

IUPAP Commission 19 (Astrophysics) - Activity report 2014–2017

1. Commission membership 2014–2017

Chair:	Grazina Tautvaišienė [<i>Lithuania</i>]
Vice-chair:	Gerry Gilmore [<i>United Kingdom</i>]
Secretary:	Patrick Woudt [<i>South Africa</i>]
Members:	Petr Hadravský [<i>Czech Republic</i>] Shuang-Nan Zhang [<i>China</i>] Chanda Jog [<i>India</i>] Michel Rieutord [<i>France</i>] Rafael Rebolo [<i>Spain</i>] Marat Mingaliev [<i>Russian Federation</i>] Andreas Burkert [<i>Germany</i>] Sabine Schindler [<i>Austria</i>] Sung Won Kim [<i>Korea</i>] Chryssa Kouveliotou [<i>United States</i>] Pietro Ubertini [<i>Italy</i>]
Associate members:	Hans Kjaeldsen [<i>Denmark</i>] Wieping Liu [<i>China</i>] Keiichi Maeda [<i>Japan</i>] Virginia Trimble [<i>United States</i>]

2. IUPAP Young Scientist Prize in Astrophysics 2014–2017

Commission 19 received a large number of outstanding nominations for the IUPAP Young Scientist Prize in the field of Astrophysics. The commission selected the following winners in the period 2014-2017:

2014 - Dr Nanda Rea (*University of Amsterdam, NL*) for her valuable contribution to the study of neutron stars. In particular for the discovery that magnetars can have low dipolar magnetic fields in line with the normal pulsar population, at variance with the long-standing belief that the electron critical magnetic field was a lower limit for magnetar-activity to take place.

2015 - Dr Sylvain Guiriec (*University of Maryland, USA*) for his insightful and innovative contributions towards understanding the nature of gamma ray burst prompt emission, in particular the establishment of multi-component spectra, and the discovery of a new Peak Energy – Luminosity relation showing that GRBs can be used as standard candles and thereby as unique cosmological probes.

2016 - Dr Nikku Madusudhan (*University of Cambridge, UK*) for his pioneering and outstanding contributions to the characterization of exoplanetary atmospheres which have led to the first insights into various physical processes and chemical compositions of exoplanetary atmospheres, and have laid the foundations for understanding planetary formation and migration based on exoplanetary atmospheric compositions.

2017 - Dr Pratika Dayal (*University of Groningen, NL*) for her work as a theorist, combining analytic theory, numerical simulations and data interpretation, which has significantly contributed to building tantalising bridges between fields as diverse as astrophysics, particle cosmology and astrobiology.

The 2014 and 2015 winners of the IUPAP Young Scientist Prize in Astrophysics presented their work at the 28th Texas Symposium for Relativistic Astrophysics, which was held on 13-18 December 2015 in Geneva, Switzerland. The 2016 and 2017 winners of the IUPAP Young Scientist Prize in Astrophysics have been invited to present their work at the 29th Texas Symposium for Relativistic Astrophysics, where the IUPAP medal will be awarded. This symposium will be held from 3-8 December 2017 in Cape Town, South Africa.



Nanda Rea was born in 1978 in Rome, Italy. She graduated from the University of Tor Vergata/INAF- Astronomical Observatory of Rome in 2006. Since then she spent several years with different post-doctoral fellowships (at SRON and The University of Amsterdam). In 2009 she started a 5 year tenure-track at the Institute for Space Sciences (ICE) in Barcelona, part of the CSIC (the Spanish National Research Council). In 2014 she was awarded an NWO Vidi grant to build a research group in The Netherlands. She is currently a tenured staff scientist at CSIC, and a research group leader at the Anton Pannekoek Institute of the University of Amsterdam.

Since her PhD years, Nanda Rea has worked on several aspects of neutron stars, both observationally and on the interpretation side. She was invited for colloquia and seminars in many worldwide institutes (Harvard, NYU, Max Plank, University of Sydney, ATNF, IAC, and others). In 2014 she was awarded the Zeldovich Medal for Astrophysics and Space Science from COSPAR and the Russian Academy of Science, for her crucial contribution to the understanding of neutron stars with strong magnetic fields.



