The 17th Italian-Korean Symposium for Relativistic Astrophysics

Monday, August 2, 2021 - Friday, August 6, 2021

Online & Kunsan Nat'l Univ

Scientific Program

Details can be found on the symposium Home Page

Talk/Lecture Abstract

1. Remo.Ruffini, ICRA-Sapienza University Rome/ICRANet
Title: The birth and raise of Relativistic Astrophysics
Abstract: The first space observations of the binary X-ray source Sco X1 (Giacconi 1963), the optical jetted emission in the Quasar 3C 273 (Schmidt 1963), the radio-optical observations of the Crab Pulsar (Bell - Hewish 1967), signaled the beginning of Relativistic Astrophysics. The identification of the neutron stars was soon followed by the conceptual introduction of a «black hole», by R. Ruffini and J.A. Wheeler in 1971 of which we are celebrating the 50th anniversary in this 17° Italian-Korean Symposium (IK17). Black Holes are based on the geometry of a Kerr rotating spacetime in general relativity with mass-energy characterized by mass, charge, and angular momentum (Christodoulou and Ruffini 1971). Fifty years later, through the largest ever multiwavelength observational effort, we are finding evidence that indeed the above “black hole mass-energy” originates the most luminous sources in our Universe: Gamma-Ray Bursts (GRBs), Active Galactic Nuclei (AGN), and Ultra-High Energy Cosmic Rays (UHECRs). These topics have been addressed successfully in the last 33 years in the IRAP Ph.D. as well as in the seventeen Italian-Korean Symposia (IK). New additional fundamental topics are being developed in the new JIRA Ph.D. program (http://www.icranet.org/documents/posterUSTC-UNIFE.pdf), see also the 16th Marcel Grossmann (MG16) meeting for recent developments in this research field (http://www.icranet.org/video_mg16) and this 17th Italian- Korean meeting.

2.Dong-Hoon Kim, Seoul National University (□□□, □□□)
Title: Pulsar radio emission with effects of gravitation and rotation
Abstract: The magnetosphere of, and electromagnetic (EM) radiation from pulsars are usually described in the framework of classical electrodynamics. For some pulsars, however, whose emission heights are relatively close to the surface of the neutron star, general relativistic effects might modify the emission from the pulsar. We consider a magnetic dipole model of a pulsar to investigate general relativistic effects on EM radiation from it. Our study includes general relativistic modifications applicable to some significant issues in pulsar astronomy, such as the magnetosphere structure and pulse profiles. We implement computation of the magnetic field in the pulsar magnetosphere from a solution to Maxwell's equations defined in the strongly curved spacetime around a pulsar and find that the field exhibits a strong gravitational effect. The effect modifies curvature radiation of a pulsar, which then leads to modifications of the pulse profiles of radio emission. In addition, we find the effect of rotation to asymmetrize the pulse profiles along the longitudinal phase. We take the pulsar PSR J1828-1101 as an example and work out Stokes parameters to simulate the pulse profiles for its main and interpulse emissions theoretically, which exhibit the gravitational effects clearly; however, their testability is beyond the current detection capabilities, with the absolute magnitude of the pulse profiles not being precisely predictable.

3.Lang Liu, Institute of Theoretical Physics, China
Title: Gravitational and Electromagnetic Radiation from Binary Black Holes with Electric and Magnetic Charges
Abstract: In this talk, we will derive the equations of motion of black hole binaries with electric and magnetic charges and explore features of static orbits. By using a Newtonian method with the inclusion of radiation reaction, we calculate the total emission rate of energy and angular momentum due to gravitational radiation and electromagnetic radiation. It is shown that the emission rates of energy and angular momentum due to gravitational radiation and electromagnetic radiation have the same dependence on the conic angle for different orbits. Moreover, we obtain the evolutions of orbits. We find that a circular orbit remains circular and an elliptic orbit becomes quasi-circular due to electromagnetic and gravitational radiation. Our results provide rich information about dyonic binaries and can be used to test black holes with magnetic charges.

4.Chen-Te Ma, APCTP
Title: Quantum correction of the Wilson line and entanglement entropy in the pure AdS_3 Einstein gravity theory
Abstract: We calculate the expectation value of the Wilson line in the pure AdS 3 Einstein gravity theory and also the entanglement entropy in the boundary theory. Our one-loop calculation of entanglement entropy shows a shift of the central charge 26. Finally, we show that the Wilson line provides the equivalent description to the boundary entanglement entropy. This equivalence leads to a concrete example of the building of “minimum surface=entanglement entropy”.

