From Our Star to Far Stars: Variation and Variability

British–Hungarian–French N+N+N Workshop for Young Researchers

Budapest, Hungary, 15-17 January, 2007

Abstract Book

BRITISH COUNCIL Hungary

The N+N+N Young Researchers' Workshop scheme, initiated and funded by the British Council, aims to provide an opportunity for young researchers to exchange ideas, knowledge and information by coming together in the framework of N+N+N workshops and meetings. Here the term N+N+N workshop refers to a workshop involving a number of researchers from the UK and an equal number from the other participating countries. The workshop should be followed by real and virtual networking to sustain the contacts made with a view to producing a proposal for longer-term externally funded collaboration or applications for further funding.

Topics

The meeting will focus on astronomy and astrophysics. Several space- and ground-based observatories as well as sophisticated computer modelling are revolutionising our understanding of surrounding outer space – from the closest star (our Sun) to the far galaxies. We started to learn how planets, stars and galaxies are born, how do they interact and how they die. We aim to understand how the Sun affects our terrestrial environment and the life on Earth. In combining high resolution observations with comprehensive theoretical studies, it is now possible to provide an unparalleled insight into the underlying mechanisms of governing processes in the solar system and galaxies. Although several former problems were already solved, high-resolution observations and powerful computation facilities have brought up many new questions to be answered.

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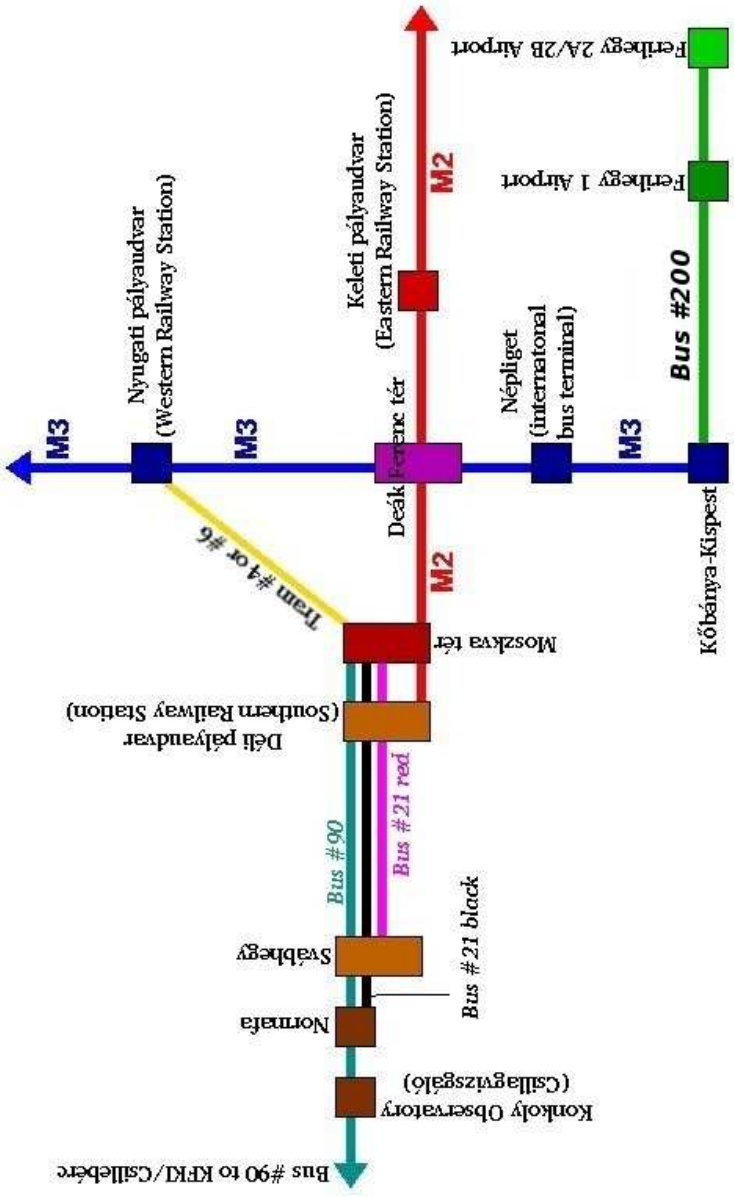

Useful informations about Hungary

Budapest has a temperate continental climate. Seasons are usually well defined, with July and August the hottest months ($28 - 30°$C, $82 - 86°$F) and December and January the coldest, when temperatures may fall to $-15°$C or just $+5°$F.
Budapest is in the Central European Time Zone. In the winter months this means clocks are set at GMT + 1 hour, and in the summer (March to the end of October) GMT + 2 hours.
Public holidays are observed on the three national holidays (15th March, 20th August and 23rd October), on 1st May, and on the main religious festivals and holidays.

Electricity:

Voltage in Hungary is 230 volts, and plugs are of the two-pin continental type.

Telephone:

The international code for Hungary is 36, the area code for Budapest is 1. To call a number within Hungary, first dial 06. Budapest telephone numbers comprise seven digits, all other areas' have six digits (excluding the area code in both cases). To make an international call from Hungary, first dial 00, then the country code followed by the area code and the subscriber's telephone number. Public telephones accept either coins (20, 50, and 100 forints) or telephone cards (available from tobacconists, newsagents, post offices, and petrol stations). Cheap rate runs at night and on public holidays. To call a (Hungarian) mobile telephone, first dial 06, followed by the subscriber's seven-digit number starting with either 20-, 30- or 70-.

