Astronomija/Astronomy

Report of Abstracts

https://conferences.lu.lv/e/155

Abstract ID : **1**

RESULTS OF MULTICOLOR QUASISYNCHRONOUS OBSERVATIONS OF ACTIVE ASTEROID (6478) GAULT

Content

The results of quasi-synchronous optical observations of the asteroid (6478) Gault, carried out on the Zeiss-1000 telescope of the Sanglokh Observatory Institute of Astrophysics NAST and the 1.3-m and 0.61-m telescopes of the Skalnato Pleso observatory of the Astronomical Institute of the Slovak Academy of Sciences in August-October 2020 are presented in this paper. The object episodically shows a signs of cometary activity and therefore is classified as an active asteroid in the Main Belt. The apparent and absolute brightness of the asteroid in the BVR bands was determined; the light curve indicates the inhomogeneity of the asteroid's surface. Based on the color indices the mineralogical composition of the asteroid was suggested. According to our estimates, the average diameter of the asteroid is 2.8±0.13 km, the upper limit of the asteroid's rotation period is found to be 2.695±0.004 hours. During the observation period the activity of the asteroid was not detected.

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Presenter: KOKHIROVA, Gulchehra

Track Classification: Astronomija/Astronomy

Contribution Type: poster presentation

Status: SUBMITTED

Submitted by **KOKHIROVA, Gulchehra** on **Friday, February 18, 2022**

Abstract ID : 2

Photometric Features of Comet P/2019 LD2 From Observations at the Sanglokh Observatory

Content

Optical observations of the short-period comet P/2019 LD2 (Atlas) discovered in June 2019 were carried out in August 2020 at the Sanglokh International Astronomical Observatory (IAOS) of the Institute of Astrophysics of the National Academy of Science of Tajikistan with the Zeiss-1000 telescope using broadband filter R. The absolute brightness of the comet according to our measurements is 11.41±0.03m, the dust production parameter and the upper limit of the nucleus radius are estimated as 250±6.5 cm (at ρ=4.05″) and rmax=6.1± 0.1 km at albedo A=0.12, respectively. The distribution of brightness along the tail and dust tail structure were found. It is shown that the largest dust particles with a size of more than 100 μm are located near the surface of the comet's nucleus, and the size of the tail particles decreases with distance from the nucleus. Photometric data indicate that during the monitoring period, the comet was in a stage of normal cometary activity, associated mainly with the recent passage of perihelion. An analysis of the comet's orbit showed that it is indeed in the transition from the Centaur group to Jupiter family comet.

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Presenter: KOKHIROVA, Gulchehra

Track Classification: Astronomija/Astronomy

Contribution Type: poster presentation

Status: SUBMITTED

Submitted by **KOKHIROVA, Gulchehra** on **Friday, February 18, 2022**

Abstract ID : 3

Stellar radial velocities without spectroscopy

Content

Author: *Dainis Dravins, Lund University*

Radial motion of astronomical objects along the line of sight is normally measured as wavelength displacements of spectral lines, interpreting those as caused by the Doppler effect. However, wavelengths can be influenced by also other effects, why it is useful to explore alternative ways of measuring the physical motion.

This is possible with accurate astrometric measurements of stellar positions. In principle, one could obtain the stellar distance from its trigonometric parallax, repeat the measurement sometime later, and infer the stellar velocity from the change in distance. However, that method is still too difficult: even for the rapidly moving Barnard's star, the annual change of parallax is expected to be only 34 microarcseconds. While this effect should be (marginally) measurable by the Gaia satellite, it will not be practical for stars in general.

Another method measures how stellar proper motions change over time. For a star moving in the Galaxy, the proper motion corresponds to the angle under which its velocity vector is observed. For an approaching star, this angle increases over time and provides the relative change of velocity, which obtains an absolute value if the star's distance is known.

The accuracy of space astrometry is now adequate to determine such 'perspective acceleration'. Data from the current ESA astrometric satellite Gaia can be combined with results from the earlier epoch of Hipparcos to obtain radial velocities of many nearby stars. For 55 stars the uncertainty is below 10 km,s^{-1}, and for seven it is even below 1 km,s^{-1}. Some of these stars are white dwarfs, where the gravitational redshift amounts to several tens of km,s^{-1}, revealed as the difference between astrometric and spectroscopic radial velocities.

