Usage Report for Fiscal Year 2018

Project Title: Supernova remnants: from the explosion to the interstellar medium

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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 to reach a complete understanding. Because of the complex multi-scale physics involved, this study requires the use of state-of-the-art numerical simulations. In particular they have to be 3-dimensional to properly reproduce the SNR geometry.

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

2. Specific usage status of the system

The main focus of the project so far has been to use realistic supernova models (obtained from colleagues in Germany) as inputs for the SNR simulations.
To do this, I have used the local computer cluster of the iTHEMS project, which was upgraded last year. It is smaller then Hokusai but was sufficient for this phase.
On Hokusai I have only done a few simulations, to check the results and to test the system.

3. Result

4. Conclusion

5. Schedule and prospect for the future

The first phase of making the link between the supernova and the supernova remnant is complete. The software pipeline is in place. The first results have shown the validity of the approach.
The project has good perspectives, and the next steps shall make more use of Hokusai:
- The simulations so far were hydrodynamics only. Next we will compute the ionization state and thermal emission of the supernova ejecta, to compare with X-ray observations. Because of the need to follow the individual species, this will require more memory. The new BigWaterfall computer will be good for this thanks to its larger memory per core.
- The simulations were made for only one SN explosion model. Next we will re-do the simulations and analysis for the complete grid of SN models from our collaborators. Since there is 14 such models (and only for this set of models, there are other kinds), this will require more computing time. Hokusai will be helpful thanks to its larger number of CPUs.