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Dynamics of Cosmic Neutrinos in Galaxies

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Abstract. The cosmic background of massive (about 1 eV rest-energy) neutrinos can be cooled to extremely low temperatures, reaching almost completely degenerated state. The Fermi velocity of the neutrinos becomes less than 100 km/s. The equations of dynamics for the cosmic background neutrinos are derived for the spherical and axisymmetrical thin circular disk galaxies. The equations comprise the gravitational potential and gravity of the uniform baryonic disk galaxies. Then the equations are integrated analytically over the disk radius. The constant radial neutrino flux in spherical galaxies favors formation of the wide unipotential wells in them. The neutrino flux in the axisymmetrical galaxies suggests to favor the evolution in the direction of a spherically symmetrical potential. The generated unipotential wells are observed as plateaux in the velocity curves of circular stellar orbits. The constant neutrino density at galactic centers gives the linear part of the curves. The derived system of quasilinear differential equations for neutrinos in the axisymmetrical galaxies have been reduced to the system of the Lagrange-Charpit equations: the coupled differential equations, specifying the local neutrino velocities and dynamics of motion along trajectories, and an additional interconnected equation of the neutrino mass conservation, which can be applied for the determination of density of the neutrino component in galaxies.

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A Distant Chandra Galaxy Cluster CL J1415.1+3612: Constraint on Evidence of the Cool-core Phenomenon

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Abstract. Deep *Chandra* observations of the distant cluster of galaxies, CL J1415.1+3612, are analyzed in order to determine the main physical characteristics of the intracluster medium. We also investigate some properties of a cool-core phenomenon at $\sim$10 kpc. Combining all *Chandra* observations, we derive the average temperature (kT = 6.77±0.54 keV) and the metal abundance (Z = 0.84±0.16 $Z_{\odot}$) of the cluster. Assuming hydrostatic equilibrium and spherical symmetry, and using deprojected temperature and surface profiles, we estimate the value of total mass of the cluster within R_{2500}, R_{500} and R_{200} and find the fraction of gas for these radii. The gas mass fraction of CL J1415.1+3612 at R_{500} is typical for X-ray clusters, $(2.2\pm0.5)\cdot10^{14}$ $M_{\odot}$. The total mass is equal to $3.8\pm0.4\cdot10^{14}$ $M_{\odot}$ at R_{200} and the corresponding gas fraction is $f = 0.21\pm0.06$. In addition, we measured the cooling time of the central region ($\sim$10 kpc) as $t_{\rm cool} = 0.163\pm0.021$ Gyr. The value of entropy in the same region is $K_{\rm c}$ = 12.1±2.6 keV cm^2. We also checked the redshift value of the cluster using the iron line $K\alpha$ in the X-ray spectra of CL J1415.1+3612. Our analysis makes this galaxy cluster to be one of the best investigated distant massive clusters in the X-ray range.

Key words: galaxies: clusters: intergalactic medium; individual: CL J1415.1+3612 – X-ray: galaxies: clusters

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Structural Parameters of Star Clusters: Stochastic Effects

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Abstract. Stochasticity of bright stars introduces uncertainty and bias into derived structural parameters of star clusters. We have simulated a grid of cluster V-band images, observed with the Subaru Suprime-Cam, with age, mass and size representing a cluster population in the M31 galaxy and derived their structural parameters by fitting King model to the surface brightness distribution. We have found that clusters less massive than $10^4\,M_\odot$ show significant uncertainty in their core and tidal radii for all ages, while clusters younger than 10 Myr have their sizes systematically underestimated for all masses. This emphasizes the importance of stochastic simulations to assess the true uncertainty of structural parameters in studies of semi-resolved and unresolved clusters.

Key words: galaxies: star clusters: general – galaxies: individual (M31)

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Angular Momentum in Dwarf Galaxies

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Abstract. We study the "angular momentum catastrophe" in the framework of interaction among baryons and dark matter through dynamical friction. By means of Del Popolo (2009) model we simulate 14 galaxies similar to those investigated by van den Bosch, Burkert and Swaters (2001), and calculate the distribution of their spin parameters and the angular momenta. Our model gives the angular momentum distribution which is in agreement with the van den Bosch et al. observations. Our result shows that the "angular momentum catastrophe" can be naturally solved in a model that takes into account the baryonic physics and the exchange of energy and angular momentum between the baryonic clumps and dark matter through dynamical friction.

Key words: cosmology: theory, large scale structure of Universe – galaxies: formation

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A Tale on Two Close Binaries in Pegasus

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Abstract. We present the simultaneous light and radial velocity curve analysis of two contact binaries in Pegasus using the Wilson-Devinney code. The following absolute astrophysical parameters are determined: masses, radii and effective temperatures. BB Peg is a W-subtype W UMa-type binary, components of which are main sequence stars with $0.50\,M_\odot$ and $1.40\,M_\odot$. The radii of its components are $R_1 = 0.81\,R_\odot$ and $R_2 = 1.28\,R_\odot$. V407 Peg is an A-subtype contact binary composed of two subgiant components with masses $1.70\,M_\odot$ and $0.43\,M_\odot$, and radii $R_1 = 2.17\,R_\odot$ and $R_2 = 1.25\,R_\odot$. Comparisons with the theoretical models for solar composition by Girardi et al. (2000) confirms our classification and supports the results.

Key words: stars: binaries: eclipsing – stars: fundamental parameters – stars: individual (BB Peg, V407 Peg)

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Cosmic-ray Induced Diffusion in Interstellar Ices

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Abstract. Cosmic rays are able to heat interstellar dust grains. This may enhance molecule mobility in icy mantles that have accumulated on the grains in dark cloud cores. A three-phase astrochemical model was used to investigate the molecule mobility in interstellar ices. Specifically, diffusion through pores in ice between the subsurface mantle and outer surface, assisted by whole-grain heating, was considered. It was found that the pores can serve as an efficient transport route for light species. The diffusion of chemical radicals from the mantle to the outer surface are most effective. These species accumulate in the mantle because of photodissociation by the cosmic-ray induced photons. The faster diffusion of hydrogen within the warm ice enhances the hydrogenation of radicals on pore surfaces. The overall result of the whole grain heating-induced radial diffusion in ice are higher abundances of the ice species whose synthesis involve light radicals. Examples of stable species synthesized this way include the complex organic molecules, OCS, H_2O_2 and cyanoplyynes.

Key words: astrochemistry – molecular processes – ISM: clouds – ISM: molecules – ISM: cosmic rays