Overview of stellarator theory at the University of Montana

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Overview

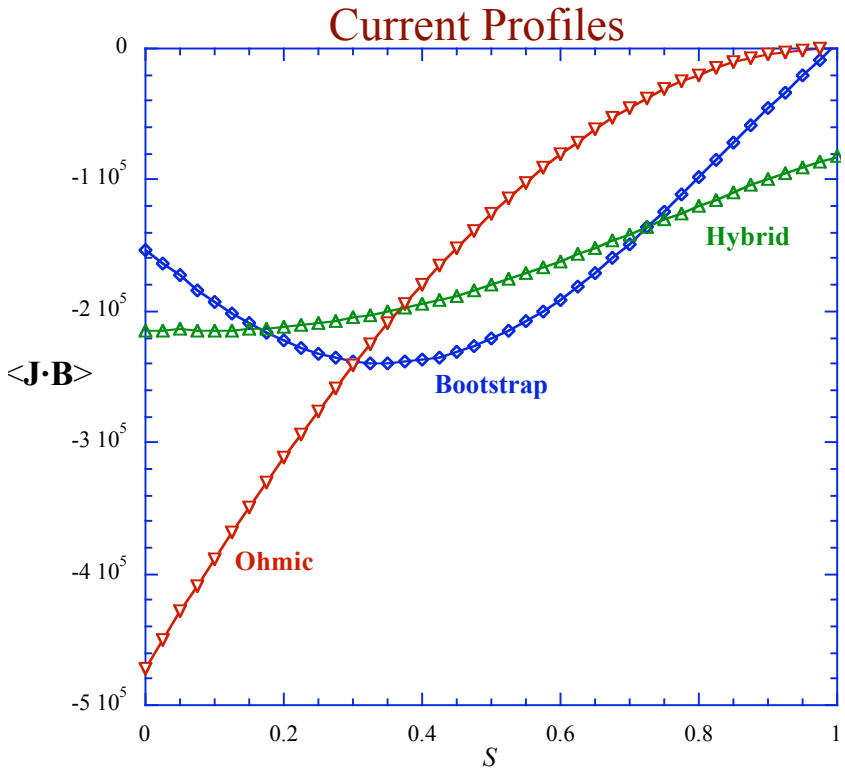
- Numerical studies for QPS
  - Ideal MHD stability studies
  - Flexibility studies
- High-β compact stellarator studies
  - Second ballooning stability in quasi-symmetric stellarators
- Development of improved optimization algorithms
  - A breeder algorithm

