GEMINI NORTH ADAPTIVE OPTICS (GNAO)

“LASER LAUNCH TELESCOPES (LLTs)”

OPTICIAL TRAIN

V 1.0

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Change Record

Version	Date	Description	Owner Name
1.0	4/7/20	Extracted from CoDR document for RFP purposes	E. Marin

Contents

1 BEaCoN

The BEaCoN systems will be the system that is used to link the Toptica laser to the laser launch telescopes. This system will be produced in house instead of contracted out to a third party. Gemini has experience developing Beam Transfer Optics used at each site, and more recently has the experience of building two new beam injection modules to link the Toptica lasers to existing BTOs. By leveraging this experience, we can keep the development of the beam transfer optics in house and reduce overall cost and risk. Figure 1 below shows a 3D model of the 2 beam Beam Expander and Control Node (BEaCoN).

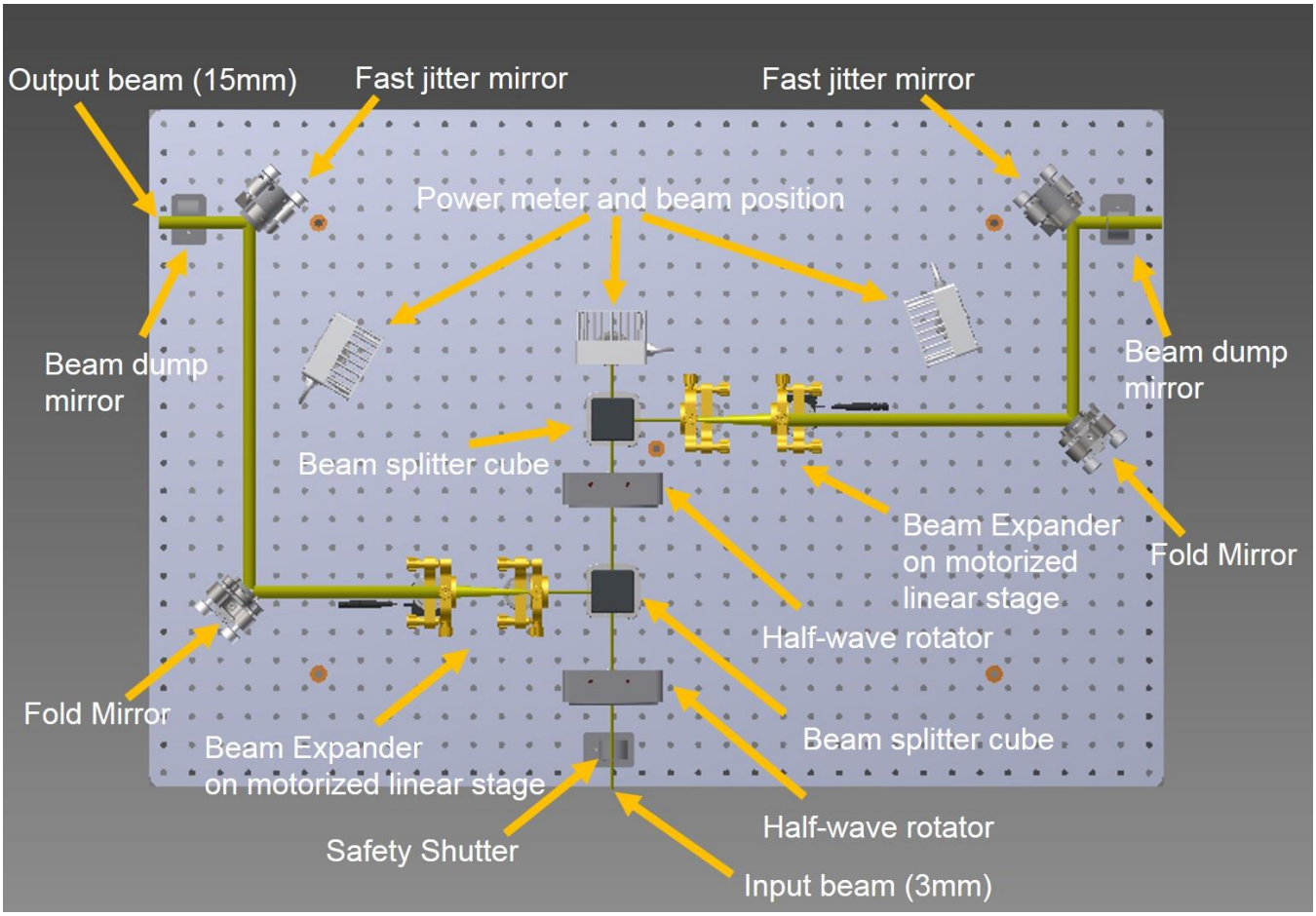

Figure 1 A 3D model of the BEaCoN module,

the BEaCoN module is responsible for expanding the beam, correcting uplink focus, and for fast beam positioning

2 Safety Shutter

The safety shutter is the first component of the BEaCoN that the Toptica laser will encounter after exiting the Toptica laser head. The safety shutter is part of the safety

interlock system and is designed to be tripped if an unsafe condition is detected. The safety shutter consists of an anodized aluminum blade that moves between open and closed positions. The safety shutter cannot open if a safety interlock is tripped.

3 Half Wave Rotator

The second and fourth optical elements in the BEaCoN are half wave plates. They are fixed to mechanical mounts on the optical bench and will be housed in motorized rotation stage that allows changes to the output polarization remotely. The half wave rotator changes the polarization state of the Toptica laser allowing the beam to be divided into two laser beams of equal power at the beam splitter cube. Half wave plates that meet the power and wavelength requirements of the Toptica laser, mechanical mounts, and motorized rotation stages are all commercially available.

4 Beam Splitter Cube

The third and fifth elements in the BEaCoN are high energy polarizing Beam Splitting Cubes (BSC). The BSCs will transmit P-polarized light and reflect S-polarized light at a 90 degree angle. BSCs that work at the Toptica laser power and wavelength are commercially available and are in use in both the Gemini North and Gemini South beam injection module.

