Isfahan University of Technology

IUT International E-Newsletter

A Window to International Activities of IUT

Volume 3, *Special Issue*

November 2021

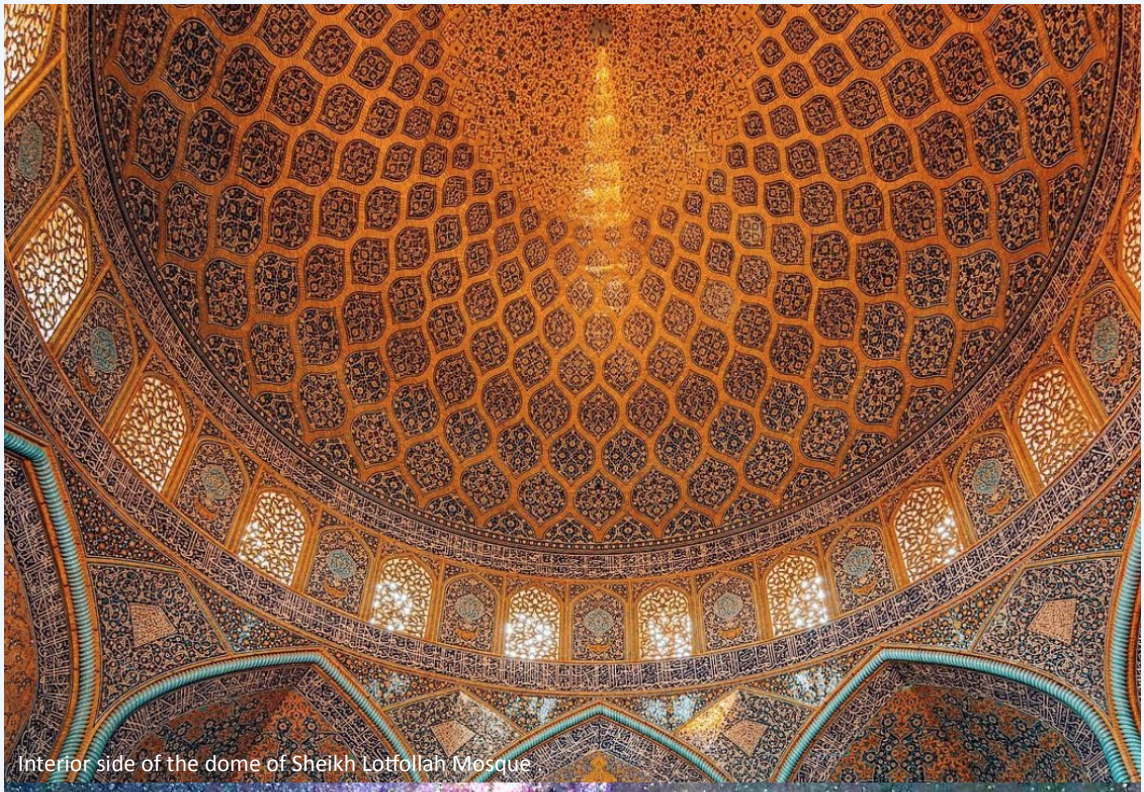
What we read in this issue:

Overview

ICRANet-ISFAHAN Astronomy Meeting

From the Ancient Persian Astronomy to Recent Developments in Theoretical and Experimental Physics, Astrophysics and General Relativity

Iran with the Ulugh Beg map of the "fixed stars" proposed by Abd al-Rahman al-Sufi (Azophi) around 964 CE has been among the first countries, centuries ago, to extend the knowledge of our Universe outside our planetary system. Persian astronomers made very important contributions to the fields of astronomy with the construction of Maragheh observatory in 1259 CE and Ulugh Beg Observatory in the 1420s. In 2021, a new generation of Iranian scientists is exploring the Universe in the Iranian National Observatory (INO).



Interior side of the dome of Sheikh Lotfollah Mosque

Iranian National Observatory (INO), Isfahan.

Overview

ICRANet-ISFAHAN Astronomy Meeting

Isfahan as a historical city in the center of Iran and as one of the world's most beautiful cities was the host of the first series of ICRANet-Isfahan Astronomy Meeting which was held virtually from 3-5 November 2021. This meeting was organized to provide great opportunities for discussing astronomy from the ancient Persian astronomy to recent developments in observational astronomy, high energy astrophysical phenomena such as Gamma-Ray Bursts (GRBs) and Active Galactic Nuclei (AGNs), Theories of Gravity, General Relativity and its Mathematical Foundation, Black Holes, Dark matter and Early Universe Cosmology. For further information about ICRANet-ISFAHAN Astronomy Meeting please visit: https://indico.icranet.org/ and for watching recorded videos please visit:
https://www.youtube.comwatchv=6nM0WwpawdM&list=PLr5RLbSWSonuzZt0K4CkKjbHuKcYgpSZl
(https://b2n.ir/a23935)

Overview

A workshop on "Data Science in Astrophysics" was held during the meeting on November 4th, and a certificate was issued to the participants who completed the tasks.

This meeting is under the aegis of the honorable Mohammad Ali Zolfigol, Minister of Science, Research and Technology (MSRT), Islamic Republic of IRAN.

Scientific Committee:

Remo Ruffini (ICRANet-Italy)**(Co-Chair)**

Yousef Sobouti (IASBS-Iran) **(Co-Chair)**

Hassan Firouzjahi (IPM,Iran)

Shahram Khosravi (KHU, Iran)

Habib Khosroshahi (IPM, Iran)

Kourosh Nozari (UMZ, Iran)

Sohrab Rahvar (SUT, Iran)

Soroush Shakeri (IUT, Iran)

Shadi Tahvildar-Zadeh (Rutgers, USA)

She-Sheng Xue (ICRANet-Italy)

Overview

Organizing Committee:


Soroush Shakeri (IUT, Iran) **(Chair)**

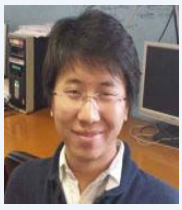

Amin Farhang (IPM and UT. Iran)

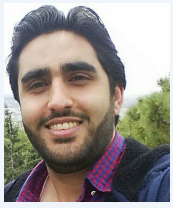

Fazlollah Hajkarim (UNIPD-Italy)


Rahim Moradi (ICRANet-Italy)


Sedigheh Sajadian(IUT, Iran)


Shahab Shahidi (DU, Iran)


Wang Yu (ICRANet, Italy)


M. H. Zhollideh Haghighi(IPM,KNTU, Iran)

The Welcoming Speeches

Message of the Esteemed Minister of Science, Research and Technology of the Islamic Republic of Iran, His Excellency Professor Mohammad Ali Zolfigol on the Occasion of the ICRANet-Isfahan Astronomy Meeting, 3-5 November 2021.

Professor Mohammad Ali Zolfigol
Minister of Science, Research and Technology of the Islamic Republic of Iran

In the Name of the Most High
Distinguished Scholars and Scientists,
Esteemed participants,
Ladies and gentlemen,

I feel proud and privileged to address this august gathering to those who have come together to recount some of the most intriguing and astonishing aspects of our Universe within the framework of what we have come to call astronomy, from the ancient times to the present. It is, therefore, quite befitting that the ICRANet-Isfahan Astronomy Meeting is being held in the ancient, beautiful, and historical city of Isfahan hosted by our colleagues at Isfahan University of Technology. We only regret that our distinguished guests are not here to be able to experience Isfahan in person.We, at the Ministry of Science, Research and Technology, consider the ICRANet-Isfahan Astronomy Meeting a significant event and hope that will mark the beginning of many research projects and collaborations both here and abroad.

My special thanks go to the Director of the International Centre for Relativistic Astrophysics Network, Professor Remo Ruffini, and his colleagues for converging on Isfahan. I trust that the ICRANet-Isfahan office at IUT will become an active hub that would serve to establish lasting links between Iranian astronomers and their new partners in the whole network. The Ministry of Science, Research, and Technology fully supports the scientific endeavors of ICRANet and Iranian astronomers.

I understand your scientific organizers have planned to have a glance at the history of ancient astronomy in Iran as well as the modern one practiced in Iranian universities and research centers. This is a very thoughtful provision and will allow you, scholars, to better assess the potentials of your colleagues for more extensive collaborative research and on a personal note, I assure you of the full support of the Ministry in this respect. In fact, in the past decade, it has been a deliberate and publically announced policy of the Ministry to urge and support the universities administratively and financially to go international.

I hope that your deliberations in this meeting will bear fruitful results leading to continued collaborations between Iran and ICRANet and especially between Iran and Italy, a country with which we have had deep historical ties well before its modern nationhood in the mid-nineteen century and with those people we share many cultural commonalities.

Finally, I am certain that you will join me in hoping that the future ICRANet- Isfahan meetings will take place face-to-face so that in addition to academic exchanges, our guests will be able to feast their eyes on the wonderful architecture of the numerous monuments of this wonderful city.

Mohammad Ali Zolfigol,
Minister Science, Research and Technology,
Islamic Republic of Iran

Message of Professor S. M. Abtahi, the honerable President of Isfahan University of Technology, for the Oppening Session of ICRANet-Isfahan Astronomy Meeting, Nov. 3rd, 2021.

Professor S. M. Abtahi, President of Isfahan University of Technology, (IUT)

In the Name of God

Dear scholars and scientists, honorable guests, ladies, and gentlemen;

On behalf of Isfahan University of Technology, it is my great pleasure to welcome and thank the eminent speakers and all the participants today for the three-day ICRANet- ISFAHAN Astronomy Meeting. I would also like to sincerely thank the organizers of this event, the Director of the International Centre for Relativistic Astrophysics Network, Professor Remo Ruffini, and his colleagues and also our colleagues at IUT Department of Physics.

Astronomy is one of the earliest sciences in the world and historical records of astronomical measurements date back to about 5000 years ago. IRAN, since centuries ago, has been among the first countries to develop this science. Ancient astronomy in Iran has created a solid ground for modern research work in Iranian universities and research centers.

Isfahan University of Technology, as one of the leading universities in Iran, was founded about 40 years ago. Today, IUT is ranked among the top Asian Universities by International standards. IUT has 14 departments with about 11000 students and 600 faculty members and offers four disciplines of engineering, basic sciences, agriculture, and natural resources.

Isfahan University of Technology was the first Iranian institution that signed an agreement with ICRANet in 2016. Since then, we have enjoyed many collaborations such as exchanging students and faculty members. We have had several joint activities including joint webinars on different astrophysical occasions.

Isfahan University of Technology participated actively in the last Marcel Grossmann Meeting (MG18) which is one of the greatest meetings related to relativistic astrophysics, gravitation, and cosmology. IUT organized a parallel session in Dark Matter Searches in that great meeting. Iranian scientists and IUT members have made remarkable contributions to this field of science with various publications in highly ranked scientific journals in past years.

I hope Iran would become a member state of ICRANet in a near future. We are interested in establishing joint degree programs with ICRANet member institutions and playing a major role in IRAN's academic realm and scientific activities in astrophysics in collaboration with ICRANet.

Today, we are very proud to host the ICRANet-Isfahan Astronomy Meeting in the beautiful and historical city of Isfahan. We are hosting more than 32 invited speakers and participants from more than 16 countries.

I hope that your debate and networking in these meetings will result in continued collaborations and create new opportunities for more joint activities between Iran and ICRANet.

We will be proud to organize the future ICRANet-Isfahan meeting series every 3 years at Isfahan University of Technology. We hope to see every one of you here in 2024 in person so that you would enjoy the magnificent beauties of the city of Isfahan.

Once again, I appreciate your participation in this international event held by ICRANet and IUT, and hope it will open up new ways for future scientific collaboration between our institutions. I sincerely hope you will enjoy today and the next two days of deliberations and networking.

Thank you very much for your participation!

Message of Professor Remo Ruffini, the Honerable Director of ICRANet, for the Opening Session of the ICRANet-Isfahan Astronomy Meeting- November 3, 2021.

Professor Remo Ruffini, Director of ICRANet

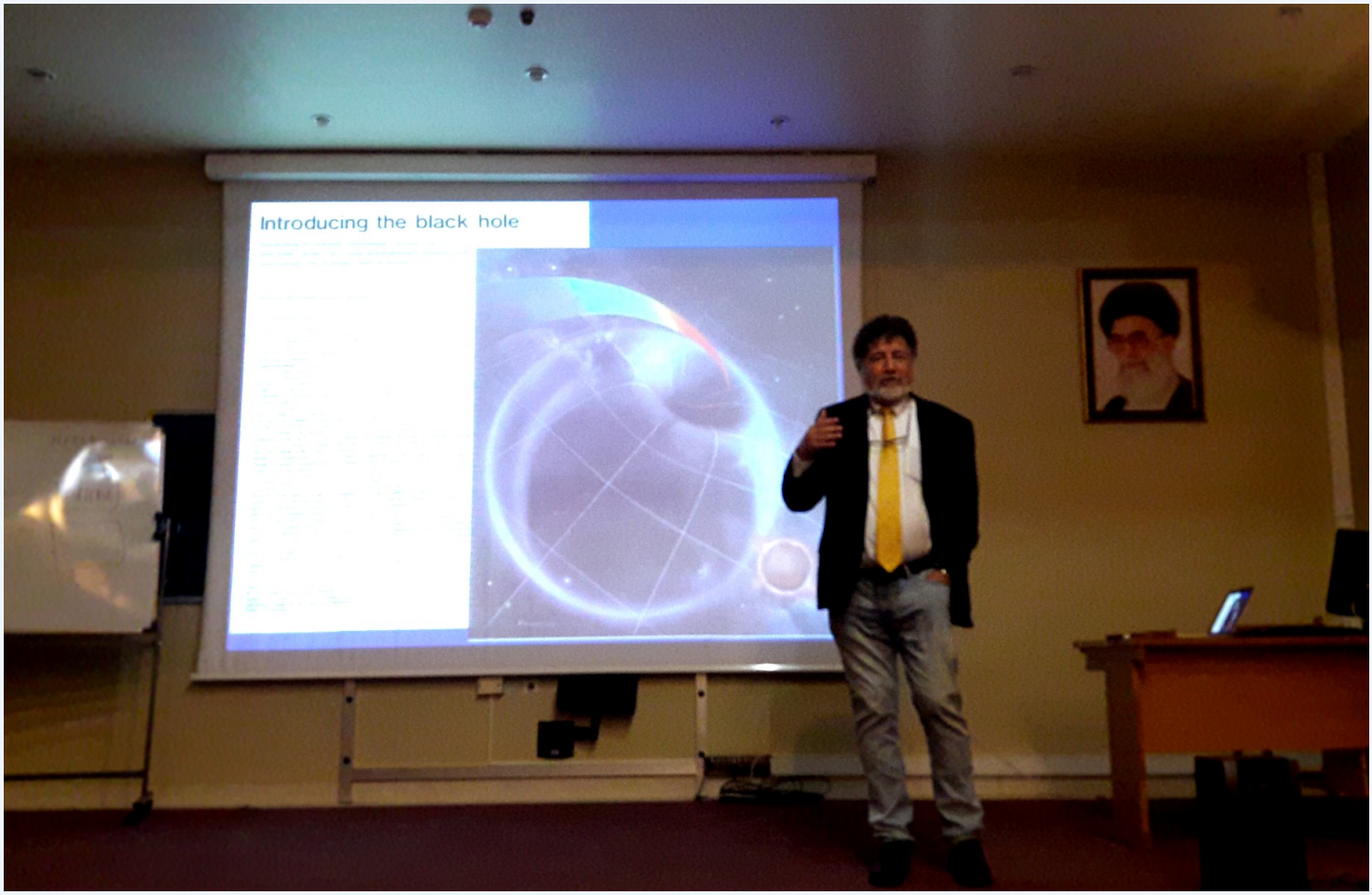
I always remember with great pleasure my first journey to the Islamic Republic of Iran, when I visited the Biruni Observatory, created by Prof. Bob Koch and by Ed Guinan from the University of Pennsylvania, at the University of Shiraz. The Observatory is located on the mountains, overlooking the beautiful town of Shiraz. Since then, I had the great pleasure to continue my many interactions with Prof. Yousef Sobouti, repetitively in Rome, at ICRANet center in Pescara as well as at the Institute for Advanced Studies in Basic Sciences (IASBS) in Zanjan. I admired the structure of that Institute: it has the serenity, like the Institute for Advanced Studies in Princeton used to have, offering the possibility to access the library day and night and open to everyone: this is becoming a rare and beautiful example on planet Earth. In the meantime, ICRANet has signed collaboration agreements with many Universities and researches Institutes in the Islamic Republic of Iran:

- Alzahra University
- Damghan University
- Institute for Advanced Studies in Basic Sciences (IASBS)
- Institute for Research in Fundamental Sciences (IPM)
- Isfahan University of Technology (IUT)
- Sharif University of Technology (SUT)
- Shiraz University
- University of Mazandaran

The ICRANet – IUT collaboration has been started since 2010, with more than 8 PhD students who came to ICRANet for short and long visit periods, jointly supported by ICRANet and by the Ministry of Science, Research, and Technology of the Islamic Republic of Iran. In addition, we have in ICRANet as Adjunct Professor, Soroush Shakeri and, as a full Professor, Rahim Moradi. We promoted an intense visiting program for short periods from many of the Universities with which we have signed collaboration agreements. The novelty is that we have enrolled 2 new graduate students from the Islamic Republic of Iran (one from the University of Mazandaran and one from Alzahra University). Both are registered at the International joint PhD in relativistic astrophysics (JIRA PhD), recently established between the University of Ferrara (UNIFE) and the University of Sciences and Technology of China (USTC), with the collaboration both of ICRANet and ICRA.

Following this experience, it has been particularly significant to hold this meeting under the aegis of H.E. Mohammad Ali Zolfigol, Minister of Science, Research and Technology of the Islamic Republic of Iran. I was particularly honored to transmit to him the message sent to his predecessor, with the unanimous approval by the ICRANet Steering Committee of the possibility for the Islamic Republic of Iran to join ICRANet as a Member State. We look forward to seeing progresses between the Islamic Republic of Iran and the Republic of Italy, depositary of the ICRANet agreement. Since its establishment, I have always encouraged the collaboration between ICRANet and all countries. We assume that fundamental scientific knowledge has a universal value: it is politically neutral and it is a driving force for the development of mankind through international cooperation.

I'm extremely happy to thank everybody, especially Prof. Soroush Shakeri from Isfahan University of Technology, its President, Professor S. M. Abtahi, as well as Prof. Yousef Sobouti to have prepared such a remarkable program, which occurs on the celebration of the 50th anniversary of the introduction of the Black Hole. The key message is that, after 50 years, we finally observed the Black Holes and we can really assert what my dream was 50 years ago: Black Holes are alive and we see their actions, their emissions all over the spectrum, from the radio to the optical in X-ray, in Gamma Rays and in TeV radiation. We are learning by the observations all over the Universe to the depth of 15 billion light years of distance, the fundamental science which we were unable to learn before on Planet Earth. Some of these results will be presented in this outstanding meeting.



Prof. Remo Ruffini in a visit from the Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan.

Astronomy in Iran, an Update, 2021

How was the Modern Astronomy Introduced into the Iranian Universities

Prof.Yousf Sobouti
Institute for Advanced Studies in Basic Sciences- zanjan (IASBS) And Iran Academy of sciences (IAS)

What I present here today to this august body of audience is an update of what I have done in 2006 in the IAU Special Session for Astronomy in the developing world.

In spite of her renowned pivotal role in the development of astronomy on the world scale during the 9th to 15th centuries, Iran's rekindled interest in modern astronomy is a recent happening. Since the late 18th and early 19th centuries amateurs and philanthropists have promoted modern astronomy by their writings and translations of astronomical literature. Small telescopes were available for watching the sky, if not for any scientifically planned project. The University of Tehran (UT) is established in 1935. Celestial mechanics was taught in its Mathematics Department. Solar physics and special theory of relativity were the regular courses in the Physics Department. I myself learned the basics of the special theory of relativity in our classical mechanics' course and the rudiments of the Riemannian geometry and curved spacetimes in my math physics courses.

A breakthrough in the introduction of space physics to the Iranian Society came with the creation of the Geophysics Institute (GI) of UT in the 1950's. A modest solar observatory equipped with small solar telescopes and appropriate H, IR, and UV filters was established. The late Dr. Alinush Terian, a gracious Iranian-Armenian lady was in charge of the operation of the observatory. In the late 1950, with the sponsorship of Prof. H. Keshi Afshar, Director of GI, Iran became a member of the International Astronomical Union (IAU). In the early years, Dr. Terian was representing Iran in IAU.

Serious attempts to introduce astronomy into university curricula and to develop it into a respectable and worthwhile field of research began in the mid-1960's. The pioneer was Shiraz University which should be credited for the first few dozen of astronomy- and astrophysics- related research papers in international journals, for training the first half a dozen of professional astronomers, and for creating the Biruni Observatory (BO). Here I take the opportunity to acknowledge the valuable advice of Bob Koch and Ed Guinan of the University of Pennsylvania in the course of the establishment of this observatory. The Observatory celebrated its 40th anniversary in 2017. It is renovated under the directorship of Dr. Moin Musleh. Presently, BO is the only operating astronomical observatory in the country.

At present the astronomical community of Iran including cosmologists consists of about 550 professionals, roughly half university faculty members, and half MSc and PhD students. According to the Web of Science, the scientific contribution of its members in 2021 exceeded 4500 papers in reputable international journals. This is slightly lower than one percent of the scientific contribution of Iran, ~48000 in 2020.

Among the existing observational facilities, Biruni Observatory with its 51cm Cassegrain, OCD cameras, photometers and other smaller educational telescopes, is by far the most active place. A number of smaller observing facilities exist in Tabriz, Meshed, Isfahan, Zanjan, Tehran, Babol and other places.

In addition to the optical observatory, the first cosmic ray observatory was established by Jalal Samimi in the 80s at Sharif University of Technology (SUT). The observatory is working based on plastic scintillators and Cherenkov radiation. More than 10 Ph.D. students finished their thesis working with these instruments. Recently the University of Semnan also developed its astroparticle detectors.

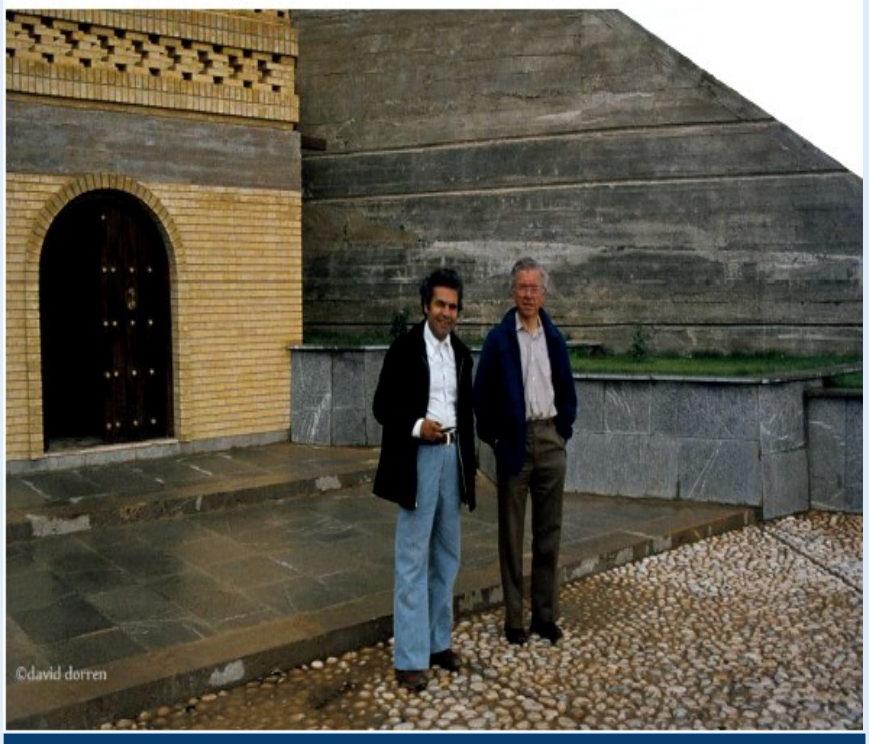
The cosmology group of SUT is an internationally recognized research team. Initiated by R. Mansouri and followed by his students, the group works mainly on structure formation and early universe.

Also, since 2008, S. Rahvar of SUT and his students are collaborating with an international observational project on exoplanet detection. In the past 20 years, astronomers of Iran have staged an intensive campaign to have an Iran National Observational (INO) of their own. The initial planning was for a 2-m class telescope with CCD-based instrumentation. Thanks to Reza Mansouri from Sharif University the plan was updated to 3.4 m Cassegrain. We hope to have its first light in about 10 months. The present Director of INO is Habib Khosroshi, PhD from IASBS-Zanjan. The site selection for INO was done by an international team of advisor and a team of ... experts from the Institute for Advanced Studies in Basic Sciences headed by S. Nasiri, PhD, Shiraz University.

The astronomical society of Iran (ASI), though some 45 years old, has expanded and institutionalized its activities since 1990's. ASI sets up seasonal schools for Novices, organizes annual colloquia and seminars for professionals and supports a huge body of amateur astronomers from among high schools and university students. Over 30 of 420 ASI members are also members of IAU and take active part in its events.

Last but not least, "Nojum", the Farsi word for astronomy, is the only astronomical monthly magazine of the Middle East. Nojum is founded by Reza Mansouri and a team of Nojum lovers from among his circle. Nojum celebrated its thirtieth the last sprig.

Thanks for attention



Prof. Yousef Sobouti, the then Director of Biruni Observatory with Prof. Sir Fred Hoyle, October 1977, Shiraz.

Biruni Observatory, Shiraz.

Geographical Dispersion of Participants

The ICRANet-Isfahan Astronomy Meeting was arranged by inviting 33 prominent speakers from 16 different countries including Iran, Italy, Germany, United States of America (USA), United Kingdom (UK), Sweden, Russia, China, France, Armenia, Kazakhstan, NewZealand, Chile, Denmark, Argentina, Australia.

More than 190 participants and attendees registered in the meeting which provided a very active scientific atmosphere with fruitful discussions. There were participants from Iran, Italy, Iraq, India, Bangladesh, Pakistan, Poland, Brazil, South Africa, Germany, USA, UK, Sweden, Russia, Taiwan, France, Armenia, Kazakhstan, Australia.

