Galaxies Formation and the Origin of Active Galactic Nuclei

The origin of Active galactic nuclei (AGNs) is still on of the most important mysteries of modern astronomy. It is now generally believed that AGNs are originated from super mass black holes (SMBHs) in the centers of galaxies. On the other hand, large galaxies are formed from small galaxies. However, galaxies do not only merge passively; they might also trigger violent star formation and the activities of the super massive black hole in the host galaxies. Therefore, AGN activities must be related to galaxy evolution. There are a lot of fundamental problems that are still unsolved given the significant efforts of the astronomical community in the past 40 years. Some of the puzzling but fundament problems such as what is the origin of the AGN?, i.e., in what circumstance a galaxy will host an AGN; why do different AGNs have different observed properties? e.g., why are some AGNs radio-loud while others radio quiet? Do they have different host galaxies? Do some AGNs have no broad line regions (BLRs)? e.g., what are the origin of BL Lacs and non-hidden BLR Seyfert 2? Do different AGNs have different origins or they can be connected within a unification framework? If they do, what is the real unification scheme? If they are intrinsically different, what is the origin of the difference? Is there any evolutional connection between different types of AGNs? What are the AGN activities related to the star formation activities of the host galaxies. In this project, students might use different observational techniques and data to probe relevant questions. Possible topics include (but are not limited to):

1. Radio and far infrared data analysis: We will use radio and far infrared data to compare the relation between the AGN and star formation activity to investigate the relation between the AGN activity and star formation and the KS relation between AGN and normal galaxies.

2. Millimeter and sub-millimeter observations and data analyses: We will use ALMA and SMA observations (and archive data) to investigate the gas distribution in the nuclear regions of different types of AGNs.

3. Optical and Near infrared observations and data analyses: We will use CFHT and other optical/near infrared data, such as SDSS and 2MASS, to investigate the morphological types of the host galaxies of AGNs in order to probe the possible evolution connection among different types of AGNs.

4. Optical variability observations: We will use data from Lulin one meter telescope (LOT) and Pan-STARRS to investigate the variability of AGNs; in particular, we want to probe the possible variability in some non-HBLR Seyfer 2 galaxies and red QSOs.

The results of this project are expected to have important impacts on the field of AGN researches. This project will also provide suitable training on observations and data reduction for students.