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Progress on a new Fast Multipole Method based Grad-Shafranov solvers ANTOINE CERFON, Courant Institute of Mathematical Sciences NYU, ZYDRUNAS GIMBUTAS, National Institute of Standards and Technology, LESLIE GREENGARD, Courant Institute of Mathematical Sciences NYU — In tokamaks, transport processes and MHD stability depend strongly on the magnetic field curvature and shear. Since both curvature and shear are functions of the second derivatives of the solution of the Grad-Shafranov equation (GS equation), it is critical to design highly accurate Grad-Shafranov solvers that can compute these derivatives with very good accuracy. We recently showed that an effective way to design a fast and highly accurate solver is to view the GS equation as a nonlinear Poisson equation [1]. We solved this Poisson problem combining conformal mapping techniques with Fourier and integral equation methods on the unit disk, and obtained high order accuracy for the second derivatives of the solution of the GS equation [1]. Conformal mapping techniques become more inefficient as the elongation of the plasma cross-section increases, and even fail if the surface has a separatrix. In order to handle arbitrary fusion-relevant geometries in a robust manner, we are designing a new fixed boundary Grad-Shafranov solver that relies on the Fast Multipole Method to solve the associated Poisson problem [2].

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[2] F. Ethridge and L. Greengard, SIAM J. Sci. Comput.23, 741 (2001)

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