

## **Enclosure 8**

# **The International Ph.D. Programs in Relativistic Astrophysics**







# INTERNATIONAL JOINT PH.D. IN RELATIVISTIC ASTROPHYSICS

## DOUBLE PH. D. DEGREE IN PHYSICS FROM UNIVERSITY OF FERRARA AND UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA

**RELATIVISTIC ASTROPHYSICS** encompasses a wide range of observational and theoretical subjects at the basis of our understanding of the structure and evolution of the Universe. Recent remarkable progress in these fields has motivated the University of Science and Technology of China (USTC) and the University of Ferrara (UNIFE) to found the International Joint Ph.D. Program in Relativistic Astrophysics (JIRA Ph.D. program), in collaboration with the International Center for Relativistic Astrophysics (ICRA) and the International Center for Relativistic Astrophysics Network (ICRANet), which root long-term partnerships with USTC and UNIFE. The aim of the Program is to ensure a high level of education and a high quality academic research based on the historical strong records in the field of Relativistic Astrophysics of these institutions.

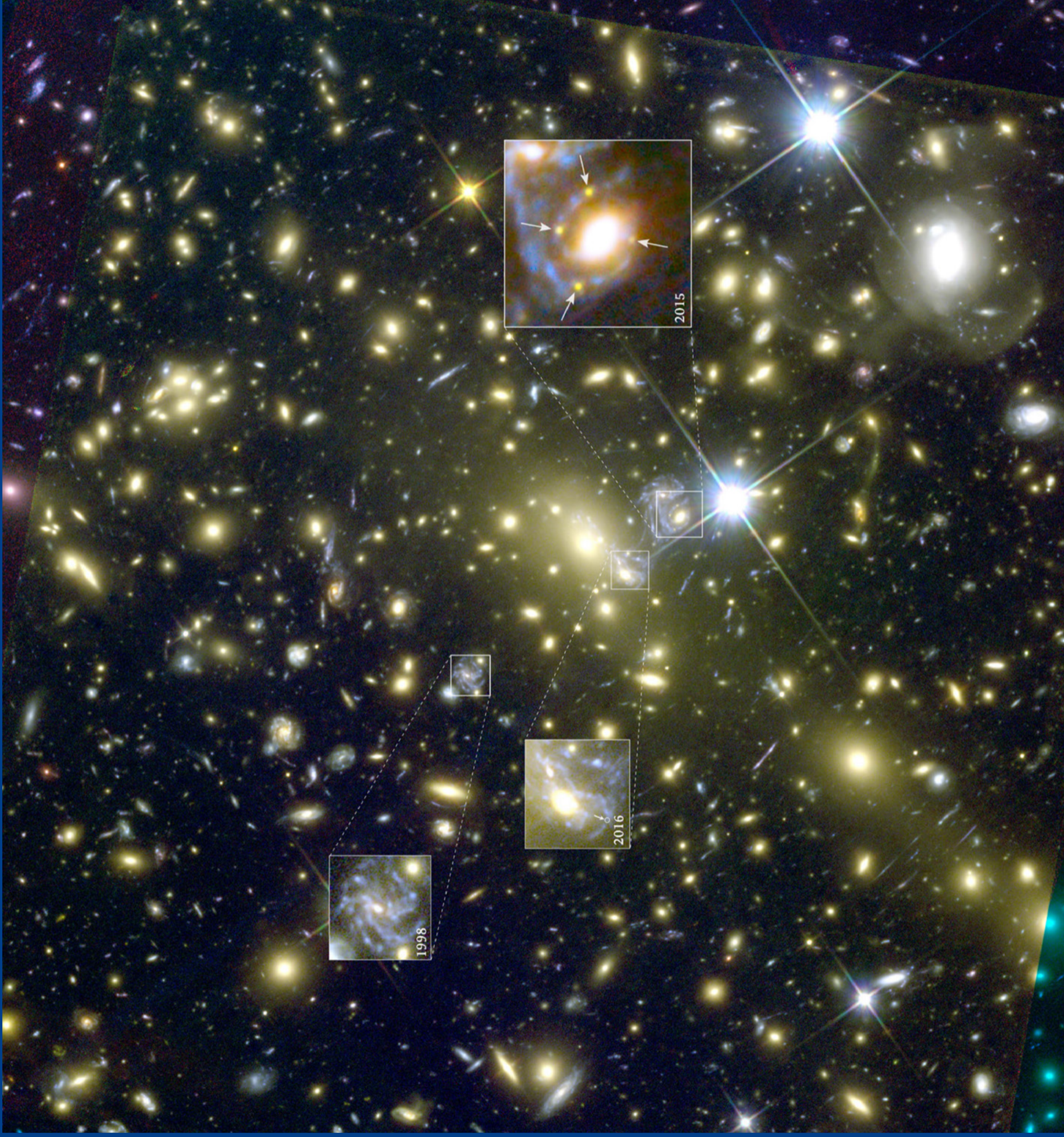
**THE FIRST SPACE OBSERVATIONS** of the binary X-ray source Sco X1 (Giacconi 1963), the optical jetted emission in the Quasar 3C273 (Schmidt 1963), the radio-optical observations of the Crab Pulsar (Bell - Hewish 1967), signaled the beginning of Relativistic Astrophysics. The identification of the neutron stars was soon followed by the conceptual introduction of a «black hole» based on the geometry of a Kerr rotating spacetime in general relativity with mass-energy characterized by mass, charge, and angular momentum (Christodoulou and Ruffini 1971). Fifty years later, through the largest ever multiwavelength observational effort, we are finding evidence that indeed the black hole mass-energy originates the most luminous sources in our Universe: Gamma-Ray Bursts (GRBs), Active Galactic Nuclei (AGN), and Ultra-High Energy Cosmic Rays (UHECRs). These topics have been addressed successfully in the last 33 years in the IRAP Ph.D. New additional fundamental topics are being developed in this new JIRA Ph.D. program, see also e.g. the 16th Marcel Grossmann (MG16) meeting for recent developments in this research field: [http://www.icranet.org/video\\_mg16](http://www.icranet.org/video_mg16).

