様式２

，（2014 年 2 月改定）

滞在型研究員報告書

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１．滞在型研究員として国立天文台滞在中に行った活動について簡単にお書きください。

I mainly worked on the light element synthesis in supernovae via neutrino-nuclear reactions. I had discussions with Prof. Kajino in NAOJ, and Prof. Kim in Korea Aerospace University, Prof. Cheoun and Dr. Yang in Soongsil University who were visiting NAOJ during my stay. In the discussions, we learned effects of neutrino oscillation in supernovae on production of Li and B. We then understood why we can estimate parameters of neutrinos from meteoritic light element abundances. In this collaboration we aim to calculate yields of light elements in supernovae with wide ranges of masses and initial metallicites. Then, I explained a strategy for the numerical calculation to collaborators.

We should mainly take into account two items in order to complete constructing a numerical code for supernova nucleosynthesis. One is import of time evolutions of radius, density, and temperature of supernova mass coordinate mesh points. The data of the time evolutions will be given by hydrodynamic calculation for explosion. The calculation is undertaken by Dr. Ko Nakamura in Waseda University, and is now under way. Another is an effect of neutrino oscillation on neutrino energy spectra. I consulted Dr. Kawagoe in University of Tokyo on a numerical treatment of the oscillation effect. We carried forward this project on supernova nucleosynthesis communicating with Dr. Nakamura and Dr. Kawagoe during this stay.

In addition, I had a discussion on effects of possible atomic processes on big bang nucleosynthesis with Prof. Kajino, Prof. Balantekin in University of Wisconsin, Madison, and Prof. Hagino in Tohoku University who were visiting NAOJ. Previously, we calculated binding energies of nuclides and long-lived exotic charged massive particle (X^-), and recombination rates of nuclides and X^-. I learned from Prof. Hagino that more sophisticated calculations such as the

coupled-channel calculation may result in different values of recombination rates. Precise calculations are important since the rates affect primordial ^{7}Li abundance in the big bang nucleosynthesis model with the X^- particle. Therefore, the precise calculation is an interesting future work.

Moreover, I taught Mr. Sunaga, who is a graduate student and was visiting Prof. Kajino during my stay, a big bang nucleosynthesis code. He is going to investigate effects of possible resonances of light nuclides on big bang nucleosynthesis in future. I explained how to establish a Linux environment in his Windows laptop, run a big bang nucleosynthesis code, and plot figures.

２．今回滞在型研究員として得られた成果について簡単にお書きください。

We are in construction of a numerical code for light element synthesis via supernova neutrino process. During this stay I improved the code by correcting errors and adding explanations in the code to make the code reader-friendly. Then, I distributed the code as well as its brief user instruction to Dr. Yang and Dr. Nakamura. In this code, a main structure for calculation of supernova nucleosynthesis has already been constructed, and 1101 nuclides and 14255 nuclear reactions and beta-decay have been taken into account. Nucleosynthesis can then be calculated by solving nuclear rate equations. The reaction rates from the latest version of JINA Reaclib database (V2.0, 2014) have been built into the code. For the moment, phenomenological simple time evolutions of density and temperature are assumed, and neutrino effects are not included. During this stay, I also started to make routines for neutrino oscillation, and am still working on that. After the two items described in the last box in this document are addressed, we will obtain final results of supernova nucleosynthesis.

３．この制度について何か御意見がありましたら、お書きください。

I appreciate the NAOJ very much for supporting such an excellent exchange program. I sincerely believe that this provides substantial enrichment for both parties, and is an excellent pillar of supporting science, beyond institutional and specific-project funding. Shaping a community of scientists who can communicate well and stimulate each other is a necessity, and this program is a very effective complement to conferences on one end and sabbaticals or other long-term visits on the other end.