Ronchi test for measurements for the mirror surface of the CBM-RICH detector*

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The CBM RICH detector will be operated with CO_2 radiator gas, MAPMTs (Multi-Anode Photo Multiplier) as photodetector and spherical glass mirrors as focusing element. Surface homogeneity is one of the important properties required for the single mirror tiles. The global homogeneity has been tested with the $D0$ measurement as reported earlier [1]. Local deformations e.g. by the mirror holding structure can be investigated with the Ronchi test method from which first results are discussed in this contribution.

The principle of the Ronchi test is quite simple. A grating, called Ronchi ruling, consisting of fine, opaque, equally spaced lines ruled onto a transparent substrate is projected onto the whole mirror surface. The shadows of these lines then appear on the face of the mirror under test and will be reflected back onto a camera. The shape and position of these bands is examined and interpreted to give information about the shape of the mirror's surface. Contrary to the $D0$ measurement the Ronchi test thus allows to get information on local mirror deformations which is of particular interest considering e.g. inhomogeneities which may be caused by the mirror mounts.

The Ronchi test is inherently qualitative and needs detailed comparison to a computer model in order to assess possible distortions more quantitatively. The band shapes observed in the Ronchi test can be caused by many different mirror types, i.e. surface profiles. Therefore the pattern seen in the Ronchi test has to be compared with a virtual, perfect mirror copy of the mirror under test. However, the qualitative picture quickly achieved and presented in this contribution already reveals a lot of useful information about the mirror at a glance. It later may also be used for a fast semi-qualitative test which allows to quickly check the local mirror homogeneity in particular after gluing the mirror mounts.

Figure 1 shows the sketch of the experimental setup for the $D0$ measurement, which was used for the Ronchi test as well. The only difference is the usage of the Ronchi grating in front of the CCD camera (c) and the laser point source (b). The Source-Camera (SC) unit is located exactly at the mirror radius R. The active area of SC is located in the same plane orthogonal to the optical axis of the mirror. A mirror prototype with a curvature radius of 3 m from SLO Olomouc was tested. The mirror is flashed with light from the point source. If the mirror would have an ideal spherical shape the fringes seen on the camera would appear straight. Deviations from the spherical surface cause deformations of the fringes, but the measurement is only sensitive to changes of the curvature radius perpendicular to the grating direction. In order to get a complete picture of a given mirror, several different grating orientations should be measured.

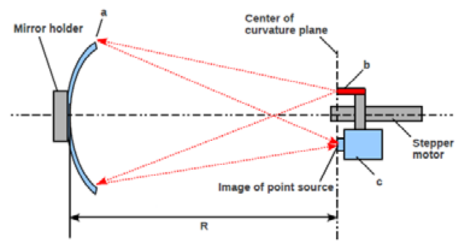

Figure 1: Experimental setup.

Figure 2 shows the image of a reflected light on the camera chip. The left Ronchigram was obtained at the distance of 3 m (nominal curvature), the right plot was obtained at 3.01 m. A possible interpretation of the deformed fringes in the center can be a depressed center of the mirror. The three dark sports correspond to local deformations due to the mount system [2]. Cutting the squared mirror tiles from the produced circular shapes in the manufacturing process can be the reason for the modification of fringes seen at the mirror edges. For further detailed understanding of the mirror surface the comparison with a computer model is under way.

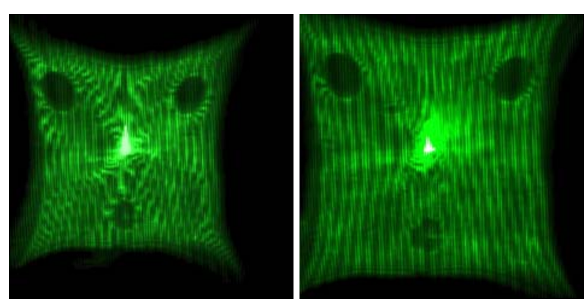

Figure 2: CCD camera view. Left: for R = 3 m. Right: for R = 3.01 m

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References

[1] E. Lebedeva, CBM Progress report 2011, p.37
[2] V. Dobyrn et al, CBM Progress report 2011, p.39.