

# FEL WAVE-FRONT MEASUREMENTS IN THE SOFT X-RAY REGION AT FLASH

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## Abstract

FEL wave-fronts in the soft X-ray region were measured for individual pulses at FLASH, the Free-Electron Laser in Hamburg, using a Hartmann sensor. The Hartmann principle is based on an array of pin holes, which divides an incoming photon beam into a large number of sub-rays monitored in intensity and position on a CCD camera. Thus, a Hartmann type sensor is largely independent of the photon wavelength. The FEL wave-front is identified by comparison of the local slopes of the incident wave-front to a perfect spherical wave generated by a pinhole. Ray tracing in upstream direction based on the measured wave-front allows determination of focal spots in size and position. The wave-front sensor is used for alignment of FLASH beam lines, in particular the focusing optics, and it proved a valuable tool to observe the FEL beam quality as well as performance of optical elements, such as metal foil filters or a gas attenuator.

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