ROMANIAN ACADEMY
ASTRONOMICAL INSTITUTE
ROMANIAN ACADEMY CLUJ-NAPOCA BRANCH - ASTRONOMICAL OBSERVATORY CLUJ-NAPOCA
ROMANIAN NATIONAL COMMITTTEE OF ASTRONOMY

"BABEŞ-BOLYAI" UNIVERSITY CLUJ-NAPOCA
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
FACULTY OF PHYSICS

7TH INTERNATIONAL CONFERENCE ON ASTRONOMY, ASTROPHYSICS, SPACE AND PLANETARY SCIENCES

International Conference, 10-12 July 2023, Cluj-Napoca

Programme

In the framework of Cluj Academic Days 2023,
„RoSSA" Contract – a grant of the Ministry of Research, Innovation and Digitization, CNCS/CCDI – UEFISCDI, project number P-III-P2-2.1-SOL-2021-2-0192.

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Front cover: False color image of Sculptor Galaxy taken at Astronomical Observatory Cluj-Napoca with CDK 24″ PlaneWave telescope and SBIG STL 6303E CCD camera, R filter, 30s.

Back cover: False color image of Pinwheel Galaxy taken at Astronomical Observatory Cluj-Napoca with CDK 24″ PlaneWave telescope and SBIG STL 6303E CCD camera, R filter, 30s.

Monday, July 10th 2023

Astronomical Observatory Cluj-Napoca
Str. Cireşilor nr. 19

9:00

Registration

09:45

Plenary session 1
Chairman: Vlad TURCU

Mihai BARBOSU
Rochester Institute of Technology, Rochester, New York, USA
Tracking Artificial Satellites from Optical Observations

Radu DANESCU[1], Attila FUZES[1], Razvan ITU[1], Vlad TURCU[2]
[1]Technical University of Cluj-Napoca, Cluj-Napoca, Romania
[2]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
Real time acquisition and processing system for LEO region surveillance

Coffee & tea break

11:30

Plenary session 2
Chairman: Mihai BARBOSU

Diana IONESCU[1,2], Georgeta MARIS MUNTEAN[2,1]
[1]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[2]Institute of Geodynamics "Sabba S. Ștefănescu" of the Romanian Academy, Bucharest, Romania
An Investigation of Properties of the Coronal Holes Producing HSSs

M. BIRLAN[1], P. VERNAZZA[2], M. FERRAIS[2], L. JORDA[2], J. HANUŠ[3], B. CARRY[4], M. MARSSET[5], M. BROŽ[3], R. FETICK[2], M. VIIKINKOSKI[6], F. MARCHIS[2,7], F. VACHIER[8], A. DROUARD[2]
[1]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[2]Aix Marseille Université, CNRS, CNES, Laboratoire d'Astrophysique de Marseille, Marseille, France
[3]Institute of Astronomy, Charles University, Prague, Czech Republic
[4]Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Laboratoire Lagrange, France
[5]Department of Earth, Atmospheric and Planetary Sciences, MIT, Cambridge, USA
[6]Mathematics and Statistics, Tampere University, Finland
[7]SETI Institute, Carl Sagan Center, CA, USA
[8]IMCCE, CNRS, Observatoire de Paris, PSL Université, Sorbonne Université, Paris, France
New estimation of density for the largest main-belt asteroid

Ruxandra TOMA[1], Ovidiu VADUVESCU[2]
[1]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[2]Isaac Neewton Group, Santa Cruz de Tenerife, Spain
EURONEAR - The European Near Earth Asteroids Network

13:00

Lunch

16:00

Plenary session 3
Chairwoman: Diana IONESCU

Tiberiu HARKO[1], Haidar SHEIKHAHMADI[2,3], S. N. SAJADI[4], Hossein MOSHAFI[5]
[1]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[2]School of Astronomy, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran
[3]Centre for Space Research, North-West University, Potchefstroom, South Africa
[4]School of Physics, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran
[5]School of Astronomy, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran
Astrophysical properties of Weyl geometric black holes

Teodora MATEI[1], Tiberiu HARKO[1,2,3]
[1]Department of Physics, Babes-Bolyai University, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[3]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
Warm inflation with boundary terms in a non-metric Weyl-type geometry

Paul A. BLAGA[1], Cristina BLAGA[1], Tiberiu HARKO[2,3,4]
[1]Babes-Bolyai University, Faculty of Mathematics and Computer Science, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[3]Department of Physics, Babes-Bolyai University, Cluj-Napoca, Romania
[4]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
Jacobi stability of circular orbits around Weyl black holes

Daria VISA[1], Tiberiu HARKO[1,2,3], Gabriela MOCANU[3]
[1]Department of Physics, Babes-Bolyai University, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[3]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
Mimetic Weyl geometric gravity

18:00

Poster session

20:00

Conference Dinner

Tuesday, July 11th 2023

Astronomical Observatory Cluj-Napoca
Str. Cireşilor nr. 19

09:00

Registration

09:30

Plenary session 4
Chairwoman: Cristina BLAGA

Eugen RADU
Department of Mathematics, Aveiro University, Portugal
Black holes and scalar fields

Jeff HODGSON[1], Benjamin L'HULLIER[1], Yannis LIODAKIS[2], Sang-Sung LEE[3], Arman SHAFELIOO[3], Jacobo ASOREY[4], Lorena Amaya RUIZ[1]
[1]Sejong University, Seoul, South Korea
[2]University of Turku, Finland
[3]Korea Astronomy and Space Science Institute, Daejeon, South Korea
[4]Complutense University of Madrid, Spain
Cosmological QUOKKAS - Quasar observations on the KVN from to Korea to Australia and South Africa

Lorena Amaya RUIZ[1], Jeff HODGSON[1], Benjamin L'L'HULLIER[1], Yannis LIODAKIS[2]
[1]Sejong University, Seoul, South Korea
[2]University of Turku, Finland
Analysis of flare characteristics and angular diameter distance and matter density of the Universe estimation for selected sources from the MOJAVE Database

