NEID Queue Operations: Design, Implementation, and Current Performance

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Instrument Fast Facts:

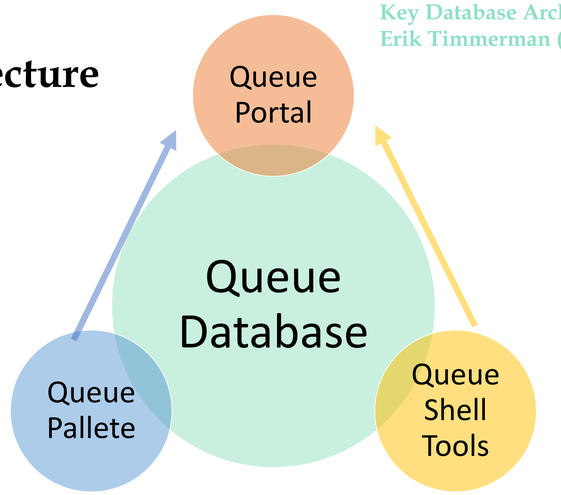
Where? WIYN 3.5 m Telescope @ Kitt Peak National Observatory (Tucson, AZ, USA)
Wavelength Coverage: 380-930 nm (continuous coverage)
Resolution:
- R~110,000 in "High Resolution" mode (0.92'' diam. Fiber)
- R~70,000 in "High Efficiency" mode (1.5'' diam. Fiber

Precision: <30 cm/s (single measurement precision)
Calibrations:
- Daily: Morning/afternoon calibrations –
  - darks, flats, wavelength calibrators (i.e. arc lamps, Fabry-Perot etalon, laser frequency comb)
- Every NEID night:
  - 1-2 RV standards
  - 25 - minute intermediate calibrations near midnight
  - Bracketing etalons between each target

See https://www.wiyn.org/Instruments/wiynneid_observers.html for details.

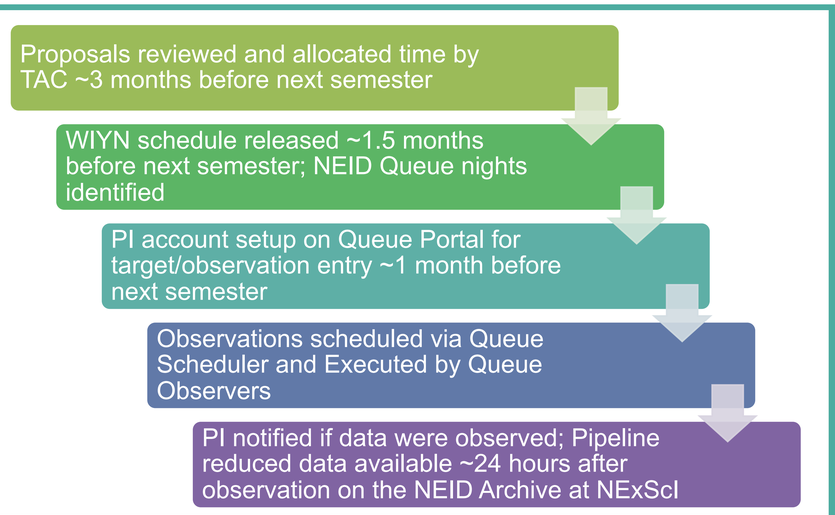
Queue Architecture

Key Database Architect:
Erik Timmerman (NOIRLab)



Queue Database: A PostgreSQL (Postgres) database that holds information describing user accounts, programs, targets and observation data
Queue Portal: A secure website with a Django Python backend – the principal user access point to the NEID database
Queue Palette: A Python GUI that allows the observer to select and send target and observation information to the telescope operator and NEID observing GUIs
Queue Shell Tools: A set of scripts (predominantly Python-based) that interact with the database and portal to do everything from scheduling to time accounting

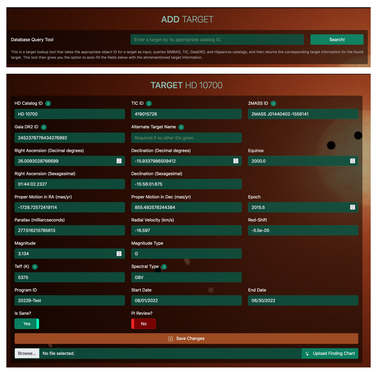
Land Acknowledgment: Ask us more!
Kitt Peak National Observatory sits atop I'oligam Du'ag. Astronomers are honored to be permitted to conduct scientific research on I'oligam Du'ag (Manzanita Bush Mountain), in the homeland of the Tohono O'odham Nation. We honor their past, present, and future generations, who have lived here for time immemorial and will forever call this place home.

