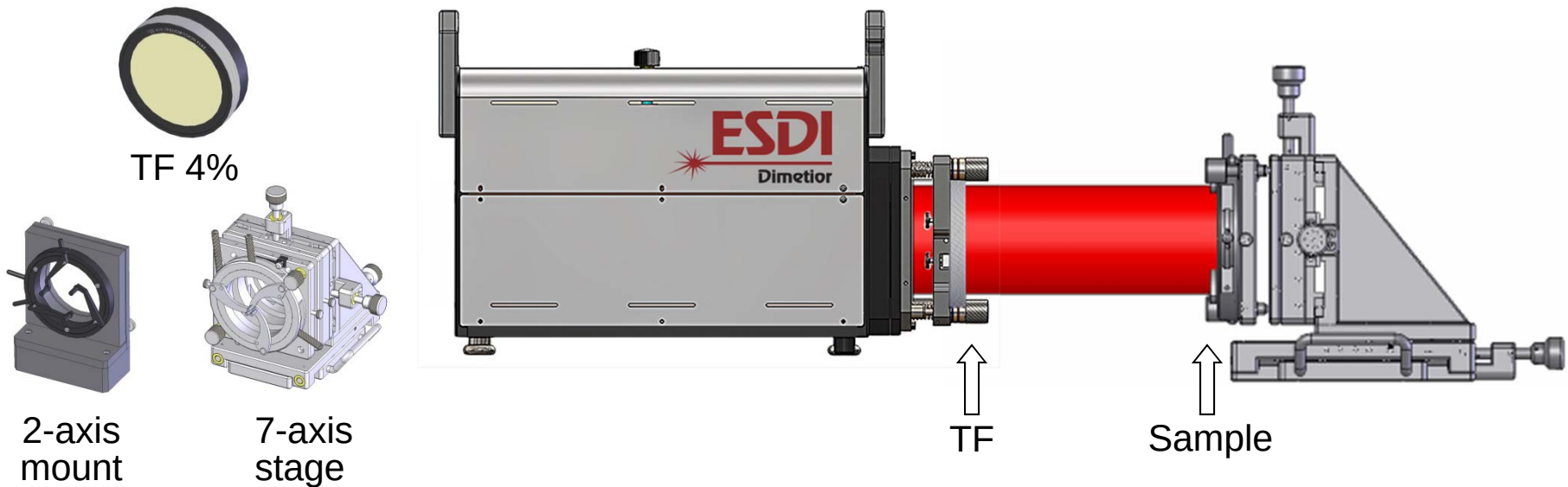


INTERFEROMETER CONFIGURATIONS

A Guide to Interferometer Setups



Surface Flatness



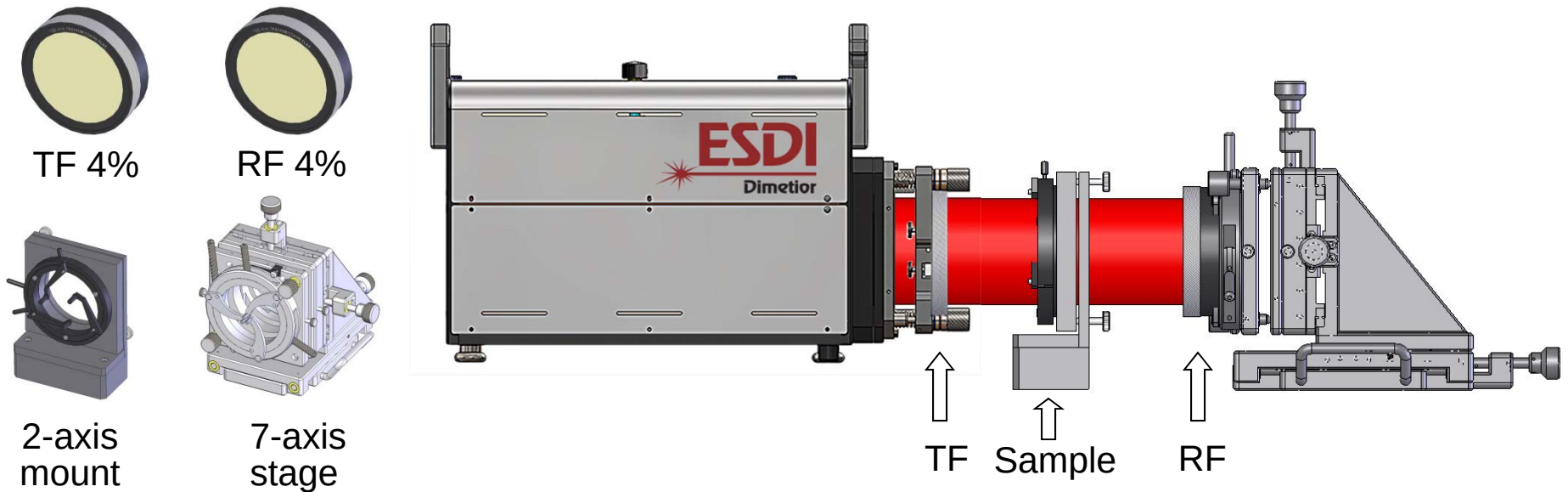
Measurement of surface flatness of plano elements: mirrors, prisms, & windows.

Test object must be held so that the surface under test can be aligned in two axes of tilt.

Align Mode: rough alignment

View Mode: fine alignment

Plano Transmitted Wavefront



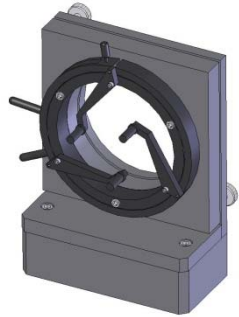
Measure distortion of a plane wave transmitted through the element under test.

