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NEW FRONTIERS IN BLACK HOLE ASTROPHYSICS

IAU SYMPOSIUM 324

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Logo of the IAU Symposium 324 on the background of NGC 6240 (Logo Credit: Branko Žalar, Photo Credits: X-ray: NASA/CXC/MIT/C. Canizares, M. Nowak; Optical: NASA/STScI)

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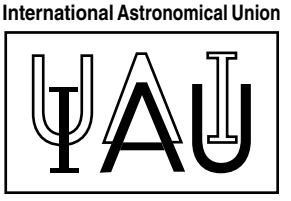

NEW FRONTIERS IN BLACK HOLE ASTROPHYSICS

PROCEEDINGS OF THE 324th SYMPOSIUM OF THE INTERNATIONAL ASTRONOMICAL UNION HELD IN LJUBLJANA, SLOVENIA SEPTEMBER 12–16, 2016

Edited by

ANDREJA GOMBOC
University of Nova Gorica, Slovenia

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Preface

Black holes lie at the heart of some of the most fascinating astrophysical phenomena. The International Astronomical Union Symposium 324: "New Frontiers in Black Hole Astrophysics" marked the 100th anniversary of Schwarzschild's solution of Einstein's field equations, which set the scene for the theoretical prediction of black holes. Although they were at first considered as a purely mathematical curiosity, it is now well established that they are ubiquitously present in the Universe. In the last few decades our understanding of black holes has come an impressively long way, with the last major discovery in this field being coalescing black holes producing gravitational waves. Gravitational waves, also predicted in 1916, remained elusive for a long time - therefore, it was our outmost pleasure to mark during the symposium the first anniversary of the first direct gravitational wave detection, which started a new era in astronomy.

In addition to historical perspective, the symposium was timely also in terms of scientific and technological points of view. Technological advances across the electromagnetic spectrum and beyond to multi-messenger signature are coming of age. The new generation of gravitational wave detectors is operational, improved sensitivity in neutrino detectors is available, the multi-wavelength community has an impressive suite of ground- and space-based facilities covering a wide range of energy bands and timescales. And on the theoretical side, astrophysics communities are providing new testable predictions from advances in numerical simulations.

IAU symposium 324 was held from September 12 to 16, 2016 in Slovenia's capital city Ljubljana. It was organized by the University of Nova Gorica and opened by the Slovenian Minister of Education, Science and Sport, Dr. Maja Makovec Brenčič. The symposium brought together 130 observational and theoretical experts from 30 countries across the globe to discuss the current state-of-the-art in the astrophysics of black-hole driven systems and their exploitation in testing fundamental theories of physics. The scientific program began with a historical introduction given by Virginia Trimble and concluded with the symposium summary by Carole Mundell. The program consisted of 24 invited talks, 57 contributed talks and 30 posters. Topics of presentations and discussions spanned a wide range and included similarity and diversity of black hole systems, gamma ray bursts, tidal disruption events, active galactic nuclei, gravitational waves, black hole systems as multi-messenger sources and tools for testing theories of gravity and elementary particles, current and future large experimental facilities, and opening of new observational horizons.

Scientific highlights of the symposium included presentations and discussions on:

· *Similarities and diversities of black hole systems*, how a large-scale disk dynamo creates large-scale, long-lived jets; influence of time-dependent collapse history, growth of supermassive black holes and seed black holes.

· *Magnetic field in black hole systems*, in particular spatially resolved images of jets, polarisation, multi-messenger signals, and advances in numerical simulations of the magnetic field effects.

· *Tidal Disruption Events* and origin of UV/optical emission in them, rareness of relativistic events, possible unification scheme, host galaxies properties, estimation of type and mass of disrupted star, and many other puzzles unresolved due to a small number of these events discovered so far.

· *The birth of gravitational wave astronomy*, the information contained in gravitational wave signals (inspiral, merger and ringdown phase), potential electromagnetic signals, and possibilities of constraining the neutron star equation of state.

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· *Tests of fundamental physics and black holes*, including quantum gravity 'zoo' and advances in theoretical modelling of gravitational waves.

Poster's presenters were given an opportunity to give a short highlight talk of their work and to take part in the best poster competition with prizes drawn from traditional Slovenian natural produce.

Social program of the symposium included a walking tour of Ljubljana, symposium dinner and trip to Postojna Caves and Lanthieri mansion in Vipava.

