Jet Propulsion Laboratory
California Institute of Technology

Status of LBTI and the HOSTS Survey

Phil Willems

for the LBTI/HOSTS team

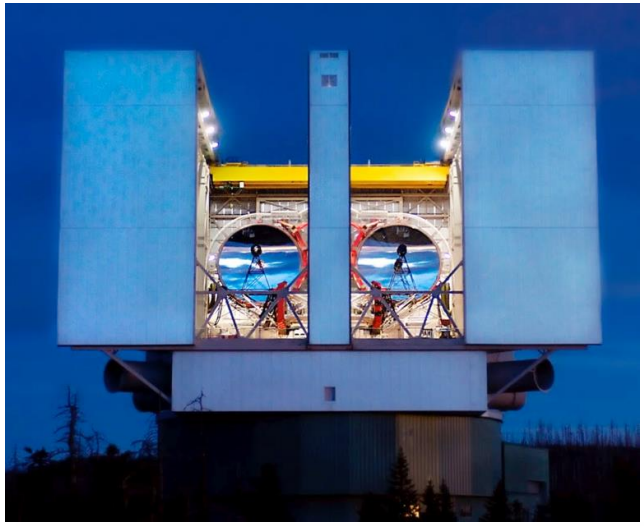
CL#17-0022

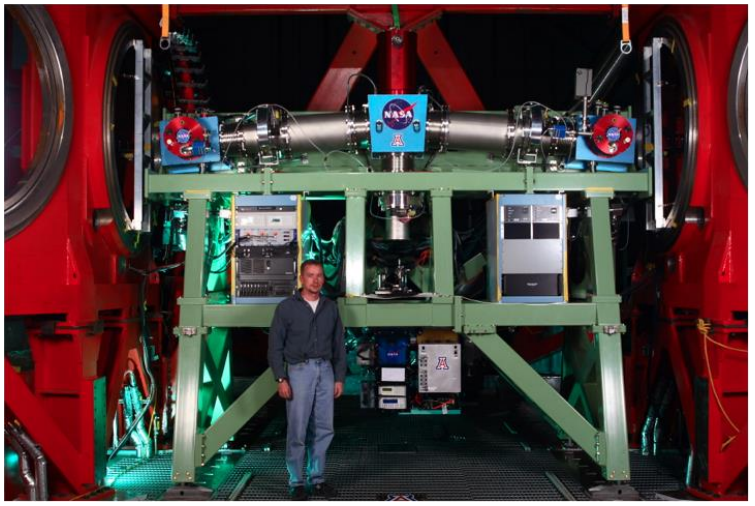
January 3, 2017

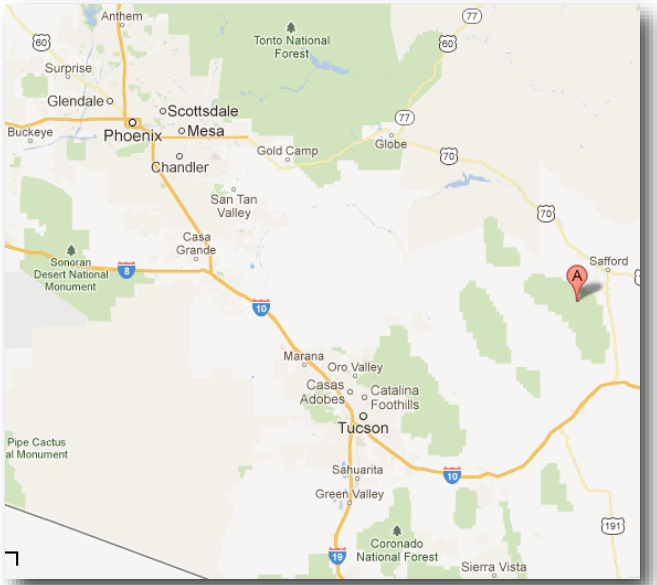
New LBTI Project Scientist

Chris Gelino of NExScI has joined LBTI as its new Project Scientist, replacing Rafael Millan-Gabet.