Typically used for windows, filters, and prisms.

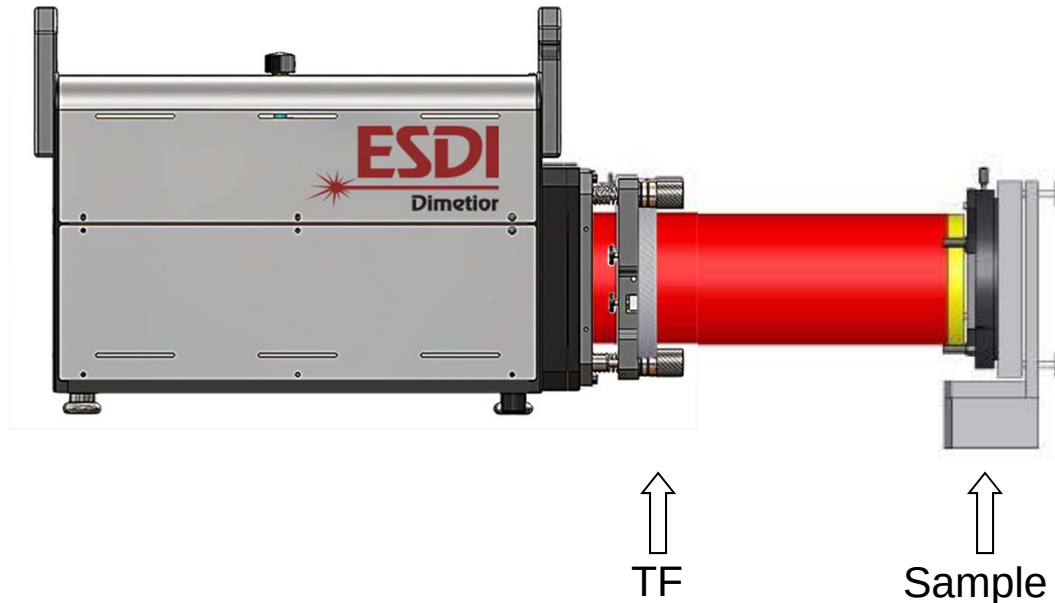
Glass & other transparent material may be examined for homogeneity.

Since the measurement beam passes through the element under test, this element need only be placed nominally perpendicular to the optical axis of the test beam. No special mount or alignment is required.

Parallelism (Very Small Wedge)



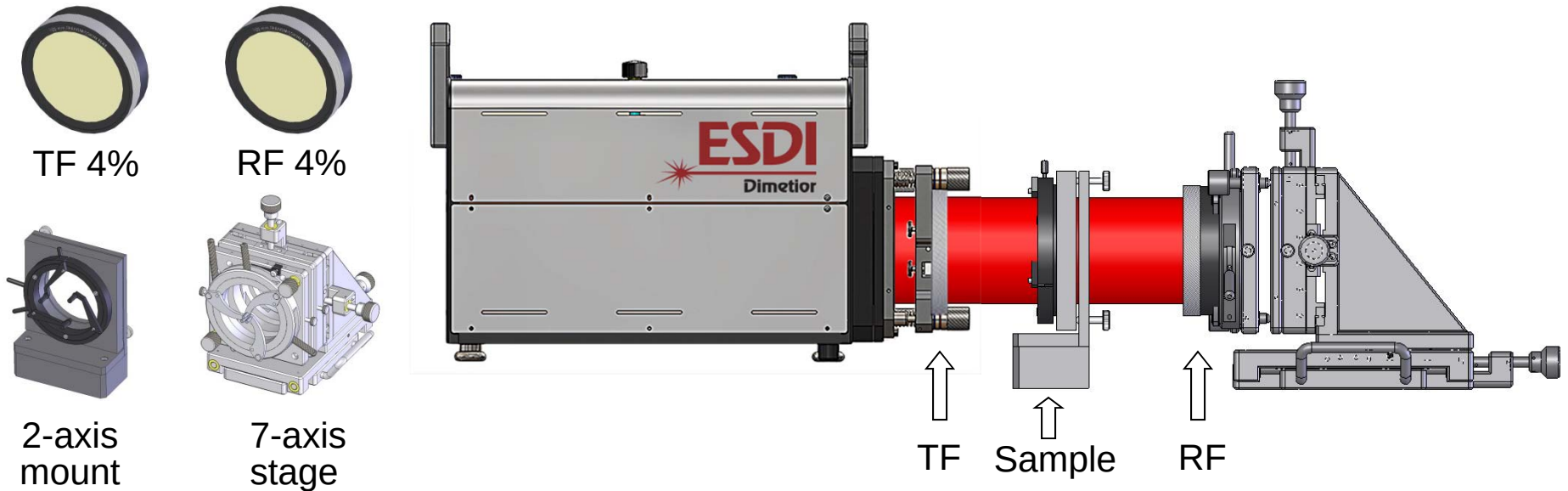
2-axis
mount



Measurement of very small wedges requires no auxiliary optics because interference is obtained between wavefronts reflected from the two surfaces of a transparent element.

The element must only be placed nominally perpendicular to the interferometer output beam. The optical and mechanical wedge can be calculated from the resulting interference pattern.

Parallelism (Wedge)



For medium wedges, the Plano Transmitted Wavefront setup can be used. This and other techniques, some with a fraction of an arc second resolution, can be used to measure wedge using a phase measuring interferometer.

The element must only be placed nominally perpendicular to the interferometer output beam. The optical and mechanical wedge can be calculated from the resulting interference pattern.