Coffee & tea break

11:30

Plenary session 5
Chairman: Tibor HEGEDUS

Jacobo ASOREY
Universidad Complutense de Madrid, Spain
IPARCOS
Cosmology from SKA Observatory precursors

Aurelia PASCUT[1], J.P. HUGHES[2]
[1]"Stefan cel Mare" University of Suceava, Romania
[2]Rutgers University, N.J., U.S.A
X-ray study of the merging cluster of galaxies AS0592

Zoltan JAGER, Gyula M. SZABÓ
ELTE, MTA-ELTE Exoplanet Research Group, Gothard Astrophysical Observatory, Hungary
Numerical applications in modern astrophysics

13:00

Lunch

16:00

Plenary session 6
Chairman: Tiberiu HARKO

Tibor HEGEDUS[1,2,3], Zoltan JAGER[2], Zsolt KERESZTY[1,3], Istvan LEDNECZKI[2]
[1]AstroTech KFT, Baja, Hungary
[2]University of Szeged, Hungary
[3]Hungarian Meteoritics Society
Planetary defense-related activity program at Baja Observatory

T. BORKOVITS[1,2,3,4,5], S. A. RAPPAPORT[6], T. MITNYAN[1,2], I. B. BIRO[1,2], I. CSANYI[1], A. FORRO[7,8], T. HAJDU[7,8,9], J. SZTAKOVICS[9], A. PAL[7]
[1]Baja Observatory of the University of Szeged, Hungary
[2]ELKH-SZTE Stellar Astrophysics Research Group, Baja, Hungary
[3]Konkoly Observatory, Research Centre for Astronomy and Earth Sciences, Budapest, Hungary
[4]ELTE Gothard Astrophysical Observatory, Hungary
[5]MTA-ELTE Exoplanet Research Group, Hungary
[6]M.I.T. Department of Physics and Kavli Institute for Astrophysics and Space Research, Cambridge, MA, USA
[7]Konkoly Observatory, Research Centre for Astronomy and Earth Sciences, ELKH, MTA Centre of Excellence, Hungary
[8]MTA CSFK Lendulet Near-Field Cosmology Research Group
[9]Eszterhazy Karoly Catholic University, Department of Physics, Hungary
Then and now: A new look on the eclipse timing variations of hierarchical triple star candidates in the primordial Kepler-field, revisited by TESS

Alexandru POP[1], Maria CRACIUN[2]
[1]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
[2]'T. Popoviciu' Institute of Numerical Analysis, Romanian Academy, Cluj-Napoca, Romania
Orbital period variability of U CrB - a new approach

Alexandru POP
Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
On the estimation of the statistical significance of peaks in amplitude spectra

20:00

Dine Around

Wednesday, July 12th 2023

Astronomical Observatory Cluj-Napoca
Str. Cireşilor nr. 19

09:00

Registration

09:30

Plenary session 7
Chairman: Mirel BIRLAN

Maria CRACIUN[1], Tiberiu HARKO[2]
[1]'T. Popoviciu' Institute of Numerical Analysis, Romanian Academy, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
Observational constraints on Weyl geometric gravity from the SPARC galactic rotation curves database

Bogdan TEODORESCU[1], Laurentiu CARAMETE[2]
[1]Department of Physics, Babeș-Bolyai University, Cluj-Napoca
[2]Institute of Space Science, Măgurele, Romania
Populating the Zone of Avoidance with statistically generated galaxies according to a fractal distribution of galaxies

Marcello DE CICCO[1], Iharka SZUCS-CSILLIK[2]
[1]Observatório Nacional, Programa de Pós-Graduação em Astronomia do Observatório Nacional (PPGA/ON/MCTI) Brazil
[2]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
Numerical investigation of an Earth-grazing Fireball's Close Approach

Coffee & tea break

11:30

Plenary session 8
Chairwoman: Iharka SZUCS-CSILLIK

Iharka SZUCS-CSILLIK[1], Furtike SZUCS-CSILLIK[2]
[1]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
[2]Tancsics-Mihaly High School, Hungary
The Origin of the Alphabet: some engraved symbols from the Neolithic period in Southeast Europe

M. H. NAIMAN[1], I. SZUCS-CSILLIK[2], D. PRICOPI[3], V. CHIRILA[4]
[1]Astroclub Bucharest, Romania
[2]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca
[3]Astronomical Institute of Romanian Academy, Astronomical Observatory Bucharest
[4]Astro Nauticus Mangalia, Romania
NameExoWorlds 2022 Edition and the Romanian approved names

12:30

Conference concluding remarks

ABSTRACTS

ORAL PRESENTATIONS

Plenary session 1

Title: Tracking Artificial Satellites from Optical Observations

Author: Mihai BARBOSU
Rochester Institute of Technology, Rochester, New York, USA

Abstract: Real-time tracking of artificial satellites through optical observations enables more precise monitoring and management of satellites in orbit. Space dynamics models incorporate fundamental principles of celestial mechanics used in predicting the motion of artificial satellites affected by various perturbations, such as atmospheric drag, gravitational perturbations, and solar radiation pressure. However, there are limitations associated with these models, determined by uncertainties in initial conditions. In this paper, we explore the integration of optical observations into these models in order to obtain more accurate real-time predictions of satellite positions and trajectories.

Title: Real time acquisition and processing system for LEO region surveillance

Author: Radu DANESCU[1], Attila FUZES[1], Razvan ITU[1], Vlad TURCU[2]
[1]Technical University of Cluj-Napoca, Cluj-Napoca, Romania
[2]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca

Abstract: The Low Earth Orbit region is filled with active satellites but also with space debris, which can often change their orbit. Many of such objects pose threat to space operations, and some are due for atmospheric reentry. Constant tracking and surveillance is necessary to anticipate and prevent incidents. We propose a hardware and software system for wide field surveillance, which includes acquisition, astrometric calibration, and astrometric reduction, all performed in real time. As one of the challenges of surveillance is astrometric calibration, we have analyzed the options for increasing the accuracy of the results by combining multiple calibrations, without the loss of real time capabilities.

