

# Science Driven Requirements for Seeded Free Electron Lasers

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Recent theoretical and experimental progress in the physics and technology of electron beams has shown the possibility of producing fully coherent, variable polarization and tunable X-ray pulses. This development opens new possibilities to design and build free-electron lasers (FELs), to produce high intensity, femtosecond and fully coherent soft X-ray pulses.

Here we will review the experiments and the ideas that represent the science frontier in time-resolved spectroscopy, coherent imaging and scattering studies.

A particular attention is given to the new free-electron laser (FEL) source FERMI@Elettra seeded at 260 nanometers with an external laser and operating in the single cascade high gain high harmonic (HG) mode and in the double cascade mode. This marks the first successful operation of FERMI@Elettra in its planned configuration, i.e., as a next-generation seeded free-electron laser source.