Session:	**[B5A-4] S4 : Galaxies, AGN and Cosmology**
Date:	August 22, 2014 (Friday)
Time:	09:00~10:25
Room:	Room D (Room 105~106)
Chair:	Habib G. Khosroshahi (Institute for Research in Fundamental Science)

[B5A-4-1] **09:00~09:20**

[Invited] Shock Waves and Nonthermal Processes in Clusters of Galaxies

Dongsu Ryu (Ulsan National Institute of Science and Technology, Korea) and Hyesung Kang

Cosmological shock waves result from supersonic flow motions induced by hierarchical clustering of nonlinear structures in the universe. These shocks govern the nature of cosmic plasma through the thermlization of gas, acceleration of nonthermal, cosmic-ray (CR) particles, generation of turbulent flow motions, and amplification of magnetic fields. We present the distribution and properties of shocks formed in cosmological simulations of a concordance LCDM universe, with a special emphasis on those in clusters of galaxies. We show that in a substantial fraction of clusters, shocks with Mach number of several or larger exist in outskirts within and around the virial radius. They are mostly accretion shocks formed by the infalling flows of the WHIM along filaments. With high Mach numbers, the acceleration of CRs is most active at the shocks. We discuss the implications of their existence for the radio and X-ray observations of clusters of galaxies.

[B5A-4-2] **09:20~09:40**

[Invited] Multi-Scale Outflows in Active Galactic Nuclei

Tinggui Wang (University of Science and Technology of China, China)

AGN feedback is thought to play crucial rule in regulating the growth of galaxies as well as supermassive black holes at their centers. Outflows have been detected nearly at all scales and over a wide ionization range of the gas, and thus were considered as one form of such feedback. This talk will focus on physical properties of outflows on parsec to kiloparsec scales as traced by broad and narrow emission or absorption lines, and their correlations with other nuclear properties. We will stress the similarity of outflows on these scales, and propose a continuous outflow in the two regions. We found positive correlations between the velocity of outflow and infrared emission, suggesting a connection between outflows and hot and warm dust on these scales. We emphasize the importance of multiwavelength studies in exploring the nature of outflows.

[B5A-4-3] **09:40~09:55**

Coronal Gas Flow and Its Condensation in AGN Black Hole Disk Accretion

R.E. Taam (Academia Sinica Institute of Astronomy and Astrophysics, Taiwan), B. F. Liu, E. Qiao, and W. Yuan

The nature of accretion is of fundamental interest in the study of supermassive black holes in AGN and stellar mass black holes in black hole X-ray binary systems. The accretion process in these two classes of objects is thought to be similar, however, there are several observational differences that are difficult to interpret within the same framework. We explore, in a simple model, the possibility that the flow in an accretion disk is described by more than one gaseous component, given that the physical state of gas in the central regions of galaxies is characterized by both hot, ionized and cool molecular gas components. As a first examination of this model, we consider the limiting case of the flow of a geometrically thick coronal gas component and study its condensation to a cool gas component in an optically thick accretion disk surrounding a supermassive black hole. For mass accretion rates less than about 0.01 (expressed in Eddington units), condensation does not occur and the accretion flow takes the form of a corona/ADAF. For higher mass accretion rates (> 0.02), it

is found that the coronal mass flow rate decreases and the cool mass flow rate increases with decreasing radius. Here the hot gas partially condenses to the cooler regions characterizing the underlying optically thick disk as it flows towards the black hole. For accretion rates of order 0.1, the mass flow rate of the coronal gas can attain values of order 0.02 in the innermost regions of the disk surrounding the black hole. In this picture, the X-ray emission is increased above that expected for a disk without a significant coronal mass flow, which can help to elucidate the production of strong X-ray radiation and its relative importance with respect to the optical and ultraviolet radiation in high luminosity AGN.

[B5A-4-4] **09:55~10:10**

The Mass-metallicity Relation as Clues to Galaxy Feedback Models

Joo Heon Yoon (University of California Santa Barbara, USA), Crystal L. Martin, and Alaina Henry

The rise in gas-phase metallicity over the critical era when star formation activity plummets at intermediate redshifts provides a key target for cosmological models of galaxy evolution. In such models, suppression of the gas accretion rate allows the equilibrium metallicity to grow while the prescription adopted for the mass loss rate in galactic winds shapes the slope of the mass - metallicity relation below the characteristic stellar mass. We examine the mass-metallicity relation down to $M_{star} = 10^8\ M_{sun}$ at z=0.6-0.7. For precise metallicity measurements, we conduct optical (Keck/DEIMOS) and NIR (Keck/MOSFIRE) observations for 28+45 galaxies. This is the first metallicity measurements for low-mass galaxies at intermediate redshift. Using Hα, Hβ, [OII], [OIII], & [NII] emission lines, we have achieved precise measurements of metallicity, dust reddening, and SFR. Our samples include mass-selected galaxies to test any bias based on emission-line selection. Completion of our observation will provide accurate constraints in the galaxy feedback models in cosmological simulations.

[B5A-4-5] **10:10~10:25**

Apparent Inward Motion of the Parsec-scale Jet in the BL Lac Object OJ 287 Simultaneously with the Gamma-ray Flares during 2011-2012

Satoko Sawada-Satoh (National Astronomical Observatory of Japan, Japan), Kazunori Akiyama, Kotaro Niinuma, Hiroshi Nagai, Motoki Kino, Filippo D'Ammando, Shoko Koyama, Kazuhiro Hada, Monica Orienti, Mareki Honma, Katsunori M. Shibata, and Yuji Ueno

We have carried out frequent monitoring of the BL Lac object OJ 287 in the 22-GHz band from 2010 November to 2012 September using the VLBI Exploration of Radio Astrometry (VERA) telescope array. The 22-GHz light curve of OJ 287 clearly shows three flare events: in 2011 May, 2011 October, and 2012 March, with an activity timescale of < 4 months. The second radio flare event occurred at the same time as the gamma-ray flare detected by the Large Area Telescope on-board Fermi in 2011 October, while the third radio flare seems to precede the gamma-ray flare of 2012 April. This behavior is different from what was observed during the gamma-ray flare in 2009. One jet component moved outward with an apparent superluminal speed of 11 c from 2010 November to 2011 November at a position angle of ~160 degree from North to West, and then it changed direction, moving inward with an apparent superluminal speed of 4 c. The turning point of the jet motion seemed to occur at the same time as the gamma-ray flare in 2011 October. We find a tight connection between an apparent inward motion of the parsec-scale jet and gamma-ray flaring activity seen from 2011 November to 2012 August. Higher resolution images with the Very Long Baseline Array (VLBA) at 43 GHz allow us to detect a new innermost jet component that appeared in 2011 October, simultaneously with the gamma-ray flare. The observed inward motion could be caused by the new jet component unresolved at 22 GHz in the innermost region.