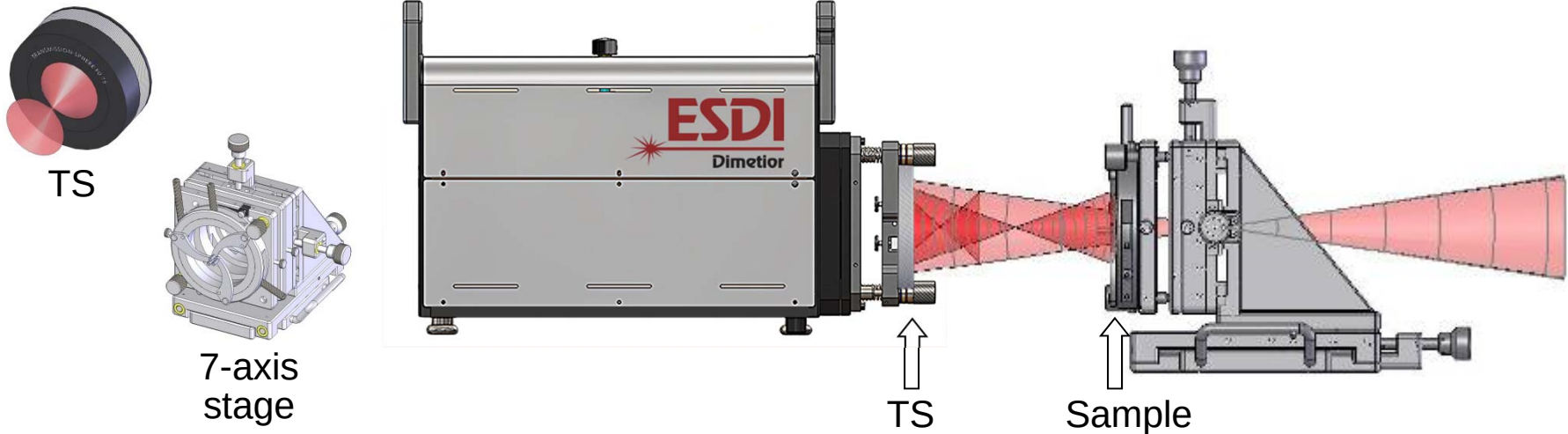
Prism & Corner Cube Tests



Many prisms and corner cubes can be measured as if they were a plano (facing a transmission flat on the interferometer). For pieces with high equivalent reflectivity (i.e. > 40%) an attenuation filter can be used, or a high reflectivity flat in place of the 4% transmission flat.

Our *IntelliWave*[™] software can calculate angle errors as well as transmitted wavefront errors.

Transmission Sphere Selection



To fill the aperture of a concave or convex surface, the R/number of the surface under test is calculated:

$$R/number = \frac{\text{Radius of curvature of test surface}}{\text{Clear aperture of test surface}}$$

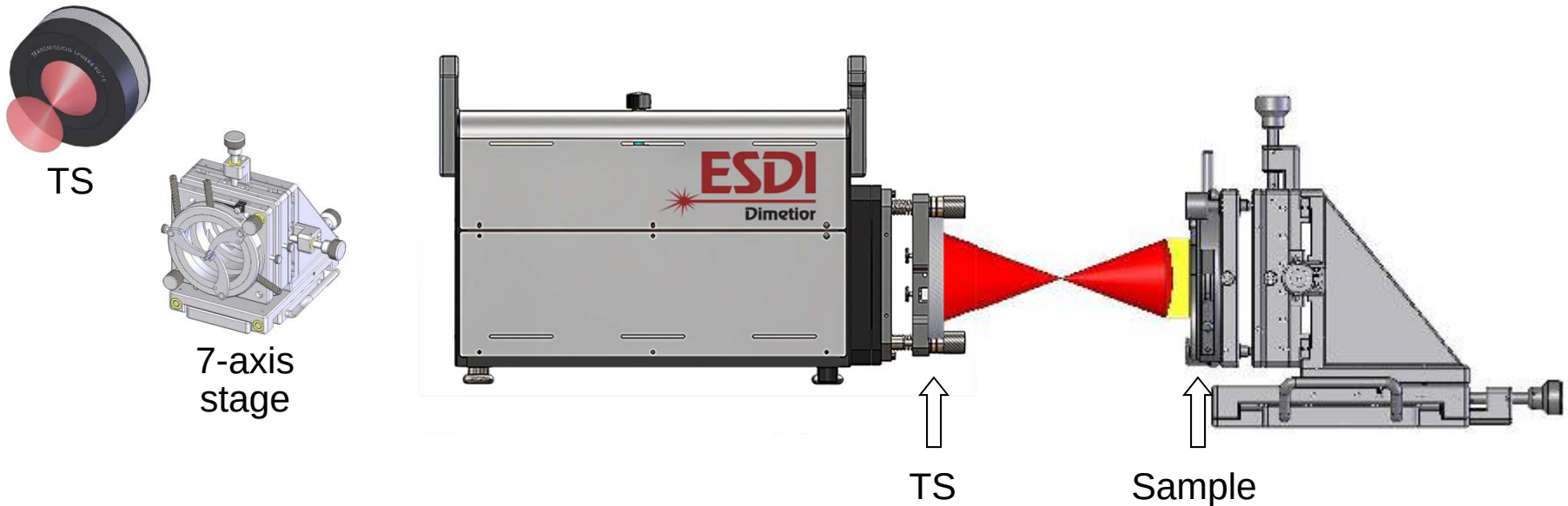
R/number smaller than f/number:

The interferogram will not fully cover the entire aperture of the surface under test.

