Update on Wistell progress with visitors

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Wistell Meeting, Aug 24, 2018

Overview of Andrew Ware visit

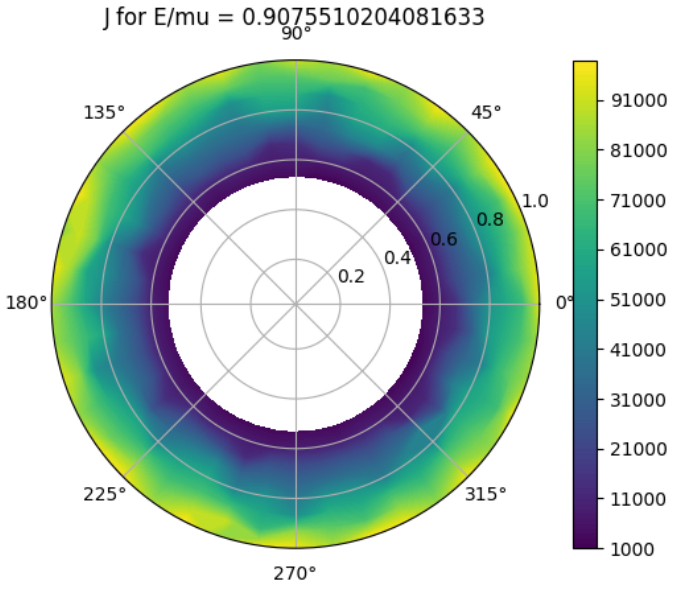
- **Goals, in rough order of priority**
- J and J^* optimization - mostly complete
- Ballooning optimization in Stellopt - complete
- Import Nemov guiding center code into Stellopt - partially complete

J and J^* optimization

J is the second adiabatic invariant:

$$\int_a^b v_{||}\, dl$$

where the integration is on a field line between particle bounce points.
J^* optimization is already in STELLOPT, but not really appropriate for QH.
J calculation was written (by me) but not yet integrated into STELLOPT. Based on results from M. Drevlak's week, this may not be relevant.



J calculation for HSX, for particles with turning points at $B_{\min} = E/\mu = 0.9$ T

Ballooning optimization

- Set up run with Ballooning optimization and current calculationg with BOOTSJ
- Unfortunately, ran into repeated crashes during optimization
- Crashes are a regular STELLOPT “feature” and are resolved mainly by adjusting weights

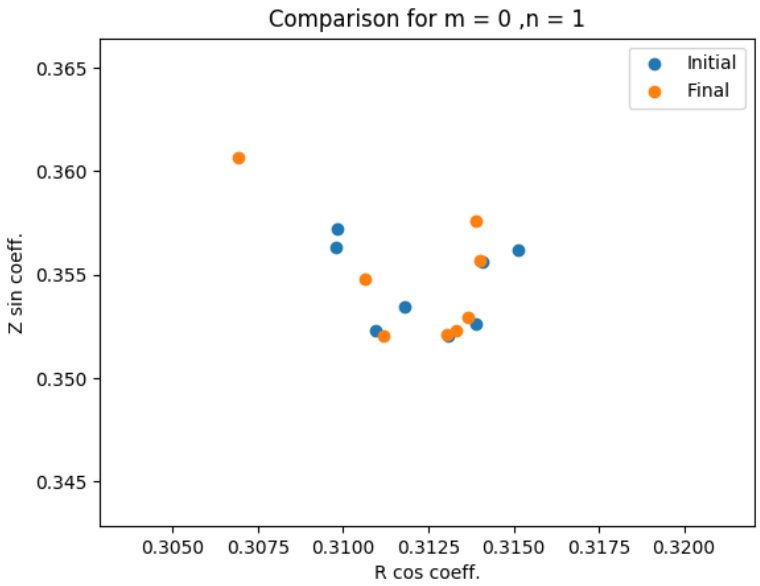
Importing Nemov orbit following into STELLOPT

