

Time Domain Astronomy at the W.M. Keck Observatory

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WMKO

- Major Partners:
 - UC, CalTech, NASA, UH
- 9 Facility Instruments (currently)
 - 4 on Keck I
 - 5 on Keck II (*soon to be 6*)
- Demand for TDA science growing
 - Transients, Targets of Opportunity (ToO)
 - Cadence Observations
- “Classically” Operated
 - Partners had separate policies on TDA

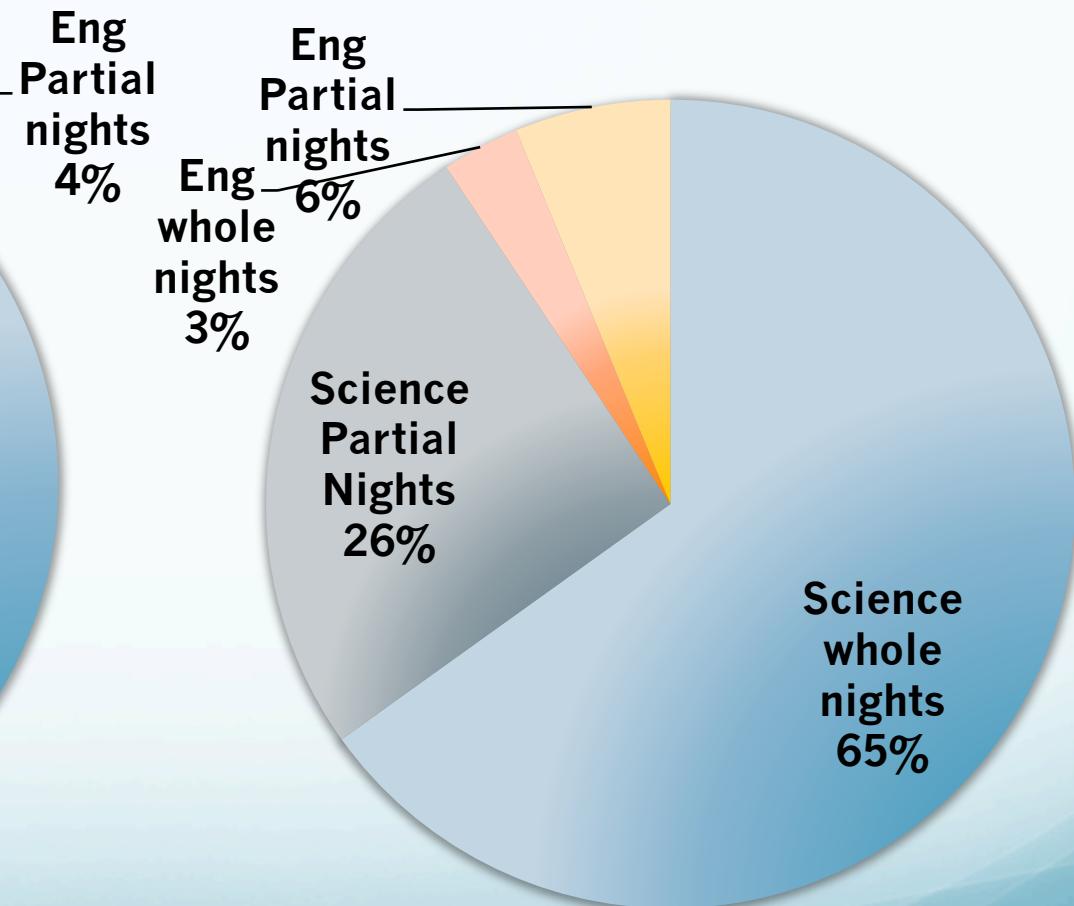
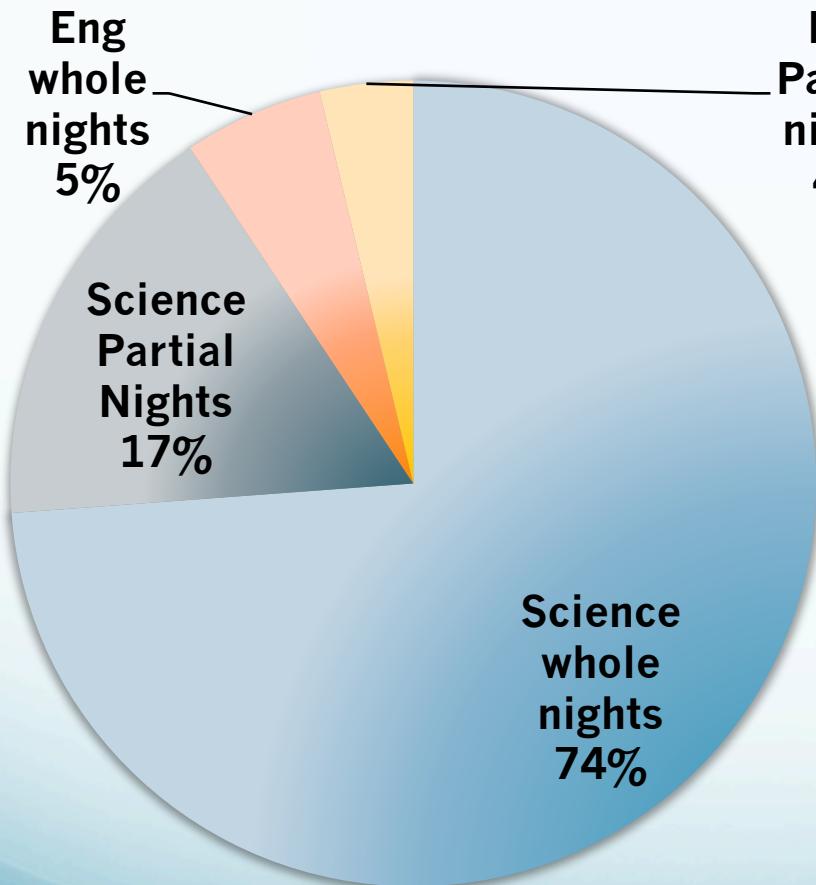


