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Supplementary material for: Monte Carlo simulation method of polarization effects in Laser Compton Scattering on relativistic electrons

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Abstract: Simulations for the interaction between:

- 1 nm/1.24 keV X-ray beam and 10 MeV electron beam;
- 100 pm/12.4 keV X-ray beam and 10 MeV electron beam;
- 50 pm/24.8 keV X-ray beam and 10 MeV electron beam;
- 10 pm/124 keV X-ray beam and 10 MeV electron beam;
- 532 nm/2.33 eV laser beam and 500 MeV electron beam;
- 532 nm/2.33 eV laser beam and 3500 MeV electron beam;

The angle of incidence was varied with 18° steps from head-on $\theta_i = 0°$ up to $\theta_i = 162°$. Ideal electron and photon beams have been considered. For all cases, a linear polarized incident photon beam was considered, with the plane of polarization situated in plane ($\tau = 0°$) and perpendicular ($\tau = 90°$) to the plane defined by the incident photon and electron beams. The electron beam was considered to be unpolarized.

For high energy electron beams of 500 and 3500 MeV, the geometry for the NewSUBARU BL01 was considered, with the interaction point placed in the center of the straight beam-line and the imaging plate was placed at 12 m downstream of it, in front of the C1 collimator position. For low energy electron beams of 10 MeV, the the imaging plate was placed at 1.5 m downstream of the interaction point.

Keywords: Only keywords from JINST's keywords list please

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Contents

1 Simulation results

The figures presented here show the simulation results related to the polarization properties in the cases mentioned in the abstract. Each line corresponds to a given incident angle between incident photon and electron beams. Starting from top to bottom, the results are represented for 0° (head-on), 18°, 36°, 54°, 72°, 90°, 108°, 126°, 144° and 162°. Starting from left to right, the odd columns correspond to incident photon linear polarization lying in the defined by the incident photon and electron beams ($\tau = 0°$), while the even columns correspond to perpendicular polarization plane ($\tau = 90°$).

For each case, the figures show:

- columns 1 and 2: γ-ray beam intensity spatial distribution on the imaging plate;
- columns 3 and 4: $P_1^{(LAB)}$ Stokes parameter distribution as function of γ-ray energy;
- columns 5 and 6: γ-ray energy distribution of polarization vector azimuthal angle;
- columns 7 and 8: $P_1^{(LAB)}$ spatial distribution on the imaging plate.

