Summary of Monday sessions

Marek Sikora

Kraków, April 2015

Andrew Hamilton:

There have been extraordinary claims that the quantum behaviour at black hole horizons differs dramatically from the classical behaviour -- that there may be a "firewall" at the horizon. Such conclusions are based on elementary misconceptions regarding classical horizons.

Christopher Reynolds:

Black hole spins in AGN. The disk-jet-spin connection in AGN. Cyclical "dissapearence" of the innermost portions of accretion disk in BLRG 3C120. X-ray dips followed by radio flares.

Tuomas Savolainen:

First results of the ultra-high resolution space-VLBI observations of jets in nearby AGN, 3C84, M87, and CenA were reported. Images of 3C84 reveal a rich structure inside 1 pc:

- edge-brightened jet between the core and the moving feature C3;
- hot spot behind the leading edge of the slowly moving emission feature C3 – likely a working surface between the jet and ISM;
- core is resolved transverse to the flow direction at 22 GHz and edge-brightened emission is seen upstream of the core.

Jean-Pierre Lasota:

Generalization of the mechanical Penrose process of black-hole rotational energy extraction to the case of matter and non-gravitational fields represented by an energy-momentum tensor satisfying the weak energy condition was presented.
It was demonstrated that the Blandford-Znajek mechanism is rigorously a Penrose process and that the GRMHD simulations of electromagnetic extraction of black-hole rotational energy satisfy the conditions on the horizon imposed by the Penrose process,
and argued that the extraction of black-hole energy must involve interaction with its surface.

Robert Penna

Reformulation of the Blandford-Znajek (BZ) model using the membrane paradigm. The membrane paradigm replaces the black hole with a fluid membrane living at the horizon. The membrane paradigm was extended so that future null infinity is also replaced with a fluid membrane. In this formulation, the force-free BZ equations become circuit equations. The membranes at the horizon and at infinity have the same surface resistivity, 377 Ohms. This implies that all roughly uniform force-free magnetic fields achieve near perfect impedance matching, with \Omega_F\Omega_H ~ 0.5.

Serguei Komissarov:

A review of some recent developments on how the Blandford-Znajek mechanism operates. The focus is on the roles played in this mechanism by the event horizon and the ergoregion.

Kenji Toma:

The origin of the electromotive force in BZ process is ascribed to the ergosphere. For the B field threading the horizon, neither the negative-energy particle nor the negative-energy electromagnetic energy is essential in the steady state. The boundary of force-free plasma and vacuum propagating toward the horizon has cross-field current and displacement current flow, creating toroidal B field and Poynting flux.

Amir Levinson:

Mass loading mechanisms: protons from AF; protons from neutron decays; pairs from gg. Plasma injection and outflow formation in magnetosphere of Kerr black holes.

Carlos Palenzuela:

Several generalizations of the Blandford-Znajek mechanism were presented. They include black holes with its spin misaligned with respect to the external magnetic field, boosted black holes, and binary black holes in a force-free environment. It was shown that the BZ process is also possible in regular spacetimes without an horizon.

Jonathan McKinney:

Polarized radiative transfer of GRMHD; simulations showing spectra and images/movies for SgrA*. Annihilation of magnetic fields → thermally driven transient jets (no BH spin is required).

Antonios Nathanail:

The current flows and the angular velocity of the magnetic field lines were self-consistently derived by solving the Blandford & Znajek equation using the inner and outer light surfaces. Black hole magnetospheres were shown to naturally develop an electric current sheet that may play a very important role in the dissipation of the black hole rotational energy and can be responsible for the emission of high energy radiation. An analytic expression for the black hole spinning-down by the BZ mechanism was derived and demonstrated to fit well the light curves of the long duration GRBs.

Alexander Tchekhovskoy:

The factors that control the power of jets in accreting black hole systems were discussed; the observational evidence for the presence of dynamically important magnetic fields was reviewed; and new results on the interactions of jets with ambient medium were presented.

Aleksander Sądowski:

The numerical methods that allow for global simulations of accretion disks in general relativity were described and detailed solutions for disks accreting above the Eddington rate were presented. It was shown that the radiative jets they produce can be very powerful even without any extraction of the black hole rotational energy.

Hung-Yi Pu:

By assimung that the dominating electromagnetic component of the energy flux per flux tube is conserved at the surface where the inflow and outflow are separated, the outflow part of the solution can be constrained by the inflow part. Based on the above idea, a self-consistent, semi-analytical jet model for a cold, Poynting flux dominated GRMHD flow along a parabolic streamline was constructed.