Quantum Signatures in Free-Electron Lasers (FEL) Light

The FEL radiation is emitted by a beam of magnetically accelerated relativistic electrons.
In the Self Amplified Spontaneous Emission (SASE) FEL is the interaction between the undulating electrons and they spontaneous radiation emission that regroups the electrons into micro-bunches, thus providing a source of random self-phase-coherent radiation spikes not mutually coherent.
Instead, in a "seeded" FEL, as FERMI at the Sincrotrone Trieste Laboratory, the electrons are first exposed to an external "seeding" laser pulse with a field that is several order of magnitude larger than the spontaneous radiation field, hence driving the FEL process and ending up in a quasi-single EUV or soft X-ray pulse proved to be highly coherent at the first and second order.
However, recently, much interest has been gathering about how much "lasing" the FEL light is. This is an important question in view of the possible applications not only to studying high energy processes in matter, but also to possibly starting the foundations of an X-ray quantum optics.
The purpose of the project is the investigation of the different degrees of coherence and quantum coherence in the SASE, respect to "seeded" FEL light, along with to what degree the quantum coherent states in the seeding laser pulse are transferred to the FEL radiation.
The project will be pursued in close collaboration with prof. Fulvio Parmigiani and its experimental group at the seeded FEL facility in Trieste.

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References:

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