LARGE SURVEYS WITH SMALL TELESCOPES

Past, Present, and Future (Astroplate III)

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ABSTRACT BOOKLET

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Digital Transformation of Cultural Heritage: Exploring and Curating Historical Resources

Andrea Rapp

The Arts and Humanities are among the early adopters of computer technology. In the late 1940s, the linguist and Jesuit Father Roberto Busa S.J. convinced Thomas J Watson and IBM that the exploration of Thomas Aquinas' works could be more efficient using new digital methods. The index Thomisticus and the Corpus Thomisticum - a digital lemmatized collection of all works of Thomas Aquinas have gone through all phases of technological development - via punched cards, magnetic tapes and the WWW - and are still accessible today. Since then, a multitude of artifacts and resources have been digitized, so that by now although only a fraction of the entire cultural heritage is digitally available, a critical mass for the development of digital research methods nevertheless exists. The talk will show exemplary which strategies Digital Humanities use to generate, interlink and explore knowledge from historical sources.

Astronomical Photographic Archives: Past, Present, Future

Rene Hudec

There are more than 10 millions astronomical photographic negatives (glass plates and planfils/films) worldwide. Most of them represent stellar fields and solar images, but there are also numerous negatives with other celestial objects. There is large variety of these negatives (wide field and narrow field direct images, multiple images, low dispersion and high dispersion spectra etc.). I will give review and discussion of these databases including recent progress in their digitization and scienfic use.

Making Full Use of Astronomy's Rich Photographic Heritage

Elizabeth Griffin

We all know that Astronomy has a wonderful, rich, diverse but distributed heritage of photographic plates, counting into the millions. Most are well ordered, and in a reasonable (though often rather questionable) state of preservation. As such, they are the envy of many other natural sciences. But Astronomy's heritage data are generally unstaffed, lack routine monitoring and care, and lack any future if they stay as they are. Some efforts are now being made, and some of the collections are being, or have been, digitized in some manner; Harvard is making good progress with digitizing the biggest of all collections with a purpose-built machine. But there are many other collections, in various countries, with no future, and if nothing is done on a global scale we risk losing a great deal of unrepeatable science. Positive action on that global scale is needed as a matter of urgency, before the expert knowledge about handling and interpreting photographic observations is no longer available to us. This paper will describe what is being discussed to those ends, and seeks space for a plenary discussion as to what is feasible.

The photographic heritage of astronomy in Bonn

Michael Geffert

From the beginning of the photographic observations by Küstner in Bonn at 1900 it was planned that future astronomers may use these data for the determination of proper motions. This idea was realised by astronomers of Bonn starting in 1981. Their efforts resulted mainly in determinations of proper motions of stars in open and globular clusters. Moreover, astronomers from Hoher List observatory took plates for the search of variable stars.

We give an overview of the projects using photographic plates of Bonn university and other telescopes like the famous observations of the Carte du Ciel.

Sternberg Astronomical Institute's plate collection: the present and future of its scientific use

Nikolay Samus

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The astronomical plate collection of Moscow Observatory (now P.K. Sternberg Astronomical Institute, SAI, of M.V. Lomonosov Moscow University) was founded by Prof. S.N. Blazhko in 1895. The latest sky photographs in the collection were taken in 2005. The total number of direct sky photographs, obtained with different telescopes and kept at different SAI departments, is estimated as 60000. The most valuable and actively used of them are 22300 direct plates taken in 1948–1996 with the 40-cm (f = 160 cm) astrograph, each covering a 10 by 10 degrees sky area down to a typical limiting magnitude of B=17. Digitization of these plates is under way since 2006. We use scans of star fields to discover and study new variable stars of the MDV ("Moscow Digital Variable") series. By 2018, we published discovery announcements for MDV 1 – MDV 870. A part of these data were used to compare the results of automatic variable-star classification and traditional classification performed by experts. A large fraction of our new discoveries turn out to be in Gaia DR2 variable-star lists. However, the Gaia team has not yet published their results for eclipsing stars (apparently because of difficulties of reliable period determination resulting from Gaia sampling). With the advent of Gaia and other deep time-domain surveys, the focus of our work may shift from identification of new variable stars to a study of their secular behavior including period variations, changes of mean brightness, etc. Our software is inefficient in detecting transient phenomena (objects that stay below the plate limit most of the time). We are looking for better solutions. Other parts of the SAI plate collection may be useful for astrometry and for discovering transient events in the M31 and M33 galaxies.

