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StarDriver: A highly flexible laser driver for inertial confinement fusion

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StarDriver is a class of laser fusion drivers that minimizes laser-plasma instabilities and improves laser-plasma coupling by the use of multi-beam laser architecture with both large system frequency bandwidth and dense, wide k-spectrum. It comprises 5000-25000 individual lasers (beamlets), each delivering nominally 100 joules in pulses of ~3-30 ns at a nominal wavelength of ~355 nm with better than 3-5 diffraction-limited performance. The beamlets are individually relatively narrowband (<1THz) to facilitate maximum laser performance, but the ensemble of beamlets span a wide frequency range. Currently available laser media enable $\Delta\omega/\omega \sim 2\%$ at 355 nm with the possibility of system bandwidths approaching 10% in the future. Each beamlet has 2D SSD. StarDriver provides optimal asymptotic smoothing for hydrodynamic instabilities (0-1%), innovative focusing strategies including zooming, and the large bandwidth enables extremely rapid hydrodynamic smoothing times ~ 30 fs. The distribution of frequencies among the beamlets allows flexibility for fine control of the seeding of the Rayleigh-Taylor instability. The ultra-broad bandwidth combined with the large k-spectrum of the beamlets irradiating the plasma corona may enable complete suppression of the most problematic laser-plasma instabilities such as stimulated Brillouin backscatter, stimulated Raman scatter, cross-beam energy transfer, and the two plasmon decay instability. StarDriver offers potentially superior flexibility in laser drivers for ICF, enabling almost arbitrary sequencing of wavelength, polarization, focus, and fine control of the spatio-temporal properties of the drive in the corona. The highly modular strategy of StarDriver should enable an attractive development pathway as well as maximizing overall system efficiency.

Biography

David Eimerl has an MA from Oxford University and obtained a PhD from Northwestern University in 1973. He became a Program Leader and Chief Scientist at the Lawrence Livermore National Laboratory in the Laser/ICF Program. In 2000, he founded EIMEX, providing contract services in lasers, optics, lasers in medicine, patent prosecution and custom high performance computer codes. He has published more than 140 papers in refereed journals and has several patents.

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