ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών
ΙΔΡΥΘΕΝ ΤΟ 1837

ΤΜΗΜΑ ΦΥΣΙΚΗΣ

ΤΟΜΕΑΣ
ΑΣΤΡΟΦΥΣΙΚΗΣ, ΑΣΤΡΟΝΟΜΙΑΣ ΚΑΙ ΜΗΧΑΝΙΚΗΣ

ΠΑΡΟΥΣΙΑΣΗ ΕΡΕΥΝΗΤΙΚΗΣ ΔΡΑΣΤΗΡΙΟΤΗΤΑΣ
ΥΠΟΨΗΦΙΩΝ ΔΙΔΑΚΤΟΡΩΝ
Ακαδημαϊκού Έτους 2025-2026

Ημερομηνίες Παρουσίασης Ομιλιών:
Τρίτη 26.5.2026, ώρα 10:00-17:00

Αίθουσα Διαλέξεων Τομέα

Ηλεκτρονικός σύνδεσμος:
Join from the meeting link:
https://uoa.webex.com/uoa/j.php?MTID=mfa5a2d5d1d2a24b49a3e733bcc7b2efd

Τρίτη 26.5.2026

Συντονίστρια: Καθηγήτρια Δ. Χατζηδημητρίου

10:00-10:20 Μυρτώ Κωλέττη
«Chromospheric Signatures of a Coronal Hole Jet»
Κύριος επιβλέπων: Δρ. Κων. Γοντικάκης, Διευθυντής Ερευνών ΚΕΑΕΜ, Ακαδημίας Αθηνών

We investigate the chromospheric and transition-region signatures of a small-scale coronal-hole jet observed with the Interface Region Imaging Spectrograph (IRIS), together with observations from the Atmospheric Imaging Assembly (AIA) and Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO). Prior to the jet onset, a dark absorption structure, consistent with a mini-filament, is observed. To analyze the spectral properties of the event, Mg II h&k profiles are fitted using a seven-Gaussian curve, utilizing a Genetic Algorithm and Reinforcement Learning optimization. Diagnostic quantities are derived, including the Red-Blue asymmetry, peak separation, and core depth. The jet spire exhibits mostly blue-shifted profiles with enhanced peak separations and deeper central reversals compared to the surrounding regions, indicating strong velocity gradients and increased chromospheric opacity. In addition, a bright redshifted structure is detected near one of the footpoints of the mini-filament-like structure, interpreted as possible plasma drainage along magnetic field lines. Our results demonstrate that coronal-hole jets leave distinct signatures at chromospheric heights and highlight the diagnostic potential of Mg II spectra for studying jet dynamics.

10:20-10:40 Έλενα Αντωνοπούλου
«Black Hole Imaging: Flares in the Galactic center»
Κύριος Επιβλέπων: Αντώνιος Ναθαναήλ, Ερευνητής Γ’, ΚΕΑΕΜ Ακαδημίας Αθηνών

General Relativistic Radiative Transfer (GRRT) is the process of tracking the trajectory of light rays as they approach the vicinity of extremely compact objects, such as supermassive black holes. We present the first results of our high performance GRRT code (Black Hole Imaging) in reproducing the observed flaring behavior in the vicinity of Sagittarius A* and seek out the optimal orbital parameters for modeling similar phenomena. In particular, we set our focus on the bright Near-Infrared flares observed by GRAVITY Collaboration et al. 2018 and investigate the impact of the hot spot angular velocity, the observer inclination, and the black hole spin in the resulting trajectory. Next, we shift our attention to Magnetically Arrested Disk models (MADs), that are among the most suitable candidates for describing the gas accretion and observed emission around supermassive black holes. We employ a MAD accretion disk with a distinct counter-clockwise rotation to investigate the evolution of magnetized flux tubes generated during a prominent flux eruption event. Specifically, we model the motion of hot spots, formed on the disk's equatorial plane due to magnetic reconnection, as they travel along these flux tubes at a fraction of the speed of light. Our findings impose strict constraints on disk dynamics, revealing that hot spots with a relativistic ejection velocity are able to balance out the counter-clockwise dragging of the accretion disk and demonstrate a clockwise motion in the sky that is in good agreement with the observed flares in the Galactic center. Furthermore, our study imposes constraints on the inclination of Sagittarius A*, which should lie on the face-on range between [0, 34] and [163, 180] degrees, in accordance with the results of E.H.T.C. et al. 2022. In conclusion, this work emphasizes the role of MAD configurations in modeling gas accretion near SgrA* and provides a direct correlation between the quasi-periodic flux eruption events, characteristic of MAD simulations, and the episodic flaring activity in the Galactic center.