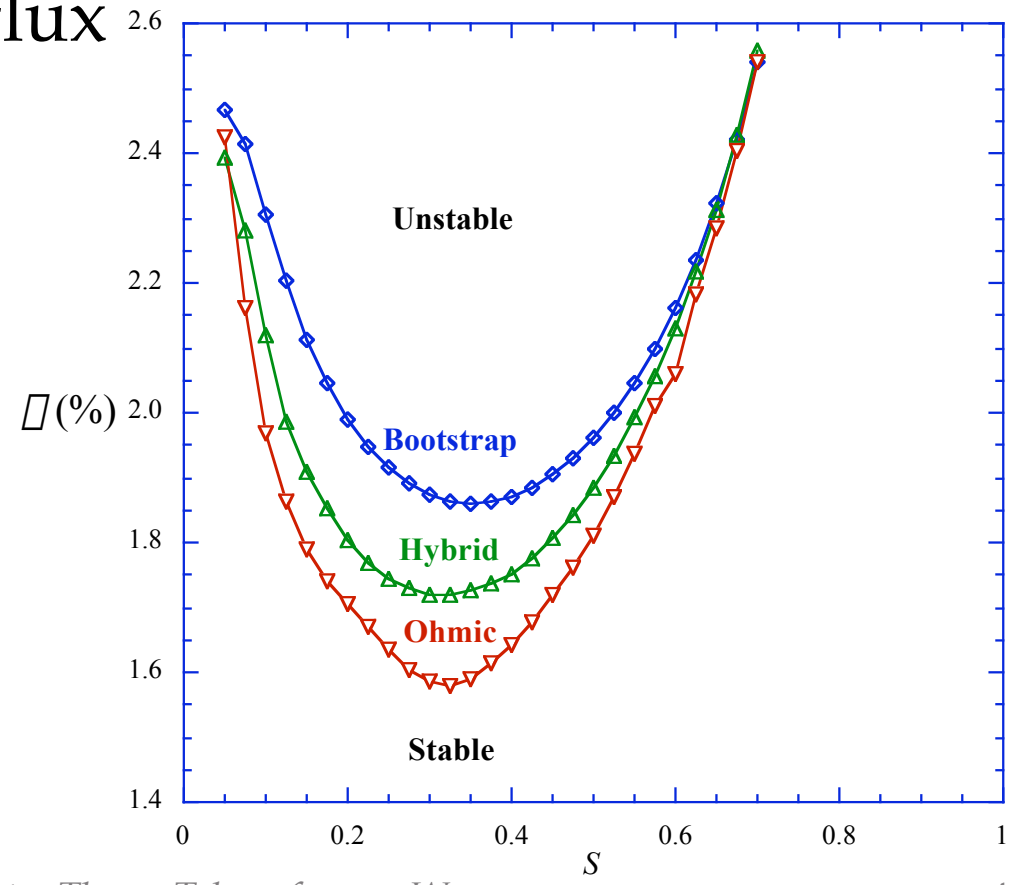
Numerical studies for QPS

- Mercier Stability
  - Stability criteria checked in VMEC
- Ballooning Stability
  - Using COBRAVMEC and TERPSICHORE to test infinite- and finite-n ballooning stability
- Kink and Vertical Stability
  - Using TERPSICHORE to test stability for n=0 and n=1 modes in QPS

Numerical studies for QPS : Impact of the current profile on ballooning stability

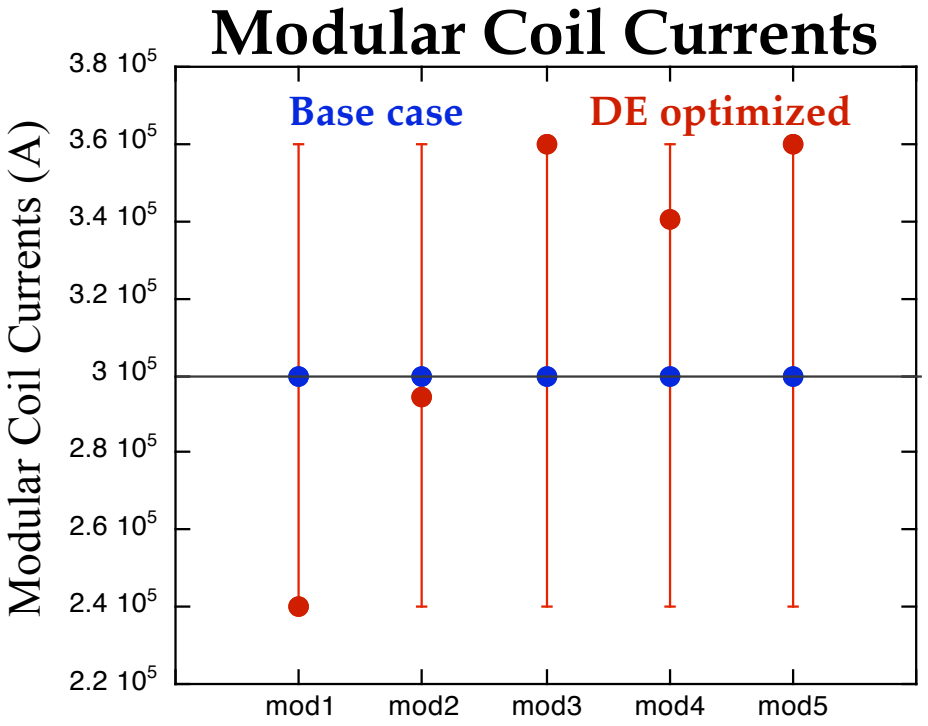
- □ at marginal stability as a function of the normalized flux