Sylvain Guiriec was born in 1978 in Brest, France. In 2002 – 2003, he obtained a Masters degree in Material Sciences as well as an Engineering degree in Atomic and Molecular modeling and simulation, and computational structural analysis and design from the Institut Supérieur des Matériaux du Mans, France. He worked for two years as a young researcher at the Oak Ridge National Laboratory, USA, and at the Universitat Politècnica de Catalunya, Spain, where he studied radiation damage for the nuclear research field. In 2004, he obtained a Masters degree in Astrophysics, Planetology and Space Sciences & Techniques and an Engineering degree in Space

Sciences & Techniques from Paul Sabatier University and the Institut Supérieur de l'Aéronautique et de l'Espace (SUPAERO), France. He received his PhD in December 2007 in Astrophysics from the Montpellier II University, France. His thesis was both theoretical and instrumental: (i) he studied the theoretical aspects of GRBs and made predictions of observability with the *Fermi* Gamma-ray Space Telescope (*Fermi*), and (ii) he participated to the integration and tests of the *Fermi*/Large Area Telescope (LAT), for which he developed an algorithm for suppressing its proton background.

After the launch of *Fermi* mid-2008, Sylvain Guiriec joined the National Space Science and Technology Center, USA – associated to the NASA Marshall Space Flight Center – with a 3-year postdoctoral position at the University of Alabama in Huntsville, USA. His main efforts focused on the observational analysis of GRBs, leading to the discovery of the first clear evidence for photospheric emission in their prompt emission. He also worked on Magnetars, Solar Flares and Terrestrial Gamma-ray Flashes. Since 2011 Sylvain Guiriec worked at NASA Goddard Space Flight Center, USA, first as a fellow of the NASA Postdoctoral Program and then as an Assistant Research Scientist affiliated with the University of Maryland, College Park and the Center for Research and Exploration in Space Science & Technology.



Nikku Madhusudhan was born in 1980 in India and pursued his undergraduate studies at the Indian Institute of Technology, Banaras Hindu University, in Varanasi, India. He then went to the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, USA, where he obtained a masters degree in engineering in 2004 and a PhD in Physics (astrophysics division) in 2009. After his PhD, he held postdoctoral positions at MIT (2009-2010), Princeton University (2010-2011), and Yale University (2012-2013) where he was the YCAA Prize Postdoctoral Fellow. In 2013, he joined the faculty of the Institute of Astronomy at the University of Cambridge, UK, as a university lecturer in astrophysics. In 2017, he was promoted to a tenured Readership (equivalent associate professorship) in astrophysics and exoplanetary science at Cambridge.

Dr. Madhusudhan has made several seminal contributions to the study of exoplanetary atmospheres over the past decade. His PhD work gave birth to exoplanetary “atmospheric retrieval”, which allows statistical estimation of atmospheric properties of exoplanets from their observed spectra. This work and its variants have made possible detailed measurements of atmospheric chemical abundances and temperature profiles of various exoplanets and sub-stellar objects ever since. His work led to the first statistical constraints on atmospheric chemical abundances, temperature profiles, non-equilibrium chemical processes, etc, in numerous objects. In another major development, in a series of papers in 2011-2012, he demonstrated the feasibility of measuring carbon-to-oxygen (C/O) ratios in hot giant exoplanets and demonstrated the critical implications of C/O ratios for various atmospheric and interior properties of exoplanets. These works have galvanized intense activity both in theoretical and observational studies to investigate C/O ratios in exoplanets and sub-stellar objects, and the C/O ratio has emerged to be the most desirable observable in exoplanetary atmospheres with upcoming large facilities such as the JWST. Among other results, his work also suggested unexpectedly low H₂O abundances in several hot Jupiters. Such chemical measurements have motivated new interdisciplinary efforts for connecting exoplanetary atmospheric compositions to their formation processes, a frontier area where Dr. Madhusudhan has also played a pioneering role in recent years.

Dr. Madhusudhan’s scientific contributions and leadership role have been widely recognized in exoplanetary science and astrophysics. His work has been recognized with the Yale YCAA prize fellowship in 2011 and the 2014 Vainu Bappu Gold Medal in astrophysics in 2016, followed by the present 2016 IUPAP Medal in astrophysics, besides numerous invitations to seminars/colloquia/conferences, review talks/papers, and large projects.



