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Development of magnetic resonance imaging (MRI) system using beta-NMR technique

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Today, the technology of magnetic resonance imaging (MRI) has been established and it is essential in the medical field. MRI is the method of making an in-situ image by utilizing nuclear magnetic resonance (NMR). However, the MRI technique has rarely been put to practical use for elements other than hydrogen because of the sensitivity issue. On the other hand, the technique of beta-ray-detecting NMR (beta-NMR) makes it possible to observe NMR for various elements with extremely high sensitivity by measuring the asymmetry of the beta-ray emission from polarized radioisotopes (RIs). By utilizing beta-NMR, we aim to create a 3-dimensional (3D) MRI system. We have developed a detector set with plastic scintillation fibers, which enables us to track back the trajectory of beta-rays. Moreover, by seeking the beta-ray asymmetry at each position in the sample, we can create a magnetic resonance image. We conducted experiments using a spin-polarized ^{12}B($I = 1, T_{1/2} = 20$ ms) beam at HIMAC heavy-ion synchrotron facility of the National Institutes for Quantum Science and Technology. We obtained the data from various samples of mixtures as well as simple substances. We have successfully obtained a 1D image of the beta-ray asymmetry for ^{12}B in Si. The data analysis for 3D imaging are now in progress.
It is expected that this new technique will be applied to non-destructive and non-contact testing related to various fields such as medical and materials science.
In this conference, we will present our new results of the analyses. We will also show some idea that a combination of beta-NMR and mu-SR will expand this technique.

Primary author: Mr SUGISAKI, Takato (Dept. Phys. Osaka Univ.)

Co-authors: KIMURA, Yoko (Dept. Phys. Osaka Univ.); Mr TAKAYAMA, Gen (Dept. Phys. Osaka Univ.); Dr TANAKA, Masaomi (RIKEN); Prof. MIZOI, Yutaka (Osaka Electro-Communication Univ.); Prof. MIHARA, Mototsugu (Dept. Phys. Osaka Univ.); Prof. FUKUDA, Mitsunori (Dept. Phys. Osaka Univ.); Ms OTANI, Yurika (Dept. Phys. Osaka Univ.); Ms FUKUTOME, Miki (Dept. Phys. Osaka Univ.); Mr TAGUCHI, Ryo (Dept. Phys. Osaka Univ.); Mr CHEN, Sutain (Osaka Univ.); Mr ISHITANI, Soshi (Osaka Univ.); Ms MIYAHARA, Rina (Osaka Univ.); Mr WATANABE, Kaoru (Osaka Univ.); Prof. IZUMIKAWA, Takuji (IRP NiiGata Univ.); Mr NOGUCHI, Norihide (Dept. Fundamental Sciences Niigata Univ.); Mr TAKATSU, Kazuya (Dept. Fundamental Sciences Niigata U.); Prof. NISHIMURA, Daiki (Tokyo City Univ.); Mr TAKAHASHI, Hiroyuki (Tokyo City Univ.); Mr YANO, Asahi (U. of Tsukuba); Ms SEKI, Hibiki (Saitama U.); Prof. OTSUBO, Takashi (Dept. Fundamental Sciences Niigata U.); Prof. MATSUTA, Kensaku (Dept. Phys. Osaka Univ.); Prof. KITAGAWA, Atsushi (QST); Prof. SATO, Shinji (QST)

Presenter: Mr SUGISAKI, Takato (Dept. Phys. Osaka Univ.)

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