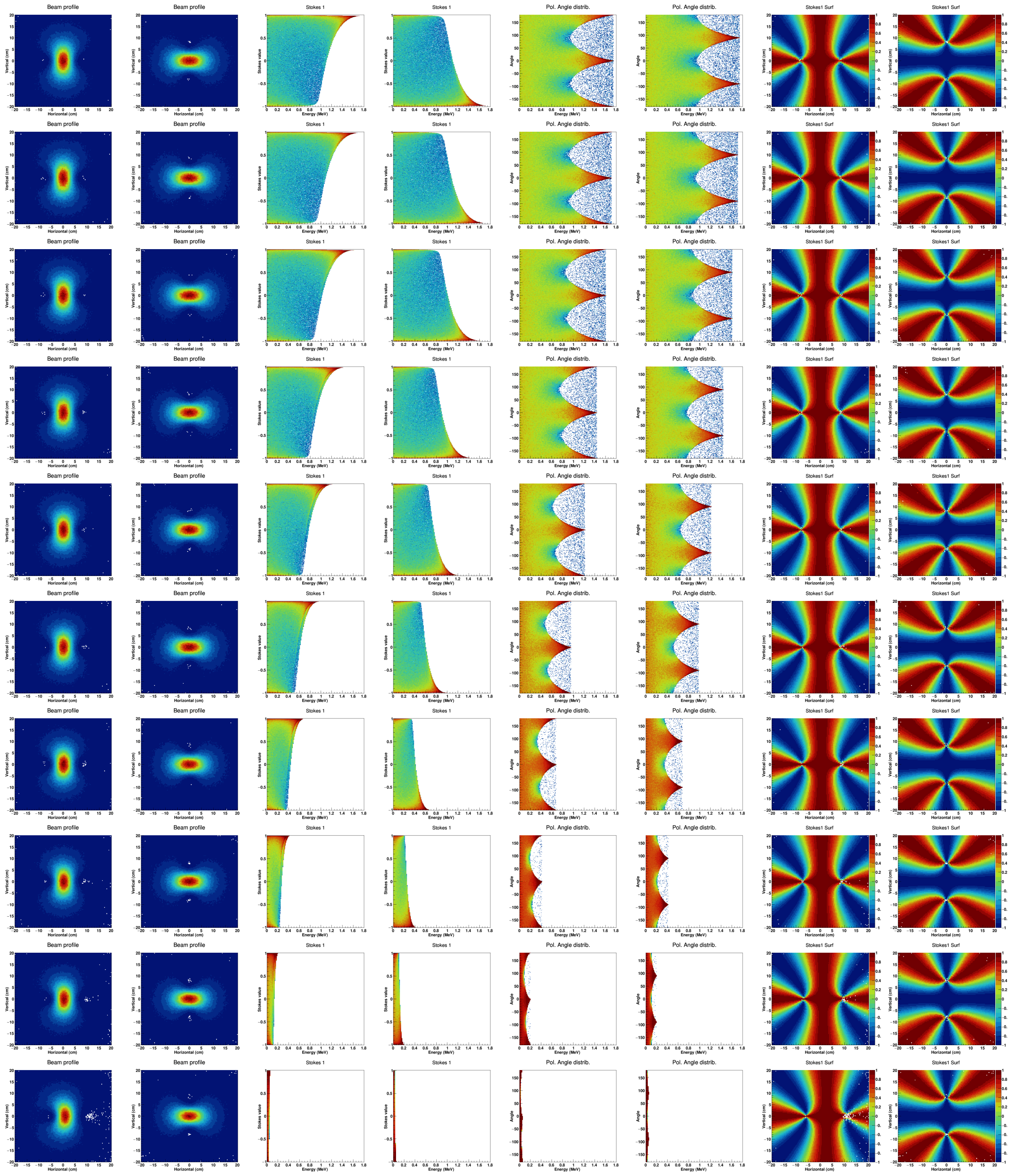

Figure 1. Compton scattering of 100 % linear polarized 1000 pm wavelength X-rays on 10 MeV electrons.

