

Benchmarking multiple alpha particle following codes

A. Bader, M. Drevlak

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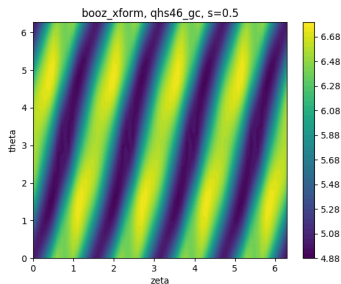
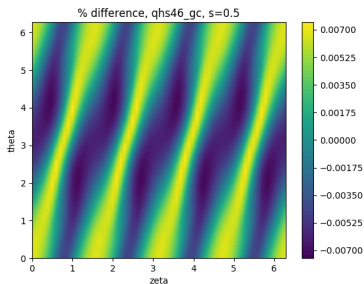
- Evaluation of certain equilibria show significant differences between different codes.
- Differences are likely caused by the following:
 - Different representations of the magnetic field
 - Accumulated errors from following particles for long times

Lot's of codes - all somewhat different

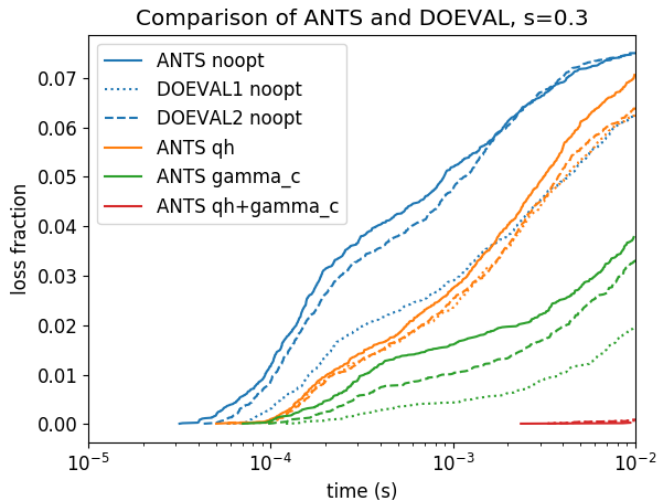
- DOEVAL - M. Drevlak
 - Uses Boozer representation
 - Launches uniformly on flux surface and isotropic in phase space
 - Adams-Bashforth integration
- alpha_lifetime - V. V. Nemov
 - Converts VMEC to cylindrical geometry
 - Launches randomly along field line and isotropic in phase space
 - Runge-Kutta integration
- ANTS - M. Drevlak
 - Converts VMEC to cylindrical geometry
 - Launches uniformly on flux surface and isotropic in phase space
 - Adams-Bashforth integration
- OFBZ - S. Murakami
 - Uses Boozer representation
 - Launches at user input locations and pitch angles
 - Runge-Kutta integration

Two methods of conversion to Boozer coordinates

- VM2MAG Workhorse at IPP-Greifswald
- BOOZ_XFORM Workhorse at PPPL (and here)

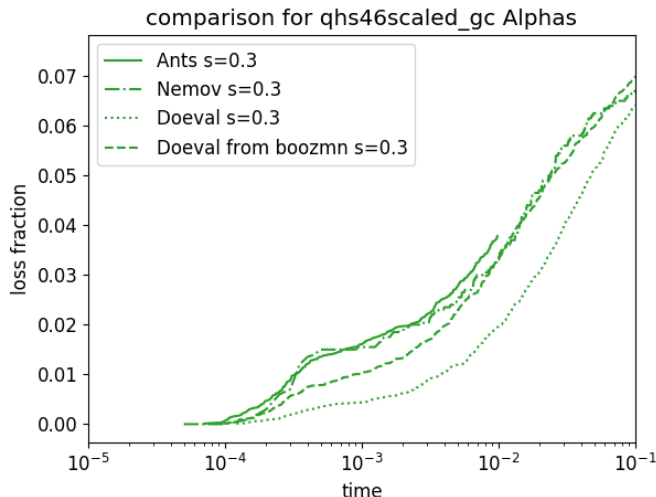


Comparison of ANTS and DOEVAL



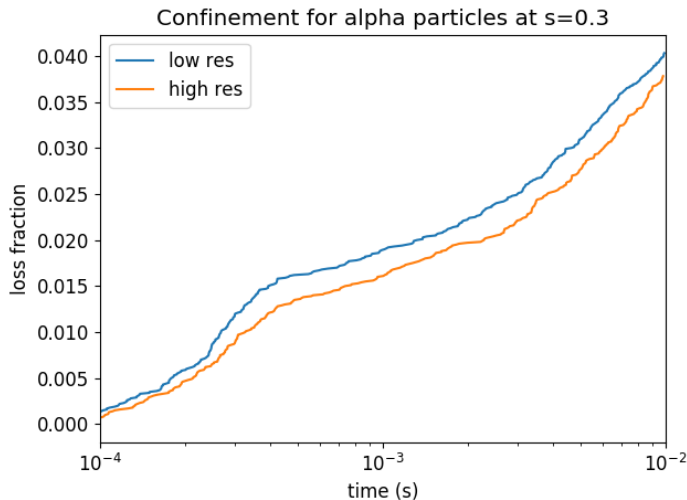
DOEVAL1 - uses VM2MAG. DOEVAL2 - uses B00Z_XFORM

Long time scale comparison with `alpha_lifetime`



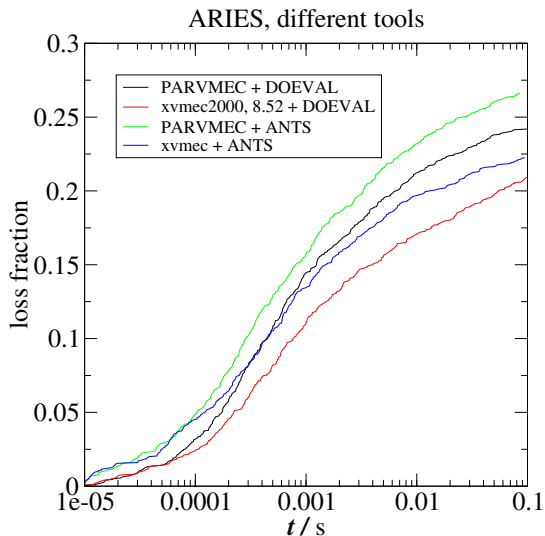
`alpha_lifetime` agrees closely with ANTS on short time scales,
and agrees closer to DOEVAL + BOOZ_XFORM on longer time scales

Resolution of the grid in ANTS



High resolution includes $2E7$ points. Grid size is 1.2 GB. Difficult to go much further without improved data formats.

VMEC and PARVMEC produce different results!



Plot from Michael Drevlak using an optimized ARIES result, showing differences between calculations with VMEC and PARVMEC.

Codes disagree for certain configurations

- In certain configurations there is some divergence in the particle confinement
- Other configurations produce good agreement
- VM2MAG tends to produce results that are more significant outliers
- All results for the paper have been re-calculated with high resolution ANTS
 - None of the main conclusions appear to change
 - Differences between VMEC and PARVMEC really need to be tracked down, those are troubling