10:40-11:00 Παναγιώτης Μυλωνάς
«A study of metrics that deviate from the Kerr metric and their correlation with observed signals»
Κύριος επιβλέπων: Καθηγητής Θεοχάρης Αποστολάτος

In the era of gravitational wave detection, we are provided with a new and powerful tool for testing the General Theory of Relativity in the regime of strong gravitational fields. Specifically, the aim of the present work is to investigate whether the objects involved in strong gravitational signals are indeed black holes described by the Kerr metric, in accordance with the prevailing scientific theory, or if they are other astrophysical objects that deviate from the Kerr metric. For this reason, the deviations caused in the trajectories of test particles around the aforementioned deformed Kerr metrics will be studied. These findings are expected to contribute to the interpretation of gravitational wave observations and characteristic signatures from signals originating from gravitational radiation sources.

11:00-11:20 Ελένη Λαβασά
«Contributions to Solar Energetic Particle Analysis and Forecasting»
Κύριος επιβλέπων: Δρ. Αθανάσιος Παπαϊωάννου, Εντεταλμένος Ερευνητής ΙΑΑΔΕΤ Εθνικού Αστεροσκοπείου Αθηνών

Solar energetic particles (SEPs) are among the most important space weather hazards, affecting spacecraft operations, astronaut safety, and technological systems. This work contributes to SEP analysis, transport modeling, and forecasting through the combined use of observational studies, physics-based simulations, and machine learning techniques.This year's progress focused on four main areas. First, SEP event data analysis and catalogue generation were performed using multi-instrument and multi-spacecraft observations. Second, the 1D SEP propagator model was significantly refined, improving its numerical robustness and enabling its application to additional SEP events. Third, previously developed machine learning methods for forecasting SEP events at energies >10MeV, were successfully extended to high-energy proton events exceeding 100MeV, using a new catalog based on combined SOHO/ERNE & SOHO/EPHIN observations. Such high-energy protonsare of particular importance for operational space weather applications due to their enhanced radiation hazard potential.Finally, an analytic approach is under development, for inferring transport and injection parameters from the observed SEP pulse shape, providing a computationally efficient complement to numerical simulations.Overall, this year's work advances the understanding and forecasting of SEP events by combining data-driven and physics-based approaches within a unified framework.

11:20-11:40 Χάρης Τσάκωνας
«The Merger-Driven Origin of the Vast Extended Stellar Disc Around the Andromeda Galaxy»
Κύρια επιβλέπουσα: Καθηγήτρια Δέσποινα Χατζηδημητρίου

The closest giant spiral, the Andromeda galaxy (M31), shows compelling evidence for a recent, gas-rich major merger event. Pronounced substructures in its inner halo and a kinematically hot stellar disc, globally affected by a recent star formation episode, are telltale evidence that may be directly linked to a major (mass ratio ∼1:4) merger event that took place 2−4 Gyr ago. Spectroscopy of resolved giant stars in the remote outskirts (Rpro j = 40−70 kpc) of M31's disc revealed a vast extended structure that rotates with a circular velocity close to the HI gas. In addition, the spatial distribution and substantial rotation signal of two conspicuous groups of tightly packed globular clusters (GCs) in the outskirts (Rproj > 25 kpc) of the disc pose challenges to understand their origin. We employ an available N-body hydrodynamical simulation of a major merger (mass ratio 1:4) that reproduces the morphology of the inner halo substructures, the disc age-velocity dispersion relation, and the star formation history in the disc. We compare model particles with resolved tracers (stars, GCs) in the M31 disc. To examine the evolution of the progenitor M31 disc -that appears to get stretched, distorted, and warped due to the gravitational perturbation inflicted by the major merger- we investigate the properties of the pre- versus post-merger discs of the simulated analog. The merger transforms the disc of the progenitor galaxy, which becomes kinematically hot and asymmetric. In addition, the post-merger disc gets stretched by a factor of ∼2 and its extent spans distances greater than 40 kpc. The stellar warp in populations older than 2 Gyr is characterized by a monotonic decrease of inclination with radius, with outer stars appearing more face-on at larger galactic radii. These results provide a comprehensive picture of the evolution of the giant disc of the Andromeda galaxy, the closest merger-inflicted massive galaxy. The major merger simulation successfully reproduces independent observations of resolved tracers at the outer edges of M31's extended disc.