LBTI and HOSTS







The Large Binocular Telescope Observatory

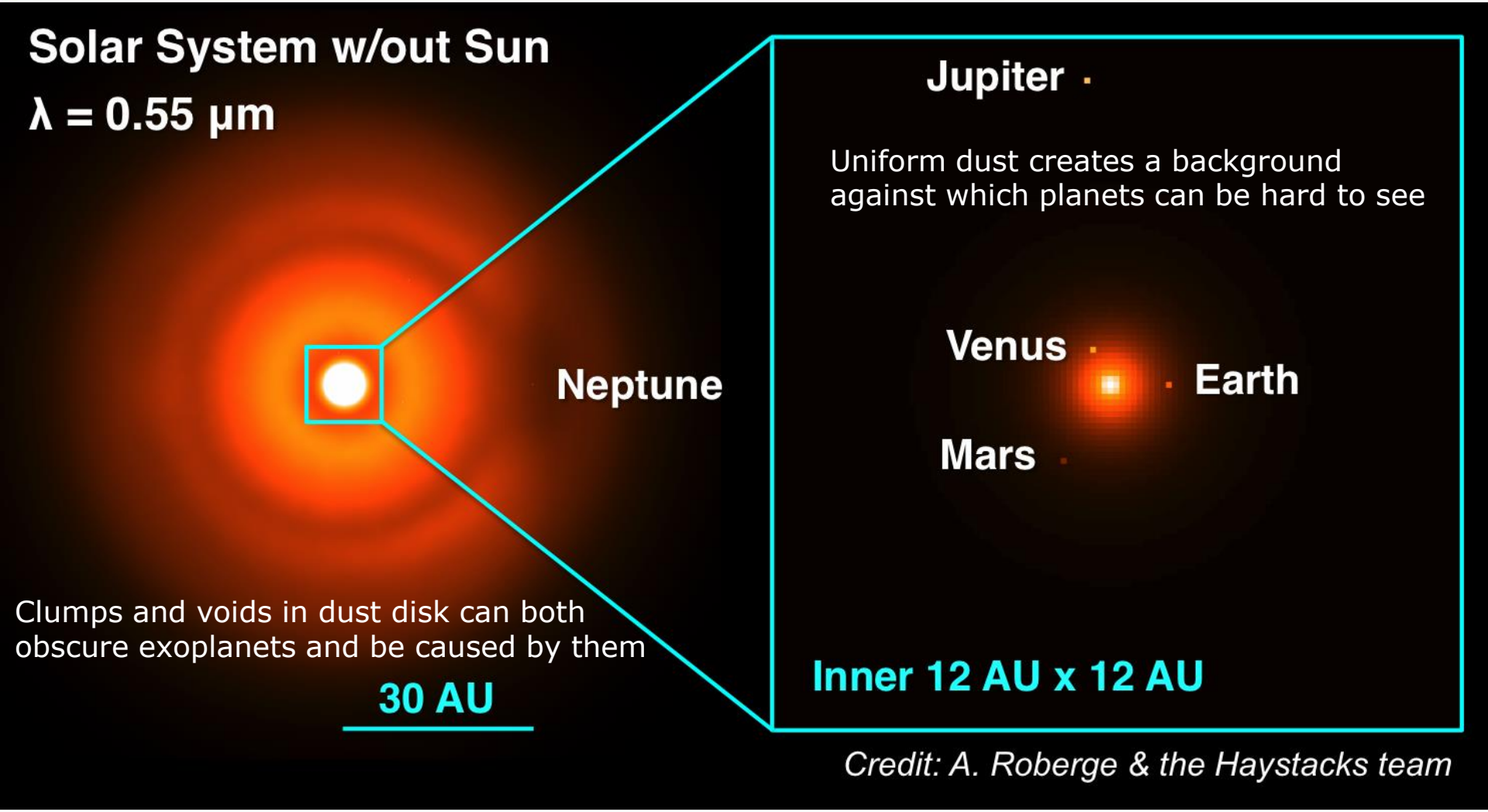
(W109°53′20.63″ N32°42′04.71″ 3221m MST=UT-7)

Mt. Graham International Observatory, Arizona

- LBTO is located on Mt. Graham in Arizona
- LBTI is a mid-infrared nulling interferometer
- Designed to carry out the Hunt for Observable Signatures of Terrestrial planetary Systems (HOSTS)

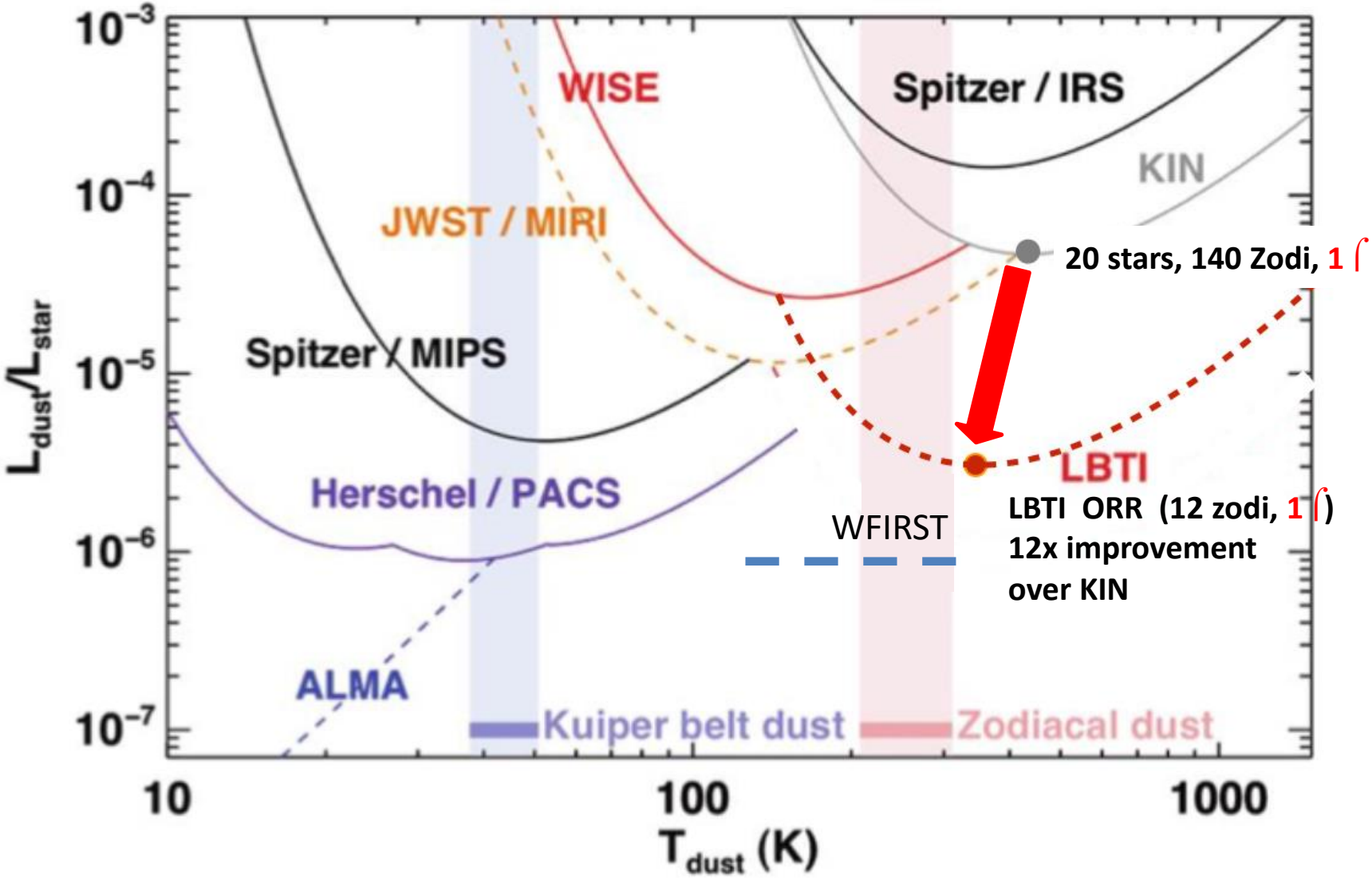
- Managed by Exoplanet Exploration Office at JPL
- Operated by University of Arizona
- Data archiving at NExScI

