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Baltic Astronomy, vol. 20, 109–123, 2011

Star Classification Possibilities with the Gaia Spectrophotometers. III. The Classification Accuracy with Decontaminated BP/RP Spectra

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Abstract. A medium-band 12-color photometric system, based on the decontaminated Gaia BP/RP spectra, has been proposed in our Paper II. Here we analyze a possibility to apply some versions of this system for the determination of temperatures and gravities of stars both in the absence and the presence of interstellar reddening. The possibility to supplement this system with the broad BP and RP passbands is verified. We conclude that the system gives an acceptable accuracy of temperatures and luminosities if the accuracy of color indices is 0.02 mag or better and if the parallaxes of stars are known.

Key words: stars: fundamental parameters (classification, colors, spectral types, temperatures, gravities, luminosities) – space vehicles: Gaia

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Towards the Automatic Estimation of Time Delays of Gravitational Lenses

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Abstract. Estimation of time delays from a noisy and gapped data is one of the simplest data analysis problems in astronomy by its formulation. But as history of real experiments show, the work with observed datasets can be quite complex and evolved. By analyzing in detail previous attempts to build delay estimation algorithms we try to develop an automatic and robust procedure to perform the task. To evaluate and compare different variants of the algorithms we use real observed datasets which have been objects of past controversies. In this way we hope to select the methods and procedures which have highest probability to succeed in complex situations. As a result of our investigations, we propose an estimation procedure which can be used as a method of choice in large photometric experiments. We cannot claim that the proposed methodology works with any reasonably well sampled input dataset. However we hope that the steps taken are in correct direction and the developed software will be useful for observational astronomers.

Key words: cosmology: observations – gravitational lensing – methods: statistical

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Preface

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Abstract. Proceedings of the International Conference "Expanding the Universe", held at Tartu, Estonia, on 2011 April 27–29 on the occasion of the 200th anniversary of the Tartu observatory. Published in Baltic Astronomy, vol. 20, no. 2, p. 145–316. Editors: Ch. Sterken, L. Leedjärv and E. Tempel.

Key words: history of astronomy

Baltic Astronomy, vol. 20, 159–168, 2011

Some Pages of History of the Specula Dorpatensis, the Elder Sister of Pulkovo Observatory

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Received: 2011 June 5; accepted: 2011 June 30

Abstract. This paper gives an overview of the history of Tartu (Dorpat) Observatory.

Key words: history of astronomy

Baltic Astronomy, vol. 20, 169–178, 2011

How Struve and Tenner Started the Work of their Life

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Abstract. The great Russian-Scandinavian arc measurement was initiated by two men: F. G. W. Struve and C. F. Tenner. When they decided to join their endeavours, they both had obtained a substantial experience – Struve had completed the Livonia triangulation and he had measured the meridian arc from Jekabpils to Hogland, and Tenner had finished the triangulation for the Vilnius government and was continuing it for Kurland, Grodno and Minsk governments. In 1827 Tenner came forward with the idea to join their arcs, and during the meeting of both men in Tartu in 1828 they signed the respective agreement. The most difficult point in merging the projects was the use of measuring rods with different units of length: Struve used European toises and Tenner Russian sazhens. These rods had to be thoroughly compared, which they did and the results were checked independently by F. F. Schubert and F. W. Bessel who found them to be in a very good accordance. The later extension of the meridian arc northward to Fuglenes and to Stara-Nekrasivka in south allowed Struve to determine the preliminary result for the oblateness of the Earth with a great precision ($\alpha = 1{:}294.73$).

Key words: triangulation – geodetic measurements – geodetic instruments – Struve arc

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Anders Celsius' Contributions to Meridian Arc Measurements and the Establishment of an Astronomical Observatory in Uppsala

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Abstract. Astronomy has been on the curriculum of Uppsala University from at least the middle of the 15th century. However, since Uppsala also was the ecclesiastical centre of Sweden, the acceptance of new ideas, such as the Copernican heliocentric system, was slow. At the same time, more peripheral universities in the Swedish empire, including Dorpat/Tartu, enjoyed a larger freedom. It was not until the early 18th century that a 'modern' astronomy emerged in Uppsala. This effort was to a large extent led by Anders Celsius (1701–1744), who was able to establish good international contacts with astronomers in continental Europe. Celsius participated in De Maupertuis' expedition to the far north of Sweden, in order to measure the meridian arc and determine the shape of the Earth. This paper explores how Celsius became involved in De Maupertuis' expedition, and how this effort paved the way to the establishment of a fully equipped astronomical observatory, including an extensive collection of books and instruments, most of which survives up to this day.