Plenary session 2

Title: An Investigation of Properties of the Coronal Holes Producing HSSs

Authors: Diana IONESCU[1,2], Georgeta MARIS MUNTEAN[2,1]
[1]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[2]Institute of Geodynamics "Sabba S. Ștefănescu" of the Romanian Academy, Bucharest, Romania

Abstract: We will investigate the properties of coronal holes (CHs) that produced high speed streams (HSSs).
Based on the HSSs Catalog (Besliu-Ionescu et al., 2022) we will focus on which CH feature could be the main characteristic in producing a geoeffective HSSs.
We will also analyze if this geo effectiveness could be influenced by a combination of certain CH properties. The period corresponding to the descending phase of SC24 will be analyzed. The structure of CHs varies during the solar cycle, most of the geoeffective HSSs being detected during the descending phase.

Title: New estimation of density for the largest main-belt asteroid

Authors: M. BIRLAN[1], P. VERNAZZA[2], M. FERRAIS[2], L. JORDA[2], J. HANUŠ[3], B. CARRY[4], M. MARSSET[5], M. BROŽ[3], R. FETICK[2], M. VIIKINKOSKI[6], F. MARCHIS[2,7], F. VACHIER[8], A. DROUARD[2]
[1]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[2]Aix Marseille Université, CNRS, CNES, Laboratoire d'Astrophysique de Marseille, Marseille, France
[3]Institute of Astronomy, Charles University, Prague, Czech Republic
[4]Université Côte d'Azur, Observatoire de la Côte d'Azur, CNRS, Laboratoire Lagrange, France
[5]Department of Earth, Atmospheric and Planetary Sciences, MIT, Cambridge, USA
[6]Mathematics and Statistics, Tampere University, Finland
[7]SETI Institute, Carl Sagan Center, CA, USA
[8]IMCCE, CNRS, Observatoire de Paris, PSL Université, Sorbonne Université, Paris, France

Abstract: Results of ESO Large program of observations for large asteroids using VLT/SPHERE/ZIMPOL asset are presented. The sample consists of 39 bodies with $D \geq 100$ km and in particular most $D \geq 200$ km main-belt asteroids (20 among the 23). The sample reflects the compositional diversity present in the main belt thus the following taxonomic classes were recorded: A, B, C, Ch/Cgh, E/M/X, K, P/T, S, and V. The presentation will focus mainly on the new results regarding their densities, shapes, and spins.

Title: EURONEAR - The European Near Earth Asteroids Network

Authors: Ruxandra TOMA[1], Ovidiu VADUVESCU[2]
[1]Astronomical Institute of the Romanian Academy, Bucharest, Romania
[2]Isaac Neewton Group, Santa Cruz de Tenerife, Spain

Abstract: The EURONEAR project aims to study near earth objects following a couple of goals: 1. Constraining the orbits of poorly known asteroids with highly uncertain parameters using astrometry to measure positions; 2. Determining the physical properties and chemical composition of near earth objects using photometry and spectroscopy. The project's methods will be presented and the most interesting results will be highlighted. For instance, we developed our own MOPS software and discovered 12 near earth asteroids. Our work has been published in ~30 publications. Some of our objects have received names of Romanian astronomers. Last but not least, the project will also be presented as a good way to perform education and outreach.

Plenary session 3

Title: Astrophysical properties of Weyl geometric black holes

Authors: Tiberiu HARKO[1], Haidar SHEIKHAHMADI[2,3], S. N. SAJADI[4], Hossein MOSHAFI[5]
[1]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[2]School of Astronomy, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran
[3]Centre for Space Research, North-West University, Potchefstroom, South Africa
[4]School of Physics, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran
[5]School of Astronomy, Institute for Research in Fundamental Sciences (IPM), Tehran, Ira

Abstract: We consider the astrophysical properties of an exact black hole solution obtained in Weyl geometric gravity theory, from the simplest conformally invariant action, constructed from the square of the Weyl scalar, and the strength of the Weyl vector only. The action is linearized in the Weyl scalar by introducing an auxiliary scalar field. In static spherical symmetry, this theory admits an exact black hole solution, which generalizes the standard Schwarzschild solution through the presence of two new terms in the metric, having a linear and a quadratic dependence on the radial coordinate. We consider in detail the motion of the massive particles and photons in this geometry, and we obtain the positions of the stable circular orbits from the extremum of the effective potential. The perihelion precession. The light deflection, the shadow, and the Shapiro effect in this Weyl type geometry are also investigated. The quantum properties of the black hole are also considered, and the Hawking temperature and the mass loss rate due to the Hawking radiation are obtained by using both analytical and numerical methods. The obtained results may lead to the possibility of testing Weyl geometry, and its effects, at the level of the Solar System, and by using the observational properties of black holes.

Title: Warm inflation with boundary terms in a non-metric Weyl-type geometry

Authors: Teodora MATEI[1], Tiberiu HARKO[1,2,3]
[1]Department of Physics, Babes-Bolyai University, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[3]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca

Abstract: We consider the effects that emerge in the warm inflationary scenario in the presence of the boundary terms in the Einstein gravitational field equations. We assume that the boundary contribution can be described in a non-metric, Weyl-type geometry. The dissipative scalar field, whose evolution is obtained from a variational principle, is considered, together with the Weyl vector, as the source of the radiation and matter in the early Universe. Cosmological dynamics is studied by using the generalized Friedmann equations in the presence of non-metricity, and the balance equations for radiation and matter, respectively. The solutions of the cosmological evolution equations are obtained numerically, and they show that matter creation determines the transition from an accelerating inflationary phase to a decelerating one, with the Weyl vector playing an important role in this process.

