

ICRANet Scientific Committee meetings 2024

Twenty second meeting



ICRANet

- *Document Scientific Committee 2024 1: Minutes of the meetings on January 24, 2025 (first session) and of February 4, 2025 (second session)*
- *Document Scientific Committee 2024 2: Conclusion and statistical significance of the reports of the Scientific Committee*
- *Document Scientific Committee 2024 3: Seven results of the international visibility of ICRANet in 2024*
- *Final approval*

***Document Scientific Committee 2024 1: Minutes of the meetings
on January 24, 2025 (first session) and of February 4, 2025 (second session)***

The first session of the meeting starts at 9:15 AM on January 24, 2025 in presence and via GoToMeeting at the following link: <https://global.gotomeeting.com/join/750192021>

The following members are present:

Prof. Narek Sahakyan (Armenia)
Prof. Gabriele Gionti, S.J. (proxy to Prof. Gregory Vereshchagin)
Prof. Yu Wang (ICRA)
Prof. Remo Ruffini (Director of ICRANet)
Prof. Massimo Della Valle (Italy, Chairman of the ICRANet Scientific Committee)

The additional following persons are present:

Prof. Carlos Raul Arguelles (ICRANet Adjunct Professor)
Prof. Luca Izzo (INAF-Osservatorio di Capodimonte)
Prof. Seyed Mohammad Taghi Mirtorabi (ICRANet Adjunct Professor)
Ridha Mohideen Malik (JIRA PhD student)
Prof. Rahim Moradi (IHEP)
Prof. Jorge A. Rueda H. (ICRANet Faculty Professor)
Prof. Costantino Sigismondi (ICRANet Adjunct Professor)
Prof. Gregory Vereshchagin (ICRANet Faculty Professor)
Prof. She-Sheng Xue (ICRANet Faculty Professor)

The meeting is chaired by Prof. Massimo Della Valle, who thanks all the presents for their participation. The minutes are taken by the Director.

The Chairperson asks the Director to report to the Committee.

The Director presents the status of the Staff, visiting scientists and graduate students at the Pescara Center (the Volume CV), as well as the 3 volumes of the ICRANet scientific report 2024 to the Scientific Committee, which are composed as follows:

Volume CVs: https://www.icranet.org/report2024/volume_CV.pdf

Volume 1: <http://www.icranet.org/report2024/Volume1.pdf>

Volume 2: <http://www.icranet.org/report2024/Volume2.pdf>

Volume 3: <http://www.icranet.org/report2024/Volume3.pdf>

The Director then invites ICRANet scientists to illustrate their respective fields of research:

- **h 9:30 AM – h 10:20 AM: Prof. Yu Wang**

The work on GRB 240825A (www.icranet.org/documents/WangYu_GRB240825A.pdf)

Link YouTube: https://www.youtube.com/watch?v=sf7zWTbysJw&list=PLr5RLbSWsSonsIcUsVGKjeZzPapywyl_KE

- **h 10:25 AM – h 10:35 AM: Prof. Luca Izzo**

Commented on the data acquisition of the James Webb Space Telescope on the source GRB 240825A
Link YouTube: https://www.youtube.com/watch?v=KO6OE0Qvlt&list=PLr5RLbSWsSonsleUsVGKjeZzPapywyl_KE&index=2

- **h10:40 AM – h 11:10 AM: Prof. Jorge A. Rueda H.**

Physics and Astrophysics of Compact Objects (Volume 3: <https://www.icranet.org/SR20244/rueda.pdf>)
Activities with Brazil (Volume 2: <https://www.icranet.org/report2024/brasile.pdf>)

Link YouTube: https://www.youtube.com/watch?v=CmwxcEPk_Nc&list=PLr5RLbSWsSonsleUsVGKjeZzPapywyl_KE&index=3

- **h 11: 15 AM – h 11: 25 AM: Coffee break**

- **h 11:27 AM – h 11:40 AM: Prof. Gregory Vereshchagin**

Theoretical Astroparticle Physics (Volume 2: <https://www.icranet.org/SR2024/vereshchagin.pdf>)

Link YouTube: https://www.youtube.com/watch?v=bkPaE-waWJY&list=PLr5RLbSWsSonsleUsVGKjeZzPapywyl_KE&index=4

- **h 11:40 AM – h 12:10 PM: Prof. Remo Ruffini**

Link YouTube: https://www.youtube.com/watch?v=bkPaE-waWJY&list=PLr5RLbSWsSonsleUsVGKjeZzPapywyl_KE&index=4

- **h 12:10 PM – h 12:35 PM: Prof. Gregory Vereshchagin**

ICRANet-Minsk report 2024 (Volume 2: <https://www.icranet.org/SR2024/minsk.pdf>)

ICRANet activities in Belarus (Volume 1: <https://www.icranet.org/report2024/bielorussia.pdf>)

Link YouTube: https://www.youtube.com/watch?v=bkPaE-waWJY&list=PLr5RLbSWsSonsleUsVGKjeZzPapywyl_KE&index=4

- **h 12:40 PM – h 1:10 PM: Prof. Massimo Della Valle**

Supernovae (Volume 3: https://www.icranet.org/SR2024/della_valle.pdf)

Link YouTube: https://www.youtube.com/watch?v=scz0UHJpKz8&list=PLr5RLbSWsSonsleUsVGKjeZzPapywyl_KE&index=5

- **h 1:10 PM – h 3:30 PM: Lunch break**

- **h 3:30 PM – h 4:10 PM: discussion with prof. Carlos Arguelles, to be concluded in the second session of the meeting**

The Chairman invites the participants to discuss Item 2 of the agenda “Miscellaneous business”.
Nothing remains to be discussed.

Prof. Christopher Fryer (Arizona University) and Prof. John Mester (Stanford University) were absent in the today first session of the meeting, but will be present in the second session.
The meeting ends at 4:20 PM on January 24, 2025.

Signatures

Prof. Narek Sahakyan, Representative of Armenia

Prof. Gabriele Gionti, S.J. (proxy to Prof. Gregory Vereshchagin)

Prof. Yu Wang, President of ICRA

Prof. Remo Ruffini, Director of ICRANet

Prof. Massimo Della Valle, Representative of Italy, Chairman

The second session of the meeting starts at 9:00 AM on February 4, 2025 in presence and via GoToMeeting at the following link: <https://global.gotomeeting.com/join/750192021>

The following members are present:

Prof. Narek Sahakyan (Armenia)
Prof. Gabriele Gionti, S.J. (proxy to Prof. Gregory Vereshchagin)
Prof. Yu Wang (ICRA)
Prof. Remo Ruffini (Director of ICRANet)
Prof. Christopher Fryer (Arizona University)
Prof. John Mester (Stanford University)
Prof. Massimo Della Valle (Italy, Chairman of the ICRANet Scientific Committee)

The additional following persons are present:

Prof. Carlos Raul Arguelles (ICRANet Adjunct Professor)
Prof. Carlo Luciano Bianco
Prof. Jaan Einasto (University of Tartu)
Prof. Manuel Hohmann (University of Tartu)
Prof. Seyed Mohammad Taghi Mirtorabi (Alzahra University, ICRANet Adjunct Professor)
Prof. Jorge A. Rueda H. (ICRANet Faculty Professor)
Prof. She-Sheng Xue (ICRANet Faculty Professor)

The meeting is chaired by Prof. Massimo Della Valle, who thanks all the presents for their participation. The minutes are taken by the Director.

The Chairperson asks the Director to report to the Committee.