Phone numbers for emergency case:

Emergency service: 112

Ambulance: 104

Police: 107

Fire service: 105

Inland enquiries: 198

Universal enquiries: 197

International enquiries: 199

Auto club-help number: 188

Speaking clock: 180

Tourinform telephone enquiries: 438-8080

24-hour medical assistance: 200-0100 (Falck SOS Hungary)

24-hour dental assistance: 267-9602

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Programme

Talks

Sunday – 14 January

19:00– *Welcome coctail in Hotel Normafa*

Monday – 15 January

9:45–10:00	Martin, David	British Council	Opening
		Celestial Mechanics	
10:00–10:30	Érdi, Bálint	Eötvös University	Dynamical investigations of exoplanetary systems – Invited Talk
10:30–10:50	Süli, Áron	Eötvös University	On the probability of dynamic habitability of systems around far starts
10:50–11:10	Borkovits, Tamás	Baja Astronomical Observatory	Dynamics of hierarchical triple systems with distorted stellar components
11:10–11:40	*Coffee break*		
11:40–12:00	Schwarz, Richard	Eötvös University	Survey of habitable Trojan planets
12:00–12:20	Renner, Stefan	Paris Observatory	Equilibrium configurations for co-orbital satellites and applications
12:20–12:40	Ehrenreich, David	Institut d'Astrophysique de Paris	Possible properties of extrasolar planets: oceans under ice
12:40–12:50	*Short poster reviews in Celestial Mechanics (5 min/poster)*		
12:50–14:30	*Lunch*		
		Solar Physics	
14:30–15:00	Erdélyi, Róbert	University of Sheffield	Heating of Solar and Stellar Coronae – Invited Talk
15:00–15:20	Caillol, Philippe	University of Sheffield	Absolute and convective instabilities in an inviscid compressible mixing layer
15:20–15:40	Malins, Chris	University of Sheffield	Numerical simulations of the leakage of photospheric p-modes into the 2D non-magentic solar atmosphere
15:40–16:00	Török, Tibor	University College London	A flux rope model for solar eruptions

16:00–16:30	*Coffee break*		
16:30–16:50	Pascoe, David	University of Warwick	Sausage oscillations of coronal loops
16:50–17:10	Bian, Nicolas	University of Manchester	Basic aspects of magnetic reconnection in the solar corona
17:10–17:30	Attrill, Gemma	University College London	Coronal Wave: Magnetic footprint of a CME?
17:30–17:55	*Short poster reviews in Solar Physics(5 min/poster)*		

Tuesday – 16 January

9:30–9:50	Pintér, Balázs	University of Wales Aberystwyth	Helioseismic Modes in the Solar Atmosphere
9:50–10:10	Verth, Gary	University of Sheffield	Magneto-seismology of the Solar Corona
10:10–10:40	*Coffee break*		
	Stellar Physics		
10:40–11:10	Oláh, Katalin	Konkoly Observatory	Changing Stellar Activity Cycles – Invited Talk
11:10–11:30	Vida, Krisztián	Eötvös University	Results of the photometry of the spotted dM1-2e star EY Draconis
11:30–11:50	Watson, Christopher	University of Sheffield	Imaging the cool stars in interacting binaries
11:50–12:10	Csizmadia, Szilárd	Konkoly Observatory	Remarks on close binaries
12:10–12:30	Klagyivik, Péter	Eötvös University	Observable effects of metallicity on Cepheid variability
12:30–14:00	*Lunch*		
14:00–	*Parliament, Labyrinth of Buda Castle, Viticulture-programs in Budafok ...*		

Wednesday – 17 January

9:10–9:30	Sódor, Ádám	Konkoly Observatory	Studying Blazhko RR Lyrae stars with the 24-inch telescope of Konkoly Observatory
9:30–9:50	Dékány, István	Konkoly Observatory	The double-mode RR Lyrae variable BS Comae
9:50–10:10	Crouzet, Nicolas	Observatoire de la Côte d'Azur	COROT and ASTEP: an opportunity to understand gamma Doradus and delta Scuti variable stars

10:10–10:30	Antonova, Antoaneta	Armagh Observatory	Pulsating Coherent Radio Emission from Ultracool Dwarfs
10:30–10:55	*Short poster reviews in Stellar Physics(5 min/poster)*		
10:55–11:20	*Coffee break*		
Galactic/Extragalactic Astronomy & Cosmology			
11:20–11:50	Csabai, István	Eötvös University	Virtual Observatories – Invited Talk
11:50–12:10	Székely, Péter	University of Szeged	Multi-object spectroscopy of globular clusters
12:10–12:30	Fuentes-Carrera, Isaura	Observatoire de Paris-Meudon	Metallicity spreads in massive globular clusters
12:30–14:00	*Lunch*		
14:00–14:20	Marschalkó, Gábor	Eötvös University	Molecular abundances and anomalous diffusion
14:20–14:40	Gabányi, Krisztina Éva	HAS Research Group for Physical Geodesy and Geodynamics	Effects of the turbulent ISM on radio observations of quasars
14:40–15:10	*Coffee break*		
15:10–15:30	Hetesi, Zsolt	Eötvös University	Statistical Analysis and Monte Carlo Simulation of the Data of Cosmological Relevant Ia Supernovae
15:30–15:50	Lorenz, Larissa	Institut d'Astrophysique de Paris	Inflationary cosmology with a short distance cutoff
15:50–16:00	*Conclusions and closing the meeting*		

Posters

Celestial Mechanics		
Nagy, Imre	Eötvös University	A stability study of Solar system's binaries
Kovács, Tamás	Eötvös University	Changing the phase space structure in the Sitnikov Problem
Solar Physics		
Kiss, Zoltán Tamás	Baja Astronomical Observatory of Bács-Kiskun County	Behaviour of sunspot polarities during the reversal of dynamo field direction

Douglas, Mark	University of Sheffield	MHD Waves in Curved Waveguides
Chifor, Cristina	University of Cambridge	Multi-wavelength studies of solar filament eruptions
Baker, Deborah	University College London	Exploring the relationship between CMEs, CME source regions and coronal holes
Hirn, Attila	KFKI Atomic Energy Research Institute	Tritel - Space Dosimetry with a Novel Hungarian Instrument
Stellar Physics		
Jurkovic, Mónika	University of Szeged	Pulsation and Orbit of AU Pegasi
Hurta, Zsombor	Eötvös University	Long term behaviour of RV UMa
Bognár, Zsófia	Konkoly Observatory	More frequencies of KUV 02464+3239
Sahin, Timur	Armagh Observatory	Variability and evolution in various classes of post-AGB stars
Pereira, Caroline	Armagh Observatory	Variability in Subdwarf B Stars

