



## LBT PROJECT 2x8,4m TELESCOPE

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# LBT PROJECT 2 X 8,4m OPTICAL TELESCOPE

## Instrument Rotator and Cable Chain Requirements Analysis

	Signature	Date
Prepared	Robert Meeks	11-Oct-06
Reviewed		
Approved		

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1. Revision History

Issue	Date	Changes	Responsible
a	11-Oct-06	First Draft	Robert Meeks

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### 3. About this document

#### 3.1. Purpose

The purpose of this document is to define the requirements of the LBT instrument rotators. These requirements were primarily identified through discussions with various engineers and potential users of the LBT.

#### 3.2. Reference Documents

None.

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## 4. Requirements Analysis

### 4.1. Operations

#### 4.1.1. General operational requirements

- Each rotator must support a specified instrument weight, moment of inertia, and imbalance
- Each instrument rotator must have a specified physical interface for an instrument.
- It must be possible to use all rotators simultaneously.
- The instrument rotator software modules must provide a user interface displaying operational data of interest to telescope operators, astronomers, and instrument scientists.
- The instrument rotator software modules must provide a user interface to allow telescope operators, astronomers, and instrument scientists to issue operational commands to each rotator.

#### 4.1.2. Initialization

The following procedures must be performed when starting up each rotator.

- Allow initialization to be performed independently by a trained Telescope Operator
- Allow a rotator to be initialized while another rotator is operating and the telescope is making observations. After initialization the unused rotator should be kept in “standby” mode for later use.
- Monitor the startup process, log diagnostic information, and provide feedback to the operator.

#### 4.1.3. Between exposures

Between exposures, either when moving from one object to the next or when preparing for a new exposure on the same object, a rotator must

- Make sure there is enough remaining travel in the cable wrap to perform the next observation. This should be transparent to the user.
- Prepare the wrap for planned observation by automatically “unwrapping” if necessary.
- Rotate independent of telescope movement to orient an instrument to specified parallactic angle. The setting and reporting of position should have a resolution of at least 1/100 degree
- Rotate at up to 5 degrees per second to quickly move to a new position.
- Move quickly without necessarily moving smoothly. (Non smooth motion permitted)
- Accept and respond to a command to unwrap

#### 4.1.4. During exposures

While performing science observations each rotator must:

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- Track smoothly without any “jumps” or other erratic motion
- Rotate at proper rate to track stars or other celestial objects

#### 4.2. Installation and maintenance

##### 4.2.1. General maintenance requirements

- The instrument rotator software modules must provide a user interface displaying maintenance and diagnostic data of interest to engineers and technicians.
- The instrument rotator software modules must provide a means for logging maintenance and diagnostic data of interest to engineers and technicians.
- The instrument rotator software modules must provide a user interface to allow engineers and technicians to issue commands to each rotator necessary to facilitate maintenance. These commands may be different than those required for operation and may involve movements prevented during operation for safety reasons. Restricting these unsafe commands to local usage or other safety restrictions is acceptable.

##### 4.2.2. Instrument rotator

- The design of the instrument rotators must be such that preventive maintenance can be accomplished in a reasonable amount of time by skilled observatory technicians.
- The reliability of the instruments rotators must be such that the frequency and duration of corrective maintenance tasks do not result in more than a specified amount of “downtime” from science operations.
- All instrument rotator and cable wrap components must have lifting points to support their installation on the telescope.
- The cable wrap must provide access to allow cables and hoses to be installed and removed.

##### 4.2.3. Instrument

Each instrument rotator must do the following to support instrument installation, daily service, and corrective and preventive maintenance:

- Move to an installation position that may vary by instrument
- Slowly “jog” rotation to facilitate mechanical alignment
- Support a large imbalance or moment
- Move to a service position that may vary by instrument
- Lock and/or hold position safely to allow instrument maintenance to be performed. This could involve significant changes in loads applied to the rotator.

##### 4.2.4. Telescope maintenance

Each instrument rotator must do the following to support telescope calibration, corrective maintenance and preventive maintenance:

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- The bent Gregorian rotator assemblies must provide clearance for the bell jar to support primary mirror coating
- It must be possible to set each rotator to a specific position while performing pointing model observations
- It must be possible to command each rotator to track telescope position while performing pointing model observations

#### 4.3. Safety and Health

##### 4.3.1. Status monitors

- The instrument rotators must each sense and display:
  - Time to limit of the cable wrap for current observation
  - Current to each motor
  - Position of each sensors
  - Following error for each axis
  - Temperature of each motor as well as auxiliary temperature sensor
  - Status of each limit switch and proximity sensor

##### 4.3.2. Interconnection observatory interlock system

- Each rotator must respond appropriately to the observatory interlock system
- Each rotator must have one or more EStop buttons on or close to it

##### 4.3.3. Protect against unsafe situations

- A lockout key for instrument, including feedback
- A means for physically preventing motion of the rotator during maintenance must be provided
- Out of limit excursions must be physically prevented with hard stops or similar devices

#### 4.4. Environmental

##### 4.4.1. Temperature and Humidity

- Must operate when ambient temperature and humidity are within specified limits

##### 4.4.2. Heat dissipation

- Must meet a specified heat dissipation budget with all instruments operating but balanced within specified limits
- Exposed external surface temperature must be within a specified delta-T of ambient temperature during operation

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