The Director continues the presentations done in the first session of the meeting and invites ICRANet scientists to illustrate their respective fields of research:

- **h 9:00 AM – h 9:15 AM: opening remarks by Prof. Remo Ruffini**

Link YouTube: <https://www.youtube.com/watch?v=ky27gskHZ-I&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3>

h 9:15 AM – h 9:45 AM: Prof. John Mester

Link YouTube: <https://www.youtube.com/watch?v=ky27gskHZ-I&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3>

- **h 9:45 AM – h 10:10 AM: Prof. Jaan Einasto and Prof. Manuel Hohmann**

Cosmology Group of Tartu Observatory (Volume 2: <https://www.icranet.org/SR2024/einasto.pdf> + <https://www.icranet.org/SR2024/hohmann.pdf>)

Link YouTube: <https://www.youtube.com/watch?v=QadtK1Qqk8A&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3&index=2>

- **h 10:10 AM – h 10:30 AM: Prof. Seyed Mohammad Taghi Mirtorabi**

Link YouTube: <https://www.youtube.com/watch?v=Q32KpBNDzJo&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3&index=3>

- **h 10:30 AM – h 11:30 AM: Prof. Narek Sahakyan**

Multiwavelength and Multimessenger emission from Active Galactic Nuclei (Volume 2: <https://www.icranet.org/SR2024/sahakyan.pdf>)

Link YouTube: <https://www.youtube.com/watch?v=Z38cBHAbXN8&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3&index=4>

- **h 11:30 AM – h 11:45 AM: coffee break**

- **h 11:45 AM – h 12:00 PM: Prof. Carlo Luciano Bianco**

Gamma-Ray Bursts (Volume 2: <https://www.icranet.org/SR2024/bianco.pdf>)

- **h 12:00 PM – h 12:40 PM: Prof. Yu Wang**

Artificial Intelligence (Volume 2: https://www.icranet.org/SR2024/wang_yu.pdf)

Link YouTube: <https://www.youtube.com/watch?v=S3EpttXX00E&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3&index=5>

- **h 12:40: PM – h 1:00 PM: Prof. Shesheng Xue**

Electron-positron pairs in physics, astrophysics and cosmology: from heavy nuclei to black holes (Volumes 2 and 3: <https://www.icranet.org/SR2024/xue.pdf>)

- **h 1:00 PM – h 3:00 PM: lunch break**

- **h 3:00 PM – h 3:45 PM: Prof. Christopher Fryer**

Developing the tools to model Supernova and Kilonova emission from GRBs (www.icranet.org/SR2024/fryer.pdf)

Link YouTube: <https://www.youtube.com/watch?v=66SFfVS3rfM&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3&index=6>

- **h 3.45 PM – h 4:30 PM: Prof. Carlos Raul Arguelles**

Self-gravitating Systems of Dark Matter Particles (Volume 3: <https://www.icranet.org/SR2024/arguelles.pdf>)

Link YouTube: <https://www.youtube.com/watch?v=heWKRDX12D8&list=PLr5RLbSWSonuwKPmNWnbFSTZn2eZgZ-t3&index=7>

- **h 4.30 PM – h 5:15 PM:** The Director recalls the request by the University of Tartu to become a Member of ICRANet (see Enclosure) and asks Prof. Jaan Einasto to present the candidature. Prof. Einasto recalls the ongoing collaborations since many decades, also with the Toravere Observatory, as well as the meetings with Ambassador Sergio Romano. The Director recalls the textbooks on the large scale structure of the Universe written by Prof. Einasto. The Scientific Committee unanimously gives positive opinion to the adhesion of the University of Tartu to ICRANet.

The Director presents the document “Scientific Committee 2024 2”, as well as the document “Scientific Committee 2024 3” here attached. The Scientific Committee unanimously approves both documents.

The Chairman invites the participants to discuss Item 2 of the agenda “Miscellaneous business”. Nothing remains to be discussed.

Prof. Massimo Della Valle, Chairman of the Scientific Committee, thanks all the participants and the Director for their presentations and calls for a vote.

The Scientific Committee unanimously approves the Scientific Report and warmly congratulates with the Director for the achievements of ICRANet in 2024.

The meeting ends at 5:15 PM on February 4, 2025.

Signatures

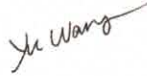
Prof. Narek Sahakyan (Armenia)



Prof. Gabriele Gionti, S.J. (proxy to Prof. Gregory Vereshchagin)



Prof. Yu Wang (ICRA)



Prof. Remo Ruffini (Director of ICRANet)



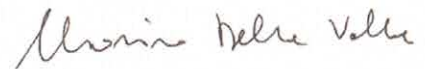
Prof. Christopher Fryer (Arizona University)

Christopher Fryer Digitally signed by Christopher Fryer
Date: 2023.02.17 08:33:01 -0700

Prof. John Mester (Stanford University)



Prof. Massimo Della Valle (Italy, Chairman of the ICRANet Scientific Committee)



Place, date 03/02/2025

To the Chairperson of the ICRANet Scientific Committee

Dear Chairperson,

I hereby nominate Prof. Gregory Vereshchagin as my proxy for the 22nd Meeting of the ICRANet Scientific Committee, which will be held on February 4, 2025 at the ICRANet Hq in Pescara as well as via GoToMeeting
Sincerely,

Signature

Handwritten signature in black ink, appearing to read "G. Vereshchagin, S. I."

Document Scientific Committee 2024 2: Conclusion and statistical significance of the reports of the Scientific Committee

Summary of ICRANet Scientific Report 2024

This document summarizes the report on ICRANet's scientific activities in 2024. The summary is divided into four core activities of ICRANet:

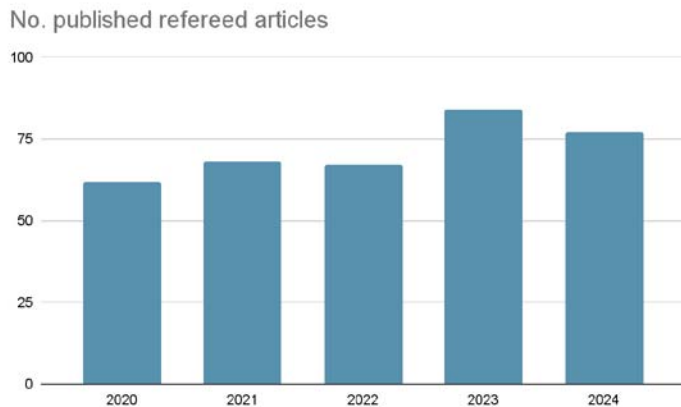
- 1. Research Initiatives**
- 2. Training and Education**
- 3. Dissemination and Outreach**
- 4. International Meetings and Conferences**
- 5. International Scientific Cooperation**

The extensive report presented by the ICRANet Director, Prof. Ruffini, can be found on the ICRANet website. Link: [ICRANet Scientific Report 2023](#).

1. Research Initiatives

Scientific Publications

In 2024, ICRANet researchers published **78 peer-reviewed papers** in relativistic astrophysics (see Fig. 1 and its annexed table). The publications include **12 co-authored with the MAGIC Telescopes Collaboration** by ICRANet Armenia (see report of Prof. Narek Sahakyan in the section on Armenia) and **5 ICRANet publications on Artificial Intelligence**. The 2024 published articles currently have an **H-index = 9**. The average number of publications in the five years 2020-2024 is **72**.



Year	N. papers
2020	62
2021	68
2022	67
2023	84
2024	78
Total:	359

Figure 1: Annual number of articles published in refereed journals by ICRANet researchers in the last five years, 2020-2024. The year-over-year number is in the annexed table. Data from the NASA Astrophysics Data System (NASA/ADS) (<https://adsabs.harvard.edu/>).

Prof. Remo Ruffini (ICRANet Director), Prof. Behzad Eslam Panah (ICRANet-Mazandaran, Iran), and other ICRANet scientists appeared in the 2024 update of the publicly available database of over 100,000 top scientists listed by Elsevier. This database of top-cited scientists provides standardized information on citations, h-index, co-authorship adjusted hm-index, and citations to papers in different authorship positions. Prof. Remo Ruffini is among the top 2% of most cited authors. This work used all Scopus author profiles as of August 1, 2024. To consult the complete list: [Top scientists Elsevier analysis](#).

