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Galactic spiral pattern beyond the optical size induced by the triaxial dark halo

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Abstract. We suggest a possible mechanism for the formation of non-tidal gaseous structures in galactic outskirts. According to recent observations, extended spiral structures are detected beyond the optical radii $R_{\rm opt}$ in numerous disk galaxies. Such features can be clearly seen in deep HI and UV images (e.g., NGC 3198, NGC 3359, NGC 2841, NGC 3198). We argue, based on our gas-dynamical simulations, that such outer spirals could form as a result of the interaction of the galactic disk with the triaxial host dark matter halo.

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

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High resolution gravitational lens model

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Abstract. A new model of gravitational lens – high-resolution gravitational lens based on the metric of gravitational field produced by N moving and rotating finite-sized bodies – is proposed. The model is applied to the case of a double galaxy gravitational lens. It is pointed out that previous searches for gravitational lensing in double systems focused on eclipsing binaries and were based on the analysis of their photometric variability. Unlike other authors, we determined the extra terms to be added to the refraction angle to account for the motion and rotation of the bodies. We show that the allowance for the motion of galaxies decreases the shifts of the images of the lensed object and that this effect is detectable in the current state of astronomical observations.

Key words: gravitational lensing: micro – galaxies: individual (NGC 4567, NGC 4568)

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Detection of unresolved binaries with multicolor photometry

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Abstract. The principal goal of this paper is to specify conditions of detection of unresolved binaries by multicolor photometry. We have developed a method for estimating the critical distance at which an unresolved binary of given mass and age can be detected. The method is applied to the photometric system of the planned *Lyra-B* spaceborne experiment. We have shown that some types of unresolved binary stars can be discovered and distinguished from single stars solely by means of photometric observations.

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On the formation of tails in the Galactic tidal field

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Abstract. The trajectories of stars of a cluster moving in the Schuster-Plummer potential on a circular orbit in the Galactic plane (Bok's problem) are investigated. The impact of initial conditions on stellar motions, in particular on the possibility of escape of a star from the cluster, is analyzed, and numerous computations of stellar orbits are performed for various initial values of energy and momentum with respect to the cluster. Stars escaping from the cluster are shown to move mostly in spiral orbits and form well-defined spiral tails.

Key words: methods: numerical – Galaxy: kinematics and dynamics

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On the possibility of applying the quasi-isothermal Stäckel's model to our Galaxy

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Abstract. An earlier derived quasi-isothermal Stäckel's model of mass distribution in stellar systems and the corresponding formula for space density are applied to our Galaxy. The model rotation curve is fitted to H I kinematical data. The structural and scale parameters of the model are estimated and the corresponding density contours for our Galaxy are presented.

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Visual binaries: cross-matching and compiling of a comprehensive list

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Abstract. Visual binary stars make up the largest set among observed types of binaries (currently more than 110 000 systems are known containing more than 230 000 components). However, statistical analysis of this sample is a complicated task because a number of catalogues of visual binaries contain various data for evidently overlapping sets of objects. To use the complete dataset, one needs to cross-match these catalogues, i.e. to gather all the available information on visual binary stars into a single list. We have compiled a comprehensive set of visual binaries using data from the current versions of the Catalog of Components of Double & Multiple stars (CCDM); Tycho Double Star Catalogue (TDSC), and The Washington Visual Double Star Catalog (WDS). The resulting list[1] contains 130 873 pairs, and we also provide trigonometric parallaxes for 14 319 of them drawn mostly from the Hipparcos catalogue.

Key words: binaries: visual – catalogs

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The evolution of a supermassive retrograde binary embedded in the accretion disk

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Abstract. In this note we discuss the main results of a study of a massive binary with unequal mass ratio, q, embedded in an accretion disk, with its orbital rotation being opposed to that of the disk. When the mass ratio is sufficiently large, a gap opens in the disk, but the mechanism of gap formation is very different from the prograde case. Inward migration occurs on a timescale of $t_{\rm ev} \sim M_{\rm p}/\dot{M}$, where $M_{\rm p}$ is the mass of the less massive component (the perturber), and $\dot{M}$ is the accretion rate. When $q \ll 1$, the accretion takes place mostly onto the more massive component, with the accretion rate onto the perturber being smaller than, or of order of, $q^{1/3}\dot{M}$. However, this rate increases when supermassive binary black holes are considered and gravitational wave emission is important. We estimate a typical duration of time for which the accretion onto the perturber and gravitational waves could be detected.