References:
L.Lindegren & D. Dravins: *Astrometric radial velocities for nearby stars*, Astron.Astrophys. **652**, A45, (2021); arXiv:2105.09014
K.Croswell: *Astronomers uncover new way to measure the speed of stars*, Proc.Nat.Acad.Sci. USA, **119**, e2122586119 (2022)

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Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **DRAVINS, Dainis** on **Friday, February 25, 2022**

Abstract ID : 4

Bright flares of navigation satellites

Content

Bright 3rd magnitude flare of the navigation satellite Kosmos 2419 was detected accidentally by author on October 10, 2021. Calculated brigthness of the satellite was approximately 13th magnitude. 19 hours of photographic observations were performed in total and 9 more navigation satellite flares were found in the range of 3rd to 7th magnitude. Causes and circumstances of the satellite flares were investigated leading to the conclusion that flares are caused by sunlight reflection from satellite solar panels when the satellite is near the antisolar point and its phase angle is small. Bright flares of the navigation satellites can interest astronomers because such object can be misidentified with Near Earth Asteroid. Excess brightness can also disturb satellite ranging observations of navigation satellites.

Primary author: VILKS, Ilgonis (Museum of University of Latvia)

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **VILKS, Ilgonis** on **Monday, February 28, 2022**

Abstract ID : 5

Institute of Astronomy of University of Latvia in 25 years

Content

Institute of Astronomy of University of Latvia was founded in 1997. In 2022 institute celebrates its 25th anniversary. Author is presenting a short overview of history of Institute of Astronomy highlighting its scientific, teaching, science communication activities, analyzing the achievements of institute staff. Institute of Astronomy was established by merging Baldone Radioastrophysical Observatory with the Astronomical Observatory of University of Latvia. It is one of the largest astronomical institutions in Latvia. Main research directions are investigation of carbon stars, observations of asteroids, satellite laser ranging and photonics. In all these fields technical upgrades were performed and remarkable accomplishments achieved.

Primary author: VILKS, Ilgonis (Museum of University of Latvia)

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **VILKS, Ilgonis** on **Monday, February 28, 2022**

Abstract ID : 6

Microwave observations of the Sun with VIRAC RT-32 radio telescope: Testing of the Low Noise Wideband Spectral Polarimeter

Content

An interest to various coronal hole-like structures associated with local open magnetic fields (“dark coronal corridor”, “coronal partings”, “small coronal hole”, “S-web”) as to one of sources of the slow solar wind is still growing up. Some part of structures of interest could be observed in microwaves as areas of reduced brightness temperatures below a quiet Sun ones at corresponding frequencies (LTR – Low Temperature Regions). Microwave spectral polarimetric observations of LTRs could offer some new possibilities for the spatial analysis of plasma parameters of coronal hole-like structures.

Taking into account a low contrast of LTRs its reliable microwave observations need some contradictory requirements for receiving equipment (wide dynamic range, enhanced signal/noise ratio and a long term stability). The newly developed solar spectral polarimeter which corresponds to these requirements have both circular polarizations and wavelength range of 2.1-7.5 cm (4.1-14.3 GHz) divided to 12 frequency channels. This spectral polarimeter is mainly expected for observations of eventual LTRs during the maximum of the solar activity in 2024-2025.

The presentation concerns on some test observations of the Sun with the new low noise wideband spectral polarimeter performed at VIRAC (Ventspils International Radio Astronomy Centre) RT-32 radio telescope in 2021.

Primary author: BEZRUKOVS, Dmitrijs (Ventspils International Radio Astronomy Centre)

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **BEZRUKOVS, Dmitrijs** on **Thursday, March 3, 2022**

Abstract ID : 7

Reconfigurable space object optical tracking system of GGI – the first results of observations

Content

The Institute of Geodesy and Geoinformatics (GGI) of the University of Latvia (UL) is focused now on configuring of the optical tracking system for positional astrometric observations. The system is eventually intended for both positional and laser ranging observations. It has Alt-Alt mount and consists of two 16″ F/10 receiving optical tube assemblies (OTAs) and a laser collimator. The instrument can contribute to the collection of observations of satellites, space debris and near-Earth objects (NEOs).

In this study the results of astrometric subsystem's tests for astrometric position determination are presented. The astrometry module supports near-real-time image acquisition and analysis, star image recognition, reference star selection and identification, astrometric processing of frame data using NOVAS astrometry package, object coordinate determination, frame stacking and star ephemeris calculation. Stars of magnitude up to 17-18 can be recognized by the software with an exposure duration of up to one minute. Frame stacking is proposed to increase this limit by several magnitudes.

