Session:	**[B2A-5] S5 : Compact Objects, High Energy and Particle Astrophysics**
Date:	August 19, 2014 (Tuesday)
Time:	11:00~12:25
Room:	Room E (Room 107)
Chair:	Ronald Taam (Academia Sinica Institute of Astronomy and Astrophysics)

[B2A-5-1] **11:00~11:20**

[Invited] Outflow from Hot Accretion Flows

Feng Yuan (Shanghai Astronomical Observatory, China), Defu Bu, and Maochun Wu

Both HD and MHD numerical simulations of hot accretion flows have indicated that the inflow accretion rate decreases inward. Two models have been proposed to explain this result. In the adiabatic inflow–outflow solution (ADIOS), this is because of the loss of gas in the outflow. In the alternative convection-dominated accretion flow model, it is thought that the flow is convectively unstable and gas is locked in convective eddies. We investigate the nature of the inward decrease of the accretion rate using HD and MHD simulations. We calculate various properties of the inflow and outflow such as temperature and rotational velocity. Systematic and significant differences are found. These results suggest that the inflow and outflow are not simply convective turbulence; instead, systematic inward and outward motion (i.e., real outflow) must exist. We have also analyzed the convective stability of MHD accretion flows and found that they are stable. These results favor the ADIOS scenario. We suggest that the mechanisms of producing outflow in HD and MHD flows are the buoyancy associated with the convection and the centrifugal force associated with the angular momentum transport mediated by the magnetic field, respectively. The latter is similar to the Blandford & Payne mechanism but no large-scale open magnetic field is required. We discuss one observational application, namely the formation of the Fermi bubbles in the Galactic center.

[B2A-5-2] **11:20~11:40**

[Invited] Gravitational Radiation Captures of Two Black Holes

Gungwon Kang (Korea Institute of Science and Technology Information, Korea), Jakob Hansen, Peter Diener, Hee-Il Kim, and Frank Loeffler

We have investigated gravitational radiation capturing processes of two non-spinning equal mass black holes in weakly hyperbolic orbits (e.g., eccentricities of 1.0 ~ 1.4) by solving Einstein equations numerically. In the presence of a supermassive black hole in galactic nuclei, fully general relativistic understandings of such dynamical capturing processes become important to the formation of black hole binaries. We find that most of gravitational wave emissions occur when two black holes encounter closely. This explains why the multipole contributions higher than l=2 are negligible (e.g., about 1%) even if the orbit is quite eccentric or non-quasi-circular. The capturing cross section has been compared with the corresponding 2.5 post Newtonian results. They agree well for small initial energies, but differ up to about 40% for large initial energies. We also analyzed the features of energy and angular momentum radiations and gravitational wave forms.

[B2A-5-3] **11:40~11:55**

Constraining the Magnetic Field in the Accretion Flow of Low-Luminosity Active Galactic Nuclei

Erlin Qiao (Chinese Academy of Sciences, China) and B. F. Liu

Observations show that the accretion flows in low-luminosity active galactic nuclei (LLAGNs) probably have a two-component structure with an inner hot, optically thin, advection dominated accretion flow (ADAF) and an outer truncated cool, optically thick accretion disk. It is found that the truncation radius as a function of mass accretion rate is strongly affected by including the magnetic field within the framework of disk evaporation

model, i.e., an increase of the magnetic field results in a smaller truncation radius of the accretion disk. In this work, we calculate the emergent spectrum of an inner ADAF + an outer truncated accretion disk around a super-massive black hole. It is found that an increase of the magnetic field from β=0.8 to β=0.5 (with magnetic pressure Pm =B2/8π = (1-β) Ptot, Ptot= Pgas+ Pm) results in an increase of ~8.7 times of the luminosity from the truncated accretion disk, meanwhile results in the peak emission of the truncated accretion disk shifting towards a higher frequency by a factor of ~5 times. We found that the equipartition of gas pressure to magnetic pressure, i.e., β=0.5, failed to explain the observed anti-correlation between L2-10 keV /LEdd and the bolometric correction κ2-10keV (with κ2-10 keV = Lbol /L2-10 keV). The emergent spectra for larger value β=0.8 or β=0.95 can well explain the observed L2-10 keV/LEdd - κ2-10keV correlation. We argue that in the disk evaporation model, the electrons in the corona are assumed to be heated only by a transfer of energy from the ions to electrons via Coulomb collisions, which is reasonable for the accretion with a lower mass accretion rate. Coulomb heating is the dominated heating mechanism for the electrons only if the magnetic field is strongly sub-equipartition, which is roughly consistent with observations.

[B2A-5-4] **11:55~12:10**

Mass Accretion Rate of Transonic Rotating Accretion Flow

Du Hwan Han (Kyungpook National University, Korea) and Myeong-Gu Park

We studied how the mass accretion rate of transonic rotating accretion flow depends on the physical conditions of gas at the outer boundary, equation of state of gas, and the viscosity description. The flow with angular momentum much smaller than the Keplerian value has mass accretion rate similar to the classic Bondi accretion rate. However, the flow with significant angular momentum has mass accretion rate much smaller than the Bondi rate. We calculated the mass accretion rate under various equation of state and viscosity description. The implication of the result regarding the growth of supermassive black holes is discussed.

[B2A-5-5] **12:10~12:25**

Accretion-Jet Model for the Hard X-ray Γ-L Correlation in Black Hole Accreting Systems

Qi-Xiang Yang (Shanghai Astronomical Observatory, China), Feng Yuan, and Fu-Guo Xie

We investigate the correlation between the 2-10 keV X-ray luminosity (in unit of Eddington luminosity;) and the photon index of the X-ray spectrum for both active galactic nuclei (AGNs) and black hole X-ray binaries (BHXBs). We make use of the observational data from a large sample and the sources span a wider range of luminosity than all previous works. We find that the photon index is positively or negatively correlated with the X-ray luminosity , for above or below a critical value,. This result is the same for BHBs and AGNs and consistent with previous works. But the correlation slopes are different for different individual sources. Moreover, when, we found, which is more evident in the BHB subsample, that the photon index is roughly independent of the X-ray luminosity. We explain these correlations in the framework of a coupled hot accretion flow-jet model. The hot accretion flow includes the advection-dominated accretion flow (ADAF) and the luminous hot accretion flow (LHAF) when the accretion rates are low and high, respectively. The latter will become into two-phase due to the thermal instability when the accretion rate is higher and may finally evolve into the usual "disk-corona" configuration. The positive correlation is explained as because of the Compton scattering of the seed photons from cold clumps in the two-phase accretion flow, the negative correlation at moderate X-ray luminosity regime is because of the change of optical depth of hot accretion flow. The slope of the negative correlation is a function of the parameter of the hot accretion flow, which describes the fraction of the turbulent dissipation that directly heats electrons. This may be the reason why the correlation slope of different sources are different. At last, the constant at very faint X-ray luminosity regime is because that the X-ray radiation is dominated by the jet rather than the accretion flow.