The Role of HOSTS for NASA Missions

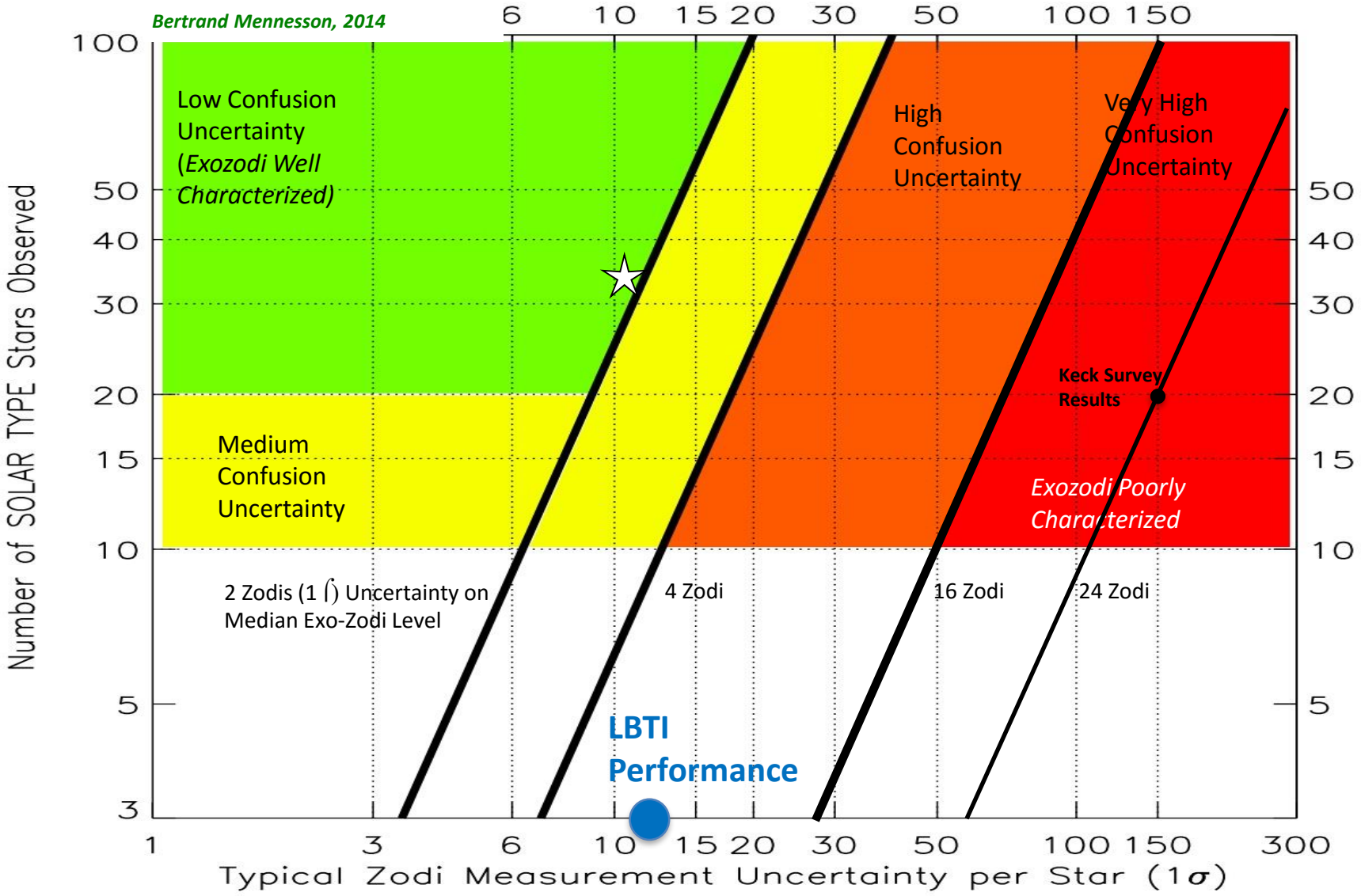


NASA needs a sense of how 'foggy' the habitable zones of nearby stars are.

