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Fast convergence methods for calculating the magnetic field from coils[1] CAOXIANG ZHU, Princeton Plasma Physics Laboratory, NICK MCGREIVY, Princeton University, STUART HUDSON, Princeton Plasma Physics Laboratory — Calculating the magnetic field from coils using the Biot-Savart law is required for numerous plasma physics applications. One of the most-used strategies is to approximate the (filamentary) coils with N straight segments and then use the Hanson-Hirshman expression (Hanson Hirshman, Phys. Plasmas, 9(10):4410, 2002) to compute the field produced by each segment. The Hanson-Hirshman expression efficiently calculates the exact field from a straight filamentary segment and is only singular on the segment itself. However, the piecewise-linear approximation to a generally smooth coil filament results in a discontinuous tangent vector, and thus only quadratic convergence is obtained with respect to N. In this presentation, we introduce fast, higher-order approximations for calculating the magnetic field from coils that exploit a continuous tangent. The convergence of the magnetic field calculation from circular coils, D-shaped TF coils and stellarator non-planar coils can be significantly improved with negligible extra computation cost.

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Caoxiang Zhu
Princeton Plasma Physics Laboratory

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