R/number larger than f/number:

The interferogram will be smaller than full size on the monitor, which can be compensated for by using the interferometer's variable zoom.

Concave Surface Figure



A transmission sphere transforms the Main-frame output beam into a precise spherical wavefront for the evaluation of spherical surfaces and lenses. A concave spherical surface is examined for surface figure and irregularity, i.e., the deviation from the best-fitting sphere, by placing its center of curvature coincident with the focus of the transmission sphere.

Adjustment of the surface under test can be provided by a 7-axis stage used with both spheres and flats (which need tilt adjustment).

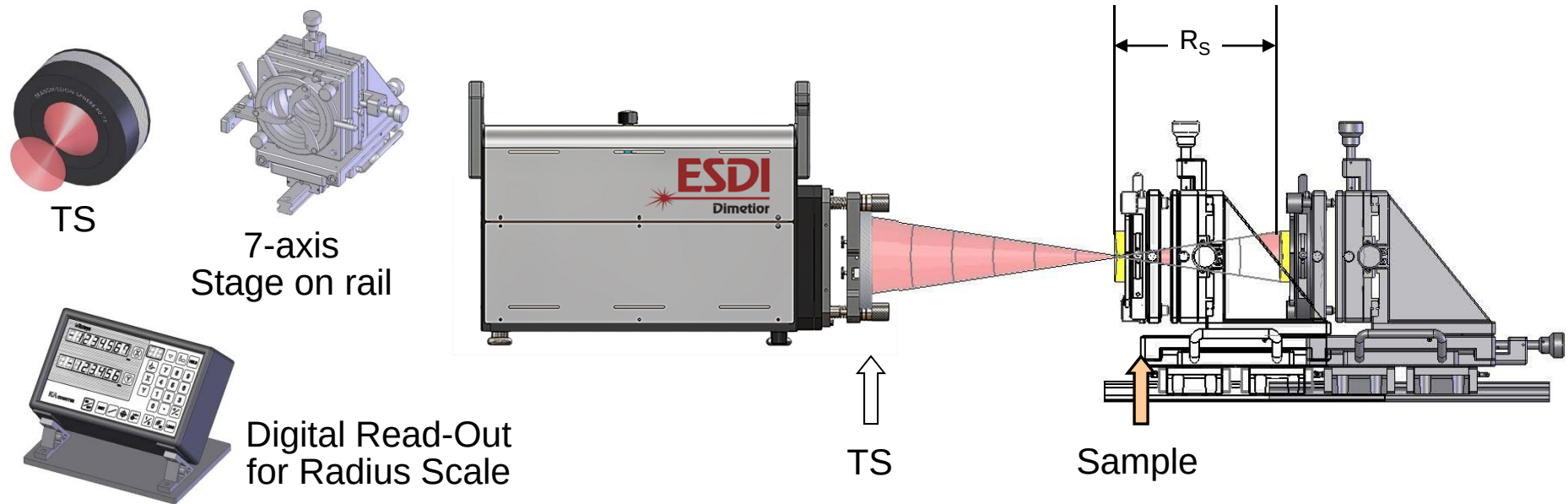
Convex Surface Figure



Convex spherical surfaces are examined for surface figure and irregularity. For selecting the optimum transmission sphere, two criteria must be met. First, the radius of curvature of the convex surface tested must be less than the back focal length of the transmission sphere.

Second, the radius of curvature of the surface tested divided by the clear aperture, i.e., the R/number, should be greater than or equal to the f/number of the transmission sphere. Adjustment of the tested surface is provided by a 7-axis stage.

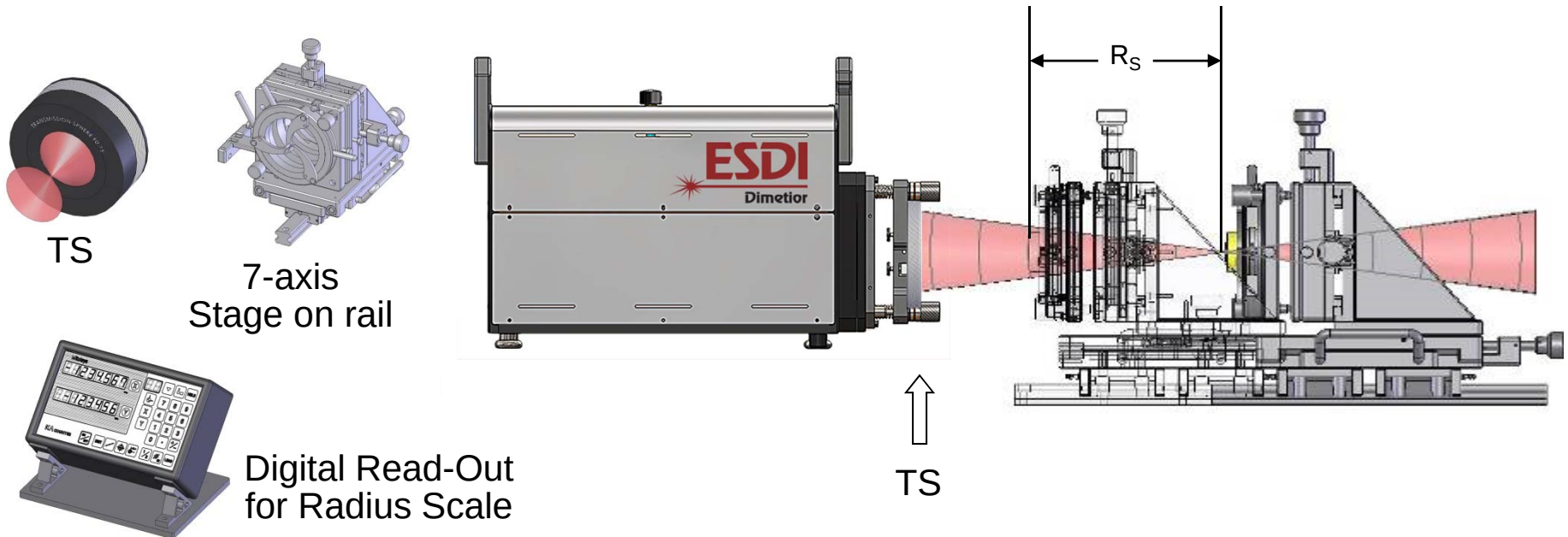
Radius of Curvature (concave)