Social Programme

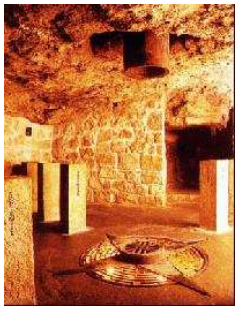
Visiting the Hungarian Parliament

"The motherland does not have a house." Thus wrote bitterly Mihály Vörösmarty, one of the greatest poets of the Hungarian heroic age of bourgeois civilization, in 1846. Indeed, through the hundreds of years that the grandsons of the conquering chieftain Árpád ruled the country the diet didn't have a regular house. But there was no need for it, as they - the prelates, the barons, the nobles and the burghers - were "the country". Where they walked, judged, debated - that was the "motherland". Since the time of St. Stephen, Hungary's legendary founder, the greatest turn of the wheel in Hungarian history occurred in Vörösmarty's generation - the Age of Reform and the Revolution of 1848 that followed. Spurred by economic need, social unrest and the flowering of culture, the hundredthousands of privileged in society and the millions in the lower classes coalesced into a historical community, the Hungarian nation. And this nation, now being consciously formed by the great men of the age - István Széchenyi, Miklós Wesselényi, Ferenc Deák, Lajos Kossuth, Ferenc Kölcsey, Sándor Petőfi -, was very much in need of a physical home. As a counterweight to the royal palace rising high on Buda Hill, the Pest side of the Danube was chosen to symbolize that Hungary's destiny lay with popular democracy and not with royal whim.
Over the past thousand years the Hungarian diet has held its sessions from Sopron to Szabolcs, from Besztercebánya to Szeged, from Nagyszombat to Rákos field, and since the l8th century primarily in Pozsony, today known as Bratislava. In July 1843, the reform opposition tabled an old proposal that the legislature should be moved to the new capital, Pest-Buda. In September a parliamentary commission took the matter in hand, and after several fruitful discussions, the future Minister himself, Gábor Klauzál, declared that "because there is a place, the dream will become a reality". But in the ensuing decades only design competitions were realized where often not even prizes were awarded. By the time, forty years later, a law concerning the construction of a parliament was finally passed, the concept of parliament had changed dramatically. Not only was a completely different physical home envisioned but the notion of popular representation and the government responsible to it had a completely different sound as well by the end of the century. The competition announced in 1882 was won by Imre Steindl (1839-1902), a professor at the Technical University. The unanimous opinion of art historians and thousands of visitors alike is that theParliament designed by Imre Steindl is one of the happy exceptions of historical eclecticism.

Labyrinth of Buda Castle

The unique calcereous tuff caves of Castle Hill were created as an effect of the hot water sprigs at the dawn of the history of the Earth. These caves then served as refuge as well as hunting ground for the prehistoric man (the "Hunter of Buda") appearing half a million years ago. Later the small caves were connected to each other and also to the cellarage of the houses of the Castle District for economic and military purposes, and the complex thus developed into a veritable labyrinth. In the 1930s, as part of the wartime defence program, the complex of cellars was converted into a shelter large enough to accomodate as many as ten thousand people at time. Reinforced - and also disfigured - with concrete, it served as a secret military installation during the Cold War.





Viticulture-programs in Budafok and dinner in György-Villa

Visiting the biggest barrel of the world in the Triple Oleander Cellar

The biggest wood barrel of the world still in use can be seen in this cellar since 1974. The dimensions of the barrel are considerable. Its volume more than one hundred thousand litres, exacly 102.230 l, length 6.14 metres, diameter at head and bottom is 4.7 metres, at its belly 5.8 metres. The weight of the hoops amounts to 4 tons and its total weight is approximately 18 tons. After a short walk in the cellar the guests will come to the giant barrel, and that is where the wine-tasting will take place, tasting 2-4 kinds of wine.

György-Villa

György-Villa is a living testament to the culture and spirit of past ages, to its hard-working winemaker's everyday efforts and its builder's love for life. In Budafok these vineyards and orchards used to be watched over from Roman watchtowers, then at the end of the fifteenth century the area went into the hands of the Grey Friars of Buda, who dug and built a cellar here. The erection of the building began in 1827, and it also served as a symbol of the wine region's prosperity. It then changed hands several times and took its present shape in 1867 after a wine merchant called György Dőry had it rebuilt for his girlfriend as a Christmas present. In 1872 the united capital started expanding at an enormous pace and as a result the once flourishing vineyards disappeared. After 1986 the building and the park went under a complete renovation. The company's premium wine family György-Villa Selection with its carefully selected and handled wines mature in the cellar of the villa in Budafok, which has centuries-long vinicultual traditions and serves as a wine museum. The wine specialities of György-Villa come from the Etyek-Buda wine region, famous for itswhite wines and the Villány wine region, noted for its reds. The György-Villa

Selection with its fine varietal wines is one the most popular wine families in gastronomy. The villa, with its picturesque setting, houses a museum and is a host to series of programs, art evenings and lectures on viniculture. Lovers of good wines and culture are all welcome to the building, which houses and gave its name to the company's premium wine family.

Abstracts

Part One

Celestial Mechanics

Dynamical investigations of exoplanetary systems
Invited Talk

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At the moment 209 exoplanets are known in 179 extrasolar planetary systems. There are 21 multiple systems with two and more planets. This multitude of planetary systems raises interesting dynamical problems. In my talk I overview some recent developments in the dynamics of exoplanetary systems. I discuss the dynamical classification of multiple systems and the secular behaviour of their planets. The stability of the habitable zones of exoplanetary systems is also considered and a recently developed stability catalogue is described. Finally, the question of hypothetical Trojan exoplanets is addressed and in connection with this problem the structure of the size distribution function of the stability region around the Lagrangian point L4 depending on the eccentricity and the mass parameter is discussed.

Notes:

On the probability of dynamic habitability of systems around far starts

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In this paper we estimate the likelihood to find habitable Earth-like planets on stable orbits in extrasolar planetary system using a catalogue of the habitable zones. In a former paper an elaboration of a stability catalogue of the habitable zones were reported. This catalogue contains numerous stability maps, that shows where Earth-like planets could reside in stable orbits. The data of the catalogue were used in order to generate probability values on the mass parameter-eccentricity plane for different mean anomalies. On the date second order surfaces were fitted, and from the sets of coefficients an averaged surface were determined. Once the mass parameter of the system and the eccentricity of the giant are known one can directly derive the likelihood of finding Earth-like planet.

