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Exploring the Impact of Spatio-Temporal Couplings on Ultra-Intense Laser Pulses

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The goal of this thesis is to explore the impact of Spatio-Temporal Couplings (STCs) on ultra-intense laser pulses and their role in relativistic particle acceleration. STCs, which link a pulse's spatial and temporal properties, can affect propagation and impact interactions with matter. The project implements advanced metrology methods and develops propagation simulations using real data from high-power laser systems to model and study STCs. By reconstructing laser beam propagation and analyzing spatio-temporal distortions, this work aims to apply the findings to particle acceleration experiments for improved performance in laser-driven particle acceleration and nuclear photonics.

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