**THE JIRA PHD PROGRAM** is addressed to highly qualified candidates from all over the world who meet the admission criteria established by regulations in force at the two Partner Institutions. Students who will successfully defend their theses will be awarded with a double Ph.D. degree, a «Doctor in Physics» issued by UNIFE and a «Doctoral degree» by USTC. Each student will spend at least 12 months at each Partner Institution. The research fields of the JIRA PhD Program include theoretical and observational topics in general relativity, cosmology, multi-messenger astrophysics, high-energy astrophysics, astro-particle physics, classical and relativistic quantum field theory.

**THE JOINT COORDINATION COMMITTEE (JCC)** of the JIRA PhD includes Rosati P. (UNIFE, Chair), Cai Y.F., (USTC), Gerbino M. (UNIFE-INFN), Rueda J. A. (UNIFE-ICRANet), Ruffini R. (ICRANet Pe), Yuan Y.F. (USTC).

**THE JCC** will operate in coordination with the Academic Board of the PhD Course in Physics at UNIFE and the School of Physical Sciences at USTC.

**USTC AND THE DEPARTMENT OF PHYSICS AND EARTH SCIENCES** at UNIFE have a cooperation agreement with ICRANet on research and education. USTC is a founding and active member of the International Center for Relativistic Astrophysics (ICRA) since 1985.



The massive galaxy cluster MACS J1149.5+223 ( $z=0.54$ ) where the multiply imaged supernova (SN) «Refsdal» was discovered (Kelly et al. 2015). The SN is then lensed 4 times (arrows) by the additional lensing effect of a cluster galaxy. Due to the time delays through the warped spacetime, the same SN event can be seen in different places at different epochs.