Records from the past: variable stars from the Asiago plate archive

Roberto Nesci

Direct plates archives may be used to remeasure stars which were the target of the observations or to look at other stars discovered to be interesting only at a later time. I present here two cases: a search for Long Period Variable (LPV) stars on IR plates, and a search for past outbursts of a recently discovered cataclismic variable. Long period red variables (LPV) have been searched in a collection of Schmidt plates of the Asiago Observatory taken in the I band, centered on Gamma Cas and covering the years 1967-1975. These plates were not used by the original investigators. Digitization was made at the Perugia University and analysis was performed with the PyPlate software developed for the APPLAUSE project. Twentyone variables were found, nearly doubling the number of presently known variables in the field. Ten stars have Mira light curves, two of them with marked double period. Spectroscopic follow-up gave a large fraction of Carbon stars (7/21) and of S-type stars (6/21). Blue plates of the same field were also taken in pair with the IR ones and I have used them to explore the past behaviour of ASASSN-18aan, a CV variable recently discovered robotically. Thre past flares were identified and a possible recurrence time scale of about one year was found.

Photographic and Digital Surveys at Sonneberg Observatory

Peter Kroll

Sonneberg Observatory run photographic sky surveys (Sky Patrol and Field Patrol) from 1923 through 2010, the plates of which have mostly been digitized. The goal of continuation of the surveys by digital means has gradually been realized by fish-eye cameras and small telescopes monitoring of selected fields. The talk provides a brief overview on current scanning, observing and analysing activities.

The APPLAUSE-Project: The plate archives

Ulrich Heber, Detlef Groote

The Dr. Remeis-Sternwarte in Bamberg, the Leibniz-Institut für Astrophysik, Potsdam and the Hamburger Sternwarte host important astronomical plate archives. Astronomers from those institutions teamed up to digitize their archives, calibrate and integrate them into the publically available database APPLAUSE. In an international collaboration also the plate archive of the Tartu observatory was included. Here we briefly describe the instrumentations used and the history of the plate archives of the collaboration.

Impact of the ASAS-SN survey and the Moscow's photographic plates archive on the nature of the emission line star HBHA 1704-05

Augustin Skopal

The star HBHA 1704-05 was originally classified as an emission-line star (Kohoutek and Wehmeyer, 1999). On the basis of The All Sky Automated Survey for SuperNovae (ASAS-SN), the object was cataloged in the VSX as an semi-regular variable with a periodicity around 418 days. At the beginning of August 2018, the ASAS-SN survey indicated a rapid brightening of the star. Following high-cadence photometric and spectroscopic observations clarified the nature of HBHA 1704-05 as a symbiotic star in outburst. Monitoring the object within the ASAS-SN survey for around 3.5 years revealed a wave-like variation with the amplitude DV $\sim$ 0.7 mag and a period of $\sim$ 495 days. Our close inspection of the Moscow's photographic plates archive revealed another 2-mag outburst of HBHA 1704-05 lasting from 1968 to around 1990, during which a regular variation with the same period and phase, but amplitude of $D(m_{pg}) \sim 1$ mag, emerged. These properties support the nature of HBHA 1704-05 as a symbiotic binary with the orbital period of 495 days. Close similarities with other symbiotic systems are briefly discussed.

Long-term activity of cataclysmic variables and related objects (large amplitude features)

Vojtech Simon

Cataclysmic variables and their relatives (low-mass X-ray binaries) are very active objects. We summarize the dominant features of their activity. We show that monitoring by various types of instruments is necessary to detect the events (e.g. outbursts, transitions between the high and low states) which are often unpredictable. Histograms of brightness provide us with the properties of activity of various types of such objects. Photographic monitoring spanning for about a century enables to study the properties of the light curves. We also show how the photographic light curves can be combined with the CCD and visual observations. The long monitoring also shows that the activity of some objects dramatically changed during several decades. We also briefly summarize the astrophysical interpretations of the long-term activity.