11:40-12:00 Alessio Liberatori
«Revisiting the asymptotic giant branch stellar evolutionary phase with Gaia and other data»
Κύρια επιβλέπουσα: Καθηγήτρια Δέσποινα Χατζηδημητρίου

This presentation outlines the characterization of Asymptotic Giant Branch (AGB) carbon stars across the Milky Way and Magellanic Clouds using photometric SED fitting. By analyzing over 14,000 sources and tracking 13 Miras across pulsation phases, we demonstrate the physical evolution of stellar and dust parameters, confirming that pulsations partially drive mass loss. Furthermore, spectroscopic observations from Skinakas and LAMOST reveal unexpected H-alpha emission, investigated here as a byproduct of pulsation-driven atmospheric shock waves. Finally, we introduce optimized machine learning frameworks, including XGBoost and deep neural networks, to predict mass-loss rates directly from photometry and continuously interpolate synthetic model grids for efficient parameter estimation.

12:00-12:20 Διάλειμμα

12:20-12:40 Πηνελόπη Αγγελοπούλου
«Study of the dynamics of energetic particles in Saturn´s magnetosphere»
Κύριος επιβλέπων: Δρ. Κωνσταντίνος Διαλυνάς, Ερευνητής Β', ΚΕΔΕΤ Ακαδημίας Αθηνών

Planetary magnetospheres are powered by external sources like the solar wind, internal sources such as the planet itself or its moons, or a combination of the above, also depending on the system's rotational speed. Earthis a slowrotatorand its magnetospheric system is primarily solar-driven,while Jupiter's is dominated by its rapid rotation and plasma loading from Io. Although Saturn is a fast rotating planet, with its magnetosphere being heavily mass-loaded by Enceladus' plumes, there has been several evidence of the solar wind driving part of the system's dynamics.
Magnetospheres can also be described by their average state and the frequency and duration of all possibleplasma and energetic particle variations taking place within them.Despite the complexity of the Kronian system, both the average state and range of fluctuations happening in the magnetosphere have become accessible through the measurements of the Cassini-Huygens mission. What is still not understood though, is the time scale of these fluctuations. It remains unclear how significant is the solar wind for driving the plasma processes in Saturn's magnetosphere, compared to the planet's internal drivers.
For the purpose of this thesis, we will analyze>3 keVion and electron measurementsfrom the Cassini mission, specifically from the Magnetospheric Imaging Instrument (MIMI).Our goal is to determinethe different components of the magnetospheric variability, by connecting coronal mass injection (CME) eventstopossible phenomena within the Kronian magnetosphere towardunderstanding the relative contribution of internal and external factors that shape the dynamics of Saturn's magnetosphere. The research employs Python-based data analysis and specialized mission software to analyze and compare the pre-event and post-event magnetospheric conditions.

12:40-13:00 Ευαγγελία Χριστοδούλου
«A Comprehensive Study of Yellow Supergiants in the Magellanic Clouds and Beyond»
Κύρια επιβλέπουσα: Δρ. Άλκηστη Μπονάνου, Ερευνήτρια Α' ΙΑΑΔΕΤ Εθνικού Αστεροσκοπείου Αθηνών

Yellow supergiants (YSGs) represent a rare and short-lived evolutionary phase in the upper Hertzsprung–Russell diagram, marking a transitional stage in the evolution of massive stars. We present medium-resolution VLT/FORS2 optical spectroscopy for a sample of 13 YSGs. The majority of our targets are located in the Magellanic Clouds, with three additional objects residing in more distant galaxies. We assign spectral types and luminosity classes to all stars in the sample, searching for spectral variability. Using a custom-made grid of ATLAS stellar atmosphere models, we determine their fundamental parameters, namely their effective temperature (T_{eff}) and surface gravity (log g). Furthermore, aiming to study their photometric variability, we construct their light curves using publicly available archival data. We present the preliminary results of our analysis and discuss their implications for massive star evolution at low metallicity. Our findings will help us determine the evolutionary status of these objects and provide valuable empirical constraints for stellar evolution models.

13:00 -13:20 Γεώργιος Σταματάκης
Κύριος επιβλέπων: Δρ. Άννα Μπελεχάκη, Διευθύντρια Ερευνών ΙΑΑΔΕΤ, ΕΑΑ

13:20 -13:40 Δημήτριος Κοκκινάκης
«Χρονική Εξέλιξη Διαταραχών σε Μαγνητισμένα Ρευστά»
Κύριος επιβλέπων: Καθηγητής Νεκτάριος Βλαχάκης

Μελέτη της χρονικής εξέλιξης, τυχαίων αρχικών διαταραχών, συμβατών όμως με τις εκάστοτε οριακές συνθήκες, όλων των φυσικών μεγεθών που καθορίζουν μια αρχικά αξισυμμετρική μαγνητισμένη ομαλή ροή.