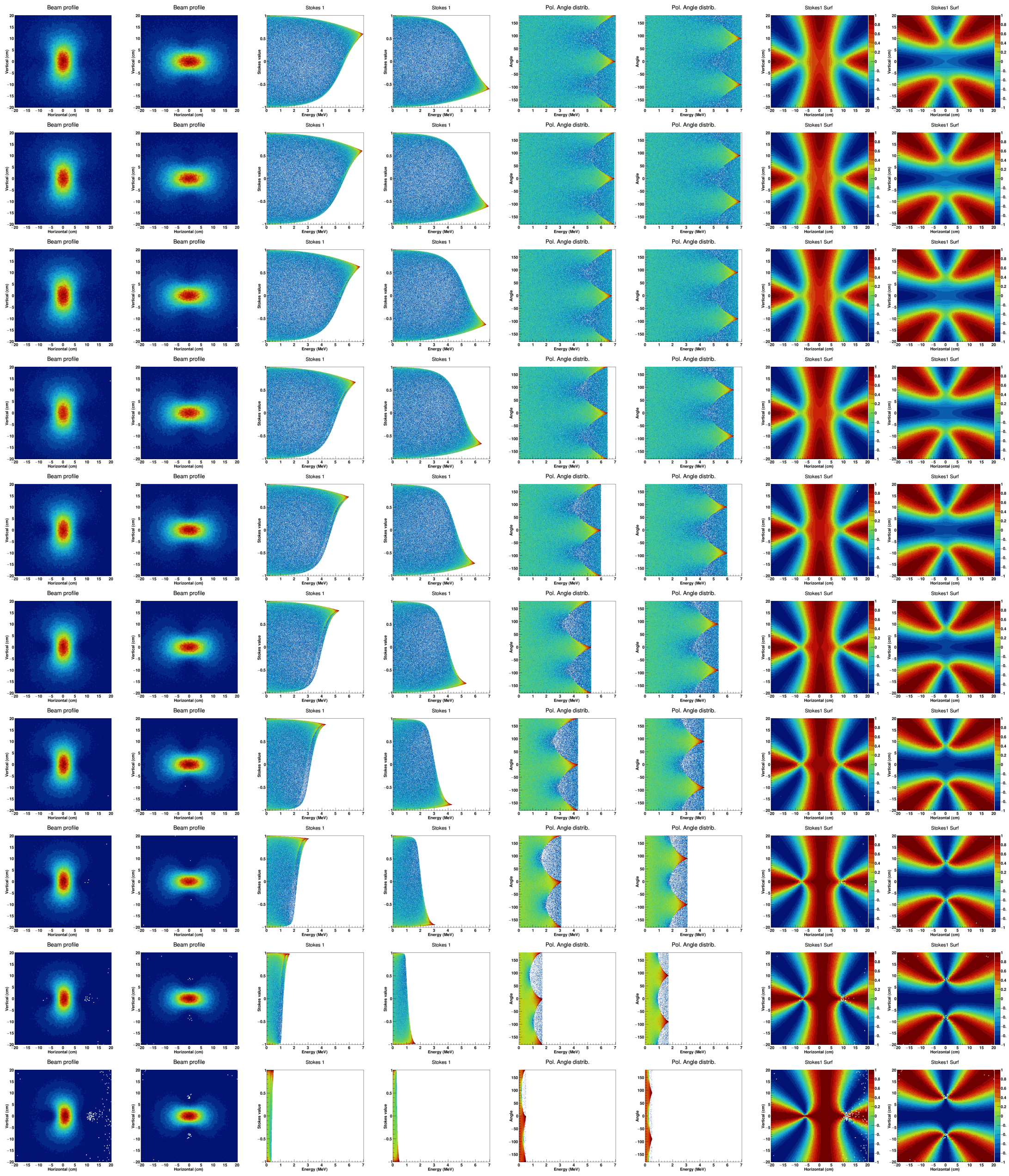

Figure 2. Compton scattering of 100 % linear polarized 100 pm wavelength X-rays on 10 MeV electrons.

