

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

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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  $10^{18}$  cm<sup>-3</sup>. 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

[1] A. Savert et al., Phys. Rev. Lett. 115, 055002 (2015).

[2] A. Buck et al., Nat. Phys. 7, 543 (2011).

[3] B. Hidding et al. Phys. Rev. Lett. 104, 195002 (2010).