Notes:

Dynamics of hierarchical triple systems with distorted stellar components

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We studied the motion of hierarchical triple stellar systems consisting of a close pair with distorted components revolving on eccentric orbit, and a more distant third companion. Both detailed numerical integrations, and analytical calculations were carried out. In this lecture we concentrate mainly on the perturbations in the true longitude (measured from the plane of the sky) of the eccentric binary as this quantity is directly related to the occurence of the eclipsing minima, and consequently to the mathematical form of the O–C diagram. We give an analytical form of the O–C curve included the perturbations of a third body besides the dynamical effects of the usual tidal forces. Numeric studies are applied on the well-known apsidal motion system AS Camelopardalis, where a very weak evidence for a third companion already was reported some years ago.

Notes:

Survey of habitable Trojan planets

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More than 209 extrasolar planets have been discovered, but only a few of them lie in the habitable zone (=HZ). The HZ is the region around a star where an earth-like planet can have liquid water and a stable atmosphere. Another problem is that the size of the most detected extrasolar planets is too large for the formation of life. That is the reason why we study the dynamical stability of potential additional habitable planets. We concentrate our studies on the dynamical possibility of earth-like planets in the 1:1 mean-motion-resonance with Jovian like planets of extrasolar systems. For the so-called Trojan planets in the HZ, we used the planar elliptic restricted three body problem with different mass ratios and eccentricities of the primary bodies. The numerical computations were done by a Burlirsh-Stoer integrator and we check the stability by using the Lyapunov Indicator and the maximum eccentricity. Our survey used a very fine grid of initial conditions to create a catalog which shows the largeness of the stable region. This work also examine the behaviour and the size of the stable zone of the real extrasolar systems, where the initial conditions of the giant planets lie fully in the HZ. We can conclude that the comparison of the stable region with real systems and the catalog shows no large difference. From that it follows we can use the catalog as a helpful tool, but we have to calculate longer (integration time up to 10 Myrs) to consider also how the resonances act on the orbit of a Trojan planet.

Notes:

Equilibrium configurations for co-orbital satellites and applications

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The problem of the Lagrangian points is extended to derive general results on the existence of stationary configurations. For N co-orbital satellites with small but otherwise arbitrary masses, the existence of equilibrium points depends on the parity of N. If N is odd, then for any arbitrary angular separation between the satellites, there always exists a set of masses which achieves stationarity. Physically acceptable solutions (positive masses) restrict this existence to sub-domains of angular separations. If N is even, additional conditions must be verified. The case $N = 3$ is treated completely, giving all the possible solutions and their stability. For $N > 3$, numerical methods are given. These results are applied to explain the confinement of the four co-orbital Neptune ring arcs. They might be also useful for studying the dynamics of exoplanetary systems.

Notes:

Possible properties of extrasolar planets: oceans under ice

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Extrasolar planets as light as a few Earth masses are now being detected. Such planets are likely not gas or ice giants. We present a study on the possible properties of the small and cold extrasolar planets, applied to the case of the recently discovered planet OGLE 2005-BLG-390Lb. This planet (5 Earth masses) orbits 3 astronomical units away from an old M-type star of the Galactic bulge. The planet should be entirely frozen given the low surface temperature (40 K). However, depending on the rock-to-ice mass ratio in the planet, the radiogenic heating could be sufficient to make the existence of liquid water within an icy crust possible. This possibility is estimated as a function of the planetary mass and the illumination received from the parent star, both being strongly related by the observational constraints. The results are presented for water-poor and water-rich planets. We find that no oceans can be present in any cases at 10 Gyr, a typical age for a star of the bulge. However, we find that in the past, when the planet was 5 Gyr old, liquid water was likely present below an icy surface. Nevertheless, the planet is now likely to be entirely frozen.

Notes:

A stability study of Solar system's binaries

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The dynamical structure of the orbital element space of some binary Kuiper belt objects (KBO) and main belt binary asteroids are studied in the model of the spatial restricted three-body problem via numerical methods. Our results indicate that there may exist one or more satellites around most of the studied binaries. We conclude that the possible existence of the satellites could help to decide which mechanism was forming the binary systems. We also show that the KBO 1999 RZ253 is younger than 2.2 Gy.

Notes:

Transient chaos in dynamical astronomy

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It is well-known that in nonintegrable dynamical systems could appear chaotic behavior. In our work we show that there are special initial conditions in the phase space which are starting points of the finite time chaotic motions i.e. transient chaos. These initial conditions constitute an asymmetric Cantor-cloud with zero-measure in phase space. Additionally, our results show that the transient chaos is more robust than the permanent chaos.

Notes:

Part Two

Solar Physics

Heating of Solar and Stellar Coronae
Invited Talk

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The temperature rise in solar and stellar atmospheres is one of the fundamental and yet still unresolved questions of 21st century space plasma astrophysics. In spite of the multi-fold efforts spanning over half a century, including the many superb technological advances of high-resolution ground-based observations and space missions (Yohkoh, SOHO, RHESSI, TRACE, Hinode, Stereo) and theoretical developments (both analytical and computational), the unveiling the details of the complex and subtled processes of atmospheric (magneto)plasma heating remained an exciting job.
In the present lecture I review the various popular heating mechanisms put forward in the extensive existing literature. The heating processes are, somewhat arbitrarily, classified as hydrodynamic (HD), magnetohydrodynamic (MHD) or kinetic in nature based on the model medium. These mechanisms are further divided based on the time scales of the ultimate dissipation(s) involved (i.e. AC versus DC heating, turbulent heating). In particular, attention is paid to discuss shock dissipation, Landau damping, mode coupling, resonant absorption, phase mixing, and, reconnection.
Finally, I briefly review the various observational consequences of the many proposed heating mechanisms and varify them with high-resolution ground-based and satellite data currently available.

Notes:

Absolute and convective instabilities in an inviscid compressible mixing layer

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This study aims to examine the effects of compressibility on shear flow instabilities. This analysis is of interest in astrophysical flows. Indeed, the observations of the Sun's photospheric layers show evidence of the presence of flows that are at speeds of a substantial fraction of the sound speed. We focus on the instability of a wavepacket and not on this of a single mode as most of previous studies dealt with. The compressible-flow modal theory predicts instability whatever the Mach number. We improve the description of the latter by considering the notions of absolute and convective instabilities. We study an inviscid and compressible two-dimensional mixing layer at an arbitrary Mach number subject to a two-dimensional disturbance. The mixing layer is defined by a parametric family of mean velocity and temperature profiles. The eigenvalue problem is solved with the help of a spectral method coming down to a standard matrix resolution. We ascertain the effects of the distribution of temperature and velocity in the mixing layer on the transition between convective and absolute instabilities.