The first results of observations have shown positioning accuracy up to 1′ in zenith area and up to 4′ at low elevation. The main source of position wandering presently seems to be some backlash in the main mirror attachment. After optimization of mount error model structure, and, possibly, reinforcements in OTA, the positioning accuracy of up to 5″-10″ is expected.

Project No: 1.1.1.2/VIAA/4/20/619.

Primary authors: HARITONOVA, Diana; ZARINS, Ansis; RUBANS, Augusts

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **HARITONOVA, Diana** on **Thursday, March 10, 2022**

Abstract ID : 8

EVN imaging of 3 variable sources IRAS 20126+4104, G90.925+1.486 and V645 Cyg

Content

We present results of a milliarcsecond precision study of 3 highly variable sources monitored by Irbene radiotelescopes. IRAS 20126+4104 two diverse trends of variability can be noted, first long term flux drop on blue shifted spectral features, second quasi-periodic fluctuations starting from April 2020 with a 40 days period. In combination with EVN images, we have found convincing evidence of raising accretion rate and pulsations of central YSO. Individual cloudlet morphology evolution during the last 15 years show complete structural changes in several coudlets and no difference in others. Regarding G90.925+1.486 our obtained images are first with few milliarcsecond restitution relieving maser cloud distribution and shapes. Noticeable result is a difference in a lost flux from two main spectral components. V645 Cyg shows very orienteering maser cloudlet distribution along North - South direction.

Primary authors: ABERFELDS, Artis (Ventspils University of Applied Sciences); SHMELD, Ivars

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **ABERFELDS, Artis** on **Sunday, March 13, 2022**

Abstract ID : 9

Image processing of asteroids and rotation period calculation from light curves

Content

Baldones Observatory plays an important international role in new asteroid discovery, as well as asteroid astrometric position publication in MPC circulars – more than 50 discoveries and more than 6000 asteroid astrometric positions where published in less than 4 years. To increase the extent of information about these asteroids, physical properties can be calculated. One of the most important ones – asteroid rotation period.

To precisely calculate rotation period, accurate time-resolved photometry is needed. To achieve precision of 0.03^m, the following was done: each sky region was observed for at least 3 days. The images were processed in "MaxIm DL", "Astrometrica" and "Lemur" (new generation of "CoLiTec") to reduce data, make brightness and position measurements and do differential photometry. In parallel, a program in Python is developed to do the same things specifically for the needs of Baldone Observatory. All astronomical objects can be extracted from the image, background noise can be estimated and relative brightness can be measured autonomously with the program.

For data to be usable, corrections must be made. As objects in time have different distances from the observer and Sun, they are reduced to unit geocentric and heliocentric distances. The time for light to reach the observer also changes relative to distance to observer, so light time corrections are made. For measurements to be in phase, phase corrections is also applied. After that rotation period is calculated using Fourier series, iterating through guesses of periods, and finding the best guess by r squared. To test the program, "The Asteroid Photometric Catalog" was used. For every asteroid the calculated period was compared with published periods. The testing program is also autonomous and can be used for different databases with small changes in the program.

Primary author: NAGAINIS, Kristers (University of Latvia Institute of Astronomy)

Co-author: EGLITIS, Ilgmars (Institute of Astronomy, University of Latvia)

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **NAGAINIS, Kristers** on **Monday, March 14, 2022**

Abstract ID : 10

CORONAL MAGNETOGRAPHY OF A SUNSPOT SURROUNDED BY MAGNETIC FLUX OF OPPOSITE POLARITY

Content

Sunspots surrounded by magnetic flux of opposite polarity give rise to a set of specific dome-shaped magnetic field lines and to regions of quasi-transverse (QT-) propagation of microwaves. As a result, the changes of microwave polarization in such QT-regions do not meet the regularities deduced for bipolar active regions passing across the solar disk. We recognize the effects of QT-propagation and present the analyses of polarization transformations in sunspot-associated microwave sources. These sources observed with radio telescopes are proven to be of fan-spine topology. We reveal some relations between the wavelength at which the depolarization is observed and the coronal field at the top of the fan-spine magnetic configuration. We confirm that these structures of the fan-spine configuration are robust and can be represented by potential field models. The potential-field representation is consistent with both the radio and EUV observations.

