Program of the 2nd Summer School of Hel.A.S.

DAY	11 July 2016	12 July 2016	13 July 2016	14 July 2016	15 July 2016
Time					
09:00-09:30	Registration				
09:30-11:00	Charmandaris and Xilouris	Georgantopoulos	Papadakis	Contopoulos	Student Presentations (see the detailed program of the day in the 3rd page)
11:00-11:30	Coffee break	Coffee break	Coffee break	Coffee break	
11:30-13:00	Magdis	Georgantopoulos	Emmanoulopoulos	Petropoulou	
13:00-15:00	Lunch break	Lunch break	Lunch break	Lunch break	
15:00-16:00	Charmandaris	Georgantopoulos	Papadakis and Emmanoulopoulos	Mastichiadis and Petropoulou	
16:00-16:30	Coffee break	Coffee break	Coffee break	Coffee break	
16:30-17:30	Xilouris	Akylas and Mountrichas	Papadakis and Emmanoulopoulos	Vlahakis	
17:00-18:00	Discussion	Discussion	Discussion	Discussion	
19:00-20:30		Visit at NOA			
20:30-22:00		Dinner at NOA			

Tutors and Tutorials:

- **Charmandaris V. (Univ. of Crete and NOA): Infrared diagnostics of dust and gas emission in galaxies**
- **Xilouris E. (NOA): Semi-empirical and ab initio modelling of galaxy SEDs**
- **Magdis G. (Univ. of Copenhagen): Probing the physics of galaxies at moderate and high redshift**
- **Georgantopoulos J. (NOA): The AGN central engine**
- **Georgantopoulos J. (NOA): Surveys for AGN**
- **Papadakis I. (Univ. of Crete): X-rays from AGN**
- **Emmanoulopoulos D. (Univ. of Southampton): AGN variability**
- **Contopoulos I. (RCAAM): The launching of jets from astrophysical accretion disks and black holes**
- **Petropoulou M. (Purdue Univ.): Radiation processes in relativistic jets**

Afternoon Exercises

- **Measuring the SFR in galaxies (Monday)**
- **Measuring the stellar mass in galaxies (Monday)**
- **X-ray spectra of AGN using the XSPEC software (Tuesday)**
- **Timing tools and variability analysis of AGN (Wednesday)**
- **Formation of the multi-wavelength jet emission (Thursday)**
- **MHD simulations with PLUTO (Thursday)**

Program of student talks on 15 July 2016	
Time	
9:30-9:55	**Alexandros Filothodoros, The Energy States of Cygnus X-1**
9:55-10:20	**Ektoras Pouliasis, Hubble Catalogue of Variables**
10:20-10:45	**Alexandros Psychogyios, Morphology of local Luminous Infrared Galaxies**
10:45-11:10	**Ioannis Liodakis, Detecting the Elusive Blazar Counter-Jets**
11:10-11:40	**Coffee break**
11:40-12:05	**Eugene Zhuleku, Magnetic towers in astrophysical accretion disks**
12:05-12:30	**Stella Boula, Is the Blazar Sequence related to accretion disk winds?**
12:30-12:55	**Dimitrios Kantzas, Hadronic Models in type IIn Supernovae**
12:55-13:15	**Concluding remarks**

Abstracts:

Alexandros Filothodoros
PhD candidate, University of Zielona Góra, Poland

The Energy States of Cygnus X-1

We will focus on the galactic X-ray source Cygnus X-1 and especially on the methods used to categorize its spectral states. This is possible using the soft and hard X-ray detectors on board various satellites.

The long term statistics of the spectral states' duration and variability, along with the information coming from spectral analysis, could help us define some physical criteria for a universal spectral state definition.

Ektoras Pouliasis
PhD candidate, University of Athens

AGN in the Hubble Catalogue of Variables

This work is part of the validation of the “Hubble Catalogue of Variables” (HCV), a new project of the European Space Agency that has been launched at the National Observatory of Athens and aims to identify variable sources (extended and point-like) in the Hubble Source Catalogue (Whitmore et al. 2016) through different variability indices. We aim to identify variable sources and especially Active

Galactic Nuclei (AGN) through optical variability selection in the GOODS South deep field. In particular, we used Hubble Space Telescope (HST) z-band images taken over 5 epochs, separated by ~45 days and performed aperture photometry using SExtractor to derive the lightcurves of the sources. Two statistical methods (rms deviation & interquartile range) were employed for variability search, resulting in a final sample of 150 variable candidates, having removed the artifacts by visual inspection and keeping only those sources with known redshift. The redshifts of the variable candidates range from 0.05 to 5.72, while the faintest source detected has a z-band magnitude of 26.6. The number of X-ray counterparts observed by the Chandra telescope increases with exposure time (2Ms → 4Ms → 7Ms), indicating that the X-rays do not go as deep as the optical. Hence, this method can detect a larger number of low luminosity AGN, which are dominated by the host galaxy.

