# MEASURING SPATIAL-TEMPORAL COUPLINGS USING MODAL MULTI-SPECTRAL WAVEFRONT RECONSTRUCTION

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## Motivation

With the possibility of using high-power laser systems as drivers for particle acceleration, laser diagnostics becomes even more relevant in that field. The investigation of Spatio-Temporal Couplings (STC) is of upmost importance to ensure stable, high-intensity operation of high power lasers such as the ATLAS 3000 at the Center for Advanced Laser Applications (CALA). The full description of the Spatio-Spectral phase $\Phi(x, y, \omega)$ is required in order to diagnose STC. The experimental setup presented in this poster is simple and affordable, and allows the full retrieval of the Spatio-Spectral phase $\Phi(x, y, \omega)$. This poster presents the simple experimental setup as well as preliminary results.

## Experimental Setup

The diagnostic consists of a Shack-Hartmann sensor and a Spectral-Filterwheel that houses up to nine Bandpass-Filter. The experimental setup is shown in Figure 1. The collimated beam is recorded by the Shack-Hartmann camera. Figure 2 shows the recorded Shack-Hartmann image for on spectral filter. The measurement is repeated for nine filter positions, corresponding to nine wavelengths, as indicated in Figure 3.

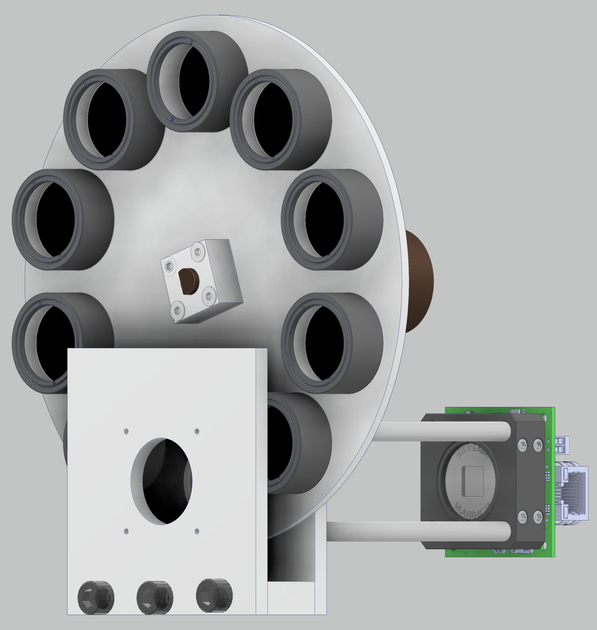

Figure 1:Experimental Setup: The collimated beam is transmitted through the Spectral-Filterwheel. The beam is then imaged onto a Shack-Hartmann Sensor.

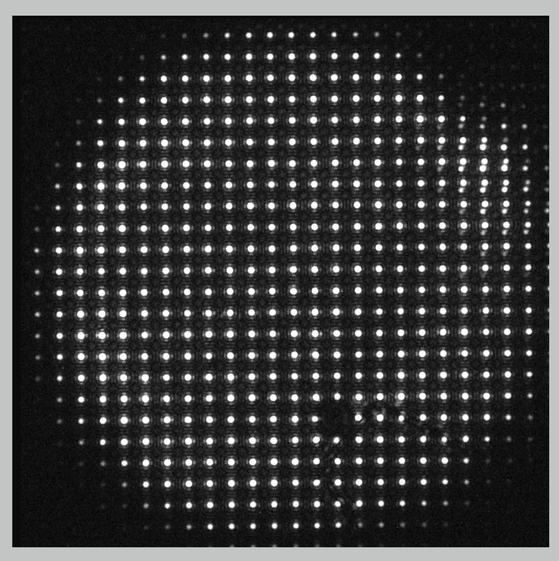

Figure 2:Image recorded by the Shack-Hartmann Sensor.

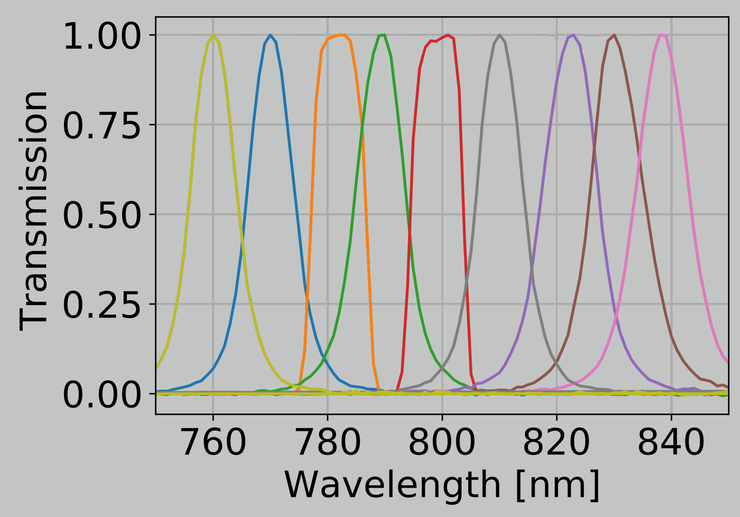


Figure 3:Transmission of each Bandpass-Filter shown in Figure 1.

