

our sample have H $\delta$  absorption line profiles that extend well beyond the central kpc. Most interestingly, we found a negative correlation between the H $\delta$  gradient slopes and the fractions of the stellar mass produced during the starburst, suggesting that stronger starbursts are more centrally-concentrated. I will discuss the results in relation with the origin of PSBs.

### [석 GC-11] Properties of Merger-Driven Shocks in Clusters of Galaxies

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Shock waves have been observed in the outskirts of galaxy clusters. They are commonly interpreted as being driven by mergers of sub-clumps, so are called “merger shocks”. We here report a study of the properties of merger shocks in merging galaxy clusters with cosmological hydrodynamic simulations. As a representative case, we describe the case where sub-clusters with mass ratio  $\sim 2$  go through an almost head-on, binary-like merger. Because of the turbulent nature of hierarchical clustering, shock surfaces are not uniform, but composed of parts with different Mach numbers. As merger shocks expand from the core to the outskirts, the average Mach number,  $\langle M_s \rangle$ , increases. The shocks propagating along the merger axis could be observed as X-ray shocks and/or radio relics. The kinetic energy through the shocks peaks at  $\sim 1$  Gyr after shock launching, or at  $\sim 1 - 2$  Mpc from the core. The most energetic shocks are found to have the kinetic-energy weighted Mach number,  $\langle M_s \rangle_\phi \simeq 2 - 3$ , and the CR-energy weighted Mach number,  $\langle M_s \rangle_{CR} \simeq 3 - 4$ . We then discuss the observational implications of our results.

### [구 GC-12] Magnetic fields in clusters of galaxies

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Magnetic fields in clusters of galaxies play a critical role in shaping up the intracluster medium. Their existence has been established through observations of synchrotron emission, especially from radio relics and halos, as well as observations of rotation measure. In the so-called Sausage relic, which is one of Mpc-size giant radio

relics detected in the outskirts of merging clusters, for instance, the magnetic fields are believed to have a few  $\mu\text{G}$  strength and a Mpc scale. The observed magnetic fields are conjectured to be produced by the process of small-scale turbulence dynamo. To investigate the dynamo origin, we simulate the development of turbulence and the follow-up amplification of magnetic fields in galaxy clusters using a three-dimensional magnetohydrodynamical(MHD) code. Turbulence is induced in highly stratified backgrounds expected in clusters, and driven sporadically mimicking major mergers. We here present preliminary results, aiming to answer whether the turbulence dynamo scenario can explain observed magnetic fields in clusters of galaxies.

### [구 GC-13] Statistical Moment Analysis of the Strong DLA Profiles

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Incorporating the fully quantum mechanical computation of scattering cross-section and statistical moment analysis of absorption profiles, we investigate the Lyman line asymmetry of extremely high column density systems. Recent high redshift observations detected strong damped Lyman alpha systems (DLAs) whose column density is larger than  $N_{\text{HI}} \sim [10]^{+21.3} \text{ cm}^{-2}$ . Absorption profiles of these DLAs are characterized by the broad and asymmetric damping wing. For accurate description of radiation damping, the second-order time-dependent perturbation theory is adopted. To quantitatively address line asymmetry, we define a distribution function for each Lyman line, and compute statistical moments (mean, standard deviation, skewness and kurtosis) regarding column densities  $N_{\text{HI}} > [10]^{+18} \text{ cm}^{-2}$ . In this work, we present statistical properties of the intrinsic line profiles, and compare them with the Lorentzian cases.

### [구 GC-14] Revealing the Powering Mechanism of Lyman Alpha Blob via Polarization

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Ly $\alpha$  blobs are mysterious, giant (~100 kpc), glowing gas clouds in the distant universe.

They occupy the dark matter halos that will evolve into the richest groups and clusters today. The blob's gas may be the proto-intracluster medium and their embedded galaxies are considered as the progenitors of massive cluster galaxies. Yet we do not know why Ly $\alpha$  blobs glow. There are evidences of kinematic measurements to exclude shocks and winds from AGN or starbursts as a power source, suggesting that photoionizing radiation or scattering of Ly $\alpha$  photons might be responsible. Polarization mapping can discriminate between these photo-ionization and scattering. Previous results of imaging polarimetry for Ly $\alpha$  nebulae are roughly consistent with scattering models. However the polarization morphologies in those of previous results are all different, motivating our polarimetric survey of Ly $\alpha$  nebulae for the statistically meaningful sample. As initial results of our survey, we present the total polarization map of the LABd05 which has the spatial offset between the peak of Ly $\alpha$  surface brightness and an obscured AGN. We detect the significant polarization in this target with the radially increasing polarization gradient, suggesting that scattering plays major role within this nebula. The polarization pattern is more aligned with the Ly $\alpha$  peak rather than the AGN (the potential energy source), indicating that the Ly $\alpha$  photons are originated from the region near the peak of Ly  $\alpha$  intensity.

### [구 GC-15] Impact of Lyman alpha pressure on metal-poor dwarf galaxies

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Understanding the origin of strong galactic outflows and the suppression of star formation in dwarf galaxies is a key problem in galaxy formation. Using a set of radiation-hydrodynamic simulations of an isolated dwarf galaxy, we show that the momentum transferred from resonantly scattered Lyman-alpha(LyA) photons can suppress star formation by a factor of two in metal-poor galaxies by regulating the dynamics of star-forming clouds before the onset of supernova explosions (SNe). This is possible because each LyA photon resonantly scatters and imparts ~10-300 times greater momentum than in the single scattering limit. Consequently, the number of star clusters predicted in the simulations is

reduced by a factor of ~5, compared to the model without the early feedback. More importantly, we find that galactic outflows become weaker in the presence of strong LyA radiation feedback, as star formation and associated SNe become less bursty. We also examine a model in which radiation field is arbitrarily enhanced by a factor of up to 10, and reach the same conclusion. The typical mass-loading factors in our metal-poor dwarf system are estimated to be ~5-10 near the mid-plane, while it is reduced to ~1 at larger radii.

### [구 GC-16] Polarization as a Probe of Thick Dust Disk in Edge-on Galaxies: Application to NGC 891

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Radiative transfer models were developed to understand the optical polarizations in edge-on galaxies, which are observed to occur even outside the geometrically thin dust disk, with a scale height of ~0.2 kpc. In order to reproduce the vertically extended polarization structure, we find it is essential to include a geometrically thick dust layer in the radiative transfer model, in addition to the commonly-known thin dust layer. The models include polarizations due to both dust scattering and dichroic extinction which is responsible for the observed interstellar polarization in the Milky Way. It is found that the magnetic fields in edge-on galaxies are in general vertical (or poloidal) except the central part, where the magnetic fields are mainly toroidal. We also find that the polarization level is enhanced if the clumpiness of the interstellar medium, and the dichroic extinction by vertical magnetic fields in the outer regions of the dust lane are included in the radiative transfer model. The predicted degree of polarization outside the dust lane was found to be consistent with that (ranging from 1% to 4%) observed in NGC 891.

### [구 GC-17] The 105-month Swift-BAT all-sky hard X-ray survey

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We present a new catalog of hard X-ray sources