After the first BSC there will be two beams of equal power in the BEaCoN module. The transmitted beam will go to the second half wave rotator and BSC while the reflected beam will propagate to a beam expander. Each BSC will divert each laser beam to its own motorized beam expander.

5 Beam Expander

The beam expander will serve two purposes, expanding the beam from 3mm to 15mm in diameter and adjusting the uplink focus. The beam expanders consist of off the shelf optics set up to produce a reverse Galilean telescope. The optics will be mounted on commercially available motorized linear stages that will be used to adjust the focus. The main cause of defocus will come from thermal variations and the second cause will be from field dependent focus shifts in the LLT. The beam expander will have enough range to compensate for both of these effects. The beam expander will operate via an open loop model for both temperature and field dependent focus shifts.

6 Beam Positioning Mirrors

The beam positioning mirrors are standard flat optics that will be used to direct the mirror down the optical bench towards the fast jitter mirror. After the initial alignment these mirrors will be mounted in place and will have no moving stages.

7 Fast Jitter Mirror

The fast jitter mirror is used to correct for uplink tip/tilt errors as sensed by the GNAO LGSWFSs. The mirror will be mounted in place with a fast piezo stage capable of up to 1kHz movements corresponding to a few arcseconds on-sky. The piezo will be driven by the GNAO RTC in closed loop.

8 Beam Dump Mirror

The beam dump mirror is the last elements of the BEaCoN before the beams exit to the LLTs. This mirror is on a linear stage that will move in and out of the beam path. When the BDM is in it sends the laser beam to a power meter and when the BDM is out the beams will propagate to the LLTs. The BDM is also an essential part of the safety system as it serves as the main way to stop laser propagation during a safety event.

9 Power Meters

All power meters are commercially available and will be a quad cell 2x2 power meter that will allow for both measuring the power and position of the beam. The first power meter in the bench is after the second BSC, which under normal operations will not receive enough laser power for measuring purposes. This power meter will be used for calibration and initial alignment purposes. The other two power meters are located after the BDMs, these will be used to keep track of the laser power and the laser position inside the BEaCoN module before the injection into the LLTs.