WMKO Policy on Time Domain Astronomy

- New scheduling rules to accommodate cross-institutional cadence and targets of opportunity
- Rules apply to all major partners
 - Keck scheduler now has more flexibility
- Designed to minimize impact on short programs (1/2 night or smaller)
- Limitations
 - Only TAC approved programs (no discretionary time)
 - No instrument changes
 - Number of interrupts, snapshots, limited per TAC partner
 - 60 min clock time for ToO
 - 60 min for snapshot cadence programs
 - Volunteer twilight program

Night Distribution

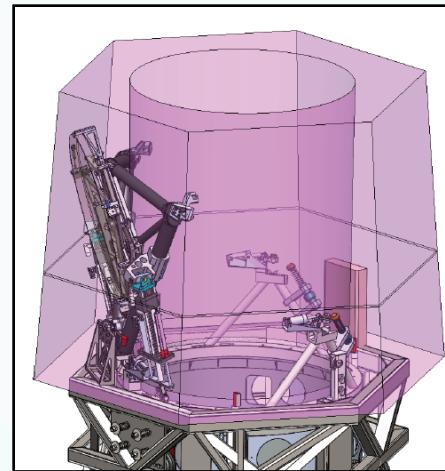
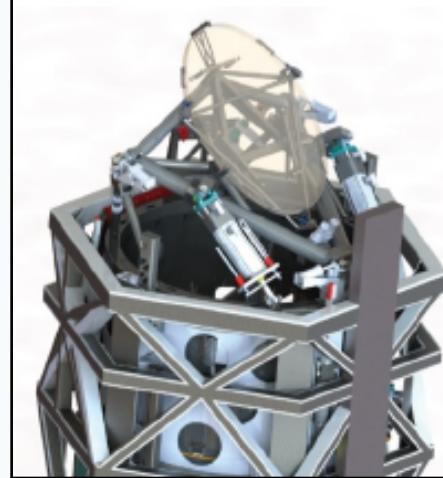
Past New