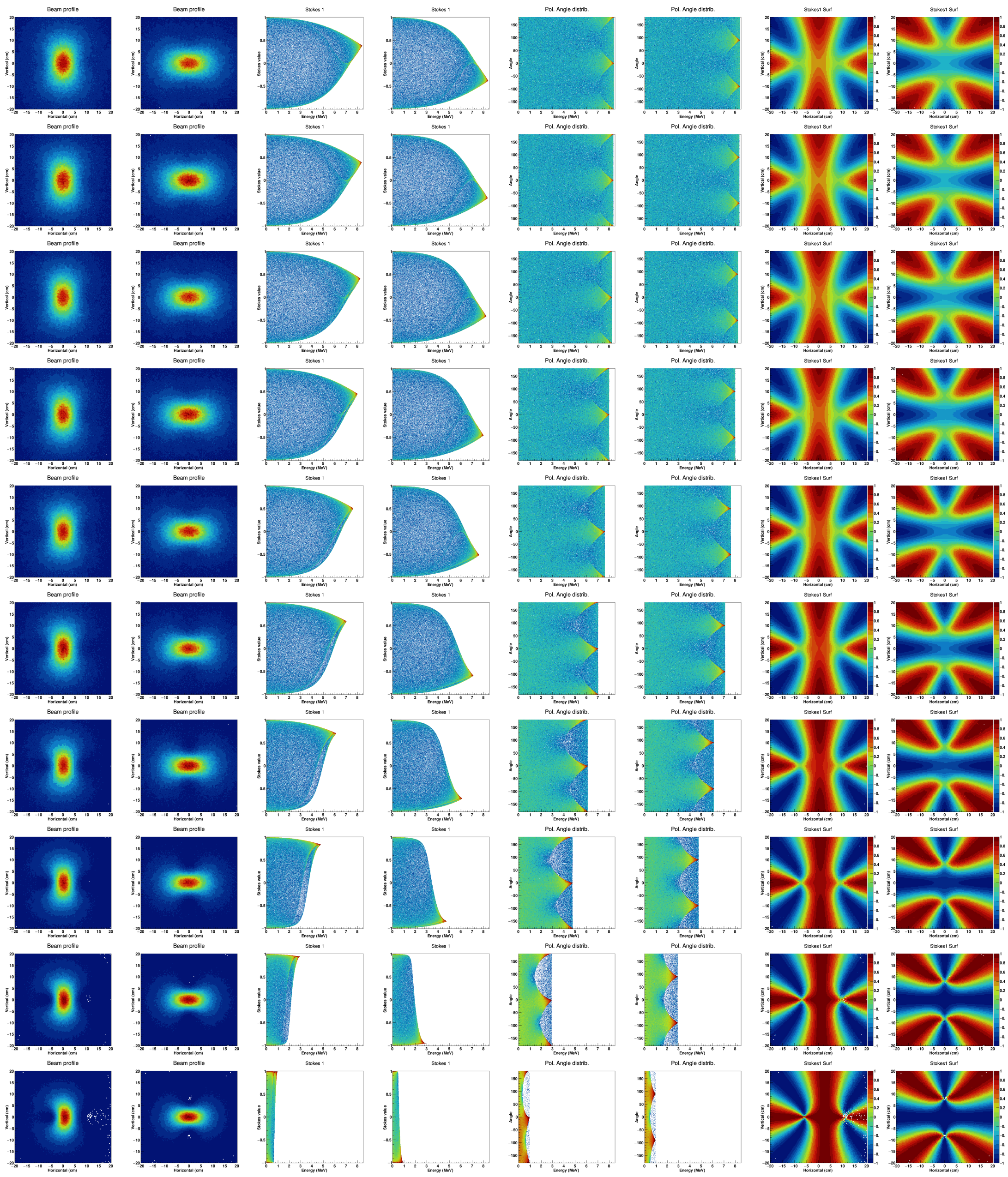

Figure 3. Compton scattering of 100 % linear polarized 50 pm wavelength X-rays on 10 MeV electrons.

