Contribution ID: **21** Type: **Contributed Talk**

Generation of superradiant single cycle light pulses.

Monday, 14 July 2025 11:15 (15 minutes)

Plasma-based accelerators provide a compact and efficient means of generating ultra-relativistic particles [1], making them strong candidates for next-generation light sources. These X-ray sources are inherently ultrafast, highly-collimated, and energetic, with applications in biology, plasma physics, and material and high energy density science. These sources are compact and affordable but produce incoherent radiation. Making them coherent and superradiant will radically increase the attractiveness of these light sources, by placing them on equal footing to the brightness of X-ray sources today, such as free-electron-lasers (FEL).

One of the most consolidated X-ray source configurations in plasma accelerators is based on nonlinear Thomson scattering [2]. Here, relativistic electrons from a plasma-based accelerator interact with a counter or copropagating, intense laser pulse. Temporal coherence and superradiance are highly sought features in this context because the peak brightness increases very favourably with the number of light-emitting particles squared [3]. This is in stark contrast with temporally incoherent sources, where the peak intensity grows linearly with the number of emitters.

This work presents results on the generation of superradiant emission from electron bunches interacting with an azimuthally polarised laser pulse. We investigate how this interaction evolves at varying electron densities and examine the collective effects that lead to enhanced, superradiant radiation.

References

[1] T. Tajima and J. M. Dawson, Phys. Rev. Lett. 43, 267 (1979).

[2] E. Esarey et al., Phys. Rev. E 48, 3003 (1993).

[3] J. Vieira et al., Nature Physics 17, pages 99–104 (2021).

Primary authors: THAKUR, Bhushan (Instituto Superior Tecnico, Lisbon); VIEIRA, Jorge (Instituto Superior Técnico)

Presenter: THAKUR, Bhushan (Instituto Superior Tecnico, Lisbon)

Session Classification: Session 1: HPC for laser plasma accelerators