Key words: history of astronomy

Baltic Astronomy, vol. 20, 187–194, 2011

Bernhard Schmidt and the Schmidt Telescope for Mapping the Sky

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Abstract. Bernhard Voldemar Schmidt (1879–1935) was born in Estonia. He ran an optical workshop in Mittweida, Saxonia, between 1901 and 1927. Astronomers appreciated the quality of his telescopes. Starting in 1925, working freelance in Hamburg Observatory, he developed a short focal length optical system with a large field of view. He succeeded in inventing the "Schmidt Telescope" in 1930, which allows the imaging a large field of the sky without any distortions. Shortly after Schmidt's death, the director of the observatory published details on the invention and production of the Schmidt Telescope. After World War II, Schmidt telescopes have been widely used. The first large Schmidt telescope was built in 1948, the "Big Schmidt" (126 cm), Mount Palomar, USA. Schmidt telescopes are also important tools for cosmology. The result of the Palomar Observatory Sky Surveys (1949–1958, 1985–1999) is a data base of about 20 million galaxies and over 100 million stars, supplemented in 1971 by the ESO Schmidt for the southern sky. Also high resolution spectrometers can be fitted to the Schmidt telescope. The 80 cm Schmidt telescope of Hamburg Observatory, planned since 1936, finished 1955, is on Calar Alto, Spain, since 1975. Combined with two objective prisms, it was used for a Quasar survey project.

Key words: instrumentation: Schmidt telescopes, astrophotography

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Ernst Julius Öpik, Solar Variability and Climate Change

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Abstract. This paper covers some aspects of the life and work of the Estonian astronomer Ernst Öpik (1893–1985), who contributed to a very wide range of astronomical disciplines, and whose publications span more than 70 years. He worked in Estonia, the Soviet Union, the United States, Germany and Northern Ireland. His visions on the role of solar variability in global climate change are emphasized, and his opinions on modelling in science are explained, in addition to his views about scientific refereeing and publishing.

Key words: history of astronomy – Sun: variability – Earth: climate change

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Recent Advances in Solar Physics at VIRAC: Analysis of Solar Active Regions in Microwaves

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Abstract. A brief historical review of the development of solar physics and solar radio astronomy in Latvia and its current status is presented.

Key words: history of astronomy – radio telescopes – Sun: radio radiation, flares, corona, sunspots

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Grigori Kuzmin and Stellar Dynamics

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Abstract. Grigori Kuzmin was a very gifted dynamicist and one of the towering figures in the distinguished history of the Tartu Observatory. He obtained a number of important results in relative isolation which were later rediscovered in the West. This work laid the foundation for further advances in the theory of stellar systems in dynamical equilibrium, thereby substantially increasing our understanding of galaxy dynamics.

Key words: stellar dynamics – galaxies: elliptical and lenticular, cD – galaxies: kinematics and dynamics – galaxies: structure

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Astrometry Lost and Regained

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Abstract. Technological and scientific developments during the past century made a new branch of astronomy flourish, i.e. astrophysics, and resulted in our present deep understanding of the whole Universe. But this brought astrometry almost to extinction because it was considered to be dull and old-fashioned, especially by young astronomers. Astrometry is the much older branch of astronomy, in fact 2000 years of age, which performs accurate measurements of positions, motions and distances of stars and other celestial bodies. Astrometric data are of great scientific and practical importance for investigation of celestial phenomena and also for control of telescopes and satellites and for monitoring of Earth rotation. Our main subject is the development during the 20th century which finally made astrometry flourish as an integral part of astronomy through the success of the Hipparcos astrometric satellite, soon to be followed by the even more powerful Gaia mission.

Key words: astronomical instrumentation – astrometry – history of astronomy

Baltic Astronomy, vol. 20, 231—240, 2011

Dark Matter

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Abstract. I give a review of the development of the concept of dark matter. The dark matter story passed through several stages from a minor observational puzzle to a major challenge for theory of elementary particles. Modern data suggest that dark matter is the dominant matter component in the Universe, and that it consists of some unknown non-baryonic particles. Dark matter is the dominant matter component in the Universe, thus properties of dark matter particles determine the structure of the cosmic web.

Key words: cosmology: dark matter, dark energy, galaxies, clusters of galaxies, large-scale structure of the Universe

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Tracing Galaxy Evolution by their Present-Day Luminosity Function

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Abstract. Galaxy luminosity functions are derived for different morphological types and various colors of galaxies, to trace the evolutionary effects which a priori should be different for void and supercluster galaxies. We also analyse how the galaxy group content changes in the large-scale environment. One of the principal results is the conclusion that the evolution of spiral galaxies is almost independent of the global environment. Meanwhile, the luminosity function of elliptical galaxies depends strongly on the environment. This shows that the global environmental density is an important factor in the formation of elliptical galaxies. The results of the present study clearly show that, except the local/group environment, the global (supercluster-void) environment plays an important role in the formation and evolution of galaxies.