The surface under test is translated along the optical axis of the interferometer until the surface under test coincides with the transmission sphere focus. A null fringe pattern provides an indicator of the point where the surface coincides with the focus. The scale is then zeroed out (zero position).

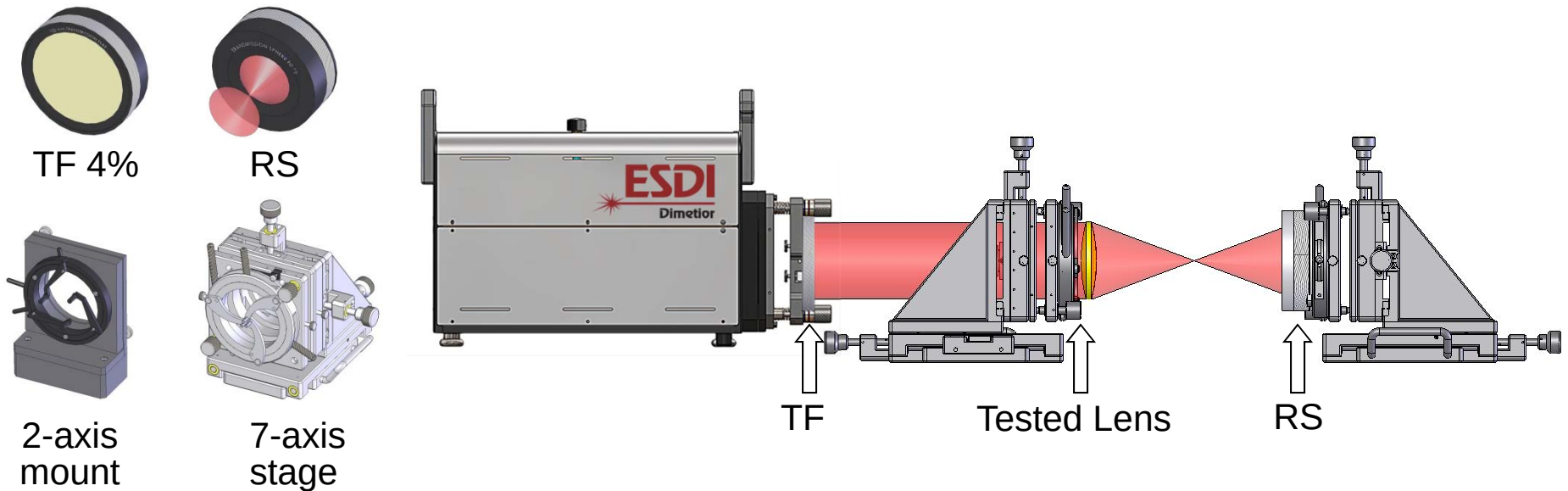
The surface under test is then translated along the optical axis until the surface under test coincides with the confocal position. The distance that the surface under test is translated, R_s , is equal to the radius of curvature of the surface.

Radius of Curvature (convex)



Surface figure, irregularity, and radius of curvature measurement setups for **convex** surfaces.

Lens/System Performance (1)



Lenses or optical system quality can be measured by examining the distortion of the transmitted wavefront. For a lens or system focused for infinity, the lens can be placed in the collimated measurement beam and a high quality concave or convex sphere can be used to retro reflect the transmitted wave-front.

By rotating the optical axis of the lens under the test with respect to the axis of the measurement beam, performance at various field angles can be determined.

Lens/System Performance (2)



