NExScI
NASA Exoplanet Science Institute

LESSONS LEARNED

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NASA Exoplanet Science Institute

NExScI enables near term science and helps build the Exoplanet community

- Provide professional education and training
  - Sagan Fellowship program
  - Sagan Summer workshops
- Foster community interaction
  - Host/co-host exoplanet conferences
  - Support Exoplanet Exploration Program (ExEP) activities at AAS, DPS...
- Support science operations for NASA facilities
  - Keck observing for mission support and long term science goals
  - Large Binocular Telescope Interferometer for Exozodiacal Project
  - Kepler Science Analysis System for Kepler project
- Curate and provide access to exoplanet data
  - Exoplanet archive and tools emphasizing community use of Kepler data and multi-mission analysis
  - CoRoT mission portal
- Carry out research consistent with ExEP goals

NExScI's Basic Parameters

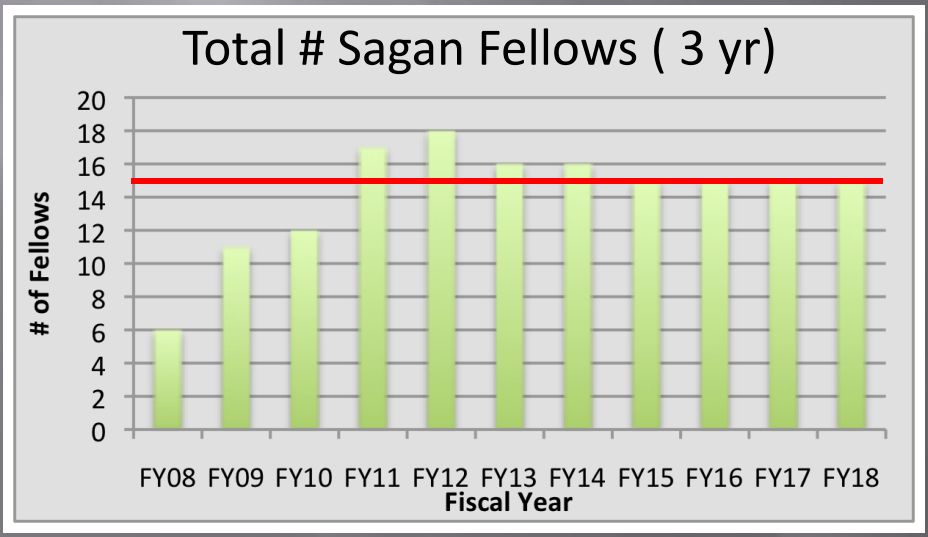
- ***Missions –*** Evolving mix of ground-based and space-based facilities, archives, conferences and training activities
- ***Userbase –*** Exoplanet researchers, debris disks, planet & star formation, Keck users in all areas of astrophysics and solar system
- ***Archive data volume*** –Keck Archive (>10 TB) and Exoplanet Archive (1.4 M light curves from Kepler, CoRoT, ground surveys)
- ***Instruments*** – All Keck instruments, Large Binocular Telescope Interferometer, Kepler (careful to avoid redundancy with MAST)
- ***Wavelength coverage*** – 0.5-10 μm
- ***Program model*** – both GO/PI, Key Project, and GTO
- ***Proposals/cycle*** – 65 -75/semester for Keck; ~70/yr for Sagan
- ***Users/cycle*** – 23 - 28/semester for Keck; 5 – 7 new/yr for Sagan
- ***Funding model*** –RSAs for Keck; CREI contracts for Sagan
- ***Default proprietary data period*** – 18 month (general Keck), 12-36 for Key Projects per HQ agreement; 3 yr for LBTI

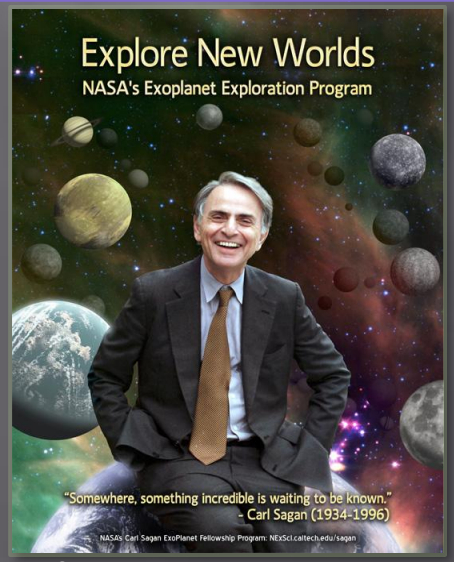
RECOMMENDED BEST PRACTICES

Grow A Community

- Use a combination of fellowships, workshops, hosted conferences, and dedicated presence at AAS and other meetings to foster and grow new field