Notes:

Numerical simulations of the leakage of photospheric p-modes into the 2D non-magentic solar atmosphere

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One of the dominant coherent signals in Doppler velocity in the solar photosphere are p-modes with periods with a power peak of about 300 seconds, and, coherence lengths of up to about 5Mm. These strong 300 second oscillations represent a superposition of many modes with different wavelengths but the same period. The propagation of these p-mode signals into the higher solar atmosphere is one of the key drivers of oscillatory motions in the higher solar chromosphere and corona. We examine numerically the propagation of waves driven harmonically at the photosphere, with wavelengths up to the maximum coherence length of 5Mm, into the non-magnetic solar atmosphere. The unperturbed solar atmosphere is modelled by a 2-dimensional VAL IIIc atmosphere. It is shown that by driving with a coherent velocity signal representing the observed photospheric velocities but for a simple superposition of a small number of p-modes with periods of 300 seconds that, (i) resonant cavity oscillations are generated in the lower chromsophere, (ii) reflection at the transition region leads to the development of cavity modes in the upper and mid chromosphere, and, (iii) even in the absence of a magnetic field it is possible to generate fine-structures extending from a dynamic transition region into the lower corona.

Notes:

A flux rope model for solar eruptions

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We propose a flux rope model for the triggering and initial driving of large-scale solar eruptions. The model is based on two ideal MHD instabilities, the helical kink instability and the torus instability, and their interaction.
We present numerical simulations of the instabilities which reproduce essential properties of both confined eruptions and coronal mass ejections (CMEs) in very good agreement with the observations. We also show that the torus instability provides a unified model of the apparently disparate classes of fast and slow CMEs. Finally, we briefly discuss the implications of the simulation results on magnetic clouds studies and on the relationship between CMEs and flares.

Notes:

Sausage oscillations of coronal loops

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Analytical theory predicts the existence of trapped global (or fundamental) sausage fast magnetoacoustic modes in thick and dense coronal loops only, with the periods estimated as the ratio of double the loop length and the Alfvén speed outside the loop. We extend this study to the leaking regime, considering global sausage modes of long loops with small density contrasts.
Anti-symmetric fast magnetoacoustic perturbations (sausage, or $m = 0$ modes) of a low β plasma slab with the symmetric Epstein profile of plasma density are modelled numerically. It was found that long loops with sufficiently small density contrast can support global sausage leaky modes of detectable quality. The periods of the leaky modes are found to be approximately determined by the loop length and the external Alfvén speed. If the loop length can be estimated from imaging observations, the observed period of this mode provides us with the information about the Alfvén speed outside the loop. For typical flaring coronal loops, the estimated periods of the global sausage modes are about 5-60 sec.

Notes:

Basic aspects of magnetic reconnection in the solar corona

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The role of magnetic reconnection as a heating mechanism for the solar corona is considered. First, basic relevant mechanisms that modify the pace of a spontaneous reconnection process, the resistive tearing instability, are proposed and studied: viscosity, coriolis force, Hall effect. The theory of one-off forced magnetic reconnection at a neutral X-point by slow redistribution of the magnetic flux at its boundary surface is presented. For ongoing boundary perturbations, the relevant situation for coronal heating, a modification of the Taylor problem of forced magnetic reconnection allows self-consistent calculation of the averaged heating rate involved in the process. This averaged heating rate is derived and discussed for a visco-resistive plasma.

Notes:

Coronal Wave: Magnetic footprint of a CME?

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We investigate the properties of two classical EIT coronal waves. The two source regions of the associated CMEs possess opposite helicities and the coronal waves display rotations in opposite senses. We observe two types of dimming: deep core dimmings near the flare site and widespread diffuse dimming, accompanying the expansion of the EIT wave. We also report a new property of these EIT waves, namely that they display dual brightenings: a persistent brightening at the outermost edge of the core dimming regions and simultaneously a diffuse brightening constituting the leading edge surrounding the expanding diffuse dimmings. We demonstrate that such behaviour is consistent with the idea that a diffuse EIT wave is the magnetic footprint of an erupting CME. We propose a new mechanism where driven magnetic reconnections between the skirt of the expanding CME magnetic field and favorably orientated quiet-Sun magnetic loops generate the observed bright diffuse front. The dual brightenings and the widespread diffuse dimming that accompany these EIT waves are identified as innate characteristics of this process.

Notes:

Helioseismic Modes in the Solar Atmosphere

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New aspects of the Sun are revealed almost day by day, due to modern technology. Ground-based and space-born helioseismic observatories reveal the hidden structures of the solar interior. At the same time, satellites sent out to monitor the atmosphere and border environment of the Sun provide us astonishing images and movies with high temporal and spatial resolution, which reveal the unexpectedly complex and beautiful structures and dynamics of the atmosphere of our star. The complexity of the physics of the Sun is even higher by the fact that the solar interior and its atmosphere are strongly coupled, according to recent observations. The pulsation of the solar surface is caused by acoustic waves traveling in the solar interior. These fundamental (f) and pressure (p) helioseismic modes are not bounced back completely at the surface to the interior, but they can partially penetrate into the atmosphere. The f and p magneto-acoustic waves are investigated in solar atmospheric magnetohydrodynamic models to see the effects of a magnetic atmosphere on the spectral behaviour of f- and p-mode oscillations. The theoretical results suggest that frequency shifts and temporal variations of line width of helioseismic modes, observed during a solar cycle, can be caused by atmospheric magnetic fields of varying strength and activity. The models also provide a technique which can contribute to magnetic mapping of the Sun.