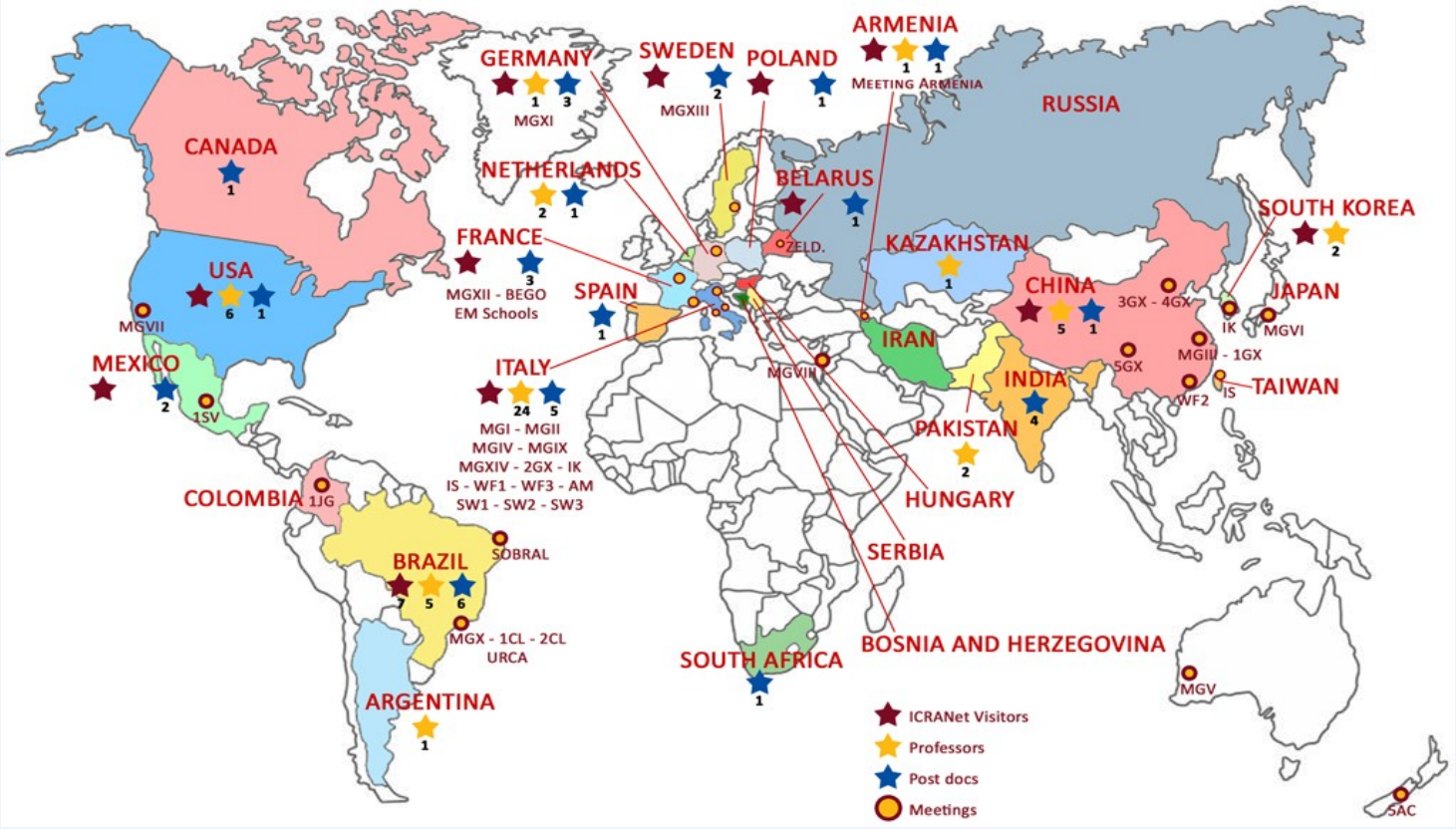
History of ICRANet at a Glance

ICRANet, the International Center for Relativistic Astrophysics Network, is an international organization promoting research activities in relativistic astrophysics and related areas. ICRANet was founded in 1985 by renowned Italian physicist Remo Ruffini, Professor Riccardo Giacconi (winner of the Nobel Prize for Physics in 2002), Professor Abdul Salam (winner of the Nobel Prize for Physics in 1979), Professor Paul Boynton (professor at George Washington University), and several other leading physicists. Professor Remo Ruffini has been the director of this research institute since 2005.

ICRANet Seats and Centers

ICRANet members are four countries and three Universities and Research Centers. The members are the Republic of Armenia, the Federative Republic of Brazil, the Italian Republic, the Vatican State, the University of Arizona (USA), Stanford University (USA), and ICRA. The headquarters is located in Pescara, Italy. ICRANet has signed collaboration agreements with over 60 institutions, universities, and research centers in different countries. One of the chief responsibilities of ICRANET is to help the growth and development of international activities in the field of relativistic astrophysics and other fields related to physics in different countries. Currently, ICRANet has several operative centers such as:

- ICRANet headquarters in Pescara, The Physics' Department of University "La Sapienza" in Rome, (Italy)
- The Presidium of the Armenian National Academy of Sciences (Yerevan, Armenia)
- Isfahan University of Technology (Isfahan, Iran)
- National Academy of Sciences of Belarus (Minsk, Belarus)



Map of the Institutions worldwide which signed an agreement with ICRANet, with the corresponding exchanges of professors, researchers and post-docs, as well as with the joint meetings organized.

ICRANet-IRAN Collaboration

Some leading Universities and Institutes in Iran are now collaborating with ICRANet, and some additional ones have requested to collaborate, the ones with signed agreements are:

- Alzahra University
- Institute for Advanced Studies in Basic Sciences (IASBS)
- Institute for Research in Fundamental Sciences (IPM)
- Isfahan University of Technology (IUT)
- Sharif University of Technology (SUT)
- Shiraz University (SU)
- University of Mazandaran (UMZ)
- Damghan University (DU)

ICRANet–Isfahan Overview

Isfahan University of Technology (IUT), as one of the leading universities in Iran, is founded in 1974 and started its academic activities in 1977. IUT is one of the pioneers among the National universities and has been ranked among the top Asian Universities in the International University Rankings. IUT has 14 faculties and departments with about 11000 students and 600 academic members and offers four disciplines of engineering, basic sciences, agriculture, and Natural resources in all three study levels of BSc, MSc, and PhD.

Prof. Remo Ruffini, director of the International Center for Relativistic Astrophysics Network (ICRANet), Italy, and Dr. Narek Sahakiyan, the director of ICRANet-Armenia center, visited IUT on December 20 and 21, 2016. Following this meeting, the ICRANet Office in Isfahan University of Technology (IUT) has been inaugurated by Prof. Ruffini and Prof. Modarresh Hashemi, the then president of IUT, during a formal opening ceremony. The main purposes of establishment of this office that is located at the Department of Physics of IUT are developing research activities in relativistic astrophysics, organizing workshops and schools, exchanging researchers, faculty members, and graduate students. The establishment of this office is following the past scientific collaboration between IUT researchers and students with ICRANet.

IUT- ICRANet Collaboration

The IUT-ICRANet collaboration started from 2010, with more than 8 PhD students who went to ICRANet for short and long visit periods, jointly supported by ICRANet and by the Ministry of Science, Research and Technology of the Islamic Republic of Iran. There have been several joint activities between ICRANet and IUT including joint webinars on different astrophysical occasions. IUT and ICRANet members have made remarkable contributions to the field of relativistic astrophysics with various publications in highly ranked scientific journals in past years.

Saghar Batebi

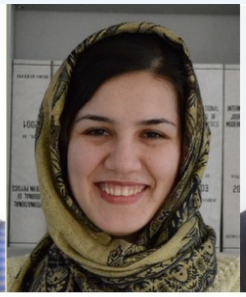
19 of November 2014 to 19 of May 2015

Rohollah Mohammadi

3 of March to August 2010

Ehsan Bavarsad

9 of February to 9 of March 2011



Seddigheh Tizchang

19 of November 2014 to 19 of May 2015

Rashid Riahi

24 of August 2016 to 8 of February 2017

Iman Motie

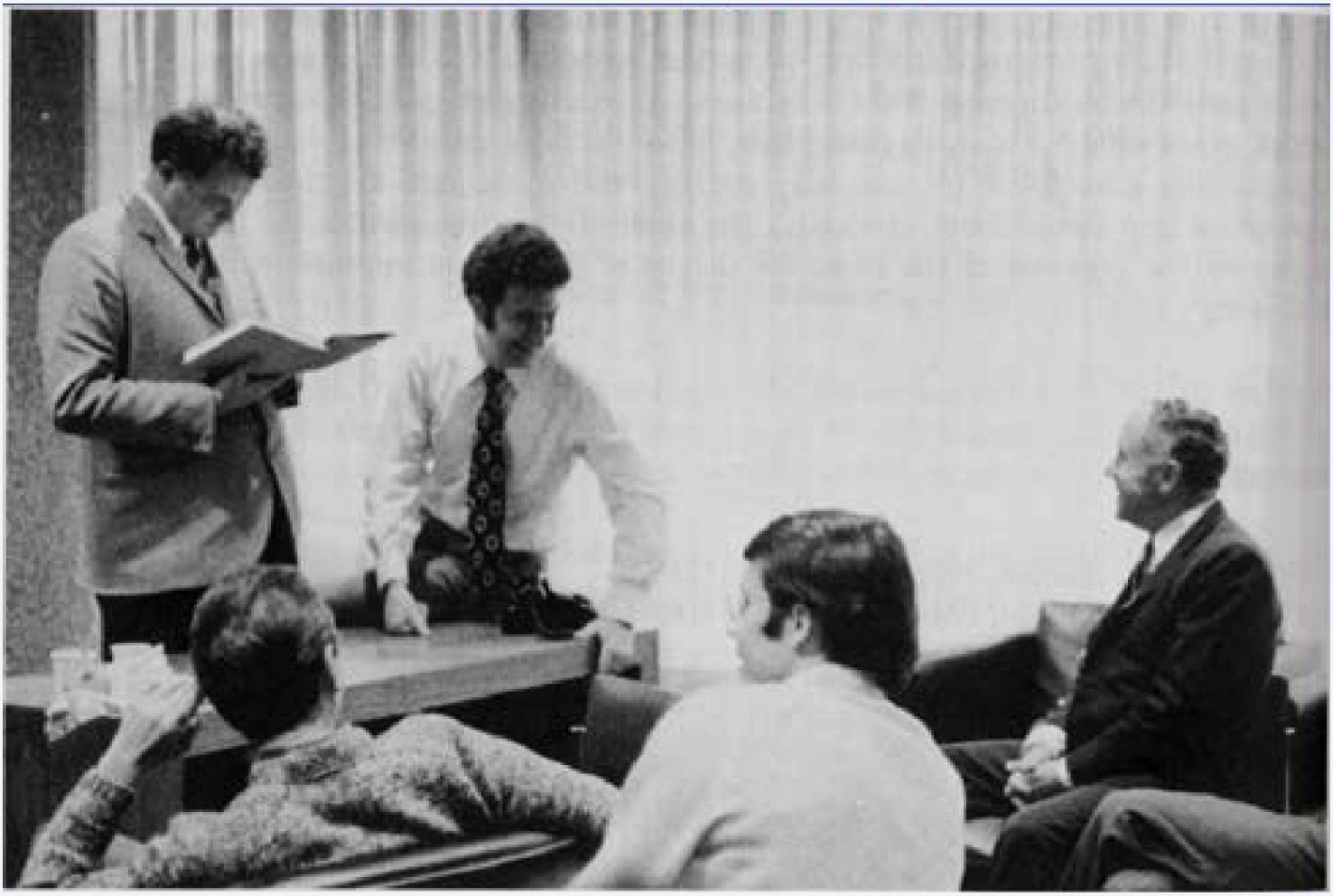
1 of October 2010 to 28 of February 2011

From left to right: She-Sheng Xue, Wang Yu, Remo Ruffini, Rahim Moradi, Soroush Shakeri and Razie Pakravan

On the nature of the ultrarelativistic prompt emission phase of GRB 190114C and GRB 180720B

Prof. Remo Ruffini (ICRA/ ICRANet/ INAF)

ICRANet-Isfahan Astronomy Meeting, November 3, 2021



On the 50th anniversary of "Introducing the Black Hole", we have reached a new understanding of Gamma-Ray Bursts (GRBs). One of the main unexpected results has been the discovery, by the Fermi satellite, of the ultra-relativistic prompt emission phase (UPE emission) in GRB 190114C and GRB 180720B. We are illustrating the path to this discovery as well as the conceptual development of the quantum and classical electrodynamics process, ranging down to 10-15 seconds. This represents progress in the terra incognita of the very short time scale of a GRB, both in the classical and quantum domain and indicates new fundamental physical regimes, previously unknown on our planet Earth.

Speakers List:

Shahram Abbassi
Ferdowsi University of Mashhad and IPM, Iran

Hossein Haghi
IASBS-Iran

Yerlan Aimuratov
Fesenkov Inst.,
Kazakhstan

Fazlollah Hajkarim
UNIPD-Italy

Lorenzo Amati
Italian National Institute for Astrophysics (INAF) - OAS Bologna, Italy

Lucca Izzo
University of Copenhagen, Denmark

Massimo Della Valle
Italian National Institute for Astrophysics (INAF) - Capodimonte Astronomical Observatory, Italy

Richard Kerner
Sorbonne University, France

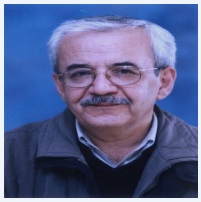
Laura Becerra
PUC, Chile

Roy Patrick Kerr
University of Canterbury, New Zealand and ICRANet, Italy

Kuantay Boshkaev
Al-Farabi Univ., Kazakhstan

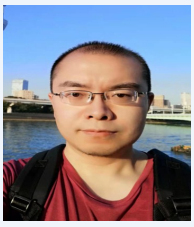
Habib Khosroshahi
Iranian National observatory (INO), IPM, Iran.

Carlos Arguelles
Univ. La Plata,
Argentina



Hossein Masoumi Hamedani
Iranian Institute of Philosophy, Iran

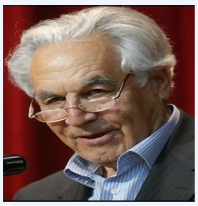
Pierluca Carenza
Stockholm University, Sweden



Ruoyu Liu
NJU, China

Speakers List:

Rahim Moradi
ICRANet-Italy



Yousef Sobouti
IASBS-Iran

Roberto Peron
Italian National Institute for Astrophysics (INAF), Italy

Lee Spitler
Macquarie University, Australia

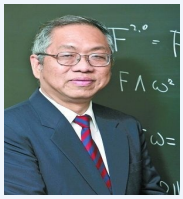
Jorge Rueda
ICRANet, Italy

Clement Stahl
Strasbourg University, France

Remo Ruffini
ICRANet, Italy

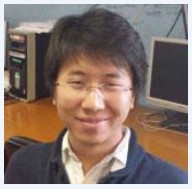
Shadi Tahvildar-Zadeh
Rutgers University, USA

Hossein Safari
University of Zanjan, Iran



Shing-Tung Yau
Harvard University, USA and Yau Mathematical Sciences Center, China

Fatemeh Tabatabaei
IPM, Iran

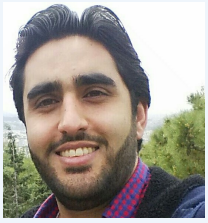


Wang Yu
ICRANet, Italy

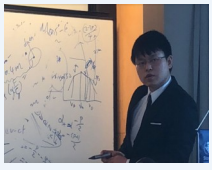
Narek Sahakyan
ICRANet-Armenia

Alexander Zakharov
BLTP, JINR, Dubna, Russia

Soroush Shakeri
Isfahan University of Technology, ICRANet-Isfahan, Iran



M. H. Zhollideh Haghighi
IPM and KNTU, Iran



Liang Li
ICRANet, Italy

Abstract of Lectures

Date: Wednesday 3 November 2021

Chair Persons: Prof. Sohrab Rahvar (SUT, Iran) , Prof. Carlo Luciano Bianco (ICRANet, Italy), Prof. Habib Khosroshahi (Iranian National Observatory (INO), IPM, Iran), Prof. Gregory Vereshchagin (ICRANet, Italy)

Prof.Habib Khosroshahi
IPM, Iran

Iranian National Observatory; Status and Vision

Iranian National Observatory (INO) is located on Mt Gargash at 3600m covering a gap in the longitude distribution of modern mid-size telescopes. The INO project is now in its final stage of completion and is approaching the first light. Major milestones including the civil construction, installation of the dome, manufacturing of the 3.4m optical telescope, and installation of the telescope at the site have been completed. The telescope is going through engineering tests aimed at the commissioning of the pointing and tracking. A suite of instruments has been planned, taking advantage of a sub-arcsecond seeing and the longitude, including a high-resolution imaging camera and a spectrograph with the ability to switch between the instruments in response to transient events. INO offers a platform for regional and international collaborations in astronomy and cosmology.

