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How does the mass transport in disk galaxy models influence the character of orbits?

Euaggelos E. Zotos

Department of Physics, School of Science, Aristotle University of Thessaloniki, GR-541 24, Thessaloniki, Greece; e-mail: evzotos@physics.auth.gr

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Abstract. We explore the regular or chaotic nature of orbits of stars moving in the meridional (R, z) plane of an axially symmetric time-dependent disk galaxy model with a central, spherically symmetric nucleus. In particular, mass is linearly transported from the disk to the galactic nucleus, in order to mimic, in a way, the case of self-consistent interactions of an actual N-body simulation. We thus try to unveil the influence of this mass transportation on the different families of orbits of stars by monitoring how the percentage of chaotic orbits, as well as the percentages of orbits of the main regular resonant families, evolve as the galaxy develops a dense and massive nucleus in its core. The SALI method is applied to samples of orbits in order to distinguish safely between ordered and chaotic motion. In addition, a method based on the concept of spectral dynamics is used for identifying the various families of regular orbits and also for recognizing the secondary resonances that bifurcate from them. Our computations strongly suggest that the amount of the observed chaos is substantially increased as the nucleus becomes more massive. Furthermore, extensive numerical calculations indicate that there are orbits which change their nature from regular to chaotic and vice versa and also orbits which maintain their orbital character during the galactic evolution. The present outcomes are compared to earlier related work.

Key words: galaxies: kinematics and dynamics – structure – chaos

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Diffusional separation of calcium isotopes in chemically peculiar stellar atmospheres

L. Sapar, A. Sapar, R. Poolamäe and A. Aret

Tartu Observatory, 61602 Tõravere, Estonia; sapar@to.ee

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Abstract. Diffusional separation of calcium isotopes in the atmospheres of hot chemically peculiar stars is studied. In addition to the usual radiative acceleration effect, the light-induced drift is taken into account. We propose that microturbulence in stable stellar atmospheres is generated by the interaction between plasma particles and radiative flux. Formulae for the microturbulent velocity and microturbulence diffusion coefficient are derived. Data on isotopic and hyperfine splitting of the calcium spectral lines have been collected as an input file. The equilibrium Ca isotope concentrations are found in model computations, iteratively correcting the radiative acceleration values. The general picture of Ca isotope stratification is found to be similar to our previous results obtained for Hg isotopes: dominating overabundance of the heaviest isotope. Diffusional stratification of Ca isotope concentrations in atmospheres of late B and early A spectral types are computed and visualized in figures. The isotope abundances on the inner boundary surface were fixed to be the solar ones. The computed Ca II infrared triplet line profiles are compared with the observed line profiles in a high-dispersion spectrum of HD 175640.

Key words: stars: atmospheres – stars: chemically peculiar – stars: abundances – diffusion – turbulence

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Improvements in the spherical collapse model and dark energy cosmologies

A. Del Popolo[1,2,3]

[1] *Dipartimento di Fisica e Astronomia, University Of Catania, Viale Andrea Doria 6, 95125 Catania, Italy*

[2] *INFN sezione di Catania, Via S. Sofia 64, I-95123 Catania, Italy*

[3] *International Institute of Physics, Universidade Federal do Rio Grande do Norte, 59012-970 Natal, Brazil*

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Abstract. In the present paper, we study how the effects of deviations from spherical symmetry of a system, produced by angular momentum, and shear stress, influence typical parameters of the spherical collapse model, like the linear density threshold for collapse of the non-relativistic component (δ_c) and its virial overdensity (Δ_V). The study is performed in the framework of the Einstein-de Sitter and ΛCDM models, and assuming that the vacuum component is not clustering within the homogeneous non-spherical overdensities. We start from the standard spherical top hat model (SCM) which does not take account the non-spherical effects, and we add to this model the shear term and angular momentum term, which are finally expressed in terms of the density contrast, δ. We find that the non-spherical terms change the non-linear evolution of the system and that the collapse stops "naturally" at the virial radius, differently from the standard spherical collapse model. Moreover, shear and rotation gives rise to higher values of the linear overdensity parameter and different values of Δ_V with respect to the standard spherical collapse model.

