Running Time Test of the 3D pnStudy Module on BlueHive Cluster

Baowei Liu

July 10, 2015

1 Abstract

This is running time report for AstroBEAR with 3D pnStudy module on 120 cores of BlueHive. It includes a simple introduction of the BlueHive system, the set up of the test and the test results for runs with different resolutions. Hopefully this will help to estimate the running time or computing resources for the same code to do production runs with different resolutions, on different number of processors or other machines.

2 BlueHive System

Here's some basic specifications of the BlueHive nodes used for the test:

- Each node has 2 intel Xeon E5-2695 v2 processors (2.4 GHz, 30M Cache) with 12 cores each.
- Each node has 64 - 512 GB memory
- The computing nodes are connected with FDR10 Infiniband interconnect

Since there are many users on BlueHive system, each node may have many different jobs running on it. And each job are not limited to run on the cores of the same node. For example, a job reqesting for two cores may get one core from one node and another code from a different node..

3 Setup

The running time depends on how the grid refinement is done as well as how many cores you run the job. A good refinement scheme (which means the finest grids only happen in the most important areas) could make the code run several times faster than a poor one. In this test I use a grid refinement as shown in Fig. 1 which may not be the case when doing productions runs. The resolution for the test is 32^3 with 4 or 5 levels of AMR refinement (equivalent to 8 or 16

zones per radii). The 3D data files are modified from a 2D production run and only run a very short time (about 3 years if put in Astrophysics unit while we usually need to run about 600 years in production runs).

Here's the main parameters in the global.data and problem.data for the test:

```
!! global.data
nDim = 3 ! number of dimensions for this problem (1−3)
GmX = 32,32,32 ! Base grid resolution [x,y,z]
MaxLevel = 4 ! Maximum level for this simulation (0 is fixed grid)
GxBounds = −32d0,0d0,−32d0,32d0,64d0,32d0
...
start_time = 0d0
final_time = 0.0404d0
final_frame = 101 ! The final frame [10]
lRestart = T ! restart flag [F]
restart_frame = 100 ! The frame from which restarts should be
```

```
!! problem.data
tamb = 1d3 ! ambient temp, 1cu = 0.1K (100K=1000cu)
namb = 4e3 ! ambient density in cell above lunch surface. 1cu = 1cm^−3
stratified = t ! true = add a 1/r^2 background 'AGB stellar wind'
torus = f ! true − add torus to the background
...
outflowType = 2 ! TYPE OF FLOW 1 cyl jet, 2 conical wind, 3 is clump
njet = 4d2 ! flow density at launch zone, 1cu = 1cm^−3
Rjet = 1d0 ! flow radius at launch zone, 1cu = 500AU (or clump radius)
vjet = 2e7 ! flow velocity , 1cu = cm/s (100km/s=1e7cu)
tjet = 1d3 ! flow temp, 1cu = 0.1K (100K=1000cu)
```

4 Test Results

Based on our experience, the current AstroBEAR code has a very good scaling performance up to at least 1,200 cores and good scaling performance up to 10,000 cores. In Fig 2 we show that the 3D pnStudy module also has a good strong-scaling result which agrees with our other scaling tests.

In Table 1 we show the running time for the test and the estimated running time for production runs for different resolutions on 120 cores. The table can be used to estimate the running time on different number of cores or on other machines assumming the code has a perfect strong scaling.