The Huntsman Telescope-a Canon lens array designed for low surface brightness imaging

In this talk, I give an update about the Huntsman Telescope, new astronomy observing system that makes use of an array of 10 Canon lenses to take images of extremely faint astronomical sources. Inspired by the Dragonfly Telephoto Array, the system is designed to better understand galaxy evolution through the study of low surface brightness structures. I'll describe the science motivation, show preliminary data, and give an update on how the commissioning of the system at Siding Spring Observatory, Australia. I'll also review other initiatives with Huntsman, including a sub-second transient detection mode. https://huntsman.space/

Prof. Lee Spitler
Macquarie University, Australia

Prof. Massimo Della Valle
Apodimonte Astronomical Observatory - INAF, Naples, Italy

Supenovae (SN) - Gamma-ray Burst (GRB) Connection

We review the observational status of the supernova/gamma-ray burst connection. Present data suggest that SNe associated with GRBs form a heterogeneous class of objects including both bright and faint hypernovae and perhaps also `standard' Ib/c events. Evidence for an association with other types of core-collapse SNe (e.g. IIn) is much weaker. After combining the local GRB rate with the local SN-Ibc rate and beaming estimates, we find the ratio GRB/SNe-Ibc in the range ~0.5-4%. In most SN/GRB associations so far discovered, the SN and GRB events appear to go off simultaneously. In some cases, data do not exclude that the SN explosion may have preceded the GRB by a few days. Finally, we discuss a number of novel questions started by recent cases of GRB-SN associations.

Abstract of Lectures

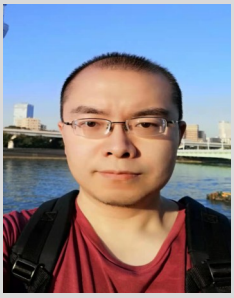
Date: Wednesday 3 November 2021

Prof. Lucca Izzo
University of Copenhagen, Demark

Gamma-ray Bursts in the Optical Domain

I will give a bird's eye view on GRBs from the optical perspective, my talk will be a general introduction to GRB astrophysics, with main focus on the observational aspects. I will start with an introduction to the GRB phenomenon and then will move soon to talk about my activity as GRB observer, using some of the largest telescopes in the world. I will show some data, mainly spectra and light curves, and possible applications with these data. Last, I will talk briefly about GRB host galaxies.

Origin of High-energy Galactic Cosmic Rays: Implication from Recent Ultrahigh-energy Gamma-ray Observations



Prof. Ruoyu Liu
Nanjing University | NJU, China

Observations of gamma-ray emission with energy above 100 TeV is a useful probe of the long-sought PeV cosmic-ray sources. In this talk, I will briefly review recent observations by the LHAASO, HAWC, and ASgamma experiments on sources and diffusive emission with energy above 100 TeV, and then discuss their implications for the origin of high-energy Galactic cosmic rays.

Multiwavelength and Multimessenger view of blazars

Prof. Narek Sahakyan
ICRANet-Armenia

I will discuss the recent progress in multiwavelength and multimessenger observations of blazars and the current status of the theoretical models applied to model their emission. Blazars, the most extreme subclass of AGN having jets that move relativistically towards the observer, are characterized by highly variable non-thermal emission across the entire electromagnetic spectrum, from radio up to very high energy gamma-ray bands. The emission properties of blazars in the spectral and time domains will be presented and discussed using the data collected from their observations in optical/UV, X-ray, and gamma-ray bands. In addition, the recent progress in the observations of very high-energy neutrinos from blazars will be discussed.

Abstract of Lectures

Date: Wednesday 3 November 2021

Prof. Lorenzo Amati
Italian National Institute for Astrophysics (INAF) - OAS Bologna, Italy

Cosmology with Gamma-Ray Burst

Gamma-Ray Bursts constitute one of the most fascinating and relevant phenomena in modern science, with strong implications for several fields of astrophysics, cosmology, and fundamental physics. In this review, I will focus on the perspective key role of GRBs for cosmology. Indeed, the huge luminosity, the redshift distribution extending at least up to z~10, and the association with the explosive death of very massive stars make long GRBs (i.e., those lasting up to a few minutes) potentially extremely powerful probes for shedding light on the main open issues in our understanding of the early Universe: star formation rate evolution up to the first generation of stars (pop-III), cosmic reionization, luminosity function and metallicity evolution of primordial galaxies up to the "cosmic dawn". At the same time, interesting correlations between luminosity / radiated energy and spectral photon peak energy are subject of intensive investigations for "standardizing" GRBs and using them for measuring cosmological parameters, investigating the nature and evolution of "dark energy" and testing non-standard cosmological models. I will also report on the status, concepts, and expected performances of space mission projects aiming at fully exploiting these unique potentialities of the GRB phenomenon, thus providing an ideal synergy with the large e.m. facilities of the future like LSST, ELT, TMT, SKA, CTA, ATHENA.

Black Hole Hyperaccretion Disks and Gamma-ray Bursts

Prof.Shahram Abbassi
Ferdowsi University of Mashhad, Iran

Gamma-ray bursts (GRBs) are the most luminous explosions in the Universe, and their origin and mechanism are the focus of intense research and debate. Black hole hyperaccretion model is one of the plausible candidates for the central engine of gamma-ray bursts and their activity is supposed to result in complicated explosion phenomena including gamma-ray bursts, gravitational waves, and their electromagnetic counterparts. In the inner regions of such disks, photons are totally trapped due to high density and temperature. Getting cool through neutrinos and antineutrinos efficiently, these accretion disks are also called Neutrino Dominated Accretion Flows (NDAFs). Moreover, the high magnetic field (~ 10^15−16G) and large density (~ 10^10g cm−3) can be considered as the two important physical features of these disks, and as a result, self-gravity and gravitational instability might be of a crucial role in these dense hyperaccretion flows. As well, the magnetic field is proposed to be of considerable importance via both large and small scale impacts. After providing an introduction to the GRB's and the candidates of their central engines, we focus on these two factors (self-gravity and magnetic field) to probe their potential effects on the hyperaccretion disk's structure, in addition to their subsequent impacts on the GRB's spectral features. In other words, we apply these two features to provide an explanation for the prompt Gamma-ray emission with its highly variable structure in the early time and the electromagnetic afterglow emission associated with the late time activity of the GRB's central engine.

Abstract of Lectures

Date: Wednesday 3 November 2021

Prof.Laura Becerra
PUC, Chile

SPH simulations of the Induced Gravitational Collapse

The Induced Gravitational Collapse (IGC) paradigm points to a binary origin for the long-duration gamma-ray burst (GRBs) associated with supernovae (SN). In this one, a carbon-oxygen core (COcore) explodes in a Type Ib/c SN in presence of a close neutron star (NS) companion. The SN triggers a hypercritical accretion into the NS and depending on the initial binary parameters, two outcomes are possible given place to two families of long GRBs: binary-driven hypernova (BdHNe), where the NS reaches its critical mass, and collapses to a black hole (BH), emitting a GRB; and x-ray flashes (XRFs) where the hypercritical accretion onto the NS is not sufficient to induce its gravitational collapse. We perform three-dimensional (3D) numerical simulations of the IGC paradigm with the smoothed particle hydrodynamics (SPH) technique. We determine whether the star gravitational collapse is possible and assess if the binary holds gravitationally bound or it becomes unbound by the SN explosion.

Az Zarreh Taa Aaftaab:
The Role of General Relativity in the Structure of Elementary Particles of Matter

Prof.Shadi Tahvildar-zade
Rutgers, USA

It was a largely unfulfilled dream of Einstein to arrive at a quantum theory of atomistic matter that included electrodynamic phenomena, and one in which the principles of general relativity would reign supreme. Even though he is generally considered to have failed in this quest, his unifying vision remains a powerful one to this date. In this talk, we explore some of the ways in which Einstein's dream may one day be realized, including (1) a general-relativity-based formulation of the joint evolution of classical fields together with point-particles that are sources of those fields, (2) a well-motivated deformation of classical nonlinear theories to quantum theories in which the motion of particles is guided by linear waves on particle configuration space, and (3) ring-like particles inspired by general relativity and a possible resolution of the dark matter puzzle.

Abstract of Lectures

Date: Thursday 4 November 2021

Chairperson: Prof. Hassan Firouzjahi (IPM, Iran) , Prof. Remo Ruffini (ICRANet, Italy) , Prof. Shahab Shahidi (DU, Iran) , Prof. Soroush Shakeri (IUT, Iran)

Prof. Roy Patrick Kerr

University of Canterbury, New Zealand and ICRANet, Italy

"Science is Undermined Every Time We Let Ideology Substitute for Actual Truth" - Ethan Siegel

Last year I showed that the Kerr metric, either ingoing or outgoing, contains light rays whose affine lengths are finite, and yet they do not end at some singularity. This destroys all the singularity theorems as they assume this cannot happen. I was then told that the "singularity" exists in the maximal extension, say in Kruskal. I checked the derivation of these and found that the determinant of the alleged metric tensor is zero on all the horizons in Kruskal. Not only that but the protagonists all seem to think that this is OK! It isn't. Kerr and Eddington-Finkelstein are their own maximal extensions. If time permits I will also show why "soft hair" is fool's gold and why the Kerr-Schild approximation method gives the Ligo curves in its first step

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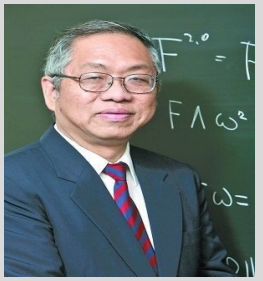
Angular Momentum to a Distant Observer



Harvard University, USA and Yau Mathematical Sciences Center, China

The notion of angular momentum in general relativity has been a subtle issue since the 1960s, due to the discovery of ``supertranslation ambiguity": the angular momentums recorded by two distant observers of the same system may not be the same. In this talk, I shall show how mathematical theory identifies a correction term and leads to a new definition of angular momentum that is free of any supertranslation ambiguity. This is based on joint work with Po-Ning Chen, Jordan Keller, Mu-Tao Wang, and Ye-Kai Wang

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Prof.Jorge Rueda

ICRANet, Italy

Gravitomagnetic Interaction of a Kerr Black Hole with a Magnetic Field as the Source of the High-energy Radiation of Gamma-ray Bursts

It is shown how the gravitomagnetic interaction of a Kerr black hole (BH) with a surrounding magnetic field induces an electric field able to accelerate surrounding charged particles to ultra-relativistic energies. Along the BH rotation axis, electrons/protons can reach even thousands of PeV leading to ultrahigh-energy cosmic rays (UHECRs) from stellar-mass BHs in long gamma-ray bursts (GRBs) and from supermassive BHs in active galactic nuclei (AGN). At off-axis latitudes around the BH vicinity, particles are accelerated to hundreds of GeV, and by synchrotron radiation emit high-energy GeV photons. Such a process occurs at all latitudes within 60 degrees of the polar axis. The theoretical framework describing these acceleration and radiation processes, how they extract the rotational energy of the Kerr BH, as well as the consequences for the astrophysics of GRBs are outlined.

Abstract of Lectures

Date: Thursday 4 November 2021

Prof.Claus Lämmerzahl

ZARM, university of Bremen

New High Precision Tests of General Relativity

General Relativity (GR) is a consequence of the Einstein Equivalence Principle. Accordingly, tests of GR are either tests of its foundation or test of consequences of GR. In general, tests of the foundations are zero tests. Test of predictions of GR relies on certain notions like standard clocks or nonrotating frames which can be defined within GR and which are basic in the prediction of certain numerical values for particular effects. We outline the structure of these tests and report on recent high precision laboratory tests of foundations and of consequences of GR. At the end, the importance of quantum tests of GR is emphasized and the importance of fundamental tests for practical applications is outlined.

Exploring Gravitation in the Inner Solar System: Giuseppe Colombo, Mercury and the BepiColombo Mission

Prof.Roberto Peron

National Institute of Astrophysics (INA) - IAPS, Italy

The Solar System is an arena where multiple scientific paths intersect and interact. Seen from the point of view of fundamental physics, it is a test bench where the machinery of gravitation can be more directly accessed, albeit in its "weak-field" appearance. It is particularly the case of planet Mercury, due to its relative proximity to the Sun. Fundamental contributions to its exploration came from an Italian scientist, Giuseppe "Bepi" Colombo, who in particular proposed an effective trajectory strategy for the Mariner 10 probe. After this pioneering mission and the more recent MESSENGER one, it is now the turn of a European mission, BepiColombo, to further enlarge our knowledge of Mercury and the near-Sun environment. The mission and its scientific objectives will be presented, with particular regard to the planned tests of general relativity theory and to Mercury geodesy and geophysics.

Prof.Hossein Safari

University of Zanjan, Iran

The Role of Campfires in the Heating of Solar Coronal Plasma Observed by Solar Orbiter and Solar Dynamics Observatory

Accurate detection of brightenings such as campfires (with length scales larger than 400 km and smaller than 4000 km) and bright coronal points is essential to explain the several million degrees of the solar coronal plasma. We develop a machine learning method via the Zernike moments to automatically identify and track brightenings observed by Solar Orbiter/EUI and Solar Dynamics Observatory (SDO)/ AIA. The method detected 8678 campfires for a sequence of 50 EUI at 174 A images. We identify more than two million coronal bright points for ten years of AIA data at 171 A observations. We show that most of these brightening features are generated at the super granule boundaries, where high concentration magnetic flux is placed.