## Preliminary result

The recorded Shack-Hartmann image is used to reconstruct the wavefront, as shown in Figure 4 for a selection of wavelengths. The reconstructed wavefront is used to fit the Zernike polynomials for each wavelength. A dependency between Zernike amplitude and frequency can indicate Spatio-Temporal Couplings. So far this principle was tested with chromatic lenses.

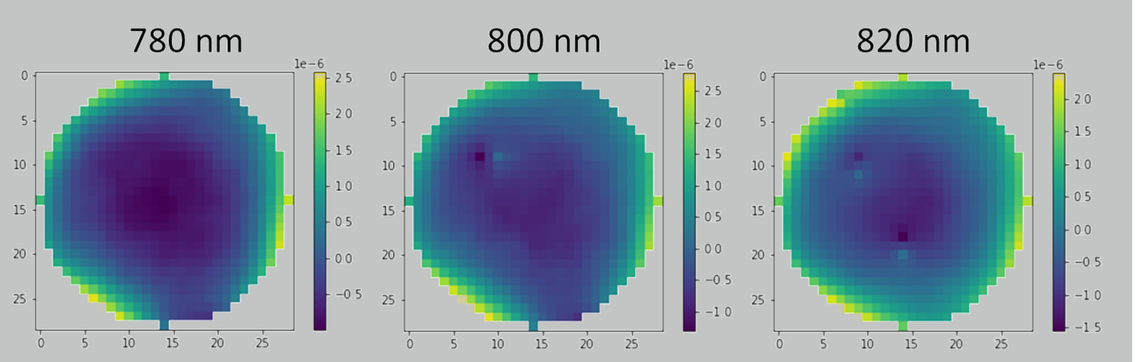


Figure 4:The reconstructed wavefront for a number of selected wavelengths.

Figure 5 shows the measured Pulse Front Curvature introduced by a 35 mm chromatic lens in a 4f-imaging system.

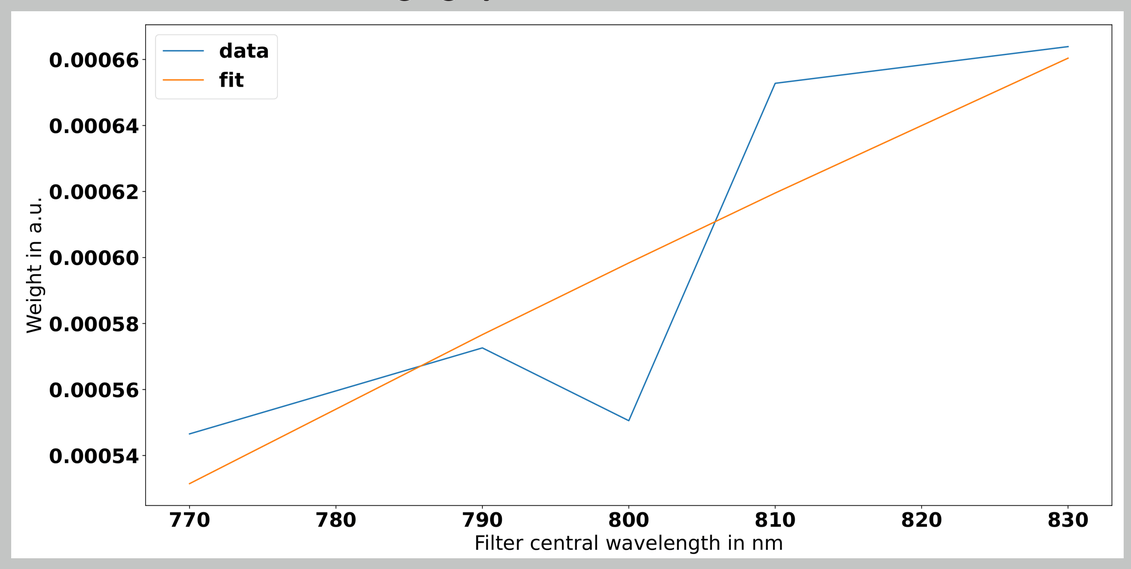


Figure 5:Measurement of a Pulse Front Curvature (PFC) introduced by a 35 mm chromatic lens.

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