National Aeronautics and Space Administration

Astrophysics




Internal Scientist Funding Model

Astrophysics Advisory Committee
July 19, 2017

Paul Hertz
Director, Astrophysics Division
Science Mission Directorate
@PHertzNASA

ISFM: Context

- NASA has approximately 1000 civil servant scientists (this does not include JPL)
- The role of NASA's civil servant scientists is to
  - Contribute to the Agency's many missions by serving as program and project scientists, instrument scientists, mission planners, scientific data archivists and analysts, and leading researchers in their fields
  - Conduct a broad variety of activities in original research, in technology development, and in service to the outside scientific community, bringing to bear the unique facilities and capabilities of NASA Centers
  - Participate with their community colleagues in competition and peer review to keep NASA scientists up-to-date and on the forefront of their respective fields
- It is in the national interest that these activities be conducted and supported in a way that optimizes the NASA workforce's productivity and realizes its leadership potential
- Of the 1000 scientists, ~150 FTE (spread over ~350 scientists) are funded through competed research awards
  - The majority of the funding for civil servant scientists comes from other sources, such as flight projects and instruments, science teams, community service, directed supporting research and technology, and Center internal funding

ISFM: Changes

- NASA is adjusting its internal funding model for civil servant scientists to include more directed work for critical-sized groups
  - This is an internal realignment to use NASA civil servant scientists more efficiently
  - It focuses on work that can best be done or only be done at NASA Centers
  - It does not affect the balance between internal and external funding
  - All directed work will be externally reviewed
- Objectives and benefits of this new model
  - Enhance the value of Agency funds by having the NASA civil servant scientists work on tasks that are substantial, strategic, focused, and that enable the broader science community, rather than compete with the external science community
  - Ensure that NASA civil servant scientists advance tasks that meet NASA objectives and can best/only be done at NASA Centers, resulting in science, technology, capabilities, and missions that are tightly integrated
  - Ensure a critical mass of selected capabilities necessary to conduct complex research on key topics
  - Adopt a strategic implementation that will reduce the number of proposals written by NASA civil servant scientists and improve the efficiency of inherently governmental work
- There will be no change in the balance of the research budget allocated between NASA civil servant scientists and the external community
  - The new funding model is designed to be neutral regarding the fraction of funding going to the external scientific community

ISFM: Goals

- The amount of directed Research and Analysis (R&A) work at the Centers will be increased
  - This will result in a decrease in R&A proposals from NASA Center scientists
  - NASA civil servant scientists may still compete for R&A, but in reduced numbers
  - Mission AOs and mission-funded guest observer (GO) programs will not be directed
- All directed R&A work will be collaboratively planned between the Centers and HQ/SMD Divisions
  - The amount and type of directed work will vary between individual Centers and Divisions
- All directed R&A work will be peer reviewed
  - This will include both initial and periodic external peer reviews
- The fraction of R&A funding going to the Centers will remain consistent with historical levels and the increase in directed R&A work at the Centers will not impact the balance between internal and external funding