Title: Jacobi stability of circular orbits around Weyl black holes

Author: Paul A. BLAGA[1], Cristina BLAGA[1], Tiberiu HARKO[2,3,4]
[1]Babes-Bolyai University, Faculty of Mathematics and Computer Science, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[3]Department of Physics, Babes-Bolyai University, Cluj-Napoca, Romania
[4]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca

Abstract: The Weyl conformal gravity, introduced to unify gravity and electricity, at the beginning of the 20th century. There is a renewed interest in this (fourth order) theory of gravity, after, starting with 1989, several black hole exact solutions have been found. In this note we analyze the Jacobi stability of circular geodesics around a spherically symmetric Weyl black hole. The Jacobi or KCC (Kosambi-Cartan-Chern theory) stability is a differential geometrical theory which describes the deviations of the entire trajectory of a dynamical system with respect to the nearby ones. The present analysis may lead to a new understanding of the stability properties of Weyl black holes, and give some constraints of the free parameters of the solution..

Title: Mimetic Weyl geometric gravity

Author: Daria VISA[1], Tiberiu HARKO[1,2,3], Gabriela MOCANU[3]
[1]Department of Physics, Babes-Bolyai University, Cluj-Napoca, Romania
[2]Department of Theoretical Physics, National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest, Romania
[3]Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca

Abstract: We consider a mimetic type extension of the Weyl geometric gravity theory, by assuming that the metric of the space-time manifold can be parameterized in terms of a scalar field, called the mimetic field. Within the framework of the mimetic field, it is possible to provide a geometrical explanation for Dark Matter and the late-time acceleration. Initially, we formulate the conformally invariant gravitational action with a new degree of freedom - the Weyl vector, where we include the effective matter action and the mimetic field via the Lagrangian multiplier formulation. The field equations are obtained from the variational principle; this is accomplished by varying the action with respect to the metric tensor, the Weyl vector, the scalar field and the Lagrange multiplier. Linearization of the gravitational action is achieved through the integration of an auxiliary term, the scalar field. In the present paper, the cosmological evolution of the mimetic Weyl theory is explored for an isotropic and homogeneous FLRW (Friedmann–Lemaitre–Robertson–Walker) universe, by obtaining the Friedmann equations of the standard general relativity. Finally, we discuss some cosmological applications, and we compare the results of the theory with a standard model.

Plenary session 4

Title: Black holes and scalar fields

Authors: Eugen RADU
Department of Mathematics, Aveiro University, Portugal

Abstract: With the recent discovery of the Higgs boson and the detection of the gravitational waves, the study of scalar fields and black holes became important directions of research in modern physics. In this talk we shall start by reviewing the basic aspects of these two seemingly unconnected subjects. The tension between the existence of black holes and the presence of non-trivial scalar field configurations, as encoded in the black hole 'no hair' conjecture, will also be discussed. Finally, we shall review a number of recent results which circumvent the 'no hair' conjecture, allowing for black holes surrounded by 'scalar clouds', with potential relevance in astrophysics.)

Title: Cosmological QUOKKAS - Quasar observations on the KVN from to Korea to Australia and South Africa

Author: Jeff HODGSON[1], Benjamin L'HULLIER[1], Yannis LIODAKIS[2], Sang-Sung LEE[3], Arman SHAFELIOO[3], Jacobo ASOREY[4], Lorena Amaya RUIZ[1]
[1]Sejong University, Seoul, South Korea
[2]University of Turku, Finland
[3]Korea Astronomy and Space Science Institute, Daejeon, South Korea
[4]Complutense University of Madrid, Spain

Abstract: Measuring distances vs redshift (more commonly known as a Hubble Diagram) is one of the most fundamental yet difficult observations that can be made in astronomy. Every time the diagram has been extended to greater and greater distances (or higher redshifts), important discoveries have been made. Most recently this was the accelerating expansion of the universe, for which the 2011 Nobel Prize was awarded. The discovery was accomplished using Type Ia supernovae, but they are based on the 'distance ladder' and can only be seen to a redshift of ~2. Active Galactic Nuclei (AGN) are unique objects as they can be seen at both low redshift (z~0) and high redshift (z~6). For this reason, they have long been sought as a distance measure with limited success. It is within this context that we are beginning the Cosmological QUOKKA project. The core assumption is that the radio variability observed is constrained by the speed of light. Multiplying the timescale of variability by the speed of light gives a linear size estimate which can then be compared against the apparent size using Very Long Baseline Interferometry (VLBI). In this presentation, I will describe the method, some early results (including a measurement of the Hubble Constant) and the details of our observational project using the Korean VLBI Network and the Mopra telescope in Australia and HartRAO in South Africa. Preliminary observations have been performed with confirmed detections on the Korea to Australia baseline of z=4.6. The highest redshift source detected on the full array is z=3.1.