Digitized photographic plate photometry with VaST software

Kirill Sokolovsky

Photographic emulsion is a non-linear light detector which makes it difficult to perform photometry with digitized plates using conventional software. Inexpensive flatbed scanners (often used to digitize plates) provide image quality acceptable for photometry, but introduce complex image distortions (notably, the hacksaw pattern) that complicate astrometry and source identification. VaST is a photometry package designed from the ground up to handle such images. It relies on SExtractor for source detection/photometry, matches source lists derived from plates exposed at different epochs and cross-calibrates their magnitude scales to construct lightcurves of all the detected objects. An array of statistical methods can be applied to these lightcurves to identify variable objects. Accurate celestial positions of variable objects are measured by using nearby sources to compute local corrections to the approximate plate solution obtained with Astrometry.net. VaST is used mostly with the Moscow collection plates, but is intended to be a general-purpose tool for lightcurve extraction from a series of digitized photographic images.

PyPlate: a software package for processing digitized astronomical photographic plates

Taavi Tuvikene

Digitizing an archive of photographic plates yields a set of image files and accompanying metadata files. To handle and process these data efficiently, we have developed a Python package PyPlate. PyPlate provides methods to read data from CSV and FITS files, to make calculations with various observation timestamps, to create consistent and easily readable FITS headers, to write plate metadata into a database, to extract sources from plate images, to carry out astrometric and photometric calibration on the extracted sources, and to output the source data to a database or files on disk. We will show how the PyPlate software was used for building the APPLAUSE database and discuss how it can be applied elsewhere.

False-positives detection with convolutional neural networks

Gal Matijevic

Digital scans of photographic plates are more complicated to handle in comparison to the CCD frames. Due to their fragile nature and age they are subject to several effects that act as a source of false-positive detections. Among these effects are surface dust speckles, scratches, emulsion damage, and writing traces. Besides those the optical systems used to acquire the images come with their share of aberrations which make the removal of false-positives harder. The APPLAUSE database already consists of a few billion detected sources, many of which are not of astrophysical nature. Their detection and / or removal is very important for practical purposes but it is obviously not a trivial task. We will present a convolutional neural network based pipeline that efficiently and quickly weeds out the false-positive detections and is also capable of assigning false-positive probability to individual sources in less clear-cut cases. Our plan is to use its output in the next APPLAUSE data release.

The APPLAUSE archive: concept, building with PyPlate, and hands-on tutorial on usage

Harry Enke

In this three-part session we (T. Tuvikene, H. Enke) will first present the concept of the archive, describe its building blocks and features.

The second part of the session is devoted to the PyPlate software, a Python package developed for handling and processing digitised photographic plates. We will show how it was used for building the APPLAUSE archive and discuss how it can be applied elsewhere.

During the hands-on session, the third part, we will explore various methods of accessing the APPLAUSE database, from browsing the image viewer and using simple forms to submitting SQL queries and writing scripts. We will show how to combine data from different tables in order to write efficient queries. All participants are welcome to try the examples.

Astrometric Surveys: from photographic plates to CCDs

Norbert Zacharias

A review is given about astrometric, ground-based surveys including plate measure machines and CCD techniques. The Astrographic Catalogue project of around 1900 was the first of its kind, followed by AGK2, AGK3, Palomar and other Schmidt plate surveys and modern astrographs dedicated for astrometry (Hamburg, USNO). The full potential of those surveys could only recently be realized using accurate plate measure machines (PDS, NOFS, StarScan, DAMIAN). The UCAC project was the first all-sky astrometric survey performed using a CCD detector, while the URAT program was the last such ground-based effort.

