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Gradient-Based Optimization of Stellarator Equilibria (PhD Oral-24)[1] ELIZABETH PAUL, Princeton University, MATT LANDREMAN, THOMAS ANTONSEN, University of Maryland, College Park — Modern stellarators have traditionally been designed without analytic derivative information, instead applying gradient-based methods with finite-difference approximations or gradient-free methods. We present the first optimization of fixed-boundary stellarator equilibria with analytic derivatives obtained from an adjoint method. This technique is based on the well-known self-adjointness property of the MHD force operator, which has recently been generalized to allow for perturbations of the rotational transform and the currents outside the confinement region. This self-adjointness property is applied to develop an adjoint method for computing the derivatives of functions that depend on MHD equilibrium solutions, such as the magnetic well and rotational transform, with respect to perturbations of coil shapes or the plasma boundary. The application of this technique provides a reduction of the number of required function evaluations by a factor of $\sim 10^2$, enabling efficient convergence toward the optimum configuration. A discussion of the optimization technique and examples of optimized configurations will be presented.

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Elizabeth Paul
Princeton University

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