Notes:

Magneto-seismology of the Solar Corona

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MHD waves in solar coronal loops, which were previously only predicted by theory have now actually been detected with instruments such as TRACE and SUMER on-board SOHO. These observations have given the solar community an important and novel tool to measure fundamental parameters in the magnetically embedded solar corona. Theory has been developed to derive detailed diagnostic information (density, magnetic field loop structure, geometry, stratification).
This talk will illustrate how information about the magnetic and density structure along coronal loops can be determined by measuring the frequency or amplitude profiles of standing fast kink mode oscillations.

Notes:

Behaviour of sunspot polarities during the reversal of dynamo field direction

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According to our present knowledge based on the recent solar dinamo models, the direction of the magnetic field reverses about every 11 years, causing the sunspot cycle as ropes of magnetic field lines emerge to the surface of the Sun and manifest as sunspots in the photosphere. Forgács-Dajka et al.(2004) found that the sequential Schwabe cycles overlap each other more and more in the secular time scale, but the behaviour of the reversal of the dynamo field direction could not be studied using the Greenwich Royal Observatory's sunspot data. In this paper we examined the sunspots polarities using the NSO magnetic synoptic maps around the 11-year Schwabe minima as other possibility one can consider some additional stochastic phenomena in the solar dynamo.

Notes:

MHD waves in spherical waveguides

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Large-scale eruptive events such as flares and CMEs are known to generate global waves propagating over distances comparable to the solar radius. Here we investigate the propagation of coronal EIT waves, modelled as fast magnetoacoustic modes propagating at a spherical interface in the presence of a radial magnetic field. Using simple numerical investigations we reproduce the geometrical damping of EIT waves and set up conditions for generation of loop oscillations by global EIT waves.

Notes:

Multi-wavelength studies of solar filament eruptions

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Multi-wavelength analyses of two flare-associated filament eruptions will be presented. The wavelength coverage for these events is particularly good, ranging from microwave images from NoRH, EUV observations taken by TRACE and SOHO/EIT as well as X-ray imaging and spectroscopy with RHESSI. When on disk, observations are complemented by SOHO/MDI magnetograms providing information about the photospheric magnetic field, which is crucial for understanding the initiation of these eruptions. We discuss the possible eruption triggers and evolution, as well as correlations between the filament eruption and the HXR footpoint motion.

Notes:

Exploring the relationship between CMEs, CME source regions and coronal holes

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Coronal holes are regions of monopolar magnetic field on the Sun where the field is considered to be "open" towards interplanatary space. Magnetic bipoles emerging in this monopolar environment naturally interact with this surrounding "open" magnetic field. We expect that active regions within or on the boundary of coronal holes will be more eruptive since reconnection removes field lines which stabilize potentially eruptive active region filaments/flux ropes. We explore the relationship bewteen CMEs, CME source regions and coronal holes.

Notes:

Tritel - Space Dosimetry with a Novel Hungarian Instrument

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One of the many risks of long-duration space flights is the excessive exposure to cosmic radiation, which has great importance particularly during solar flares and higher solar activity. Since space radiation mainly consists of charged heavy particles (protons, alpha and heavier particles), the equivalent dose - which characterizes the stochastical biological effectiveness of the radiation - differs significantly from the absorbed dose (physical dose). Monitoring of the cosmic radiation on board space vehicles is carried out on the basis of wide international co-operation. Research and development of a three dimensional silicon detector telescope, called Tritel, began in the KFKI Atomic Energy Research Institute several years ago in order to characterize the cosmic radiation in terms of dose equivalent. The main benefit of the three-axis arrangement is that it is going to exclude mostly the highly anisotropic sensitivity of the recently used one-dimensional silicon telescopes. Elements of the Tritel telescope system, issues of the electronic block diagram, requirements for the mechanical constructions and possibilities of data handling and data evaluation are analyzed in this paper. Several flight opportunities have already come in sight onboard the International Space Station - one within the framework of the European SURE program, the other in cooperation with the Institute of Biomedical Problems, Moscow - and a student satellite (SSETI ESEO) as well. The 3D silicon telescope should be the first device of its kind used for measuring the dose astronauts are subjected to.

Notes:

Part Three

Stellar Physics

Changing Stellar Activity Cycles
Invited Talk

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The lengths of the solar activity cycles, like the 11 years long Schwabe and the 80 years long Gleissberg cycles, as the sunspot data reveal, are not stable. However, they do not change randomly, rather the cycles are continuously changing in time. Activity cycles, sometimes multiple cycles, similar to the solar ones, are derived for several active stars, from long-term photometric data. Using Fourier analysis the resulting cycle lengths are usually "quasiperiods", with high scatter around the mean period values, or are just marginal detections. The reason of these results well could be that the cycle periods are not stable but are changing in time like the solar cycles.
We show results from analysing long-term stellar datasets which are compiled from archival photographic and long-term photoelectric observations, using a time-frequency analysis program package (TiFrAn). All rough cycle periods, even marginal detections that were derived earlier from Fourier analysis, are confirmed. However, we find that most of the cycle lengths are varying in time, which makes the detection problematic with conventional methods, like the simple periodogram analysis, as it is seen from the earlier results. The varying cycle lengths can give observational constraints for the fast developing dynamo theories and calculations.

Notes:

Results of the photometry of the spotted dM1-2e star EY Draconis

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Our four-band photometry and spot modelling of the ultra fast rotating (P=0.459 days) EY Draconis shows interesting features like spots and flares in the stellar photosphere and chromosphere, which confirm the results of authors dealing with the object. The star shows a stable modulation of the lightcurve over 60 rotations, however, there seems to be a longer variaton of the brightness on a timescale of 300 days, which follows from the ROTSE data. This long-period variation seems to be confirmed also from our observations. If it is verified, EY Dra would be the first ultrashort period star in the rotational period-activity cycle diagram with such a short cycle.

Notes:

Imaging the cool stars in interacting binaries

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Magnetic activity is thought to play a key role in the evolution, behaviour and accretion dynamics of interacting binaries. Despite its importance, however, little is known about the magnetic nature of these systems. By obtaining images of their stellar surfaces, one can study the manifestations of magnetic activity, such as cool starspots, in detail. Unfortunately, direct images of these binaries would require 100-km class telescopes. I briefly review the astro-tomographic techniques required to map the surfaces of these stars, culminating in 3D movies showing the presence of giant starspots and the impact of irradiation from nearby companions.