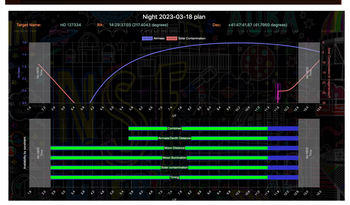


NEID Queue Portal:

Key Portal Architects:
Diego Gomez, Eli Golub (NOIRLab)

Target Entry Key Features:
- **Database Query Tool** – Allows user to pre-fill target info from SIMBAD, TIC, GaiaDR2, and Hipparcos
- **Finder Chart Upload** – Allows user to upload their own finding chart (PanSTARRS finding charts are also generated for each field during scheduling)
- **Verification procedure** -- Automatic checks allow PIs and WIYN staff to inspect target (observation) entries for common errors before ingesting new targets (observations) into the Queue Database





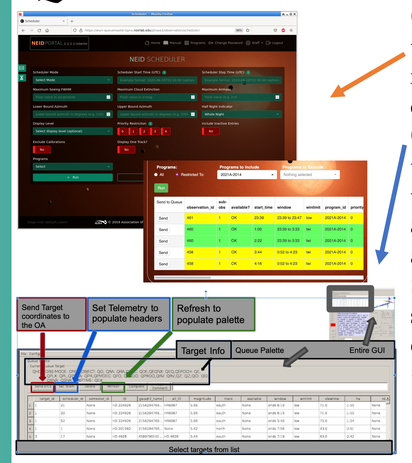
Observation Entry Key Features:
- **Status Flag** – Allows user to activate or inactivate observations which changes their visibility to the scheduler
- **Priority Selection** – Users can assign each observation a priority bin based on TAC awarded priorities
- **Timing Type** – Users specify whether observations should execute over a range of dates or orbital phases
- **SNR Trigger** – Users specify either a fixed exposure time or a SNR trigger
- **Observability Flags (Time Critical and Low Precision)** – Users can indicate whether targets are time critical and/or whether they can be observed when NEID is in a low-precision state
- **Planning Tool** – Shows night or semester observability of a target given user's observing constraints

Scheduler Principles:

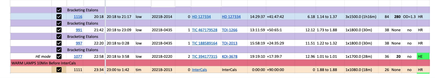
Key Scheduler Architect:
Mark Everett (NOIRLab)

- Major use case is EPRV measurements. Design guided by Hobby-Eberly Telescope queue (includes HPF) and its users.
- Each WIYN stakeholder must get equal value from their NEID queue share (i.e. equivalent allocations across 5 priority levels).
- Scheduling reflects TAC decisions
- Users can update programs as the semester proceeds; scheduling need not anticipate long-term plans for an observation
- Observation requests *compete* against all other available observations for time in the schedule
- Primarily priority driven scheduling; Priority level is not a direct reflection of scientific merit and should be determined by the observability of each target over the course of the semester
- Allows dynamic scheduling for nighttime schedule updates
- Schedules are recommendations and observers maintain control

Queue Observer's Tools:

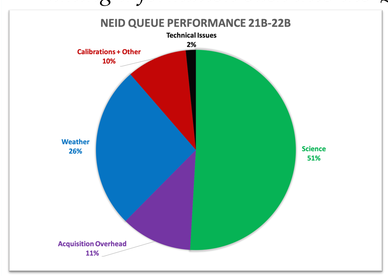


Queue Portal Scheduler: Allows QOs to search for and select observations for the night; Selections are sent to the queue palette
Queue Palette: GUI interface between the Portal/Database and both the telescope (sending target coordinates) and NEID (sending observing settings and telemetry
Schedule Tracker: Python-generated spreadsheet for QOs to track observations throughout the night



Time Accounting & Queue Performance:

Time Accounting:
- Shell scripts extract exposure times, overheads, and QO comments into a single spreadsheet
- Time accounting is manually verified to ensure basic data quality (e.g. seeing restrictions were met, the proper number of exposures were executed, etc).
- PIs are then notified of any observations via an email that includes an updated accounting of their program time remaining.
- *Future upgrades include enhanced automation and the ingestion of program timing information back into the Queue Portal.*



Queue Performance: The Queue is performing well, with minimal technical losses due to the queue's ability to transition to low-precision programs as needed. *Acquisition overheads have improved with each subsequent semester and continuing to reduce these overheads is our current focus with planned software upgrades.*