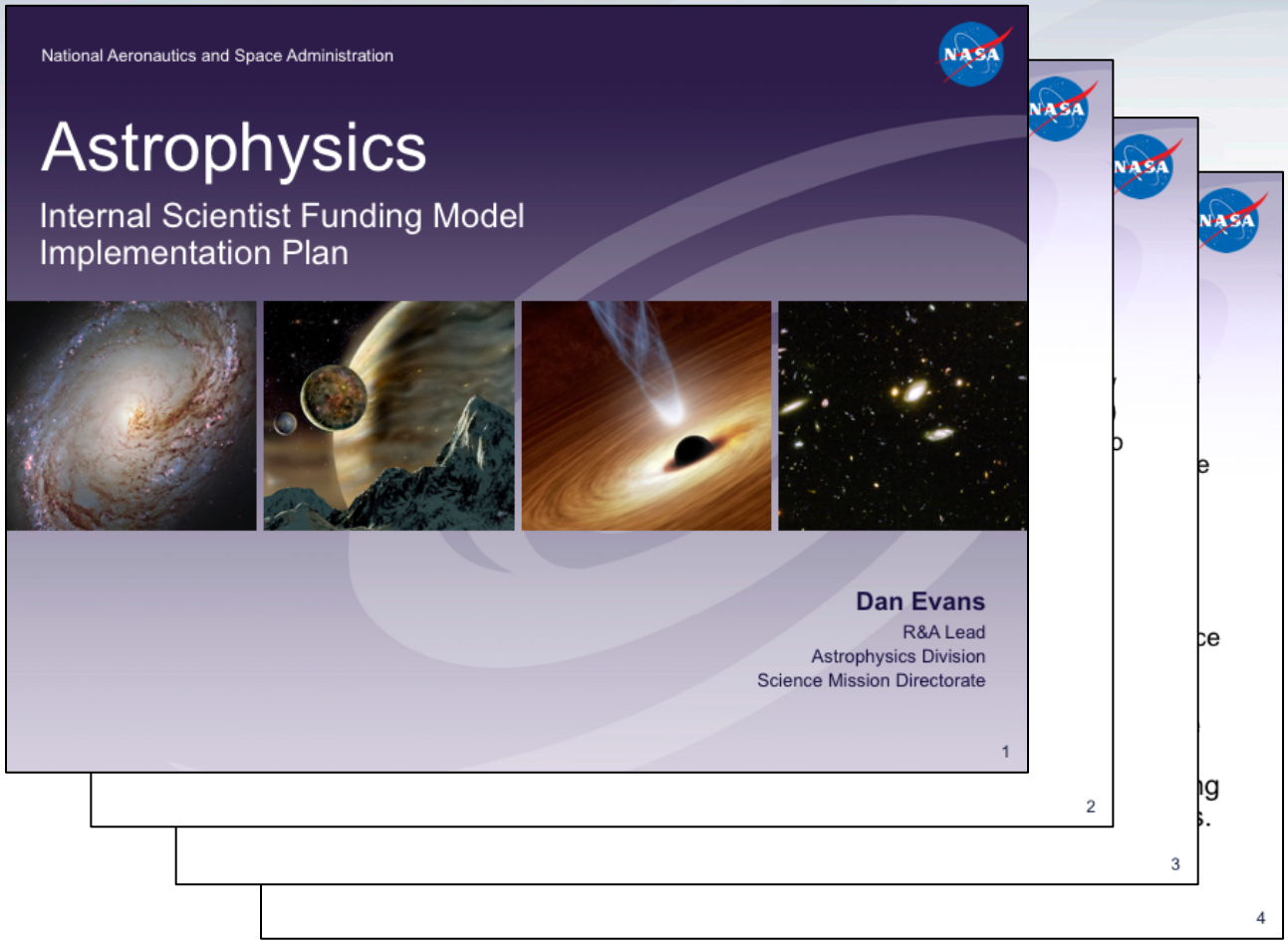
ISFM: Qualities of Directed Work

- Aligns workforce with Agency Capability leadership model
- The full range of activities performed by internal scientists is eligible for direction, including hypothesis-driven research
  - Directed work can include procurements.
- The focus of larger directed projects will be on research that is
  - Strategic,
    - Utilizes unique NASA facilities, capabilities and/or skills or is of such duration or scope that the government benefits by NASA doing it in house.
    - Requires or benefits from long-term stability, especially for the long-term availability of some capability whose utilization may not be required at all times, but whose availability is required.
  - Science Enabling,
    - Provides a service or supports research being done by the scientific community; i.e., other researchers depend/rely on the results of this work.
  - Forward leaning and ambitious, and
  - Distinctive
    - Not “me, too” research
    - Not to create new capabilities at Centers in direct competition with capabilities already in existence in external organizations

Astrophysics ISFM Principles

- The Astrophysics Division is intentionally adopting a cautious approach to its Directed Work Packages
- Only work that is clearly in the national interest will be directed
  - A few exceptions
  - GO programs are excluded (~50% of Astrophysics research funding)
- Rolling up existing ROSES awards into a larger work package will only be accepted if it is demonstrated that the combined package exceeds the sum of its parts
  - Otherwise work is not strategic nor is it best done at a Center
  - This may differ from the practice of the other divisions
  - Simply requesting that an existing research award be directed is unlikely to succeed unless there is a strong reason to do so
- APD is unlikely to accept work packages with substantial cost growth unless there is a compelling reason to do so
  - E.g., a recommendation from the Decadal or mid-Decadal reports, or if the work supports planned strategic growth areas
- Astrophysics work packages must be proposed from Center Division leadership and negotiated with HQ Division leadership

