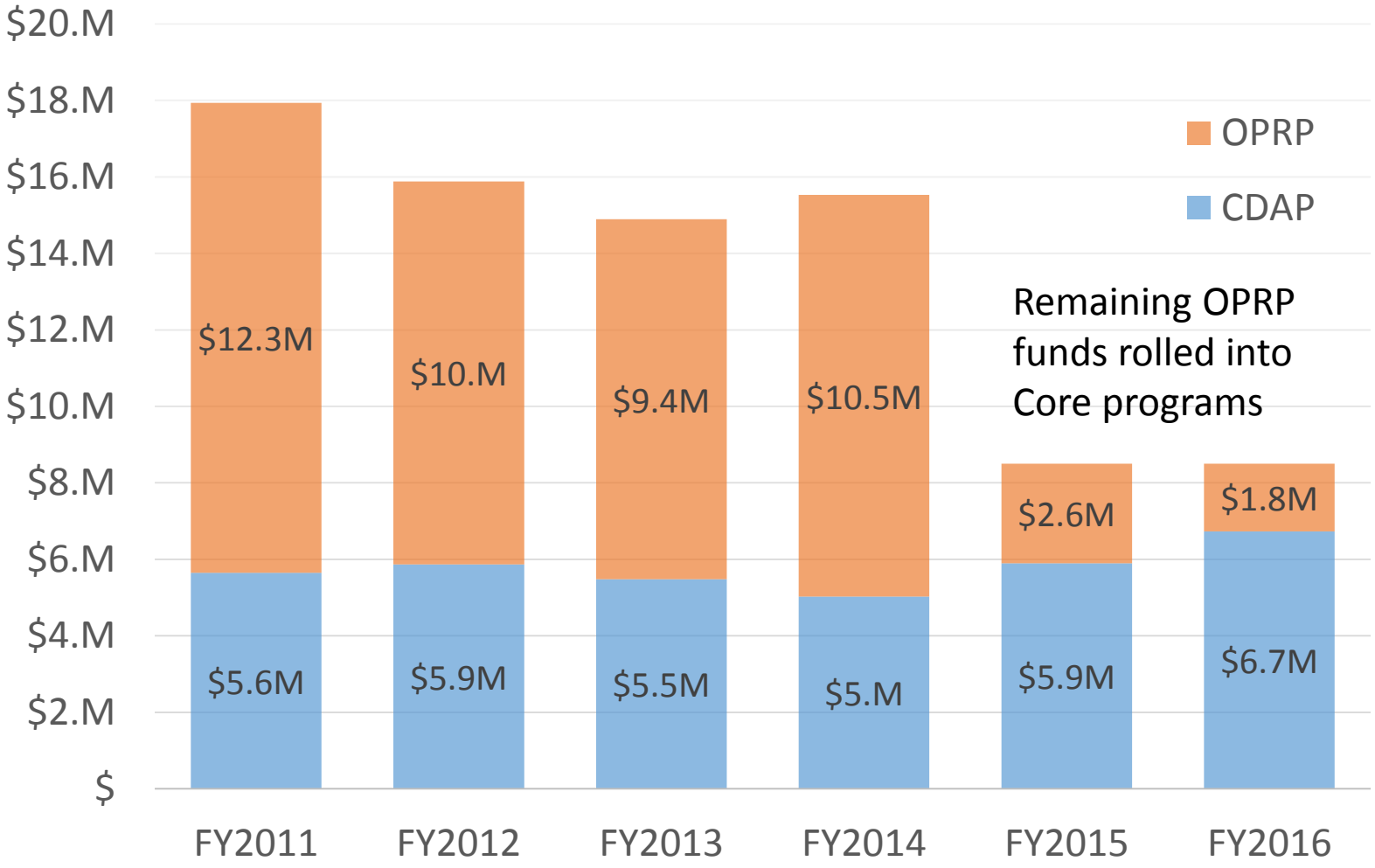
- Total PDART-type Outer Planets Proposals in ROSES 2010-2013
  - 27-37 (6.75-9.25/year)

OPRP and CDAP

- Outer Planets Research Program solicited proposals that analyzed spacecraft data, including from the Cassini spacecraft

- When the R&A program was restructured, the fraction of the OPRP portfolio that was supporting CDAP-relevant awards was moved (with their budgets) into the CDAP portfolio
  - About 1/3 of the active OPRP awards moved to CDAP
  - The CDAP budget increased to $8.5M (FY15) from ~$5M (FY14)

