Ultra-fast probing of plasma wave dynamics in a wakefield accelerator

Hao Ding¹, Max Gilljohann¹, Johannes Götzfried¹, Sabine Schindler¹, Felix Daiber¹, Ludwig Wildgruber¹, Johannes Wenz¹, Konstantin Khrennikov¹, Matthias Heigoldt¹, Mathias Hüther¹, Andreas Döpp¹, Andreas Döpp¹, and Stefan Karsch¹,²*

¹Ludwig-Maximilians-Universität München (LMU), Am Coulombwall 1, 85748 Garching, Germany  
²MPI für Quantenoptik (MPQ), Hans-Kopfermann-Strasse 1, 85748 Garching, Germany  
*stefan.karsch@mpq.mpg.de

We report on results obtained with a few-cycle microscopic diagnostic [1] at the ATLAS laser facility. This diagnostic allows direct observation of the laser-plasma interaction at densities of a few 10¹⁸ cm⁻³. In particular, we have investigated the evolution of plasma waves for different injection schemes and have used Faraday rotation [2] as complementary diagnostic to measure the electron bunch length. Furthermore, we directly observe - for the first time - that the laser-accelerated electron beam drives its own plasma wave in a second, subsequent gas jet target, paving the way for hybrid-wakefield accelerator schemes [3].

References