The publication list 2024 can be found here: [ICRANet Publications 2024](#).

In addition, ICRANet publishes circulars in the General Coordinates Network (GCN) circular archive of NASA (website: [GCN - Circulars](#)). The GCN Circulars are rapid astronomical bulletins submitted by and distributed to community members worldwide. They are used to share discoveries, observations, quantitative near-term predictions, requests for follow-up observations, or future observing plans related to high-energy, multi-messenger, and variable or transient astrophysical events. In 2024, ICRANet published **two (2)** GCNs:

- the GCN circular n° 37964 released on October 30: [GRB 241025A: The discovery of a BdHN I from data of Swift, Fermi, SVOM and Einstein Probe telescopes](#)
- the GCN circular n° 37536 released on September 17: [GRB 240825A: The nature of the afterglow motivates the search of the associated supernova](#)

Press Releases

ICRANet publications significantly contributed to advancing the physics of black holes, supernovae, gamma-ray bursts, neutron stars, high-energy and astroparticle physics, dark matter, and cosmology. Press releases highlight the impact of ICRANet science.

In 2024, **two (2)** Press Releases were issued on ICRANet scientific results:

- 1) **On May 10**, *Aurora predicted for the dawn of Saturday 11 may also in Italy*. The press release highlights that the ICRANet expert in Solar Physics, Costantino Sigismondi, promptly organized an event to observe in visible light the two energetic X-ray solar flares that reached the Earth on May 10.
- 2) **On May 9**, *Discovering Early Gamma-Ray Burst Emissions with Cosmological Time Dilation*. The press release highlights the results of the article “*Probing electromagnetic-gravitational wave emission coincidence in a type I binary-driven hypernova family of long GRBs at very-high redshift*” by C. L. Bianco et al., published in The Astrophysical Journal on May 9, 2024: [Probing Electromagnetic Gravitational-wave Emission Coincidence in a Type I Binary-driven Hypernova Family of Long Gamma-Ray Bursts at Very High Redshift](#). The results of this paper were also highlighted in the science mass media channel of the Istituto Nazionale di Astrofisica (INAF): [Tre lampi gamma al rallentatore cosmologico](#)

The ICRANet Press Releases and links can be found at www.icranet.org/PressReleases.

Research/professor visiting program

Visitors to ICRANet Headquarters in Pescara

- Prof. Seyed Mohammad Taghi Mirtorabi (Alzahra University, Iran), January 18 – February 1, July 6-August 13, 2024
- Prof. Giorgio Sonnino (Université Libre de Bruxelles), January 29, 2024
- Prof. Marco Muccino (Al-Farabi Kazakh National University, University of Camerino), January 29, 2024
- Prof. Arban Uka (Epoka University, Albania), January 28 – 30, 2024
- Prof. Massimo Della Valle (Capodimonte Observatory, Italy) January 28 – 30, September 16-17, November 1 – 3, December 21-23, 2024
- Dr. Mikalai Prakapenia (ICRANet Minsk), February 5-16, 2024; May 28 – June 8, 2024
- Dr. Rahim Moradi (Institute of High Energy Physics - Chinese Academy of Science IHEP CAS), February 9-26, 2024
- Dr. Fatemeh Rastegarnia (Institute of High Energy Physics - Chinese Academy of Science IHEP CAS), February 9-26, 2024
- Prof. Vincenzo Guidi (University of Ferrara), March 12, 2024
- Prof. Paolo Natoli (University of Ferrara), March 12, 2024
- Prof. Costantino Sigismondi (ICRANet adjunct Professor, ITIS Galileo Ferraris Rome), April 5-7, 2024; April 14-14, 2024; April 24-29, 2024; May 10-13, 2024; June 15-16, 2024; September 27-28, 2024;
- Shurui Zhang (USTC, University of Ferrara), April 10-26, 2024; September 3-11, October 18-23, 2024;
- Dr. Stanislav Komarov (Belarusian State University, ICRANet center in Minsk - Belarus), May 3-18, 2024
- Prof. Nelson Alonso Velandia Heredia (Pontificia Universidad Javeriana), June 23-25, 2024
- Prof. Galileo Violini (Pontificia Universidad Javeriana), June 23-25, 2024
- Prof. Carlos Raul Arguelles (Universidad Nacional de La Plata, Argentina), July 6-14, 2024
- Prof. Giorgio Torrieri (Universidade Estadual de Campinas), July 12-18, 2024
- Prof. Mohammad Gadri (University of Tripoli), July 29-August 5, November 6-13, 2024
- Prof. Grant Mathews (University of Notre Dame, USA), October 21-27, 2024

Visitors to ICRANet-Ferrara

- Dr. Tales Augusto Oliveira Gomes (Universidade Federal do Espírito Santo), November 2024-April 2025.
- Dr. Alexandre Magno Rodrigues Almeida (Universidade Federal do Espírito Santo), November 2024-April 2025.
- Prof. Carlos Arguelles (Universidad Nacional de La Plata, Argentina), June 24-July 5, 2024.
- Dr. Zenia Zuraiq (Indian Institute of Science), June 22-July 6, 2024.
- Prof. Banibrata Mukhopadhyay (Indian Institute of Science), July 3-6, 2024.
- Prof. Santiago Vargas (Universidad Nacional de Colombia), March 4-6, 2024.

Attended meetings

In 2024, ICRANet researchers participated in the following international conferences:

- “Black Holes & Cosmology” (BHCos 2024), March 11-15, 2024, Nassau (Bahamas).

- “Planetarium Day 2024”, March 17, 2024, Ortona (Italy).
- “6th Galileo-Xu Guangqi Meeting” April 19-24, 2024, Hengyang (China).
- “35th Tehran International Book Fair (TIBF)”, May 8-18, 2024.
- “45th COSPAR Scientific Assembly”, July 13-21, 2024, Busan (South Korea).
- “XXIV Gamow International Astronomical Conference”, August 19-23, 2024.
- The 17th Marcel Grossmann Meeting, July 7-12, Pescara (Italy).
- “High Energy Astrophysics and Cosmology in the Era of All-Sky Surveys”, October 7–11, 2024, Yerevan (Armenia).
- The 3rd Julio Garavito Armero Meeting, November 12-15, Bogota and Bucaramanga (Colombia).
- “MDPI 2024 Nobel Prize in Physics Prediction Roundtable Forum”, October 8, 2024, online.
- “Complex Systems in Medicine and Posturology”, November 8, 2024, Novedrate (Italy and online).

2. Training and Education

JIRA PhD Program

In April 2021, the USTC and the University of Ferrara (UNIFE), with the collaboration of ICRA and ICRANet, signed the cooperation agreement that established the Joint International Relativistic Astrophysics (JIRA) PhD Programme. After the challenging COVID-19 pandemic, in December 2022, the first Chinese student from the USTC of the JIRA PhD program, Zhang Shurui, arrived in Italy. The student completed the first year of PhD at ICRANet-Pescara, and from December 2023 to December 2024, S.-R. Zhang followed his PhD program at ICRANet-Ferrara at UNIFE. From the end of 2024 to November 2025, the student will follow his last year of PhD at USTC in China.

Two new PhD students, Giorgia Di Rosa from Italy and Ridha Fathima Mohideen Malik from India, started in November 2024 the PhD program at UNIFE with fellowships financed by the Università G. d’Annunzio Chieti-Pescara. The research work of the students will be co-supervised by Prof. Remo Ruffini at ICRANet-Pescara, Prof. Jorge A. Rueda at ICRANet-Ferrara, and Prof. Piero Rosati and Prof. Cristiano Guidorzi at UNIFE.

PhD Program at ICRANet-Armenia

ICRANet-Armenia receives PhD positions from the government of the Republic of Armenia, allowing students to pursue a PhD in astrophysics at ICRANet. Five (5) students have obtained their PhD degrees since 2015, and two (2) students are currently in the 2nd and 3rd year of their PhD programs:

- Khachatryan Mher: 2nd year of PhD course.
- Manvel Manvelyan: 3rd year of PhD course.