Notes:

Remarks on close binaries

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According to our present knowledge, contact binary stars are the most common objects in the Universe because about 1% of all stars belong to this class. In spite of their high spatial density in the Galaxy, we know very little about their internal structures, evolution and processes in them.
We studied their period variations, energy transfer between the components and their surface brightness distribution.
In the lecture some part of the results of our small group is overviewed.

Notes:

Observable effects of metallicity on Cepheid variability

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Dependence of phenomenological properties of Cepheids on the heavy element abundance is studied. It is found that the ratio of the radial velocity and the B-band photometric amplitude, as well as the slope parameter (expressing the wavelength dependence of the photometric amplitudes) depends on the metallicity of the stellar atmosphere, particularly for long period Cepheids.

Notes:

Studying Blazhko RR Lyrae stars with the 24-inch telescope of Konkoly Observatory

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About a dozen field RR Lyrae stars has been observed with the 24-inch Heyde telescope of the Konkoly Observatory at Svábhegy, Budapest, since its refurbishment in 2003. Most of the observing time is allocated for the investigation of the Blazhko modulation, a phenomenon that still does not have a satisfactory explanation. The obtained multicolour CCD observations are unique in extension. The accuracy of the measurements makes it possible to detect low amplitude modulation of the light curve as well. The discovery of Blazhko stars with low modulation amplitudes warns that the incidence rate of the Blazhko modulation is, in fact, much larger than it was previously expected, which makes the efforts exploring the cause of the modulation even more important. A summary of our measurements and results achieved during the last 3 years are presented.

Notes:

The double-mode RR Lyrae variable BS Comae

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Double-mode RR Lyrae stars (RRd's) are important in astrophysics because they provide a unique opportunity to derive the absolute physical parameters and consequently the evolutionary status of these stars. Whereas there are many RRd stars known in various galaxies (e.g. Magellanic Clouds) and globular clusters, only a few are known in the Galactic field. The purpose of this study is to add another object to this latter group of stars. We present a detailed study of the pulsational behaviour of the field RRd variable BS Comae based on our extended multicolour CCD photometry obtained with the 24" automated telescope of the Konkoly Observatory. The time series extracted from more than 1000 frames in each of the BV(RI)c bands allow us a high precision analysis of the properties of the combination frequencies due to nonlinear coupling. The large number of data points and the 0.01 magnitude accuracy of the individual measurements allow us to detect frequency components down to the millimagnitude level. At this accuracy we found no sign of other components than of those of the two main modes and their linear combinations up to order five.

Notes:

COROT and ASTEP: an opportunity to understand gamma Doradus and delta Scuti variable stars

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Pulsation phenomenon is an ideal way to sound the interior of stars. A better understanding of gamma Doradus and delta Scuti variable stars could therefore lead to new constraints on stellar structure along the main sequence. Two current projects deal with asteroseismology. First, the space mission COROT (Convection, Rotation and planetary Transit) will observe simultaneously 4 fields of 1.4 deg each, continuously for up to 150 days. Two bright delta Scuti stars are among the primary targets, plus probably tens of fainter gamma Doradus stars. The satellite is about to be launched, and first data are expected for the beginning of 2007. Secondly, the ASTEP project (Antarctica Search for Transiting Extra-solar Planets) is partly dedicated to the detection of variable stars such as gamma Doradus and delta Scuti. This consists in a fully automatic 40 cm telescope, still under development, to be installed at Dome C, Antarctica. This exceptional site offers a 3 months long night observation period during the Antarctic winter, with almost no clouds and no precipitation. The first winterover is planned for 2008. After a short description gamma Doradus and delta Scuti stars, both projects will be presented, and their potential will be discussed and compared.

Notes:

Pulsating Coherent Radio Emission from Ultracool Dwarfs

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A number of ultracool dwarfs have ben detected as reletively strong sources at radio frequencies, despite the low X-ray and H-alpha luminosities. The characteristics of this radio emission have led to the speculation that it is incoherent gyrosynchrotron radiation similar to the radio emission detected from more massive stars with X-ray emitting coronae. On the other hand, the radio emission from one such dwarf, TVLM 513-46546 , is periodic with rotation, arguing for a more directive coherent process from compact source regions. The radio observations of TVLM 513-46546 are characterized by extremely bright, 100% circularly polarized bursts of short duration. These burst conclusively confirm the coherent nature of the radio emissionand require magnetic field strengths of about 3 kG for TVLM 513-46546. Until now, it was believed that coherent emission from stellar sources was confined to transient bursts or flares. For TVLM 513-46546, the transient nature of the emission is due to the rotation of the dwarf and the strong beaming of the emission. The resultant periodic light curve is reminiscent of the coherent emission detected from pulsars. Recently we conducted observations of another ultracool dwarf, LSR J1835+3259, whose radio emission characteristics are similar to those of TVLM 513-46546.

Notes:

Pulsation and Orbit of AU Pegasi

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AU Pegasi is a pulsating star in a spectroscopic binary system with an orbital period of 53.26 days. In the interval between 1960 and the 1990's an extremely rapid period increase was observed, but in the last 15 years the observation show that the period set in 2.411 days. Fourier analysis of photometric data taken at the Piszkéstető Mountain Station of the Konkoly Observatory in the period 1994-2005 showed that AU Pegasi is pulsating in two modes simultaneously, and the ratio of the frequencies of the two modes is 0.705, a value common for the double mode classical Cepheids. This fact and the shape of the light curve point out that this star is not a Type II Cepheid, despite its galactic position and published metallicity. From the observation of emission in Hα profiles we can assume that there is interaction between AU Pegasi and its companion. All this shows that this is a very special Cepheid which deserves further investigation.

Notes:

Long term behaviour of RV UMa

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RV UMa is one of the most extensively studied RR Lyrae stars showing Blazhko modulation. Its photometric observations cover more than 90 years. The published photoelectric observations of RV UMa obtained at the Konkoly Observatory (Kanyo, 1976) was re-considered and completed with previously unpublished data. During the time interval of the observations the periods of both the pulsation and the modulation varied within 0.000007 and 0.9 day ranges, respectively. We have found a definite but not strict inverse relation between the pulsation and modulation periods of RV UMa.

