【Grant-in-Aid for Specially Promoted Research】

Science and Engineering

Title of Project : Nuclear Emulsion - New deployments for fundamental and interdisciplinary researches in the 21st century -

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Research Project Number : 18H05210 Researcher Number : 90183889
Keyword : Nuclear Emulsion. elementary particle physics, Astronomy, Muon radiography

【Purpose and Background of the Research】

Nuclear Emulsion, which has a history of about 100 years, is still contributing to the progress in elementary particle physics by the discovery of Tau-neutrino and the discovery of Tau-neutrino appearance in neutrino oscillation. Adding to those, applications to interdisciplinary researches are rapidly extending. Examples are Muon radiography (e.g. discovery of a big void in Khufu Pyramid) and balloon born large aperture Gamma-ray telescope.

Those movements are realized by fully automated nuclear emulsion read-out system developed by us and the lab-made nuclear emulsion also developed by us from 2010. The latter has a meaning to take back still-worth technical resources from the company to the university dealing with the market shrinkage, and to give additional values through new developments.

In this research project, we will develop an automated nuclear emulsion read-out system which has ~40times faster scanning speed than the current system, a nuclear emulsion film production system which can deal with 10000m^2/year and adding new features to nuclear emulsion. Those developments will push forward strongly the currently running and coming researches in the region of fundamental and interdisciplinary researches.

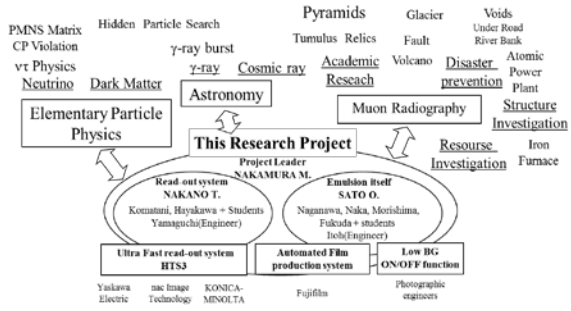

Fig1. This research project and the related research regions.

【Research Methods】

① R&D of 40times faster read-out system by adopting slant optics.

② R&D of automated emulsion film production systems to deal with 10000m^2/year level request.

③ Preparation of the gel production recipe database to give the best solution to a specified purpose. Realization of low background nuclear emulsion and sensitivity ON/OFF function.

【Expected Research Achievements and Scientific Significance】

In the field of elementary particle physics, application to interdisciplinary research region becomes important in parallel with the search for the phenomena beyond the established standard model. As we have nothing in the energy frontier until today. We must extend the frontier to any possible directions, neutrino research at where the first break of the standard model was found, the intensity frontier to explore the hidden sectors. Also dark matter is the subject beyond the standard model. NINJA@JPARC, DsTAU & SHiP@CERN and NEWSdm@LNGS are the related emulsion projects.

Relating to the application, discovery of new structures in Khufu Pyramid by muon radiography shows how the technologies developed for particle physics can shed new light on the interdisciplinary field. In the region of astronomy, nuclear emulsion can realize a balloon born γ ray telescope with 10times larger aperture and one order finer resolution than Fermi satellite.

In those interdisciplinary researches, repeat of "try and error" is very important. Nuclear emulsion can lower the barrier of "try and error", by its low cost, easily accessible tools for detector production and analysis. Also its scalability will allow easy project extension.

The outputs from this research project will become a powerful motive force to push forward the fundamental & interdisciplinary researches.

【Publications Relevant to the Project】

・"Expanding Horizon of the Nuclear Emulsion Applications", Journal of the Society of Photographic Science and Technology of Japan, Vol 71, No5, 2008 (in Japanese).

【Term of Project】 FY2018-2022

【Budget Allocation】 455,400 Thousand Yen

【Homepage Address and Other Contact Information】

http://flab.phys.nagoya-u.ac.jp/2011/