Project Title:

Supernova remnants: from the explosion to the interstellar medium

Name: Gilles FERRAND

Laboratory at RIKEN: Cluster for Pioneering Research, Astrophysical Big Bang Laboratory

---

１．Background and purpose of the project, relationship of the project with other projects

This project is about supernova remnants (SNRs), which are the final stage of evolution of some stars, and as such are key in the cycle of matter in the Galaxy. The aim is to reveal the mechanisms that shape SNRs, from their generation in a supernova explosion to their dilution in the interstellar medium. I want to elucidate how different explosion engines produce different SNRs, and how SNRs interact with their environment – and how these effects play together. This study requires the use of 3-dimensional simulations to properly reproduce the SNR geometry.

This project is complementary with other research done in my laboratory, on SNRs and more generally on explosive phenomena.

２．Specific usage status of the system and calculation method

The main point of the project is to use realistic supernova models in 3D (obtained from colleagues in Germany and in Japan) as inputs for my own SNR simulations.

To do this, I had mainly been using the computer clusters of the iTHEMS program, while doing complementary tests on Hokusai / BigWaterfall. This FY I have started to rely more on this more powerful machine, with >150,000 CPU hours used to study the D6 SN model in more details.

３．Result

In the first steps of the project, we have shown how the imprint of the SN can be seen on the young SNR, and that different SN models produce different remnants. With the new, ongoing simulations, we have calculated the ionization state and the thermal emission of the shocked plasma. We are working with different other groups in order to make a comparison of our model predictions with observations of young galactic SNRs.

４．Conclusion

The project of making the link between supernova studies and remnant studies has been successful, and is opening new perspectives on both sides.

５．Schedule and prospect for the future

The schedule of the project is uncertain due to end of primary employment at RIKEN. A computer like Hokusai would be useful for the future of the project, in particular to increase the spatial resolution. The current simulations have been done at moderate resolution of 256^3. Now that we have some good models, we may re-run them at higher spatial resolution of maybe 1024^3.