RICH Prototype Mirror Reflectivity Tests

Tyler Lemon, Mary Ann Antonioli, Peter Bonneau, Aaron Brown, Pablo Campero, Brian Eng, George Jacobs, Mindy Leffel, Marc McMullen, and Amrit Yegneswaran
Physics Division, Thomas Jefferson National Accelerator Facility, Newport News, VA 23606
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This note presents the results of the reflectivity tests performed on a prototype mirror, which could be used for the next RICH sector, fabricated by collaborators from Núcleo Milenio de Formación Planetaria (NPF).

NPF's 150-mm diameter, prototype, planar mirror is made with three layers: carbon-fiber-reinforced polymer backing, aluminum reflective layer, and silica protective layer. Such mirrors could be used in RICH if their reflectivity is greater than 90%.

For the reflectivity R tests, the RICH mirror reflectivity test station [1] was used. A LabVIEW program was written to synchronize the control of a Czerny-Turner monochromator and data acquisitionfrom a picoammeter. The developed program allows multiple measurements of a single spot at a given wavelength, λ; data are recorded in an Excel file.

Using double-sided tape, the prototype mirror was attached to linear stages set up in a two-axis configuration, Fig. 1. This setup allows for fine adjustment of the mirror's x and y coordinates, enabling the test beam to be aimed at scratches or voids on the mirror's surface.

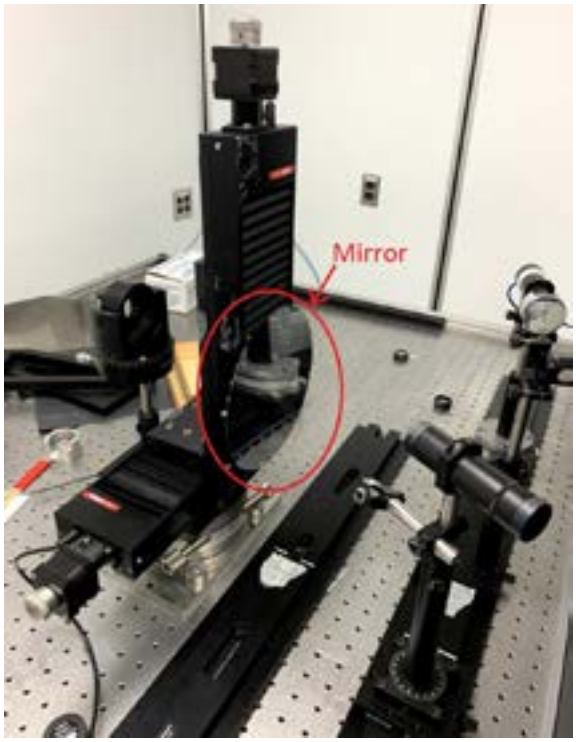

FIG. 1. Prototype mirror on linear stage in reflectivity test station.

For the tests, 14 points were selected on the mirror's surface, Fig. 2, for each of which, $R(\lambda)$ was measured 25 times for $\lambda \in$ [350 nm, 650 nm] in steps of 15 nm (21 wavelengths).

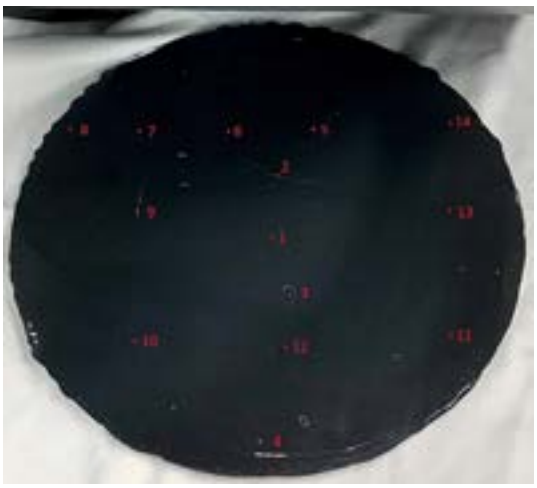

FIG. 2. Test locations on mirror surface.

Table I shows the mirror's overall average reflectivity $\langle R \rangle$ calculated for all test λ.

Spot #	$\langle R \rangle$ [%]	σ [%]	Comment
1	83.32	0.83	center of mirror
2	84.61	1.10	on large scratch
3	87.22	1.47	on void in surface
4	80.05	1.52	on large scratch
5	86.18	1.15	on small scratch
6	84.87	0.83	-
7	86.94	1.00	-
8	86.15	1.43	-
9	87.41	1.74	-
10	86.05	1.29	-
11	91.13	3.40	-
12	83.89	0.86	-
13	86.75	1.18	-
14	87.82	1.76	-

TABLE I. $\langle R \rangle$ for spots shown in Fig. 2.

Figure 3 shows the λ dependance of the mirror's reflectivity. Data displayed are the average reflectivity at a given λ for all spots tested $\langle R(\lambda) \rangle$. Also shown is that for $\lambda \in$ [350 nm, 500 nm], $\langle R(\lambda) \rangle$ is ~88% For $\lambda \in$ (500 nm, 650 nm], λ decreases linearly to ~84%.

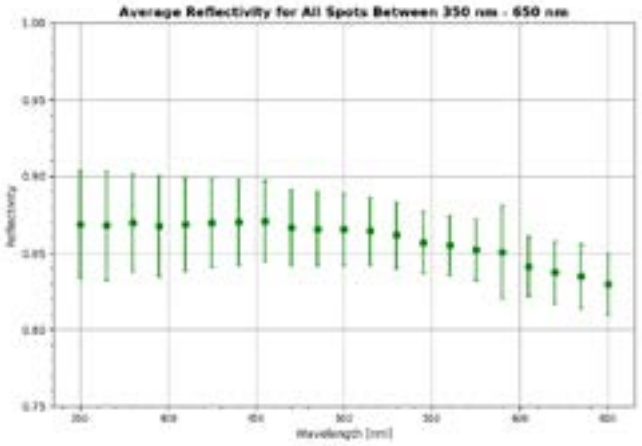

FIG. 3. FIG. 3. Plot of $<R(\lambda)>$.

In conclusion, the NPF prototype mirror's overall reflectivity was measured to be ~85% in the visible and near-infrared spectrum.

[1] T. Lemon, et al., *RICH Spherical Mirror Acceptance Tests,* DSG Note 2018-08, 2018.