Detectability of Exozodi Emission for ExoPAG Report (Roberge *et al.* 2012)



LBTI Requirements to Inform Design of Future Missions

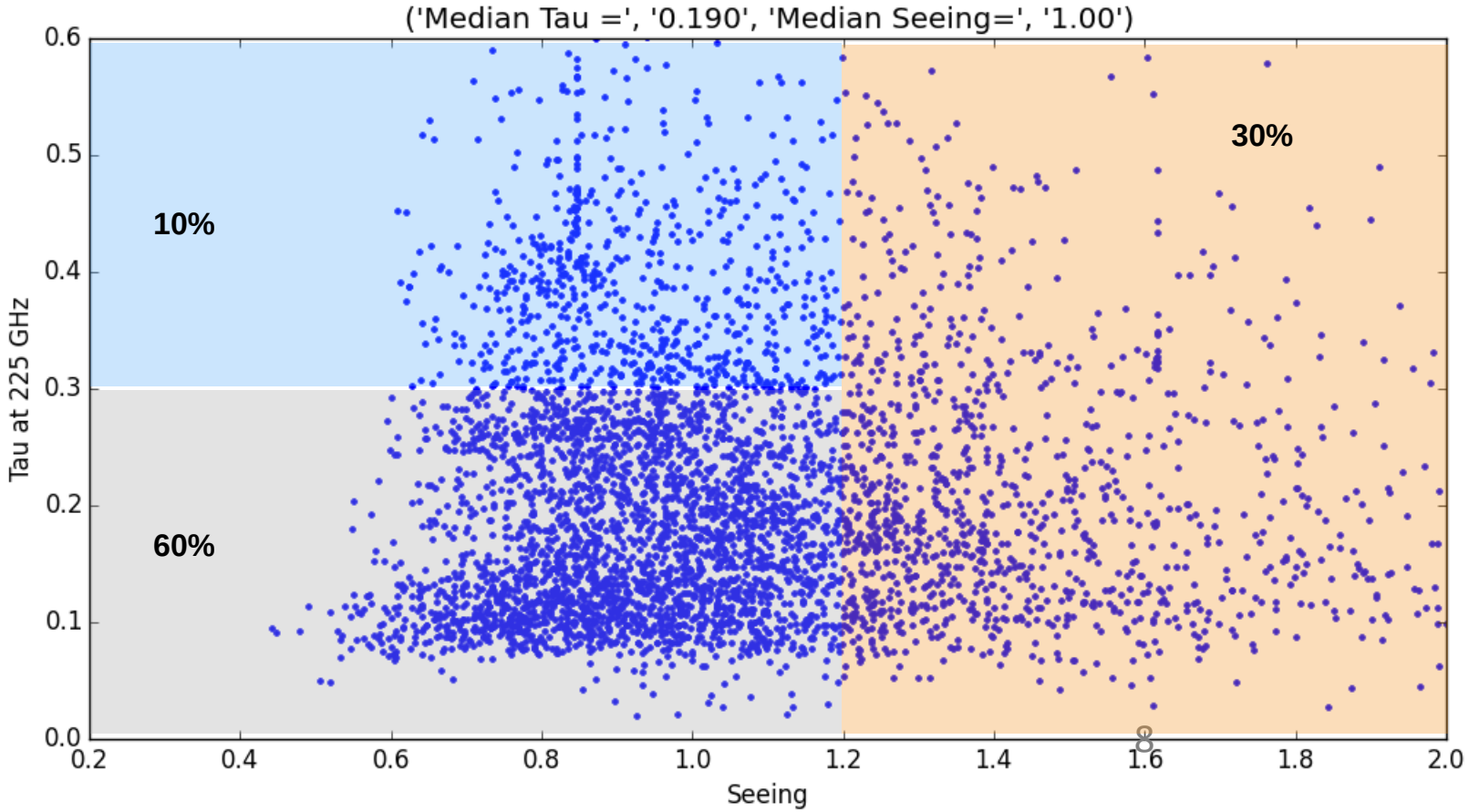


Termination Review

- The 2015-2016 observing season that followed the ORR produced data for only one HOSTS star, with insufficient nights remaining in plan to complete survey.
- NASA held a termination review July 12 to determine whether and how to continue the LBTI project to complete HOSTS.
- Review outcome:
  - NASA directs LBTI to make a plan to continue HOSTS through FY18
    - with expected LBTI share of telescope time, this provides a full semester of schedule margin over four semesters for telescope or instrument downtime
  - Plan is to measure at least 35 HOSTS target stars at ORR sensitivity
  - Continuation contingent upon certain changes in LBTI project management, in particular queue scheduling and new mission assurance procedures

