Instituto de Física Teórica UAM-CSIC

From July 15 to 19

The IFT Summer School allows exploration of the secrets of black holes with world experts

- **The Summer IFT School (SIFTS 2024) tackles the physics of these fascinating objects from multiple perspectives.**

- **30 international graduate students will enjoy a unique opportunity to learn and network with renowned speakers.**

- **The different perspectives on black hole studies include field theory, quantum gravity, general relativity, thermodynamics, and even astrophysical observation.**

Madrid, July 15, 2024.- The Institute for Theoretical Physics (IFT UAM-CSIC) hosts the second edition of its summer school, Summer IFT School (SIFTS 2024) with the theme: "Fundamental Aspects of Black Hole Physics". This international event, aimed at master's and doctoral students, offers a unique opportunity to delve into theoretical physics through lectures and informal sessions with renowned experts. The program presents a unique opportunity for young people, not only to apply different approaches to physics in the study of black holes alongside world experts but also to establish networks that can boost their professional development in the future.

This year's edition features 30 students, mostly from Europe, who will benefit from the wisdom of some of the most respected names in black hole physics: **Luca Santoni, Chris Pope, Malcolm Perry, Alberto Zaffaroni, and Luciano Rezzolla**. Each will address different theoretical and practical aspects related to black holes, providing a comprehensive and diverse view of this fascinating field of study.

Maria José Rodríguez y Óscar Valera, both IFT researchers, coordinate the SIFTS since its first edition.

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From quantum gravity theories to images of the Event Horizon Telescope

The program covers a wide range of approaches to black hole physics. A black hole is a region of spacetime where a mass has collapsed under its own gravitational field, leading to a singularity. This singularity is "hidden" by what we know as the event horizon, a boundary beyond which nothing can escape, not even light.

Luca Santoni from Columbia University (USA) will discuss **the relationship between black hole perturbations and effective field theories**, with applications in gravitational waves, one of the most promising areas of research in recent years. **Gravitational waves**, first detected in 2015 by the LIGO interferometer, constituted the first direct proof of the existence of these objects, as they were detected from the merger of two black holes.

Luca Santoni (CNRS) is introduced by María José Rodríguez before giving his talk on effective field theories in black hole dynamics. /IFT.

Meanwhile, Chris Pope, the Stephen Hawking Professor of Fundamental Physics at Texas A&M University, will address black hole configurations as solutions to **quantum gravity theories**. One of the greatest challenges of modern physics is to unify relativity, which explains macroscopic objects, with quantum mechanics, which deals with the peculiar behavior of elementary particles, beyond our everyday experience.

Black holes are ideal for studying quantum gravity theories due to their extreme conditions, where intense gravitational fields allow observation of relativistic and quantum phenomena in their highest expression. The region around the event horizon and the singularities at the center of black holes offer crucial clues about gravity at quantum scales.

Black holes have **thermodynamic properties**, such as temperature and entropy, that relate quantum mechanics to gravity, and studying these properties can offer fundamental insights into the union of these two theories. Malcolm Perry from the University of Cambridge and Queen Mary University of London will focus on the fundamental aspects of black holes in general relativity and thermodynamics. Meanwhile, the microscopic perspective of thermodynamics will be provided by Alberto Zaffaroni from the University of Milan-Bicocca, who will explain why black holes have temperature and entropy.

Finally, Luciano Rezzolla from Goethe University Frankfurt will provide an introduction to how black holes affect their surroundings and the surrounding light, highlighting their role in obtaining the **first images of black holes** through the Event Horizon Telescope (EHT).

The first photograph of a black hole, revealed on April 10, 2019, shows the supermassive black hole at the center of galaxy M87. Captured by the EHT project, this historic image was made possible by an international collaboration that used very long baseline interferometry to create a virtual Earth-sized telescope. Later, in 2022, the EHT obtained the first photograph of the black hole at the center of our own galaxy, Sagittarius A.*

Cutting-edge research: a platform for new talent

One of the most valuable elements of SIFTS will be the practical session, where participants can present and discuss their current research. This voluntary activity not only allows students to receive feedback from experts but also to connect with other researchers and potential collaborators, strengthening the academic community around black hole physics.

With this comprehensive approach, the IFT summer school aims not only to deepen the academic knowledge of its participants but also to inspire future research and collaborations in the exciting field of black hole physics.

IFT

The Institute for Theoretical Physics (IFT) UAM-CSIC was officially created in 2003 as a joint research center belonging to the Spanish National Research Council (CSIC) and the Autonomous University of Madrid (UAM). It is the only Spanish center dedicated entirely to research in Theoretical Physics. The IFT members develop research in the frontiers of Elementary Particle Physics, Astroparticles and Cosmology, in order to understand the fundamental keys of Nature and the Universe. They are also leading many research projects, both at the national and international level. The IFT is part of the strategic line `Theoretical Physics and Mathematics´ of the Campus of International Excellence (CEI) UAM+CSIC established in 2009. Since 2012, it is credited as Severo Ochoa Centre of Excellence. Besides purely scientific activity, in the IFT is also conducted intensive training tasks of young researchers and professionals through the graduate program in Theoretical Physics with mention of excellence from the CEI and the Ministry of Education. In addition, the Institute carries out the important task of transferring knowledge to society through several outreach programs.

For more information and interviews, please contact:

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