Proposed SLR optical bench required to track debris using ~1550 nm lasers.


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Abstract: A previous study has indicated that by using ~1550 nm wavelengths a laser ranging system can track debris objects in an “eye safe” manner, while increasing the expected return rate by a factor of ~2/unit area of the telescope[1]. In this presentation we develop the optical bench required to use ~1550 nm lasers, and integration with a 532 nm system. We will use the optical bench configuration for NGSLR as the baseline, and indicate a possible injection point for the 1550 nm laser. The presentation will include what elements may need to be changed for transmitting the required power on the ~1550 nm wavelength, supporting the alignment of the laser to the telescope, and possible concerns for the telescope optics.

References:

Discussion

• Three optics need to be removable without realignment when replaced,
  • the 1550 nm injection mirror,
  • the optic splitting the 532 nm signal for alignment
  • the optic splitting the 1550 nm signal for alignment
• The 1550 nm beam expander might need to have the ability to be adjusted
• The 1550 nm side is an aperture share setup
• The 1550 nm transmission mirror in this design is mostly a transmission optic with a small mirrored section (aperture sharing)
• Due to shared paths for the transmission and receive detector should be gated to protect from backscatter light from the transmission
• Detector may also require chopper wheel for additional stray light reduction
• The 1550 nm laser might be large enough that placement on the optical bench is impractical, could use a fiber to couple the laser to the bench
• Parts or all of the 1550 nm optical bench could be placed above the 532 nm optical bench

Additional considerations

-Telescope optics, particularly the Coude path mirrors, need to be able to handle high power laser pulses in the 1550 nm wavelength
- The optical bench should be designed to be as modular as possible to facilitate installation into different systems

Maximum Eye Safe Power

<table>
<thead>
<tr>
<th></th>
<th>532 nm</th>
<th>1064 nm</th>
<th>1550 nm</th>
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<tbody>
<tr>
<td>10 sec exp.</td>
<td>0.0001 J</td>
<td>0.001 J</td>
<td>0.982 J</td>
</tr>
<tr>
<td>0.25 sec exp.</td>
<td>0.0001 J</td>
<td>0.001 J</td>
<td>37.767 J</td>
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- Based on results using USAF LHAZ6.0 which is calculated using 2014 ANSI standards
- Calculated using 1 ns pulse, 50 Hz rep rate, 25 cm beam diameter
- 1550 nm remains eye safe at orders of magnitude higher power than 1064 or 532 nm