



# European Astronomical Society 2014 Prizes

## Tycho Brahe Prize

The 2014 Tycho Brahe Prize is awarded to **Prof. Antoine Labeyrie** in recognition of his innovative concepts and inventions now widely used in modern optical imaging at high angular resolution.

## Lodewijk Woltjer Lecture

The 2014 Lodewijk Woltjer Lecture is awarded to **Prof. Rashid Sunyaev** for his outstanding career in theoretical and high-energy astrophysics, cosmology, X-ray astronomy and space research.

## MERAC Prizes

The 2014 MERAC Prizes for the Best Doctoral Thesis are awarded in

### Theoretical Astrophysics

to **Dr. Claudia Del P. Lagos** for her thesis on the treatment of star formation and feedback in simulations of galaxy formation.

### Observational Astrophysics

to **Dr. Amaury Triaud** for his thesis on the discovery and characterisation of many new exoplanetary systems.

### New Technologies

to **Dr. Boon Kok Tan** for his thesis on detector technologies for sub-millimetre wave astronomy.

The awardees are invited to give a plenary lecture at the European Week of Astronomy and Space Science (EWASS) to be held in Geneva, Switzerland on 30 June – 4 July 2014.

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The European Astronomical Society (EAS) promotes and advances astronomy in Europe. As an independent body, the EAS is able to act on matters that need to be handled at a European level on behalf of the European astronomical community.

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## Tycho Brahe Prize

The 2014 Tycho Brahe Prize is awarded to **Prof. Antoine Labeyrie** in recognition of his innovative concepts and inventions now widely used in modern optical imaging at high angular resolution.

*The Tycho Brahe Prize is awarded in recognition of the development or exploitation of European instruments or major discoveries based largely on such instruments.*

*The Tycho Brahe Prize is funded by the [Klaus Tschira Stiftung](#), a German foundation, which was established by the physicist Klaus Tschira in 1995 as a non-profit organisation. Its primary objective is to support projects in natural sciences, mathematics, and computer sciences, raising public awareness and appreciation for these fields.*

The European Astronomical Society awards its 2014 Tycho Brahe Prize to Professor Antoine Labeyrie in recognition of his outstanding contributions to modern optical imaging at high angular resolution. Having invented holographic gratings, he proposed the technique of speckle interferometry, which allowed to reach the diffraction limit of even the largest telescopes. Next, he was first to obtain interference fringes between two separate telescopes after the early single-telescope demonstration by A. Michelson et al. nearly a century ago. He continues to produce an amazing variety of innovative concepts for optical interferometry with large diffracting pupils.

Labeyrie's deep understanding of optics and physics fuelled his interest in the challenges of astronomical observing, particularly in ways to improve angular resolution. He proposed the method of 'speckle interferometry' and in 1970 applied it with collaborators to improve the angular resolution of the Palomar 5-m telescope by a factor of 50, leading to many discoveries on single and multiple stars.

He then undertook to build multi-telescope interferometers to push angular resolution beyond that achieved in the 1920's by A.A. Michelson and F.G. Pease with their 20 and 50 feet interferometers. In 1974 he proved that light could be combined from separate telescopes, even large ones, with the 'Interféromètre à deux Telescopes' (I2T), confirming the few early results by Michelson and adding some 20 new measurements of stellar angular sizes. This pioneering work led him to promote the idea of connecting existing or planned telescopes, such as the VLT in Paranal, and the Keck Interferometer in Hawaii.

As he worked to develop the theory of image formation with multi-aperture instruments, the concept of 'hypertelescope imaging' occurred to him, and he conceived practical ways to implement the principle, which leads to optical arrays of many small apertures which perform much better, in theory, than fewer large ones, at given collecting area.

During the development of adaptive optics for large telescopes in the early 80s, Labeyrie proposed the use of an artificial star, created with a laser beam, and described the necessary theory. Laser Guide Stars are now a cornerstone of the adaptive optics systems of the E-ELT. Because of atmospheric limitations in the optical domain, Labeyrie has always advocated the case for space interferometry missions.



*Antoine Labeyrie is of French nationality. He did his studies at the University of Paris and at the Institut d'Optique Théorique et Appliquée, where he obtained his Master's. He received his PhD from the University of Orsay in 1968, before starting his career as an optical engineer at the CNRS in 1971. He was appointed Professor at the Collège de France in 1991 and became a member of the Académie des Sciences in 1994. Throughout his career, Labeyrie has proved that he is an astronomer of singularly innovative genius, the source of the most important breakthroughs in the field of high angular resolution astronomy. Reaching the diffraction limit in optical light, then breaking through even this frontier by the practical application of interferometry was revolutionary, although it appears commonplace now.*



## Lodewijk Woltjer Lecture

The 2014 Lodewijk Woltjer Lecture is awarded to **Prof. Rashid Sunyaev** for his outstanding career in theoretical and high-energy astrophysics, cosmology, X-ray astronomy and space research.