LBTI Now Uses Queue Scheduling

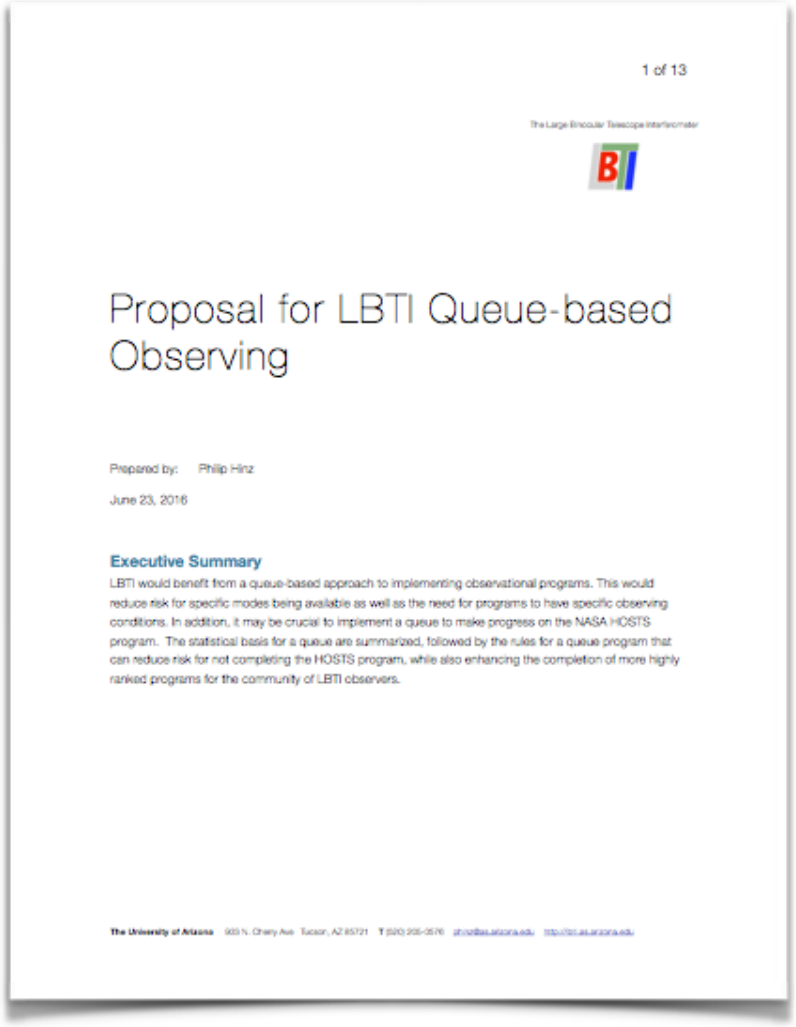
- Analysis of observing statistics indicates 60% of cloud-free time is sufficiently calm and dry for HOSTS, i.e. 36% of all observing time in semesters.



Queue Summary

Agreed set of rules to prioritize HOSTS science:

- First 4 suitable nights each semester to be used for HOSTS.
  - Results in 12 stars per semester
- High Priority (highest 50%) AZ science executed in non-HOSTS suitable time.
  - After first HOSTS 4-night allocation is used, other high priority AZ science moves ahead of HOSTS in queue for smooth, dry nights
- Additional HOSTS and AZ nights in queue if more time is available each semester.
- Note: Some non-HOSTS LBTI programs are still classically scheduled at preference of proposer, <10% in 2016B.
  - Example: near-Earth asteroid observation with very limited window of opportunity
- Queue typically provides 6 nights of schedule margin over 4 needed in a 36 night semester.



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The Large Binocular Telescope Interferometer

LBTI

Proposal for LBTI Queue-based Observing

Prepared by: Philip Hinz

June 23, 2016

Executive Summary

LBTI would benefit from a queue-based approach to implementing observational programs. This would reduce risk for specific modes being available as well as the need for programs to have specific observing conditions. In addition, it may be crucial to implement a queue to make progress on the NASA HOSTS program. The statistical basis for a queue are summarized, followed by the rules for a queue program that can reduce risk for not completing the HOSTS program, while also enhancing the completion of more highly ranked programs for the community of LBTI observers.

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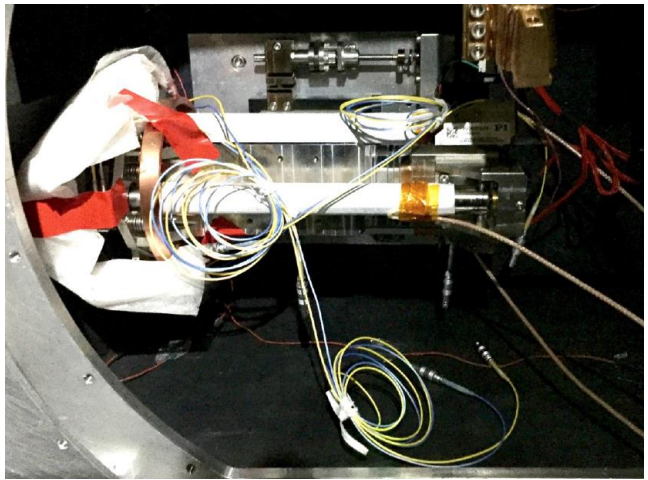
Mission Assurance: More Rigorous than Before, Though Not Like a Flight Project

- LBTI now has two new Mission Assurance personnel:
  - Doug Kelly is the Mission Assurance Manager for LBTI at the University of Arizona
  - Steve Watson of JPL is providing additional Mission Assurance support.
- LBTI uses LBT's IssueTrak system for its Problem/Failure Reporting
- Instrument modifications go through CCB Review, led by MAM Kelly, with JPL participation
- Risk Management procedures updated
- All MA processes reviewed by LBTI Project every six weeks
- Pre-run LBTI health checklists are now maintained online
- LBTI PI Phil Hinz in regular meetings with LBTO management to advise LBT's mission assurance procedures

Slow Start to the 2016B Observing Semester

- On August 26, a mixed rain and hailstorm overwhelmed LBT's roof drain, flooding the roof and spilling water on the telescope.
- None of the telescope core optics were affected, but the telescope's hydraulic bearing fluid was contaminated with rainwater and needed replacing.
- Some water poured onto LBTI, but the only damage was to a power supply communication board that was quickly replaced.
- No impact on LBT or LBTI observing schedule or performance.
- New hybrid pathlength corrector froze twice and was replaced.