ICRANet participation in other international PhD programs

1) Since 2022, ICRANet-Ferrara has participated in the International PhD Program in Astrophysics, Cosmology, and Gravitation (PPGCosmo) through the mentorship of PhD students. PPGCosmo is a joint PhD program of **16** institutions in **9** countries. Currently, **3** PhD students with PPGCosmo fellowships perform their research under the supervision of Prof. Rueda from ICRANet-Ferrara. As part of the PhD training, the students perform **6-month** academic visits to ICRANet-Ferrara as part of their research activities:

- Tulio Ottoni from Universidade Federal do Espírito Santo (UFES) visited ICRANet-Ferrara from **November 2023 to April 2024**. The research topic is *Astrophysical tests of alternative*

theories of gravity, focusing on pulsars and dark matter probes.

- Tales Augusto Oliveira Gomes from Universidade Federal do Espírito Santo (UFES) is performing the visit to ICRANet-Ferrara from **November 2024 to April 2025**. The research topic is *Cherenkov radiation from quantum vacuum around pulsars*.

- Alexandre Magno Rodrigues Almeida from Universidade Federal do Espírito Santo (UFES) is performing the visit to ICRANet-Ferrara from **November 2024 to April 2025**. The research topic is *Fast Radio Bursts models involving double white dwarf mergers*.

2) Since 2021, ICRANet-Ferrara has participated in the PhD Program in Astronomy at the Universidad de La Plata (UNLP) in Argentina by co-supervising PhD students who hold fellowships from that program. Currently, **1** PhD student from UNLP, Valentina Crespi, performs research under the co-supervision of Prof. Jorge A. Rueda from ICRANet-Ferrara. As part of the PhD training, the students perform academic visits to ICRANet-Ferrara as part of their research activities.

ICRANet participation in university courses

ICRANet's proposal to teach a 54-hour course, "***Physics and Astrophysics of Black Holes***", for the undergraduate course in Physics at the University of Ferrara has been approved by the Department of Physics and Earth Sciences. Prof. Jorge A. Rueda, who is in the ICRANet seat at the University of Ferrara, delivers the course.

Undergraduate courses developed by ICRANet-Minsk. Dr. Mikalai Prakapenia has initiated two novel lecture courses for the Belarusian State University undergraduate students: "***Relativistic Astrophysics***", 4th year, 50 hours, and "***Relativistic Kinetics***", 5th year, 108 hours.

3. Dissemination and Outreach

Lectures, meetings, and conferences organized by ICRANet are transmitted online through the ICRANet YouTube Channel. Since March 2016, ICRANet has uploaded **381** videos to the channel and received **50.351** visualizations. In 2024, the following ICRANet activities in the year were transmitted via streaming, and the videos remained available:

- The plenary sessions of the 17th Marcel Grossmann Meeting Zeldovich meeting, held in Pescara on July 7-12, 2024. Link: [MG17 Plenary Sessions](#).

For more details, visit the ICRANet YouTube Channel at www.youtube.com/@icranet5462.

ICRANet participates annually in the "European Research Night" by organizing initiatives for the general public in all its seats, enhancing interaction with the local community. Once again, ICRANet has actively participated in The European Researchers' Night, held **on September 27, 2024**. The ICRANet centers in Pescara, Nice, and Ferrara organized activities for the occasion, including online activities. The PDF of the program can be found here: [ICRANet program European Researchers Night 2024](#).

The outreach activity "*Universo a km 0*", co-organized by ICRANet-Ferrara, offers public conferences by distinguished scientists, joined by didactic and laboratory experiences. In 2024, it organized **seven (7)** events, bringing science to a public of more than **700** people. For more details: www.universokm0.com.

ICRANet-Minsk researchers prepared the special issue “Science and Innovations” journal published by the National Academy of Sciences of Belarus in April 2024. For more information, consult the link: [Science and Innovations](#)

ICRANet started on September 27, 2024, the series of activities “Solar Astrophysics and Relativity”, organized by Prof. Costantino Sigismondi for the High School Galileo Galilei of Pescara students. The activity comprises nine sessions from September 2024 to January 2025. The program is available on the website: https://www.icranet.org/Solar_Flares

4. International Meetings and Conferences

In 2024, ICRANet organized the following meetings:

- *The 3rd Julio Garavito Armero Meeting* from November 12–15, 2024, in Bogota and Bucaramanga, Colombia. Over 50 scientists from Latin America and Italy participated in the third edition of the meeting, and over 100 people attended every evening public lecture.

- *High Energy Astrophysics and Cosmology in the Era of All-Sky Surveys* from October 7–11, 2024, in Yerevan, Armenia. Over 110 scientists from Italy, Germany, France, Norway, China, the Russian Federation, the United States, England, Iran, Israel, and others participated in the conference.

- *The 6th Galileo-Xu Guangqi Meeting* (GX6), held from April 19-24, 2024, in Hengyang, China, in conjunction with the 2024 Annual Meeting of the Division of Gravitation and Relativistic Astrophysics of the Chinese Physical Society. Over 700 scientists, mainly Chinese but with a significant international presence, attended the meetings that the Chinese Physical Society and ICRANet jointly organized. Link: [GX6 Meeting](#)

On the occasion of the GX6 meeting, the Mayor of Hengyang, Mr. Zhu Jian, offered a dinner in honor of Prof. Ruffini. The Secretary Liu Yue-Gao and three members of the Chinese Academy of Sciences, Rong-Gen Cai, Wu Yue-Liang, and Ouyang Zhong-Can, and Prof. Wenbin Lin, local organizer of the GX6 meeting, were also present at the dinner. A photo of the dinner can be seen here: [Photo](#)

The 17th Marcel Grossmann Meetings on Recent Developments in Theoretical and Experimental General Relativity, Gravitation, and Relativistic Field Theories (MG17) from July 7 to 12, 2024 in Pescara (Italy), in collaboration with the Università degli studi Gabriele d'Annunzio di Chieti-Pescara (Ud'A). Meeting website link: [MG17website](#). The poster of the MG17 can be downloaded here: [MG17poster](#)

More than 700 participants from 45 different countries attended the conference. Thanks to the financial support provided by IUPAP, many scientists from developing countries also could participate in the MG17. The rich program of the MG17 was articulated in 41 plenary presentations, three public lectures, and 64 parallel sessions for a total of 631 scientific contributions. The meeting exceeded every expectation and confirmed its world-leading role in Relativistic Astrophysics since 1985 by ICRA and, in the most recent years, thanks to the collaboration with the ICRANet center in Pescara.

The official opening ceremony of the MG17 meeting took place on Monday morning, July 8, in the presence of Marco Marsilio, President of Abruzzo Region, and Carlo Masci, Mayor of Pescara.

Following the MG meetings tradition, the MG17 Awards have been assigned during an official ceremony on July 9. This year, the Individual Awards went to:

Prof. Di Li (FAST radio telescope, China) and Prof. Christopher Lee Fryer (Los Alamos National Laboratory, USA). The Institutional Awards went to the CHIME/FRB Team and were presented to Prof. Victoria Kaspi (McGill University, Canada). The MG17 Awards booklet is available here: [MG17 Awards](#)

- Three conferences on the 2024 leap year have been organized by Costantino Sigismondi, ICRANet Adjunct Professor, on February 24 at Lanciano, on February 26-27 at ICRANet Headquarters as well as at the High School Galileo Galilei in Pescara, and on February 29 in Rome, at the Cathedral S. Maria degli Angeli e dei Martiri. The main objective of these meetings has been to understand better what is behind these two civil calendar reforms valid for the whole world, both prepared in Rome: Julius Caesar's algorithm and Gregory XIII's algorithm.

