Telescope systems at Lick Observatory and Keck Observatory

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UCO/Lick Observatory
Everything has changed – FK4 -> FK5 -> IAU 2000
Machines do all the computing
Software implements the algorithms
Need code libraries that know the conventions
Available Software

- Starlink Library for Astrometry (SLALIB)
  - FK4 and FK5
- IAU Standards of Fundamental Astronomy (SoFA)
  - FK5 and IAU 2000
- Naval Observatory Vector Astrometry Software (NOVAS)
  - IAU 2000
  - unencumbered
Pointing the telescopes

- Telescope inceptions span 125 years
- Absence of leap seconds affects each differently
Lick Observatory
James Lick 36-inch refractor
Lick refractor control panel
Shane 3-m reflector
Shane 3-m reflector
Original Shane control panel
New Shane control room
Nickel 1-m reflector
Shane and Nickel

- both are equatorial
- Shane guider FOV ~3 arcmin, Nickel ~7 arcmin
- Nickel original control via 6502 microprocessor & steppers
- Shane received another 6502 “TELCO” for guiding
- slews were manual for both
- TELCO replaced by Intel/Linux “POCO” around 2005
- POCO uses SLALIB
- POCO + new encoders on Nickel → automatic slewing
- both now allow remote observing via Internet
- TTs always on duty for Shane slews
- absence of leap seconds will affect Shane first
Keck 10-m reflectors
Keck 10-m primary
Keck 10-m control room
Keck 10-m reflectors

- segmented primaries in alt-azimuth mount
- guider FOVs ~3 to 3.5 arcmin
- typical blind slew accuracy ~7 to 8 arcsec
- occasional slews off by 40 arcsec → nearby catalog star
- OAs always on duty for slews
- DCS uses SLALIB and GPS time server
- absence of leap seconds → new pointing software soon
APF 2.4-m reflector
APF 2.4-m reflector

- monolithic primary in alt-azimuth mount
- dome and telescope purchased from vendor
- contract specification of 10 arcsec slew accuracy
- guider FOV < 3 arcmin
- intended for fully robotic operation
- time input from GPS receiver over serial line
- pointing software is closed source
- absence of leap seconds → failure to point
APF software

- never send a programmer to do an astrometrist's work
APF workaround

Note. The terminology used in this diagram is intended to facilitate explanation, and is not definitive.

Diagrammatic representation of the relationship between the two systems: the "ephemeris" system using E.T., and the "Greenwich" system using U.T.

Ephemeris mean sun” is not...