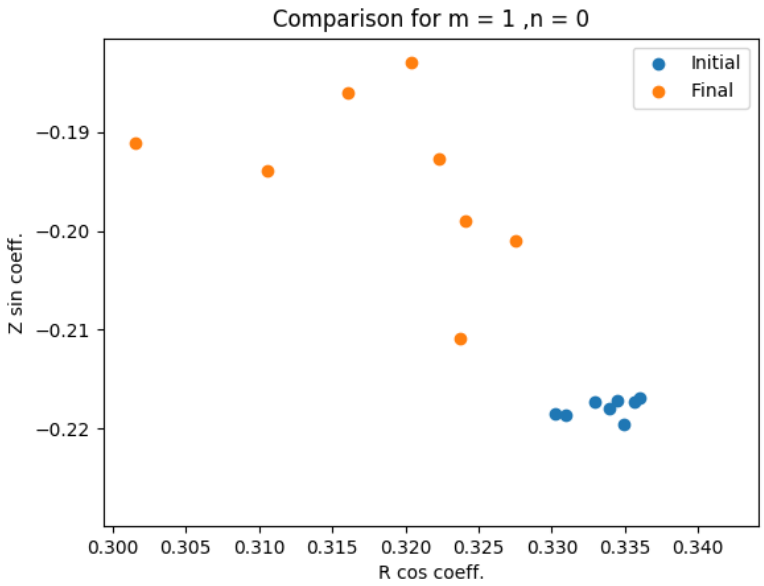
- Current status - framework for introduction of Nemov metric implemented in STELLOPT (Bader)
- Nemov metric successfully run in standalone format (Ware)
- Full integration of Nemov code into STELLOPT - status unknown

Overview of Michael Drevlak visit

- Learn how to run ROSE
- Test case for rose - optimization for energetic particles
- Learn how to run ONSET

Convexity test of ROSE





- Procedure identical to STELLOPT - initialize optimizations for the same target (here QH) with slightly different initial configurations
- m and n components were varied by 0.01%
- 10 ROSE runs were initiated, 1 crashed
- ROSE shows identical non-convex behavior to STELLOPT - problems are with the search space not the choice of STELLOPT optimizer

ROSE runs with several optimization choices

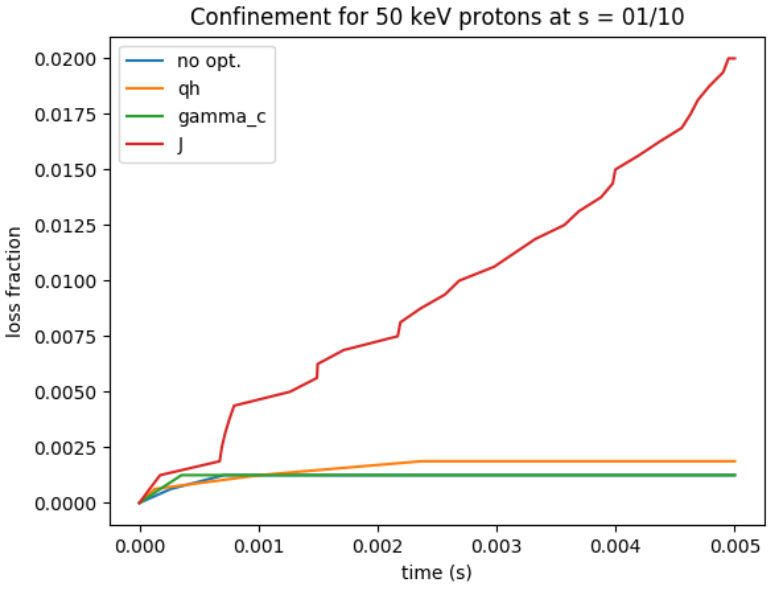
- ROSE runs included several different optimization targets
- QH - optimize for Quasi-symmetry
- γ_c Optimize for Nemov's γ_c metric
- J optimize to minimize deviations of J on a flux surface