**TOPICS FOR THESESES, LECTURERS AND THESIS ADVISORS FOR THE USTC-UNIFE Ph.D. PROGRAMME**

**ACTIVE GALACTIC NUCLEI and SUPERMASSIVE BLACK HOLES**  
Gilli R. (INAF Bologna), Giommi P. (ICRANet Pe), Mirzoyan R. (MPL), Fan X. (University of Arizona), Punsly B. (ICRANet Pe), Sahakyan N. (ICRANet Ye), Yuan Y.F. (USTC, ICRA)

**WHITE DWARFS, NEUTRON STARS AND BLACK HOLES**  
Becerra Bayona L. M. (Universidad Católica de Chile), Cherubini C. (ICRA, UNICAMPUS), Drago A. (UNIFE), Feng L.-L. (SYSU), Pagliara G. (UNIFE), Popov S. (Sternberg Institute Moscow), Postnov K. (Sternberg Institute Moscow), Rueda J.A. (ICRANet Pe), Ruffini R. (ICRANet Pe)

**DARK MATTER, SELF-GRAVITATING SYSTEMS AND GALACTIC STRUCTURE**  
Argüelles C. (UNLP, ICRANet Pe), Becerra - Vergara E. A. (ICRANet Pe, UIS), Krut A. (ICRANet Pe), Filippi S. (ICRA, UNICAMPUS)

**LARGE SCALE STRUCTURE, COSMOLOGY, CMB**  
Cai Y.F. (USTC), Gerbino M. (UNIFE-INFN), Gruppuso A. (INAF Bologna), Lattanzi M. (UNIFE-INFN), Merloni A. (MPE), Natoli P. (UNIFE), Pagano L. (UNIFE), Rosati P. (UNIFE), Sunyaev R. (IKI, MPE), Trombetti T. (INAF Bologna)

**THEORY AND PRECISION TESTS OF GENERAL RELATIVITY**  
Belinski V. (ICRANet Pe), Bini D. (CNR, ICRANet Pe), Cherubini C. (ICRA, UNICAMPUS), Jantzen R. (Villanova University, ICRANet Pe), Kerr R. P. (ICRANet Pe), Kramer M. (MPIfR), Kunz J. (University of Oldenburg), Lämmerzahl C. (ZARM, University of Bremen), Li D. (CAS), Perlick V. (ZARM, University of Bremen)

**MULTI-MESSENGER AND TIME DOMAIN ASTRONOMY**  
Guidorzi C. (UNIFE), Moradi R. (ICRANet Pe), Orlandini M. (INAF Bologna)

**GRBs' THEORY**  
Bianco C. (ICRANet Pe), Fryer C. L. (LANL), Moradi R. (ICRANet Pe), Pak-Hin T. (SYSU), Piran T. (Hebrew University Israel), Rueda J.A. (ICRANet Pe), Ruffini R. (ICRANet Pe), Yuan Y.F. (USTC, ICRA)

**GRB and SUPERNOVAE OBSERVATIONS**  
Della Valle M. (INAF), Izzo L. (Niels Bohr Institute, INAF), Li L. (ICRANet Pe), Lipunov V. (Sternberg Institute Moscow), Michelson P. (ICRANet Stanford), Moradi R. (ICRANet Pe), Omodei N. (Stanford University), Tavani M. (INAF Rome), Wang Y. (ICRANet Pe), Zhang B.B. (Nanjing University), Zhang S.-N. (IHEP CAS)

**RELATIVISTIC PLASMAS THEORY IN ASTROPHYSICS AND COSMOLOGY**  
Aksenov A. (ICAD of RAS Moscow), Vereshchagin G. (ICRANet Pe)

Credits: NASA/ESA HST data: J. Lotz (STScI) and the Frontier Fields team; M. Postman (STScI) and the FLASH team, T. Treu (UCLA) and the GLASS team; ESO VLT spectroscopic data: C. Grillo (Unimi), P. Rosati (UnIFE) and the ZOOMING team

