Summary of the thesis work of Dr. Vaidehi Sharan Paliya carried out at the Indian Institute of Astrophysics, Bangalore

TITLE: GENERAL PHYSICAL CHARACTERISTICS OF GAMMA-RAY EMITTING BEAMED AGNs IN FERMI ERA

The origin of high energy γ-ray emission from blazars, a peculiar class of active galactic nuclei (AGN) has always been an important problem in AGN physics. The launch of *Fermi*-Gamma-Ray Space Telescope in the year 2008, supplemented by multi-wavelength monitoring from both ground and space based observational facilities, has given an opportunity to understand the high energy emission processes in AGN. Though majority of the γ-ray emitting sources are blazars, *Fermi* as of today has also discovered γ-ray emission from about a dozen Narrow Line Seyfert 1 (NLSy1) galaxies. The first part of the thesis of Dr. Paliya aimed to understand the nature of some of these γ-ray emitting NLSy1 galaxies. Towards this he used data from both ground based (for optical and infrared bands) and space based telescopes (for gamma-ray, X-ray and UV). Using observations from the Himalayan Chandra Telescope and the 1.3 m telescope of ARIES, Nainital, the thesis has found that the gamma-ray emitting NLSy1 galaxies have optical flux variability properties within a night similar to that of blazars. It was also found that the broad band spectral energy distribution (SED) of gamma-ray emitting NLSy1 galaxies have the typical double hump structure similar to blazars. The γ-ray spectrum of these objects cannot be explained by Synchrotron Self Compton mechanism and an additional source of seed photons for inverse Compton scattering is required. The necessity of external Compton process to reproduce the γ-ray window of the SED hints for their similarity more with the flat spectrum radio quasar (FSRQ) category of AGN than BL Lac objects. A prominent accretion disk radiation has been observed from couple of γ-NLSy1 galaxies and also some of them exhibit a pronounced curvature in the γ-ray spectra. In the γ-ray luminosity versus γ-ray spectral index plane, these objects occupy a region where their luminosities are lower than FSRQs but the spectral indices are steep and similar to FSRQs. From detailed analysis, Dr. Paliya has found that the five γ-ray emitting NLSy1 galaxies are the low black hole mass counterparts of FSRQs. In the process of this work, he has also developed a code in *Python* language which takes into account all the emission mechanisms to explain the observed broad band SED of AGN.

The second part of his thesis, using a sample of four blazars, aimed to constrain the physical processes happening in the central regions of AGN as well as to put constraints on the location of the γ-ray emitting region. Both of the above mentioned aims of his thesis were accomplished by (a) generation and modelling of the broad band SED of the sources under study using near simultaneous data in the IR, optical, UV, X-rays and γ-rays and (b) flux variability over a wide range of wavelengths. By fitting his newly developed SED code, to the blazars studied in his thesis using multi-band simultaneous/near-simultaneous data, Dr. Paliya has found that **all blazars do not behave the same at all times, and different physical processes are needed to explain the same source at different times.** His new observational findings pose serious challenges to existing models on the emission processes in AGN and demand the need for improved theoretical models to explain observations The conclusions of the thesis work of Dr. Paliya are

1. A broadband exhaustive study of carefully selected blazars pointed the diversity of the radiative processes working in their relativistic jet. The work carried out during the thesis work, therefore, clearly reflect the level of complexity involved in understanding the physics of blazars.
2. Gamma-ray emitting -NLSy1 galaxies are low black hole mass FSRQs.

This thesis work resulted in more than a dozen first author publications, amongst that, two are single author publications of which one is in Astrophysical Journal Letters.