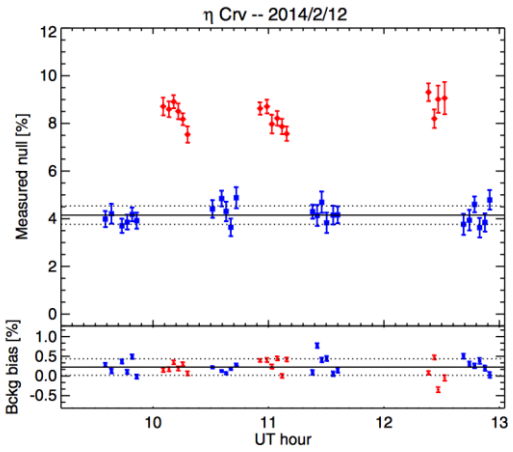


LBTI Adaptive Secondary Mirror Technical Problems

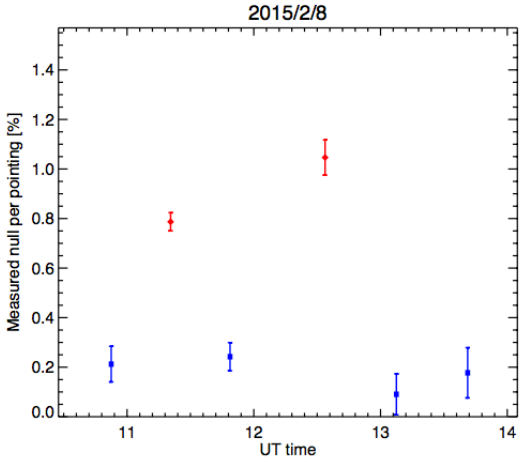
- In early October, a power supply on the right secondary mirror failed, severely hampering adaptive operation and requiring a month to diagnose and repair.
  - Most of LBTI's October block was lost to HOSTS
  - Team completed partial observation of alpha Cep nonetheless
- In mid-December, the electrical contacts to many of the right AdSec's capacitive sensors failed, preventing adaptive operation.
  - The mirror is now off the telescope and will be repaired next week
  - LBTI December and first January runs are lost to HOSTS, second January run is planned to be fully operational
  - Six of eight nights of LBTI's first January run are rescheduled to February.

