Activity Report of the NAOJ Visiting Scholar Program

 Host Project/Division:
 JASMINE project
 Name of Host Scientist: Takuji Tsujimoto

 Name of Visiting Scholar:
 Gerhard Hensler

 Title:
 Visiting Professor

 (Choose the appropriate one)

 Period:
 from 2015/04/10 to 2015/05/20 & from 2015/10/07 to 2015/11/25

I. Report from the visiting scholar

[i] Achievement during the period of stay (in comparison with the initial plan)

(Collaborative Research)

The originally envisaged and planned collaborative research topics listed in the application were numerous and various and were aimed at serving as the basis of possible collaborations. During my visits I approached several groups and staff members at NAOJ and other Japanese universities. The following topics were targeted as joint collaborative projects and discussed in multiple meetings. The research activities are set up for a longer term and will be continued for the next years.

In chemo-dynamical galaxy models of the visiting professor and his group a dependence of N/O-O is detected, namely, that for large supernova energy efficiencies the abundances of extremely metal-poor halo stars can be reproduced, while for 1% only dwarf galaxies (DGs) are fitted. This issue will be elaborated under two aspects:

1. With the host Prof. Takuji **Tsujimoto** the possibility of a scatter in the element production by different stellar mass ranges was discussed as well as an observational strategy to relate the gas mixing with supernova (SN) type II energies. We also inspected possible observational signatures in Milky Way dwarf satellite galaxies as consequence of the gas-phase mixing efficiencies.

2. That chemo-dynamical models with extremely efficient gas-phase mixing reproduce the N/O-O abundances of extremely metal-poor Milky Way halo stars more appropriately was also discussed with Prof. Wako **Aoki** but without coming to a clear conclusion so that this exploration is still under debate.

Another aspect from chemo-dynamical DG models shows that the abundance ratios of Mg/Fe can become largely subsolar in agreement with observations of Milky Way satellites and also of large N/O ratios in some gas-rich DGs. Whether this observational signature is pointing towards different yields of alpha elements by metal-poor stars or is caused by differences in the SNe II-to-Ia enrichment processes was discussed among us (**Hensler, Tsujimoto, Aoki**).

Since the star-formation rate in dwarf irregular galaxies is low, differences between Halpha- and UVderived rates could be explained by a top-light stellar mass function. Direct spectral observations of DG star clusters and applied population synthesis can shed light on the mass function. The visiting professor and his host studied the consequences of lacking massive stars and, by this, the reduction of their element yields. Dedicated spectral observations of giants in low-mass faint nearby satellite galaxies distinguishing between tracer elements from intermediate and massive stars are planned and the inspection of existing spectra is on the way. For this purpose we identified e.g. barium and magnesium as ideal tracer elements, respectively.

One of my further active research topics deals with gas infall into galaxies under two aspects. At first, the passage of infalling gas clouds through hot galactic halo gas must have dynamical and thermal effects on the clouds. I presented our numerical and analytical models. Moreover, how infalling gas clouds interact with gas disks in galaxies is a yet less explored problems. Not only the trigger of star formation in disk regions where star formation should be prohibited from stability analyses, but also chemical peculiarities in star-forming sites are postulated. With Prof. **Naoto Kobayashi** and his team at NAOJ and University of Tokyo we discussed their observations and possible observational strategies according to the models of element abundances in HII regions where the star formation is triggered by the collision of a primordial gas cloud with the gas in a galactic disk.

On a visit to Hokkaido University in Sapporo I presented in a talk on DGs the effects of star-formation self-regulation and discussed this issue intensively with Prof.s Elisabeth **Tasker** and Asao **Hab**

(Education)

Concerning education and dissemination of my research projects I intensively contributed by frequent seminar presentations as listed below which are also aimed at triggering and boosting cooperation with Japanese colleagues:

1) NAOJ seminar on "Dwarf Galaxies as ideal laboratories to study astrophysical processes", May 8, 2015;

2) Seminar on "The Shape and Survival of High-velocity Clouds", May 19, 2015, at Tokyo University;

