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Bulk scattering evaluation of the Suprasil 311SV fused silica

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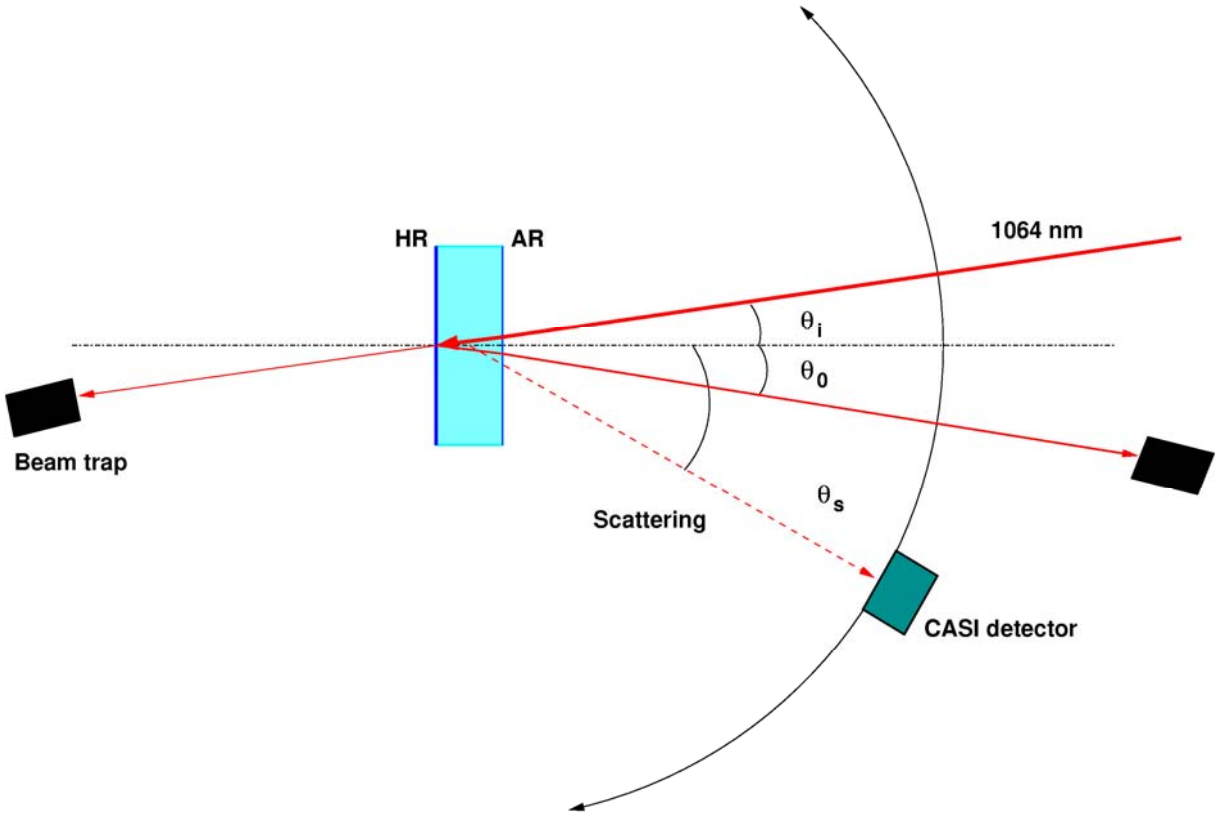
1 Introduction