One Million Variable Stars from the OGLE Survey

Igor Soszynski

The Optical Gravitational Lensing Experiment (OGLE) began in 1992 and it has now become one of the world's largest optical surveys devoted to searching for variability in the sky. During its long history, the OGLE survey collected about one trillion individual photometric measurements for over two billion stars in the Milky Way and in nearby galaxies. These data has led to many discoveries in various fields of astronomy: gravitational lensing and microlensing, extrasolar planets, structure of galaxies, cosmic distance scale, Kuiper belt objects, etc. Variable stars occupy a special position among the most important achievements of the survey. The OGLE Collection of Variable Stars currently contains nearly one million objects of various types and this is the largest set of variable stars ever obtained by any astronomical project. I will present the most spectacular OGLE discoveries in the field of variable stars.

Robotic astronomy with the Las Cumbres Observatory

Yiannis Tsapras

The Las Cumbres Observatory (LCO) is an independent, non-profit foundation dedicated to time-domain astronomical observations at optical wavelengths. To this end, LCO has constructed a homogeneous world-wide network of 21 robotic telescopes, which includes the two 2m Faulkes telescopes, 9×1m telescopes, and 10×40cm telescopes. The telescopes are outfitted for imaging and spectroscopy at wavelengths between the atmospheric UV cutoff and the roughly 1-micron limit of silicon detectors.

The Dragonfly Telephoto Array: Exploring the Low Surface Brightness Universe

Allison Merritt

The Dragonfly Telephoto Array, comprised of 48 individual Canon telephoto lenses operating together as a single telescope, provides an innovative approach to low surface brightness imaging. Sub-nanometer coatings on each optical element reduce scattered light from nearby bright stars and compact galaxy centers — typically a key obstacle for integrated light observations — by an order of magnitude, and Dragonfly's large field of view (2 x 2.6 degrees for a single frame) provides a large-scale view of the low surface brightness skies. I will introduce Dragonfly, and present highlights from both past and ongoing deep optical surveys. Finally, I will provide a preview of our team's upcoming survey and instrumentation plans.

The Evryscope: Science from the First Full-Sky Gigapixel-Scale Telescope

Brad Barlow

The Evryscope, built by astronomers at the University of North Carolina, was deployed at CTIO in May 2015 and represents the world's first full-sky gigapixel-scale telescope. With its 24 separate individual telescopes sharing a common mount, the system images an 8000 square degree field of view once every two minutes. The Evryscope has been building 1%-precision, high-cadence light curves for all accessible objects brighter than 16th magnitude since August 2016 and will continue to do so for several more years. With the final Evryscope reduction pipeline having just been completed, multi-year light curves are now being produced for millions of Southern-hemisphere stars. Here I present an overview of the telescope's design and performance, and I discuss early science results with a focus on M dwarf flares, variable hot subdwarf systems, exoplanet discovery & characterization, and optical transients.

An introduction to the Zwicky Transient Facility

Thomas Kupfer

The Zwicky Transient Facility began its 3 year time-domain survey in March 2018, using its camera with a 47 square degree field on the Palomar 48-inch Schmidt telescope. As part of the its surveys, ZTF carries out high-cadence observation of selected Galactic fields as well as moderate cadence observations of a 3000 square degree field at higher declination. Additionally, 40% of ZTF observing time is dedicated to two public surveys: one covering the entire Northern sky every three nights in g and r passbands and one visiting the Galactic Plane every night in g and r. Real-time transient alerts from these surveys have been public since June 2018 and the first release of archival imaging and time series data is scheduled for Summer 2019. In this talk I will describe the survey and present some early results.

An Occultation Network as a Detector of Distant Solar System Objects

Malena Rice

We discuss the feasibility of and present initial designs and cost estimates for a large (N 2000) network of small photometric telescopes that is purpose-built to monitor V<15 Gaia Mission program stars for occultations by minor solar system bodies. The implementation of this network would permit measurement of the solar system's tidal gravity field to high precision, thereby revealing the existence of distant trans-Neptunian objects such as the proposed "Planet Nine". As a detailed example of the network capabilities, we investigate how occultations by Jovian Trojans can be monitored to track the accumulation of gravitational perturbations, thereby constraining the presence of undetected massive solar system bodies. In particular, we show that the tidal influence of Planet Nine can be discerned from that of smaller, nearer Kuiper belt objects. Moreover, ephemerides for all small solar system bodies observed in occultation could be significantly improved using this network, thereby improving spacecraft navigation and refining Solar System N-body modeling. Finally, occultation monitoring would generate direct measurements of size distributions for asteroid populations, permitting a better understanding of their origins.