*The Lodewijk Woltjer Lecture honours astronomers of outstanding scientific distinction.*

R. A. Sunyaev's interests in science cover a wide range of astrophysical issues, from the physics of elementary processes to physical cosmology. Among his results, which have become an essential part of today's astrophysics, are the 'standard' theory of disk accretion onto black holes and neutron stars (Shakura and Sunyaev 1973, 1976); the Sunyaev–Titarchuk formula (1980) for the radiation spectra generated by comptonization of low-frequency photons in hot low-density plasma; the prediction of the influence of acoustic waves in the early Universe on the angular fluctuations of the cosmic microwave background (CMB) and the spatial distribution of galaxies (1970); and the Sunyaev–Zel'dovich effect (1972), which makes it possible to use clusters of galaxies as a powerful tool of observational cosmology. Astrophysics students around the world learn Sunyaev's name in connection with these results.

R. A. Sunyaev played the decisive role in the foundation of and progress in high-energy astrophysics and X-ray astronomy in the USSR and Russia. Having created in 1982 the Department of High Energy Astrophysics at the Space Research Institute (now IKI RAN) and having become its head, he led the selection and development of the science payload, selection of observation programs, and the data analysis and interpretation for three of the most successful astrophysical observatories ever launched in the USSR and Russia: the Roentgen Observatory aboard the KVANT module of the MIR Space Station and the Granat and INTEGRAL orbital observatories.

With his characteristic energy and enthusiasm, R. A. Sunyaev continues his intense work covering a wide range of scientific problems. Among them are the physics of hydrogen and helium recombination in the Universe, the spectral distortions in CMB radiation, turbulent motions and physical processes in the hot gas of clusters of galaxies, the theory of the boundary layer at the surface of an accreting neutron star, the theory of disc accretion onto supermassive black holes, star formation in distant galaxies, and physical processes in the vicinity of the supermassive black hole in the Milky Way – this is just an incomplete list of his current interests.

*[Extract from the article '[Rashid Alievich Sunyaev \(on his 70th birthday\)](#)' by Dmitrii A Varshalovich et al 2013 Phys.-Usp. 56 311.]*



*Rashid A. Sunyaev was born and finished secondary school in Tashkent, before graduating from the Moscow Institute of Physics and Technology in 1966. He then became the PhD student of Yakov Borisovich Zel'dovich, who knew how to inspire his young colleague. The two scientists collaborated tightly over 22-years at the interface of theory and experiment. Sunyaev was Full Professor at the Moscow Institute of Physics and Technology from 1975 to 2001. He was first the Head of the Laboratory of Theoretical Astrophysics at the Space Research Institute of Moscow (1974-1982) and then of the High Energy Astrophysics Department in the same institute (1982-2002). Since 1992 he is Chief Scientist at this institute of the Russian Academy of Sciences. He became director of the Max-Planck Institute for Astrophysics in 1996 and then Maureen and John Hendricks Visiting Professor at the Institute for Advanced Study of Princeton in 2010. During his extremely successful career, Sunyaev has received numerous honours and awards all around the world.*



## MERAC Prizes

[FONDATION MERAC](#) (Mobilising European Research in Astrophysics and Cosmology) is a non-profit foundation started in 2012 with headquarters in Switzerland to recognize and support young European astronomers.

There are yearly three MERAC Prizes awarded by the European Astronomical Society. The prizes of € 20'000.– are for each of the three categories:

- ★ Theoretical Astrophysics
- ★ Observational Astrophysics
- ★ New Technologies (Instrumental/Computational)

The prizes alternate by year for:

- ★ Best Early Career Researcher Prizes (on odd years)
- ★ Best Doctoral Thesis Prizes (on even years)

The awardees are also eligible for further support from the FONDATION MERAC.

The MERAC Prize Committee was impressed by the high quality of all the 24 nominated candidates for the three MERAC Prizes of 2014.

## Best Doctoral Thesis in Theoretical Astrophysics

The 2014 MERAC Prize for the Best Doctoral Thesis in Theoretical Astrophysics is awarded to **Dr. Claudia Del P. Lagos** for her thesis in the field of galaxy formation. Dr. Lagos' thesis represents two major breakthroughs that overhaul the treatment of star formation and feedback in the simulations of galaxy formation. Her work has allowed the physical predictions of the galaxy formation models to be confronted directly with observations.