Keck I

Deployable Tertiary (Fall 2017)

- Mechanized Tertiary that can be swung in and out in place
- Rapid switch between Nasmyth and Cassegrain (~120 sec)
- Module will remain inside the Tertiary Tower
- Nasmyth instruments always available
 - OSIRIS, HIRES
- Cass Instruments available:
 - Bright time MOSFIRE
 - Dark time LRIS



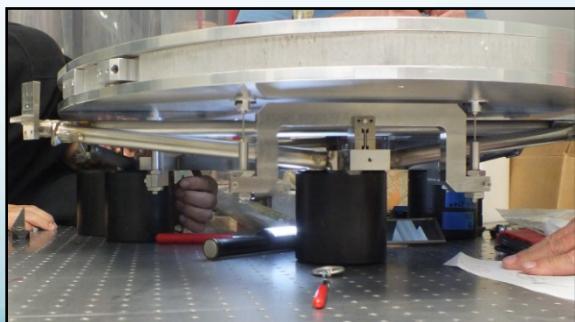
Outer and Inner Drums



Swingarm



Mirror Support Flexure



Whiffle Tree and Dummy Mirror

Keck II



- One Cass instrument: ESI
- Nasmyth Instruments
 - NIRC2 + AO at left Nas
 - NIRSPEC or DEIMOS or KCWI at right Nas
 - NIRES at bent Cas (commissioned by 2018A)

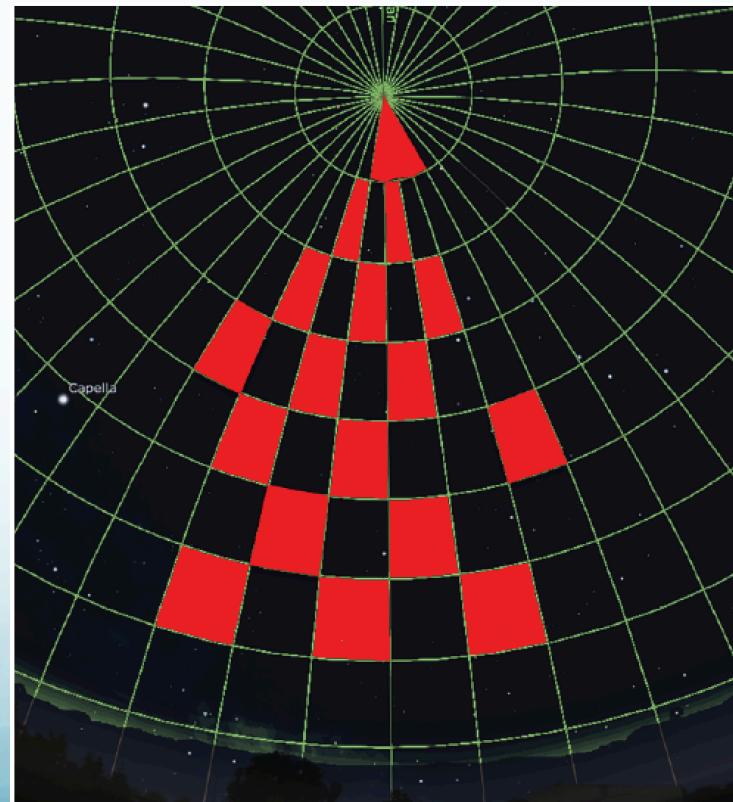
Instrument Readiness

- Maintain nightly “hot list” of instruments
- LGSAO special case
 - Satellite avoidance
 - List submitted 72 hours prior to propagation
 - Telescope avoidance (LTCS)
 - Laser power up and tuning overheads