Abstract of Lectures

Date: Thursday 4 November 2021

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Prof. Fatemeh Tabatabaei
IPM, Iran

Uncovering the Energetic of the Interstellar and the Intergalactic Medium with the SKA

Investigating the physics and energetics of the medium where galactic structures, on various scales, are formed is the most fundamental step to understanding the formation and evolution of galaxies. Modern galaxy evolution models suggest gas accretion from the intergalactic medium or from cosmic filaments as a mechanism to maintain star formation and AGNs. Through gas heating and/or gas removal, these models also propose supernova feedback and AGN feedback as mechanisms to quench massive star formation. Observational studies however have not reached a conclusive result, showing that feedback can, in some cases, trigger star formation, leaving the issue as an open challenge. It seems that we have missed some basic concepts about the formation of structures in the ISM and the IGM: What are the physical parameters/agents governing the structure formation on various scales? and what is their relative importance? How does the ISM/IGM energy balance change over cosmic time? Addressing these, it is vital to obtain a more complete picture of the ISM & IGM than what is known currently. The advent of the SKA and its new instrumental capabilities tracing the most energetic ISM components combined with the ground-breaking results from the ALMA, HST, VLT/ MUSE, etc has opened a new window shedding light on the issue. The SKA's sensitive radio continuum observations will trace high-energy particles and magnetic fields not only in star-forming regions and AGNs, but also in more quiescent regions in molecular clouds and diffuse ISM, enabling us to study the role of magnetic fields/cosmic rays in structure and star formation. On larger scales, these observations will allow us to address what determines the accretion rate from the IGM. Sensitive radio continuum observations on large scales may also bring constraints on the entity of the dark matter mapped by the HST and DECam.

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Universality of Peaking Time of Supernovae in Association with Gamma-Ray Bursts

We discuss the recent progress in Gamma-Ray Bursts - Supernova connection and make inferences coming from the universality of peaking time of Supernovae in this association.

Prof. Yerlan Aimuratov
Fesenkov Inst., Kazakhstan

Abstract of Lectures

Date: Thursday 4 November 2021

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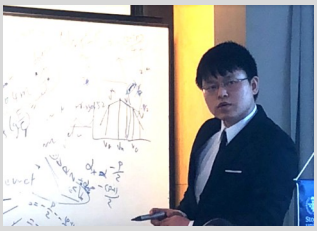


Prof. Liang Li
ICRANet, Italy

Self-Similarities and Power-laws in the Time-resolved Spectra of GRB 190114C, 130427A, 160509A, and 160625B

A new time-resolved spectral analysis performed on GRB 190114C has allowed identifying in its prompt emission observed by Fermi-GBM three specific Episodes predicted to occur in BdHNe I. Episode 1, which includes the "SN-rise" with a characteristic cutoff power-law and blackbody spectra; the Episode 2, initiated by the moment of formation of the BH, temporally coincident with the onset of the GeV emission and the onset of the ultra-relativistic prompt emission (UPE) phase a characterized by cutoff power- law and blackbody spectra; Episode 3, the "cavity", with its characteristic featureless spectrum recently described in a companion paper (Ruffini et al. 2019b). An extreme time-resolved analysis performed on an iterative process in a sequence of ever-decreasing time intervals has allowed us to find self-similar structures and power-laws in the UPE of GRB 190114C; see e.g., the companion paper (Ruffini et al. 2019a). This has led to the first evidence for the identification of a discrete quantized emission in the GeV and MeV emission presented in the companion papers (Ruffini et al. 2018b; Rueda & Ruffini 2019).

To identify and verify the BdHNe I properties in the additional sources GRB 160509A, GRB 160625B, and GRB 1340427A, and compare and contrast the results with the ones of a BdHN II source GRB 180728A (Wang et al. 2019b). We have also identified in all four sources, following the analysis GRB 130427A in the companion paper (Ruffini et al. 2018b), the GeV radiation during and following the UPE phase. Also in all the four sources, we describe the spectral properties of their afterglow emission, including the mass estimate of the vNS, following the results presented in the companion paper (Rueda et al. 2019).

In GRB 160509A and GRB 160625B, we have first identified the aforementioned three BdHN I Episodes. In the UPE phase, we have performed the time-resolved spectral analysis following the iterative process in a sequence of ever-decreasing time intervals. We have also examined both the GeV radiation and the afterglow phases. The same procedure has been repeated in the case of GRB 130427A with the exception of the UPE phase, in view of a pile-up problem. The case of GRB 180728A, a BdHN II, has been used as a counterexample.

The results of the spectral analysis have validated the common properties in all BdHNe I: the three Episodes as well as the self-similar structures and the associated power-laws in the UPE phase. The profound similarities of the results have made a significant step forward in the taxonomy of GRBs and in evidencing a standard composition of the BdHN I. This opens the opportunity for a vaster inquire of the astrophysical nature of their components in the population synthesis approach: e.g., the BH formation in all BdHN I occurs due to accretion of the SN ejecta in a tight binary system with a neutron star companion which reaches its critical mass, leading to the formation of the BH. The SN-rises in all five BdHNe are compared and contrasted. The most far-reaching discovery of self-similarities and power-laws here extensively confirmed, thanks also to the conclusions presented in the companion papers (Ruffini et al. 2018b, 2019a), leads to the existence of a discrete quantized repetitive polarized emission, both in the GeV and MeV observed by Fermi-GBM and Fermi-LAT, on a timescale as short as 10−14 s. These results open new paths in the discovery of fundamental physical laws.

Abstract of Lectures

Date: Thursday 4 November 2021

Prof. M. H. Zhollideh Haghighi
IPM and KNTU, Iran

Data Science in Relativistic Astrophysics - 1: Classification of the Stars Using Photometric Optical Data of SDSS

RR Lyrae variables are periodic variable stars, commonly found in globular clusters. They are used as standard candles to measure (extra) galactic distances, assisting with the cosmic distance ladder. They are pulsating horizontal branch stars of spectral class A or F, with a mass of around half the Sun's. They are thought to have shed mass during the red-giant branch phase and were once stars of similar or slightly less mass than the Sun, around 0.8 solar masses. In contemporary astronomy, a period-luminosity relation makes them good standard candles for relatively nearby targets, especially within the Milky Way and Local Group. They are also frequent subjects in the studies of globular clusters. We use the set of photometric observations of RR Lyrae stars in the SDSS as our data. The data set comes from SDSS Stripe 82, and combines the Stripe 82 standard stars, which represent observations of non-variable stars; and the RR Lyrae variables pulled from the same observations as the standard stars, and selected based on their variability using supplemental data. The sample is further constrained to a smaller region of the overall color –color space following ($0.7<u-g<1.35$, $-0.15 < g - r < 0.4$, $-0.15 < r - i < 0.22$, and $-0.21 < i - z < 0.25$). These selection criteria lead to a sample of 92,658 non-variable stars, and 483 RR Lyraes. Two features of this combined data set make it a good candidate for testing classification algorithms:

1- The RR Lyrae stars and main sequence stars occupy a very similar region in u, g, r, i, z color space.

2- The extreme imbalance between the number of sources and the number of background objects is typical of real-world astronomical studies, where it is often desirable to select rare events out of a large background. Such unbalanced data aptly illustrates the strengths and weaknesses of various classification methods. Our goal is to characterize the relation between the features in the data and their classes and apply these classifications to a larger set of unlabeled data. In this hands-on session, participants will learn how to use machine learning algorithms in practice and classify observed stars from optical data.

This session has two parts in the first part we try to classify objects by some well-known conventional machine learning algorithms such as logistic regression and etc. In the second part, we use Neural Network for our classification purposes.

Abstract of Lectures

Date: Thursday 4 November 2021

Prof. Rahim Moradi
ICRANet-Italy

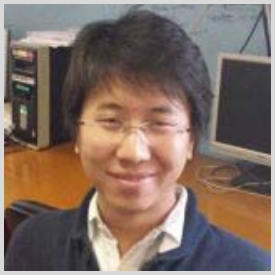
Data Science in Relativistic Astrophysics, 2-Classification of Astronomical Objects and Determining their Redshift Using Spectroscopic Optical Data of SDSS

Quasi-stellar radio sources (Quasars) or quasi-stellar objects (QSO) are high-luminosity active galactic nuclei (AGN) which are believed to be powered by accretion disks around supermassive black holes (SMBHs) with masses in the range of 1 million to 1 billion solar mass. Thanks to their high luminosity, quasars have been found to spread from redshift z~0 all the way back to z~7 when the universe was forming its first structures, namely the epoch of reionization. Therefore, studying the high-redshift quasars can be taken into account as a powerful tool to study the cosmic history and structure formation in the early universe. Owing to their existence at redshifts ranging from z=0 to z~ 7, quasars provide a new possible standard candle, like type Ia supernovae, which can infer new cosmological constraints to study the evolution of the universe.

In this part, after introducing the methods to process and prepare the spectroscopic optical data of SDSS, we represent the architecture of a 1-dimensional convolutional neural network (CNN) to estimate the redshift of quasars in Sloan Digital Sky Survey IV (SDSS-IV) catalog from DR16 quasar-only (DR16Q) of eBOSS. We show how this CNN can be easily extended in order to classify stars, galaxies, and quasars as well as prediction of their redshift. The CNN takes the flux of the quasars as a 1--dimensional array and their redshift as labels. Therefore, This CNN extracts the spectroscopic features of SDSS data and predicts the redshift of quasars. We finally represent a similar CNN, but less efficient, which is already used by the SDSS website to classify the quasars, stars, and galaxies, as well as predict the redshift.

In this session, participants will learn how to process the SDSS spectral data in order to implement them in 1-dimensional CNN and observe the preliminary results.

Data Science in Relativistic Astrophysics, 3-More Networks and More Areas



Prof.Wang Yu
ICRANet, Italy

Based on the first two tutorials, we introduce more types of neural networks applied to more kinds of astronomical data.

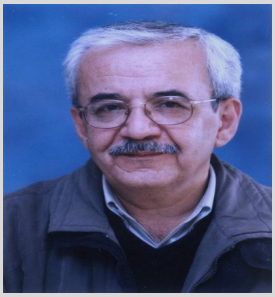
In the above example of inferring redshift from SDSS data, we build simple but efficient 1D CNN networks and obtain accurate results. We further complicate the CNN network by introducing advanced structures such as Residual, Attention, etc., and applied the latest networks from the industry field to the same data to infer redshift and to test whether the accuracy has improved.

Secondly, we make a brief introduction to gravitational wave and gamma-ray burst data, and transfer the above networks to the machine learning subjects of gravitational wave and gamma-ray burst. Astronomical data are nothing but temporal and spatial data, we hope this short tutorial can broaden the horizon and be able to build the network flexibly.

Abstract of Lectures

Date: Friday 5 November 2021

Chairpersons: Prof. Shahram Khosravi (KHU and IPM, Iran) , Prof. Jorge Rueda (ICRANet, Italy) , Prof. She-Sheng Xue (ICRANet, Italy)



Prof. Hossein Masoumi Hamedani
Iranian Institute of Philosophy, Iran

The Light of the Moon: Ibn al-Haytham and Galileo

In a treatise entitled On the Light of the Moon, the physicist and mathematician of the 10th-11th centuries Ibn al-Haytham proves that the Moon is not a polished body and that it does not reflect the light it receives from the Sun in the way a convex mirror does. Almost six centuries later, Galileo takes up the same problem in his famous Dialogues Concerning the Two Great World System. By a method which is somewhat different from that of Ibn al-Haytham, he arrives at a similar conclusion.

The aim of this article is to discuss the similarities and the differences of the two methods and the conclusions their authors draw from them.

Astronomy in Islamic World - a European perspective

Prof.Richard Kerner
Sorbonne Université, France

Arab and Islamic Civilization emerged at the crossroads in a double sense, as a bridge between the Greco-Roman Antiquity and European Modernity in time, and as the junction between the declining Roman Empire and the still vigorous Indian and Persian civilizations in space. In this talk, we shall highlight the most important contributions of Islamic Polymaths to Mathematics and Astronomy, paving the way to the next stage of the development of science which occurred in the late Middle Ages in Europe.

Prof.Carlos Arguelles
Univ. La Plata, Argentina
ICRANet, Italy

Dark Matter Fermions: From Linear to Non-linear Structure Formation

Relaxation mechanisms of collisionless self-gravitating systems of fermions in cosmology can lead to equilibrium states which are stable, long-lived, and able to explain the dark matter (DM) halos in galaxies. The most general fermionic DM profile out of such a mechanism develops a degenerate compact core which is surrounded by an extended halo. When applied to the Milky Way, it is demonstrated that the outer halo can explain the rotation curve of our Galaxy, while the central DM-core explains the dynamics of all the best resolved S-cluster stars orbiting SgrA *, without assuming a central black hole (BH). When such novel core-halo DM profiles are applied to larger galaxies, the dense DM core can reach the critical mass for gravitational collapse into a BH of ~ 10^8 Mo. This result provides a new mechanism for supermassive BH formation in active galaxies directly from DM, leading to a paradigm shift in the understanding of galactic cores.

Abstract of Lectures

Date: Friday 5 November 2021

Prof. Hosein Haghi
IASBS, Iran.

The Dynamics of Ultra-diffuse Dwarf Galaxies in MOND

In this talk, I will review the current state of research on the apparently dark matter-free ultra-diffuse dwarf galaxies, emphasizing what our research team has investigated in recent years. In particular, I will focus on galaxies NGC 1052-DF2 and NGC 1052-DF4 in the framework of MOND. Due to the non-linear Poisson equation in MOND, a dwarf galaxy has weaker self-gravity when in close proximity to a massive host. Using our analytic formulation and fully self-consistent live N-body models in MOND, I will show you how the dynamics of these galaxies are in good agreement with MOND prediction.

Prof. Clement Stahl
Strasbourg U., France

Probing the First Instants of the Universe with Large Scale Structure

In this talk, I will discuss the state of the art in the field of large-scale structure for cosmology. I will in particular discuss the novel approach of effective field theory which allows to integrate out complicated small scales physics. I will entertain the possibility that it is now possible to propagate a primordial signal throughout cosmic history and detect it in future galaxy surveys, In this sense, large scale structures could be used to constrain primordial physics and thus push forward our fundamental understanding of our universe.

Prof. Alexander Zakharov
BLTP, JINR, Dubna, Russia

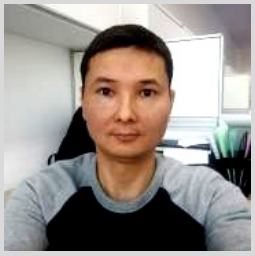
Shadows Around at Sgr A* and M87* as a Tool to Test Gravity Theories

The shadow around the supermassive black hole in M87 was reconstructed in 2019 based on its observations with the Event Horizon Telescope in 2017. Recently polarization map for the M87* shadow was presented. We discuss opportunities to evaluate parameters of alternative theories of gravity with shadow observations, in particular, a tidal charge could be estimated from these observations.