Title: Analysis of flare characteristics and angular diameter distance and matter density of the Universe estimation for selected sources from the MOJAVE Database

Authors: Lorena Amaya RUIZ[1], Jeff HODGSON[1], Benjamin L'L'HULLIER[1], Yannis LIODAKIS[2]
[1]Sejong University, Seoul, South Korea
[2]University of Turku, Finland

Abstract: Very Long Baseline Interferometry (VLBI) observations provide the highest angular resolution possible, with milliarcsecond scale resolution frequently achieved. Often they used to observe the relativistic outflows emanating from supermassive black holes found in active galactic nuclei (AGN). The MOJAVE (Monitoring Of Jets in Active galactic nuclei with VLBA Experiments) program is a long-running AGN monitoring program, observing relativistic motions within AGN jets at the sub-parsec level. The study of flares, which are intense bursts of radiation, in the light curves of these sources, can provide insights such as the physical processes occurring near supermassive black holes, the cosmological distribution of AGNs, and their role in the evolution of galaxies. Also, they could be useful to test different cosmological models by measuring “causality distances” - where the variability observed in the light-curves is assumed to be constrained by the speed of light and therefore used to calibrate the flaring region as a standard ruler. 15 sources were selected from the MOJAVE database paying attention that their light curves had well-defined prominent flares and enough data points to carry out an analysis. We then analyze each flare, dividing them into "rise" and "decay" stages. And a variability timescale, tvar, was determined. Then, by assuming there is a maximum brightness temperature that the sources can achieve, relativistic effects can be calibrated and therefore, the angular diameter distance, DA, can be calculated. By fixing the Hubble Constant (and some other assumptions), a direct measure of the matter content of the universe (Omega_m) was made, albeit with large errors at this stage.

Plenary session 5

Title: Cosmology from SKA Observatory precursors

Authors: Jacobo ASOREY
Universidad Complutense de Madrid, Spain
IPARCOS

Abstract: We are currently living a fruitful era of cosmology from wide field optical cosmological surveys. By analyzing the clustering of matter, we can use the growth of structure to understand dark energy or to test different models of gravity. However, we will soon enter the multi-tracer and multiwavelength astrophysics era. Radio Continuum Cosmology Clustering surveys will map the matter distribution using Active Galactic Nuclei (AGN) and star forming galaxies (SFG) over a large area and up to high redshifts, and will be crucial to discriminate between current theoretical models. At the same time, we plan to use 21cm intensity mapping as a cosmological probe with surveys such as Tianlai or CHIME and SKAO in the future. In my talk, I will address some of the cosmological prospects of using the Australian Square Kilometer Array Pathfinder (ASKAP) with the Evolutionary Map of the Universe survey (EMU), especially considering the EMU pilot survey and the first cosmological results using data from the Rapid ASKAP Continuum Survey. I will finally address the intrinsic limits of radio continuum cosmology clustering surveys regarding the number density of the different types of galaxies, the limits on the possibility of dividing the sample in several redshift bins and most importantly, how the intrinsic size of galaxies and the limiting technology will reach a hard flux limit of 100 nJy.

Title: X-ray study of the merging cluster of galaxies AS0592

Authors: Aurelia PASCUT[1], J.P. HUGHES[2]
[1]"Stefan cel Mare" University of Suceava, Romania
[2]Rutgers University, N.J., U.S.A

Abstract: In this talk I will present the results of our study of the AS0592 massive cluster by using 100 ks Chandra observations. AS0592 is a binary merger, at redshift of 0.22, with a global gas temperature of 9.7 keV. The two merging components are clearly visible as surface brightness peaks in the X-ray image. The primary system harbors a strong cool core (kT 4 keV), which shows signs of sloshing induced by the merger event. We detected other merging signatures such as the bullet-like morphology of the secondary, the shock front found in the vicinity of secondary and a central region of dense gas with significantly higher temperature compared to the ambient medium. I will discuss the thermodynamic properties of the AS0592 cluster and how the observed merging characteristics were used to constrain a merging scenario for this system.

Title: Numerical applications in modern astrophysics

Authors: Zoltan JAGER, Gyula M. SZABÓ
ELTE, MTA-ELTE Exoplanet Research Group, Gothard Astrophysical Observatory, Hungary

Abstract: In our time, scientific measurements are becoming increasingly data intensive, and computers have become indispensable for their management. These computers become the everyday devices in our lives, and serious calculations can also be done by personal computers. With this, the numerical methods become readily available. Complex problems can almost only be modeled numerically, so these problems can be handled with finite precision. One application is the lightcurve and spectra modeling of supernova explosions, from this the physical parameters of the exploding star, such as ejected mass, radius and energies can be determined. To this day, there is considerable research into the physics of supernova explosions, because it allows us to study extreme physical phenomena. Another application is to model the measured fluxes of exomoons (moons of planets orbiting other stars), and thus determining their chances of detection. Although many exoplanets are known, none of exomoon are known (only candidates). Yet another application is modeling the orbits of small bodies in the Solar or other systems. Solving the N-body problem is only possible numerically.

Plenary session 6

Title: Planetary defense-related activity program at Baja Observatory

Authors: Tibor HEGEDUS[1,2,3], Zoltan JAGER[2], Zsolt KERESZTY[1,3], Istvan LEDNECZKI[2]
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Abstract: Under MTH acronym ('Hungarian Bolide-observing Network') we installed a new allsky-camera system in 6 sites around the country, well covering the whole atmospheric ranges above Hungary. Each station has a multiple-camera head on the top of some building, having 7 (or in some cases 8) identical CMOS cameras, with low-distortion lenses, GPS sensor, control electronics, under a weather-proof acrylic dome, microcomputer, and UPS power supply. The hardware and software are developed by Mike Hankey (USA) and Sirko Molau (Germany). The camera system is coordinated by two of us (JZ and KZs), but all stations have local assistance. The main aims of our staff is calculating the atmospheric path and Solar System orbit of all fireballs detected by our system, deriving the possible strewn field, and trying to collect as many fallen meteorites as possible. Under the EON acronym ('European Optical Network') we installed a satellite tracking telescope system at Baja Observatory. The Celestron 11" RASA optics is equipped with a QHY268M CMOS sensor, and used on a PlaneWave alt-azimuthal direct drive mount. The regular observations were started in late October 2022. Until now we completed more than 120 hours observations of test satellites, and real targets, as well. The SST project will continue in 2023-24 adding a new feature to the observations: we shall install a 4-OTA's telescope system in a remote observing site for making multicolor photometry of selected space debris and active satellites, aiming for the possible characterization of these objects.