“Tiled” regions for fast LGS response

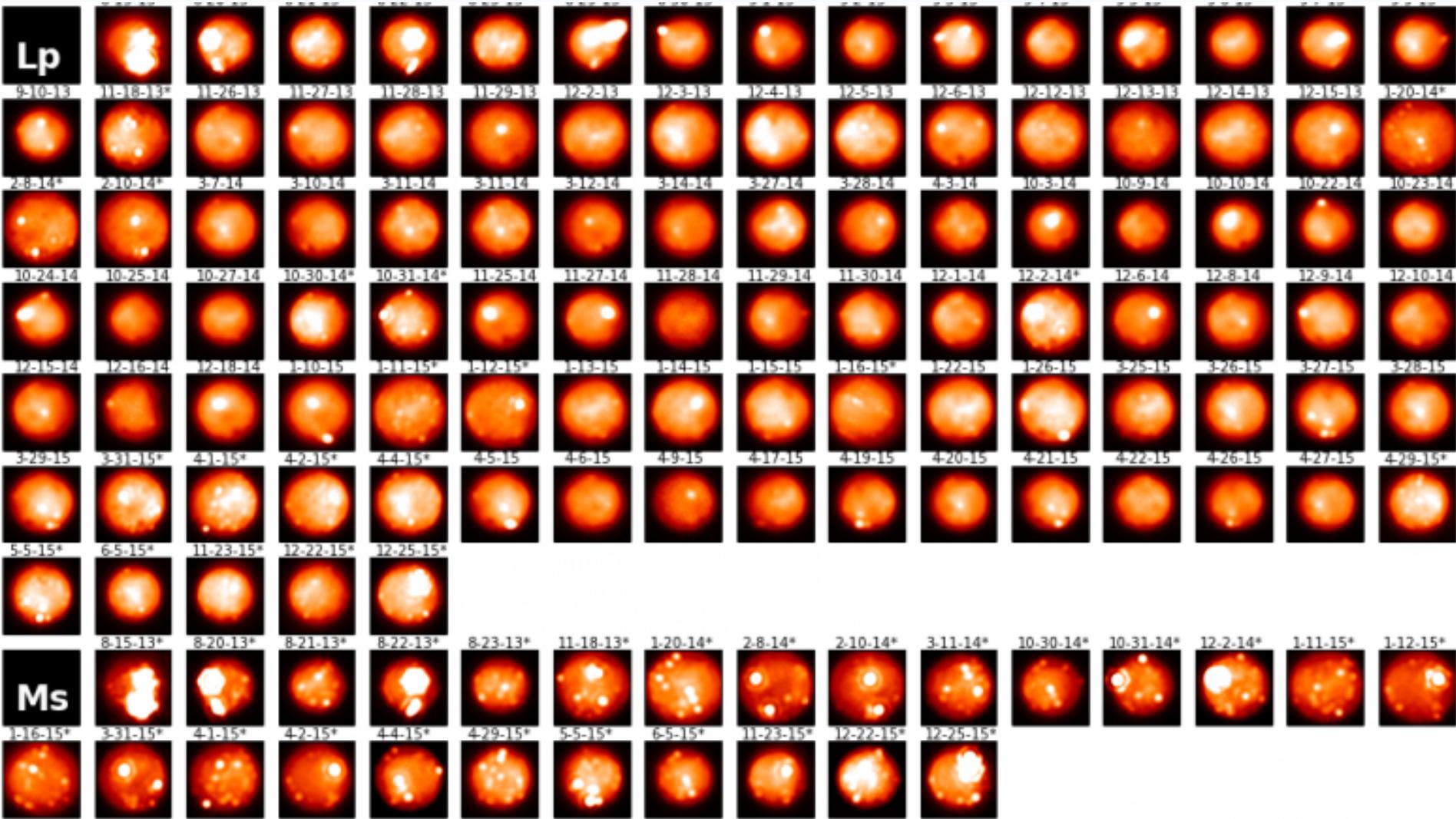
- WMKO, Christoph Baranec, Reed Riddle writing software to use large (az, el) “tiles” over the entire sky.
- Pre-approval of tiles, so a ToO should track into a tile sometime during the night.