13:40-14:00 Εμμανουήλ Καψαμπέλης
«Γενικευμένες εξισώσεις Killing σε μοντέλα Finsler-Randers»
Κύριος επιβλέπων: Παναγιώτης Σταυρινός, αφυπ. Καθηγητής Τμήματος Μαθηματικών

Στην παρουσίαση θα εξετάσουμε πως κατασκευάζονται οι εξισώσεις Killing στην Γενική Θεωρία της Σχετικότητας και πως η επίλυση τους οδηγεί στις συμμετρίες της μετρικής και του χώρου. Στην συνέχεια θα δούμε πως οι εξισώσεις Killing μπορούν να γενικευθούν στην εφαπτόμενη δέσμη και ειδικότερα σε μοντέλα Finsler-Randers. Τέλος θα εφαρμόσουμε τις γενικευμένες εξισώσεις στο μοντέλο SFR (Schwarzschild-Finsler-Randers) και θα συγκρίνουμε τα αποτελέσματα με το κλασικό μοντέλο Schwarzschild.

14:00-15:00 Διάλειμμα

Συντονιστής: Καθηγητής Ι. Δαγκλής

15:00 -15:20 Σιγιάβα Αμιναλραγιά Γιαμινί
«Προηγμένη μοντελοποίηση και ανάλυση υψηλοενεργειακών πληθυσμών διαστημικού πλάσματος»
Κύριος επιβλέπων: Καθηγητής Ιωάννης Δαγκλής

Θα παρουσιαστεί πρόοδος η οποία αφορά την ανάπτυξη μοντελοποιήσεων σωματιδιακής ακτινοβολίας. Το μοντέλο σωματιδιακής ακτινοβολίας SAPPHIREείναι μοντέλο της ESA το οποίο χρησιμοποιείται στον σχεδιασμό διαστημικών αποστολών και την εκτίμηση της θωράκισης δορυφόρων, διατάξεων και οργάνων. Θα παρουσιαστεί η επέκταση του μοντέλου, ονόματι SAPPHIRE-2S,για την παραγωγήχρονοσειρώνκαι στατιστικών μεγεθών πρωτονίων και βαρύτερων ιόντων σε SEP γεγονότα.

15:20-15:40 Κωνσταντίνα Θανασούλα
«Study of the radial diffusion mechanism effect on the trapped populations of the inner magnetosphere»
Κύριος επιβλέπων: Καθηγητής Ιωάννης Δαγκλής

Radial diffusion has been established as one of the most important mechanisms in radiation belt dynamics, as it contributes to both the acceleration and the loss of relativistic electrons in the outer Van Allen radiation belt. This process is achieved through the violation of the third adiabatic invariant due to wave-particle interactions, mainly with Ultra Low Frequency (ULF) waves in the Pc4-Pc5 range.
The main goal of this PhD is to expand the existing "SafeSpace" database, which includes power spectral density (PSD) and radial diffusion coefficient (D_{LL}) values derived from THEMIS mission data over a nine-year period, by adding PSD and D_{LL} estimates from the RBSP mission. In this way, both spatial and temporal coverage is increased, which leads to improved D_{LL} estimates.
Firstly, we compared magnetic and electric field measurements from the RBSP and THEMIS

missions in order to ensure consistency between the two datasets. The data were then transformed into the Mean Field-Aligned (MFA) coordinate system to calculate PSD and D_{LL}, which were estimated following the formalism of Fei et al. (2006).
Finally, DLL proxies for both electric and magnetic components were estimated as a function of L* and Magnetic Local Time (MLT). We found that the maximum MLT coverage per hour and L* bin is 6 hours, and that the inclusion of RBSP data, which increases the spatial coverage, leads to reduced uncertainties in the D_{LL} estimates.