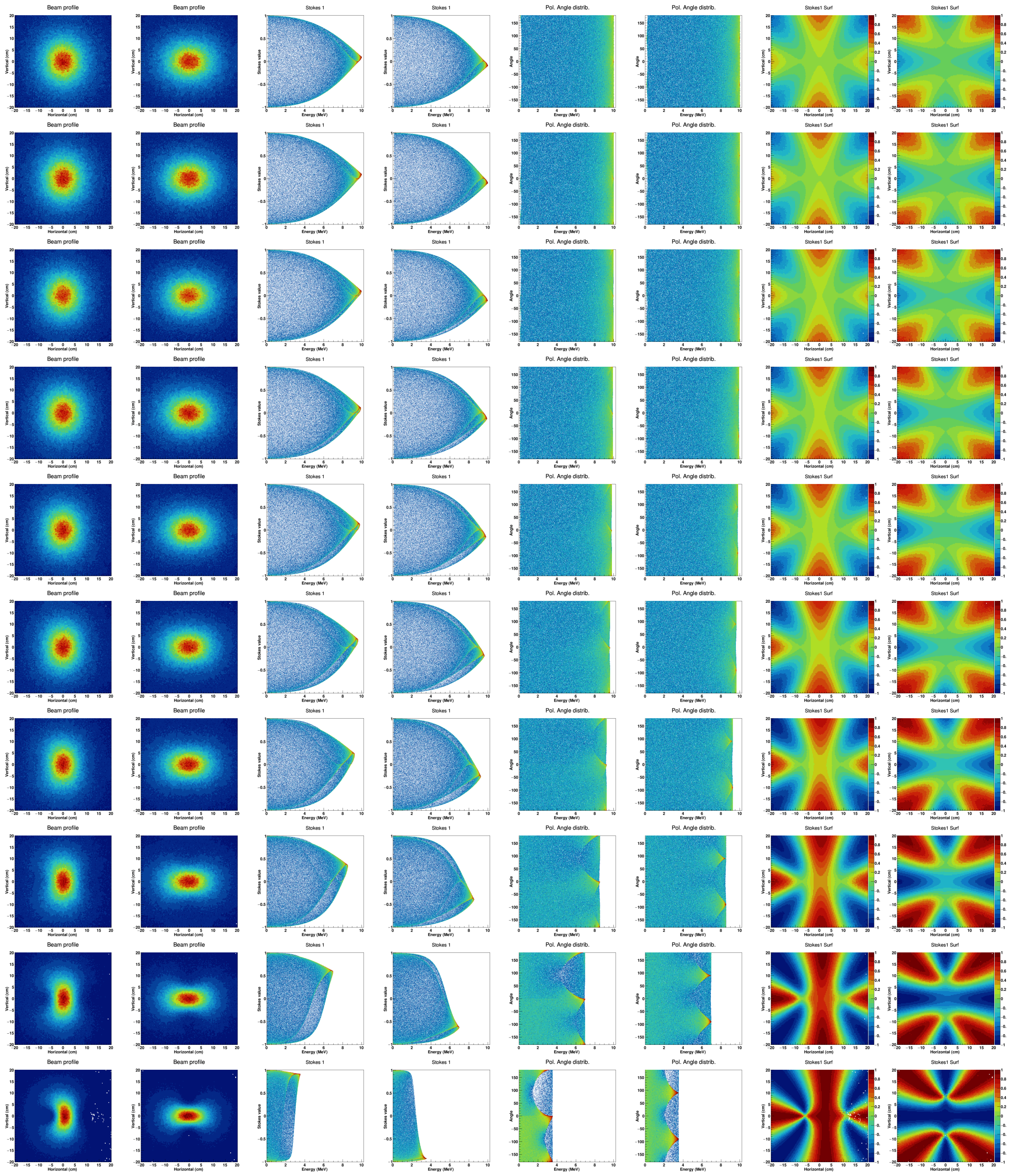

Figure 4. Compton scattering of 100 % linear polarized 10 pm wavelength X-rays on 10 MeV electrons.