Title: Then and now: A new look on the eclipse timing variations of hierarchical triple star candidates in the primordial Kepler-field, revisited by TESS

Authors: T. BORKOVITS[1,2,3,4,5], S. A. RAPPAPORT[6], T. MITNYAN[1,2], I. B. BIRO[1,2], I. CSANYI[1], A. FORRO[7,8], T. HAJDU[7,8,9], J. SZTAKOVICS[9], A. PAL[7]
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Abstract: A former analysis of eclipse timing variation (ETV) curves of eclipsing binaries (EB) observed by Kepler spacecraft during its ~4-yr-long prime mission has led to the discovery and characterization of 222 hierarchical triple star system with different confidence levels. Although the prime Kepler-mission ended in 2013 (almost exactly ten years ago), TESS space telescope revisited the original Kepler-field in the summers of 2019, 2021 and 2022, allowing to extend the time-base of high precision times of minima observations for a substantially longer interval. In this talk I present our new analysis about the extended ETV curves of the formerly identified triple star candidates and many other Kepler EBs. Besides the confirmations of the former findings and/or the improvements of the triple systems' orbital properties, the extended time-base allowed us to identify several new, longer outer period triple systems on one side, and it made also possible a more detailed study of the dynamical perturbations in the tightest triple stars, on the other side.

Title: Orbital period variability of U CrB - a new approach

Authors: Alexandru POP[1], Maria CRACIUN[2]
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Abstract: The study of the orbital period variability of the Algol type binary system U Coronae Borealis is resumed. The present, more nuanced, approach takes into account both the heteroskedastic character of the available timing data and the short and long timescales involved. According to our results, the long timescale variability component is about 90 yr. The short timescale component consists in a 43.57 yr light travel time effect (LTTE), and another quasiperiodic component which may be formally decomposed in two periodic harmonic components with 9.03 and 10.80 yr periodicities, respectively. The LTTE component may be caused by the presence of a 0.83 MSun companion, if we assume the coplanarity of its orbit and that of the eclipsing binary. This result is in excellent agreement with that of Heintze (1990), concerning the white dwarf nature of the third body in the system with a mass of 0.8 MSun. The quasiperiodic components may be related to the cyclic magnetic activity of the late spectral type companion of U CrB and, maybe, to the mass transfer occurring in the system.

Title: On the estimation of the statistical significance of peaks in amplitude spectra

Authors: Alexandru POP
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Abstract: The estimation of the statistical significance of the peaks appearing in the spectra of various astronomical time series is an important goal of the studies on variability phenomena. It is essential for the detection of unseen stellar companions. A particular situation is that in which the spectra do not display a single, dominant peak, but at least a few peaks with relatively the same order of magnitude. Two different statistics are considered to be used in Monte Carlo simulations in order to simultaneously supply estimates of the statistical significance of the peaks of interest. These approaches are illustrated relying on three recent radial velocity data sets on stars involving exoplanets: TOI-2196, TOI-4127, and TOI-733.

Plenary session 7

Title: Observational constraints on Weyl geometric gravity from the SPARC galactic rotation curves database

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Abstract: Weyl geometry is an interesting, non-metric, extension of Riemann geometry, which fully implements the fundamental requirement of the conformal invariance of the physical laws. Gravitational models constructed from the square of the Weyl geometric scalar and from the strangth of the Weyl vector can be linearized by introducing a scalar degree of freedom. The corresponding theory has an exact, static spherically symmetric solution, which can provide an effective description of the galactic rotation curves, without the need of introducing the elusive dark matter. We perform an observational test of the Weyl geometric dark matter model, by comparing the theoretical predictions of the rotation curves velocity with the observational data of the SPARC database. Our results show that the Weyl geometric gravity model can provide an acceptable description of the galactic dynamics, and of the properties of the rotation curves.

Title: Populating the Zone of Avoidance with statistically generated galaxies according to a fractal distribution of galaxies

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Abstract: The Zone of Avoidance in our galaxy is a local effect which has posed a challenge for scientists for decades now and in this article we attempt to populate the ZoA with computer-generated galaxies using statistical analysis such as Monte Carlo algorithms, or statistical correlations such as N-point correlation functions. However, while there are methods to generate galaxies, it is difficult to decide how many galaxies should be generated. In this regard we used a fractal approach and computed this number following a fractal distribution of galaxies in the Universe. Starting from a data set of about 6000 supermassive black holes, related to various galaxies in our neighborhood, having information on their position (galactic longitude and latitude), redshift, black hole mass, distance and morphology, we populate the ZoA in this data set with new data according to the method described above.

Title: Numerical investigation of an Earth-grazing Fireball's Close Approach

Authors: Marcello DE CICCO[1], Iharka SZUCS-CSILLIK[2]
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Abstract: On October 13th 1990 an earth-grazing fireball crossed the Earth's atmosphere. As we know, a grazing meteors type are meteoroid debris that enter the planetary atmosphere with a near-horizontal orbit, perigee very high to the ground, having only part of their material being ablated during air interaction. Thereso, the remaining could return to space at a different orbit after that short encounter. The grazing fireball EN131090 had absolute magnitude of -6 and lasted 10 secs, with initial velocity of 41.7 km/sec. It was observed above Czechoslovakia and Poland and registered by two Czech stations of the European Fireball Network. The modified orbit of the remaining material, which went out into interplanetary space with solidified fusion crust on its surface, was calculated using the special method for long trajectory determination of the authors Borovicka and Ceplecha (1992). Using Rebound Python package we implemented calculations for that grazing type close encounters back and forth in time, before initial conditions (IC) used for the retrograde integration and the after IC for prograde integration, then, the same steps were done running the equations of motion of perturbed two-body problem under a 4th order Symplectic Integrator. In this paper, we continue our investigations about the close encounter of the fireball EN131090 using the regularized elliptic restricted three-body problem and a 4th order symplectic integrator with 9 stages.

