INTERNATIONAL SPACE SCIENCE INSTITUTE
Hallerstrasse 6 • CH-3012 Bern • Switzerland

First Circular – Workshop of the International Space Science Institute (ISSI)

20 April 2015

Jets and Winds in Pulsar Wind Nebulae and Gamma-ray Bursts

16 - 20 November 2015

Conveners

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The Context of the Workshop

The International Space Science Institute (ISSI) is holding a series of three Workshops on physics of astrophysical objects with extreme energy release ranged from black holes of stellar mass to clusters of galaxies. The workshops series follow the ISSI Workshops hold in 2010-2014 which covered our contemporary knowledge about astrophysical magnetic fields of different scales, turbulence and particle acceleration processes in cosmic plasmas. The present Workshop intends to a wide and deep discussion of physics of astrophysical objects with energy release in form of relativistic outflows - jets and winds. The Workshop will review the observations and theory of relativistic jets and winds with the aim to understand the physics of relativistic outflows and their multiwavelength observational appearance and spectra formation.

Objectives of the Workshop

The ISSI Workshop is devoted to an in-depth discussion of complex and multi-scale fundamental studies of astrophysical objects with extreme energy release via multi-wavelength observations and modeling. The compact stellar remnants of supernova, fast rotating black holes and neutron stars - are able to give rise, with their ultra-relativistic jets and winds, to the rapid release of a large amount of energy, such as observed in gamma-ray bursts (GRBs) and soft gamma-ray repeaters, as well as long-lasting, quasi-steady, high energy sources such as pulsar wind nebulae (PWNe). The complex physics of magnetized outflows, magnetic reconnection, relativistic shocks and

particle acceleration behind GRBs and PWNe phenomena – their similarities and differences - are the subject of the Workshop.

Complex studies of these objects ~~allow to~~ address a number of fundamental problems, such as the physical mechanisms and efficiencies of conversion of the rotation and magnetic energies of the central engine into the observed electromagnetic radiation~~s~~ and neutrinos, launching of relativistic outflows, acceleration of ultra-relativistic particles. Extreme physical conditions that are present in these objects are unreachable in the terrestrial laboratories and therefore these sources provide a unique opportunity to test physical laws under extreme conditions. In addition, these sources also hold the potential for discovery of fundamental physics laws. GRBs, being the brightest cosmological transients, can be used to search for the warm-hot baryonic component (so-called missing baryon problem), and to test and constrain the Lorentz violation predicted by some models of quantum gravity. Soft gamma-ray repeaters are related to magnetars – objects with the highest ever magnetic fields.

The Workshop will review observations and theory of the magnetic field production at the observed strengths as well as their effects on the objects and the environment.

The Workshop will cover the following main themes:

The Workshop is designed to review in depth what has been achieved in observations and modelling of relativistic outflows in pulsar wind nebulae, micro-quasars, blazars and gamma-ray bursts. The main goal of the proposed ISSI Workshop is to discuss the state of the art of the research and future prospective.

Following discussions by the Conveners, it is proposed that the Workshop will cover the following main themes:

- **Multi-wavelength studies and observational properties of GRBs**
- **Status of the relativistic fireball GRB models and their modifications**
- **Soft gamma-ray repeaters: physics of magnetar emission**
- **Variety of observed relativistic wind manifestations in PWNe**
- **Giant gamma-ray flares in the Crab Nebula**
- **Physics of relativistic outflows: PWNe vs GRBs:**

  - Central engines: black holes vs magnetized neutron stars.
  - Composition of the outflows in terms of electrons, positrons and ions, and plasma magnetization.
  - Mechanisms for the acceleration of winds and jets.
  - Dynamics of the magnetized flows: internal dissipation in the optically thin regime (shocks and reconnection).

- Particle acceleration and radiative processes in highly stochastic fields

- **Jets in micro-quasars and blazars**

Presentations by those attending will be structured around the above headings. This list, subject to discussion and assessment at the Workshop, should become the set of chapter headings for the ISSI book. All of those attending will be expected to contribute to one or more of the chapters.

Product

The output of the workshop will be a volume in the Space Science Series of ISSI published by Springer, in parallel with the publication of the papers in Space Science Reviews. It is expected that a total of about 9 sections and between 15 and 20 review style and quality papers, submitted to the usual refereeing process will be published in the book. Papers will be based on talks presented at the Workshop and will reflect the discussions that will be held among the participants during the Workshop.

Location

The Workshop will take place at the International Space Science Institute, Hallerstrasse 6, 3012 Bern, Switzerland.

Attendance

This will be by invitation only with ~ 42 participants maximum including young scientists.

Young scientists

Under its special program for supporting young scientists, ISSI will invite around five early career scientists, within two years of their PhD, to take full part in the Workshop.

Funding

ISSI will provide the subsistence costs (hotel and a per diem to cover meals) to all participants but not the travel costs. There will be no registration fee for the Workshop.

Schedule

Invitations and First Circular:	30 April 2015
Registration deadline:	1 September 2015
Second Circular and final program:	1 October 2015
Hotel deadline:	22 October 2015
Workshop:	16–20 November 2015