Key words: cosmology: observations – large-scale structure of the Universe – galaxies: luminosity function, clusters, formation

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Some Properties of Galaxy Structures

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Abstract. We analysed some properties of galaxies structures based on the PF catalog of galaxy structures (Panko & Flin 2006) and the Tully NBG catalog (Tully 1988). At first, we analyzed the orientation of galaxies in the 247 optically selected rich Abell clusters, having at least 100 members. The distribution of the position angles of galaxies as well as of two angles describing spatial orientation of the galaxy planes were tested for isotropy, applying three statistical tests. We found the relation between the anisotropy and the cluster richness. The relation between the galaxy alignment and the Bautz-Morgan morphological type of the parent cluster is not present. A statistically marginal relation between the velocity dispersion and cluster richness is observed. We also analyzed ellipticities for 6188 low redshift ($z < 0.18$) poor and rich galaxy structures which have been examined along with their evolution. Finally, we analyzed the Binggeli effect and found that the orientation of galaxy groups in the Local Supercluster (LSC), is strongly correlated with the distribution of neighbouring groups in the scale up to about 20 Mpc. Analysis of galaxy structures from the PF catalog shows quite different situation – the efect is observed only for more elongated structures ($e \leq 0.3$). The effect is present in a distance range of about 60 h^{-1} Mpc.

Key words: galaxies: clusters and groups; galaxies: orientation, evolution

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Measuring the Cosmic Web

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Abstract. A quantitative study of the clustering properties of the cosmic web as a function of absolute magnitude and color is presented using the SDSS Data Release 7 galaxy survey. Mark correlations are included in the analysis. We compare our results with mock galaxy samples obtained with four different semi-analytical models of galaxy formation imposed on the merger trees of the Millenium simulation. The clustering of both red and blue galaxies is studied separately.

Key words: cosmology: observations – cosmology: theory – galaxies: statistics – large scale structure of the Universe

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Cosmological Neutrino Background and Connected Problems

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Abstract. Applying the formulae derived by us (A. Sapar 1964) for the Universe filled with baryonic matter and decoupled particles (photons and massive neutrinos), a scenario of evolution of the Universe is studied. The dark energy can be treated as the kinetic energy excess over the potential energy of all particles in the hyperbolic Universe which is going to its new, kinetic energy dominated epoch of evolution. The dark mass can be due to slowly moving rest-mass neutrinos, crossing the galaxies where they form wide iso-potential (constant orbital velocity) shells. The real Big Bang is assumed to precede the Planck unit time and this removes necessity of the later inflation phenomenon. The possibility to modify the equations of cosmology into the non-local ones by gravitational potential of the Universe is shortly discussed.

Key words: cosmology: theory, cosmic background radiation, dark matter, dark energy

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High-Quality Fast QPOs from Magnetars: an Electric Circuit Model

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Abstract. An interpretation of high-frequency (20–2400 Hz) fast quasi-periodic oscillations of magnetars in terms of an equivalent electric circuit is given. Observed periods and the very high quality of quasi-periodic oscillations are explained. The oscillation source is represented as a hot electron-positron plasma in a 'trapped fireball', a system of current-carrying magnetic loops of various sizes. The physical parameters of a 'trapped fireball' in the flare of SGR 1806-20 (2004 December 27) are estimated.

Key words: neutron stars: flares – pulsations: coronal loops – diagnostics

Baltic Astronomy, vol. 20, 281–288, 2011

Transfer Equation in General Curvilinear Coordinates

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Abstract. The differential operator of the monochromatic polarized radiative transfer equation is studied in case of statistically homogeneous turbid medium in Euclidean three-dimensional space, with arbitrary curvilinear coordinate system defined in it. An apparent rotation of the polarization plane along the light ray with respect to the chosen polarization reference plane generally takes place, due to purely geometric reasons. Using methods of tensor analysis, analytic expressions for the differential operator of the transfer equation depending on the components of the metric tensor and their derivatives are found. Considerable simplifications take place if the coordinate system is orthogonal. As an example, the differential operator of the vector radiative transfer equation in both elliptical conical coordinate system and oblate spheroidal coordinate system is written down. Nonstandard parameterization of standard elliptical conical coordinate system is proposed.

