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Recent Advances in Stellarator Optimization

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Computational optimization has revolutionized the field of stellarator design. To date, optimizations have focused primarily on optimization of neoclassical confinement and ideal MHD stability, although limited optimization of other parameters has also been performed. One of the criticisms that has been levelled at this method of design is the complexity of the resultant field coils. Recently, a new coil optimization code - COILOPT++, which uses a spline instead of a Fourier representation of the coils, - was written and included in the STELLOPT suite of codes. The advantage of this method is that it allows the addition of real space constraints on the locations of the coils. The code has been tested by generating coil designs for optimized quasi-axisymmetric stellarator plasma configurations of different aspect ratios. As an initial exercise, a constraint that the windings be vertical was placed on large major radius half of the non-planar coils. Further constraints were also imposed that guaranteed that sector blanket modules could be removed from between the coils, enabling a sector maintenance scheme. Results of this exercise will be presented. New ideas on methods for the optimization of turbulent transport have garnered much attention since these methods have led to design concepts that are calculated to have reduced turbulent heat loss. We have explored possibilities for generating an experimental database to test whether the reduction in transport that is predicted is consistent with experimental observations. To this end, a series of equilibria that can be made in the now latent QUASAR experiment have been identified that will test the predicted transport scalings. Fast particle confinement studies aimed at developing a generalized optimization algorithm will also be discussed.

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Primary author: Dr GATES, David (PPPL)

Co-authors: Dr ZOLFAGHARI, Ali (PPPL); Dr NEILSON, George (Princeton Plasma Physics Laboratory); Dr MYNICK, Harry (PPPL); Dr BRESLAU, Joshua (PPPL); Dr LANDREMAN, Matthew (University of Maryland); Dr POMPHREY, Neil (PPPL); Dr XANTHOPOULOS, Pavlos (IPP-Greifswald); Dr LAZERSON, Samuel (Princeton Plasma Physics Laboratory); Mr BROWN, Thomas (Princeton University, Princeton Plasma Physics Laboratory)

Presenter: Dr GATES, David (PPPL)

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