TDA Development

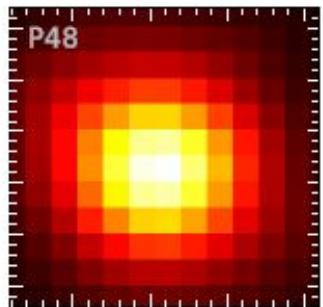
- Proposal cover sheets now include TDA specifics (ToO Cadence)
 - Cover sheets saved into data base
- TAC web interface to data base
 - Designate allocations
 - Distribute evenly
- Observing time accounting data base
 - Reconcile each semester
- Policies and procedures web information
 - http://www2.keck.hawaii.edu/inst/common/too_policies.html
- Observing Support
 - Scripted observations for cadence
 - Adding staff, Support Astronomer(s)
 - OA (TO) training

Evolution of Volcanic Eruptions on Io

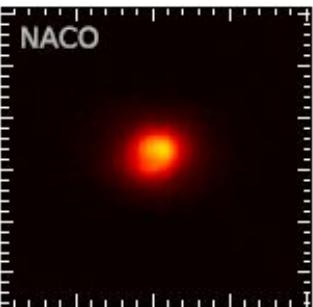


Lensed Type Ia Supernova: iPTFgeu

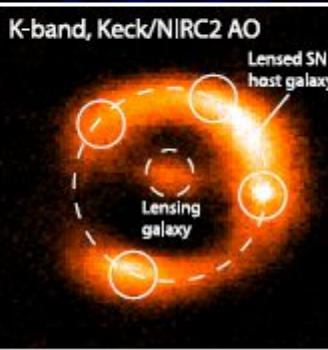
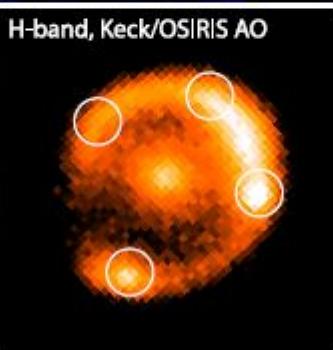
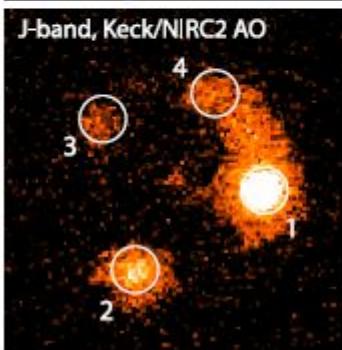
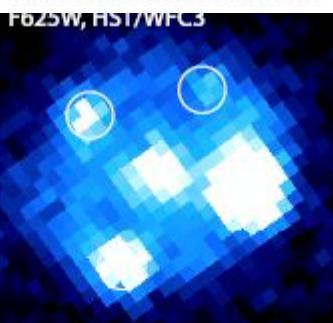
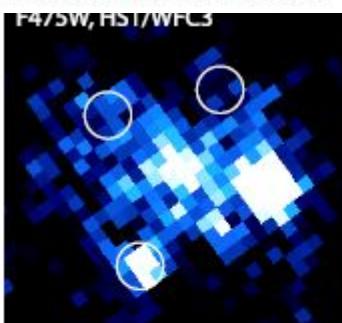
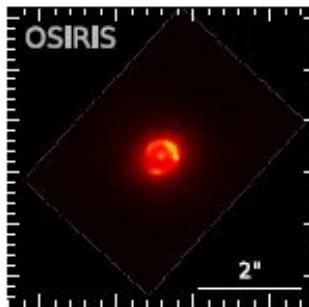
Palomar



VLT



Keck



- iPTF-discovered
 - Too bright for distance
 - Suggested lensed
- $Z_{\text{sn}} = 0.4$; $z_i = 0.2$
- Fit multi-color lightcurve of SN
 - Measure magnification ~4.4 magnitudes
- First time multiple images of aSN1a have been observed
- Resolved lensing galaxy
 - Small scale clumping

Goobar, A. et al., 2016, [astro-ph](#)

Thanks