Abstract of Lectures

Date: Friday 5 November 2021

Luminosity of Accretion Disks in Compact Objects with a Quadrupole



Prof. Kuantay Boshkaev
Al-Farabi Univ., Kazakhstan

We consider the circular motion of test particles in the gravitational field of a static and axially symmetric compact object described by the q metric. To this end, we calculate orbital parameters of test particles on accretion disks such as angular velocity, total energy, angular momentum, and radius of the innermost stable circular orbit as functions of the mass and quadrupole parameters of the source. The radiative flux, differential, and spectral luminosity of the accretion disk, which are quantities that can be experimentally measured, are then explored in detail. The obtained results are compared with the corresponding ones for the Schwarzschild and Kerr black holes to establish whether black holes may be distinguished from the q metric via observations of the accretion disk's spectrum.

Axion in Astrophysics

Prof. Pierluca Carenza
Stockholm U., OKC, Sweden

This is a review of the latest developments on axion astrophysics, with particular attention to the axion production in stellar environments and to the phenomenology of the axion-photon mixing on astrophysical scales.

Prof. Fazlollah Hajkarim
UNIPD-Italy

Production of Thermal QCD Axions in the Early Universe

We study the thermal production of axions over different scales especially around the QCD and electroweak phase transitions in the early universe. We focus on the most motivated axion models (KSVZ and DFSZ) and investigate how the thermal history can influence the production rate of hot axion as dark radiation.

This can lead to predictions for the future measurements of the cosmic microwave background by experiments like CMB-S4.

Concluding Remarks

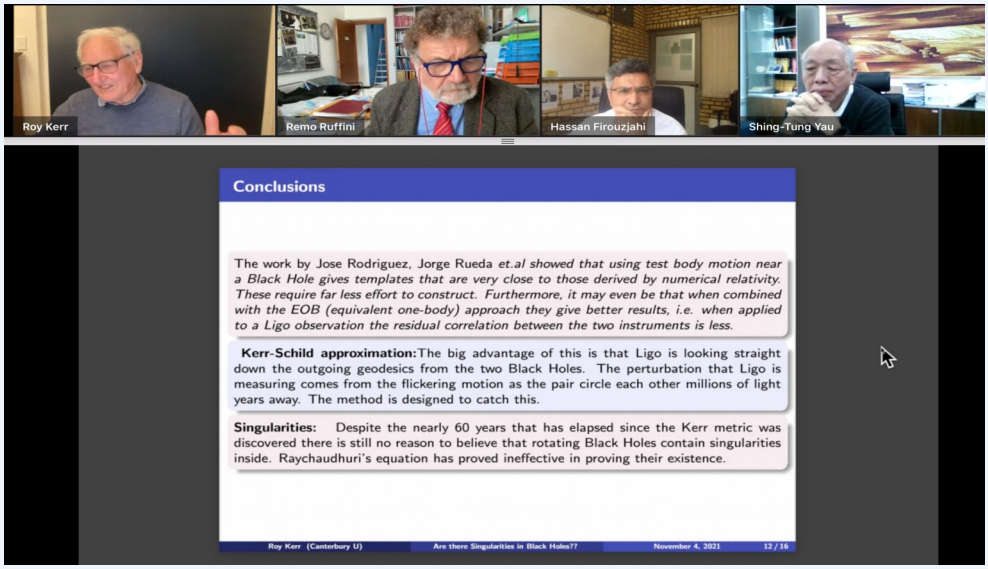
Prof. Dr. Soroush Shakeri
Faculty Member of Departmnent of Phyisics (IUT) &
Director of ICRANet, Isfahan &
Adjunct Professor ICRANet, Italy

The ICRANet-Isfahan astronomy meeting is along with more than a decade of active collaboration on the field of relativistic astrophysics between ICRANet and the Department of Physics at IUT. This meeting by inviting more than 33 prominent speakers from more than 16 countries served as a great opportunity for discussing topics ranging from the ancient Persian astronomy to recent developments in Theoretical and Experimental Physics, Astrophysics, and General Relativity.

There were more than 190 registered participants and attendees which provided a very active scientific atmosphere with fruitful discussions between participants and speakers. The opening remarks of the meeting have been presented by H.E. Mohammad Ali Zolfigol, Minister of Science, Research and Technology of the Islamic Republic of Iran. This speech has been presented by Prof. Yousef Sobouti, he also gave a talk about the development of modern astronomy in Iranian universities in the morning session. This continued by a presentation from Prof. Remo Ruffini about the 50th anniversary of “Introducing the Black Hole” and his non-stop efforts during past decades to understand the physical nature of Gamma Ray Bursts (GRBs) as the most luminous explosions in the Universe.

In the following Prof. Habib Khosroshahi presented an extensive overview about the last situation of the Iranian National Observatory (INO) and its 3.4m optical telescope, he also drew our attention to the unique potential of INO to follow the transient sources such as GRBs. We had several talks about the physics of GRBs, and GRBs in the optical domain, GRB - Supernovea connection, and using GRBs as a cosmological tool which led to many interactive discussions. The first day of the meeting finished with a presentation by Prof. Shadi Tahvildar-Zadeh about the dream of Einstein to arrive at a quantum theory of atomistic matter that included electrodynamic phenomena.

The Second day of the meeting was started with a presentation by Prof. Roy Patrick Kerr who first discovered the solution of the rotating Black Hole in 1963, he discussed about the nature of singularities and his Kerr metric which was among hot topics in most of the scientific discussions around General Relativity (GR) in the past 50 years. Afterwards, Prof. Shing-Tang Yau who is the winner of the mathematical Fields Medal in 1982 talked about the notion of angular momentum in GR. There were several talks in the morning session about some European missions in astrophysics such as New high precision tests of GR presented by Claus Lammerzahl, Mercury, and the BepiColombo mission presented by Prof. Roberto Peron, and also about Square Kilometre Array (SKA) project presented by Prof. Fatemeh Tabatabaei. This day finished with a workshop on "Data Science and Machine Learning in Relative Astrophysics” in the afternoon session.



The last day of the meeting started with a talk given by Prof. Hossein Masoumi Hamedani about the similarities and the differences of the methods of Ibn al-Haytham and that of Galileo's discussing the Light of the Moon. Then Prof. Richard Kerner presented a historical talk from a European perspective about Astronomy in Islamic World. There were also several talks about the Dark Matter, Modified Gravity, and Early Universe Cosmology in the morning and afternoon sessions which made the program of the meeting richer.

At the end, I would like to mention, It was really a misfortune that we could not host our distinguished guests in the beautiful and historical city of Isfahan. However, this situation lets us get together virtually from all around the world and enjoy the nature at a deeper level. There were many fruitful discussions around the meeting and I hope this will create new networks among participants which will result in continued collaborations and joint activities in near future. It was a great pleasure for us to have the strong support of H.E. Mohammad Ali Zolfigol, Minister of Science, Research and Technology of the Islamic Republic of Iran to this significant event which marked the continuation of a longstanding, active, and fruitful collaboration between ICRANet and Iran and, more generally, between Italy and Iran. I hope that the ICRANet-Isfahan will become an active hub between Iranian and international astronomers, being Iranian National Observatory in Isfahan province is an additional value for ICRANet-Isfahan in this direction. We hope to see everyone in the next ICRANet-Isfahan Astronomy meeting to experience Isfahan in person.

Photo Narration of the Event

- Comparison of the classical angular momentum (Dray-Streubel 1984):

$$\tilde{J} = \int_{S^2} Y^A (N_A - \frac{1}{4} C_A{}^D \nabla^B C_{DB}).$$

- CWY angular momentum:

$$J = \int_{S^2} Y^A (N_A - \frac{1}{4} C_A{}^D \nabla^B C_{DB} - c \nabla_A m),$$

where c is given by the decomposition of the shear tensor C_{AB} and has never occurred in any previous definition of angular momentum.

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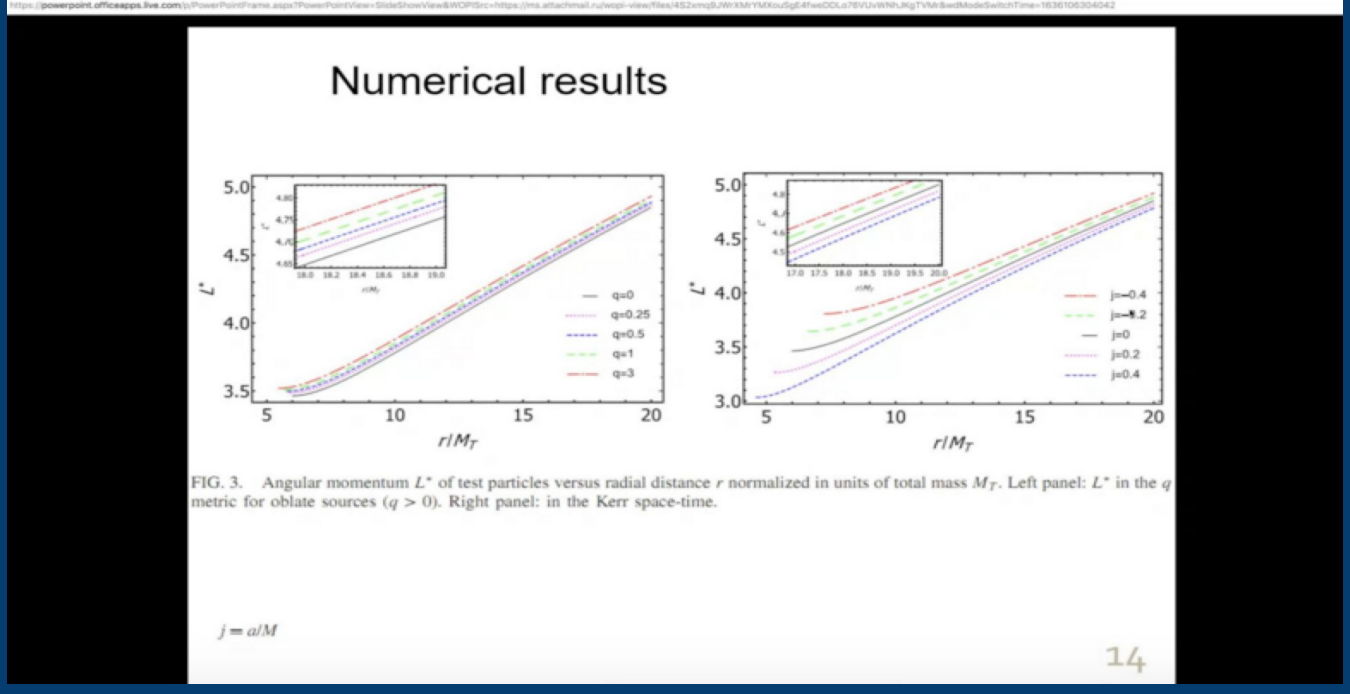
Photo Narration of the Event



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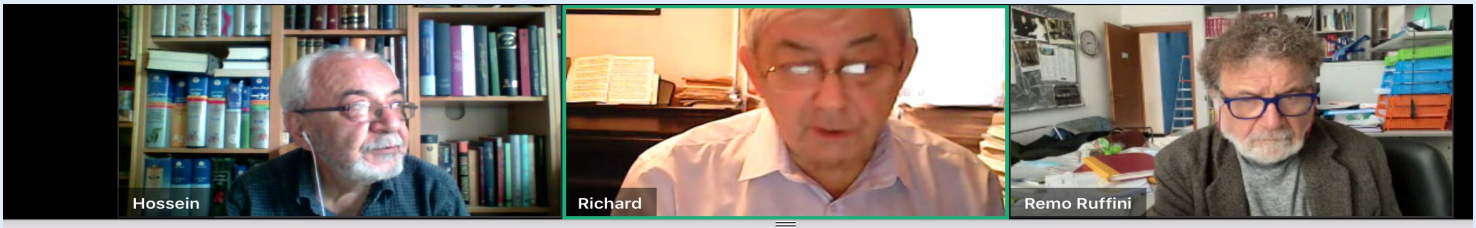