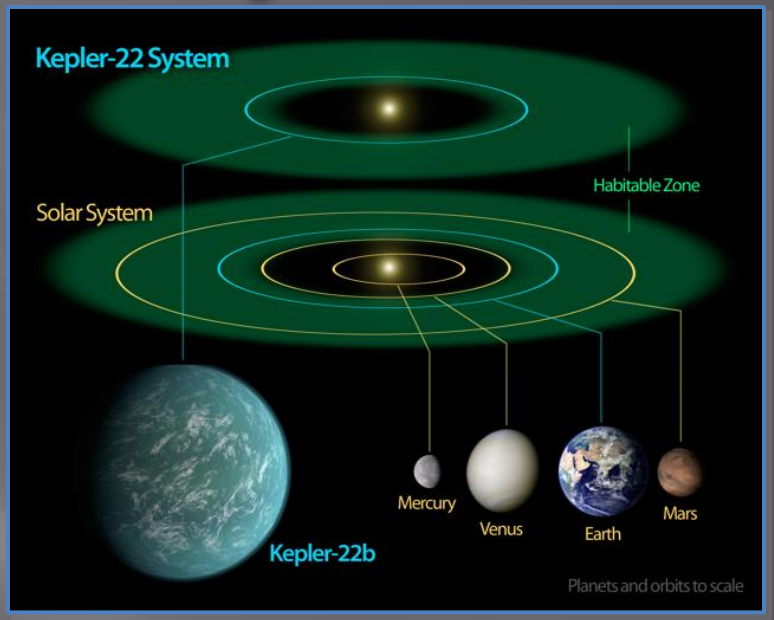
Year	Where	Speakers	Attendees	Notes
1998	Flagstaff	n/a	n/a	Interferometry
1999	Pasadena	27	72	General Interferometry
2000	Berkeley	25	54	Exoplanet Astrophysics
2001	Flagstaff	21	35	Interf. Data Reduction
2002	Cambridge	26	63	Interf. Instrumentation
2003	Pasadena	27	49	General Interferometry
2004	Pasadena	18	82	Coronagraphy
2005	Pasadena	29	89	Astrometry
2006	Pasadena	25	79	Interferometry
2007	NASA Ames	32	89	Transits
2008	Canceled*			
2009	Pasadena	27	104	Exoplanet Atmospheres
2010	Pasadena	26	116	Planet-Hosting Stars
2011	Pasadena	22	80	Microlensing
2012	Pasadena	27	150 est	Exoplanet Light Curves