Key words: cosmology: theory – large-scale structure of Universe – dark energy – galaxies: formation

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Stochasticity in star clusters: reduced random sampling method

P. de Meulenaer[1,2], D. Narbutis[1], T. Mineikis[1,2] and V. Vansevičius[1,2]

[1] *Center for Physical Sciences and Technology, Savanorių 231, Vilnius LT-02300, Lithuania; philippe.demeulenaer@ff.stud.vu.lt*

[2] *Vilnius University Observatory, Čiurlionio 29, Vilnius LT-03100, Lithuania*

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Abstract. This paper aims to contribute to the debate taking place nowadays on the two extreme schemes of sampling the stellar masses within star clusters, known as Optimal Sampling and Random Sampling. We propose a new method for sampling of stellar masses in star clusters which allows a continuous transition between the Optimal Sampling and the Random Sampling. We use a sample of young star clusters from the literature to calibrate the amount of stochasticity generated by the proposed method.

Key words: galaxies: star clusters: general

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Stochastic 2-D models of galaxy disk evolution. The galaxy M33

T. Mineikis[1,2] and V. Vansevičius[1,2]

[1] *Vilnius University Observatory, Čiurlionio 29, Vilnius LT-03100, Lithuania; vladas.vansevicius@ff.vu.lt*

[2] *Center for Physical Sciences and Technology, Savanorių 231, Vilnius LT-02300, Lithuania; tadas.mineikis@ftmc.lt*

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Abstract. We have developed a fast numerical 2-D model of galaxy disk evolution (resolved along the galaxy radius and azimuth) by adopting a scheme of parameterized stochastic self-propagating star formation. We explore the parameter space of the model and demonstrate its capability to reproduce 1-D radial profiles of the galaxy M33: gas surface density, surface brightness in the i and GALEX FUV passbands, and metallicity.

Key words: galaxies: evolution – galaxies: individual (M 33)

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Models of late-type disk galaxies: 1-D versus 2-D

T. Mineikis[1,2] and V. Vansevičius[1,2]

[1] *Vilnius University Observatory, Čiurlionio 29, Vilnius LT-03100, Lithuania vladas.vansevicius@ff.vu.lt*

[2] *Center for Physical Sciences and Technology, Savanorių 231, Vilnius LT-02300, Lithuania tadas.mineikis@ftmc.lt*

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Abstract. We investigate the effects of stochasticity on the observed galaxy parameters by comparing our stochastic star formation two-dimensional (2-D) models of galaxy evolution with the commonly used one-dimensional models with smooth star formation. The 2-D stochastic models predict high variability of the star formation rate and the surface photometric parameters across the galactic disks and in time.

Key words: galaxies: general – galaxies: evolution

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Orbits of asteroids discovered at the Molėtai Observatory in 2000–2004

K. Černis[1], I. Wlodarczyk[2] and J. Zdanavičius[1]

[1] *Institute of Theoretical Physics and Astronomy, Vilnius University, Goštauto 12, Vilnius LT-01108, Lithuania; Kazimieras.Cernis@tfai.vu.lt*

[2] *Chorzow Astronomical Observatory, 41-500 Chorzow, Poland; astrobit@ka.onet.pl*

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Abstract. The paper presents statistics of the asteroids observed and discovered at the Molėtai Observatory, Lithuania in 2000–2004 within the project for astrometric observations of the near-Earth objects (NEOs), the main belt asteroids and comets. CCD observations of asteroids were obtained with the 35/51 cm Maksutov-type meniscus telescope and the 1.65 m Ritchey-Chretien reflector. In the Minor Planet Circulars and the Minor Planet Electronic Circulars (2000–2004) we published 6629 astrometric positions of 1114 asteroids. Among them 78 were newly discovered asteroids at Molėtai, a few NEOs were found by our team independently. For the 67 asteroids discovered at Molėtai the precise orbits were calculated. Because of small number of observations, a few asteroids have low-precision orbits and some asteroids have been lost. For seven objects we present their ephemerides for 2015.

Key words: minor planets, asteroids: search, near-Earth objects, astrometry, orbits

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Catalogue of bright IDS stars with extensive cross-identifications

N. A. Lipaeva[1], V. N. Sementsov[1] and O. Yu. Malkov[2,3]

[1] *Sternberg Astronomical Institute, Lomonosov Moscow State University, Universitetskii pr. 13, Moscow 119992, Russia; valera@sai.msu.ru*

[2] *Institute of Astronomy of the Russian Academy of Sciences, Pyatnitskaya St. 48, Moscow 119017, Russia; malkov@inasan.ru*

[3] *Faculty of Physics, Moscow State University, Moscow 119992, Russia*

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Abstract. A new catalogue of bright binary stars is presented. The catalogue[1] includes bright IDS systems and bright spectroscopic binaries. Besides IDS data (coordinates, relative positions, magnitudes and spectral classification), the catalogue contains extensive cross-identification and comments for 27452 systems. The catalogue is complete to the 9th mag, but also contains stars down to about 16th mag.

