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Contribution ID: **108** Type: **Poster**

# Multiplexed magneto-optic probe of wakefield accelerators

*Monday, 22 July 2024 18:00 (1h 30m)*

Ultrashort transverse Faraday-rotation probes of laser-driven wakefield accelerators (LWFAs) have measured kilo-T magnetic fields originating from accelerating electrons and bubble sheath currents in plasmas ranging in density from >10^19 [1] to 10^17 cm-3 [2]. Such measurements have revealed e.g. wake size and shape [1,2], bunch duration [3], and longitudinal charge distribution within a bubble [2] at one location within the plasma. Here we describe a comprehensive obliquely-incident probe of all components a wake's magneto-optic tensor, including Faraday and Cotton-Mouton effects, using a three-channel Stokes polarimeter [4]. In addition, we have multiplexed the probe and detection system to record magneto-optic images at several locations along the wake's propagation path in one shot. Anticipated physics studies include dependence of B-field evolution on electron injection method, evolution of bubble size and intra-bubble charge distribution during multi-GeV beam-loaded LWFA [5],and B-field evolution during electron-beam-driven plasma wakefield acceleration.

[1] M. C. Kaluza et al.,"Measurement of magnetic-field structures in a laser-wakefield accelerator," Phys. Rev. Lett. 105, 115002 (2010).

[2] Y. Y. Chang et al.,"Faraday rotation study of plasma bubbles in GeV wakefield accelerators," Phys. Plasmas 28, 123105 (2021).

[3] A. Buck et al.,"Real-time observation of laser-driven electron acceleration," Nat. Phys. 7, 543 (2011).

[4] P. F. Colleoni et al.,"Space and time resolved measurement of surface magnetic field in high intensity short pulse laser matter interactions," Phys. Plasmas 26, 072701 (2019).

[5] C. Aniculaesei et al.,"The acceleration of a high-charge electron bunch to 10 GeV in a nanoparticle-assisted wakefield accelerator," Matter Rad. Extremes 9, 014001 (2024).

## Working group

WG1 : Laser-driven plasma wakefield acceleration

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**Session Classification:** Poster [Atrium]