High-energy astrophysics

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http://www.am.ub.edu/heaub/

Master in Astrophysics, Particle Physics, and Cosmology
Academic year 2018-19
Objectives:

To train, from the observational and theoretical point of view, a group of future researchers in HE astrophysics.

To understand the:

- physical mechanisms capable of accelerating particles to high energies and the radiative processes.

- phenomenology of various kinds of HE astrophysical sources such as supermassive BH in galactic nuclei, XRB stars, pulsars, SNR.

- most recent observational results and their impact in the models available.
Program: 30h: 24 h lectures, 6h presentations,

1. **Particle acceleration and radiation mechanisms in HE astrophysics**  
   1.1. Particle acceleration mechanisms  
   1.2. Diffusion  
   1.3. Energy losses  
   1.3. Radiative processes  
      1.3.1. Thermal emission  
      1.3.2. Synchrotron radiation  
      1.3.3. IC scattering  
      1.3.4. Bremsstrahlung  
      1.3.5. Hadronic processes  
      1.3.6. Particle annihilation

   JMP, 9 sessions  
   11 Feb – 27 Feb

2. **Accretion and ejection in relativistic sources**  
   2.1 Powerful accretion onto compact objects  
   2.2. Observational tools (analysis and fundamental diagrams)  
   2.3. X-ray binary accretion modes  
   2.4. Disks and jets  
   2.5. Black holes at all scales: from X-ray binaries to AGN

   VBR, 1 session, 4 March  
   MR, 2 sessions, 5, 6 March
3. HE gamma-ray sources in the Universe

3.1. HE γ-ray detectors and satellites
3.2. Imaging atmospheric Cherenkov telescopes.
3.3. Galactic HE γ-ray sources (pulsars, PWN, SNR, X-ray and γ-ray binaries, etc.)
3.4. Extragalactic HE γ-ray sources (AGNs, GRBs, EBL, etc.)
3.5. Fundamental physics at HE γ-rays (dark matter, Lorentz invariance, etc.)

4. Relativistic outflows at high energies

4.1. Outflows: jets and winds (general physical description)
4.2. Flow dynamics (production, propagation, content, termination)
4.3. Emission in relativistic outflows: electron-positron pairs
4.4. “ “ : protons and nuclei
4.5. Radiation reprocessing: absorption (γ-rays, radio and X-rays)
4.6. “ : electromagnetic cascades (source γ-ray transparency and consequences at lower energies)
Bibliography


ROMERO, G.E.; PAREDES, J.M. Introducción a la astrofísica relativista. Textos docents 365. Publicacions i edicions Universitat de Barcelona
Room A33M  Monday, Tuesday and Wednesday

17:40-19:00 High Energy Astrophysics (11/02/2017 - 20/03/2017)
(J.M. Paredes, V. Bosch, M. Ribó)

Work required to the students:
- Class attendance and active participation
- Exam preparation
- Active preparation/discussion of the assigned work with the supervisor
- Oral presentation of the work

Evaluation
- Participation 25%
- Exam 25%
- Written work 25%
- Oral presentation 25%
Proposed works and supervisors

Marc Ribó
M1. Supernovae at GeV-TeV
M2. Pulsars or PWN at GeV-TeV
M3. X-ray binaries (options: NSs vs. BHs, GeV emission, etc.)
M4. Gamma-ray binaries at GeV-TeV
M5. Blazars at GeV-TeV (options: EBL, neutrinos)
M6. EM emission from NS-NS mergers

Valentí Bosch-Ramon
V1. High-Energy Emission from Jet/Medium Interactions in Active Galactic Nuclei
V2. High-Energy Emission from Microquasar Jets
V3. Gamma-rays from Young Stellar Objects
V4. Disk-Jet connections in Black Hole X-ray Binaries

Another topic of your interest, either observational or theoretical