Symposium program was accompanied by several events for general public. In a public lecture on Sep 14, 2016, exactly on the 1st anniversary of the first direct detection of gravitational waves, Sheila Rowan presented a captivating story about detection of gravitational waves, in front of the packed full symposium hall. Exhibitions about black holes were on view during the symposium week in the National Assembly of the Republic of Slovenia and in the Cankar Centre, the symposium venue. After the symposium, one exhibition was put on display in Slovenian Museum of Natural History, while the other one is travelling and visiting Slovenian schools. To maximize educational outreach we invited all interested teachers to the symposium, to view the posters and listen to review talks. We organized a special teachers workshop on black holes in collaboration with the Society of Mathematicians, Physicists and Astronomers of Slovenia. General public and media exhibited large interest in the symposium, with all major TV stations and journals reporting news about the symposium and/or publishing interviews with symposium participants.

We were indeed very happy and honoured to host this symposium! It was not only the first International Astronomical Union Symposium held in Slovenia, but also the largest professional astronomy meeting in Slovenia so far.

I hope that these proceedings will serve as a summary of the highly interesting contributions and fruitful discussions held during the symposium, and that they will be especially useful to researchers and graduate students engaged in many different, yet all very exciting, research fields related to black holes.

Andreja Gomboc
Chair of the SOC and LOC
Ajdovščina, March 8, 2017

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We are grateful to members of the Scientific Organizing Committee and the Local Organizing Committee for their highly valuable contributions.

Many special thanks to Carole Mundell for co-chairing the symposium!

Financial support by Aresis Ltd. and IPZ d.o.o. is gratefully acknowledged.

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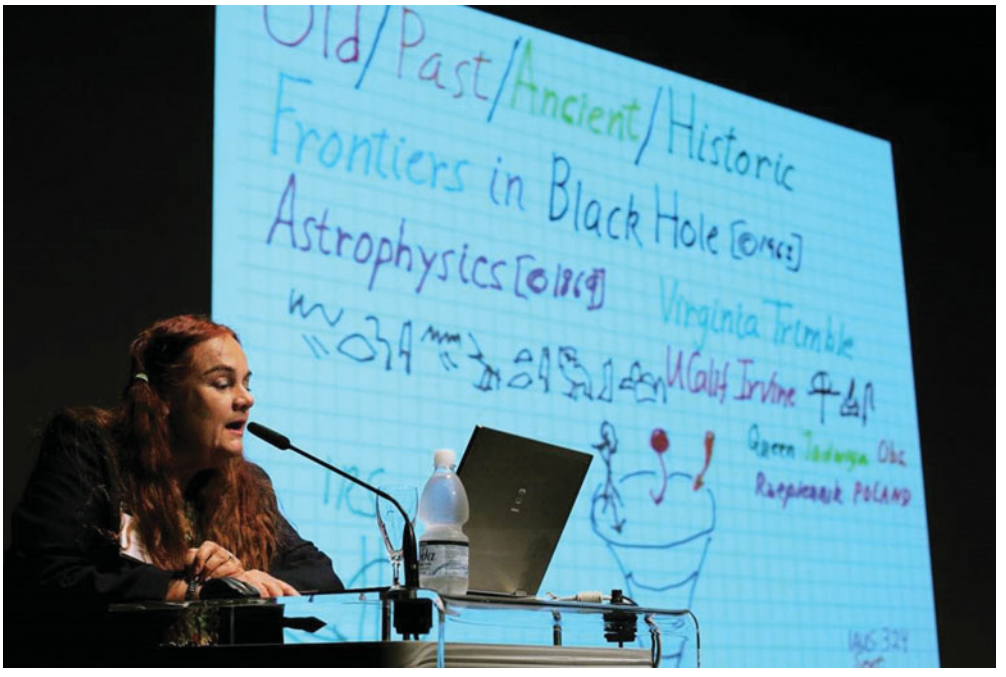

Photo 1. Introductory review of the black hole concept and development of black hole research field given by Prof. Virginia Trimble (12 Sep 2016, photo: D. Novakovič/STA).

Photo 2. Enrico Ramirez-Ruiz reviewing numerical simulations of tidal disruption events (13 Sep 2016, photo: G. Kukec Mezek).

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Photo 3. Discussions during a coffee break (photo: G. Kukec Mezek).

Photo 4. Symposium trip to Postojna Cave (14 Sep 2016, photo: G. Kukec Mezek).

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Photo 5. Announcement of the poster competition winners (15 Sep 2016, photo: G. Kukec Mezek).

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Photo 6. Public lecture on gravitational waves given by Sheila Rowan on the first anniversary of the first direct detection by the LIGO observatory (14 Sep 2016, photo: N. Tejić/STA).

Photo 7. Exhibition about black holes in the National Assembly of the Republic of Slovenia (12-16 Sep 2016, photo: B. Peršolja).

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