Towards a more complete understanding of ultrashort pulse laser ablation in liquid and air by combing time-resolved experiments with simulations

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In recent decades, ultrafast laser ablation has been extensively studied. Final state observables that may be predicted by simulations include ablation threshold, efficiency, and morphology [1]. Pump-probe techniques can measure time-resolved observables with a femtosecond temporal resolution up to the final state within several hundreds of µs [2].
Here, we present new experimental validation of models for laser ablation in air [3] and liquid [4] as well as for laser fragmentation of microparticles [5].

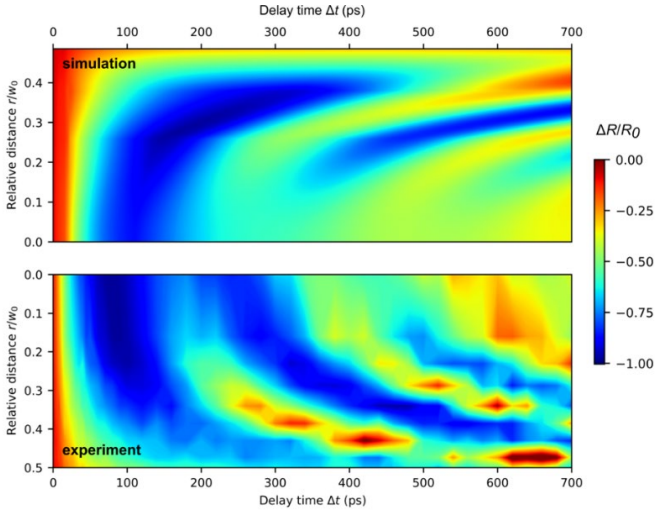

Figure: Simulated (top panel) and measured (bottom panel) transient optical response of a $Fe_{0.5}Ni_{0.5}$ target irradiated in the spallation regime [3]

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References:
[1] D. Redka, J. Winter, C. Gadelmeier et al., Appl. Surf. Sci. **594** 153427 (2022)
[2] S. Rapp, M. Kaiser, M. Schmidt et al., Opt. Expr. **24** 17572 (2016)
[3] C. Chen, M. Spellauge, D. Redka, et al., Phys. Rev. B (2025) accepted
[4] M. Spellauge, C. Doñate-Buendía, S. Barcikowski et al., Light Sci. Appl. **11** 68 (2022)
[5] M. Spellauge, M. Tack, R. Streubel et al., Small 2206485 (2023)