



Aspen Institute Italia Award 2022

***Gamma-ray bursts and gravitational waves from clashing compact stars:
solution of a long-standing astrophysical puzzle***

“Late Time Afterglow Observations Reveal a Collimated Relativistic Jet in the Ejecta of the Binary Neutron Star Merger GW170817”¹. This is the title of the study that won the seventh edition of the [Aspen Institute Italia Award](#) for collaboration and scientific research between Italy and the United States.

On August 17, 2017, the Virgo (in Italy) and LIGO (in USA) detectors observed for the first time the gravitational wave signal produced by the merger of two neutron stars. The cataclysmic event, occurring in a galaxy 130 million light years away, was also observed in different frequency bands of the electromagnetic spectrum (including X- and gamma-rays and infrared, optical, and radio signals). This marked the beginning of the era of “multi-messenger” astrophysics, based on the combination of gravitational waves and electromagnetic signals: a novel field of investigation that holds great potential in the coming years.

Among the different fundamental discoveries accompanying such an extraordinary event, it was possible to confirm that the merger of two neutron stars can launch a collimated energy outflow or jet powerful enough to produce a so-called “short Gamma Ray Burst”, ending decades of uncertainty about the origins of such energy explosions, which are among the most luminous in the universe.

By comparing electromagnetic observations collected within the first few months (since the initial gravitational wave detection) with advanced computer simulations, the winning research project marked a key step forward: it demonstrates the compatibility of the data with the hypothesis of a canonical collimated jet of energy analogous to any other short Gamma Ray Burst. In this case, it was observed not along the propagation direction of the jet itself, but from a different viewing angle. Further data collected in the following months definitively confirmed that the hypothesis supported in this work is indeed the correct one.

In the coming years, the gravitational wave and electromagnetic observation of many more neutron star mergers will allow for major steps forward in our understanding of these events and their extreme physical conditions. In this new journey, this winning research project will remain a reference point, while representing, more in general, a milestone in the field of relativistic astrophysics.

¹ The research was published in *Physical Review Letters* 120, 241103 in 2018:
<https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.120.241103>

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THE AWARD

The *Aspen Institute Italia Award* for scientific research and collaboration between Italy and the United States was launched in December 2015 in keeping with the Institute's commitment to encouraging and developing international leadership and transatlantic relations. Every year, the prize will be awarded to a research project studying applied or theoretical natural sciences, in which scientists and/or organizations from Italy and the US collaborate.

The Prize consolidates the Institute's commitment towards initiatives and meetings on important topics in the fields of science and technological innovation, with particular reference to their relevance to Italy.

The members of the Award committee are:

- Professor Giulio Tremonti, Chairman of the Award committee; Chairman, Aspen Institute Italia, Rome
- Professor Cristina M. Alberini, Center for Neural Science, New York University, New York
- Professor Alessandra Buonanno, Director, Max Planck Institute for Gravitational Physics - Albert Einstein Institute, Potsdam
- Professor Domenico Giardini, Chair of Seismology and Geodynamics, ETH, Zurich
- Professor Luciano Maiani, Professor Emeritus of Theoretical Physics, "La Sapienza" University, Rome
- Professor Giovanni Rezza, Prevention Director General, Ministry of Health, Rome
- Mr. Lucio Stanca, Vice Chairman, Aspen Institute Italia, Rome

The winners of the previous editions of the *Aspen Institute Italia Award* are:

- 2016: *Spatiotemporal spread of the 2014 outbreak of Ebola virus disease in Liberia* created a mathematical model to interpret the spread of Ebola.
- 2017: *Wind from the black hole accretion disk driving a molecular outflow in an active galaxy* demonstrated that wind coming from black holes contributes to the formation of new stars inside different galaxies.
- 2018: *The quest for forbidden crystals* demonstrated the ample scope for discovering new quasicrystals in nature (with chemical compositions as-yet unexplored in the laboratory) and for extending the results of this new field of research to other scientific spheres and to groundbreaking industrial applications.
- 2019: *A Test for Creutzfeldt–Jakob Disease Using Nasal Brushings* represented a significant step forward in diagnosing prion diseases. Above all, it opens a new and broad perspective of diagnosis in the field of neurodegenerative diseases that are more common and that have a significant social and economic impact.
- 2020: *Orbital angular momentum microlaser* focused on the ideation and realization of a miniaturized laser that produces twisted light by exploiting an “exceptional quantum point”. It is expected to revolutionize optical communications systems in the near future, with foreseeable significant impacts on both the economy and society.
- 2021: *Improved trade-offs of hydropower and sand connectivity by strategic dam planning in the Mekong* demonstrated how the strategic placement of dams – taking into consideration the spatial heterogeneity of natural processes in rivers and the cumulative impacts of multiple dams – can greatly reduce dam impacts without compromising on energy generation and energy costs. This finding was derived by combining a novel computer model for evaluating large scale impacts of dams on rivers with state-of-the art tools for decision analysis.