Key words: accretion disks – binaries – hydrodynamics – galaxies: quasars: supermassive black holes – planet-disk interactions

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On equilibrium figures of particle clouds around the Sun and stars

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Abstract. Equilibrium figures of cold gas-dust (or cometary) clouds are studied in a more general setting than the classical Roche problem. The cloud is considered to be under the influence of gravitational attraction of the central star and the tidal field of the Galaxy. Our analysis also takes into account the centrifugal forces due to the rotation of the cloud, which moves around the center of the stellar system together with the star. The limit equilibrium figure is found to have three planes of symmetry and to be shaped like a "lemon" with lateral swellings and two singular points. The shape of this figure and its cusp angles in the planes of two main sections are calculated. The average density inside the equilibrium figure is shown to be almost exactly equal to the average density of matter in the Galaxy. This coincidence cannot be accidental and means that equilibrium figures with the critical level of the total surface potential fill the entire volume of the Galaxy. A possible consequence is that the cometary clouds of neighboring stars in the Galaxy may touch each other (or even intersect because of the presence of dark matter). Hence stars may exchange comets and part of the comets in the Solar System may belong to other stars.

Key words: celestial mechanics – Galaxy: solar neighborhood

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BSDB: a new consistent designation scheme for identifying objects in binary and multiple stars

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Abstract. The new consistent scheme for designation of objects in binary and multiple systems, BSDB, is described. It was developed in the frame of the Binary star DataBase, BDB (http://www.inasan.ru), due to necessity of a unified and consistent system for designation of objects in the database, and the name of the designation scheme was derived from that of the database. The BSDB scheme covers all types of observational data. Three classes of objects introduced within the BSDB nomenclature provide correct links between objects and data, what is especially important for complex multiple stellar systems. The final stage of establishing the BSDB scheme is compilation of the Identification List of Binaries, ILB, where all known objects in binary and multiple stars are presented with their BSDB identifiers along with identifiers according to major catalogues and lists.

Key words: binaries: visual – catalogs

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Star formation and Galaxy dynamo equations with random coefficients

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Abstract. We study the influence of star formation on magnetic field in galaxies. Two approaches have been used to describe this mechanism. The first one uses some averaged approximate kinematic characteristics that appear in the galactic dynamo equations. We use the so-called no-z model that takes into account the fact that galactic disks are quite thin and hence we can consider only the field components that are parallel to the plane of the galaxy. We also use the equation that describes the evolution of magnetic helicity, which can be important for galaxies with intensive star formation. The second approach uses the dynamo equations with random coefficients, which are useful for describing magnetic fields in galaxies with rapidly changing kinematic parameters. Both methods yield similar results: if the surface star formation rate is small, the magnetic field evolution does not change very much. If the surface star formation rate is more than five times higher than in the Milky Way, the field decays.

Key words: stars: formation – galaxies: magnetic fields – ISM: magnetic fields

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Destruction of globular clusters in the Galactic gravitational field

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Abstract. We present some results of numerical simulation of a dynamical evolution of globular clusters in the tidal field of the Galaxy. An analytical description of tidal destruction of such clusters and simple estimate of their lifetimes are proposed.

Key words: Galaxy: kinematics and dynamics – globular clusters: general – methods: numerical

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Stochasticity of Galactic orbits of star clusters

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Abstract. The Lyapunov, Lagrange and Poincaré criteria are tested for orbits of 461 open clusters in an axisymmetric potential. Lyapunov exponents and Poincaré sections are computed, and all of the trajectories are found to be stable according to the Lagrange and Poincaré stability criteria. At the same time, some trajectories appear to exhibit minor instability according to the Lyapunov stability criterion.

Key words: Galaxy: kinematics and dynamics – open clusters and associations

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Velocity dispersion of ionized gas and multiple supernova explosions

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Abstract. We use 3D numerical simulations to study the evolution of the Hα intensity and velocity dispersion for single and multiple supernova (SN) explosions. We find that the $I_{\mathrm{H}\alpha}$– σ diagram obtained for simulated gas flows is similar in shape to that observed in dwarf galaxies. We conclude that colliding SN shells with significant difference in age are responsible for high velocity dispersion that reaches up to $\gtrsim 100$ km s^{-1}. Such a high velocity dispersion could be hardly obtained for a single SN remnant. Peaks of velocity dispersion in the $I_{\mathrm{H}\alpha}$– σ diagram may correspond to several isolated or merged SN remnants with moderately different ages. Degrading the spatial resolution in the Hα intensity and velocity dispersion maps makes the simulated $I_{\mathrm{H}\alpha}$– σ diagrams close to those observed in dwarf galaxies not only in shape, but also quantitatively.

Key words: galaxies: ISM – ISM: bubbles – ISM: supernova remnants – ISM: kinematics and dynamics – shock waves – methods: numerical