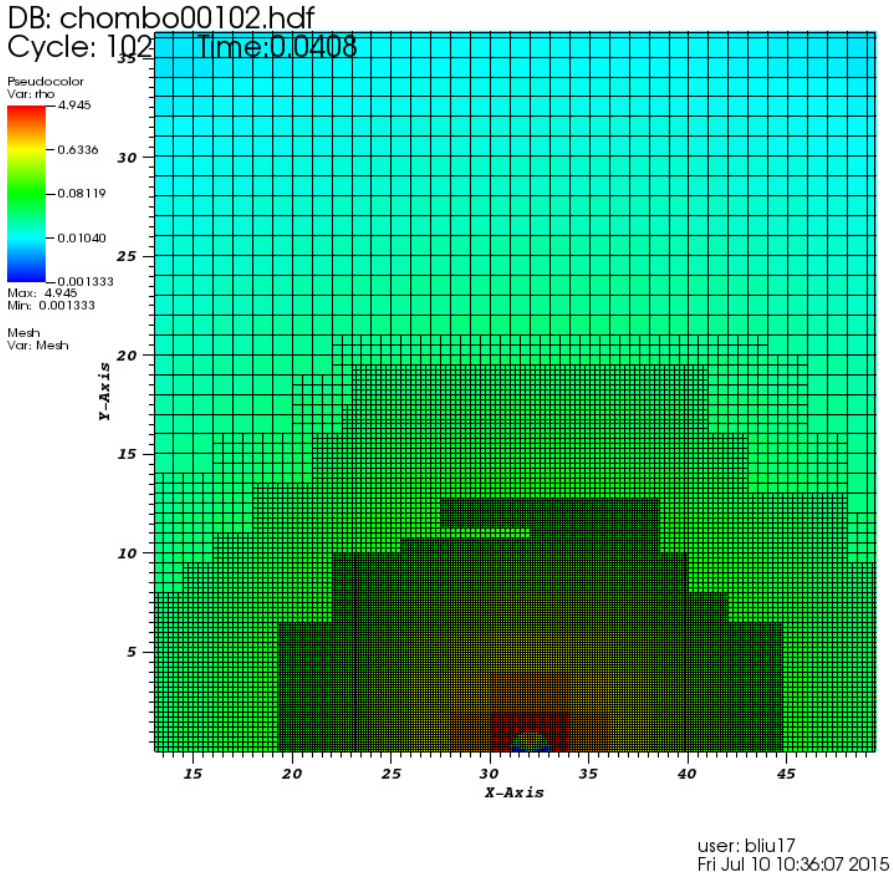

Figure 1: Mesh grid (2D slicing) of the strong scaling test for AstroBEAR with 3D pnStudy module. $R_{jet} = 1$. The resolution for this run is $32^3 + 4$ levels of AMR, Or 8 zones per radii

Table 1: Estimated running time for production runs of 3D pnStudy module for different resolutions on 120 cores on BlueHive cluster

Resolution	AMR	Test Running Time (3y)	Estimated Production Running Time (600y)
4 zones per radii	3	17 secs	$\sim$ 1 hour
8 zones per radii	4	35 secs	$\sim$ 2 hours
16 zones per radii	5	215 secs	$\sim$ 12 hours

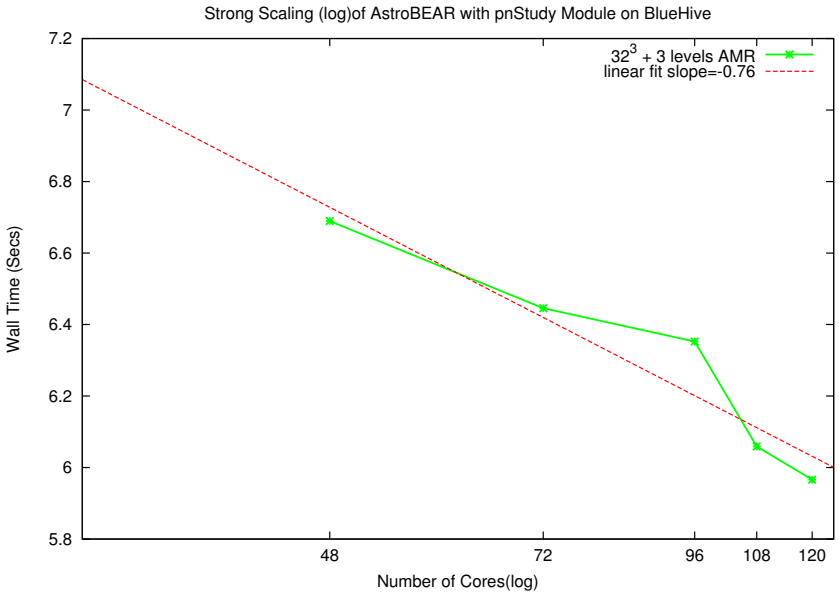

Figure 2: Current strong scaling behavior for AstroBEAR with 3D pnStudy module on BlueHive.This is a rough testing result which including the IO time. It shows a good scaling (slope=-0.77 while the perfect scaling has slope=-1). This agrees with the previous scaling test results with othe modules. Generally speaking the AstroBEAR code has a good scaling up to 1200 cores.