Previous Science Results

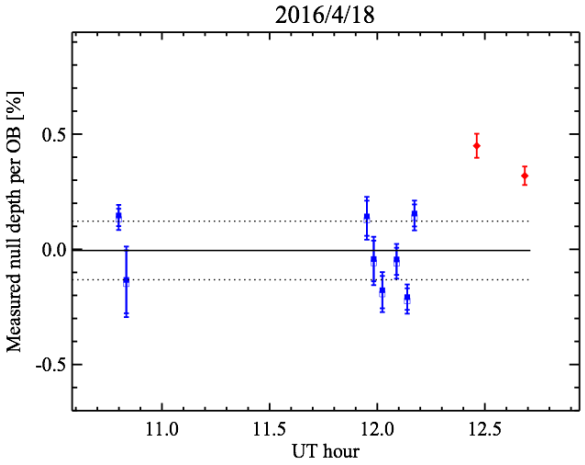
η Corvi



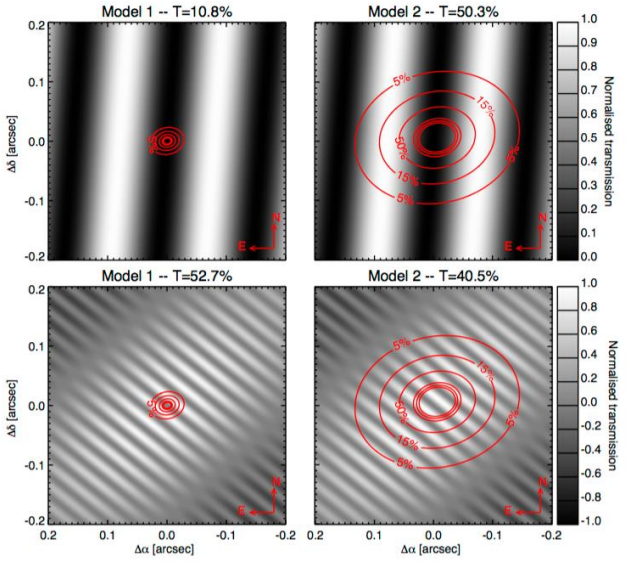
β Leo



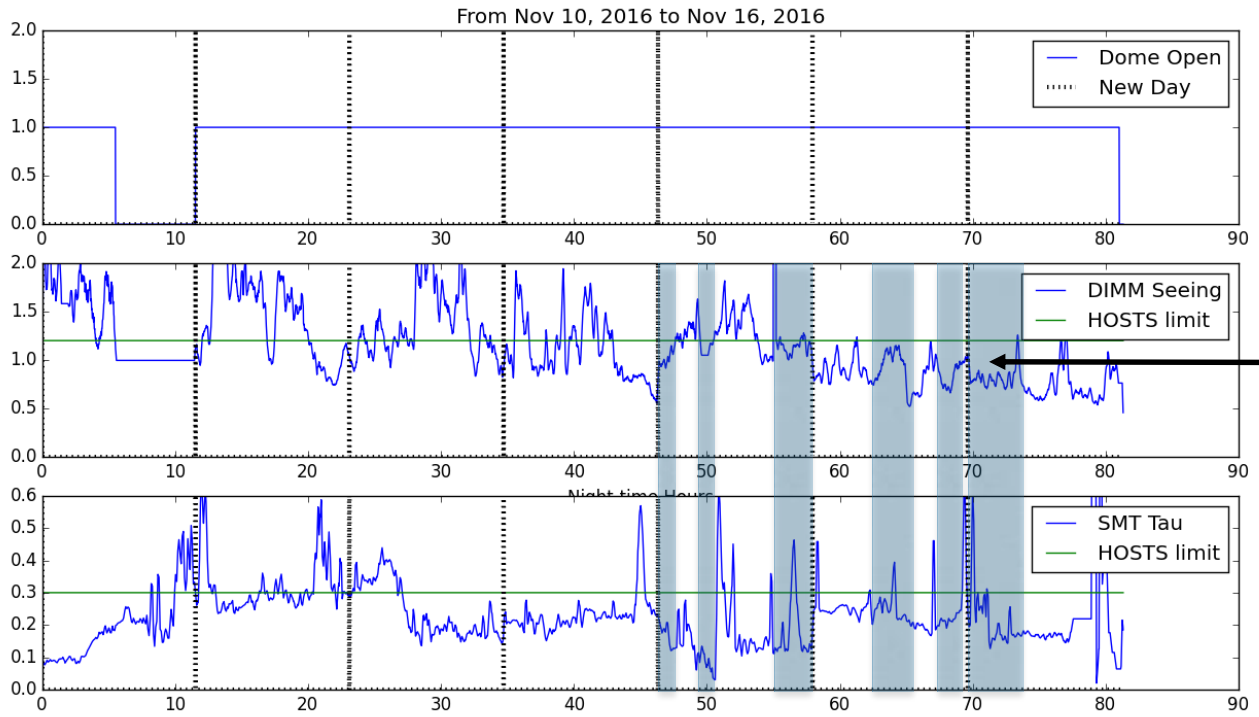
Vega



Star	Dust (zodi)	Uncertainty	Additional Information Learned
η Crv	1200	50	Dust is within 1 AU
β Leo	90	8	Warm dust likely from outer belt seen by Spitzer/Herschel
Vega	35	13	If confirmed, Vega's is faintest disk ever detected.



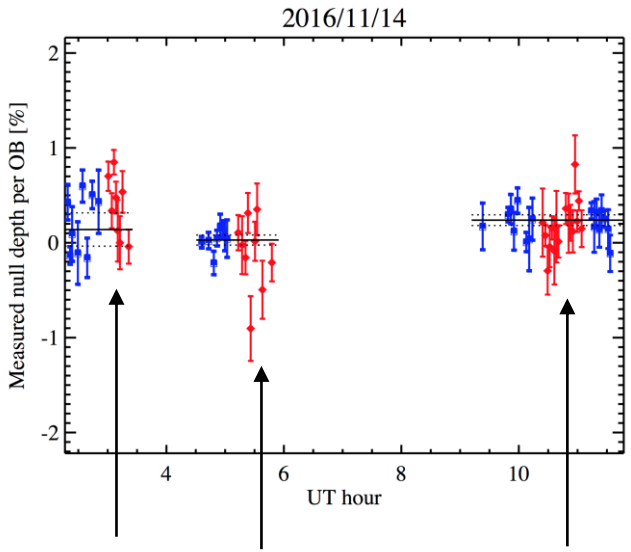
November Run Status Tracking

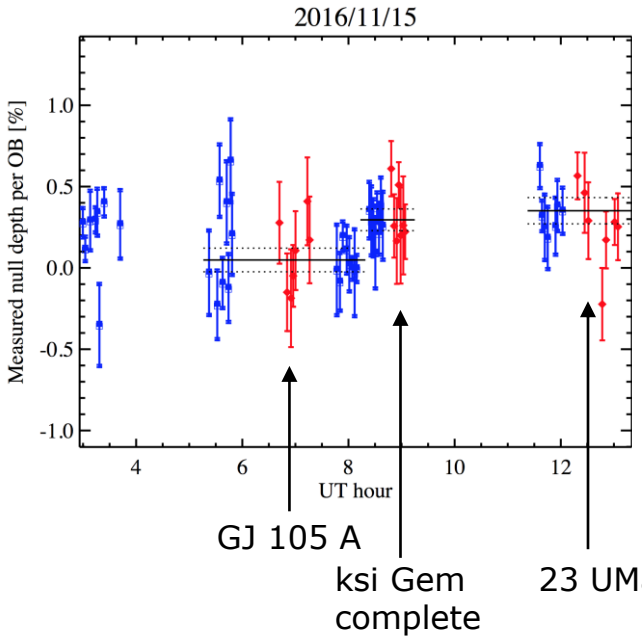


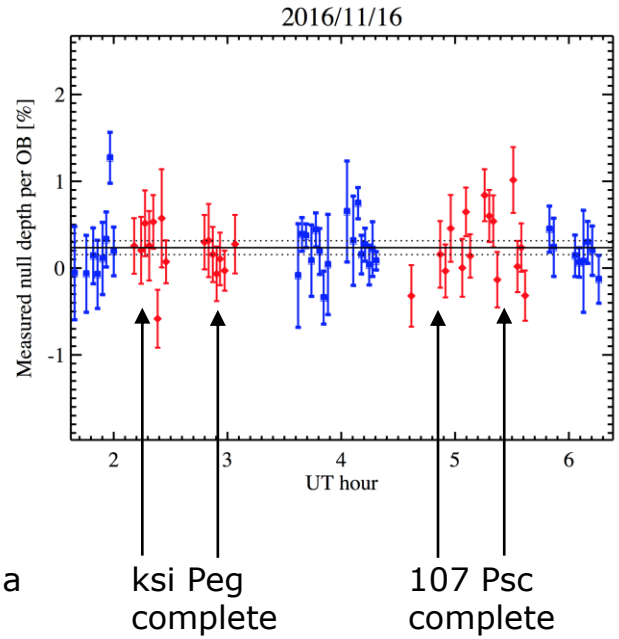
used for HOSTS

UT Date	Nov. 10	Nov. 11	Nov. 12	Nov. 13	Nov. 14	Nov. 15	Nov. 16
Open	Photom.	Spec.	Spec.	Spec.	Spec.	Spec.	Spec.
Midnight	Photom.	Spec.	Spec.	Spec.	Spec.	Photom.	Spec.
Close	Winds	Spec.	Spec.	Spec.	Spec.	Photom.	Spec.

