

**Research Report**  
**ICRR Inter-University Research Program 2019**

Research Subject: Study of supernova neutrinos in Super-Kamiokande

Principal Investigator: Michel Gonin (Ecole polytechnique universite paris-saclay)

Participating Researchers:

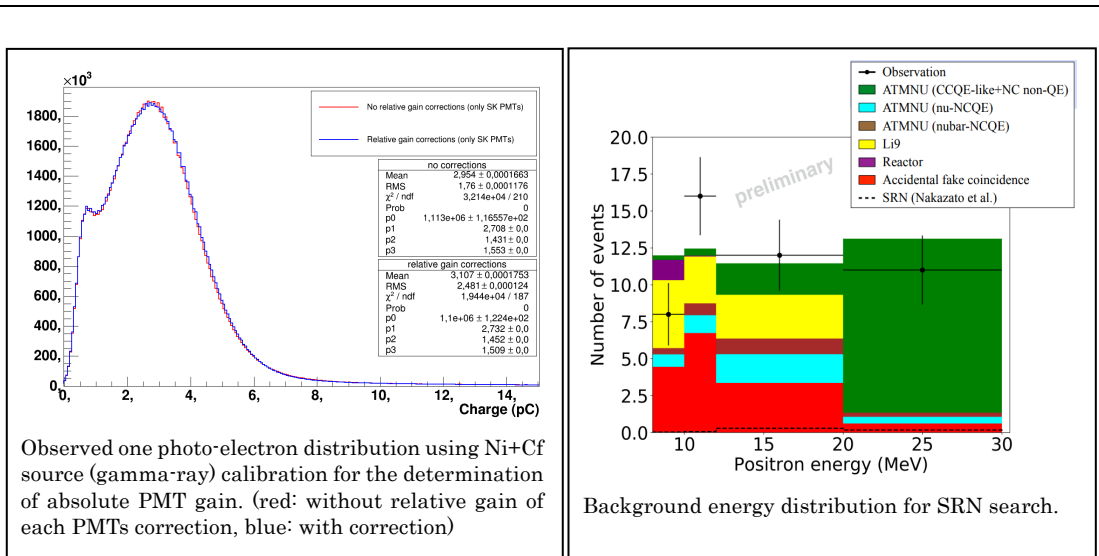
Ecole polytechnique universite paris-saclay: Alice Cofani, Oliver Drapier, Sonia El-Hedri, Thomas Mueller, Pascal Paganini

Okayama University: Yusuke Koshio, Shintaro Ito, Kaito Hagiwara, Nishtha Piplani, Masayuki Harada, Toshiaki Horai, Seiya Sakai

Summary of Research Result :

The purpose of this research is detection of the supernova neutrino in SK-Gd. There are two targets, one is neutrinos from nearby supernova explosion, the other is diffuse neutrinos from the past supernovae called 'Supernova Relic Neutrinos (SRN)'. The SK-Gd project is gadolinium loading into Super-Kamiokande (SK) to increase inverse beta decay interactions of anti-electron neutrinos. In the latter half of 2018, the SK group did the refurbishment works of the SK tank. Due to this work, we confirmed that the water leak completely stopped and ready to gadolinium loading. Just after refurbishment works, at first, we resumed pure water operation as SK-V phase from February, 2019. In FY 2019, our group performed the several detector calibration works, especially, a measurement of absolute gain calibration (left figure in the next page) and quantum efficiency measurement of each PMTs. For the preparation of the gadolinium loading, our group measured the amount of radio-active background in the gadolinium sulfate, and the result was published as listed. As for the SRN analysis in SK-IV phase, which used pure water, we developed a brand-new neutron tagging algorithm and estimated the background events caused by atmospheric neutrinos. (right figure in the next page)

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### Presentations

- [1] Y. Koshio, Status of SK-Gd., Multi-dimensional Modeling and Multi-Messenger observation from Core-Collapse Supernovae (4M-COCOS), Fukuoka, Japan, Oct. 22, 2019.
- [2] S. Ito, JPS meeting, SK-Gd プロジェクト: SK-Gd の準備状況と将来計画 (日本語), JPS meeting, Yamagata university, Japan, Sep. 17, 2019.

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