5.Daniele Gregoris, Jiangsu University of Science and Technology
Title: Cosmology with interactions in the dark sector: qualitative dynamics, singularities and applications
Abstract: In my talk, I will report on the late time attractors for some flat cosmological models whose dynamics is driven by a mixture of interacting dark energy and dark matter. The former will be described according to three different fluid models known as Redlich-Kwong, Modified Berthelot, and Dieterici, respectively, whose thermodynamical foundation will be briefly reviewed, allowing for a comparative analysis. Various modelings for the interaction term will be introduced, and then mathematical results about the qualitative dynamics and the possible occurrence of finite-time singularities for certain values of the model free parameters will be presented. Particular attention will be devoted to the case of weakly interacting fluids for which the interaction terms would be proportional to their energy density and/or to its rate of change. Dynamical system techniques will be adopted throughout this analysis. Finally, some applications of interacting fluids in light of the current open challenges of the standard cosmological model, as the Hubble tension and the coincidence problem, will be mentioned. The seminar will be loosely based on Eur. Phys. J. C (2020) 80: 112.

6.Soroush Shakeri, ICRANet-Isfahan, Isfahan University of Technology (IUT)
Title: The Role of Sterile Neutrinos in Cosmology and recent anomalies in Dark Matter Searches
Abstract: In this talk, we present an effective model for the sterile neutrino dark matter candidate. Due to new physics at the UV scale, three sterile neutrinos couple with SM fermions and gauge bosons via the SM gauge symmetric four-fermion interactions. Upon the spontaneous symmetry breaking, sterile neutrinos become massive and possess effective couplings to SM particles. We will show that the sterile neutrinos with masses around 90 keV and specific effective coupling can explain the XENON1T anomaly preserving DM astrophysical and cosmological constraints. We point out that the presence of three right-handed sterile neutrino allows to obtain correct dark matter relic density by the late entropy production due to late decay of heavier right-handed neutrinos. Moreover, four sterile neutrinos interaction can form composite scalar and pseudo scalar particles, the latter plays the role of axion, while the former the role of massive WIMP particles. Some phenomenological consequences of these new states as dark matter are discussed.
Besides, with possible sterile neutrino spectra and new effective coupling to SM particles, we try to explain the anomalies in other experiments such as muon g-2 and MiniBooNe experiment. Our scenario also offers some new distinctive features which may potentially produce observable signals in the sensitivity range of the next generation of XENON detectors such as XENONnT, LZ and DARWIN

7.She-Sheng Xue, ICRANet, Physics Department, Sapienza University of Rome
Title: joint talk with Soroush Shakeri
Abstract: TBA
Mu-In Park, Sogang U (□□□, □□□)
Title: Tests of Standard Cosmology in Horava-Lifshitz-DeWitt Gravity
Abstract: We will consider some background tests of the standard cosmology in the context of Hoava-Lifshitz-DeWitt gravity, which has been proposed as a renormalizable, higher-derivative

Lorentz-violating gravity model for quantum gravity without the ghost problem.

9.Lu Yin, Sogang U (□□, □□□)
Title: Gravitational waves from the vacuum decay with eLISA
Abstract: We investigate the gravitational wave spectrum resulted from the cos-mological first-order phase transition. We compare two models; one is a scalar field model without gravitation, while the other is a scalar field model with gravitation. Based on the sensitivity curves of the eLISA space-based interferometer on the stochastic gravitational-wave back- ground, we compare the difference between the gravitational wave spec- tra of the former and the latter cases resulted from the bubble collision process. Especially, we calculated the speed of the bubble wall before collision for the two models numerically. We show that the difference between the amplitudes of those spectra can clearly distinguish between the two models. We expect that the eLISA with C4 could observe the spectrum as the fast first-order phase transition or that with C1 as the slow first-order phase transition from the latter case.

10.Chan Park, NIMS (□□, □□□□□□□□□□)
Title: Extending the Observational Frequency Range for Gravitational Waves in a Pulsar Timing Array
Abstract: We provide an observation method for gravitational waves using a pulsar timing array to extend the observational frequency range up to the rotational frequency of pulsars. For this purpose, we perform an analysis of a perturbed electromagnetic wave in perturbed spacetime from the field perspective. We apply the analysis to the received electromagnetic waves in a radio telescope, which partially composes the periodic electromagnetic pulse emitted by a pulsar. For simple observation, two frequency windows are considered. For each window, we propose gauge-invariant quantities and discuss their observations.

