



Full Syllabus



Course Title

High energy astrophysics

Lecturer

Ehud Nakar

Semester

A

Course requirements

Submitting all homework exercises with a pass grade

Final grade components

100% exam

Course schedule

Class no. / Date	Subject and Requirements (assignments, reading materials, tasks, etc.)
1	Introduction
2	Radiative transfer - basic definitions and transfer equations
3	Relativistic effects - Doppler boost, beaming
4	Evidence for relativistic motion – superluminal motion, compactness
5	Free-free emission
6	Synchrotron emission
7	Inverse Compton emission
8	Pairs creation and annihilation
9	Newtonian hydrodynamics – introduction and fluid equations
10	Newtonian hydrodynamics – spherical wind and accretion, shock waves, self-similar solutions
11	Relativistic hydrodynamics – fluid equation
12	Relativistic hydrodynamics – spherical wind (fireball), shock wave
13	Fermi acceleration

Required course reading

none

Optional course reading

Books:

- Radiative Processes in Astrophysics; Rybicki & Lightman (weeks 2-8)
- Fluid Mechanics; Landau & Lifshitz (weeks 9-12)
- Physics of Shock Waves and High-Temperature Hydrodynamic Phenomena; Zel'dovich & Raizer (weeks 9-12)



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- Theoretical Astrophysics; Padmanabhan (weeks 9-12)
- Astrophysics in a nutshell (only 2nd edition); Dan Maoz (week 13)

Papers (Note that the papers discuss the topics studied in class but do not follow the same logic, and in some cases same assumptions, that are taken in class):

Synch spectrum from time evolving electron distribution and from relativistic blast wave:

- Sari, R., Piran, T., & Narayan, R. 1998, ApJ, 497, L17

Superluminal motion:

- Mirabel, I. F., & Rodriguez, L.F. 1995, Seventeenth Texas Symposium on Relativistic Astrophysics and Cosmology, 759, 21
- Mirabel, I.F., & Rodriguez, L.F. 1994, Nature, 371, 46
- Oren, Y., Nakar, E., & Piran, T. 2004, MNRAS, 353, L35

Compactness (limits on the Lorentz factor from gamma-gamma opacity)

- Lithwick, Y., & Sari, R. 2001, ApJ, 555, 540
- Nakar, E. 2007, Physics Reports, 442, 166; Section 3.2.1

Radio emission from supernovae

- Chevalier, R.~A. 1998, ApJ, 499, 810

Pure and loaded fireballs:

- Goodman, J. 1986, ApJ, 308, L47
- Paczynski, B. 1986, AapJ, 308, L43
- Nakar, E., Piran, T., & Sari, R. 2005, ApJ, 635, 516

Comments

Applications to models of astrophysical phenomena will be incorporated along the entire course (Supernovae, microquasars, AGNs, Gamma-ray Burst)