Asteroids monitoring with 1.2m Baldone Schmidt (code 069) telescope.

Ilgmars Eglitis

Current data. CCD observations of the asteroids are obtained with the 0.80/1.20 m, f/3 Baldone Schmidt telescope of the Baldone observatory (code 069) of the Institute of Astronomy of University of Latvia. Now the telescope is equipped with two CCD STX-16803 36 × 36 mm cameras. In the Minor Planet Circulars and the Minor Planet Electronic Circulars we published 3511 astrometric positions of 826 asteroids. Among them, 48 asteroids were newly discovered at Baldone. For 36 of these asteroids the precise orbits were calculated. The orbits and the evolution of orbital elements of two interesting asteroids, (428694) 2008 OS9 from the Apollo group and the Centaur (330836) Orius (2009 HW77), were recalculated including new observations obtained after 2011.
From the earliest years of data. The archive of Baldone Schmidt telescope contain more than 22 000 direct wide fiield images. Digital processing of photographic plates of star field allow, in addition to the main tasks to carry out a massive search for images of small bodies of the solar system and determine their coordinates. From the observations of earlier epoch, we can extract information about the locations of these bodies well before discovering them. Modern approach to processing early photographic observations with new technologies can be an effective instrument for rediscovery of asteroids and obtain correction their orbits. We analyzed the results of observations of clusters in UBVR bands and some ultraviolet plates of other star fields made on the 1.2-m Baldone Schmidt telescope.

At the moment, all images of known minor planets on 70 plates with 9.8 - 17.1 stellar magnitude were identified. The catalog of positions and magnitudes of the searching asteroids was compiled. Among them are detected positions for 10 asteroids which at the time of observation were the earliest of the world's known observations of these asteroids. All asteroids positions were compared with the ephemeris JPl DE431.

Observatorium Wendelstein - Status, Use and Future Strategy

Ulrich Hopp

We will describe the capabilities of the Observatorium Wendelstein (University of Munich,LMU), mainly of its 2m telescope with its three operational imaging and spectroscopic instruments. We will describe their performances based on a few science examples, partly survey type programs. Finally, we will discuss strategies how to benefit from the Wendelstein Observatory in times of up-coming new major astronomy resources.

Surveying exoplanets across the spectrum - following the TraCS of exoplanets

Christian Obermeier

In this talk, I will describe the efforts done by the Wendelstein observatory in following up known exoplanets and planet candidates both spectroscopically and photometrically. We are currently installing a high-resolution spectrograph, calibrated with an LFC, and a simultaneous 3-channel camera that covers photometric bands between u and Ks. With the latter, we are currently performing a transit survey where we observe primary and secondary in order to determine their Transit Colour Signature (TraCS).

Microlensing survey of M31 with the 2m Wendelstein telescope

Arno Riffeser

The determination of the mass function (MF) of stars as a function of environment and metallicity is of fundamental importance, e.g., for understanding the star formation process, the mass-to-light ratios of galaxies, and the evolution of galaxies. The pixel microlensing technique applied to images of M31 with a 2m class telescope is able to constrain the mass function of stars and remnants for the bulge of M31. The bulge of M31 is metal rich and old and in this respect very different from the environments for which for e.g. the faint-end MF can be determined up to now. On the other hand, its stellar population is similar to the one of massive elliptical galaxies. High quality observations with a PSF better than 0.8 arcsec over several weeks of the M31 bulge can yield enough micro lensing events to discriminate between some of the major currently discussed faint-end MFs (e.g. Kroupa, Zoccali, Chabrier) and additionally provide the number and distribution of stellar remnants and therefore the complete M/L ratio.