Primary authors: RYABOV, Boris (Ventspils International Radio Astronomy Center); Dr VRUBLEVSKIS, Arturs (Ventspils International Radio Astronomy Centre)

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **RYABOV, Boris** on **Tuesday, March 15, 2022**

Abstract ID : 11

Pulsar observations with VIRAC LOFAR station and nonlinear electrodynamics

Content

Authors:*Jānis Šteinbergs, Kristaps Veitners and Jesus A. Cazares*

According to classical electrodynamics, the energy flow from a pulsar can be a combination of its dipole radiation and an outflow of particles. However, the rate of change of rotational kinetic energy

$(\frac{1}{2}I\Omega^2)t = I\Omega\dot{\Omega} = \frac{2}{3}M^2 \sin^2 \alpha \Omega^4 c^{-3}$

is often different. It has been several attempts to get a more accurate expression. Using the Born-Infeld theory for the non-linear electrodynamics, we pretend to get a model that fits with the observations.

In the last few months, at VIRAC, we installed LOFAR and MPIfR Pulsare (LuMP) Software on VIRAC servers. We have already started to run test pulsar observations with the VIRAC LOFAR station. We aim to first use the freely available pulsar data from the Australia Telescope National Facility (ANTF) catalogue to develop and verify a nonlinear electrodynamics model. The most important parameters for us are Flux, Rotation and Dispersion measures, the magnetic field and pulsar galactic coordinates. If the model proves to be successful in characterising pulsar emission, we will try to extend it and apply it to our own pulsar observations.

In our presentation, we will show 1) a preliminary study of nonlinear electrodynamics metrics for pulsar data, 2) preliminary results using ANTF catalogue (Maxwell theory) and 3) also we will show our technical progress with pulsar observations of the VIRAC LOFAR station.

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Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **ŠTEINBERGS, Jānis** on **Wednesday, March 16, 2022**

Abstract ID : 12

Study of peculiar radio galaxy “Perseus A” in radio and optical bands

Content

Massive radio galaxies associated with clusters or groups of galaxies often exhibit unusual properties, both in variability and in angular VLBI structure, and in activity of relativistic jets. This is explained by presence of gravitational interaction of such galaxies with cluster neighbors, possible absorption of other galaxies in the past, as well as presence of extensive gas envelopes-halos in clusters.

During 2021 the collaborative project “Joint Latvian-Ukrainian study of peculiar radio galaxy “Perseus A” in radio and optical bands” was conducted. In the framework of this project observations and studies of fast (intra-day, intra-night) radio and optical variability of the Perseus A radio galaxy (NGC 1275), which is associated with the 3C 84 radio source, were carried out using the radio telescopes RT-32 and RT-16 in Latvia (VIRAC) and the radio telescope RT-32, which is located near Zolochiv city in Ukraine. At optical observations: optical telescopes of the observatories were involved: Baldone (Latvia) - the Schmidt telescope with a mirror 1.2 m in diameter, Vihorlat (Slovakia) - the VNT telescope with a mirror 1 m in diameter, Mayaki (Ukraine) - the AZT-3 telescope with a mirror 48 cm in diameter.

Such a coordinated program for studies of rapid AGN variability with telescopes located near the same meridian has never been carried out before. Studied elliptical Seyfert (Sy II type) radio galaxy Perseus A (NGC 1275) is of great interest because it is located in the giant cluster of galaxies Perseus (Abell 426). This X-Ray cluster is one of the brightest in the Northern sky. The Perseus A galaxy has a filamentous structure in front of it, which may be a remnant of another galaxy, being swallowed up, possibly a large satellite. This circumstance increases the probability of presence of a double supermassive black hole in the galactic core. Based on long-term observations on VLBI systems, as well as single antennas, it was shown that radio source 3C 84, which is associated with this radio galaxy, has a jet precession. Observed precession period is about 40 years or more. This source is actively observed in the X-Ray and Gamma ranges, where long-term data series have been obtained. In addition, its fast flare activity is studied in the high energy ranges, including intra-day time scales. The purpose of this study is to fill an existing gap in research and to study properties and features of fast (from several days to several hours) variability of 3C 84.

As a result of radio observations, it was found that activity of the radio source 3C 84 is not constant. Source emission mode has quiet and active phases. In the active phases, significant variability is recorded (both irregular and, less often, cyclic) with characteristic times of several hours. In quiet phases, 3C 84 has no significant variability.