Key words: radiative transfer – polarization

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Some Studies of Terrestrial Impact Cratering Rate

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Abstract. In 1984, a 28.4 Myr periodicity was detected in the ages of terrestrial impact craters and a 26 Myr periodicity in the epochs of mass extinctions of species. Periodic comet showers from the Oort cloud seemed to cause catastrophic events linked to mass extinctions of species. Our first study revealed that the only significant detected periodicity is the "human signal" caused by the rounding of these data into integer numbers. The second study confirmed that the original 28.4 Myr periodicity detection was not significant. The third study revealed that the quality and the quantity of the currently available data would allow detection of real periodicity only if all impacts have been periodic, which cannot be the case. The detection of a periodic signal, if present, requires that more craters should be discovered and the accuracy of age estimates improved. If we sometimes will be able to find the difference between the craters caused by asteroid and comet impacts, the aperiodic component could be removed. The lunar impact craters may eventually provide the required supplementary data.

Key words: solar system: Earth, impact craters, asteroids, comets, Oort cloud – Galaxy: solar neighbourhood

Baltic Astronomy, vol. 20, 297–300, 2011

Some Relations between the Stockholm and Tartu Observatories during the 19th Century

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Abstract. This article introduces the Royal Swedish Academy of Sciences and the old Stockholm Observatory. It focuses on the Swedish astronomers Jöns Svanberg and Nils H. Selander, and on their work with the Struve Geodetic Arc. The particular relations to the Tartu Observatory through Oskar Backlund and the contemporary Swedish astronomers in Stockholm are traced.

Key words: history of astronomy

Baltic Astronomy, vol. 20, 301–304, 2011

Extinction of Radiation in the Universe: from F. G. W. Struve up to Now

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Abstract. We briefly overview the most important studies that led to the understanding of the vital role of extinction of radiation in the Universe. We also point to the existing uncertainties in the determination of extinction corrections for stars and galaxies.

Key words: ISM: extinction – Earth: atmospheric extinction – galaxies: intergalactic and circumgalactic dust

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Tadeusz Banachiewicz in Tartu (1915 to 1918)

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Abstract. Tadeusz Banachiewicz (1882–1954) was an outstanding Polish astronomer, mathematician and geodesist. He was a professor at the Jagiellonian University in Cracow and director of the Astronomical Observatory (1919–1954), and had a strong influence on Polish astronomy. His achievements led to honorary degrees at universities, fellowships in academies of sciences, and the prestige of high positions in international organizations, such as the International Astronomical Union and the Baltic Geodetic Commission. He is known from both his theoretical and observational studies, his famous motto being: "*observo ergo sum*". Here we recall three years of his activity in Tartu, where Tadeusz Banachiewicz made the most important steps in his career. He arrived at Yuryev in October of 1915, employed as a young assistant. In March 1918 he became the extraordinary professor and director of the Astronomical Observatory.

Key words: history of astronomy: Tartu Observatory: Tadeusz Banachiewicz

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Studying the Patterns of the Universe

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Abstract. The SDSS galaxy catalog is one of the best databases for galaxy distribution studies. The SDSS DR8 data is used to construct the galaxy cluster catalog. We construct the clusters from the calculated luminosity density field and identify denser regions. Around these peak regions we construct galaxy clusters. Another interesting question in cosmology is how observable galaxy structures are connected to underlying dark matter distribution. To study this we compare the SDSS DR7 galaxy group catalog with galaxy groups obtained from the semi-analytical Millennium N-Body simulation. Specifically, we compare the group richness, virial radius, maximum separation and velocity dispersion distributions and find a relatively good agreement between the mock catalog and observations. This strongly supports the idea that the dark matter distribution and galaxies in the semi-analytical models and observations are very closely linked.

Key words: galaxies: groups, clusters – cosmology: dark matter, large-scale structure of the Universe

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Galaxy Superclusters Detected in the Modified PF-Catalog Using the FoF Method

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Abstract. The Modified Catalog of Galaxy Clusters and Groups (Panko & Flin 2006, PF), covering an area of 5000 square degrees in the southern sky, was used as the input for the search of galaxy superclusters. Only the estimated redshifts could be used, since the PF catalog is a 2D catalog, with the calibration correlating the redshift of galaxy clusters with the magnitude of the tenth brightest cluster galaxy. Only galaxy clusters containing more than 50 galaxies were considered, and the FoF method was applied. The nearest neighbour distances for 1711 input clusters were calculated and analyzed, and 20 isolated clusters were found with the nearest neighbour at a distance greater than $68\,h^{-1}$Mpc. A distance of $24\,h^{-1}$ Mpc between clusters was selected for the supercluster search, and 49 superclusters containing from 4 to 9 galaxy clusters were detected. Calculations for each supercluster include: its inferred center, RA, Dec, $z_{\rm est}$, the maximum distance between supercluster members and the estimated supercluster shapes. A typical size of superclusters identified here is about $55\,h^{-1}$ Mpc, and they appear mainly as elongated pancakes, with a weak correlation between the axes c/a and b/a, without a strong dependence on multiplicity.

Key words: galaxies: clusters, superclusters: general