Periodic Variables in the ASAS-SN and APOGEE Surveys

Michal Pawlak

I would like to present the results of a search for periodic variable stars among the targets observed by the Apache Point Observatory Galactic Evolution Experiment (APOGEE) using photometry from the All-Sky Automated Survey for Supernovae (ASAS-SN). The catalog consists of 1925 periodic variables selected from more than 258000 APOGEE targets. The sample is homogeneously classified into 430 eclipsing and ellipsoidal binaries, 140 classical pulsators (Cepheids, RR Lyrae and delta Scuti), 720 long period variables (pulsating red giants) and 635 rotational variables. The search was performed using both visual inspection and machine learning techniques. The light curves were also modeled with the damped random walk stochastic process. The median [Fe/H] of variable objects is lower by 0.3 dex than that of the whole APOGEE sample. The median of eclipsing binaries and ellipsoidal variables is shifted to the lower [Fe/H] by 0.2 dex. Eclipsing binaries and rotational variables exhibit significantly broader spectral lines than the rest of the sample.

MCSF: the Magellanic Clouds massive Stars and their Feedback survey

Dominik Bomans

We generated a multi-color (uBVRI, H-alpha), multi-epoch survey of the Magellanic Clouds (7x7 degree on the LMC, 4x2.5 degrees on the SMC) using the twin 15cm refractors of the "Universitätssternwarte Bochum" at Cerro Armazones, Chile. Goal of the survey was a relatively shallow (limiting B magnitude of about 19) but well sampled (1 arcsec/pix) photometry, which provides non-saturated, multi-color, multi-epoch imaging data for even the brightest stars of the Magellanic Clouds. Such a data set can not only be used for the study of massive stars and their feedback, but is also well matched to several survey plates collections for long term variability studies. We will present the survey data products, some science highlights on massive, variable stars, and explore synergies with scanned photographic plate data of the Magellanic Clouds, like the Bamberg Magellanic Clouds plates in the APPLAUSE database, and ESO 3.6m plates in the Bochum plate collection.

SPECULOOS - On the hunt for habitable planets well-suited for atmospheric characterization

Daniel Sebastian

After the astonishing discovery of seven Earth-sized planets around TRAPPIST-1, a Jupiter-sized star only 12 pc away, the hunt for temperate, rocky exoplanets goes into its next phase. The SPECULOOS survey is a new transit survey focusing on the 1000 brightest ($K \leq 12.5$) ultra-cool dwarfs (spectral type M7 or later). Its main objective is to detect temperate terrestrial worlds well-suited for detailed atmospheric characterization with upcoming JWST and ELTs. It also aims to probe the frequency and diversity of short-period planets around the lowest-mass stars and brown dwarfs. In this talk, I will present SPECULOOS, its current status, as well as its first results.

Newest results of the Next Generation Transit Survey (NGTS)

Philipp Eigmüller

In 2018 the firsts transiting exoplanets discovered with NGTS have been published. NGTS consists of twelve telescopes sited at ESO premise on Paranal, Chile. The optimal photometric conditions on site combined with the optimized instrument allow us to detect signals a magnitude smaller compared to previous ground based wide field surveys. With the sensitivity reaching more into the red wavelength NGTS focus to detect Neptune sized planets around K-dwarfs. One of these planets is NGTS-4b which lies directly in the middle of the sub-jovian desert. With its high photometric precision and time resolution NGTS data allows not only for the search of transiting exoplanets but for a wide range of scientific applications related to variability of stars. Already now several studies on stellar flares are based on NGTS data. All NGTS observations will be accessible over the ESO archive. The first light curves of hundred thousands of stars are already accessible.