Preliminary November 2016 HOSTS Data

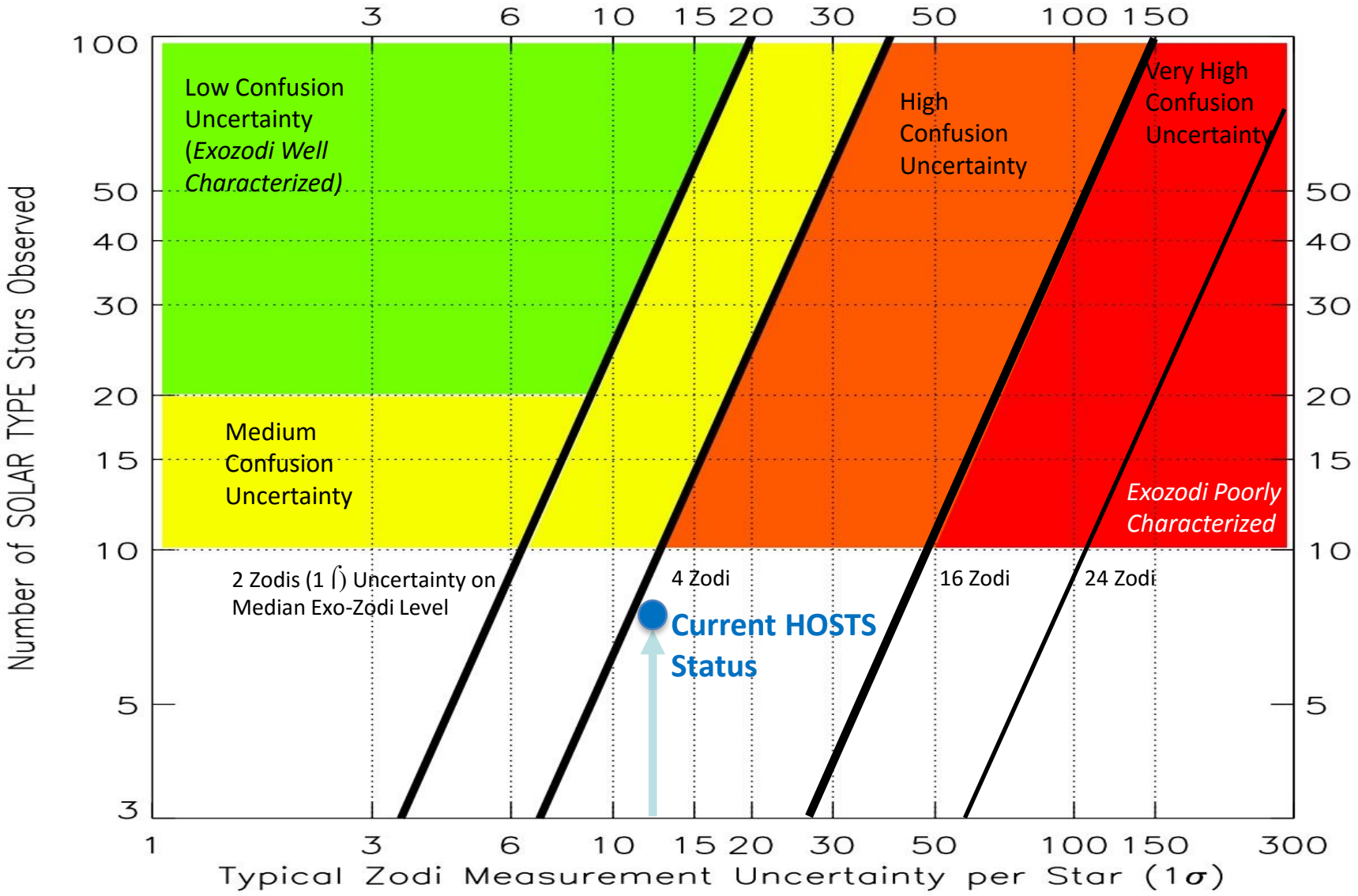






red=science objects
blue=calibrators

Progress on HOSTS Survey



Current LBTI Observing Schedule

- 66 nights scheduled for LBTI observations
  - September: 1 night
  - October: 7 nights 0.33 star observed
  - Nov: 5 nights 3.67 stars observed
  - Dec: 7 nights not usable for HOSTS
  - Jan. A: 2 nights not usable for HOSTS
  - Jan. B: 6 nights
  - Feb.: 11 nights
  - April A: 9 nights
  - April B: 6 nights
  - May: 12 nights

44 nights remain - 15.7 nights expected to be suitable for HOSTS

Future Milestones

- LBTI will be reviewed by the Astrophysics Division Program Management Panel (DPMP) at NASA HQ following the 2016-17 observing year to assess risks, operational trends and progress, and then decide whether to continue HOSTS to completion.
- A Project Assessment Review is planned at JPL for 2/17 (after the close of the 2016B semester) to evaluate progress toward the DPMP review.