ISSAC 2013 **Workshop worksheet**

1. **Tutorial.** To get familiar with the Athena code, work through each step of the online tutorial at `https://trac.princeton.edu/Athena/wiki/AthenaDocsTut`

2. **Shock-cloud interaction.** You can learn much from watching the evolution of shocks in multidimensions. The interaction of a strong shock with a spherical cloud is a good demonstration. This problem consists of a Mach 10 planar shock which over- runs a sphere (actually, an infinite cylinder in 2D) with a density 10 times larger then the background. Configure the code with
`configure --with-order=3 --with-flux=roe --with-gas=hydro --with-problem=shk_cloud`.
Run the problem using the `/tst/2D-hydro/athinput.shk_cloud`. Animate the resulting density (.ppm) images and see what happens. Try increasing the resolution as much as you can afford and see how this affects the dynamics, and dump movies of the other variables (especially useful is the pressure) by adding more `<output>` blocks to the input file using the .ppm image format. At early times, you should be able to identify the reflected and transmitted shocks near the leading edge of the clouds. At later times, the incident shock refracts around the cloud and interacts with itself, producing strong vorticity. At even later times the cloud is shredded by instabilities as it is advected off the grid. See if you can spot all these features.

3. **Applications.** Once you are familiar with running the code and analysing the output, try a more complicated application. For large problems, you will need to use MPI. Suggestions include (1) the shock-cloud interaction problem in 3D, (2) driven or decaying MHD turbulence in 2D and 3D (problem generator is `athena/apps/turb.c`), (3) a 3D unstratified accretion disk in cylindrical coordinates, following the description in Sorathia et al. (2012) (problem generator is `athena/prob/hkdisk.c`), or (4) a 3D MHD simulation of the MRI in the shearing box approximation (problem generators `athena/prob/hgb.c` or `athena/prob/strat.c`). Feel free to write your own problem generator to try your own application. Some of the problem generators have not been used in many years and may no longer be compatible with the current version of the code, so some work will be required to get each to compile and run. Feel free to ask questions!