



Aspherization of Fizeau Interferometry

Development of an aspheric transmission sphere

Project description: Measuring ranges of spherical Fizeau transmission spheres are often limited by their small irradiation diameter. To increase the measuring range, additional adapters or beam expanders are required, smaller diameters usually cannot be covered at all. For a leading international manufacturer of measurement technology asphericon developed an aspheric Fizeau lens, which counteracts these problems while being easy to handle. Compared to classical Fizeau transmission spheres, it offers a significantly increased measuring range up to R/D 0.55. Without any additional adapters, as a one-in-one single component the 4" Fizeau lens covers a measuring range, which previously could only be measured with a 6" lens. This is especially advantageous in terms of small aperture ratios.

Project realisation: asphericon's solution for the enlargement of the measurement range was achieved by designing and manufacturing of only one component. Using a high-end asphere and an innovative mount design a maximum of utilization of the Fizeau surface aperture diameter could be gained. The aspheric Fizeau transmission sphere transforms a collimated beam into a spherical wavefront. By the last surface of the lens, the Fizeau surface, the reference and the measurement wavefront gets split. A spherical lens ideally has a 4" initial aperture, whereas the aspheric lens intrinsically expands, allowing a much larger diameter of the initial aperture to be achieved. The design is optimized for long term clean components, by a convenient gripping rim and transport-secure packaging system, and suitable for other interferometers by using a 4" Zygo-Byonet connector. Moreover, it convinces with lighter weight due to the reduction of lenses, a high-quality transmitted wavefront and a Fizeau surface quality of $\lambda/10$ and $\lambda/20$.

Comparison spherical & aspheric design

Fig.1: Illustration of a typical design for a Fizeau lens including a comparison of the positions of the Fizeau surfaces for a spherical (= grey) and an aspheric (= blue) design with the same focal ratio (R/D 0.55).

Additional measuring range

Fig.2: Comparison of the measuring range of a spherical and aspheric 4" lens. The Aperture angle α is the same for both (i.e. the aspheric lens has a larger range with the same number of apertures, which can be used to measure test objects). The formula gives the relationship between R/D ratio and the angle α .