OPRP and CDAP



Funding, not Selection Numbers

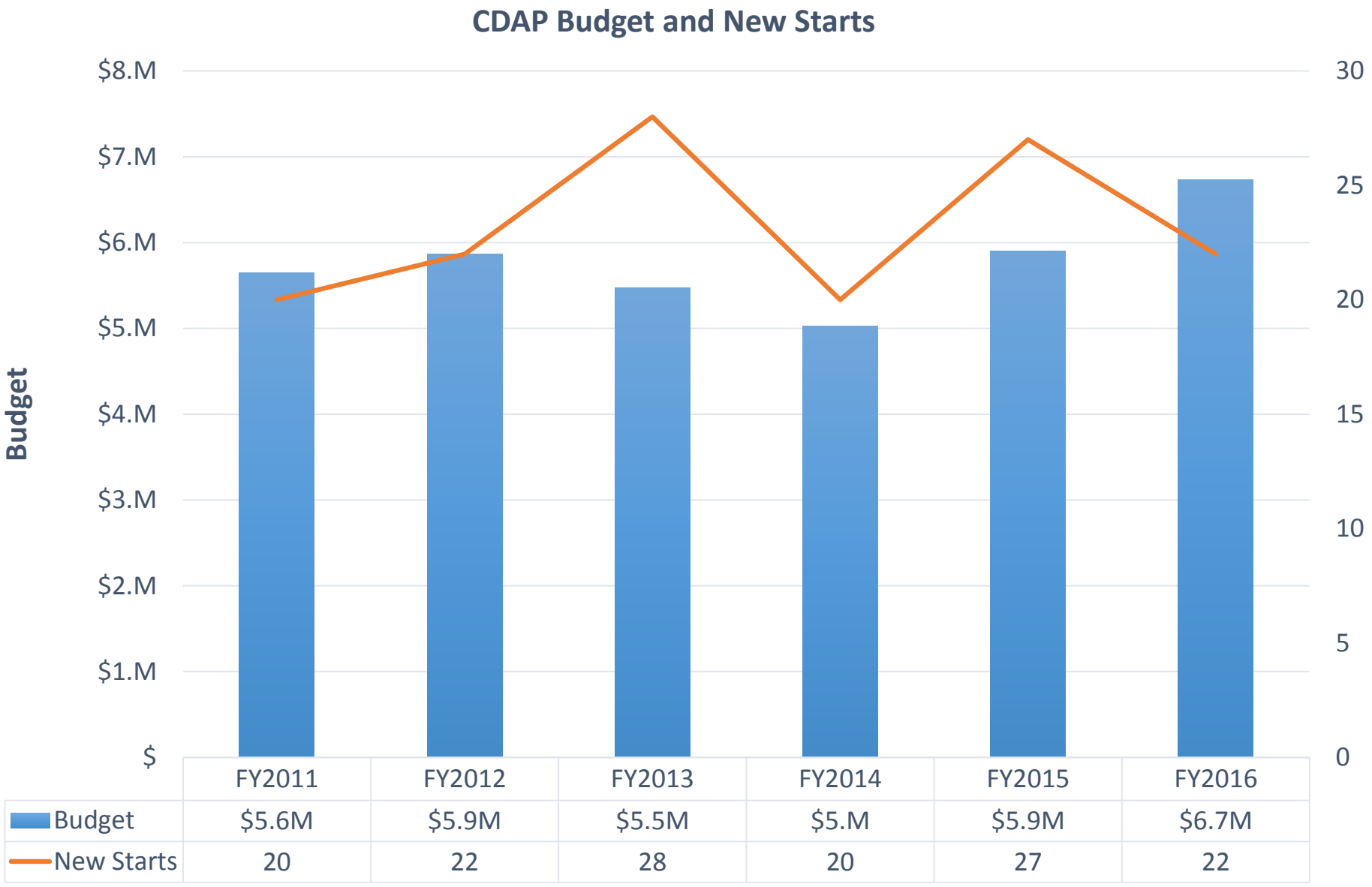
- Selection numbers and selection rates are not as informative as appear to be assumed when they are used in discussions
  - Selection rate is even less informative because it depends upon the number of proposals submitted (which itself, in practice, depends on the number of proposals submitted but not selected in previous years)
- Selection number depends on: average proposed budget for selections, average partial budget for selection, fraction of selections that are partial, the program budget, and the existing program budget commitments (which depends on selections in previous years)
  - $Sel = (PB_{full}-PB_{committed})/B_{ave}$
  - $Sel = (PB_{full}-PB_{committed})/(F_{full}*B_{full,ave} + (1-F_{full})*B_{part,ave})$