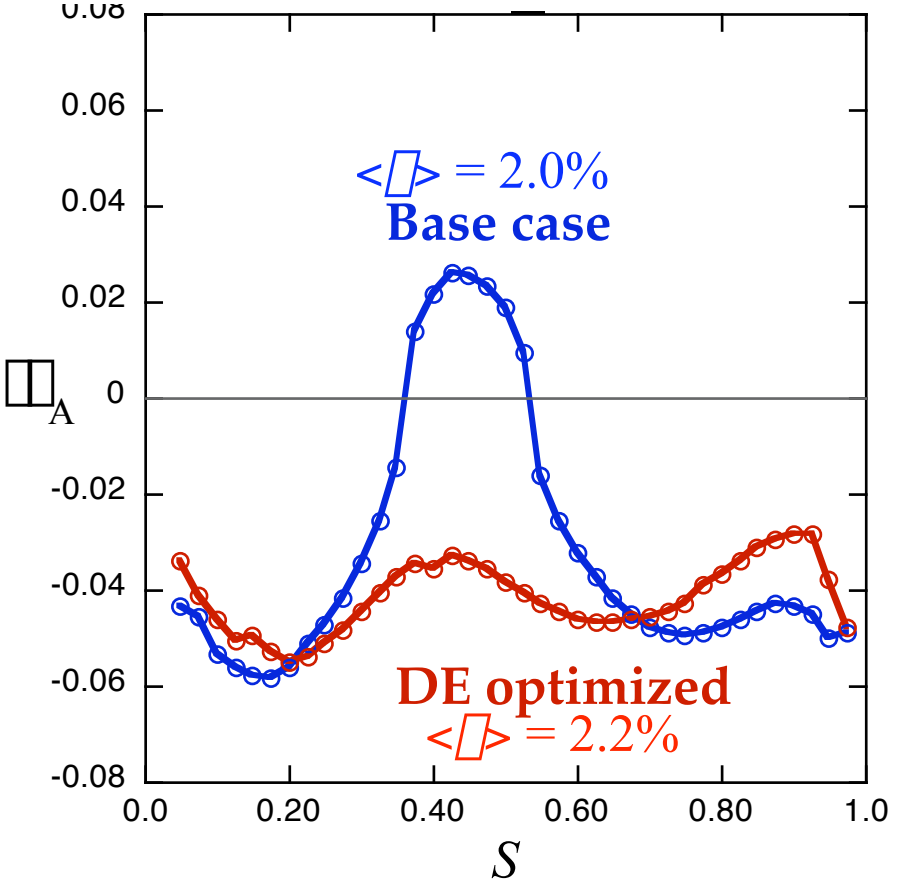




Numerical studies for QPS : Impact of external coil currents on ballooning stability

