RICH Prototype Mirror Testing

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Overview

• Collaborators from Núcleo Milenio de Formación Planetaria (NPF) in Chile fabricated mirror
  – Attempting to make mirrors for RICH and also astronomical applications

• Collaborators requested we measure its reflectivity in our test station
Reflectivity Test Station

- Monochromator provides light of specified wavelength
- Light is split into control beam and test beam using beamsplitter
- Test beam is reflected off mirror
  - For calibrations, test beam directly hits test photodiode
- Control beam and reflected test beam’s power are measured by separate photodiodes
- Photodiode current response measured by Keithley picoampmeter
Prototype Mirror

- Carbon-fiber reinforced polymer (CFRP) backing with aluminum reflective coating and silica protective coating
- Planar mirror
- 15 cm in diameter
Results – Typical Test Station Range

- 350 nm – 650 nm wavelength light tested in 15 nm steps
- 25 measurements taken at each step

<table>
<thead>
<tr>
<th>Spot #</th>
<th>Average Reflectivity [%]</th>
<th>Standard Deviation [%]</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>83.32</td>
<td>0.83</td>
<td>Center of mirror</td>
</tr>
<tr>
<td>2</td>
<td>84.61</td>
<td>1.10</td>
<td>On large scratch</td>
</tr>
<tr>
<td>3</td>
<td>87.22</td>
<td>1.47</td>
<td>On void in surface</td>
</tr>
<tr>
<td>4</td>
<td>80.05</td>
<td>1.52</td>
<td>On large scratch</td>
</tr>
<tr>
<td>5</td>
<td>86.18</td>
<td>1.15</td>
<td>On small scratch</td>
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<td>0.83</td>
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<td>1.76</td>
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</table>
Results – Typical Test Station Range

Average Reflectivity for All Spots over 350 nm - 650 nm

\[ y = -7.01 \times 10^{-3} + 2.97 \times 10^{-7} x^2 + 1.14 \times 10^{-4} x + 0.822 \]

\[ \chi^2 = 4.27 \times 10^{-5} \]
Results – Infrared Range

- Collaborators requested measuring mirror in more infrared spectrum
- Additional spots measured from 635 nm – to 800 nm
  - Range determined by eye based on monochromator output and configuration
- Because test wavelengths exceed rated range of monochromator, results most likely include large systematic error
Results – Infrared Range

- 635 nm – 800 nm wavelength light tested in 15 nm steps
- 25 measurements taken at each step

<table>
<thead>
<tr>
<th>Spot #</th>
<th>Average Reflectivity [%]</th>
<th>Standard Deviation [%]</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>5</td>
<td>84.40</td>
<td>2.29</td>
</tr>
</tbody>
</table>
Results – Infrared Range

Average Reflectivity for All Spots over 335 nm - 800 nm

\[ y = -9.45 \times 10^{-9} x^3 + 1.91 \times 10^{-5} x^2 + 1.32 \times 10^{-2} x + 4.027 \]

\[ \chi^2 = 8.02 \times 10^{-5} \]
Plotted Results for Each Spot

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Conclusion

• NPF collaborators fabricated a prototype CRFP mirror

• Mirror tested in reflectivity test station with light from 350 nm to 800 nm
  – Tests in infrared range most likely include large systematic error because test station is not specified for these wavelengths
  – Looking into test station improvements that would lessen errors

• Across all wavelengths tested, average mirror reflectivity was ~85%
Thank You