Investigation of Interactions between Galaxies and Inter-Galactic Plasmas

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【Outline of survey】

Dark matter in the universe concentrates by its gravity into big clumps, where tens to hundreds of galaxies are confined to form clusters of galaxies. Each cluster also harbors a large amount of hot plasma which emit X-rays. The dark matter, the plasma, and the galaxies contribute to the total mass of a cluster with a ratio of about 90:7:3. The galaxies are moving randomly within the gravitational potential.

The present research aims at observationally demonstrating our novel hypothesis, that "member galaxies of a cluster experience strong magneto-hydro-dynamic interactions when they swim through the plasma, and deposit their kinetic energies onto the plasma. This energy deposit causes heating and particle acceleration in the plasma, while the galaxies fall to the cluster center due to the loss of their energies". This unique hypothesis, developed through our X-ray observations with the *ASCA* satellite, can potentially solve a number of mysteries associated with clusters of galaxies. Toward this goal, we conduct X-ray observations with the new-born X-ray satellite *Suzaku*, and perform optical studies of clusters using the Subaru telescope. Our research also include an effort toward developing new hard X-ray imaging technology.

【Expected results】

We expect the following four outcomes from the present investigation.

1. Using the CCD cameras onboard *Suzaku*, it will be found that the galaxy motion is exiting plasma turbulence, and causing plasma drag and heating.
2. By searching nearby clusters for non-thermal hard X-ray signals using the Hard X-ray Detector onboard *Suzaku*, these objects will be established as particle accelerators.
3. By comparing optical angular extents of clusters observed with the *Subaru* telescope with their X-ray images, evidence will be obtained that the spatial galaxy distribution in each cluster has been shrinking relative to the X-ray distribution.
4. Basic studies of an imaging hard X-ray detector will be accomplished.

【References by the principal researcher】

- K. Makishima, H.Ezawa. Y. Fukazawa and 10 co-authors: " X-ray Probing of the Central Regions of Clusters of Galaxies, Publications of the Astronomical Society of Japan, vol.53, no. 3, p.401-420 (2001)
- K. Makishima and Y. Ikebe："The end of the cooling flow paradigm", The Astronomical Herald (Japan Astronomical Society), Vol.59 January 2004 issue、p.6-18 (in Japanese)

【Term of project】 FY2006－2010	【Budget allocation】13,900,000 yen

【Homepage address】 http://www-utheal.phys.s.u-tokyo.ac.jp/index-e.html