Key words: stars: binaries: visual – catalogs

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The half-century history of studies of Romano's star

Olga Maryeva

Special Astrophysical Observatory of the Russian Academy of Sciences, Nizhnij Arkhyz, 369167, Russia; olga.maryeva@gmail.com

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Abstract. A short review of observations and simulations of one of the most interesting high-mass stars, Romano's star in the M33 galaxy (M33 V532), is presented.

Key words: stars: individual: Romano's star (M33) – galaxies: individual: M33 – stars: supergiants – stars: Wolf-Rayet

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Observations of two unusual eclipsing binaries, FN Cam and AG Vir

E. A. Avvakumova[1], O. Yu. Malkov[2], A. A. Popov[1] and A. Yu. Kniazev[3,4,5]

[1] *Kourovka Astronomical Observatory, Institute of Natural Science, B. N. Yeltsin Ural Federal University, 19 Mira St., Yekaterinburg 620000, Russia; Ekaterina.Avvakumova@urfu.ru*

[2] *Institute of Astronomy of Russian Acad. Sci., 48 Pyatnitskaya St., Moscow 119017, Russia; malkov@inasan.ru*

[3] *South African Astronomical Observatory, PO Box 9, 7935 Observatory, Cape Town, South Africa; akniazev@saao.ac.za*

[4] *Southern African Large Telescope Foundation, PO Box 9, 7935 Observatory, Cape Town, South Africa*

[5] *Sternberg Astronomical Institute, Lomonosov Moscow State University, 13 Universitetskij Prosp., Moscow 119992, Russia*

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Abstract. Based on the results of classification of eclipsing binaries, we have compiled a list of stars that are promising objects for future study. We have started an observational campaign with telescopes of the Kourovka Observatory, Russia and present the first results of this work.

Key words: stars: binaries: eclipsing – stars: individual – techniques: photometric

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Medium resolution spectroscopy and chemical composition of Galactic globular clusters

D. A. Khamidullina[1], M. E. Sharina[2], V. V. Shimansky[1] and E. Davoust[3]

[1] *Kazan Federal University, Kremlevskaya 18, Kazan, 420008, Russia; hamidullina.dilyara@gmail.com*

[2] *Special Astrophysical Observatory, Russian Academy of Sciences, N. Arkhyz, Karachai-Cherkessian Republic, 369167, Russia; sme@sao.ru*

[3] *IRAP, Université de Toulouse, CNRS, 14 avenue E. Belin, F-31400, France; edavoust@irap.omp.eu*

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Abstract. We used integrated-light medium-resolution spectra of six Galactic globular clusters and model stellar atmospheres to carry out population synthesis and to derive chemical composition and age of the clusters. We used medium-resolution spectra of globular clusters published by Schiavon et al. (2005), as well as our long-slit observations with the 1.93 m telescope of the Haute Provence Observatory. The observed spectra were fitted to the theoretical ones interactively. As an initial approach, we used masses, radii and log g of stars in the clusters corresponding to the best fitting isochrones in the observed color-magnitude diagrams. The computed synthetic blanketed spectra of stars were summed according to the Chabrier mass function. To improve the determination of age and helium content, the shape and depth of the Balmer absorption lines was analysed. The abundances of Mg, Ca, C and several other elements were derived. A reasonable agreement with the literature data both in chemical composition and in age of the clusters is found. Our method might be useful for the development of stellar population models and for a better understanding of extragalactic star clusters.

Key words: Galaxy: globular clusters: individual: NGC 104, NGC 6121, NGC 6205, NGC 6218, NGC 6838, NGC 7078 – Galaxy: abundances

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On the mass distribution of stellar-mass black holes

O. Yu. Malkov[1,2]

[1] *Institute of Astronomy of the Russian Academy of Sciences, Pyatnitskaya St. 48, Moscow 119017, Russia; malkov@inasan.ru*

[2] *Faculty of Physics, Moscow State University, Moscow 119992, Russia*

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Abstract. The observational stellar-mass black hole mass distribution exhibits a maximum at about $8\,M_{\odot}$. It can be explained via the details of the massive star evolution, supernova explosions, or consequent black hole evolution. We propose another explanation, connected with an underestimated influence of the relation between the initial stellar mass and the compact remnant mass. We show that an unimodal observational mass distribution of black holes can be produced by a power-law initial mass function and a monotonic "remnant mass versus initial mass" relation.