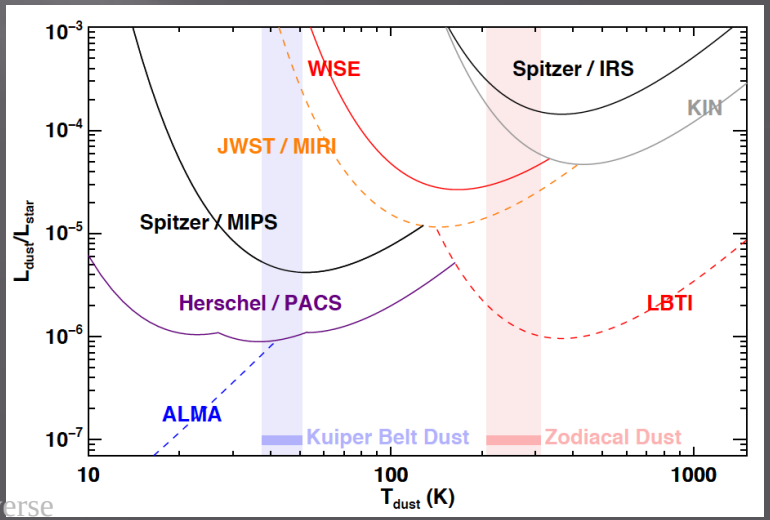




Support Space Missions With Ground-Based Telescope Time

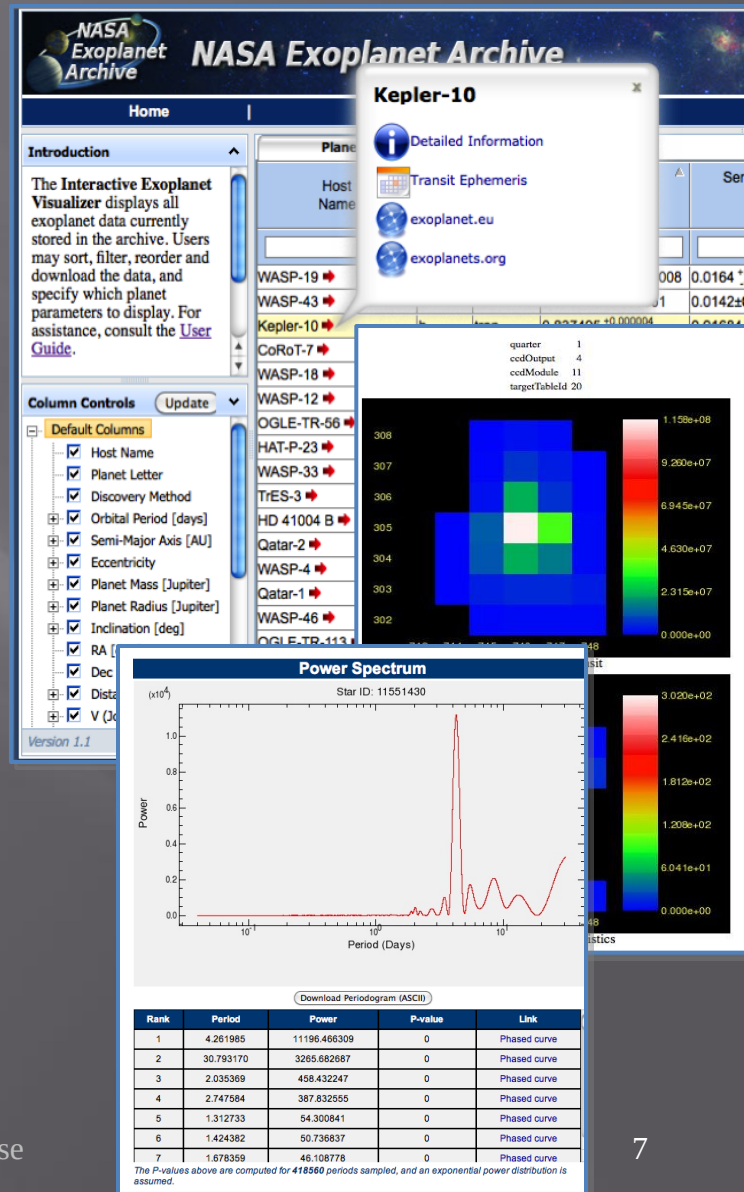
- ~45 nights/semester on Keck 1 & 2
  - PI/GO , Key Project, directed mission support
    - Peer reviewed projects (GO) in support of strategic goals in Solar Systems, Exoplanet, Cosmic Origins & Physics of the Cosmos
    - Key Projects for strategic NASA science goals
      - Determine η_{Earth} via RV
      - Measure exo-zodi with Keck Interferometer
      - CoRoT follow-up
      - Messenger, LCROSS observations
    - HQ directed mission support observations
      - WISE and Kepler follow-up
      - Ring/moon search for New Horizons
      - JWST mirror phasing demonstration
  - 3:1-7:1 oversubscription
  - Modest support for research & travel
- Coming soon: ~16 nights/year on LBTI for exozodi Key Science





Provide Integrated, Multi-Mission Datasets and Tools

- Exoplanet Archive
  - All confirmed exoplanets (RV, Kepler, CoRoT, imaging, microlensing) and Kepler candidates
  - CoRoT data interface
  - Multi-quarter plotting, normalization and phasing of public light curves
  - Periodogram and transit ephemeris
  - Ground-based transit surveys
- Tools for organization and analysis of Kepler pipeline products (KSAS)
  - Currently used by Kepler Project/Science team
  - Adapted to Exoplanet Archive for community use during Kepler extended mission
- Make data available for community
  - Keck Observatory Archive (KOA)
    - HIRES, NIRSPEC, NIRC2, KI, et al.
    - 18 month proprietary time for most data
  - LBTI Key project data, 3 years



WHAT ARE THE CONSTRAINTS IN CURRENT POLICIES?

Suggestions and Concerns–1: Appropriate Software Practices

- NASA software requirements and FISMA interpretation vary from center to center and can be onerous if not appropriately tailored
  - — Confine strictest controls to uplink related processes that directly control spacecraft (or aircraft)
  - — Progressively relax constraints on science scheduling → observation planning → downlink data processing → analysis → archiving.
  - — Data proprietary controls can be implemented without invoking high levels of formalized data security
  - — Data classifications difficult to change once established early in mission
  - — ***Industry best practices should be adequate in almost all cases***
- Each project should tailor its own standards, appropriate to project phase and nature of task
  - —External review by other science centers will ensure uniformity, acknowledgement of lessons learned, and adherence to best practices

Suggestions and Concerns–2: Funding at NASA Centers

- Sending proposal money to scientists at NASA centers is time consuming, inefficient, slow, and frustrating for all concerned
- Getting scientists at NASA centers to participate on MOWGs, TACs, etc. is often impossible due to restrictions on travel
  - This important function does not have high priority at NASA centers

Suggestions and Concerns–3: Why they call us "Science Centers"

- All important mission ***functions*** should ***have*** science center ***scientists***
- All science center ***scientists*** should ***have*** important mission ***functions***
- Appropriate mix of practicing scientists and s/w developers must work in tandem to ensure the right questions are being asked (and answered) in developing data acquisition modes, optimizing observing schedules, providing well-calibrated and well-documented datasets, and maintaining user friendly archives and tools
- Resources for scientists (for both their mission support and personal research) are often sacrificed in the proposal process and during continual budget negotiations in all mission phases

Summary

- Exoplanet research continues to grow rapidly with dramatic results coming out almost weekly
- Combination of space-based and ground-based is critical to achieving scientific goals
- Strong interactions between center scientists and developers are critical to achieving scientific goals
- Complete analysis and full community utilization of data require multi-mission archives, e.g. Kepler/CoRoT transit data plus RV and AO imaging, and specialized tools