Astrophysics ISFM Implementation Plan



Astrophysics ISFM Decision Memos

Center/Package	$/yr	Extend existing work? New commitment?	Done ?
GSFC			
X-ray mirrors	2.4M	Extends FY19-FY20	✓
X-ray calorimeters	0.9M	Extends FY18-FY20	✓
Gravitational waves	0.3M	New FY18-FY20	✓
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MSFC			
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ARC			
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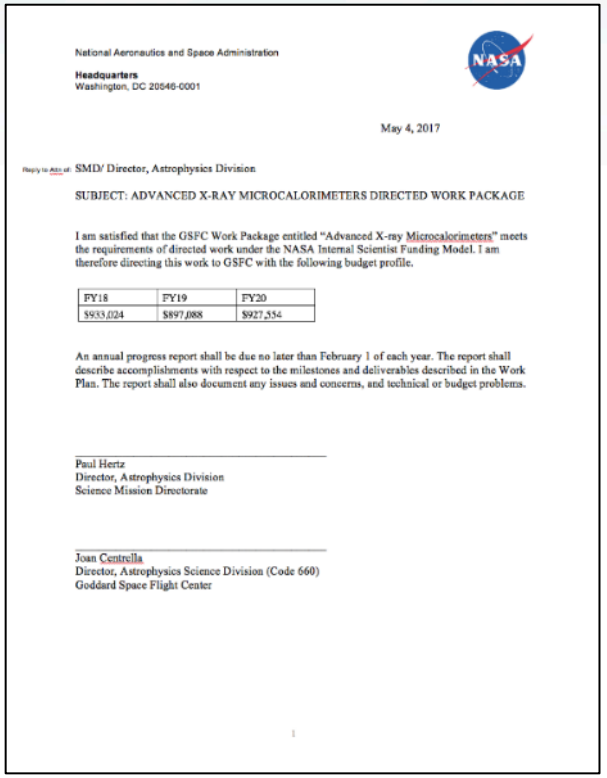
Speckle	TBD	Extends FY18	



National Aeronautics and Space Administration

Headquarters
Washington, DC 20546-0001

May 4, 2017

Reply to Attn of: SMD/ Director, Astrophysics Division

SUBJECT: ADVANCED X-RAY MICROCALORIMETERS DIRECTED WORK PACKAGE

I am satisfied that the GSFC Work Package entitled "Advanced X-ray Microcalorimeters" meets the requirements of directed work under the NASA Internal Scientist Funding Model. I am therefore directing this work to GSFC with the following budget profile.

FY18	FY19	FY20
$933,024	$897,088	$927,534

An annual progress report shall be due no later than February 1 of each year. The report shall describe accomplishments with respect to the milestones and deliverables described in the Work Plan. The report shall also document any issues and concerns, and technical or budget problems.

Paul Hertz
Director, Astrophysics Division
Science Mission Directorate

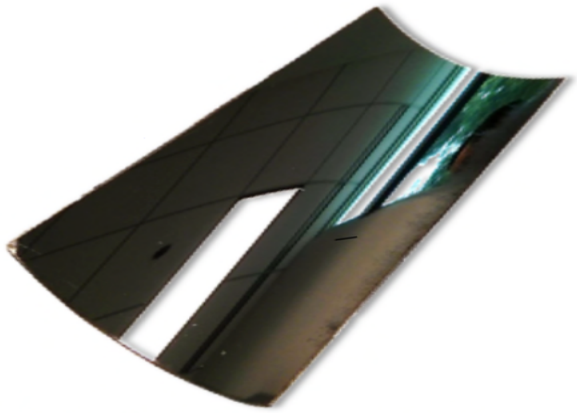
Joan Centrella
Director, Astrophysics Science Division (Code 660)
Goddard Space Flight Center