Spectroscopy for determing the statistics of planets in transit surveys

Eike W. Guenther

Since the mass and life-time of the protoplanetary disk depends on the mass of the host stars, the properties of the planets are expected to depend on the mass of the host stars too. The question thus is how the properties of planets change with the mass of the host star. Determining the statistics of planets for stars of different masses using radial-velocity surveys is not easy, because the accuracy of radial-velocity measurements strongly depends on the rotation velocity, the number of spectral lines and also on the activity-level of the host star. Transit surveys are strongly biased towards short period planets and biased against large stars but it is easy to correct for these effects. It is also relatively easy to calculate the correction factors for activity-level if the activity-level of the stars are known. Transit surveys are thus ideal to detect short-period planets of hot stars like WASP-33b, KELT-9, or MASCARA-1. In order to determine the statistics as a function of stellar mass, all we have to do is to characterize the sample of stars. For The CoRoT-mission we have done this using the AAOmega multi-object spectrograph. This worked out very well given that each CoRoT-field had a size of 1.5x3.0 (1.5x1.5) degrees and AAOmega a field-of-view of 2 degrees. However, how are we going to characterize the sample of PLATO 2.0 given that each field has size of 2250 square degrees? A new approach is certainly needed. The interesting aspect is that this is an opportunity for small telescopes, given that the main targets will be between 4 to 11 mag.

The Gaia catalogue of hot subluminous stars

Stephan Geier

Based on data from the ESA Gaia Data Release 2 (DR2) and several ground-based, multi-band photometry surveys we have compiled an all-sky catalogue of 39800 hot subluminous star candidates selected in Gaia DR2 by means of colour, absolute magnitude, and reduced proper motion cuts. We expect the majority of the candidates to be hot subdwarf stars of spectral type B and O, followed by blue horizontal branch stars of late B-type (HBB), hot post-AGB stars, and central stars of planetary nebulae. The catalogue is magnitude limited to G<19 mag and covers the whole sky. Cross-matching this catalogue with large surveys of all kinds, we are aiming to compile the first volume-complete 500 pc sample of sdO/B stars.

PLATO deep-field south: its input catalog from BMK10k observations

Klaus Strassmeier

PLATO is ESA's M3 mission for launch in 2026. It will search for extrasolar planets by means of ultra-high-precision transit photometry. This requires a well-selected and well-defined stellar input sample for optimized planet harvesting. Two long-duration PLATO fields form the core of the mission. The one field in the southern hemisphere will be observed with BMK10k well in advance of the mission for support of its target input catalog. The BMK10k survey will provide well-sampled light curves of all resolvable targets in the 2250 square degree southern field. The task is to determine false positives (mostly close-by eclipsing binaries) and extract a variability flag for all accessible stars on the basis of their long-term brightness rms. It will enable the pre-determination of precise photometric periods, in particular stellar rotation periods, and the expected degree of (spot) activity. Besides, the survey will identify and characterize the target contamination down to the BMK10k resolution limit of 2.5"/pix for every PLATO pixel and photometry window (PLATO's pixel size will be 15", similar to TESS's 21"; PLATO's photometry window is 90" squared). The survey also extends the northern STELLA Open Cluster Survey (SOCS) to the southern hemisphere with initial focus on Ptolemy's cluster.

The BRITE-Constellation and its scientific highlights

Konstanze Zwintz

During their more than six years in space, the five BRITE-Constellation nanosatellites have completed observations of more than 550 individual targets brighter than about 6th magnitude. The data have allowed us to study a variety of variability phenomena covering a wide range across the HR-diagram including different types of pulsations, wind phenomena, rapidly rotating stars (e.g. Be), binary and multiple systems, and stars with planets. Some of the prime science results therefore comprise the discovery of massive heartbeat systems, the apparent interaction of phenomena on very different time scales in Be stars, the proof of a photospheric connection for the wind variations in very massive stars, g-modes and g-mode period spacings in beta Cephei, SPB and gamma Doradus stars or the presence of only two pulsation modes in a magnetic delta Scuti star. I will give an overview of the latest scientific results obtained from BRITE-Constellation data.

Pulsating stars with TESS

Peter De Cat

The Transiting Exoplanet Survey Satellite (TESS; Ricker et al., 2015, JATIS 1, 014003) was launched on April 18, 2018, and started its scientific observations on June 25, 2018. It is gathering ultra-precise photometric observations for celestial objects with $I_C \approx 4$ - 13 and an ecliptic latitude above 6 degrees. Preselected targets are observed with a cadence of 2 minutes while full-frame images are obtained every 30 minutes. In two years time, the largest part of the sky will be scanned with 26 sectors of 24 degrees $\times$ 96 degrees for a duration of 27 days each. During the first year of the mission, the satellite is pointing to the ecliptic southern hemisphere before moving on to the north in the second year of observations. Given that the sectors overlap near the ecliptic poles, the total time span of the observations of a star can last up to 351 days, depending on its ecliptic latitude. The main aim of the mission is to detect planetary transits in the light curves of nearby stars but the TESS data will be a goldmine for variable stars of all types and flavors. The observations of the first few sectors have been released by now. During this talk, I will show the importance of TESS for asteroseismology of different types of pulsating stars based on a few examples of first results.

