Interacademic Course in Astronomy 2009
"Gamma-Ray Bursts and Their Host Galaxies"

Ralph wijers and Lex Kaper, UvA

Course schedule and description

Course summary and format

Gamma-ray bursts were 'a riddle wrapped in an enigma' for about 30 years after their discovery in the late 1960s. In 1997, however, the discovery that after the short flash of gamma rays one can observe a fading 'afterglow' in all wavelengths for hours to years revolutionised the field. It was quickly discovered that these are the most powerful explosions in the universe, an order of magnitude more energetic than supernovae. Still, like supernovae they mostly seem to originate from the deaths of massive stars. They are a typical astronomical problem: a lot of instrumental progress and phenomenological detective work was needed to uncoover their nature, but once this was done they provide a window on some very peculiar and extreme physics that cannot be tested in the lab. Also, because they are so luminous and thus visible even from high redshift, they hold significant promise as tools for studying the evolution of structure and the star formation history in our universe.

In this class, we shall first discuss the astronomical tools that are used to study GRBs. Then we discuss their astrophysics, which will require the study of relativistic dynamical and radiation processes and astrophysical shocks. We will then move on to discuss what we know about their formation and environment, via the study of their host galaxies. Finally, we will wrap up by examining the state of GRBs as cosmological tools.

Each course day will consist of about 2 hours of lectures and 1.5 hours of problem solving and discussion. Homework will be given.

Location and times

The course will be taught at the Uithof in Utrecht, in the 'kleine collegezaal aardwetenschappen', Budapestlaan 4, 3584 CD, Utrecht, on the dates below from 11am to 3:30pm. The building is very close to Astronomy and can be reached with the usual bus 12 from Utrecht Central Station. A google map indicating the location of the building can be found at www.fbg.nl/86442. The dates and topics of the course are as follows:

Date	Topic	Reading
Feb 11	Introduction and observational status	Wijers
Feb 25	Fluid dynamics and shocks I	Wijers
Mar 11	Fluid dynamics and shocks II	Wijers
Mar 25	Radiation from shocked plasmas	Wijers
Apr 08	Synthesis: the making of a GRB	Wijers
Apr 22	Spectroscopy of GRBs and spectral diagnosis of the ISM/IGM	Kaper
May 06	GRB hosts and progenitors: what do we know?	Kaper
May 20	GRBs as cosmic beacons	Wijers

Reading materials

The class will assume BSc knowledge, in particular knowledge of special relativity, introductory cosmology, and stellar and extragalactic astronomy. Fluid dynamics and shock physics, insofar as needed to understand the subject matter, will be taught. Reading materials will consist of research and review papers, some background material from books, and lecture notes. These will be provided via the course website well in time for each class. The course web site will open around February 1 at www.astro.uva.nl/∼rwijers/iac2009.

Registration

Students should follow whatever registration procedure is customary and required at their own institute, which is different from place to place. As far as the teachers are concerned, we will register students by hand as they show up for the course. Active participation in the course, as well as the exam and paper are required to pass.

Exam and grading

Testing of the acquired skills and knowledge will be done via an exam and and a literature research paper, each counting for 50% of the final grade. An exam date will be set for early June in consultation with the participating students. We shall try to arrange for this exam to be taken at the home institutions. The literature research paper may be on a topic to be chosen from a list; since some knowledge of the subject will be needed before one can choose, the list of topics will be made available in early April, and the deadline for handing in the paper will be June 20, 2009.