【Grant-in-Aid for Scientific Research(S)】

Science and Engineering (Mathematical and physical sciences)

Title of Project : Development of multi-pixel microcalorimeters aiming for small scientific satellites

Takaya Ohashi
(Tokyo Metropolitan University, Graduate School of Science and Engineering, Professor)

Research Area : Mathematical and physical sciences

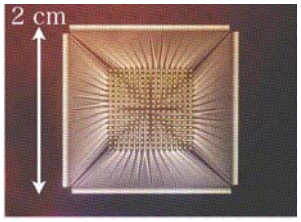
Keyword : X-ray/γ-ray astronomy, Astrophysics (experiment)

【Purpose and Background of the Research】

More than half of the baryons in the present universe are thought to distribute along large-scale structures in the form of intergalactic medium with a temperature of a few million degrees. However, most of the medium is undetected and called as dark baryons. TES microcalorimeters with a wide field of view and energy resolution of 2 eV can detect most of these baryons and reveal their 3-dimensional structure. Dark baryons will bring important information about the thermal and chemical evolution of the universe. The purpose of this research is to develop TES microcalorimeters with 256 pixels along with signal processing system and cooling system, and to build a prototype instrument for a small scientific satellite DIOS. TES calorimeters can measure non parallel beams with about 2 eV resolution, and provide almost ultimate capability in observing extended objects.

【Research Methods】

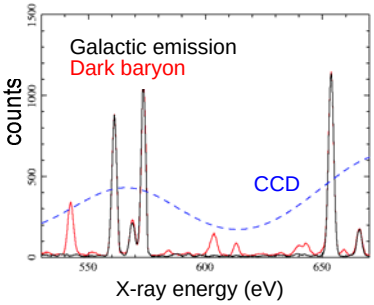
Development of 256 pixel TES calorimeters is the main purpose. We will perform this with our in-house production system. Energy resolutions we have achieved are 2.8 eV for single pixel and 4.4 eV for a 256 pixel device, which is not equipped with X-ray absorbers. By developing efficient X-ray absorbers, we will achieve the good resolution over the entire area. In parallel, SQUID multiplexing and read-out system and adiabatic demagnetization refrigerators will be developed. Prototype detector for DIOS will be produced in 5 years, and this will be further developed aiming at the launch of satellite around 2015. We will carry on international collaboration with US and European groups.



Test model of the TES calorimeter with 256 pixels.

【Expected Research Achievements and Scientific Significance】

This research will produce 256 pixel TES calorimeters for the first time, along with the read-out system, ready for satellite experiment. DIOS will weigh only about 400 kg, however its wide field of view of about 1 degree and the high energy resolution gives a sensitivity for diffuse line emission better than currently planned large X-ray facilities. DIOS can also carry out studies of dynamical motions of large-scale plasmas in supernova remnants, galaxies and in clusters of galaxies. Evolution processes of these systems will be closely examined. Also, the TES technique will provide the basis for future large X-ray missions and various forms of ground experiments.



Expected oxygen lines from dark baryons, measured with TES calorimeters.

【Publications Relevant to the Project】

・Ohashi, T., Ishida, M., Sasaki, S., et al.: DIOS: the diffuse intergalactic oxygen surveyor, SPIE **6266**, 62660G (2006)
・Paerels, F., Kaastra, J., Ohashi, T., Richter, P., Bykov, A., Nevalainen, J.: Future Instrumentation for the Study of the Warm-Hot Intergalactic Medium, Space Science Reviews **134**, 405-418 (2008)

【Term of Project】 FY2009-2013

【Budget Allocation】 86,700 Thousand Yen

【 Homepage Address and Other Contact Information】

http://www-x.phys.metro-u.ac.jp/index.html