BISER enhancement with Astra laser

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Burst Intensification by Singularity Emitting Radiation (BISER) [1] is the phenomenon of extremely bright coherent wave emission (constructive interference, N^2 effect) by singularities of multi-stream flows. High-power femtosecond lasers can produce such flows and corresponding relativistic plasma singularities in underdense plasma; these singularities emit very bright coherent x-rays [2]-[3]. We have recently performed an experiment on BISER coherent x-ray generation with the Astra Laser in the CLF RAL, UK. We observed BISER coherent soft x-rays with two spectrographs: a three-channel flat field spectrograph [4] in the forward direction (channels at -0.6, 0, and 0.8°) operating in the 17-34 nm range and a normal-incidence imaging spectrograph [5] in a 10° off-axis direction operating in the 12.4-20 nm range. Both spectrographs, in addition, provided data on the angular distribution of the BISER radiation. We took advantage of an extensive experiment term and long daily laser operation hours to optimize the laser (in particular, focal spot, which is a necessary prerequisite for BISER [6], and pulse width) and the experimental conditions (in particular, the plasma density profile). Compared to earlier experiments with similar laser power (~10 TW), these resulted in ~2 orders of magnitude enhancement in BISER photon number, providing $>10^{11}$ photons and >μJ energies per pulse in each channel at 7 TW. Such result could previously be obtained at >100 TW laser power only.

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