- *“Total eclipse at Solar Maximum”*, observations and conference, April 6-8, 2024, an online meeting chaired by Costantino Sigismondi, ICRANet Adjunct Professor. For the video of the conference: [Meeting link](#)

- *“2024 Gerbertus’ day: X-ray solar flares, Coronal Mass Ejections and Aurorae”*, May 11-12, 2024, by Costantino Sigismondi, ICRANet Adjunct Professor. For more information: [Meeting link](#)

Proceedings of ICRANet Meetings and Conferences

In 2024, ICRANet completed the publication of the proceedings of:

- The proceedings of the 17th Marcel Grossmann meeting, edited by Remo Ruffini and Gregory Vereshchagin, in preparation (2025). Contributions from the plenary speakers are being published by the International Journal of Modern Physics D (JMPD).

- The 17th Italian-Korean Symposia on Relativistic Astrophysics (IK17) by AIP Publishing (Volume 2874, Issue 1) on September 6, 2024. These proceedings also contain the article by the Director titled “From “Introducing the black hole” (1971) to the discoveries of an “alive” black hole in GRB 190114C (2021), a collection of documents prepared on the occasion of the 17th Italo-Korean meeting”. Link: [IK17 Proceedings](#)

- The volume *“ICRANet-Isfahan Astronomy meeting: from ancient Persian Astronomy to recent developments in Theoretical and Experimental Physics, Astrophysics and General Relativity”*, published in England by Cambridge Scientific Publisher, was presented in an official ceremony at the 35th Tehran International Book Fair (TIBF) on May 18-28, 2024, with an online presentation by Prof. Remo Ruffini and Prof. Yousef Sobouti (IASBS President).

- The special issue *“Remo Ruffini Festschrift”* was published on June 2024 by MDPI, Universe, in open access fashion: [Remo Ruffini Festschrift](#)

The conference celebrating Remo Ruffini's 80th birthday was held in Nice, France, from 16 to 18 May 2022, with the participation of over 90 scientists. Some of the speakers were Rashid Sunyaev, Peter Predehl, Demetrios Christodoulou, Thibault Damour, Nathalie Deruelle, Roy Kerr, Tsvi Piran, Claus Laemmerzahl, Asghar Qadir, Chen Pisin, and Marco Tavani, in the presence of Agnès Rampal, the representative of the Mayor of Nice. This special issue volume collects 10 papers written by

distinguished scholars dedicated to Prof. Remo Ruffini for his 80th birthday. The editors of this special issue are Remo Ruffini, Jorge A. Rued, Narek Sahakyan, and Gregory Vereshchagin.

- The proceedings of the 5th Zeldovich meeting, held in Yerevan (Armenia) from June 12 to 16, 2024, were published on February 25, 2024, in a special issue of Astronomy Reports (Astronomy Reports, Volume 67, Issue 2 supplement) as open access document: [Z5 Meeting Proceedings](#)

These proceedings include 20 papers resulting in 218 pages covering all topics discussed during the meeting, such as multimessenger astrophysics, early universe, large-scale structure, cosmic microwave background, neutron stars, black holes, gamma-ray bursts, supernovae, hypernovae, gravitational waves, quantum, and gravity. The editors of these proceedings are Gregory Vereshchagin, Remo Ruffini, and Narek Sahakyan.

5. Scientific International Cooperation

ICRANet-Armenia joined the MAGIC (Major Atmospheric Gamma Imaging Cherenkov) Telescopes Collaboration with full rights and responsibilities in 2017. The MAGIC Collaboration comprises about **165** astrophysicists from **24** institutions and consortia from **12** countries. The ICRANet team annually conducts one-month training and research visits to the 17-meter Cherenkov telescopes. In 2024, two scientists and one PhD student participated in the MAGIC observational shifts, spending 27 days at the MAGIC Telescopes at Roque de los Muchachos Observatory.

In 2024, ICRANet signed **five (7) new** cooperation agreements with:

- University of Tartu (Estonia).
- Universidad Federal do Cariri (Brazil). The process started in 2024, and the agreement was signed on January 15, 2025.
- Astronomical Observatory of Belgrade (Serbia).
- The Municipality of Nice for its Jules Chéret Fine Arts Museum. The Mayor of Nice, Christian Estrosi, and Professor Remo Ruffini signed this convention.
- Universidade Federal do Espírito Santo (UFES).
- University Gabriele D'Annunzio of Chieti-Pescara (Ud'A).

In 2024, ICRANet has **renewed six (6)** cooperation agreements:

- Universidad Industrial de Santander (Colombia).
- Silesian University in Opava (Czech Republic).
- Al-Farabi Kazakh National University (Kazakhstan).
- University Campus Bio-Medico of Rome (Italy).
- University of Sharjah (United Arab Emirates).
- Universidade Federal do Rio Grande do Sul (Brazil). The process started in 2024, and the renewal was signed on January 8, 2025.

In 2024, ICRANet started the process of signing collaboration agreements with the following **five (5)** universities and research centers:

- Universidad Mayor (Chile);

- Pontificia Universidad Javeriana (Colombia);
- University of Tartu (Estonia);
- Catholic Institute of Technology - CatholicTech (Italy);
- Alem University (Kazakhstan).

The **91** active cooperation agreements between ICRANet, Universities, and research centers worldwide can be consulted here: [I.C.R.A. Network - Official Documents](#)

On November 15, 2024, Prof. Ruffini (Director of ICRANet), together with Prof. Massimo Della Valle (Chairman of ICRANet Scientific Committee), met the Ambassador Extraordinary and Plenipotentiary of Italy to Panama, H.E. Fabrizio Nicoletti as well as Dr Andrea De Melis (commercial and cultural attaché of the Italian Embassy in Panama) at the seat of the Italian Embassy in Panama City. On the occasion of an official lunch, Prof. Ruffini illustrated to Ambassador Nicoletti ICRANet current activities, its main research topics, and the recent scientific results. The current projects implemented by the ICRANet Hq in Pescara and all ICRANet Seats and associated centers have been presented and discussed. The relevant role played by ICRANet in daily fostering scientific exchanges worldwide and establishing agreements with the major Universities and research Institutes worldwide was also highlighted. Both parties strongly highlighted the importance of Latin American-Italian scientific cooperation in astrophysics. They discussed the possibilities of further developing and expanding it in the region under the guidance of ICRANet.

***Document Scientific Committee 2024 3: Seven results of
the international visibility of ICRANet in 2024***

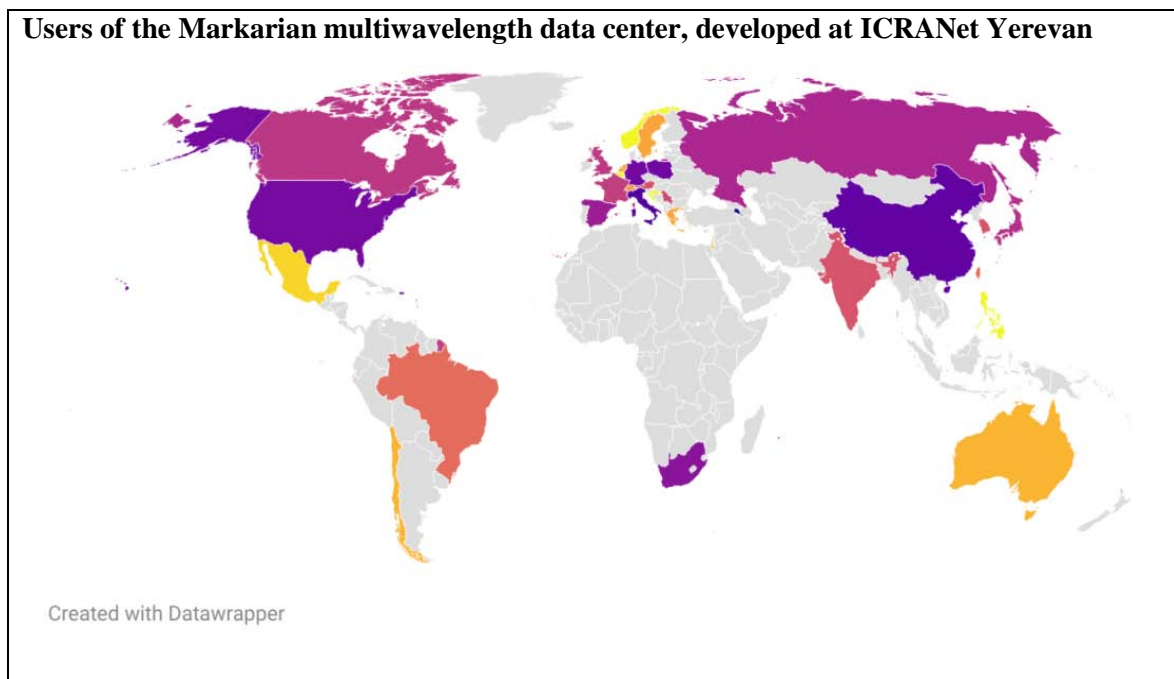
The Director notes:

1) The advance of application of Artificial Intelligence (AI) at ICRANet Yerevan and ICRANet Pescara

Artificial Intelligence (AI) is rapidly advancing and is increasingly being integrated into various scientific disciplines, including astrophysics. Its applications range from data analysis and theoretical modeling to the optimization of observational techniques. At ICRANet Yerevan and ICRANet Pescara, AI is actively utilized to enhance research in high-energy astrophysics, enabling more efficient data processing, improved modeling of astrophysical sources, and deeper insights into complex physical phenomena. In particular, a new AI-based method for modeling the multiwavelength spectral energy distribution of blazars has been developed at ICRANet Yerevan (see Report by Narek Sahakyan). Meanwhile, at ICRANet Pescara, in close collaboration with Chinese scientists, Wang Yu has developed new methods that facilitate data analysis for major scientific facilities such as LHAASO and GECAM.

Building on these experiences, ICRANet has decided to restructure all its scientific and administrative activities based on the application of AI. Weekly lectures have started, involving students at Ud'A and Universities in China (see Report on China).

Users of the Markarian multiwavelength data center, developed at ICRANet Yerevan.



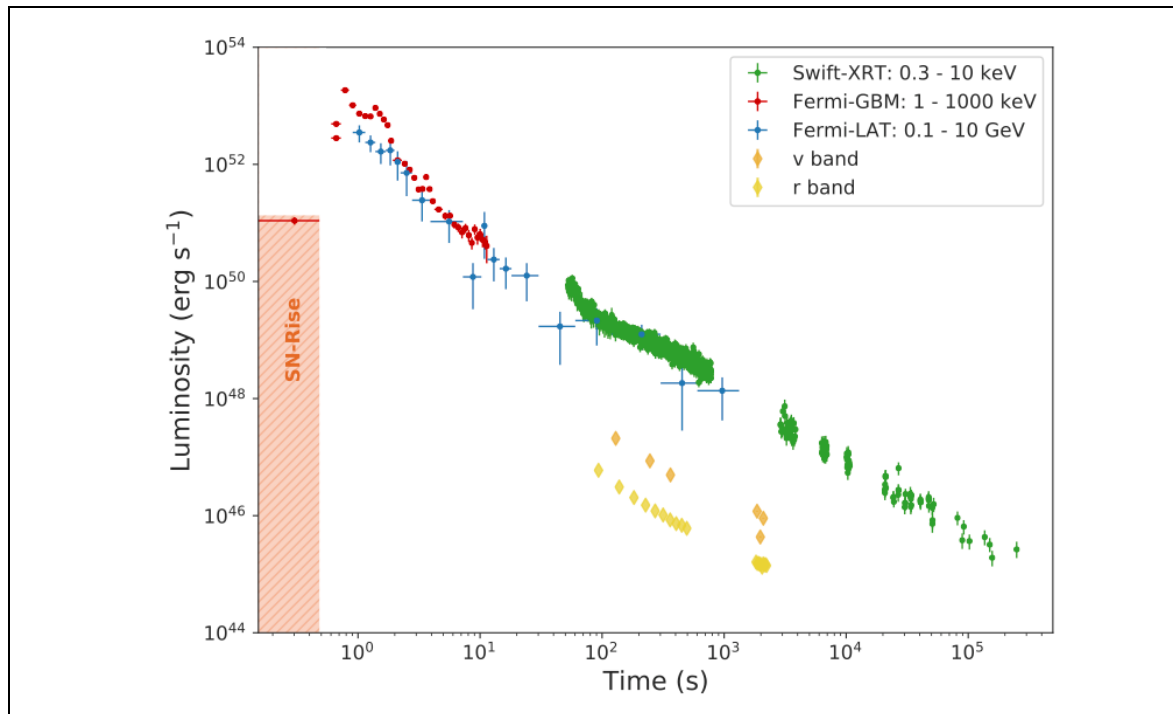
Reproduced with the kind permission of Prof. Narek Sahakyan, 2024

- Prof. Narek Sahakyan: <https://www.icranet.org/SR2024/sahakyan.pdf>
- Prof. Yu Wang report: https://www.icranet.org/SR2024/wang_yu.pdf
- Prof. Yu Wang: <https://www.icranet.org/report2024/cina.pdf>

2) GRB 240825A

Gamma-ray bursts (GRBs), discovered by the Vela satellites, were announced at the AAAS meeting in 1974 in San Francisco and recorded in the book by Herbert Gursky and Remo Ruffini (Gursky & Ruffini, 1975). They are the most powerful energy sources in the Universe. In a few seconds, their brightness is equivalent to that of all the stars in the billions of galaxies in the universe. GRBs are observed from our planet up to three events per day, and they are distributed homogeneously.

Since 2005, more than 3,000 GRBs have been followed in ICRANet Seats, with results published in about 500 articles in international journals, presented at international conferences, and edited in books and scientific magazines, guided by Roy Kerr, Jorge Rueda and Remo Ruffini. In this process, a large number of researchers and students have been educated. We privilege here the observation of GRB 240825A (Ruffini et al., 2024, GCN 37536), which exploded on August 25, 2024, promising to be a "Rosetta Stone" for understanding all GRBs, including their black hole formation in the BdHN model and their pulsar emissions associated with the supernova. This is the shortest BdHN I have ever observed, lasting only 2.4 seconds.