Pratika Dayal was born in 1984 in Chandigarh, India. She received a Masters degree in Astronomy from the University of Sussex in 2006, where she studied the triaxiality of elliptical galaxies. Her doctoral research, carried out at the International School for Advanced Studies (SISSA, Trieste) from 2006-2010, focused on modelling galaxies in the first billion years to put robust constraints on the end stages of reionization and unveiling their physical properties. She then held postdoctoral fellowships at the Leibniz Institute for Astrophysics (Potsdam, Germany) and the Institute for

Astronomy (Edinburgh, U.K.) where she combined the latest datasets and theoretical models to show that the earliest galaxies observed by the Hubble Space Telescope could be the smallest progenitors of galaxies like our own Milky Way. She then moved to the Institute of Computational Cosmology (Durham, U.K.), to take up an Addison Wheeler fellowship, where she opened up new lines of astrobiological research, ranging from modelling the habitability of the Milky Way to that of the entire Universe over 13 billion years.

Since 2016, Dr Pratika Dayal has held an assistant professorship and Rosalind Franklin Fellowship at the Kapteyn Astronomical Institute at the University of Groningen where she is leading calculations for the forthcoming era of 21cm cosmology with the Square Kilometre Array. In addition to support from the University of Groningen, since 2017 her group has been supported by the European Research Council’s starting grant.

3. Sponsored conferences by Commission 19

In 2015, the 28th Texas Symposium on Relativistic Astrophysics (13-18 December 2015, Geneva, Switzerland) has been selected for support from IUPAP. Commission 19 members *Grazina Tautvaisiene*, *Virginia Trimble* and *Shuang-Nan Zhang* are part of the Scientific Organising Committee (SOC) of the 28th Texas Symposium on Relativistic Astrophysics. URL: <http://www.isdc.unige.ch/texas2015/>

For 2016, Commission 19 expressed their strong support for the 3rd PANDA Symposium on Multi-wavelength Time Domain Astronomy, to be held from 30 May to 3 June 2016 in China. Commission 19 members *Chryssa Kouveliotou*, *Weiping Liu*, *Michel Rieutord*, *Grazina Tautvaisiene*, *Virginia Trimble*, *Pietro*

Ubertini, Patrick Woudt and Shuang-Nan Zhang are part of the SOC of the 3rd PANDA Symposium. The date of this symposium was postponed and most probably it will take place in 2018.

In 2017, the 29th Texas Symposium on Relativistic Astrophysics (3-8 December 2017, Cape Town) has been selected for support from IUPAP. Commission 19 members *Grazina Tautvaisiene, Patrick Woudt, Virginia Trimble* and *Shuang-Nan Zhang* are part of the Scientific Organising Committee (SOC) of the 29th Texas Symposium on Relativistic Astrophysics. It is the first time that the Texas Symposium is held in Africa. Details of the 2017 Texas Symposium on Relativistic Astrophysics are available at <http://texas2017.org/>

4. Meeting of Commission 19

Eight members of Commission 19 met on 7 August 2015 in Hawaii during the XXIX General Assembly of the IAU. This was the first face-to-face meeting for many members and associated members of Commission 19. The meeting was organised by the chair of Commission 19.

During the meeting in Hawaii, members of Commission 19 were acquainted with research activities by commission members and discussed the possibility of supporting the 3rd PANDA Symposium on time-domain astrophysics in China in 2016.



Members of Commission 19 at the XXIX General Assembly of the IAU in Hawaii. From left to right: *Michel Rieutord, Weiping Liu, Grazina Tautvaisiene, Pietro Ubertini, Virginia Trimble, Chryssa Kouveliotou, Patrick Woudt and Shuang-Nan Zhang.*

5. Update of the Commission 19 web site

The web site of Commission 19 has undergone a number of changes and updates. The most urgent updates have been done by a team of five volunteering commission members: *Petr Hadrava, Michel Rieutord, Grazina Tautvaisiene, Pietro Ubertini, and Patrick Woudt.* For the latest version see: <http://iupap.org/commissions/c19-astrophysics/>

This consolidated report has been compiled on 1 September 2017 by:
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Grazina Tautvaisiene, Chair Commission 19