GSFC: X-ray Mirrors

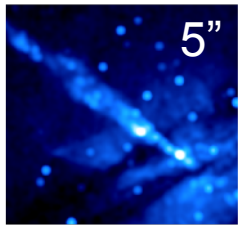
Description of package

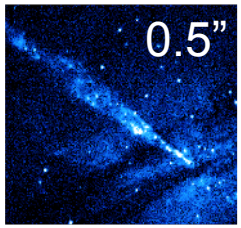
Develop X-ray mirror technologies to surpass Chandra by orders of magnitude in terms of angular resolution, collecting area, and cost.

PI: W. Zhang



Single-crystal Si mirror segment





Importance of package

- Enabling technology for Lynx and almost all future medium and flagship X-ray missions.
- Supports and enables complementary university-based efforts to improve mirror angular resolution.

Justification for direction

- Work uniquely performed at a NASA Center.
- Leverages substantial Center resources and capabilities.
- Serves as a resource to enable the wider X-ray optics community.

$2.4M/year for FY18-20

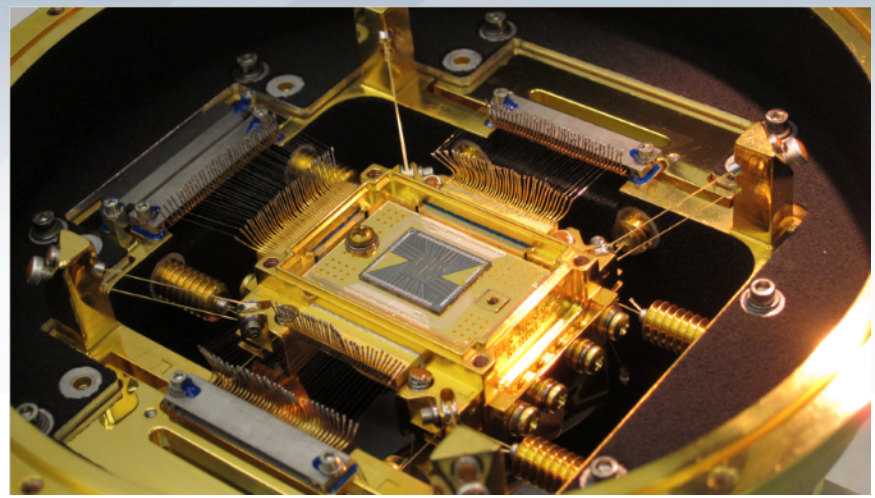
GSFC: Next-gen X-ray Microcalorimeters

Description of package

Three tasks:

1) TES Microcalorimeters
2) Magnetically Coupled Calorimeters
3) Laboratory Spectroscopy for Space Atomic Physics

PI: C. Kilbourne



Importance of package

- Small-pixel, high-count rate detector development with unprecedented energy resolution in the X-ray band.
- Detector support for Sounding Rocket programs.
- Provide atomic physics data for currently operating and future X-ray missions.

Justification for direction

- Transition-edge sensors and magnetically coupled microcalorimeters are key technologies for future X-ray missions (e.g., Lynx).
- NASA should continue to develop GSFCs leadership role in these key technologies.