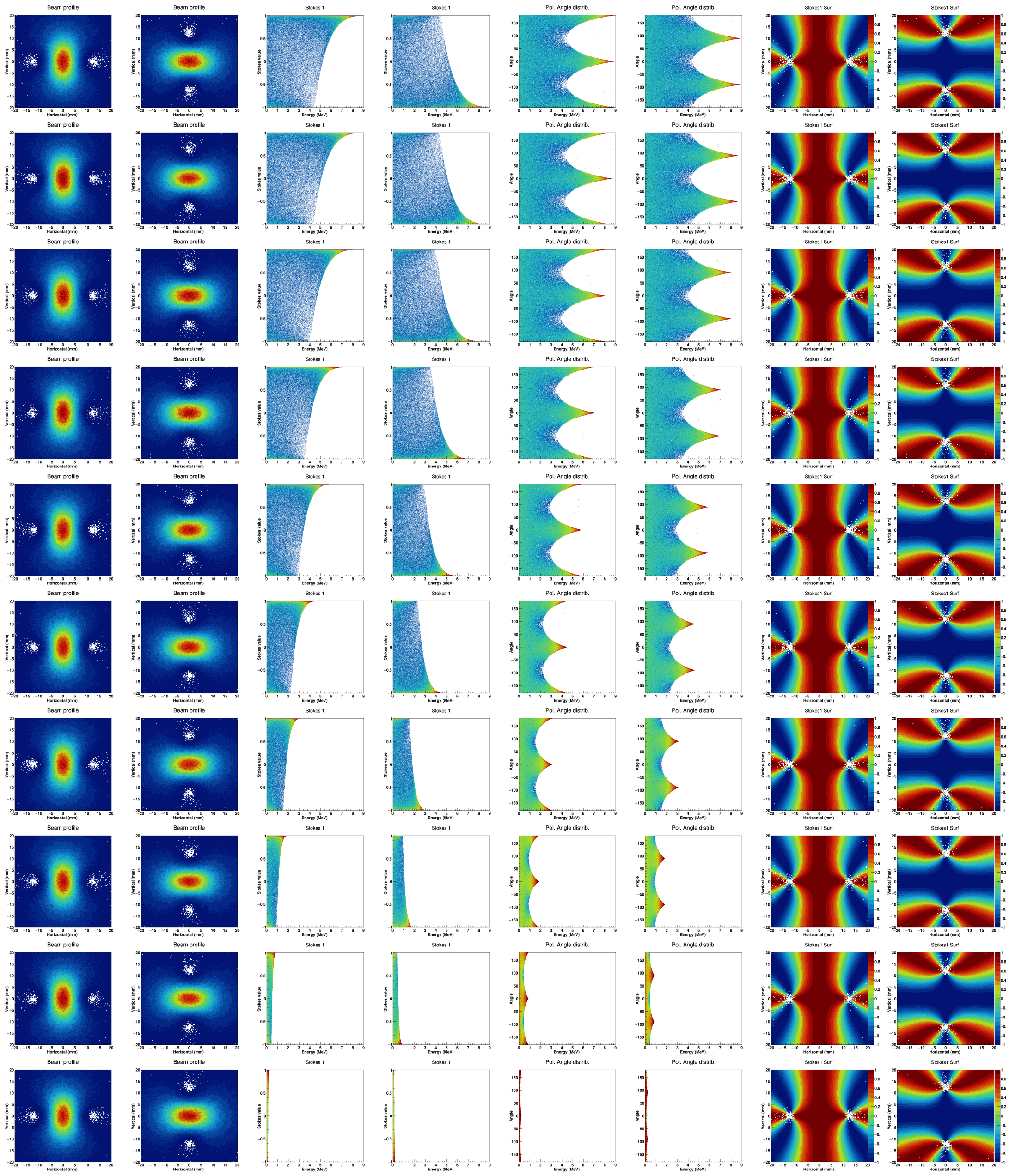

Figure 5. Compton scattering of 100 % linear polarized 532 nm wavelength laser on 500 MeV electrons.

