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**Ultracold and ultrafast: Probing quantum gases with femtosecond laser pulses** PHILIPP WESSELS, BERNHARD RUFF, TOBIAS KROKER, The Hamburg Centre for Ultrafast Imaging, STEFFEN PEHMÖLLER, Institut für Experimentalphysik, University of Hamburg, JULIETTE SIMONET, Center for Optical Quantum Technologies, MARKUS DRESCHER, Institut für Experimentalphysik, University of Hamburg, KLAUS SENGSTOCK, Center for Optical Quantum Technologies — Ultrafast lasers open new pathways for probing and manipulating ultracold atomic systems in order to address fundamental questions in quantum physics. The short pulses act as a highly localized instantaneous trigger to drive complex dynamics and enable access to coherence properties in macroscopic quantum targets and superfluid matter. We report on first experiments exploring ultracold $^{87}$Rb atoms and Bose-Einstein condensates (BEC) exposed to ultrashort laser pulses of 280 fs duration. The intense light pulses create ions within the focal region via strong-field ionization and the remaining atoms are detected by absorption imaging. Additionally, we quantify the momentum transferred to the atoms by the femtosecond laser pulse. Since the amount of generated ions is tunable, a tool with the potential to create hybrid quantum systems of few ions immersed in the trapped cloud is provided. First results already indicate the formation of a long-lived ultracold plasma state. Analyzing the charged fragments after ionization promises further insight so that we discuss perspectives on detecting ions and electrons in a new experimental setup to investigate coherence transfer from a macroscopic wave function to its microscopic constituents.

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