Coronal Solar Magnetism Observatory Memo
Nov 27, 2006

Recommendation of the COSMO Technical Advisory Committee Regarding the Choice of a Reflective or Refractive Primary For the COSMO Large Coronagraph

The COSMO Technical Advisory Committee consisting of Jean Arnaud, David Elmore, Jeff Kuhn, Haosheng Lin, Peter Nelson, Matt Penn and Steven Tomczyk have weighed the relative merits of refractive and reflective primary objectives for the COSMO large coronagraph and recommend that the COSMO large coronagraph be comprised of a refractive primary with a diameter of 1.5 meters. This decision is based on studies which are presented in several COSMO Technical Notes[1,2,3,4,5] which will only be briefly summarized here. These Technical Notes can be found at the COSMO web site at www.cosmo.ucar.edu. Technical Note No. 5, "Trade Study Summary for Reflecting and Refracting Primary Objectives for the COSMO Large Coronagraph" is especially relevant to this decision.

The precision of coronal magnetic field measurements depends both on the light gathering power of the objective as well as the level of background scattered light. Flux considerations indicate that an aperture of 1.5 meters will be adequate to achieve the COSMO science goals as long the background light is kept at low levels[1]. Extensive modeling indicates that a refracting coronagraph is likely to produce a factor of four less scattered light than a reflecting coronagraph[4]. A reflecting telescope would then require an aperture a factor of two greater than a refractor in order to achieve the same precision in the magnetic field strength for faint coronal structures. The scattering advantage of lenses over mirrors was the single most important factor in our decision to proceed with a refractive design.

Given that the largest refracting telescope in existence has an aperture of 1 meter, we understand that this decision will be perceived to entail some risk. However, technology has advanced greatly over the years and suitable blanks of glass of sufficient quality are now readily available. Finite element analysis[2] shows that gravitational self-deformation of a 1.5-m lens will not significantly affect its imaging capability.

The technical committee unanimously recommends that the project move forward with a 1.5 meter f/5 refracting design for the COSMO large coronagraph. If some unforeseen obstacle to the construction of a large refractor is encountered, then the project should fall back on a reflecting design.

References

1. Tomczyk, S., 2006, “Measurement Errors in Coronal Magnetic Field Parameters,” COSMO Technical Note No. 1.

2. Nelson, P.G., 2006, “A Finite Element Analysis of Meter-Class Refracting Primary Objectives for Coronal Polarimetry,” COSMO Technical Note No. 2.

3. Elmore, D.F., 2006, “Polarization in Reflecting and Refracting Coronagraphs,” COSMO Technical Note No. 3.

4. Nelson, P.G., 2006, “An Analysis of Scattered Light in Reflecting and Refracting Primary Objectives for Coronagraphs,” COSMO Technical Note No. 4.

5. Nelson, P.G., Elmore, D.F, and Tomczyk, S., 2006, “Trade Study Summary for Reflecting and Refracting Primary Objectives for the COSMO Large Coronagraph,” COSMO Technical Note No. 5.