Funding, not Selection Numbers

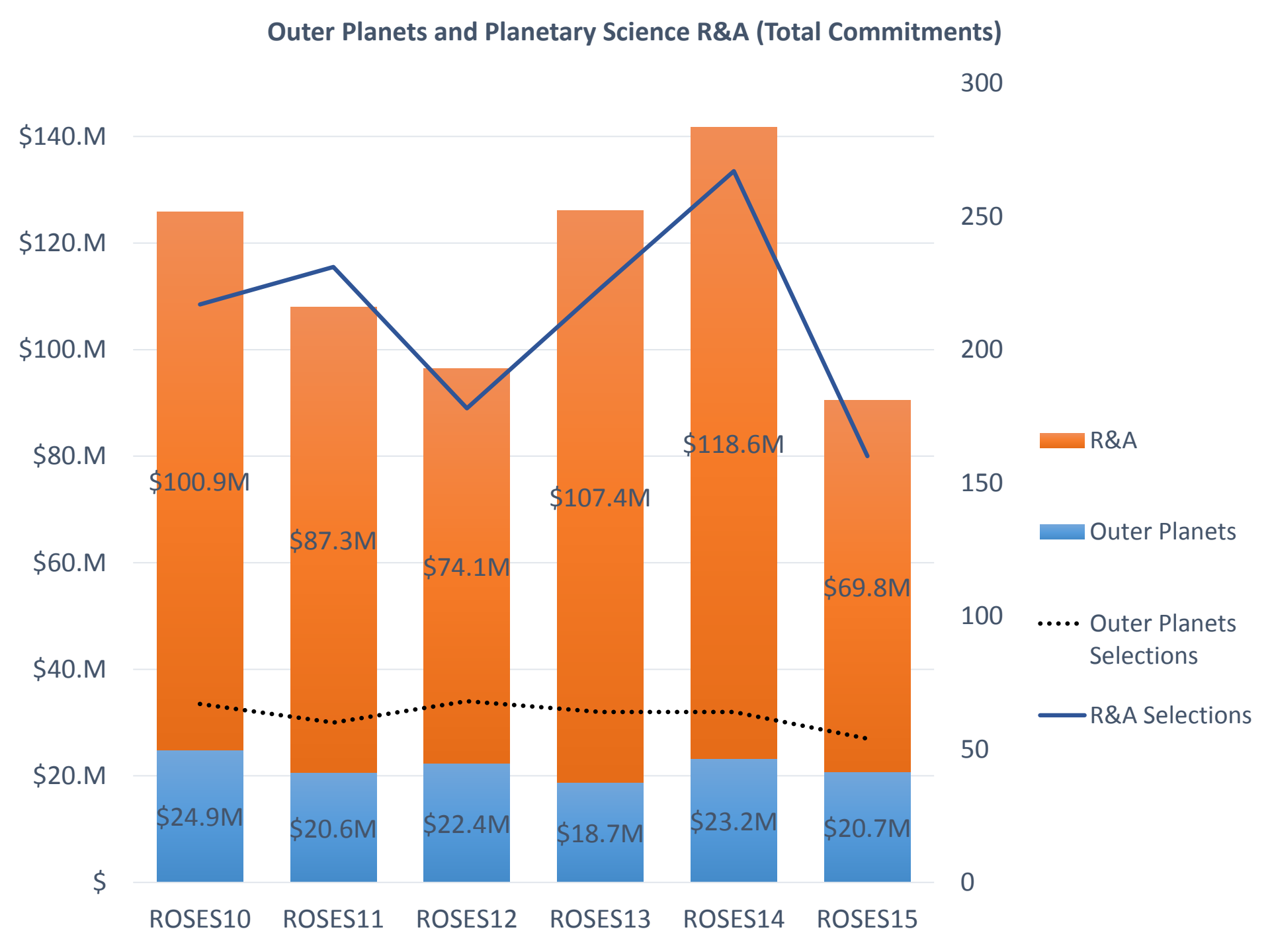
- Thought experiment: Assuming $100k remains for selections, which of the following "*funds more science*"?
  - Select one $100k/yr award
  - Select two $50k/yr award
  - Partially fund and select four awards at $25k/yr
  - Forward fund the final $100k of an existing award to free up funds in the next year

- They all use the same amount of money, but in a different way; no single number can capture that

Selection Stats



	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Budget	$5.6M	$5.9M	$5.5M	$5.M	$5.9M	$6.7M
New Starts	20	22	28	20	27	22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R&A
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R&A Selections

Funding of Outer Planets Activities

- The amount of funding that has gone to Outer Planets activities has been fairly consistent from ROSES 2010 to ROSES 2015.

- The number of Outer Planets selections has been fairly consistent once the proposals in all relevant programs have been accounted for, but is affected by proposals' awarded budgets

The End