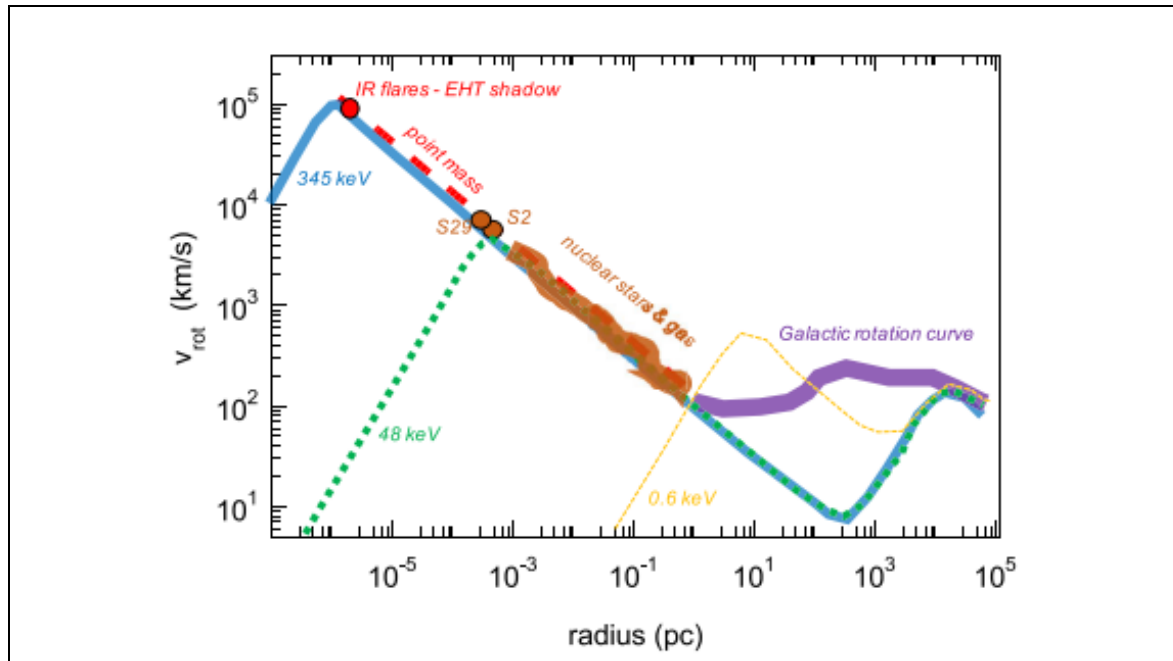
Reproduced from R. Ruffini et al, 2025

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3) Galactic Center Sagittarius A*

Prof. Remo Ruffini recalls “in 1971, just after the publication on January 1 of my article with J.A. Wheeler, **Introducing the Black Hole**, I discussed with Charly Townes at the IAS the possibility of detecting a black hole at the center of our galaxy in Sagittarius A*. I would not have expected that this initial discussion would take 53 years—punctuated by decades of publications from Genzel and Townes—alongside exceptional technological developments, leading to the “Gravity” measurements from the ESO VLT Telescope. These observations culminated in one of the most unexpected scientific results: not the discovery of a spinning Kerr black hole, as expected by Genzel, but possibly the identification of a new archetype of self-gravitating dark matter systems—pure self-gravitating fermions (X fermions) of 300 keV (see section 2 and section 6)”.

This interpretation was supported by the crucial theoretical works of ICRANet (Argüelles et al. 2018, Argüelles et al. 2019) and the work of the Ph.D. student Eduar Antonio Becerra Vergara. They demonstrated the perfect general relativity equivalence of a system of self-gravitating X fermions to a Schwarzschild black hole in Sagittarius A* (see section 4). This result was subsequently generalized to explain the flat rotation curves of galaxies, through the multi-year theoretical development of the Ruffini-Argüelles-Ruffini (RAR) model, involving the presence of 100 keV X fermions. This model introduced the concept of an underlying dark matter skeleton structures, fundamental to galactic structure, to explain the red dots (see section 6).



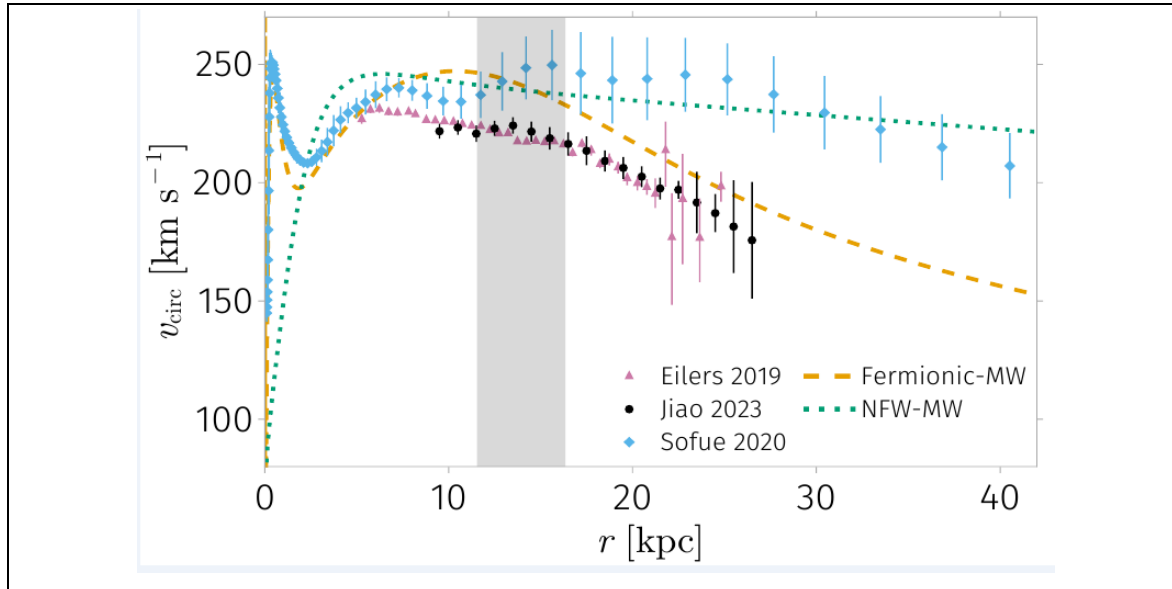
Reproduced from Fig. 10 in R. Genzel et al., 2024, by kind permission.

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4) La Plata and INOs cosmos

Dr. Carlos R. Argüelles presented the ICRANet scientific report on “Self-gravitating systems of dark matter particles” for the period 2024. The covered topics were: i) “Dark matter in the Milky Way” with 3 papers published (plus a 4th submitted) and ii) “Supermassive Black Holes: its nature and formation channels” with 2 papers published (plus a 7th submitted). In topic i) well measured stellar streams (e.g. GD-1) and S-cluster stars orbiting SgrA* were used to constraint the overall gravitational potential of the Milky Way as dominated by a fermionic dark matter component in the hundred-keV mass range. Another work was aimed to the Galaxy center to try to reproduce the relativistic images obtained by the Event Horizon Telescope for SgrA*. It was proved that dense fermion cores as predicted by the extended RAR model can produce observational signatures similar to those of black holes when illuminated by an accretion disc.

In topic 6), a new channel for supermassive black hole formation was proposed using the fermionic DM cores as black hole-seeds in the high z-Universe. Potential application to the “little red dots” as observed by the JWST Telescope was also discussed. The work done in 2024 involved the collaboration of several Ph.D students (2 of the under the direction of Dr. Argüelles), and full scientists from Argentina either from UNLP & CONICET (La Plata), and from UNC & CONICET (Córdoba); as well as from Italy within ICRANet-Ferrara and ICRANet-Pescara, with more than 9 papers published on the ICRANet Fermionic MW model in 2024, on the leadings astrophysical journals.



The rotational curves in our galaxy, included in Gaia DR3 data (Jiao et al., A&A, 2023), reproduced with the kind permission from Mestre et al., A&A, 2024.

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5) the two articles in PRL and PRR

On the single versus the repetitive Penrose process in a Kerr black hole

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(Dated: November 11, 2024)

Extracting the rotational energy from a Kerr black hole (BH) is one of the crucial topics in relativistic astrophysics. Here, we give special attention to the Penrose ballistic process based on the fission of a massive particle μ_0 into two particles μ_1 and μ_2 , occurring in the ergosphere of a Kerr BH.

