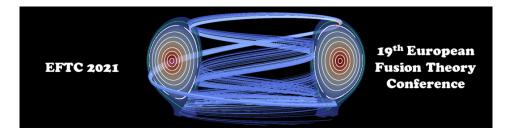Contribution ID: **41**   Type: **Oral**

Pressure effects on the topology of magnetic fields in stellarators

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Three dimensional magnetic equilibria are in general composed of nested flux surfaces, magnetic islands and chaotic field lines, although it is possible to design stellarator coil configurations that produce vacuum fields with nested flux surfaces (Pedersen, S. T. et al. 2016, Nature comm.). At finite β however, currents self-generated by the plasma, such as diamagnetic, Pfirsch-Schlüter or bootstrap, perturb the magnetic field, thus breaking nested flux surfaces and ultimately impairing confinement. To date, there is no theory, nor extensive numerical study that characterizes the maximum achievable β above which magnetic surfaces are destroyed, nor a theory on the dependency of this critical β on other relevant operational parameters. We propose using the Stepped Pressure Equilibrium Code (SPEC) (Hudson, S. R. et al. 2012, Phys. of Plasmas), which can compute 3-dimensional stepped-pressure equilibria with magnetic islands and chaos, to study the effect of finite β on the magnetic topology of stellarators. Recent numerical work significantly improved the speed and robustness of SPEC (Qu, Z. et al, 2020, Plasma Phys. Cont. Fusion), which allows large parameter scans in a reasonable amount of time (Loizu, J. et al. 2017, J. Plasma Phys.). In addition, SPEC has recently been extended to allow free-boundary calculations (Hudson, S. R. et al. 2020, Plasma Phys. Cont. Fusion) with prescribed net toroidal current profiles (Baillod, A. et al. 2021, J. Plasma Phys.). Leveraging these new capabilities, we present here the first extensive and comprehensive study of the equilibrium β-limit with bootstrap current. We consider a number of representative configurations, such as classical, quasi-axisymmetric and quasi-helically symmetric stellarators.

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