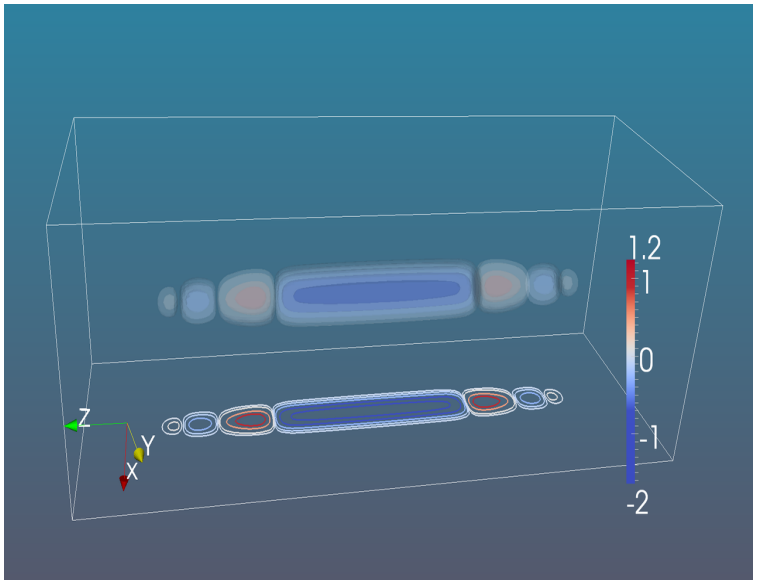
MADNESS-HFB: High Accuracy and Scalable Nuclear DFT Solver for Complex Geometries

Objectives

- Apply state-of-the-art scalable and adaptive computational tools to describe many-body nuclear and atomic problems involving complex geometries within the superfluid density functional theory
- High-order adaptive spectral approximations are used with an Object-Oriented solver environment to reduce simulation uncertainties and numerical errors

Impact

- Enable rigorous computational predictive modeling in complex physical systems in large and asymmetric domains
- Model verification of experimental results



The local 3-D pairing density for a HFB cold-fermion simulation computed by MADNESS-HFB is shown. The transversal oscillations of the pairing field are indicative of the Larkin-Ovchinnikov phase. The simulation used a box of width 320 fermis.

Accomplishments 2012

1. Solved the Hartree-Fock-Bogoliubov equations describing ultracold superfluid Fermi systems
2. Benchmarked in 3-D with 2-D spline based 2-D axial spline solver HFB-AX.
3. MADNESS-HFB is faster and scales better using more processors HFB-AX.

Reference: Pei, Fann, Nazarewicz, et. al., J. Phys. Conf. Series **402** (2012) 012035

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