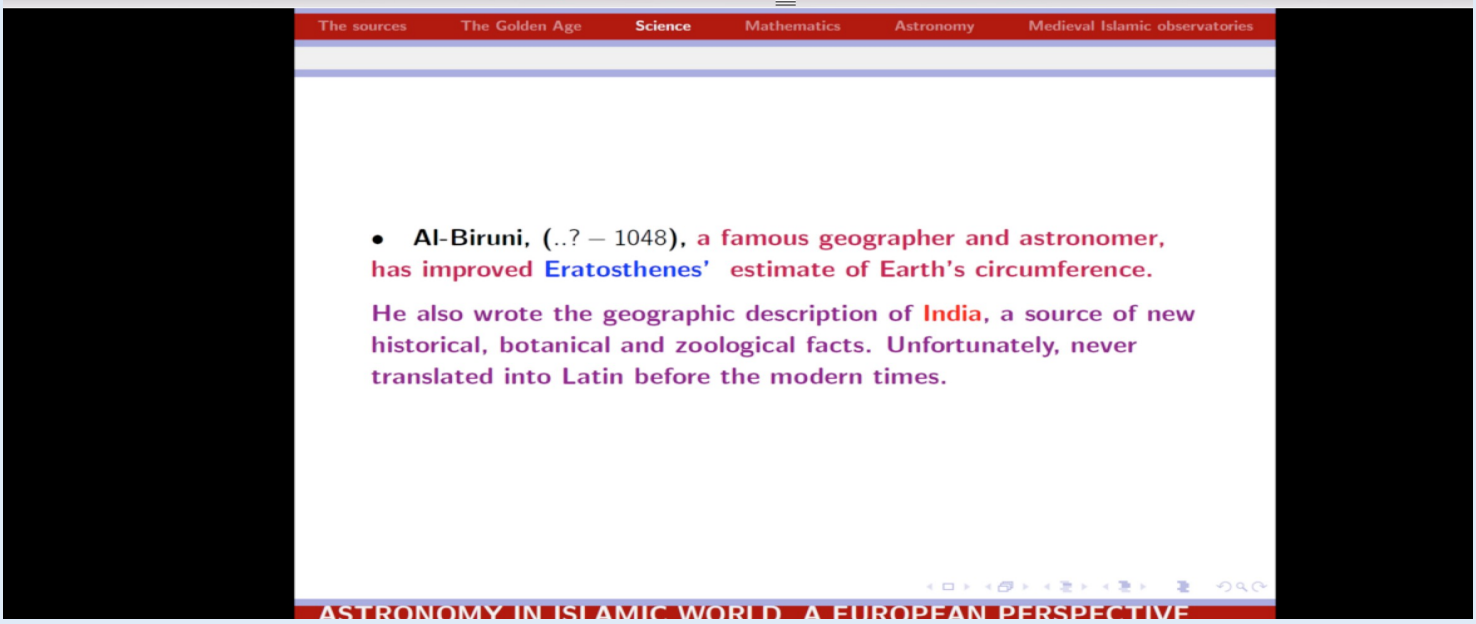

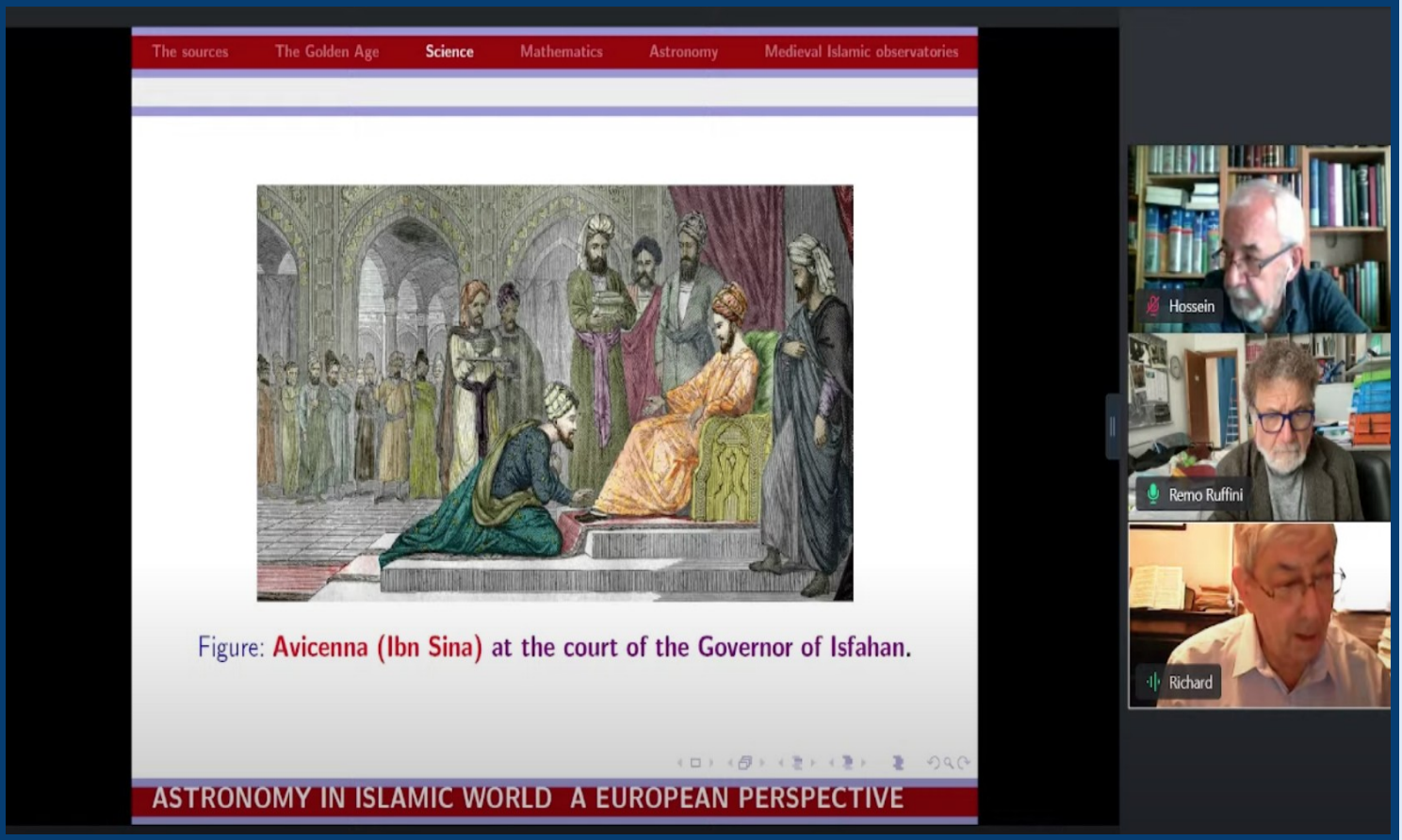

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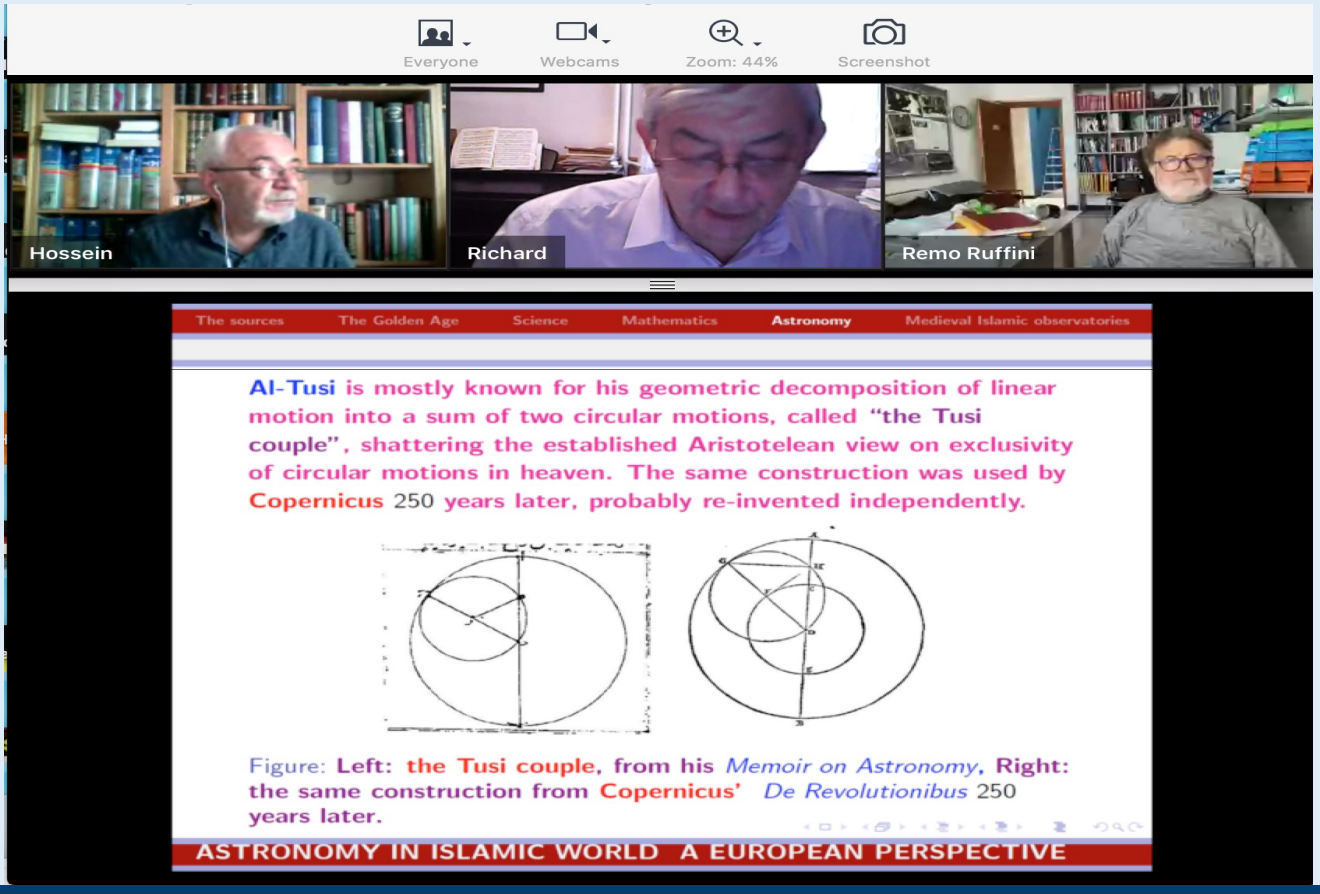

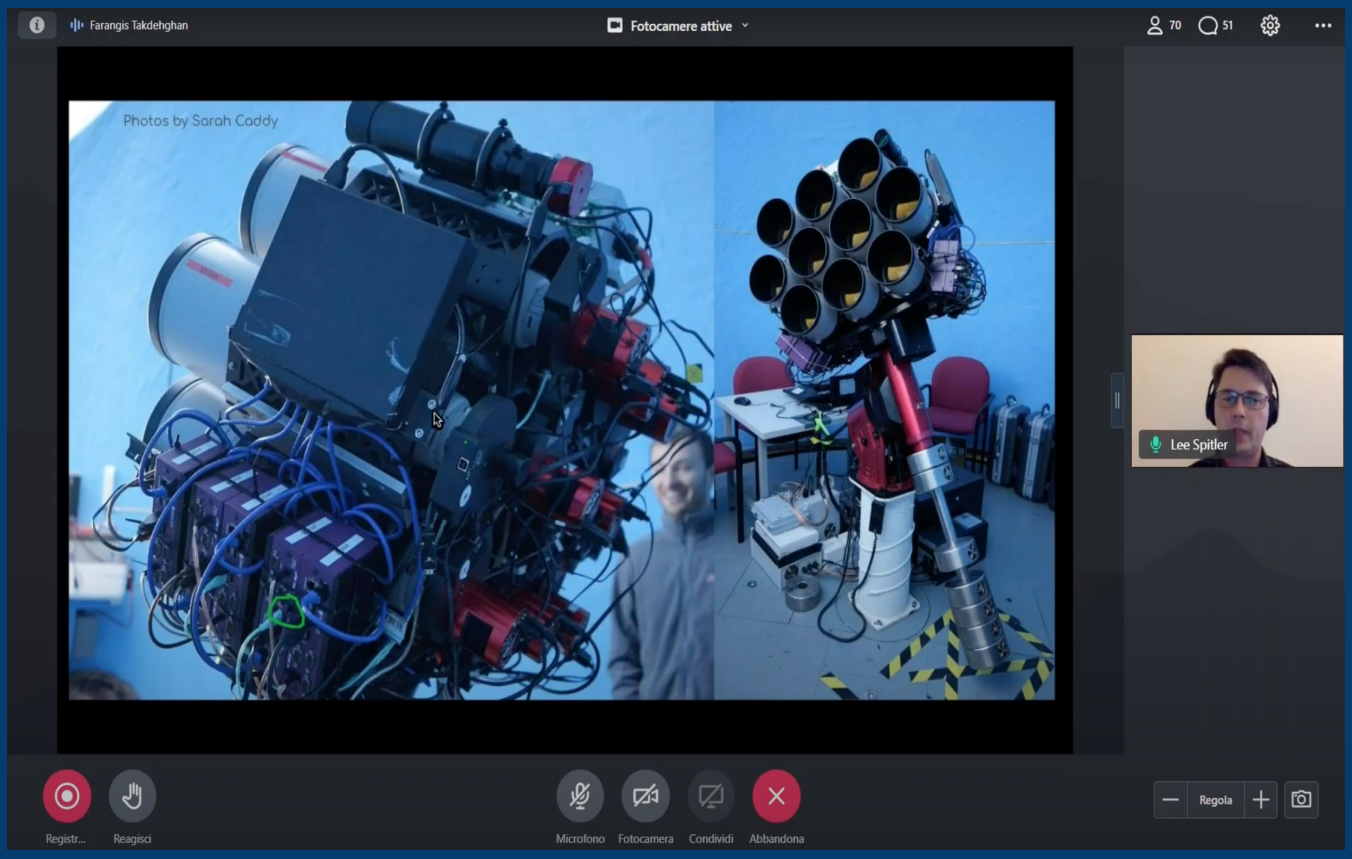

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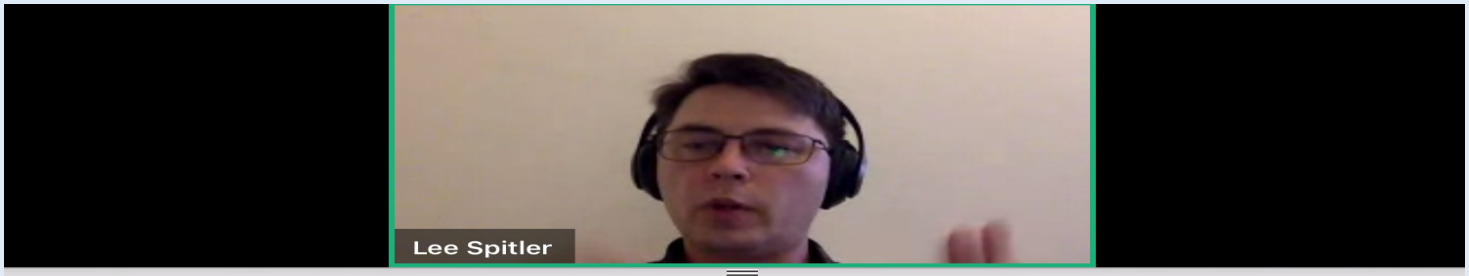