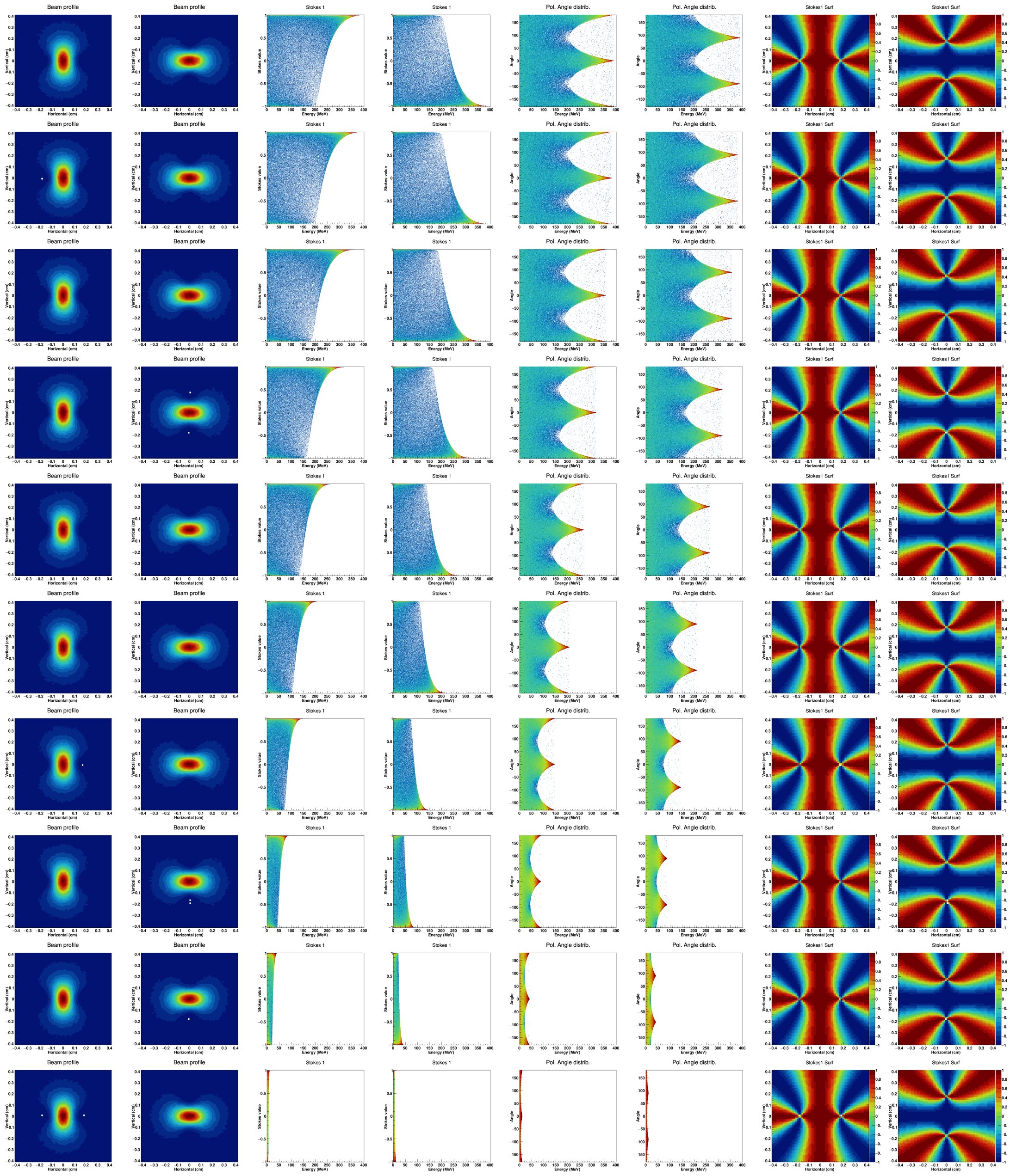

Figure 6. Compton scattering of 100 % linear polarized 532 nm wavelength laser on 3500 MeV electrons.

