The Palomar-Quest (PQ) Survey


Quest-2 camera

The PQ Survey: A new, digital, synoptic sky survey using the Quest-2 112-CCD camera at the Palomar 48” Oschin Schmidt telescope

• A collaboration between Caltech, Yale/Indiana U., and NCSA/UIUC; plus collaborations with other groups (INAOE, LBL, JPL…); started in summer of 2003
• About 50% of the telescope time, drift scan mode
• Now next-day (or so) processing → real-time
• NVO connections and standards built in from start
• Repeated observations, time baselines minutes to years
• A science and technology precursor/testbed for the LSST and other major synoptic sky surveys in the future

PQ Survey Sky Coverage

• Range -25° < δ < +30°, excluding the Galactic plane
• Ultimately cover ~ 12,000 - 15,000 deg²
• Rate ~ 500 deg²/night in 4 bands
• As August 2004, covered ~ 9,000 deg² in UBRI, of which ~ 6,600 deg² at least twice; and ~ 12,200 deg² in rizz, of which ~ 7,400 deg² at least twice; more coverage since then…

Bandpasses and Depth

Typical limiting magnitudes in a single pass:

- r lim ≈ 21.5 mag
- i lim ≈ 20.5 mag
- z lim ≈ 19.5 mag
- R lim ≈ 22 mag
- I lim ≈ 21 mag

In 4 passes (2 UBRI + 2 rizz), yearly:

- r lim ≈ 22.5 mag
- i lim ≈ 21.5 mag
- z lim ≈ 20.25 mag

In 5 years, ~ 0.8 mag deeper …

PQ Consortium

• 40% of the time used by the JPL NEAT team in the point & stare mode
• 10% of the time used by M. Brown for exploration of the outer Solar System
• 50% of the time used by Yale and Caltech in the drift scan mode, mainly for the PQ Survey proper:

http://www.astro.caltech.edu/pq/

Palomar-Quest Data Flow

Image Archive Catalogs Archive Master Archive Pipeline Data Proc. Target Selection CIT Yale NCSA JPL LBL SNF SDSC CIT Data Broker P48 P200 Follow-up
The PQ Survey Science

- Large QSO and gravitational lens survey
  - Tests of the concordance cosmology
  - Dark matter distribution
  - AGN physics and evolution
- **High-redshift (z ~ 4 - 6.5) QSO survey**
  - Probes of reionization and early structure formation
- **Exploring the time domain**
  - Supernovae, GRBs, AGN, var. stars, optical transients
  - Surprises and new phenomena?
  - Time baselines ranging from minutes (inter-CCD) to days, months, years (repeat scans) to decades (cross-match to DPOSS, SDSS, etc.)
- Galactic structure and stellar astrophysics
- Etc. etc. - think what it can do for you

PQ: QSO and Lens Search

- **The goal:**
  - discover ~ 300,000 bright QSOs, including ~ 1,000 strong lenses
  - Use as an independent check on cosmological parameters (assume an evolution model) … or assume the cosmology and constrain the evolution of DM halo assembly!

The PQ High-Redshift QSO Survey

- **New probes of the reionization era, early structure formation and biasing**, and the first QSOs (infall, enrichment, LF, MBH mass func.)
- Similar in scope and methodology to SDSS: same depth, comparable or larger area coverage (some overlap for healthy mutual cross-checks, some new)
- Expect to discover ~ 20 QSOs at z ~ 5.5 - 6.5 (reionization probes), ~ 100 QSOs at z ~ 4.5 - 5.5, and ~ 200 - 300 QSOs at z ~ 4 - 4.5 (primordial LSS probes)
- Make them public via WWW as soon as the spectra are obtained (as we did in DPOSS)
- Possible basis for a z > 7 QSO survey in NIR

Our First High-z QSO: PQ 1131+1249

Exploration of the Time Domain: A Search for Low-z Supernovae

- Calibration of the SN Ia Hubble diagram
- New standard candles from SN II
- Endpoints of massive star evolution

Exploration of the Time Domain: Optical Transients

Now developing a real-time processing and transient discovery pipeline ➔ immediate public distribution