15:40-16:00 Κωνσταντίνος Παπαδημητρίου
«Using information theory methods to study the acceleration of electron populations in the Earth's outer radiation belt»
Κύριος επιβλέπων: Δρ. Γεώργιος Μπαλάσης, Διευθυντής Ερευνών ΙΑΑΔΕΤ Εθνικού Αστεροσκοπείου Αθηνών

Currently, there is no clear understanding of the comprehensive set of parameters that controls the fluxes of relativistic electrons within the terrestrial magnetosphere. Herein, the methodology based on information theory is applied for the identification of the responsible factors that control the behaviour of energetic particles. The effect of solar wind parameters and geomagnetic activity indices on the radiation belt electrons have been investigated, as well as the interplay between populations of different energies, in an attempt to further our understanding of the acceleration and loss processes that govern their dynamics. Significant information transfer was detected from solar wind, geomagnetic activity and fluxes of very low energy electrons, into fluxes of their high energy counterparts. In addition, evidence of a local acceleration mechanism for electron energization was found, due to the direct causal relationship from relativistic into ultra-relativistic electrons.

16:00-16:20 Αφροδίτη Νάση
«Investigating the acceleration efficiency of VLF/ULF waves on different populations of outer radiation belt electrons, through multi-point observations and modelling: further development of the PSD analysis»
Κύριος επιβλέπων: Καθηγητής Ιωάννης Δαγκλής

During the second half of 2019, the Earth’s magnetosphere was impacted by a sequence of Corotating Interaction Regions (CIRs) during four consecutive solar rotations. Based on the solar wind properties, the CIRs can be divided into four groups, with the 3rd group (August–September 2019) resulting in significant multi-MeV electron enhancements, up to ultra-relativistic energies of 9.9 MeV.
This event was studied using coordinated measurements from the Van Allen Probes, THEMIS and Arase missions. Phase Space Density (PSD) radial profiles were produced and their dependence on the first and second adiabatic invariants (μ, K) was investigated, covering electron populations from seed to ultra-relativistic energies and from near-equatorial to off-equatorial mirroring.
In order to assess the relative contribution of radial diffusion and local acceleration, numerical simulations of the radiation belt environment were performed within the framework of the SafeSpace project. The temporal evolution of the simulated PSD was then compared with the observations.
The results indicated that different acceleration mechanisms may be dominant for different electron populations, with local acceleration becoming more prominent for higher K values. However, the comparison between simulations and observations revealed limitations in reproducing the observed PSD behaviour.
Our recent work has been focusing on refining the PSD calculations and ensuring consistency between the different magnetic field models (TS04 and OPQ) used in the calculation of PSD across the analysis, aiming to enable a more robust comparison between observations and simulations. In addition, the PSD is currently being calculated over the full duration of the event (July-October 2019), in order to better assess the factors that led to the enhanced acceleration efficiency of the 3rd CIR group in comparison to the rest of the CIR groups of the studied period.

16:20-16:40 **Αλεξάνδρα Αντωνοπούλου**
Κύριος επιβλέπων: Δρ. Γεώργιος Μπαλάσης, Διευθυντής Ερευνών ΙΑΑΔΕΤ, ΕΑΑ

16:40-17:00 **Γεωργία Μουτσιανά**
«Comprehensive Mapping and Statistical Analysis of Energetic Proton Distributions in Jupiter's Magnetosphere Using Juno/JEDI Data»
Κύριος επιβλέπων: Καθηγητής Ιωάννης Δαγκλής

Jupiter's magnetosphere is the largest and most energetic planetary magnetosphere in our solar system. Although charged particles reaching MeV energies are observed in other magnetospheres as well, Jupiter is distinguished by the presence of ion populations that are accelerated to tens of keV up to several MeV and even higher energies throughout its vast magnetosphere. In this study, we present a comprehensive investigation of Jupiter's multispecies energetic ion environment using data from Juno's Jupiter Energetic particle Detector Instrument (JEDI). Specifically, we use data from the JEDI-090 and JEDI-270 sensors, which provide measurements of the energy, angular, and compositional ion distributions of hydrogen (~50 keV to ~1 MeV), oxygen (~170 keV to ~2 MeV) and sulfur (~170 keV to ~4 MeV). In this survey, we present comprehensive ion maps derived from the entire Juno prime mission (orbits 1 to 34) from when the spacecraft explored the pre-midnight (~21 LT) through post-midnight and into the pre-dawn (~06 LT) sector of Jupiter's magnetosphere. These maps reveal the spatial and energetic distributions of hydrogen, oxygen, and sulfur ions, providing insights into the global magnetodisc structure, and ion distributions in both equatorial and off-equatorial regions. We also assess proton flux spectral characteristics using spectral indices and intensity factors derived from analytical fits. These provide new insights into the Jovian plasma environment, the proton spectral characteristics and the relationships between them. With this work, we aspire to highlight Juno's transformative contribution to advancing our understanding of Jupiter's magnetosphere and its broader implications for comparative planetary studies.