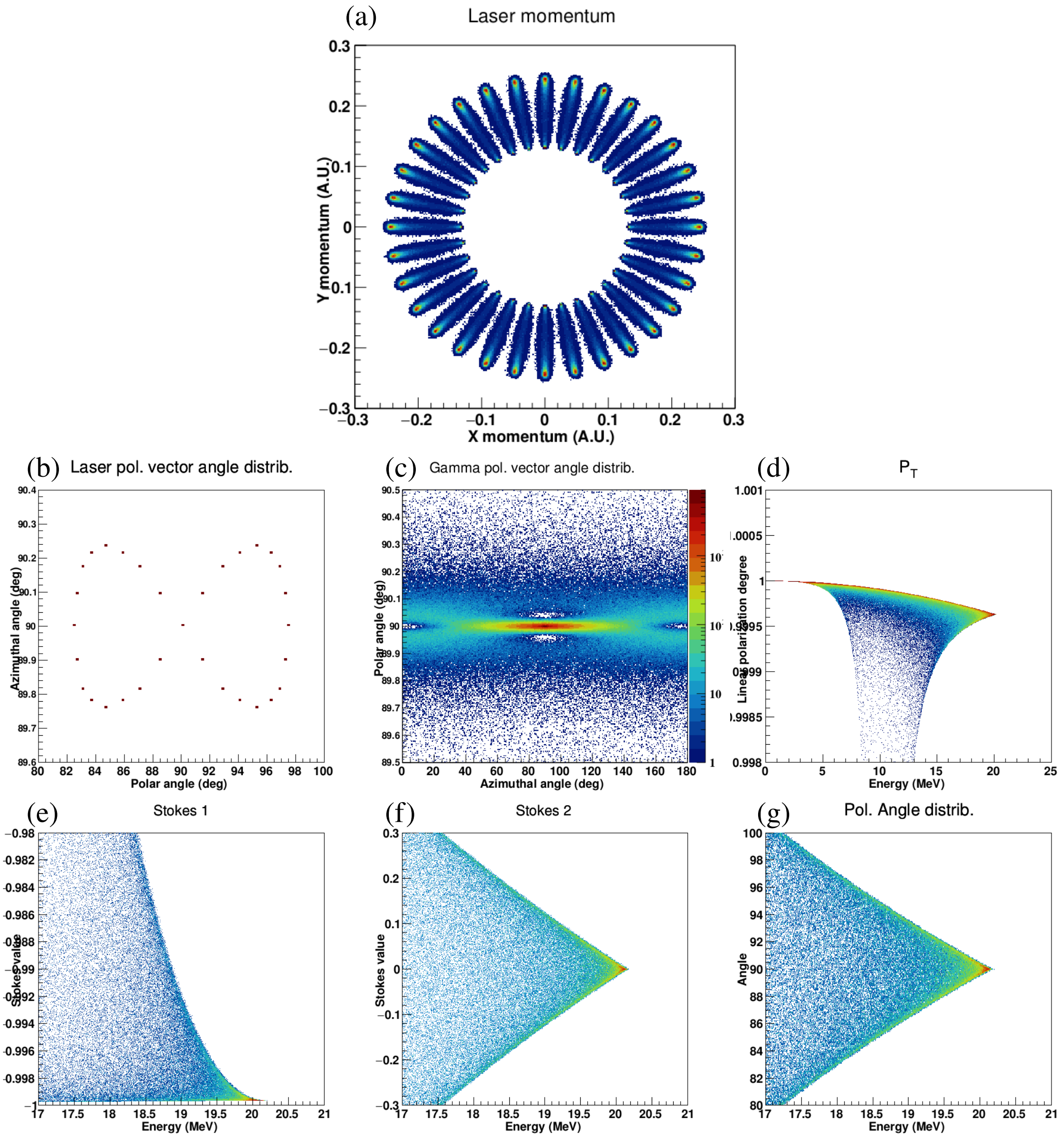

Figure 7. Simulation of LCS interaction in the EuroGammaS laser recirculator. 750 MeV electrons and 515 nm laser photons were considered. (a) Transversal distribution of laser momenta for the 32 laser pulses. Realistic electron and laser beams have been considered. Figures (b–g) show results obtained considering ideal pencil-like electron and laser beams, as following: (b) laser polarization phasor angular distribution at the interaction point, taken from https://doi.org/10.1103/PhysRevSTAB.17.033501; (c) γ-ray phasor angular distribution; (d) linear polarization degree; Distributions as function of γ-ray energy for (e) $P_1^{(LAB)}$ and (f) $P_2^{(LAB)}$ Stokes parameter and (g) polarization vector azimuthal angle.