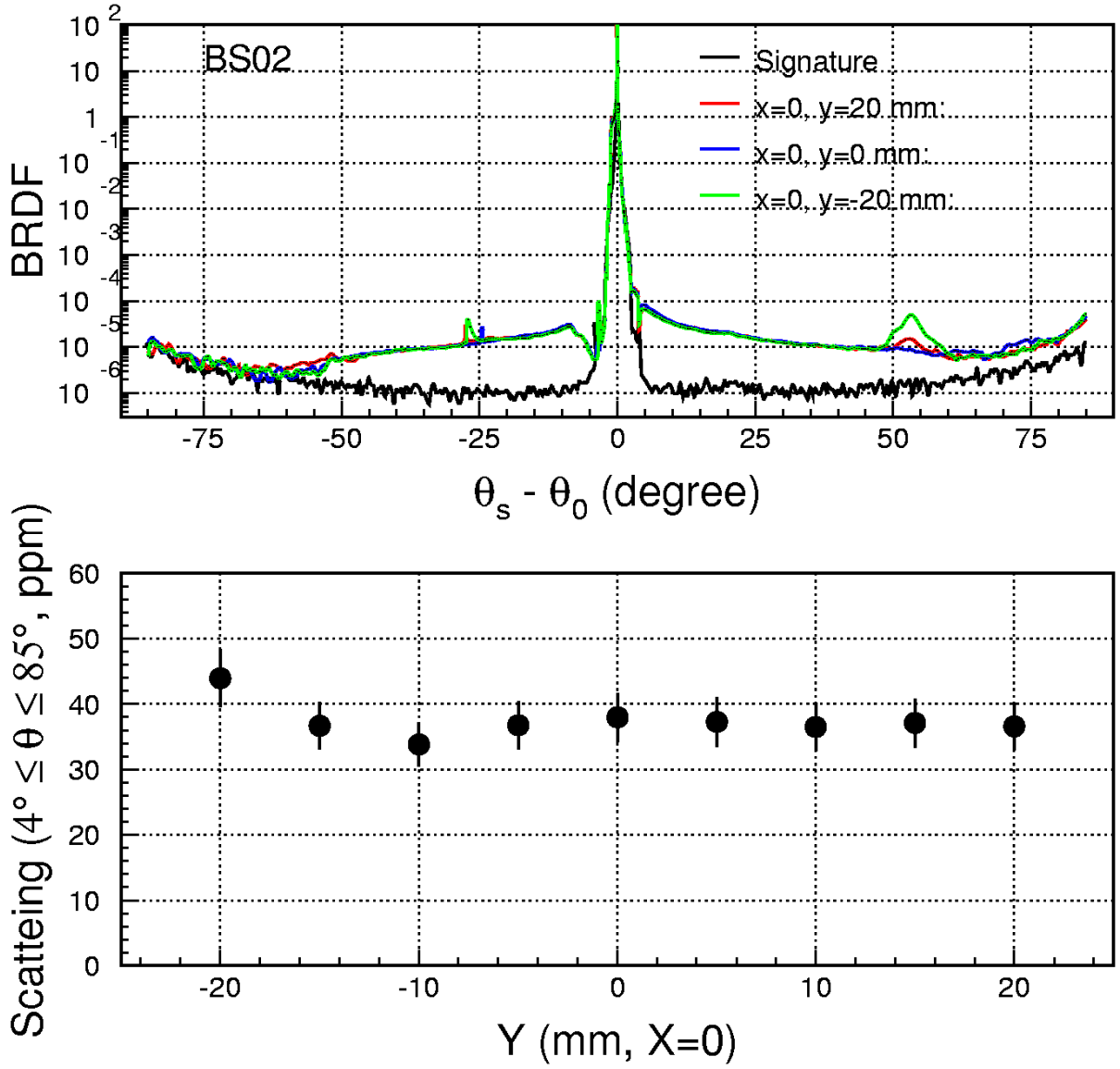
This note reports an evaluation of bulk scattering of the Suprasil 311SV fused silica, meaning low water glass. The measurement was done with a Suprasil 311SV beam splitter BS02 by the CASI system which can measure the BRDF and BTDF in 360 range in the reflection and transmission plane.

2 Measurement

Following is a schematic of the CASI measurement set-up. The beam is focused at the detector surface and has a size of 5 mm in diameter at the sample position. The BS02 was made for the 40M RSE experiment [1,2,3], it is of Φ78 × 28 mm^3, 45 coated for P polarization. Our measurement is carried out with an incident angle of 2.5° and S polarization, the reflection is measured to be 60%.



3 Result and conclusion



Total nine angular resolved scans are taken along the Y axis with a step of 5 mm, three of them are shown in the upper plot of above figure. The BRDFs of the nine scans are quit consistent, indicating a good uniformity of substrate bulk and AR and HR coatings in terms of scattering. The lower plot shows the integrated scatterings from 4° to 85° polar angle (Θ_s- Θ_0) as function of the measurement position.

The measured scattering or BRDF in this measurement is composed of three components, AR scattering of two passes, HR scattering of one pass, and bulk scattering of two passes. To get an estimation of the bulk scattering, we have to input an approximation of HR and AR scatterings.

According to this mirror' specification [3] and our previous measurement, we assume the HR and AR have an integrated scattering of 10 ppm. Therefore, in first order of approximation, the measured scattering of 40 ppm can be roughly decomposed as following:

$$40 \text{ ppm} \approx (S_{AR} + S_{Bulk} + S_{HR} + S_{Bulk} + S_{AR}) \times 60\%,$$

$$S_{AR} \approx S_{HR} \approx 10 \text{ ppm},$$

so, $S_{Bulk} \approx (40/0.6\text{-}30)/2 = 18.3$ ppm.

Since the mirror thickness is 28 mm, then

$$S_{Bulk} \approx 18.3/2.8 = 6.5 \text{ ppm/cm},$$

which is certainly in the right ballpark of this type fused silica.

References

1. Blank specification http://www.ligo.caltech.edu/docs/E/E000413-A.pdf.
2. Polishing specification http://www.ligo.caltech.edu/docs/E/E010101-B.pdf.
3. Coating specification http://www.ligo.caltech.edu/docs/E/E010194-A.pdf.