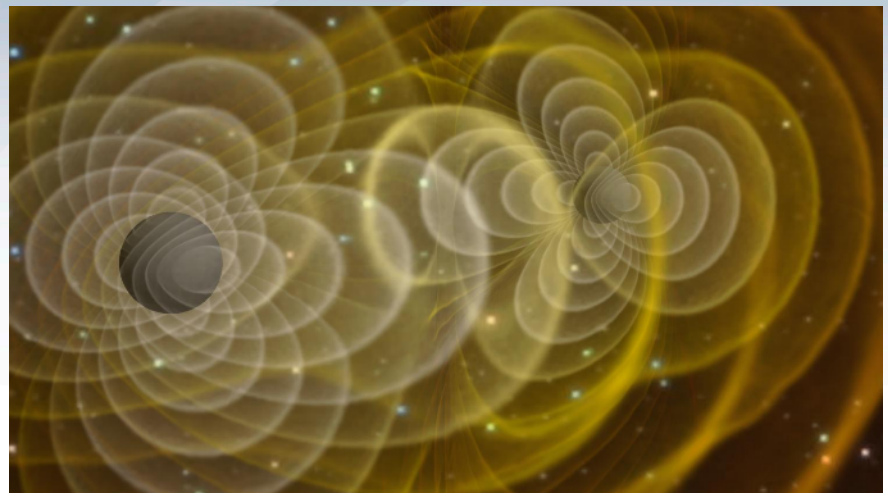
$0.9M/year for FY18-20

GSFC: Gravitational Waves

Description of package

Lay the groundwork for US LISA science. Clarify the prospects for multi-messenger astronomy observations through a variety of electromagnetic and gravitational wave simulations of merging black holes.

PI: J. Baker



Importance of package

- Provides a basis for building the US LISA science community.
- Stimulates new university research related to novel upcoming NASA capabilities in mHz gravitational-wave astrophysics.
- Package likely to grow over the coming years in response to NASA engagement with LISA.

Justification for direction

- Work best done at a Center, in order to maintain close connections with LISA development.
- Enables the wider US community to participate in future LISA science center.

$0.3M/year for FY18-20

GSFC: Sellers Exoplanet Environments Collaboration (SEEC) – with PSD

Description of package

- Development of exoplanet structure and atmosphere models.
- Development of observational tests for exoplanet theories.
- Creation of a community-coordinated modeling database and analysis portal.

PI: S. Domagal-Goldman

Importance of package

- Future exoplanet advances require cross-discipline expertise from astrophysics, planetary atmospheres and astrobiology.
- APD and PSD R&A programs are feeling the pressure of a community reinventing wheels.
- Community would benefit from tool standardization – to focus on science over tool development.

Justification for direction

- GSFC provides heritage and leadership in mission support, data centers, and data analysis tools.
- GSFC has invested in exoplanet labs and a culture that fosters cross-disciplinary science.
- GSFC has considerable roles in the missions this package will support – JWST, WFIRST, and decadal concept studies.

$100k/year for FY18-20

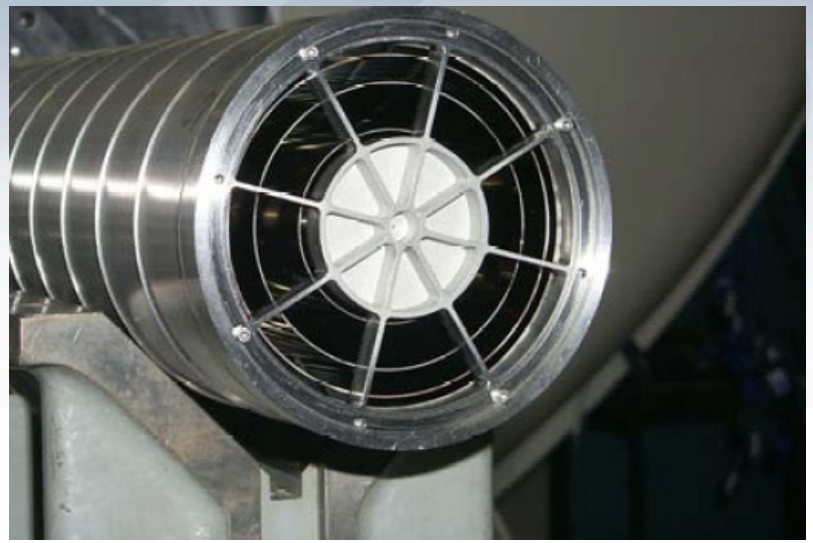
MSFC: Advanced X-Ray Optics

Description of package

Five subtasks:

1) Fabrication of X-ray mirror shells
2) Polishing of mandrels
3) Differential deposition figure correction
4) Mirror coatings
5) X-ray testing and calibration

PI: B. Ramsey



Importance of package

- MSFC leads X-ray mirror shell development and testing efforts.
- MSFC provides NASA and the nation with performance characterization test capability facilities (XRCF, SLF).

