Laser-driven particle accelerator that can generate pairs of electron beams with different energies

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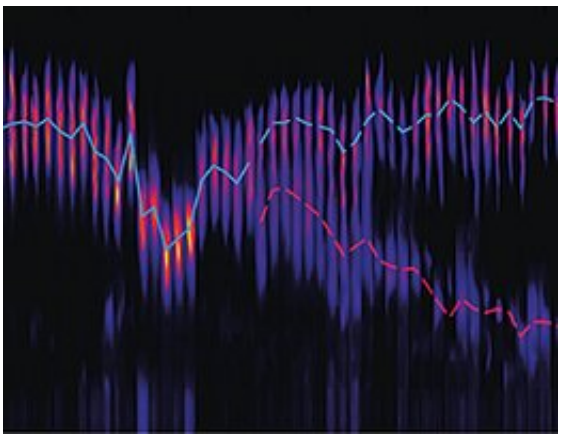

Electron spectra depending on accelerator setting. Left: tuned to single bunch operation, Right: tuned to dual bunch operation while changing the energy of second bunch. Credit: Johannes Wenz, LMU

Researchers at LMU have built the first-ever laser-driven particle accelerator that can generate pairs of electron beams with different energies.

Particle accelerator-based radiation sources are an indispensable tool in modern physics and medicine. Some of the larger specimens, such as the LHC in Geneva or the European XFEL in Hamburg, are among the most complex (and costly) scientific instruments ever constructed. Now, laser

physicists at LMU and the Max Planck Institute for Quantum Optics (MPQ), have developed a laser-driven particle accelerator that is not only capable of producing paired electron beams with different energies, but is also much more compact and economical than conventional designs.

This feat not only represents a significant breakthrough in the control of laser-driven particle accelerators, it opens new perspectives for research on the behaviour of matter on ultrashort timescales. The results lay the foundation for a new generation of experiments in ultrafast dynamics for the new method generates paired electron bunches that are only a few femtoseconds apart (a femtosecond is one millionth of a billionth of a second).

The Karsch group has already embarked on the construction of the next generation of their novel radiation source. With the ATLAS-3000 laser in LMU's new Center for Advanced Laser Applications (CALA), they are commissioning one of the most powerful lasers in the world. Potential medical applications of the newly acquired ability to create dual-energy electron bunches can now be explored, such as the development of compact, laser-driven X-ray sources for diagnostic purposes.

More information: J. Wenz et al. Dual-energy electron beams from a compact laser-driven accelerator, *Nature Photonics* (2019). DOI: 10.1038/s41566-019-0356-z

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