11.Chang-Hwan Lee, Pusan National University (□□□, □□□)
Title: Neutron Star Properties from Low-Mass X-ray Binary
Abstract: TBA

Eoin O Colgain, Sogang U (□□□ □□□, □□□)
Title: Observations on the Cosmological Principle
Abstract: TBA

Rahim Moradi, ICRANet
Title: Broad line SNe-Ibc in GRBs, and Binary Driven Hypernova model
Abstract: It is well accepted that most long gamma-ray bursts (LGRBs) are associated with broad-line SNe-Ibc. There is a broad consensus that the GRBs progenitors are massive stars. It is also well accepted that the most massive stars, or at least a significant fraction of them, are members of binary system. This facts have motivated the theoretical approach to model the LGRBs, known as the binary driven hypernova (BdHN) model. All long GRBs, in this model, are assumed to have a common binary progenitor composed of a carbon-oxygen (CO)
star of □ 10 M□ and a NS companion. Right after the CO core collapse, the new configuration is composed of the 3 components: 1) the SN ejecta expanding out of the binary system; 2) the SN ejecta accreting onto the newborn NS(νNS), which is created out of the core collapse of the pre-SN progenitor star; 3) the SN ejecta accreting onto companion NS. The further evolution of the BdHN is based on the interplay of the SN ejecta, accretting on and spinning up both νNS and companion NS. When the binary period is short i.e. ~ 5 min, accretion onto the companion NS, leads to the formation of a BH. This systems are known as BdHNe type I (BdHN I). The attention of this work is to address many roles of the SN associated with GRBs in BdHN model especially to study the fate of BH in BdHN I.

Carlos Raul Arguelles, ICRANet
Title: Fermionic dark matter profiles
Abstract: Relaxation mechanisms of collisionless self-gravitating systems of fermions, can lead to spherical equilibrium states which are stable, long-lived, and can 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 while the outer halo can explain the rotation curve of the Galaxy, the central DM-core explain the dynamics of all the best resolved S-cluster stars orbiting SgrA *, without the need of assuming a central black hole (BH). Interestingly, for the same DM particle mass used to explain the Galactic halo, the critical mass for gravitational collapse of a degenerate fermion DM core into a BH is □ 10^8 Mo. This result may provide the initial seed for the formation of supermassive BH in active galaxies, leading to a paradigm shift in the understanding of galactic cores.

15.Wonwoo Lee, Sogang U (□□□, □□□)
Title: Astrophysical applications of rotating black holes with anisotropic matter field
Abstract: We present a family of new rotating black hole solutions to Einstein's equations that generalizes the Kerr-Newman spacetime to include an anisotropic matter. The geometry is obtained by employing the Newman-Janis algorithm. As astrophysical applications, we show the shadow cast induced by the rotating black hole with that matter.

16.Dong-han Yeom, Pusan National University (□□□, □□□)
Title: Quantum boundary condition inside a black holeotropic matter field
Abstract: We investigate quantum boundary conditions inside a black hole. We first describe the anisotropic cosmology model. In addition, we extend this to the gravitational collapsing model. Finally, we extend the discussion to the recent developments of loop quantum gravity black hole models.

Jin Young Kim, Kunsan National University (□□□, □□□)
Title: Deflection of light in Born-Infeld electrodynamics
Abstract: We consider the propagation of light under a strong electric field in Born-Infeld electrodynamics. We compute the bending angle of light by a Born-Infeld-type Coulomb charge in the weak lensing limit using the effective indices of refraction. We also compute the deflection angle by the Einstein-Born-Infeld black hole.

Pisin Chen(National Taiwan University & Stanford University)
Title: Gravitaional synchrotron radiation from storage rings
Abstract: We show that relativistic charged particles executing circular orbital motion, such as that in a storage ring, can emit gravitational waves through two channels. One is the gravitational synchrotron radiation (GSR) emitted directly by the massive particle; the other is the ‘resonant conversion’, i.e., the Gertsenshtein effect, which, in this case, converts the electromagnetic synchrotron radiation (EMSR) to GWs. It is shown that the dominant frequency of the direct GSR is its fundamental mode, i.e., , where is the radius of the storage ring. In the case of CERN LHC, Hz. The dominant frequency of resonant EMSR-GSR conversion is a factor higher, and for LHC it is around Hz, with the corresponding wavelength at which, if detected, would be the first observation of gravitons.

