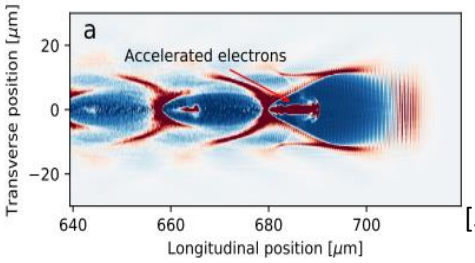
PhD Thesis

The Center for Advanced Laser Applications (CALA) in Garching-Forschungszentrum is home to the most powerful laser in Germany. Powers of 1 – 3 PW, at a repitition rate of 1 Hz, allow cutting-edge research in the fields of medical physics, accelerator physics and fundamental particle physics. To support our team for electron acceleration via laser-plasma interactions, we are looking for a talented and motivated

PhD Student

During your thesis you will work on optimizing electron acceleration using Laser Wakefield Acceleration (LWFA). LWFA is an advanced accelerator concept which utilises the electric fields in laser-driven plasma waves to accelerate electrons to GeV energies over just a few centimetres [1]. In the course of your thesis you will utilize these electron beams to conduct a very fundamental experiment in modern physics: studying the Breit-Wheeler process in the non-perturbative regime [2,3]. This experiment aims to study the quantum vacuum by creating matter from light, more precisely an electron-positron pair from the collision of energetic γ-rays and an intense laser. Predicted in 1934, this process has been experimentally tested only recently and only for a few times, and retains high relevance for the development of quantum-electrodynamic theory. The γ-rays will be generated by hitting a Bremsstrahlungs-target with the high energy electron beam from LWFA. Our high-intensity laser at CALA will not only supply the large number of laser photons in the collision beam but it will also be used to accelerate the multi-GeV electron beam to supply the colliding γ-photons via Bremsstrahlung.



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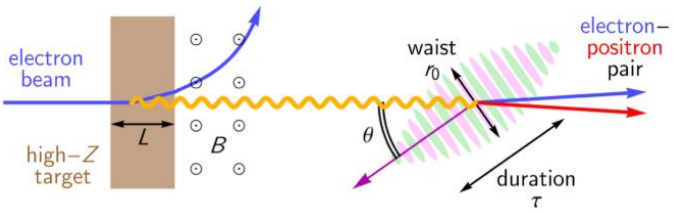

The work on this project will include the preparation and implementation of the setup for the Breit-Wheeler experiment [4], including experiments for a stable operation of the LWFA process and achieving a correct timing overlap of the γ-beam and the laser beam. The project might also include computational work e.g. using fluid simulations to design gas targets for LWFA or particle in cell simulations to simulate the LWFA process.
You should bring great motivation to working in a lab, excellent grades and enjoy team work.

If you are interested to join our team contact:
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https://www.pulse.physik.uni-muenchen.de/research/lwfa/index.html

References:
[1] S. Karsch et al. 2007 New J. Phys. **9** 415
[2] G. Breit and J. A. Wheeler. Phys. Rev. 46 (12. Dec. 1934), pp. 1087-1091
[3] T. G. Blackburn, M. Marklund 2018 Plasma Phys. Control. Fusion 60 2054009
[4] F. C. Salgado et al. 2021 New J. Phys. **23** 10500
[5] S. Schindler et al. 2019 Proc. of SPIE 11037N-1