Notes:

More frequencies of KUV 02464+3239

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Preliminary results on KUV 02464+3239, a pulsating DA white dwarf are presented. Located near the red edge of the DAV instability strip, KUV 02464 (Teff=11290 K, log g=8.08) shows large amplitude and long period pulsation modes. Up to now only one mode was known from a 50-minute-long light curve. Our more extended observations allowed the identification of three additional frequencies. Previously supposed presence of harmonics were confirmed at some parts of the light curve. This suggests arising of nonlinear pulsation effects from time to time.

Notes:

Variability and evolution in various classes of post-AGB stars0

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The work presented in this poster is performed as a part of a PhD thesis "Stellar evolution beyond the asymptotic giant branch (AGB)". Hipparcos data for B type post-AGB stars, extreme helium stars (EHes) and H deficient binaries have been obtained and analyzed for photometric variability. Since pulsation properties are related to luminosity-to-mass ratio and effective temperature, we aim to show whether any variations are comparable or distinctive to these different group of stars, and hence compare their relative luminosities.
This comparison will also help us study any evolutionary connection between first-time post-AGB stars and EHes. We have obtained several high- resolution echelle spectra of both types in order to measure their stellar atmosphere parameters and to compare their chemical composition. The spectra have been reduced with the Starlink package Echomop and normalized via our own IDL package TIGER, a package designed to overcome continuum normalization problems in echelle spectra where broad lines span two or more orders.
The measurements will be used to compare abundances of elements beyond C, N and O in first-time post-AGB star and EHe stars. The latter are believed to come from white dwarf mergers and so should show quite different characteristics. In the course of this project we also aim to determine whether or not the phosphorus (^{31}P) abundance can be used to trace EHes back to their AGB stages.

Notes:

Variability in Subdwarf B Stars

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Subdwarf B stars are helium-core burning stars located on the extreme horizontal branch. Nearly ten years ago, short-period oscillations of a few hundred seconds were detected in some of the hotter stars of this class. This discovery coincided with the prediction that opacity-driven oscillations should be excited in sdBs. While the proposed driving mechanism, known as the kappa-mechanism, supports the observations, problems remain. In particular, the coexistence of pulsating and non-pulsating sdBs sharing similar spectroscopic properties is an interesting question that needs to be addressed. Clearly, additional factors must be considered to account for the non-variable stars. One scenario invokes weak stellar winds such that, the iron reservoir needed to drive the oscillations is depleted over time. Hence, stars experiencing mass-loss at different rates or stars having significant age differences would no longer have the same composition, thereby explaining the pulsating/non-pulsating discrepancy. We thus investigate surface abundances in a sample of variable and non-variable B subdwarfs in order to establish whether a correlation exists.

Notes:

Part Four

Galactic/Extragalactic Astronomy & Cosmology

Virtual Observatories
Invited Talk

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The last decade has seen a dramatic change in the style astronomy is carried out. The dawn of the the new microelectronic devices, like CCDs has dramatically extended the amount of observed data. Large, in some cases all sky surveys emergded in almost all the wavelenght range of the observable spectrum of electromagnetic waves. This large amount of data has to be organized, published electronically and a new style of data retrieval is essential to exploit all the hidden information in the multiwavelength data.

Notes:

Multi-object spectroscopy of globular clusters

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In this talk I will present the first results of our project aiming mass spectroscopy of stars around and constituting globular clusters. We obtained medium resolution spectra around the near infrared Ca triplet of more than 10.000 stars in the 2 degree field of 5 southern globular clusters.

Notes:

Metallicity spreads in massive globular clusters

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The discoveries of a substantial metallicity spread in the two globular clusters (GCs) Omega Cen and M31-G1 have dramatically challenged the notion of chemical uniformity as a defining characteristic of these systems. During the past few years, there has been an intensive debate about the origin of the metallicity spread in GCs. The possibilities include (i) GC chemical self-enrichment, (ii) GC formation from a proto-cluster cloud inhomogeneous in metallicity, (iii) some GCs are the remaining cores of nucleated dwarf elliptical galaxies heavily pruned through tidal encounters. In this work we present HST-ACS observations of three massive and bright clusters in M31. Our goal is to quantify the intrinsic width of the red giant branch (RGB) of each cluster in order to search for any metallicity spreads that might reveal a more complex star formation history than previously assumed for this type of systems.

Notes:

Molecular abundances and anomalous diffusion

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The chemistry of molecular clouds is a complex system influenced by wide scale of different factors; amongst them one of the most important is the turbulent diffusion. Whilst the previous improved models laid emphasis on the chemistry, we wish to examine how the use of superdiffusion instead of simple diffusion changes the steady state abundances.

Notes:

Effects of the turbulent ISM on radio observations of quasars

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In radio bands, the study of compact radio sources could be affected by propagation effects. These are usually attributed to the presence of turbulent intervening material along the line of sight. J1128+592 is a newly found highly variable Intraday Variable (IDV) radio source. At present the mixing ratio between source intrinsic and source extrinsic IDV is unclear. In the source extrinsic model of IDV, the variations are interpreted as scintillation of the radio waves in the turbulent ISM of the Milky Way. One of the strongest evidence in favor of a propagation induced IDV would be the annual modulation of the observed variability timescale caused by the Earth orbiting motion around the Sun. So far, the observations of J1128+592 suggest that the changes of its variability timescale can be attributed to annual modulation.

Notes:

Statistical Analysis and Monte Carlo Simulation of the Data of Cosmological Relevant Ia Supernovae

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Ia supernovae are considered as standard candles in the measurement of several cosmological parameters. Recent investigations of the data-set have shown sistematic errors which might have appeared during the data reduction. We simulated a data-set of Ia supernovae by Monte Carlo method to investigate the possibility of a systematic error.

Notes:

Inflationary cosmology with a short distance cutoff

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The scenario of inflation provides compelling solutions not only to the Standard Model of Cosmology's problems, but also to the origin of structure formation in the Universe. Especially, inflation predicts (in agreement with current observations) a nearly scale invariant spectrum of primordial density perturbations. In recent years, there has been much excitement about the possibility that the enormous expansion during the inflationary phase of the Universe could even open a window towards physics beyond the Planck scale. I will discuss a particular model for trans-Planckian modifications on the power spectrum predictions and speculate about our options of constraining high energy physics theories by cosmological observations.

Notes: