BLUE WATERS
SUSTAINED PETASCALE COMPUTING

Allocation: GLCPC/275 Knh
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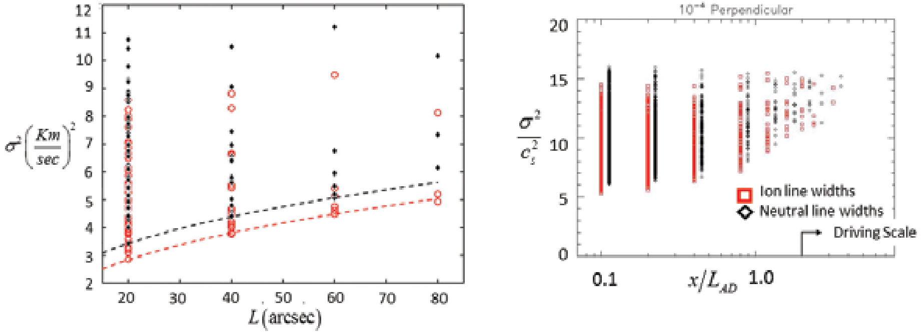
SIMULATING TWO-FLUID MHD TURBULENCE IN STAR-FORMING MOLECULAR CLOUDS ON THE BLUE WATERS SYSTEM



Left: Observed velocity dispersions as a function of length for the HCN molecule (black) and the HCO+ ion (red). The velocity dispersion in the ions is lower than that in the neutrals. Right: Shows simulated linewidth-size relationship from simulations.

Research Challenge

Larger simulations of Two-Fluid MHD turbulence in star-forming molecular clouds are needed to match the observations from the HAWC+ instrument. The simulations are extremely CPU-intensive, and only simulations with very limited resolution (5123 zones) are currently manageable. At the present resolution, we will be unable to match the observations from HAWC+. With current simulations, NASA's investment in HAWC+ will be in vain because the detailed match between simulations and observations will not be possible. The work on this newly funded grant will rectify this situation.

Methods & Codes

The core MHD algorithms in our RIEMANN code are based on higher-order Godunov schemes. The research team has been on the forefront of the effort to develop high accuracy schemes for computational astrophysics in general and computational MHD in particular. Two-fluid methods have been described in the references.

Results & Impact

This project is newly funded and is in its initial stages where large-scale simulations have been planned and are ongoing on Blue Waters. Several papers have been published by our group using lower-resolution simulations. The new work will be a substantial improvement on our previous work in terms of resolution as well as in the details of input physics and accuracy of simulation code.

Why Blue Waters

This group has also simulated at petascale on Blue Waters via the Great Lakes Consortium for Petascale Computation. We are, therefore, extremely familiar with the Blue Waters system. The PIs are also funded via NSF grant DMS-1622457 to develop computational capabilities for turbulent simulations in computational astrophysics. This newly funded proposal will provide us with the impetus for developing petascale-ready simulation tools for astrophysical turbulence and making them freely available to the greater astrophysics community.