Istituto Nazionale di Fisica Nucleare

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THE 2021 GALILEO GALILEI MEDAL GOES TO ALESSANDRA BUONANNO, THIBAULT DAMOUR AND FRANS PRETORIUS

The prize is awarded to the theoretical studies that described the behavior of two black holes spiraling around each other until they collide. Research proved to be of great importance for the analysis of the experimental data of the gravitational waves detectors VIRGO and LIGO.

The physicists Alessandra Buonanno, Thibault Damour and Frans Pretorius were awarded the Galileo Galilei Medal, a prize awarded every two years, by the National Institute for Nuclear Physics (INFN) with the Galileo Galilei Institute (GGI), its National Center for Advanced Studies in partnership with the University of Florence, to researchers who have made outstanding and seminal contributions to the advancement of research in theoretical physics.

The Prize, announced today, February 15, on the anniversary of the birthday of the great scientist Galileo Galilei, was awarded to Alessandra Buonanno, Thibault Damour and Frans Pretorius “for the fundamental understanding of sources of gravitational radiation by complementary analytic and numerical techniques, enabling predictions that have been confirmed by gravitational wave observations and are now key tools in this new branch of astronomy”.

"Professors Buonanno and Damour, and professor Pretorius proposed two complementary approaches, analytical and numerical, to describe the behavior of two black holes spiraling around each other until they collide. Their description was used for the analysis of experimental data that, in 2015, led the LIGO and VIRGO scientific collaborations to the observation of the first gravitational waves emitted by the collision of two black holes," comments Stefania De Curtis, director of GGI. “The theoretical studies of Buonanno, Damour and Pretorius were therefore fundamental for the start of a new era of gravitational astronomy and I am sure they will give even further prestige to the Galileo Galilei Medal," concludes De Curtis.

"To identify the source that generated the gravitational waves we observe on Earth, we need hundred thousand of waveform models. To achieve this goal about 20 years ago we introduced a novel approach to solve analytically the two-body problem in general relativity," explains Alessandra Buonanno. "This approach paved the way to develop the highly precise waveform models that today are routinely used by LIGO and VIRGO to detect binary systems composed of black holes and neutron stars and infer unique information about astrophysics, cosmology and gravity,” Buonanno concludes.

“In 1998 we developed a new theoretical model to describe analytically what happens when two black holes orbiting around each other get closer and closer until they merge,” says Thibault Damour. “Our model predicted that this process releases an enormous amount of gravitational radiation and provided the first analytical estimate of the full gravitational wave emitted during the last orbits and the coalescence of the two black holes,” Damour concludes.

"Being able to numerically describe the behavior of two astrophysical objects, such as black holes orbiting each other, is a very complex problem that requires long hours of computation. This problem interested me and in 2005 I came up with a first numerical solution to describe what happens when two black holes collide," adds Frans Pretorius.

Alessandra Buonanno is the director of the "Astrophysical and Cosmological Relativity" Department at the Max Planck Institute for Gravitational Physics in Potsdam. After her studies in Pisa, she had a brilliant career in theoretical gravitational physics that has taken her to work in Paris and the United States before landing in Germany. She has received numerous awards including the Leibniz Prize, the top research award in Germany.

Thibault Damour is full professor at the Institut des Hautes Études Scientifiques in Paris. Leading figure in the field of theoretical physics, he has worked on several research fields related to gravity, from black holes to cosmology to string theory and has received numerous awards during his career.

Frans Pretorius is a professor of physics at Princeton University and director of the Princeton Gravity Initiative. His main field of research is general relativity, and he has worked on a variety of topics, from gravitational collapse to black hole mergers, from cosmic singularities to black hole evaporation models.

"Galileo Galilei Medal" award

INFN founded the **"Galileo Galilei Medal"** award in honour of the father of the scientific method and of modern physics. The award was created in 2018 when the GGI was established as an INFN National Centre for Advanced Studies, in partnership with the University of Florence. Starting from 2019, the Galileo Galilei Medal is assigned every two years by an international selection committee appointed by INFN. The medal is awarded to scientists (three at most) who, in the 25 years before the date of the award, have achieved outstanding results in the areas of theoretical physics of interest to INFN, such as fundamental interactions among elementary particles, including gravity and nuclear phenomena.

The **Galileo Galilei Medal 2019** was awarded to **Juan Martin Maldacena** "for his ground-breaking ideas in theoretical physics, and especially for the discovery of duality between gravity and ordinary quantum field theory, with far-reaching implications."

The Medal

The Galileo Galilei Medal was crafted by a famous Florentine workshop, Picchiani&Barlacchi, with over a century of tradition of artistic and commemorative medals, plaques and trophies.

In the laboratory the processing of the products follows traditional methods, such as the design, the creation of the plaster model, the casting and finishing of the model, the pantograph reduction, the production of the punchcutting and the coining.

The GGI

The Galileo Galilei Institute (GGI) of Florence is the first European Institute dedicated to organising and hosting advanced workshops on the theoretical physics of fundamental interactions. The GGI is on the hill of Arcetri, a historically significant site for physics and astronomy, where Galileo Galilei spent the last eleven years of his life. The Centre organises workshops dedicated to the highlights of theoretical physics of fundamental interactions, and several PhD schools dedicated to string theory, theoretical physics of elementary particles, theoretical nuclear physics, field theory, statistical field theory, astroparticle physics and cosmology.

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