Justification for direction

- MSFC provides unique test facilities support for both internal and external X-ray optics systems (XRCF, SLF).
- Agency needs to invest in developing, qualifying, and maintaining such capabilities in the national interest.

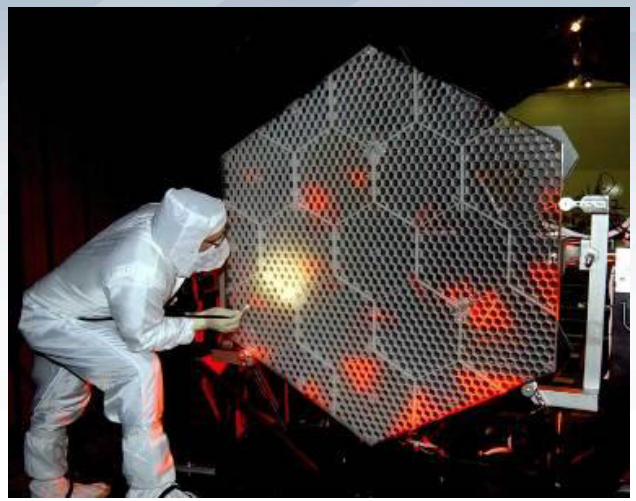
$1.9M/year for FY18-20.

MSFC: Predictive Thermal Control (PTC)

Description of package

- Multiyear effort to develop, demonstrate and mature a thermally stable telescope towards TRL6.
- Validate models that predict thermal optical performance of real mirrors.
- Derive thermal system stability specifications from wavefront stability requirement.

PI: P. Stahl



ULE® 1.4m AMSD Mirror

Importance of package

- Demonstrate the utility of a Predictive Control (PTC) thermal system for achieving thermal stability necessary for coronagraphy and other applications.
- PTC validates the model by testing a flight traceable 1.5 meter ULE® mirror in a relevant thermal vacuum environment in the MSFC X-ray and Cryogenic Facility (XRCF) test facility.

Justification for direction

- Strategic and forward-leading step to ensure dimensional stability of large spaceborne telescopes to the picometer level.
- Uniquely done at a NASA Center, and well-aligned with MSFC core capabilities.

$1.2M/year for FY18-20

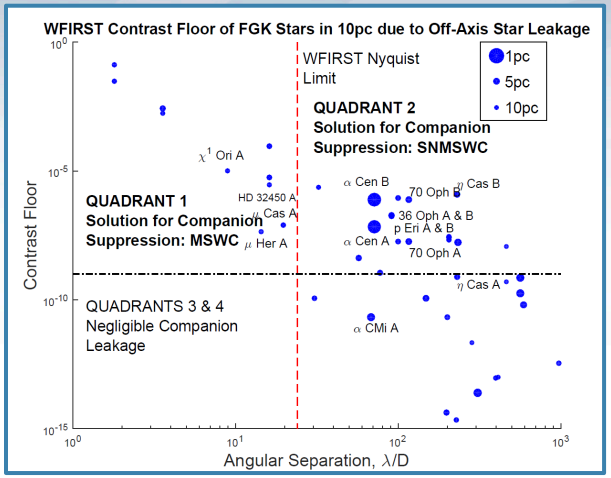
ARC: Enabling Direct Imaging of Exoplanets Around Binary Stars with WFIRST

Description of package

- Increase the exoplanet science yield of WFIRST/CGI by developing a technique to enable imaging of exoplanets around binary stars.
- Evolved Multi-Star Wavefront Control (MSWC) algorithm tuned for WFIRST.
- Raise maturity of key technologies to TRL-4 in NASA ARC test bed. Develop infusion plan for WFIRST.

PI: R. Belikov

New targets potentially enabled by MSWC



- 70 FGK stars within 10pc
- 43 multiples
- 28 need multi-star suppression, enabled by MSWC
- **67% increase in available star targets for WFIRST**

Importance of package

- Has the potential to increase the number of available targets for WFIRST/CGI by as much as 67% using the existing hardware configuration.
- MSWC could enable WFIRST/CGI to observe the α Cen A/B system.
- Provides the opportunity for WFIRST to detect potentially habitable planets.

