Filter Exchanger Requirements

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Overview

- Yes, Requirements are documented (11 pages):
  http://www.oir.caltech.edu/twiki_oir/pub/Palomar/ZTF/Requirements/CIN_670_ZTF_Filter_and_Exchanger_Requirements.docx

- Let's look at driving requirements, and note some others.

- Michael Porter will show a requirements compliance matrix.

Requirements

- Safety (personnel, telescope, instrument, filters)
  - by design and by test …. metrics/protocols TBD but “handoff” is allowed

  → cost & schedule
- Functionality
  - Automated exchange between 3 filters or none (all stowed).
  - Manual change of filter set by day (safe, easy)
  - Mechanical protection of stowed filters from dust or humans.
- Survey rate
  - Exchange time <90s [60s goal]
  - Beam obstruction <1% on axis, 2% off axis [0.5%, 1% goals]
  - Reliability: MTBF > 33,000 exchanges; down time < 2 night/yr
  - Impact on tube seeing: surface temperature with 3C of ambient.
  - Positioning accuracy: +-0.25mm in X,Y, or Z.

Safety Requirements

→ Designs are not permitted different risk posture so this translates to cost and schedule required to meet need.

- Safety for personnel
  - Interlocks
  - Limit forces?
- Safety for telescope
  - Interlocks, redundancy fro safe handoff
  - Verify by repetitive test in various orientations.
- Safety for instrument
  - Force limits
  - Soft frame surface (cannot scratch window)
- Safety for filters
  - All of the above
  - Enclosed when stowed to protect from dust and harm by humans

Functional Requirements

- Automated exchange between 3 filters
  - Or observe with no filter (all stowed)
  - Easy upgrade to more filters is desirable but not a requirement.
- Manual change of filter set by day
  - Need infrastructure to make this safe (easy)

Requirements affecting survey rate

- Exchange time <90s [60s goal]
  - Cooperative telescope motion allowed but counted as positioning overhead.
  - Currently a maximum is specified but it the average which is more interesting for survey rate. Maybe the goal is for the average.
- Beam obstruction <1% on axis, 2% off axis [0.5%, 1% goals]
- Reliability: MTBF > 33,000 exchanges; down time < 2 night/yr
  - Verification method is not yet specified.
- Impact on tube seeing: surface temperature with 3C of ambient.
- Positioning accuracy: +-0.25mm in X,Y, or Z. Tilt TBD.

Concerns

No formal requirement yet:

- Obstruction of human access to telescope interior.
- Mass of filter exchanger
- Mass of electronics
- Heat dissipation in electronic enclosure
- No back drive (part of safety requirements)
- Knowledge of positioning preserved across power cycle