Plenary session 8

Title: The Origin of the Alphabet: some engraved symbols from the Neolithic period in Southeast Europe

Authors: Iharka SZUCS-CSILLIK[1], Furtike SZUCS-CSILLIK[2]
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Abstract: Most or nearly all alphabetic scripts used throughout the world today ultimately go back to the Semitic proto-alphabet. Its first origins can be traced back to a proto-Sinatic script developed in ancient Egypt to represent the language of Semitic-speaking workers and slaves in Egypt. The oldest examples are found as graffiti in the Wadi el Hol and date to perhaps 1850 BC. On the other hand, we present some engraved Neolithic artifacts from the Vinča civilization around 6000 BC, namely the Spondylus shell from Mostonga, the round tablet from Tărtăria, the black spindle from Turdaș, the piece of amphora from Lozna, and some Neolithic potteries from Parța and Bulgaria, which, in our opinion, contain sacred symbols. The deciphered messages of the presented Neolithic artifacts are outstanding because they represent the first evidence that a Neolithic culture knew about the slight change at the beginning of the seasons (precession). They found out that some constellations on the ecliptic can be used to mark a given period. The refinement of calendars (timekeeping) and the symbols and signs on archaeological artifacts demonstrated the importance of astronomy in ancient cultures. The results show that with the spread of these sacred-celestial symbols, the foundations of the pre-writing were determined, i.e., over time, rudimentary letters could develop from the shape of constellations. Besides, these symbols could evolve into the Semitic proto-alphabet. Further, these precious Neolithic findings can be interpreted as instruments for measuring astronomical phenomena to obtain a calendar date. Consequently, the great minds preserved their knowledge of astronomy with the help of engraved amulets during rituals.

Title: NameExoWorlds 2022 Edition and the Romanian approved names

Authors: M. H. NAIMAN[1], I. SZUCS-CSILLIK[2], D. PRICOPI[3], V. CHIRILA[4]
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Abstract: The first exoplanets were discovered just three decades ago and over 5000 have been identified since. Most of these planets are only referred to by their scientific designations and have no connections to our stories and cultures. The systems to be named by NameExoWorlds 2022 are of special interest, as they are among the first exoplanet targets of the James Webb Space Telescope (JWST). NameExoWorlds 2022 is a collaboration between the Executive Committee Working Group on Exoplanetary Systems Nomenclature and the IAU Office for Astronomy Outreach. From Romania, 5 names for 5 extrasolar systems were proposed, and one proposal was approved for WASP-43 extrasolar system: Gnomon and Asrolábos - names of ancient astronomical instruments, especially for navigation. We briefly present the 2022 campaign, emphasizing its importance in stimulating young people towards astronomy.

POSTER PRESENTATIONS

Title: Efficient technique for precise orbit integration of Earth satellites

Authors: I. SZUCS-CSILLIK, V. TURCU
Romanian Academy Cluj-Napoca Branch, Astronomical Observatory Cluj-Napoca

Abstract: Thousands of satellite missions are orbiting the Earth. For the analysis of the satellite mission and the design of its trajectory, as well as for the directing, guidance and navigation of artificial satellites, it is necessary to be able to calculate the most accurate forecasts. On the other hand, the Newtonian equations of motion in rectangular coordinates become singular when the distance between the two bodies, regarded as point masses, tend to zero (close encounter). Numerical integrations provide several advantages over classical Newtonian equations, but in the case of close encounters, it is better to use the KS-regularization to study the satellite motion. To avoid the singularity, we used the regularization technique, introducing coordinate transformation to blow up the motion around the singularity and time transformation to slow down the motion. The resulting new, linear and regular second-order differential equations of motion can be used to obtain precise solutions. The precise orbit prediction of the artificial satellite's motion depends on correct initial conditions and from an adequate numerical (canonical) integrator. The analytical and numerical part of the presented efficient technique is emphasized with a concrete application for Leo satellites.

Title: On the isosceles trapezoidal four-body problem

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Abstract: The orbits of stars conserve information about the formation processes of the multiple star systems, and exploring dynamically their motion helps us to understand the evolution of stars. Accordingly, special types of the four-body problem investigated analytically and numerically can provide a better understanding of the dynamical behavior of quadruple stellar systems. This paper deals with the isosceles trapezoidal four-body problem (I4BP), where two point masses are equal with 1, while the remaining two point masses are equal with m. Consider these four point masses on the vertices of a trapezoid. Let us take the distance between the first two bodies to be 1, and between the last two bodies equal to a, and the first two particles lying on the x-axis. The length of each side is b. The position of the bodies can be marked as follows r_1(−1/2, 0), r_2(1/2, 0), r_3(a/2, (b^2−(1−a)^2/4)^1/2), and r_4(-a/2, (b^2−(1−a)^2/4)^1/2). Hence, the time evolution of the system is uniquely defined by the geometrically reduced Hamilton's equations. Further, we studied the minimizing property of the solutions and demonstrated that the minimizers of the action functional restricted to homographic solutions are the Keplerian elliptical solutions, and this functional has a minimum.

In addition, we investigated the dynamical behavior of the isosceles trapezoidal four-body problem using the surface of section method.