3) Colloquium on "The early Evolution of the Milky Way Satellite System in LCDM cosmology", May 14, 2015, at Kavli IPMU Tokyo by invitation of Prof. Ken **Nomoto**;

4) A presentation about "Gas infall to galaxies and its trigger of star formation and chemical peculiarities in HII regions" was given in a group seminar of Prof. Naoto Kobayashi (NAOJ and Univ. of Tokyo) and his collaborators in November 11, 2015;

Further presentations were given at institutes where collaborations with members already exist:

5) At University of Hokkaido, Sapporo, a talk on "Dwarf Galaxies as ideal laboratories to study astrophysical processes", October 15, 2015, was presented and a long-term cooperation with Prof. Dr. Elisabeth **Tasker** continued;

6) On a visit to Yonsei University, Seoul, (November 18 to 20) I gave a colloquium talk on "Stellar feedback in Dwarf Galaxy Evolution", November 20, 2015, where a joint collaboration with Dr. Rory **Smith** has already led to a co-authored publication (paper 1 below).

(Others)

A trip to the KIAA at Peking University, China, was undertaken (November 22-25) to discuss the collaborative project of the chemo-dynamical modelling of DGs with Prof. Rainer **Spurzem**, Dr. Peter **Berczik**, and one of my PhD students, Matthias **Kuehtreiber**, who stood at KIAA for a 3-months visit.

Since I am responsible for the organization of the next General Assembly of the IAU 2018 in Vienna, during my first visit at NAOJ, I reported to the actual president of the IAU, Prof. Norio **Kaifu** about the state of the preparations in Vienna.

On my second visit, I therefore also joined the Office of Astronomical Outreach (OAO) of the IAU hosted at NAOJ and discussed with Dr. Sze-leung **Cheung** and the OAO team the request to public outreach activities during this GA 2018 in Vienna.

[ii] Any comments on this program

The program of NAOJ to invite and host senior researchers as visiting professors is very promising. I gratefully acknowledge the hospitality by Prof. **Tsujimoto** and his colleagues and the always friendly atmosphere. The kind support of all staff persons at NAOJ, in particular, the Support Desk and the administrative ladies responsible for the guest affaires were very helpful. I gratefully appreciated it.

The very kind invitation and the generous salary by NAOJ made the length of my visit possible, which is necessary to initiate collaborations and to deepen existing joint projects. Last but not least, the accommodation at Cosmos Kaikan was extremely convenient.

I am looking eagerly forward to further strengthen the contact with the NAOJ colleagues and to successfully continue the cooperative projects.

[iii] List of publications and presentations by the visiting scholar in collaboration with NAOJ staff or graduate students

Since the visit was too short to accomplish the projects that could be started at NAOJ and to publish results of the collaborations, here we can only mention publications by the visiting professor written or co-authored during the visits at NAOJ and including the affiliation of the NAOJ:

1) Smith, R., Sanchez-Janssen, R., Beasley, M.A., et al. (HENSLER, G.): The Sensitivity of Harassment to Orbit: Mass Loss from Early-Type Dwarfs in Galaxy Clusters, 2015, MNRAS, 454, 2502

2) Boselli, A., Cuillandre, J.C., Fossati, M., et al. (HENSLER, G.): Spectacular tails of ionised gas in the Virgo cluster galaxy NGC 4569, 2016, Astron. Astrophys., in press

3) HENSLER, G., & Petrov, M.: The early gaseous and stellar mass assembly of Milky Way-type galaxy halos, 2016, in "The General Assembly of Galaxy Halos: Structure, Origin and Evolution", eds. A. Bragaglia & M. Arnaboldi, Proc. IAU Symp. No. 317, in press

Ⅱ. 以下の項目について、受入教員が記入してください。

Report from the host scientist

[iv] 本制度に対する意見、	要望など
Any comments on this program	
本プログラムのおかげで、	共同研究を飛躍的に進歩させることができたことを深く感謝致します。成果
をしっかり論文としてまと	め、将来再度このプログラムを是非利用させて頂きたいと思います。
ありがとうございました。	