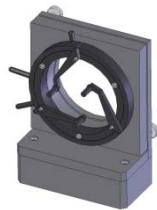
TF 4%



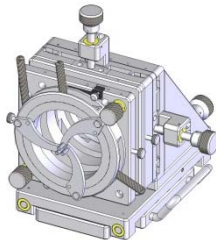
RF 4%



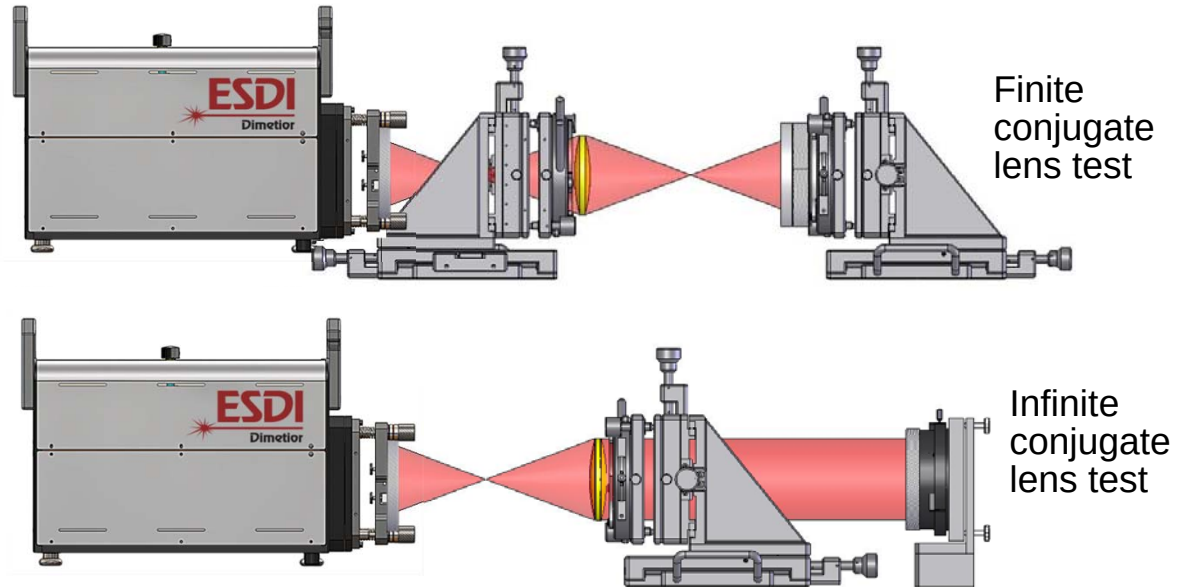
TS



2-axis
mount



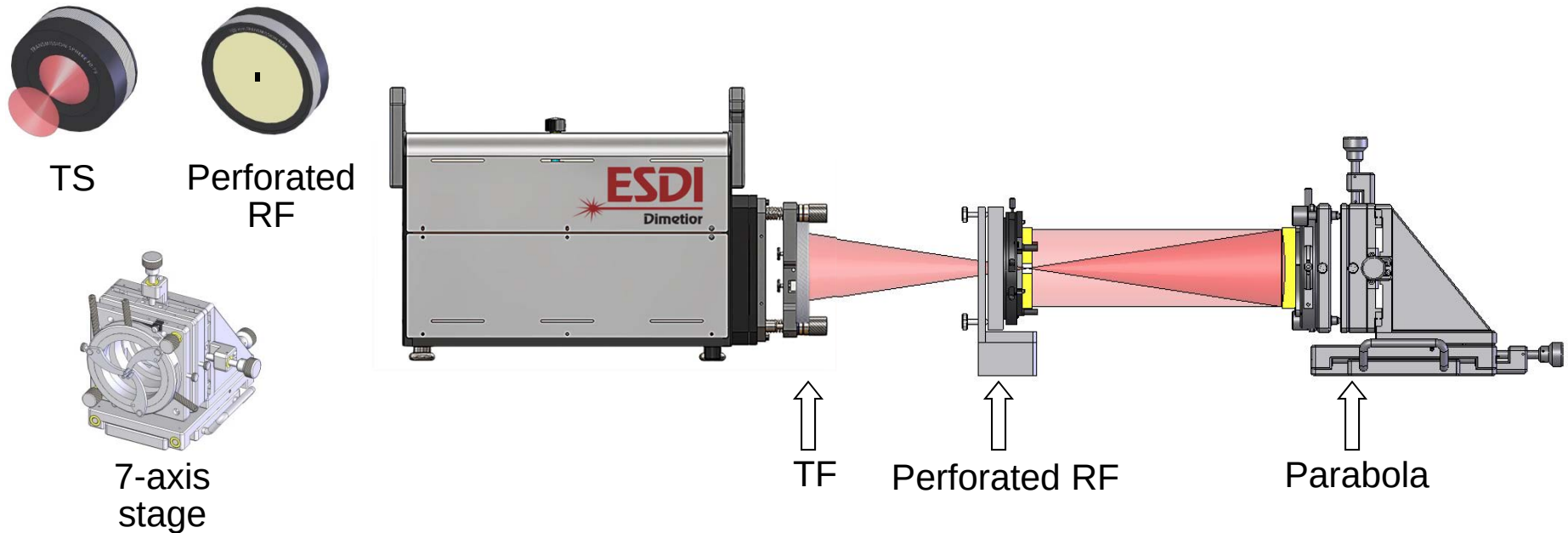
7-axis
stage



Particular situations may require an alternate lens/system setup. For lenses or systems with finite conjugates, a transmission sphere is necessary to form the “object” position in front of the lens under test. For systems with apertures larger than the sample beam of the interferometer.

or for systems with apertures much smaller than the sample beam of the interferometer, this alternate setup may be advantageous. The alignment of the elements, however, may be significantly more difficult, and errors due to misalignment may be introduced.