*Claudia Lagos is a Chilean who gained an undergraduate degree in 2007, followed by a Master's in 2009, both at Universidad Católica de Chile. With three publications at the end of her master's, Lagos was awarded a prestigious studentship jointly funded by the Science and Technology Facilities Council and the Gemini Observatory to carry out a PhD at Durham University. Lagos completed her PhD at the Institute for Computational Cosmology in November 2012. She was awarded the Department of Physics Keith Nicholas Prize for Outstanding Academic Achievement and a Springer Thesis Prize, awarded to the three best thesis in all physics each year. She recently took up a highly competitive fellowship at the European Southern Observatory in Germany. She continues to play a leading role in the development of state-of-the-art models of galaxy formation.*



Claudia Lagos' PhD thesis focused on the galaxy formation model, GALFORM, which can implement essentially all existing theoretical models of star formation. Her work overhauls the two key processes at the centre of how galaxies are made: the formation of stars and the regulation of star formation following the injection of energy into the interstellar medium. These calculations represent the first real advances in these areas in over a decade. Lagos' work allows the physical predictions of the galaxy formation model, such as the content of the interstellar medium, to be confronted directly by observations from new major telescopes, such as the Atacama Large Millimetre Array (ALMA).

The PhD thesis of Claudia Lagos was carried out at the Institute for Computational Cosmology at Durham University (UK) between October 2009 and September 2012, under the supervision of Prof. Carlton Baugh and Dr. Cedric Lacey.

## Best Doctoral Thesis in Observational Astrophysics

The 2014 MERAC Prize for the Best Doctoral Thesis in Observational Astrophysics is awarded to **Dr. Amaury Triaud** for his thesis in the field of exoplanets. During his doctorate, Dr. Triaud conducted the radial velocity confirmation of transiting exoplanet candidates produced by the WASP survey, confirming 48 new systems. By measuring the angle between the stellar rotation spin and the planet's orbital spin, he discovered that many hot Jupiters occupy non-coplanar orbits, a result that has a big impact on planet formation and orbital evolution models.

*Amaury Triaud is currently doing a postdoctoral fellowship supported by the Swiss National Science Foundation, at the Massachusetts Institute of Technology, in the USA. His path is an example of contemporary youth in Europe: born and schooled in France, he then decided to pursue his undergraduate studies at the University of St Andrews in Scotland graduating in 2007 with a Masters of Physics. His summers were spent in France (2003 & 2004), Germany (2005) and Switzerland (2006) doing research internships that nurtured his scientific career and produced his first papers. He moved to Geneva in 2007 for a four-year PhD program that was completed in August 2011. The number, variety and citation rate of his publications are a testimony of his achievements during and since his thesis. He also applied his skills to the service of multiple outreach activities to bring science to the wide public.*



Amaury Triaud conducted the radial velocity confirmation of transiting exoplanet candidates produced by the Wide Angle Search for Planets (WASP). This led to the confirmation of 48 new nearby exoplanetary systems, which are prime targets for characterisation. Triaud chose to focus on measuring the angle between the star's rotation axis and the planet's orbit. Multiple observations using ESO's HARPS spectrograph unveiled the earliest evidence for planets on retrograde orbits and found that a large fraction of hot Jupiters do not occupy orbits coplanar with their star. Those results shacked widely held believes about planet formation and migration scenarios and triggered a flurry of theoretical papers and additional observations.

The PhD thesis of Amaury Triaud was carried out at the Observatory of the University of Geneva (Switzerland) between August 2007 and August 2011, under the supervision of Prof. Didier Queloz.

## Best Doctoral Thesis in New Technology

The 2014 MERAC Prize for the Best Doctoral Thesis in New Technology is awarded to **Dr. Boon Kok Tan** for his thesis in the field of sub-millimetre wave astronomy. Dr. Tan's research for the PhD has contributed significantly to the advancement of the state of the art of coherent detector technologies. This includes fully integrated SIS mixer chips with wide RF and IF bandwidth, which are suitable for future heterodyne arrays, and advanced designs such as balanced and single side-band mixers.

*Boon Kok Tan was born in a small town (Taiping) in Malaysia. At the age of 17, he was selected to become already an undergraduate student at the University of Technology Malaysia, due to his exceptional school performance. After completing the Bachelor degree in Electrical and Electronic Engineering in 2001, he was offered a postgraduate position in Solar Engineering, and was awarded the Master degree in 2002. Following a lecturing career at Tunku Abdul Rahman University in Kuala Lumpur, he was offered a D. Phil position – funded by the prestigious King of Malaysia awards – at Oxford Astrophysics to work on the development of quantum limited coherent detectors for submillimetre astronomy. B. K. Tan obtained the D. Phil degree at Oxford in 2012. He is currently a member the Millimetre Detectors group of Oxford Astrophysics, leading the development of coherent THz detectors for the Atacama Large Millimetre Array (ALMA).*



Boon Kok Tan's thesis describes the development of receiver technologies for sub-millimetre astronomy instruments, focusing on high performance coherent cryogenic detectors operating close to the superconductor gap frequency. The mixer receiver developed in his thesis work contributed novel ideas in all three major parts of Superconductor-Insulator-Superconductor (SIS) mixers. These novel detector systems pave the way into high performance THz mixers, which will have a strong impact on sub-millimetre wave astronomy.

The PhD thesis of Boon Kok Tan was carried out at the Department of Physics and Astrophysics of the University of Oxford between October 2007 and June 2012, under the supervision of Dr. Ghassan Yassin.