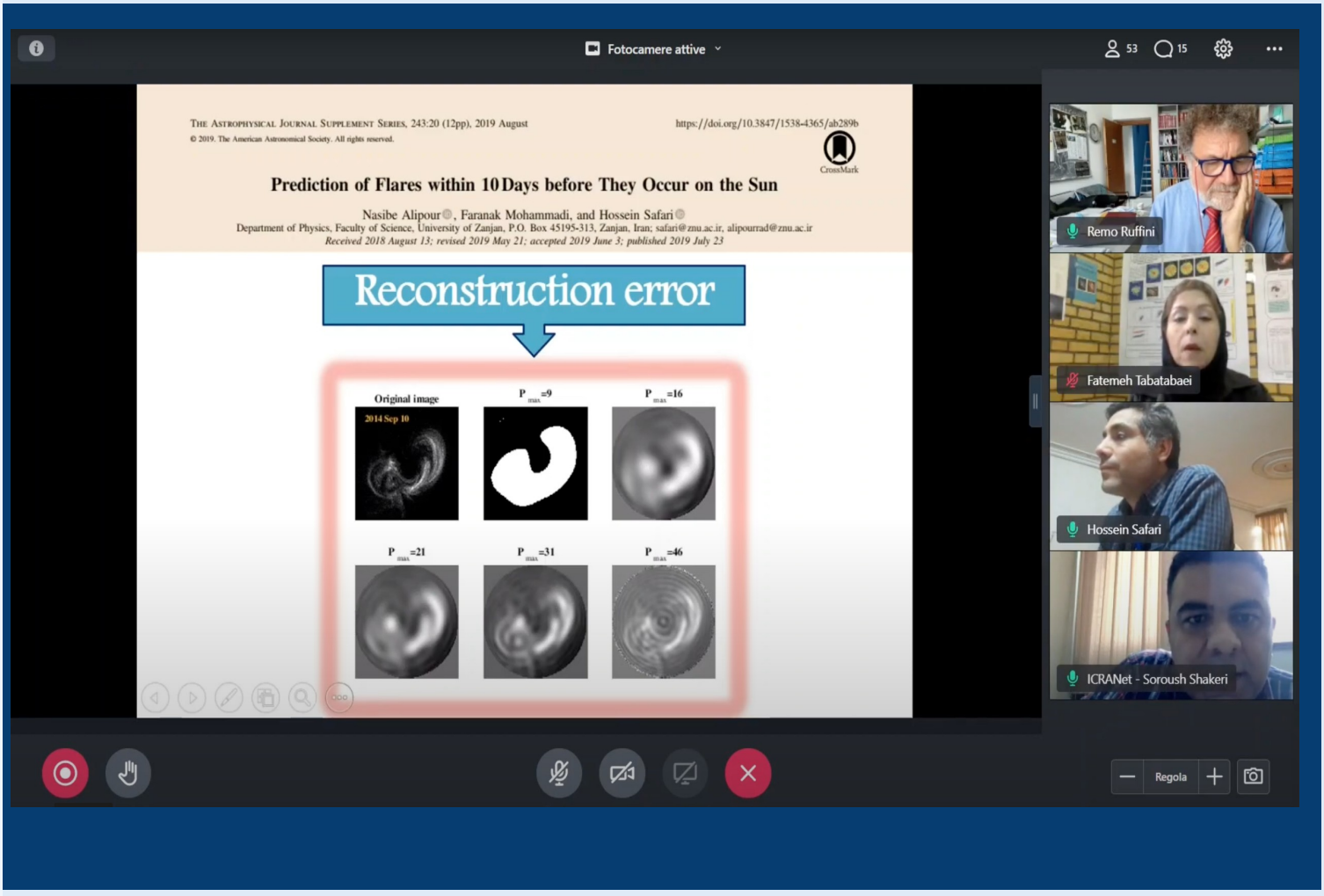

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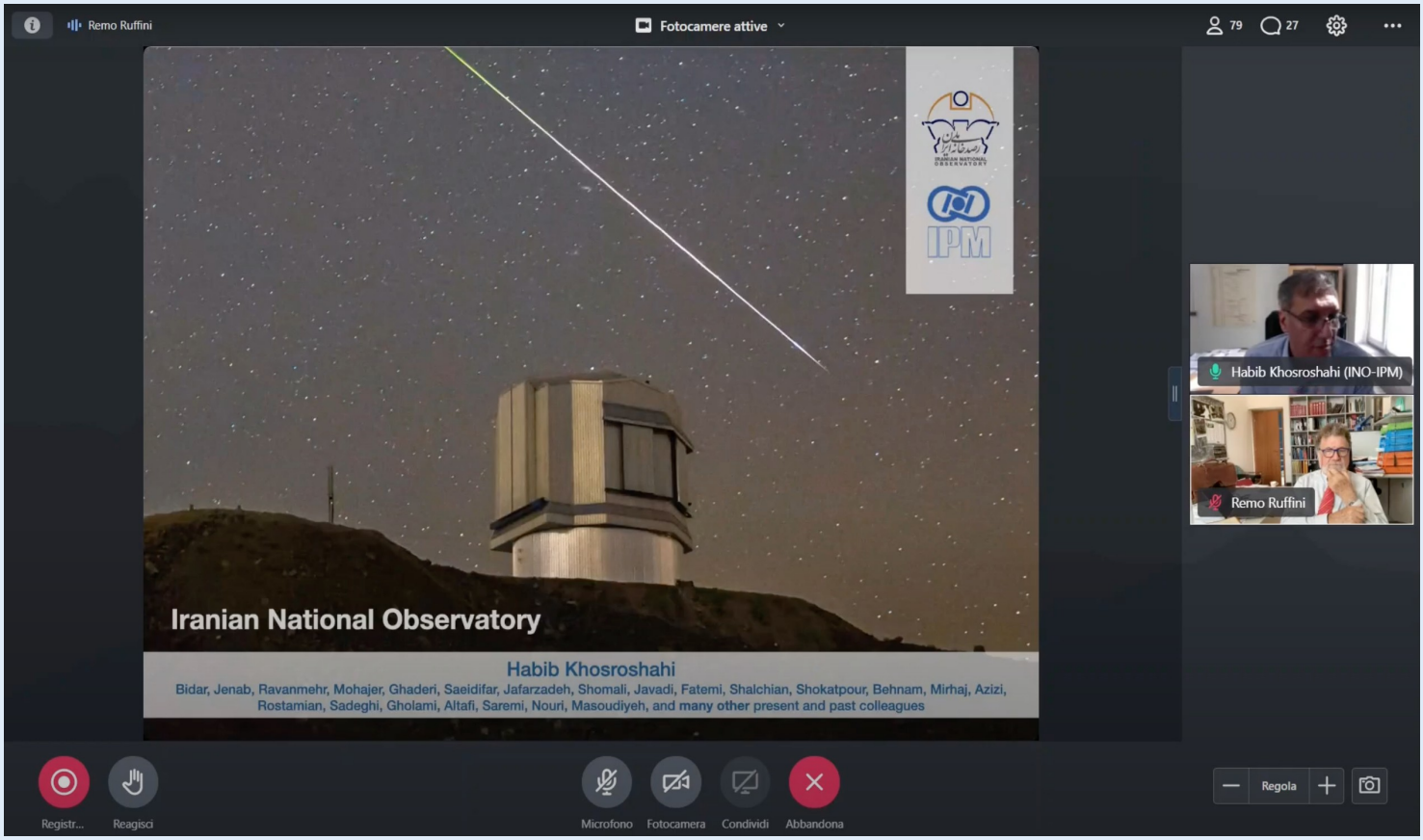

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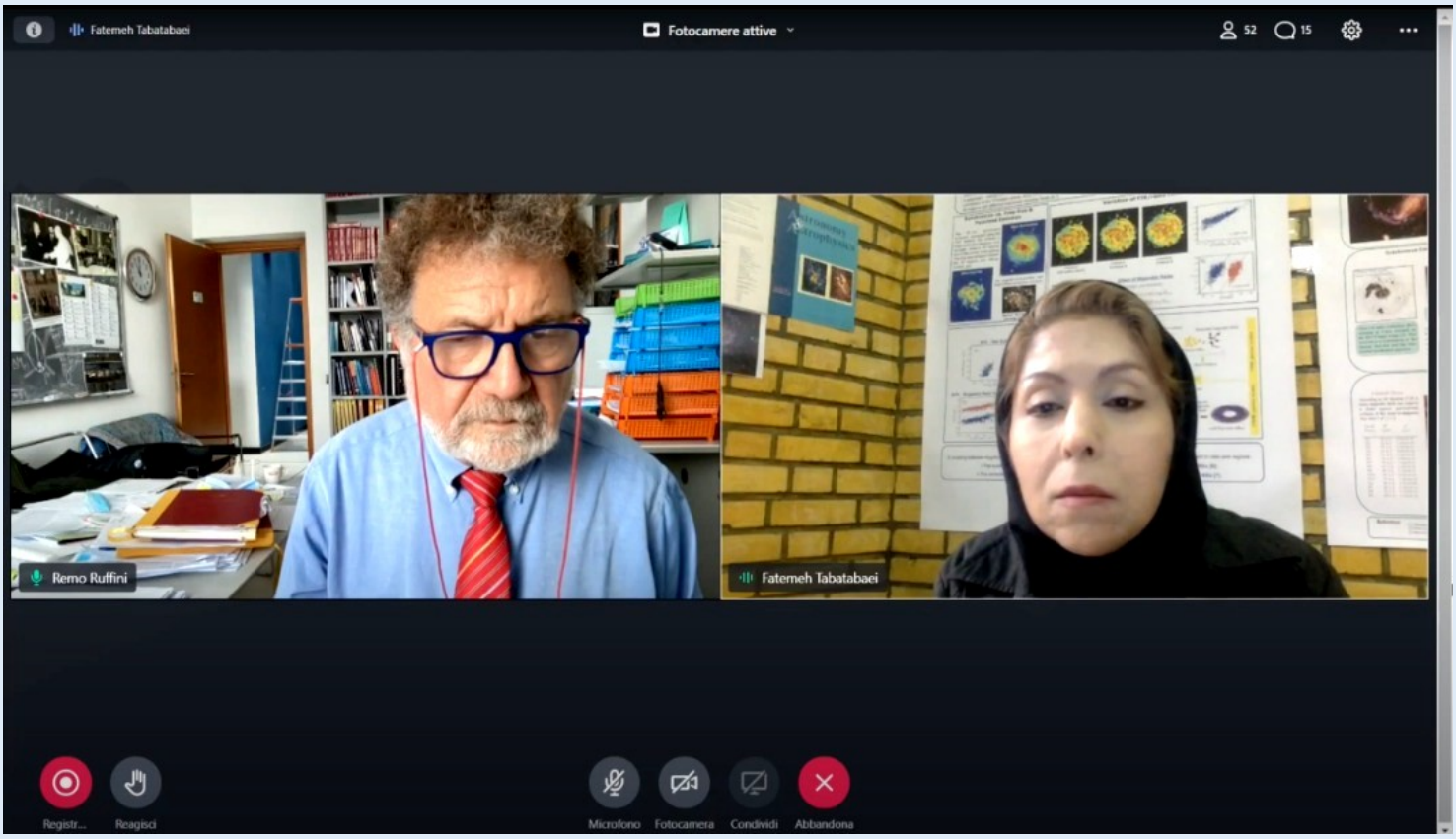

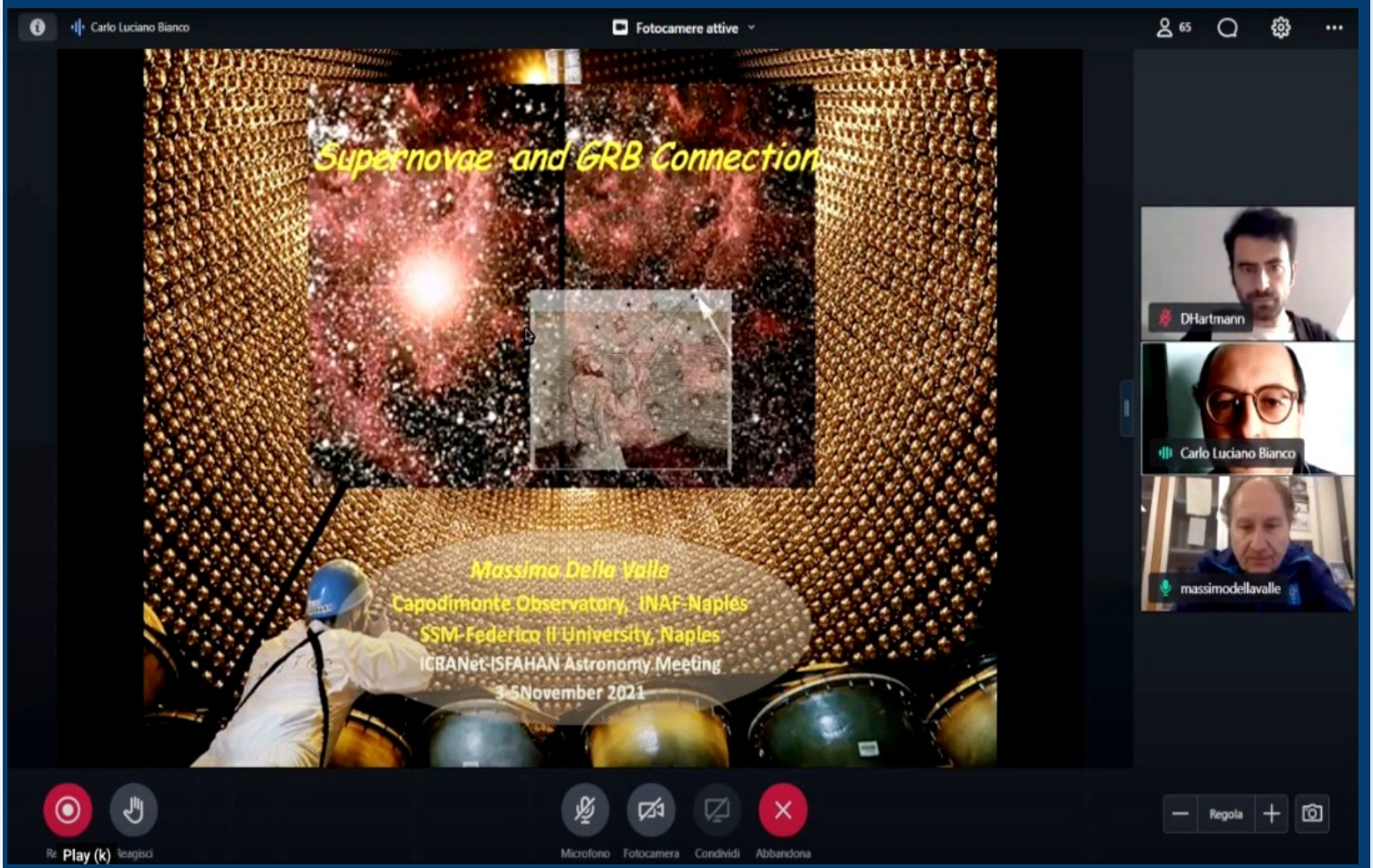

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