Review Objective

- The current five-year CA ends on February 28, 2018.

- The objective of the review is to:
  - develop findings that reflect the pros and cons of continuing this partnership for another five years.
Scope of Review

- Review the detailed information provided by NExScI
  - NASA programs conducted in the past five years
  - Keck Science Strategic Plan 2016 relevant to future NASA science missions

- Evaluate the contribution/productivity of Keck to support NASA missions and achieve NASA strategic goals.

- Estimate the promise of Keck in the next 5 years towards support of NASA missions.

- Prepare a list of findings to present to NASA’s Astrophysics Subcommittee
Review Panel Members

- Doris Daou – PSD, NASA HQ --- Chair
- Ken Johnston – USNO (Retd)--- Co-Chair
- Joel Bregman – U. Michigan
- Kathryn Flanagan - STScI
- John Gagosian – APD, NASA HQ
- Michael Garcia – APD, NASA HQ
- Susan Lederer - JSC
- Thomas Statler – PSD, NASA HQ

Ex-officio
- Hashima Hasan – Keck Program Scientist
- Mario Perez – Keck Program Executive
Review

- Presentation by NExScI
- Q&A

Major Panel Discussion Points:

- *The time allocation for strategic programs (key science) directed by NASA Headquarters and mission support vs. general science, and*

- *The cost of the program.*
Combined funding for WMKO, the community and NExScI is constant during CAN period at ~$6M/yr with small year-to-year variations

<table>
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<th>Item</th>
<th>Approx. Budget line, $M</th>
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<tbody>
<tr>
<td>WMKO (NASA Cooperative Agreement, CAN)</td>
<td>$3.8M</td>
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<td>Funding to Observers</td>
<td>$0.9M</td>
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<td>NExScI Funding</td>
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<td>MOWG/TAC Support</td>
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<tr>
<td>Keck Obs. Archive incl H/W, Award Admin, Remote site support, NExScI Infrastructure</td>
<td>$1.2M</td>
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<tr>
<td>Grand Total</td>
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Summary List of Findings for Continuing the CA with Keck = PROs

- Cost effective for future missions as well as maximizing scientific results of operational missions.
- Keck has state of the art instrumentation with significant technical improvements in 2018-2023
- Keck will be a very important resource for maximizing the scientific productivity of the JWST, TESS and WFIRST as well those already flying
- NASA is purchasing Keck nights at a very good price and has a well developed relationship that works well and is led by excellent individuals
- The proposal over subscription rate demonstrates that the community places a high value on NASA Keck time and that this will continue into the future
- NASA support is also used to aid in and enhance the interpretation of archival Keck data.
Summary List of Findings for Continuing the CA with Keck = CONs

- The amount of Keck time assigned at present to key science projects < 30%,
- The definition of mission support is not well defined, making it difficult to evaluate the effectiveness of this CA in supporting NASA missions by US scientists.
- Value of $1.2M toward archive is not yet good (<140 papers in 9 years versus the reported thousands citing Keck+NASA missions in the past 5 years), though it is improving steadily.
- NASA has paid additional for nights beyond the 45 per semester covered by the CA, in order to provide direct MS. Extra nights were at $90K/nt. This was done for WISE MS.
- Does not provide access to the sky south of the Keck declination range
- Given that many well equipped large telescopes, including national observatory telescopes, are or will be ON Line In the 2018-2023, It may be wise to consider their use
Summary

- NASA Keck Support Has:
  - Demonstrated Support of SMD Missions
  - Is Needed to Maximize Productivity of Future Missions
  - Good Value for the Cost