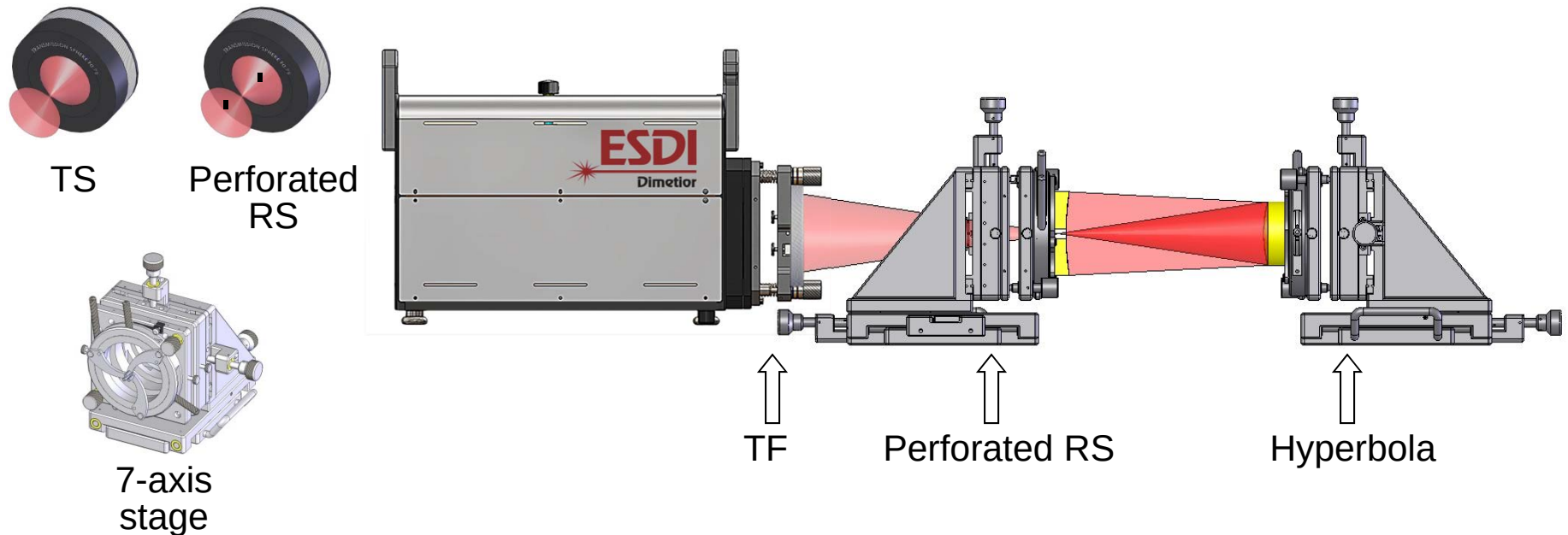
Parabola Surface Figure



The surface figure and irregularity of a parabolic surface can be measured by employing a reference flat with a small central perforation, as shown in the illustration.

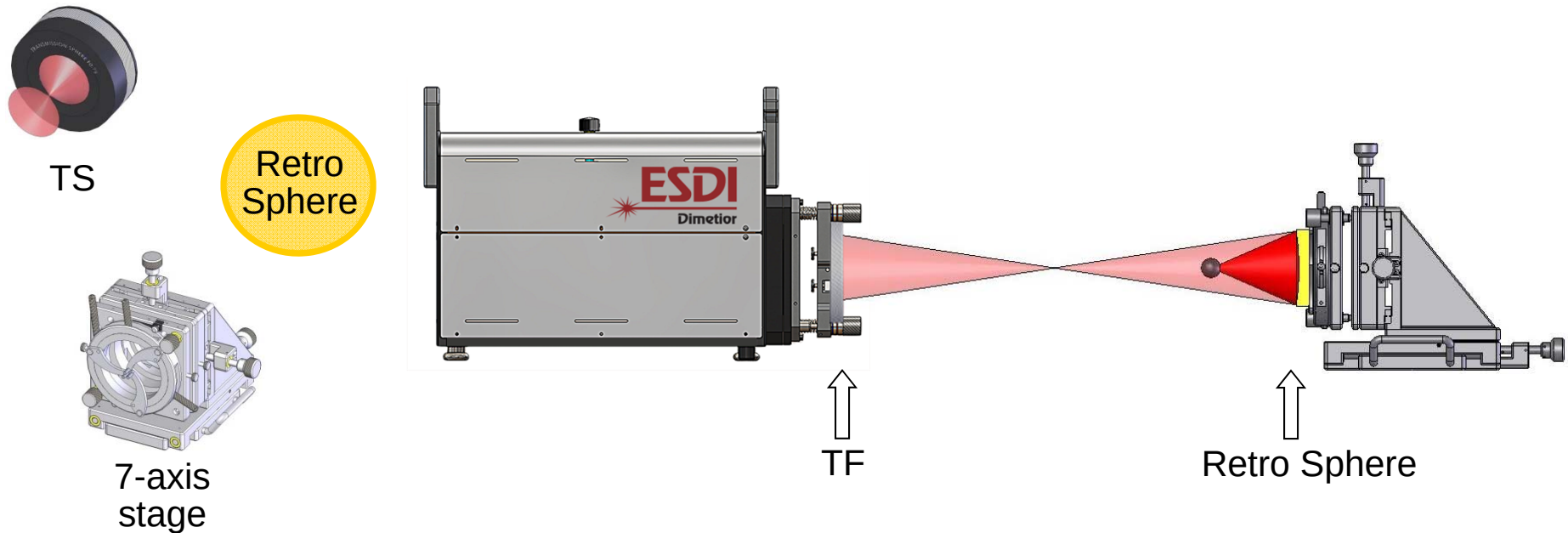
Misalignment of a parabola as well as any of the other conical surfaces discussed here will introduce alignment errors, so a 7-axis stage is recommended to align these parts.

Hyperbola Surface Figure



For a hyperbolic surface, the surface figure and irregularity can be measured as shown by using a reference sphere with a small central perforation.

Concave Elliptical Surface Figure



Concave elliptical surfaces are examined for surface figure and irregularity by positioning a glass retro sphere in the measurement beam as depicted in the illustration.

Situations may require the use of a different interferometer aperture diameter. For example, a single interferogram does not provide complete coverage when a plano surface, tested at normal incidence, is larger than the interferometer's aperture diameter. In this case, an interferometer aperture diameter at least equal to the test surface diameter is needed for full coverage with one interferogram.