Radio source 3C 84 was previously found to have a cross-correlation between the data in the radio and gamma bands with a delay of about 400 days. However, a cross-correlation between radio and optical data for 3C 84 has not yet been found. According to the research data of our Project, the characteristic times of intensity variations in the radio and optical ranges practically do not coincide, and there is no cross-correlation of intensity variations. Perhaps, this is due to the fact that 3C 84 is at a minimum of long-term activity. In our work for signal recordings on two antennas, cross-spectral analysis shows that in some sessions of quasi-simultaneous observations on the RT-32 Zolochiv and RT-32 VIRAC antennas, the presence of variations with a characteristic time of about 6 hours is detected. At the same time, duration of the obtained time series was not enough for unambiguous registration of this phenomenon. Manifestation of a quasi-period of approximately an hour duration was recorded from observations in Irbene, Latvia for 2 days. For

example, on March 15 and 16, 2021, at a frequency of 6.2 GHz, the cross-amplitude spectrum had a maximum corresponding to the characteristic time of flux density variations about 1.2 hours. This confirms that observed rapid fluctuations in the flux density at the 3C 84 source on a time scale from 1 hour to several hours are real, since they were recorded at two observatories in Ukraine and Latvia, on the same days.

As a result of intensive observations of the radio source 3C 84, which were carried out from the end of 2020 to the autumn of 2021, at radio telescopes in Latvia and Ukraine, it was found that the radio source 3C 84 really has intra-day variability in the centimeter radio range, with characteristic times from 3 to 8 hours. This is confirmed by observations on three radio telescopes, two 32-meter in Ukraine and Latvia, and 16-meter in Latvia, located at a great distance from each other (about 1000 kilometers). At the same time, faster variability of the radio source 3C 84, with characteristic times less than 3 hours, is very likely caused by ionospheric disturbances.

As a result of optical B, V, R, I observations, light curves of 3C 84 were obtained, with the longest duration from November 5, 2020 to March 25, 2021 (Vihorlat, Slovakia), and from October 11, 2020 to April 10, 2021 (Mayaki, Ukraine). Observations of 3C 84 at Baldone (Latvia) were made on 5, 7, 11, 12, 15, 17, 18, 19, 27 February 2021 and 2, 4, 5, 19, 21 March 2021. On 11 Feb 2021, a significant intra-night occurrence was recorded source variability 3C 84, with characteristic times of 10.3 and 1 hour. Also, assumed inta-night variability was recorded on Mar 2 and Feb 18, 2021, with characteristic times of 7.8 hours, 54 minutes (Mar 2) and 4.8 hours, 1.5 hours (Feb 18). According to the light curves of 3C 84 obtained at the Mayaki and Vihorlat observatories, it was found that the brightness of 3C 84 varies cyclically with an average quasi-period of 15.3 days (Vihorlat) and 16.6 days (Mayaki), with an amplitude of about 0.05 mag. These close results confirm that a cyclic change in the brightness of 3C 84 was indeed detected at two observatories, over almost the same observation time interval.

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Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Comments:

Keywords: radio galaxy, galaxy cluster, multicolor photometry, variability, radio telescope, double galactic nuclei, spectral-correlation analysis

Status: SUBMITTED

Submitted by **BEZRUKOVS, Vladislavs** on **Thursday, March 17, 2022**

Abstract ID : 13

Struve arc" as indicator of the Space Weather - first results

Content

The Struve Geodetic Arc is a chain of survey triangulations stretching from Hammerfest in Norway to the Black Sea, through 10 countries and over 2,820 km, which yielded the first accurate measurement of a meridian arc.
The research was named "Struve's Cosmic Arc" in honor of the outstanding international project of the 19th century "Struve Geodetic Arc", which united scientific, technical and intellectual resources of different countries to study the shape of the Earth. It included 265 triangulation points with length of more than 2820 kilometers (from Hammerfest city, Norway through Sweden, Finland, Russia, Estonia, Latvia, Lithuania, Belarus, Moldova and Ukraine to the Black Sea coast). Research was carried out to determine parameters of the Earth, its shape and size. Measurements under the Struve Geodetic Arc Project were carried out for 40 years (from 1816 - 1855) under guidance Director of Pulkovo Observatory Friedrich Georg Wilhelm Struve.
The aim of this project is to study the nature of the influence of space weather effects depending on the latitude and regional features of the geomagnetic field (regular field and magnetic anomalies) in the "Latvian" and "Ukrainian" parts of the Struve Arc.
In the study several parties are involved: Latvia (Ventspils International Radio Astronomy Centre (VIRAC) of Ventspils University of Applied Sciences (VUAS), Ukraine (Institute of Radio Astronomy of the National Academy of Sciences of Ukraine (IRA NASU) – Odessa observatory "URAN-4", Institute of Geophysics of the National Academy of Sciences of Ukraine (IGP NASU), Kiev, Institute of Physics and Mechanics of the National Academy of Sciences of Ukraine (IPM NASU) – observatory "URAN-3".
Main infrastructure involved in this study: VIRAC - radio telescopes 32-m and 16-m antenna in centimeters and decimeter range and LOFAR in 10 - 220 MHz range; RI NANU – radio telescopes "URAN-4" (Odessa); "URAN-3" (Lviv); IGP NANU – magnetic observatory (Odessa, Kiev, Lviv).
It is expected to investigate several phenomena's:

- Effects of extreme states of solar and geomagnetic activity.
- Calculations of models of multiple correlation dependence of cosmic radio source fluxes on the main indices of solar and geomagnetic activity.
- Changes in the fluxes of space radio sources in the solar cycle.
- Detection of the effects of the passage of the lunar tidal wave according to the data of flickering space radio sources.
- Results of manifestations of geomagnetic activity in the zone of Odessa magnetic anomaly.

In the project, for research response of space "Struve arc" to Solar activity, will use existing basis of joint Latvian-Ukrainian cooperation, in form of long-term monitoring ionospheric scintillations of powerful space radio sources (over Latvia and Ukraine), and monitoring geomagnetic variations in areas of normal and anomalous magnetic field of the Earth (including Latvia), it is planned to study in detail manifestation "space weather", during growth phase and maximum of the 25th cycle Solar activity.

Primary authors: STRAKHOV, Yevhen (Odessa I. I. Mechnikov National University); BEZRUKOVS, Vladislavs (Engineering Research Institute Ventspils International Radio Astronomy Centre (ERI VIRAC) of Ventspils University of Applied Sciences (VUAS))

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Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Comments:

Keywords: "Struve arc", Space Weather, radioastronomy, Solar activity, LOFAR, URAN.

Status: SUBMITTED

Submitted by **BEZRUKOVS, Vladislavs** on **Thursday, March 17, 2022**

Abstract ID : 14

Multi-messenger investigations of a sunspot as a source of slow solar wind

Content

We present complementary research of the AR 8535 sunspot magnetic field structure and atmosphere. We establish the existence of open field line structures in agreement with EUV observations, identify corresponding solar wind features in near-Earth measurements from the *Advanced Composition Explorer* (ACE) spacecraft, and construct a sunspot atmosphere model that includes an open field line component and qualitatively reproduces the observed reduced microwave brightness temperature in the northern part of the sunspot in *Very Large Array* (VLA) observations from 13 May 1999. These investigations motivate further research of similar ARs as sources of slow solar wind using the current state-of-the-art probes *Solar Orbiter* and *Parker Solar Probe* and the proposed *Frequency Agile Solar Radiotelescope* (FASR).

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Co-author: RYABOV, Boris (Ventspils International Radio Astronomy Centre / Ventspils University of Applied Sciences)

Track Classification: Astronomija/Astronomy

Contribution Type: oral presentation

Status: SUBMITTED

Submitted by **VRUBLEVSKIS, Arturs** on **Thursday, March 17, 2022**

Abstract ID : 15

The «Lemur» service for the high-precision processing of observations of asteroids, satellites and variable stars.

