Coherence and superradiance from a plasma-based quasiparticle accelerator

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Coherent light sources, such as free electron lasers, provide bright beams for biology, chemistry, physics, and advanced technological applications. Increasing the brightness of these sources requires progressively larger devices, with the largest being several km long (e.g., LCLS). Can we reverse this trend, and bring these sources to the many thousands of labs spanning universities, hospitals, and industry? Here we address this long-standing question by rethinking basic principles of radiation physics. At the core of our work is the introduction of quasi-particle-based light sources that rely on the collective and macroscopic motion of an ensemble of light-emitting charges to evolve and radiate in ways that would be unphysical when considering single charges. The underlying concept allows for temporal coherence and superradiance in fundamentally new configurations, providing radiation with clear experimental signatures and revolutionary properties. Here we illustrate the underlying concept in a plasma accelerator. The simplicity of the quasi-particle approach makes it suitable for experimental demonstrations at existing laser and accelerator facilities [1].

References

[1] B. Malaca *et al*, submitted (2023).