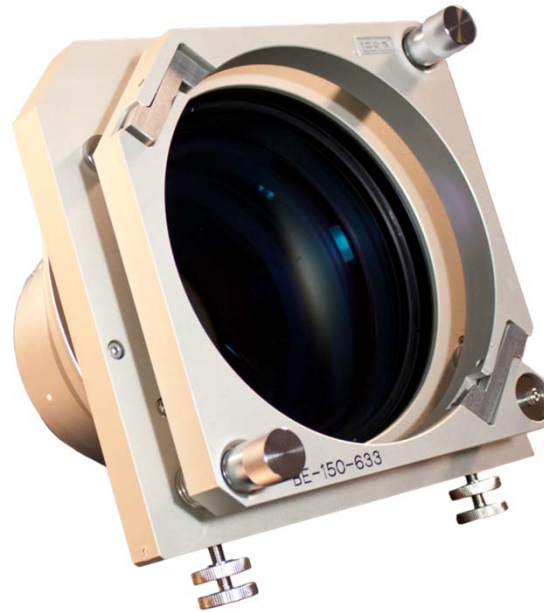
Conversely, very small plano elements can produce interferograms too small to be useful. The interferometer's 4-6X zoom obviates this problem until the elements become very small ($< 15\text{mm}$), at which point the 4-6X zoom is not enough for the interferogram to appear full size on the video monitor. For these parts, it is helpful to begin with a smaller interferometer aperture diameter.

Convex surfaces, which must be placed in a converging measurement beam, may require a larger interferometer aperture. For convex surfaces of large size and/or long radius, it may be necessary to begin with a larger aperture converging beam produced by the appropriate transmission sphere.

Aperture Converter



150mm AC



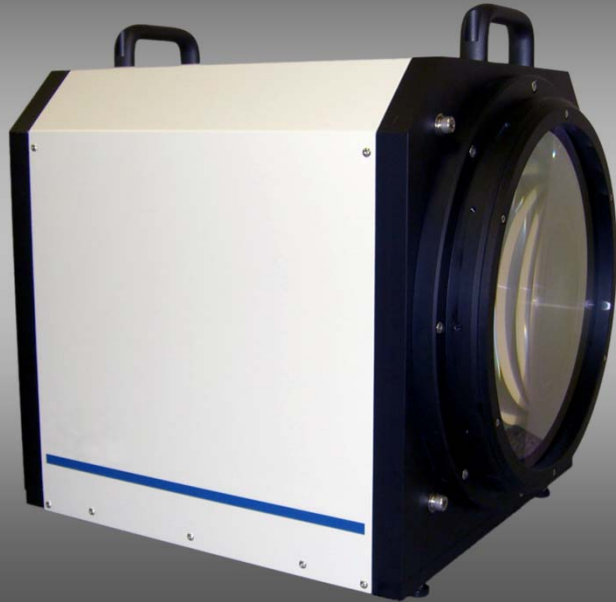
We offer an aperture converter, which can be inserted into the interferometer's bayonet mount, to convert the 100mm measurement beam to a 150mm diameter. The 150mm converter accepts all standard 150mm transmission elements.

By changing the size of the measurement beam, the aperture converters provide magnification in addition to the interferometer's 6X zoom.

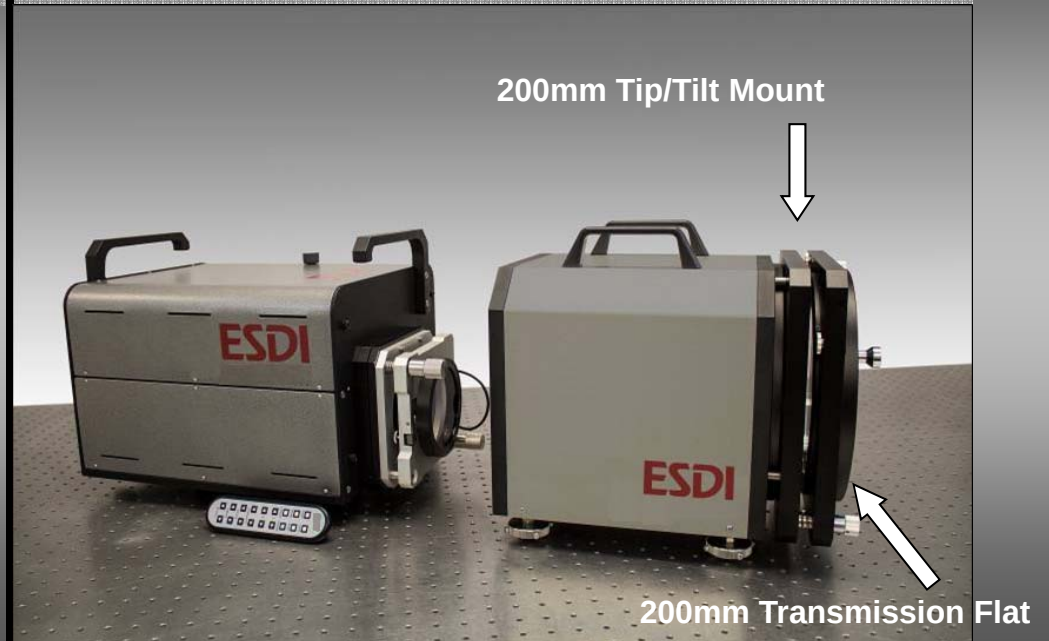
A complement of accessories is available for the 150mm aperture systems.

Beam Expanders

300mm BE



200mm BE



We also offer larger fixed beam expanders for 300mm, 200mm, and 150mm apertures with a range of accessories.

Phase-Shift Adaptor



We offer a range of Phase-Shift Adaptors for interferometer apertures of 100mm, 150mm, 200mm, and 300mm.

Transmission Flats & Spheres



We offer a range of
transmission flats and
transmission spheres.



For use with the **Marsurf FI** Fizeau interferometers:

We offer a number of stages to accommodate vertical and horizontal measurement configurations.