Title: Planetary Defense and Near Space Activity of Baja in 2022-23

Author: T. HEGEDUS[1,2] , Z. JAGER[1], Z. GODA[3], Zs. KERESZTY[2], A. LANG[4], L. PAPP[5]
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Abstract: Owing to the coordinated cooperation of the consortium of a few institutions and private partners, some special "planetary defense" and "near space" services are available by requests since 2023. First, a new, independent fireball observing network was installed and tested in 2022. Practically the whole atmospheric region over Hungary is covered up to 100-110 km by 6 stations. Each station is used in automatic operation mode, but has local technical assistance. The camera heads consist of 7 (in the case of latest installation 8) identical camera+lens combo, GPS sensor, and weather-proof acrylic dome. The local control is done by a mini-PC at the sites, but all these stations are part of the whole-earth "allsky7" system. The main aim is to produce more accurate luminous atmospheric orbits for the brightest bolides and supply better initial parameters for dark flight calculations, resulting in a better chance to uncover the possible strewn fields of future events. The DAMBALL high-altitude balloon group and SOPROBOTICS team continued the "intelligent" artificial meteoroid drop experiment. The on-flight communication and crash tests are done, now the final tests are on the way (wind-tunnel tests and the remote-controlled drop-down mechanics). The group offers near-space test opportunities for any interested space technology-related entities for flight-tests of any instruments - within a given size-, and weight limit (the maximum is about 1 kg which can be lifted over 25 km). The expected time for near-space tests is about 30 minutes (this is the average time of the gondola complex being above 25 km height), but uncontrolled.

Title: Solar Radio Activity Observations and the e-callisto Network Bucharest CALLISTO Station

Authors: Octavian BLAGOI, Liliana DUMITRU, Cristian Adrian DANESCU
Astronomical Institute of the Romanian Academy, Bucharest, Romania

Abstract: The solar radio bursts are electromagnetic spectrum emissions from the solar corona, caused by several different phenomena, linked with the solar activity in other solar atmospheric regions. We study a type II radio burst following a M3.7 class flare, which occurred in the active region AR13229 on February 24th 2023. We present our work to install and use the CALLISTO instrument and types of solar radio burst recorded at the Bucharest experimental station.

Title: Evolution of the magnetic flux around a solar flare associated with a filament eruption

Author: Liliana DUMITRU, Octavian BLAGOI, Cristian DANESCU
Astronomical Institute of the Romanian Academy, Bucharest

Abstract: Using a nonlinear force-free field (NLFFF) algorithm, we calculated the magnetic flux around M3.7 class solar flare produced by Active Region 13229 (AR 13229), located in the northern solar hemisphere (N29W24), on February 24, 2023. The solar flare is associated with a filament eruption, and these phenomena produced a coronal mass ejection with an earth-directed component. Also, we obtained the 3D magnetic configuration from photospheric magnetic magnetograms Space Weather HMI Active Region Patch (SHARP) from the Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO).

Title: ROAR: ROmanian Astronomy in the Radio domain The Potentiality of Romanian contributions to Radio Astronomy Infrastructure

Authors: Dana FICUT-VICAS, Vlad TURCU
Romanian Academy, Cluj-Napoca Branch, Astronomical Observatory, Cluj-Napoca, Romania

Abstract: We present the state of development of Radio Astronomy in Romania and the technical capabilities Romania has to make its contribution to the international radio astronomy infrastructure and research. We discuss the need for forthwith actions towards opening and developing the field of Radio Astronomy in our country.

Title: Estimation of solar radiation in Timisoara based on a new hybrid method

Author: Remus BOATA
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Abstract: The fuzzy methods represent an alternative to the statistical approach for modeling the real phenomena from nature. These techniques facilitate a realistic approach and have been used for modeling solar radiation. This study proposes a new hybrid method, based on combined statistical-fuzzy methods, as an alternative to the models constructed using only classical statistics methods or only fuzzy sets theory. The aim of this combination is to improve the accuracy of solar irradiation estimation and the results demonstrate that the new hybrid model can contribute to efficient estimation of solar irradiation.

Title: Maneuver Detection from TLE Data: A Comparative Analysis with Emphasis on Romanian Contributions and Current Space Activities

Authors: Violeta POENARU[1], Mirela BIVOLARU[1], Vlad TURCU[2]
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Abstract: In the ever-evolving landscape of satellite technology, the ability to effectively monitor and predict the trajectories of space objects is imperative. There is an escalating concern regarding the congestion of the space environment resulting from an increasing number of satellites, which poses risks of collision and the generation of space debris. Consequently,

several countries and organizations have dedicated efforts to enhance space situational awareness. European entities, including the European Space Agency (ESA) and European Commission, have made significant strides in implementing projects focused on the developing algorithms and systems for efficient maneuver detection and automated collision avoidance.
In Romania, a burgeoning interest and investment in space sciences have been evident. With an evolving national strategy aimed at boosting its space capabilities, Romania has been an active participant in various European space programs. Romanian academic institutions and research centers have been conducting cutting-edge studies focusing on the development of a system capable of acquiring data, monitoring and analyzing a space environment.
This paper presents a comprehensive comparative analysis between Two-Line Elements (TLEs) and the pre-maneuver and post-maneuver orbital data collected by Romanian optical sensors. TLEs, as widely-adopted means of representing satellite orbit data, are advantageous due to their accessibility and standardized format. However, TLE data accuracy is often constrained by simplistic models and inconsistencies in propagation methods. By meticulously examining these distinct datasets, the study aims to uncover nuanced relationships, assess the accuracy and reliability of TLEs, and shed light on the performance of Romanian optical sensors in capturing orbital information during critical pre-maneuver and post-maneuver phases. This thorough examination and comparison of the data sources will provide valuable insights, fostering a deeper understanding of the strengths, limitations, and potential synergies between TLEs and the Romanian optical sensors data.

Title: Astro-Biblio-Students

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Abstract: Since the advent of online digital journals and e-books, as well as the decrease in the number of new books and scientific journals, many specialized libraries have lost readers in various fields. The Astronomical Libraries located in Cluj-Napoca and Baja Astronomical Observatories also face this problem. In order to attract readers, especially students, the Astronomy Library organizes open days together with researchers and professors, during which the library, the publications, and some current issues of observational and theoretical astronomy are presented. Students interested in astronomy show an increasing interest in the open days of the Astronomical Observatory, as these days usually are related to an interesting astronomical phenomenon. This paper deals with the problem of a "not worked at full throttle" astronomical library and presents the Astro-Biblio-Students program as a possibility to improve this situation.

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