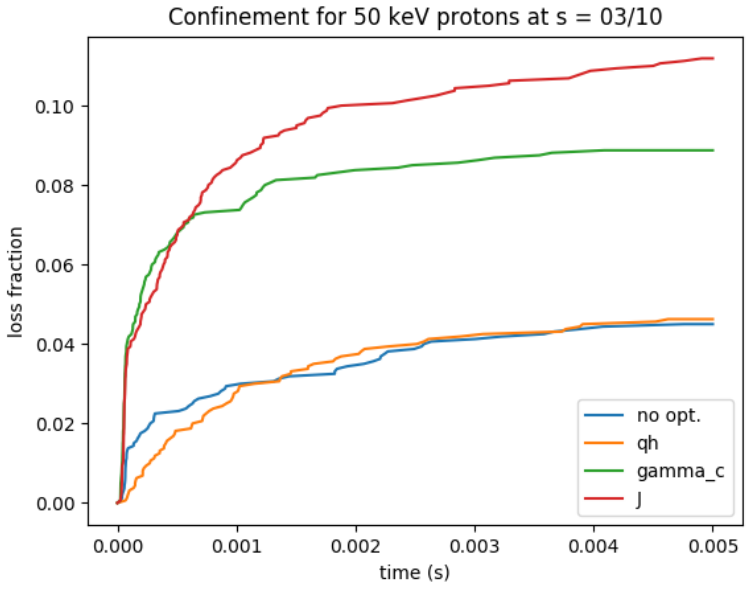
Evaluation of optimization metrics

Type	QH	ϵ_{eff}	γ_c	J
Baseline	0.0308	0.0042	0.020	2.37
QH	**0.011**	0.0028	0.016	2.17
γ_c	0.039	0.0030	**0.010**	3.66
J	0.042	0.0054	0.021	**1.97**
QH + γ_c	0.015	0.0041	0.0046	—

- Each row in the table represents a separate ROSE run which is optimized for a given target equilibrium.
- The $s = 0.6$ flux surface is targeted in every case
- No runs explicitly target ϵ_{eff}, but all ensure it is below 0.01.
- Baseline run is the QHS46 equilibrium

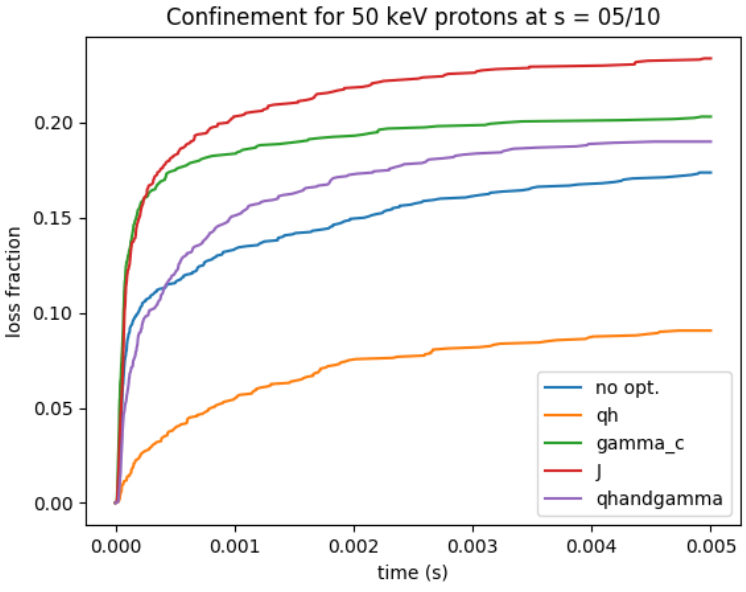
Evaluating configurations for EP confinement (1)

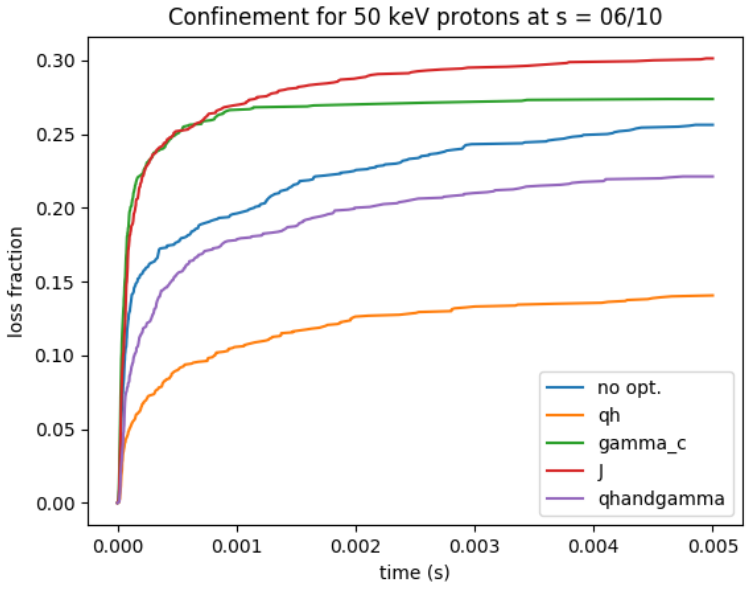




- 1600 particles followed uniformaly distrubted on the desired flux surface
- pitch angles randomly chosen for each particle
- evaluation done with M. Drevlak's DOEVAL code - follows in Boozer Coordinates

Evaluating configurations for EP confinement (2)





- 1600 particles followed uniformaly distrubted on the desired flux surface
- pitch angles randomly chosen for each particle
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—B— on field line for the four cases