Alexandros Psychogyios
PhD candidate, University of Crete

Morphology of local Luminous Infrared Galaxies

Luminous infrared galaxies (LIRGs) dominate the infrared background and the star formation rate density at z~1. Despite the rarity of their local counterparts, their study is of paramount importance as they allow exploration of their detailed morphologies that cannot be done (owing to resolution limitations) at higher redshifts. Quantifying the morphology of local LIRGs as a function of wavelength using non-parametric coefficients gives the ability to search for clues of merging signatures in an automated way.
I will present an analysis of the morphological classification of 89 LIRGs from the Great Observatories All-sky LIRG Survey (GOALS) sample, using high-resolution HST imagery at B-, I-, and H-band as well as 5.8μm imaging by Spitzer. This classification is based on the calculation of Gini and M20 non-parametric coefficients. We explore how these coefficients vary as a function of stellar mass and infrared luminosity. In addition, we investigate the relation between M20, the specific star formation rate (sSFR) and the dust temperature in this galaxy sample and find that the effectiveness of M20 as a morphological tracer increases with increasing wavelength, from the B to H band and identify a region in the Gini-M20 parameter space where ongoing mergers reside, regardless of the band. We also find that, while the sSFR is positively correlated with M20 when measured in the mid-infrared, i.e. star-bursting galaxies show more compact emission, it is anti-correlated with the B-band-based M20. We interpret this as the spatial decoupling between obscured and un-obscured star formation.

Ioannis Liodakis
PhD Candidate, University of Crete

Detecting the Elusive Blazar Counter-Jets

Detection of blazar counter-jets is difficult, but it can provide invaluable insight into the relativistic effects, radiative processes and the complex mechanisms of jet production, collimation and acceleration in blazars. We built on recent populations models in order to derive the distribution of jet-to-counter-jet ratios and the flux densities of the counter-jet in different frequencies, in an effort to set minimum sensitivity limits required for future telescope arrays in order to detect these elusive counter-jets. We found that: newly operating arrays, such as ALMA, may be able to detect >63% of BL Lac and >31% of FSRQ counter-jets, while future telescopes like the SKA and e-

MERLIN may detect up to 99% of the BL Lac and 77% of the FSRQ counter-jets. Our simulations also showed that sources with both low apparent velocity and a low Doppler factor make prime candidates for counter-jet detection. Combining our findings with literature values we have identified five such counter-jet detection candidates.

Eugene Zhuleku
Masters of Science, University of Athens
Magnetic towers in astrophysical accretion disks
The purpose of this project is to study the driving and acceleration of astrophysical jets. We study in particular, magnetic towers in accretion disks, which are formed when from a differential rotating disk the magnetic pressure increases and as a result plasma is launched outside the disk. These outflows are collimated through the environmental pressure. Lynden-Bell studied this kind of jet whose main characteristic is the opposite polarity of the magnetic field. The project has two parts.
In the first part we use Lynden-Bell's model so we consider a sequence of static configurations adopting the force-free approximation. Using energy conservation and appropriate approximations on the magnetic fields we find how the shape of the jet changes with time. In the second part we use the PLUTO code to numerically simulate nonrelativistic magnetic towers for different values of the jet-environment density ratio and the initial velocity of the jet.

Stella Boula
Masters of Science, University of Athens
Is the Blazar Sequence related to accretion disk winds?
Adopting the hypothesis that the nonthermal emission of blazars is primarily due to the acceleration of electrons, we construct a simple leptonic model in order to explain the Blazar Sequence. The acceleration process is assumed to be of the first order Fermi type and the injected electrons and photons in the emitting region of the blazar are described by spatially averaged kinetic equations. According to the leptonic scenario, the spectral energy distributions of blazars have two basic components: a low frequency component, peaking in the optical through X-rays, from synchrotron emission; and a high frequency one, peaking in the γ rays, probably originating from Compton scattering of some seed photon source, either internal (synchrotron self-Compton) and/or external to the jet (external Compton). We find an adequate description of the Blazar Sequence by assuming a wind density profile of the form $n \propto 1/r$. Higher luminosity objects have higher accretion rates, higher optical thicknesses of the wind to Compton scattering and thus higher external photon fields than the lower luminosity ones. Therefore, we present indicative Blazar Sequence models which reproduce the basic observational trends just by varying one parameter, namely the mass accretion rate.

Dimitrios Kantzas
Masters of Science, University of Athens
Hadronic Models in type IIn Supernovae
In recent years, theories that describe the acceleration of particles in an astrophysical source have been developed, so as to understand

better the origin of the non-thermal radiation and as a consequence, the physics that governs these sources. One such model is the hadronic, which suggests that the population that plays a major role in the emission of radiation is a population consisting mainly of relativistic protons. In this talk we present an application of this model in type IIn Supernovae (SN). This type of SN has been discovered recently and seems to occur in environments with very high number density of the order of $10^7 - 10^{12}$ cm^{-3}. The existence of relativistic protons within these particular sources could be proven by the radiative signatures of the products of the proton – proton collisions. These collisions produce charged and neutral pions which in turn decay into electrons, neutrinos and high-energy γ-rays through the decays $\pi^{\pm} \rightarrow \mu^{\pm} + v_{\mu}$, $\mu^{\pm} \rightarrow e^{\pm} + v_e + v_{\mu}$ and $\pi^0 \rightarrow 2\gamma$. One way to achieve the radiative description of these sources is through the use of the diffusion-loss equation, which may describe the time evolution of a population of relativistic particles in the presence of all types of losses (including the aforementioned pp collisions). In this talk we present the results arising from the numerical approach as applied to type IIn SN.