Key words: black hole physics – stars: mass function – stars: statistics

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On cluster rotation in the Galactic tidal field

Leonid P. Ossipkov

Department of Space Technologies and Applied Astrodynamics,
Saint Petersburg State University, 35 Universitetskij pr., Staryj Peterhof,
St. Petersburg 198504, Russia; leonidosipkow@yahoo.com

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Abstract. The dynamics of a rotating star cluster moving along a circular orbit in the axisymmetrical steady galaxy is considered. The generalized tensor virial theorem allows to estimate its rotation speed. Conditions for direct and retrograde rotation in the galactic plane are found.

Key words: stellar dynamics – methods: analytical – globular clusters: general – open clusters and associations: general

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Outer rings in early-type galaxies: from Vorontsov-Velyaminov to present

O. Silchenko, M. Ilyina and I. Katkov

Sternberg Astronomical Institute, Lomonosov Moscow State University, University av. 13, Moscow 119991, Russia; olga@sai.msu.su

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Abstract. 'Ringed galaxies', or disk galaxies with prominent outer ring structures, separated visually from the main galactic bodies, were discovered and intensively studied by B. A. Vorontsov-Vel'yaminov whose 110th anniversary is celebrated this year. We discuss progress reached during recent years in understanding outer ring structures of disk galaxies, in particular, the results of our spectroscopic studies on the ring gas kinematics, excitation and chemical composition.

Key words: galaxies: evolution – galaxies: structure – galaxies: kinematics and dynamics – galaxies: elliptical and lenticular

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On the construction of a new 3D atlas of stellar spectral energy distributions

A. V. Mironov[1], A. I. Zakharov[1], V. G. Moshkalev[1], O. Yu. Malkov[2,3] and E. Yu. Kilpio[2]

[1] *Sternberg Astronomical Institute, Moscow State University, 13 Universitetskij Prosp., Moscow 119992, Russia; almir@sai.msu.ru, zakh@sai.msu.ru, moshvg@mail.ru*

[2] *Institute of Astronomy, Russian Academy of Sciences, 48 Pyatnitskaya, Moscow 119017, Russia; malkov@inasan.ru, lena@inasan.ru*

[3] *Faculty of Physics, Moscow State University, Leninskie Gory, Moscow 119991 GSP-1, Russia*

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Abstract. Modern spectrophotometric atlases are burdened with significant systematic errors. In particular, the problems of spectrum calibration in the ultraviolet region are not solved; different parts of the spectrum are not thoroughly fit to each other; spectra of (even bright) stars, obtained by different authors, display large discrepancies. Here we discuss a possibility to construct a new atlas of spectral energy distributions (SEDs) for a large set of stars by comparison of empirical stellar spectra in dozens of modern spectrophotometric atlases, as well as the comparison of synthetic and observed color indices in different multicolor photometric systems. In this way we suppose to exclude most of systematic errors and construct a new three-dimensional (spectral class, luminosity class, metallicity) atlas of empirical stellar spectra for several thousand stars. After exclusion of interstellar reddenings, a semi-empirical atlas of average SEDs can be constructed for about 150–200 spectral subtypes. This would allow us to make calibrations of spectrophotometric and photometric parameters in terms of spectral types and physical parameters ($T_{\rm eff}$, $\log g$, [m/H]) and to verify the accuracy of model stellar atmospheres.

Key words: stars: fundamental parameters – stars: spectral energy distributions

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Some self-consistent models of infinitely thin stellar disks with an elliptical velocity distribution

L. P. Ossipkov

Department of Space Technologies and Applied Astrodynamics, St. Petersburg State University, 35 Universitetskij pr., Staryj Peterhof, St. Petersburg 198504, Russia; leonidosipkow@yahoo.com

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Abstract. Distribution functions are found for some models of mass distribution in infinitely thin disks with an elliptical velocity distribution (Maclaurin, Kuzmin-Toomre, Hénon and Mestel disks).

Key words: stellar dynamics – methods: analytical – disk galaxies: distribution function