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Deep sky survey of MeV gamma rays due to advanced Electron Tracking Compton Camera (ETCC) with balloon experiment

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ETCC with a TPC and scintillators, by measuring electron tracks, provides a strong background rejection by dE/dx of the track and clear imaging by the arc direction of MeV gammas for MeV Gamma Astronomy. In 2006 its background rejection was revealed by SMILE-I balloon using the dE/dx of tracks. In 2013, 30cm-cube-ETCC was developed to catch gammas from Crab in next SMILE-II balloon with $>5^\circ$ for 4 hrs. Now its sensitivity has been doubled to 10° by attaining the angular resolution of the track (SPD angle) to that determined by multiple scattering of the gas. Thus, we show the ability of ETCC to give a better significance by a factor of ~ 10 than conventional Compton Cameras by dE/dx and SPD. Based on this technology, a 40cm-cubic ETCC with CF₄ gas is expected to provide a 5times better sensitivity than COMPTEL in one month balloon, and 50cm-cube ETCCs would exceed over 10-12 ergcm⁻²s⁻¹ (1mCrab) in satellite. Here we summarize the performance of SMILE-II ETCC and its future development.

To verify, SMILE-II was irradiated by intense gammas and neutron by 140MeV proton, and measured both clear image of a weak RI without the efficiency deterioration under 10times stronger radiation than the balloon altitude

Collaboration

SMILE

Summary

TCC with a TPC and scintillators is a new type of Compton camera for MeV astronomy with measuring electron tracks to attain a strong background rejection and clear imaging by the arc direction of gammas. Now we developed 30cm-cube-ETC to catch gammas from Crab in next SMILE-II balloon experiment. Using it, we have revealed its excellent abilities of perfect background rejection and clear imaging using dE/dx and SPD angle obtained from electron tracking, by which actually improved 10times of significance compared with no use of electron tracking. This technology surely enables to access deeper Universe than Fermi (below 1mCrab) by simple extension of our present instrument.

Primary author: Prof. TANIMORI, Toru (Graduate School of Science, Kyoto University)

Co-authors: Dr TAKADA, Atsushi (Graduate School of Science, Kyoto University); Dr TOMONO, Dai (Graduate School of Science, Kyoto University); Prof. KUBO, Hidetoshi (Graduate School of Science, Kyoto University); Dr PARKER, Joseph D (Graduate School of Science, Kyoto University); Prof. MIUCHI, Kentaro (Graduate School of Science, Kobe University); Dr NAKAMURA, Kiseki (Graduate School of Science, Kyoto University); Mr ODA, Makoto (Graduate School of Science, Kyoto University); Dr SONODA, Shinya (Graduate School of Science,

Kyoto University); MIYAMOTO, Shohei (Graduate School of Science, Kyoto University); Mr KOMURA, Shotaro (Graduate School of Science, Kyoto University); Dr KUROSAWA, Shunsuke (Institute of Materials Research, Tohoku University); Mr TAKEMURA, Taito (Graduate School of Science, Kyoto University); Mr SAWANO, Tatsuya (Graduate School of Science, Kyoto University); Mr KISHIMOTO, Tetsuro (Graduate School of Science, Kyoto University); Dr MIZUMOTO, Tetsuya (Graduate School of Science, Kyoto University); Mr MATSUOKA, Yoshihiro (Graduate School of Science, Kyoto University); Dr MIZUMURA, Yoshitaka (Graduate School of Science, Kyoto University)

Presenter: Prof. TANIMORI, Toru (Graduate School of Science, Kyoto University)

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