19.Maria Giovanna Dainotti, ICRANet
Title: 2D L-T correlation and the 3D fundamental plane in multiwavelengths
Abstract: TBA

Liang Li, ICRANet
Title: Constrainng the Type of Central Engine of GRBs with Swift Data
Abstract: The central engine of gamma-ray bursts (GRBs) is poorly constrained. There exist two main candidates: a fast-rotating black hole and a rapidly spinning magnetar. Furthermore, X-ray plateaus are widely accepted to be the energy injection into the external shock. In this paper, we systematically analyze the emph{Swift}/XRT light curves of 101 GRBs having plateau phases and known redshifts (before 2017 May). Since a maximum energy budget ($sim2times10^{52}$ erg) exists for magnetars but not for black holes, this provides a good clue to identifying the type of GRB central engine. We calculate the isotropic kinetic energy $E_{rm K,iso}$ and the isotropic X-ray energy release $E_{rm X,iso}$ for individual GRBs. We identify three categories based on how likely a black hole harbors a central engine: 'Gold' (9 out of 101; both $E_{rm X,iso}$ and $E_{rm K,iso}$ exceed the energy budget), 'Silver' (69 out of 101; $E_{rm X,iso}$ less than the limit but $E_{rm K,iso}$ is greater than the limit), and 'Bronze' (23 out of 101, the energies are not above the limit).
We then derive and test the black hole parameters with the Blandford-Znajek mechanism, and find that the observations of the black hole candidate ('Gold'+'Silver') samples are consistent with the expectations of the black hole model. Furthermore, we also test the magnetar candidate ('Bronze') sample with the magnetar model, and find that the magnetar surface magnetic field (B_{p}) and initial spin period (P_{0}) fall into reasonable ranges. Our analysis indicates that if the magnetar wind is isotropic, a magnetar central engine is possible for 20% of the analyzed GRBs. For most GRBs, a black hole is most likely operating.

21.Hochoel Lee, Sogang U (□□□, □□□)
Title: Hairy Black Hole Solutions in Dilatonic Einstein-Gauss-Bonnet Theory
Abstract: Nowadays the Einstein gravity theory, also known as the general relativity, is a fundamental theory in gravity. From the point of view of high energy, the Einstein gravity theory is effective theory valid below some ultraviolet cut-off. Therefore, there are a lot of modified theories. Among those theories, I studied a hairy black hole solution in the dilationic Einstein-Gauss-Bonnet theory in which the Gauss-Bonnet term is nonminimally coupled to the dilaton field. In this talk, I will spend most of the time reviewing and inroducing the motivation. After that, the solutions of hairy black hole and the details will be introduced.

Myeonghwan Oh, Kyungpook National University (□□□, □□□)
Title: Cosmic rays produced by magnetic Penrose process in Sgr A
Abstract: Particle acceleration by magnetic Penrose process (MPP) on super massive black hole (SMBH) was produced by A. Tunsunov et al 2020. We studied high energy cosmic ray production, where neutrons produced in the accretion flow are injected into the magnetic field close to SMBH and accelerated by this MPP. We estimated high energy cosmic ray production rate and spectrum from Sgr A. Typical energy of accelerated cosmic ray is found to be around 10^15eV, and we also estimated the flux of these PeV cosmic ray and compared with the observed cosmic ray flux on Earth

Davood Rafiel Karkevandi, Isfahan University of Technology (IUT)
Title: Probing Bosonic Dark Matter inside NS by the Tidal defomability

Abstract: Compact astrophysical objects such as neutron stars (NSs) offer natural laboratories that can accrete sizable amount of Dark Matter (DM) in extreme density regimes. In this work, we study the presence of self-interacting bosonic DM in NSs through its effect on various properties of NSs. In our scenario, the bosonic DM and baryonic matter (BM) are mixed together which are interacting only through gravitational force. We show that depending on DM model parameters and the amount of DM fraction, DM can exist as a core inside
the compact star or as an extended halo around it. Thanks to the recent detection of gravitational waves from binary NSs, in addition to the maximum mass of a compact object, we consider the tidal

