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## The free-electron laser FLASH2: Challenges for photon diagnostics and beamline design

FLASH2, a major extension of the soft X-ray free-electron laser FLASH at DESY, turns FLASH into a multi-user FEL facility. First lasing of FLASH2, this new undulator line driven additionally by the FLASH linear accelerator, was achieved in August 2014 with simultaneous user operation at FLASH1. The wide wavelength range of FLASH spans from approximately 4.2 - 60 nm in the fundamental and down to below 1 nm in the 5th harmonic with pulse energies of up to several hundred  $\mu\text{J}$  and pulse lengths in the tens to hundreds of femtoseconds range. While of high interest to users, these pulse parameters pose great challenges from the photon diagnostics and beamline instrumentation point of view. Online diagnostics for beam intensity, position, wavelength, wave front, and pulse length, which are mostly pulse resolved, have been developed at FLASH1 and have now been optimized for FLASH2. The new FLASH2 experimental hall offers space for up to six experimental end stations, some of which will be installed permanently. Pump-probe facilities for XUV-XUV, XUV-optical and XUV-THz experiments will complete the FLASH2 user facility.

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