Justification for direction

- Strategic and forward-leaning package to provide major steps forward for WFIRST, HabEx, and LUVOIR.
- MSWC was developed by the team at ARC; no other teams are pursuing approaches for high-contrast imaging exoplanets in multi-star systems.
- Timely given the WFIRST schedule.

$TBD for FY18. Augmented package expected next year.

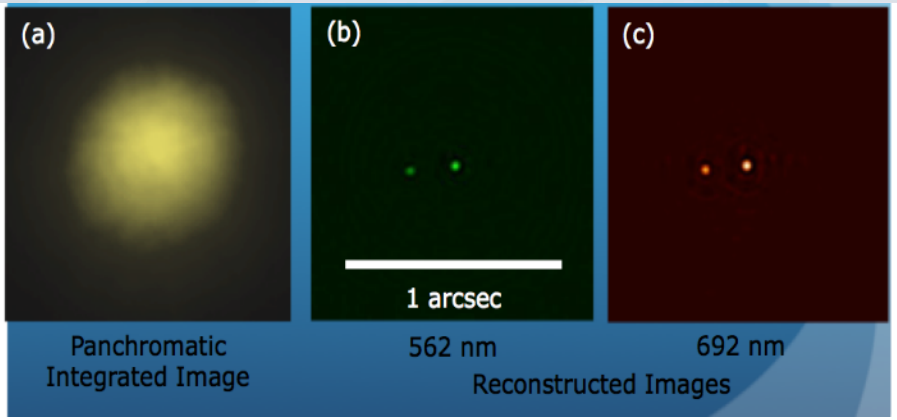
ARC: High-Resolution Imaging of Exoplanet Candidates

Description of package

- Provide validation and characterization of K2 and TESS exoplanet candidates for the community.
- Observations necessary to establish planet radius, mean density, incident flux, system architecture.
- Observational capability crucial for follow up of exoplanet candidates identified in TESS full frame images.

PI: S. Howell

Speckle Imaging of Exoplanet Candidate Stars exceeds the spatial resolution of AO observations.



Importance of package

- Speckle observations (conducted at visible wavelengths) provide significantly better spatial resolution than AO observations.
- The speckle instrument developed and led by the NASA Ames team are the only such instruments that are dedicated to exoplanet candidate follow-up.
- All observations are fully reduced and delivered to the ExoFOP archive for public access.

Justification for direction

- Instruments are unique to NASA, both in their capability and in their mission to provide follow up of exoplanet candidates identified by NASA missions.
- Enables the scientific success of the community.
- Crucial for follow up of exoplanet candidates identified in the TESS full frame images.

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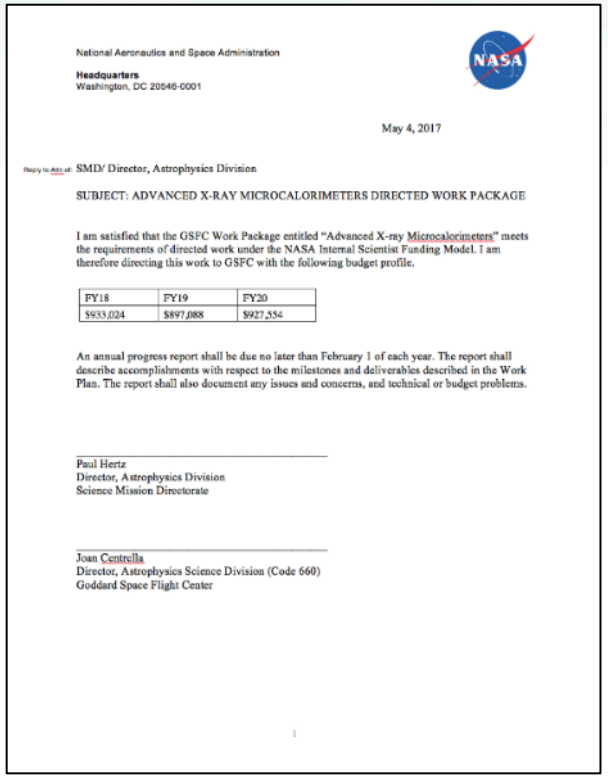

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