deformability as a new probe for the presence of DM coexisting with BM in NSs and to check the consistency with observational constraints. In this work, the parameter space of self-interacting bosonic DM such as the mass and the coupling
have been explored from the mass-radius relation and the tidal deformability by considering various amounts of DM in the system.
As the conclusion, we show that a DM core decreases the total mass of the compact object and the tidal deformability while a DM halo could increase both of them. Finally, considering various DM fractions, boson's masses and coupling constants, some constraints have been obtained on our DM model by taking into account the maximum mass limit of NS, $M \geq 2M_{\odot}$ ($M_{\odot} \equiv$ Mass of the sun) and the tidal deformability upper limit from GW170817 event, $\Lambda <= 580$ for $M = 1.4M_{\odot}$.

24.Kuantay Boshkayev
Title: Accretion disc luminosity for black holes surrounded by dark matter
Abstract: We consider the observational properties of a static black hole space-time immersed in a dark matter envelope. We investigate how the modifications to geometry induced by the presence of dark matter affect the luminosity of the black hole's accretion disc. We show that the same disc luminosity as produced by a black hole in vacuum may be produced by a smaller black hole surrounded by dark matter under certain conditions. In particular, we demonstrate that the luminosity of the disc is markedly altered by the presence of dark matter, suggesting that the mass estimation of distant supermassive black holes may be changed if they are immersed in dark matter. We show how the results presented here may help to explain the observed luminosity of supermassive black holes in the early Universe.

25.Narek Sahakyan, ICRANet
Title: Multiwavelength and Multimessenger view of blazars
Abstract: 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.

26.Jorge Rueda, ICRA/ICRANet
Title: Synchrotron emission in GRB afterglows from binary-driven hypernovae and compact star binary mergers
Abstract: I will present a unified theoretical treatment of the synchrotron radiation responsible for the associated gamma-ray burst afterglow in binary-driven hypernovae (BdHNe) and in compact star (neutron star or white dwarfs) binary mergers.

27.Sung-Won Kim, Ewha Womans University (□□□, □□□□)
Title: Gravitational Waves Generated by a Slowly Rotating Wormhole
Abstract: In this talk, the gravitational wave generation by a slowly rotating wormhole with radially pulsating throat is considered. Two types of rotating wormholes are used as the model of the wave generation: the slightly rotating Ellis wormhole and the thin-shell wormhole. The later was made from two Kerr black hole solutions. To treat the problem, the assumption of the slightly rotating is validated by the ranges of the mass. We calculated the strain amplitudes and the powers emitted in gravitational wave for each cases and life times of the wormhole through the radiation.

28.Mahdis Ghodrati, APCTP
Title: Phase transitions and curvature invariants of the Massive Banados-Teitelboim-Zanelli black

holes in massive gravity theory
Abstract: We present the Hawking–Page phase diagrams and also the curvature invariants of massive black holes in the Bergshoeff–Hohm–Townsend (BHT) massive gravity theory. The phase diagrams are between various solutions, such as the phase transitions between vacuum AdS3text{Ad}{{text{S}}*{3}}AdS3 and BTZ black hole, warped AdS3text{Ad}{{text{S}}*{3}}AdS3and warped BTZ black hole in grand canonical and in non-local/quadratic ensembles, Lifshitz black hole and the new hairy black hole solutions. We observe that except for the black holes in quadratic ensemble, for other cases in the non-chiral theory of BHT the phase diagrams are symmetric with respect to the direction of angular momentum, as we expected. We conclude that for presenting the phase diagrams of warped AdS3text{Ad}{{text{S}}_{3}}AdS3 black holes, only the grand canonical ensemble should be used. In addition we discuss the holographic boundary pictures of these curvature invariants from the structures of entanglement entropy.
Sang Pyo Kim, Kunsan National U (□□□, □□□)
Title: Magnetars as Laboratory for Strong Field QED
Abstract: The current highest ultra-intense lasers has the intensity of 10^23 W/cm^2, six order lower than the critical intensity. Magnetars, however, have been observed to possess magnetic fields of macroscopic scale two orders larger than the critical field and can be used to explore strong field QED physics. In this talk, I advance a new method for the effective action in a supercritical magnetic field together with a subcritical electric field and express the vacuum polarization parameters such the electric permittivity and magnetic permeability as in terms of Hurwitz-zeta function. Possible observations of QED vacuum polarization effects are proposed for near future missions, such as eXTP and Compton Telescope.