Content

LEMUR intraframe processing has five modules: brightness equalization and cosmetics, frames segmentation, estimation of parameters of objects images, matched filtration of images, frames identification and astroreduction.
LEMUR interframe processing has four modules: detection of fast, slow and non-zero motion, detecting satellites GEO, MEO and LEO fast, accurate and mass photometry.
The module of "Brightness equalization and cosmetics": compensates uneven sensitivity and defects of the CCD-camera, eliminates illumination from extraneous light sources (lights, passing cars), as well as uneven illumination of the frame at "dawn" or near bright stars, which allows dispensing with flat frames, the use of aligned in brightness frames significantly reduces the errors in detection and parameters estimation of objects images.
The module of "Frames segmentation": determines the set of CCD-camera pixels that correspond to the images of the objects in the frame, uses a complex of classical and original segmentation methods with their adaptive automatic selection for each frame and segment in it, classifies objects images into "circular/extended", and also selects "anomalous pixels", forms segments for objects with small size and for images of large stars with diffraction stretches, forms segments for super-extended objects.
The module of "Parameters estimation of objects images": determines the exact rectangular coordinates of objects, instrumental brightness, signal-to-noise ratio, length and other image parameters, analytical parameters estimation of circular and extended images of objects before and after the matched filter, parameters estimation of the images of the objects with an analytically undefined profile, instrumental brightness estimation of circular and extended images.
The module of "Matched filtration of images": selects images of faint stars and objects, reduces the number of false objects, matched filtration is implemented for images of objects: circular (frames with daily tracking), extended and with an analytically undefined profile (frames without daily tracking).
The module "Frames identification, astrometry, photometry": find the correspondence between stars images in frame and data of modern star catalogs, forms a catalog of objects motionless in a series of frames, establishes an analytical relationship between the rectangular frame coordinate system and the international reference coordinate system ICRS, photometry: establishes an analytical connection between instrumental brightness and brightness in the selected star catalog, linear, cubic and fifth-degree astrometric reduction models are available, automatic selection of astrometric reduction model is implemented, robust automatic selection of reference stars is implemented.
The module of "Detection of moving objects with near-zero apparent motion": Detects objects with almost imperceptible visible movement (commensurate with errors in position estimation of objects), including objects approaching the Earth at large distances.
The module of "Detection of fast moving objects": detects objects with images blurred by their own motion, discovers NEO when they are approaching the Earth, detect satellites in daily tracking mode.
The module of "Detection of moving objects in normal speed range": detects and discovers comets, asteroids and satellites in automated mode, uses the method of light-collecting, which allows energy accumulation of the images of the objects along trajectories with unknown parameters, allows to see very faint and hardly observable objects, for observation of which by traditional methods it is necessary to increase the observing potential in several times.
The module of "Accurate photometry": allows the accurate light curves creation of variable stars, allows forming a list of comparison stars only once for their subsequent usage in all observations, do mass photometry for all stars in frame with specified properties.
The Module of "Visual control of results": visualization of a series of frames and detected satel-

lites, comets, asteroids, automated satellite measuring in a series of frames: it suffices to mark the satellite in two frames, after which its measurements will be done automatically in the remaining frames with ability to control, analysis of satellite measurements in a series of frames: visualization of measurements, reports generation with measurements of asteroids and satellites in the international formats, make identification of detected asteroids and comets from MPC data allows to quickly make a decision about the possible presence of new asteroids and comets in series of frames.

Test results at the Baldone Astrophysical Observatory on the more than 900 CCD images processing ba

LEMUR is one of the best software for automatic multithreaded data processing of astrometric and photometric optical observations. Implemented as a service and independent standalone/local/built-in/corporate software with a high level of data processing automation due to the many years of experience of astronomy professionals and developers. Relieves the observer's stress by removing the operations such as manual frames comparing for objects detection and much more.
LEMUR can organize automatic detection of moving objects and light curves on frames from many telescopes. Help create a moving object detection and automate your observations.

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Multi channel detector system for laser ranging telescope LS-105

Content

A new detector unit has been developed, manufactured and installed on the LS-105 laser telescope within the framework of the ESA project "Development of a multistatic laser location for space waste at the laser location station Rīga1884". It has 3 channels. A photomultiplier (PMT) and a hybrid photodetector (HPD) operate on the 532 nm Nd-YAG laser line with a bandwidth of 2 nm. The bandwidth can be reduced to 0.15 nm with an ultra-narrowband interference filter. At the end of the longest waves in the visible spectrum range (above 540 nm), a ZWO astrocamera is installed for telescope adjustment, which in principle can also be used for tracking control. The hybrid detector has not been used in laser location practice so far. Its characteristics (quantum efficiency up to 45% at $\lambda = 500 - 550$ nm, single photon response time 600 ps, pulse rise time 400 ps) suggest that it has very good potential in this field; it is the closest task to evaluate it at practical SLR performing. All routine operations with the detector – field of view reducing, signal attenuation, channel switching – can be performed remotely. The stability of the detector performance is ensured by a thermostat system that maintains the temperature in the detector housing with an accuracy of ± 0.2K. This work was supported by the European Regional Development Fund Nr. 1.1.1.1/20/A/076. and ESA Contract No. 4000131217/20/NL/SC.

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