- Optimized only by changing external coil currents



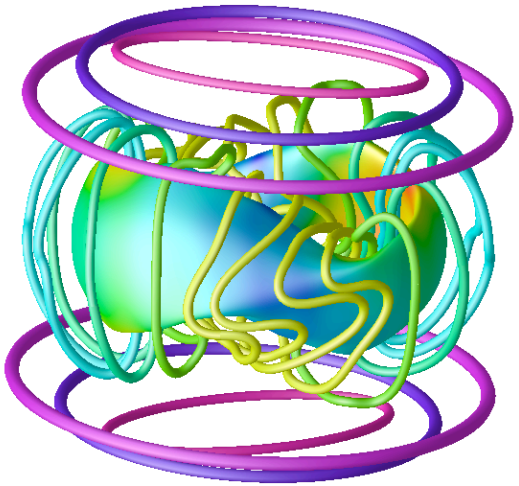


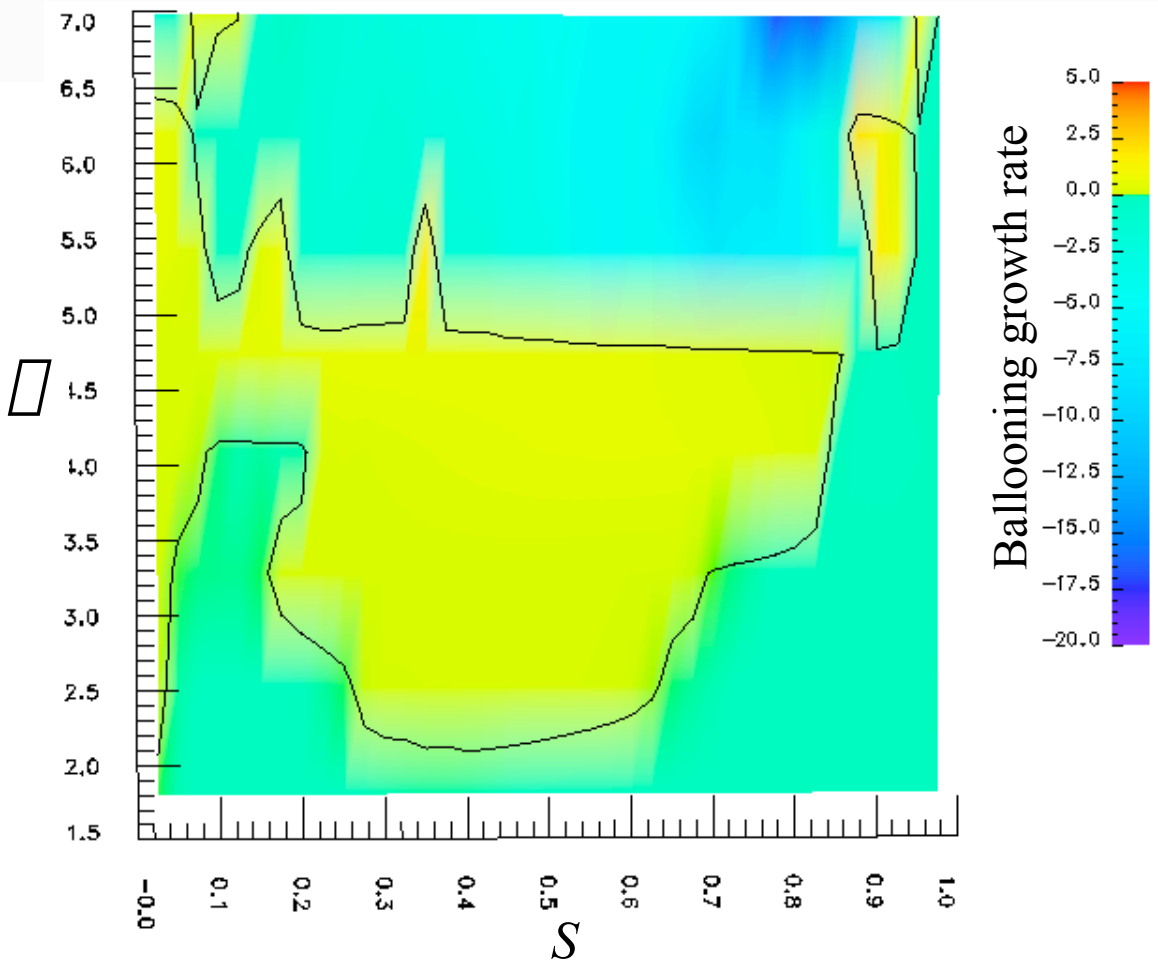
High-β compact stellarator studies

- High-β, tokamak-stellarator hybrids
  - high-shear, tokamak-like rotational transform profile
  - $|B|$ approximately poloidally symmetric
  - high interchange stability β limits up to $\langle\beta\rangle = 23\%$
- Second ballooning stability in QPS plasmas
  - Equilibria with large second ballooning stable regions have been obtained at $\langle\beta\rangle \sim 6\%$

High-β compact stellarator studies:
Minimizing the gap between 1st & 2nd stability

- Second stability in QPS plasmas with optimized profiles





Development of improved optimization algorithms: Breeder Algorithm

- Develop a hybrid optimizer which couples the global parameter space coverage of the genetic algorithm with the directness of the Levenberg-Marquadt optimization
  - Outer loop would be the genetic algorithm
  - Inner loop would optimize each member of the population using a Levenberg-Marquadt step