Role of the irreducible mass in repetitive Penrose energy extraction processes in a Kerr black hole

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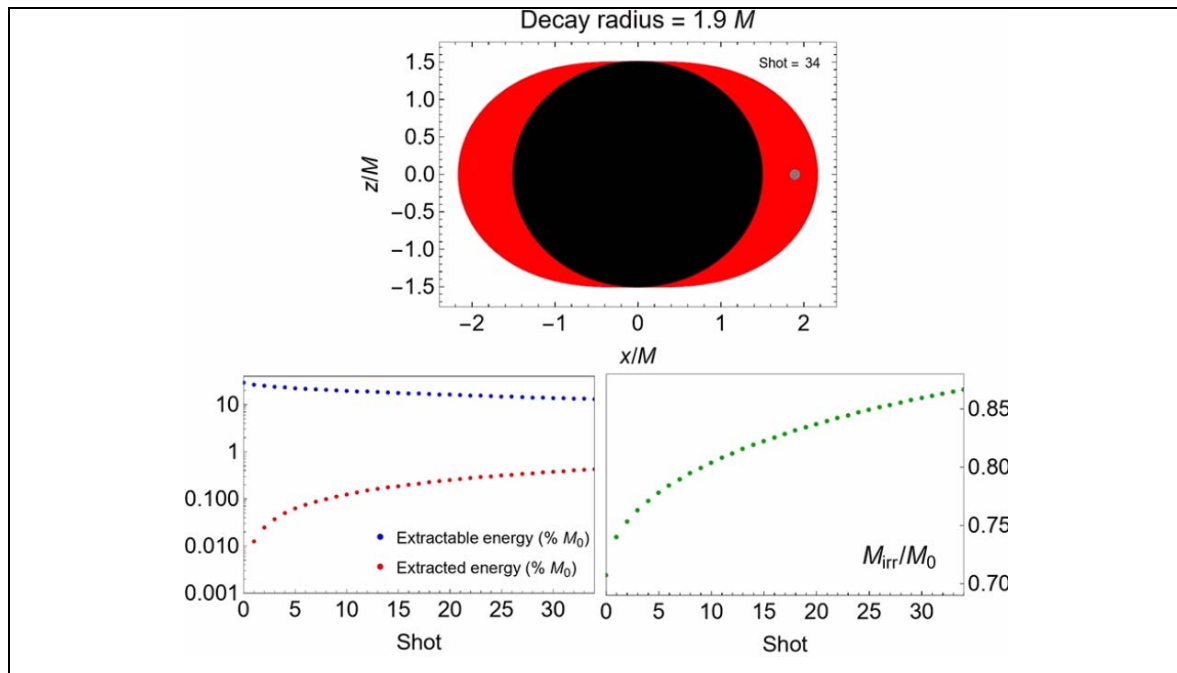
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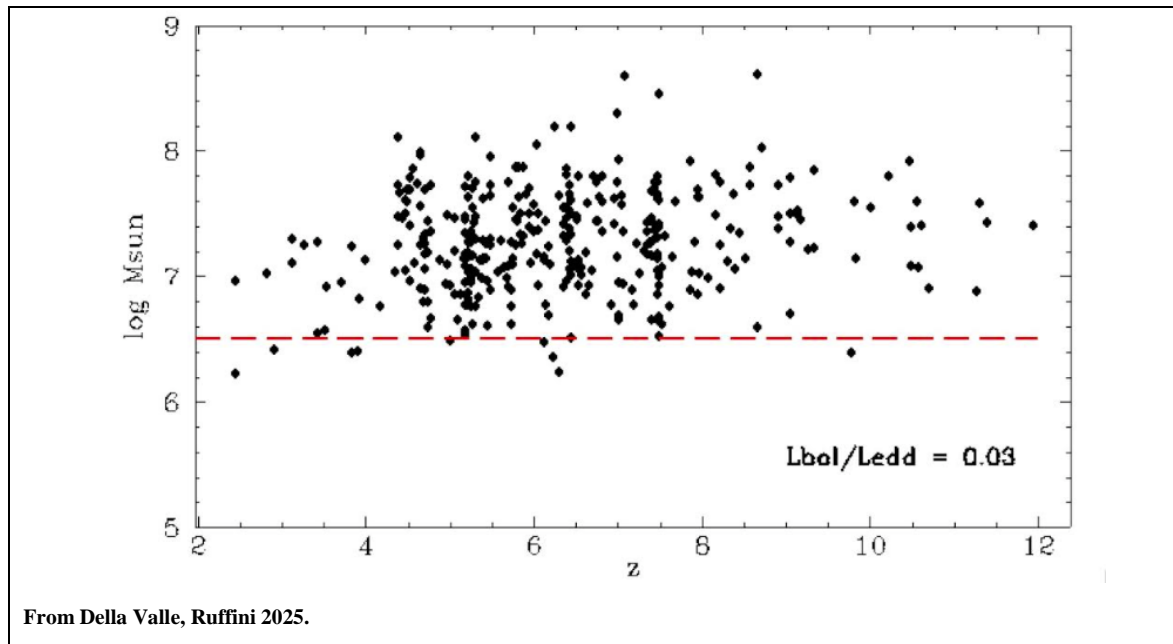
The concept of the irreducible mass (M_{irr}) has led to the mass-energy (M) formula of a Kerr black hole (BH), in turn leading to its surface area $S = 16\pi M_{\text{irr}}^2$. This also allowed the coeval identification of the reversible and irreversible transformations, soon followed by the concepts of *extracted* and *extractable* energy.



https://www.icranet.org/documents/video_dot2.mp4

6) Red dots. Sagittarius A: a “living fossil”

It was at the High Energy Astrophysics and Cosmology in the Era of All-Sky Surveys meeting (HEACOSS-2024), organized by the ICRANet center in Yerevan on October 7-11, 2024, that the exceptional presence of Luis Ho and his presentation on the “little red dots”, just discovered by the James Webb Space Telescope, galvanized the attention of all participants. The presentation by Luis Ho, in collaboration with Jenny Green, convinced us that we were witnessing one of the major discoveries in physics and astrophysics. Soon, Argüelles, Ruffini, and Rueda proposed that these objects could represent the seeds generating the massive black holes of 10^{10} solar masses at cosmological redshifts larger than 10. The determination of their masses in the range of 10^6 to 10^{10} by the group of Luis Ho and the group of Maiolino convinced us of the necessity to relate these objects to our 40 years of analysis, carried out in continuous dynamical confrontation and collaboration with the group of Reinhard Genzel and collaborators (see Sec. 3). The conclusion reached was that there was a distinct possibility that, in the Galactic Center, there is not a black hole but a system of self-gravitating fermions, each with a mass of 300 keV, which we called an “*X-Fermion*”. It was natural at this stage to strengthen our collaboration with the ICRANet group working in La Plata (see Sec. 4), and a trip to Colombia further strengthened this collaboration. The main conviction was slowly achieved that not only is the X-fermion essential to explain the nature of Sagittarius A*: a “living fossil”. An even more revolutionary conclusion was reached based on the data from Gaia: the X-fermions are actually the main constituent of the dark matter content of the Universe. We are now revisiting our previous work on inos cosmology in order to explore the effect of this mass determination on Jeans mass evolution, especially in the non-trivial aspect of deriving, from first principles, the difference between dark matter and baryonic matter in the Universe (Ruffini, Vereshchagin 2025). This approach has recently gained support from a statistical analysis establishing a lower limit on the mass of the red dots, which coincides within error bars with the mass of the self-gravitating X-fermions at the Galactic Center: $M = 4 \times 10^6$ solar masses!



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7) The 6th Galileo-Xu Guangqi meeting

Since 2009, inheriting the spirit of Galileo and Xu Guangqi, the Galileo-Xu Guangqi Meeting has built an international platform linking Eastern and Western research in relativistic astrophysics, attracting top scientists worldwide.

The 6th Galileo-Xu Guangqi Meeting (GX6) and the 2024 Annual Meeting of the Chinese Physical Society's Division on Gravitation and Relativistic Astrophysics were held from April 19 to 23 in Hengyang, China. The conference brought together over 660 participants including China, Italy, Russia, Belarus, the United Kingdom, and beyond. The event featured 23 keynote lectures and 287 specialized talks covering a wide array of topics, including black hole physics, gravitational waves, dark matter, multi-messenger astronomy, and cosmology.

GX6 significantly strengthened the partnership between ICRANet and Chinese institutions, as the University of South China formed a gravitation and relativistic astrophysics research team and signed an MOU to foster long-term collaborative research and academic exchanges.



Participants at GX6 meeting. At the center, in the first row, prof. Remo Ruffini.