Compact binaries in the TESS era

Ingrid Pelisoli

The Transiting Exoplanet Survey Satellite (TESS) has been gathering light curves for thousands of nearby stars. Although its primary goal is to find planets, the 2-minute cadence light curves obtained by TESS for pre-selected stars, with precision better than 1%, are also ideal to search for variability effects caused by a binary companion, such as reflection and eclipses. The brightness of TESS pre-selected targets also makes them ideal for ground-based follow-up, allowing for thorough characterisation of the observed systems and providing constraints for binary evolution models. In this talk, we will show recent discoveries in the field of compact binary stars made possible by TESS, as well as discuss the desired follow-up observations for these systems.

Euclid Survey Operations

Xavier Dupac

Euclid is the next ESA space telescope dedicated to cosmology, to be launched in 2022. It will perform a large survey of galaxies over 15000 sq. deg. of the Extragalactic sky. The design of the survey is mostly performed by the Euclid Consortium, with some help of the Science Operation Centre (ESA), while survey operations are performed by the SOC. In this presentation, we will concentrate on the science operation aspects of the Euclid survey, including daily planning and monitoring of the survey, planned reaction to contingencies and under-performance, re-scheduling and other modifications of the planned survey. We will also present the organizational aspect of this activity, which involves many actors of the Ground Segment.

The Hamburg Quasar Survey

Dieter Engels

The Hamburg Quasar Survey carried out 1985 - 1997 was using the Calar Alto Schmidt telescope equipped with an objective prism. The survey covered the Northern sky at galactic latitudes b > 20 deg, and declination delta > 0 deg). The spectroscopic Schmidt contain usable spectra with a seeing limited resolution of 45 Angstroem at Hgamma in the magnitude range 14 < B < 19. The HQS archive contains 1288 plates for 567 fields. These plates were scanned in full mapping mode by the Hamburg PDS microdensitometer and the digitized database was used for a variety of astronomical applications, in addition to the search for (mostly bright) quasars. The analysis of HQS prism spectra of quasars discovered by more recent sky surveys may unearth 'changing look' quasars, in which dramatic changes in the accretion process may have occurred on timescales of tens of years.

Cosmology with objects discovered by the Hamburg Schmidt surveys

Dieter Reimers

The all-sky Calar Alto/ ESO Schmidt objective prism surveys led to discoveries in the fields of

- HeII reionization/HeII Lyman forest
- a dozen bright gravitationally lensed multiple OSOs
- The most metal deficient PopII stars known

Byurakan spectroscopic surveys and their scientific discoveries

Areg Mickaelian

A review on the main characteristics of Byurakan spectroscopic surveys: Markarian survey (or the First Byurakan Survey, FBS) and the Second Byurakan Survey (SBS), their comparison with other similar surveys and the importance of Markarian galaxies and other objects discovered on the basis of FBS and SBS in modern astrophysics. Markarian Survey was the first systematic survey for active galaxies and was a new method for search for such objects. Until now, it is the largest objective prism survey of the sky (17,056 sq. deg). It was carried out in 1965-1980 by B. E. Markarian et al. and resulted in discovery of 1515 UV-excess (Markarian) galaxies. They contain many active galaxies (both AGN and Starbursts, SB), as well as powerful gamma-ray, X-ray, IR and radio sources (Mrk 180, 231, 421, 501, etc.), BCDGs (Mrk 116) and interacting/merging systems (Mrk 266, 273, etc.). They led to the classification of Seyfert galaxies into Sy1 and Sy2 and the definition of SBs. Markarian galaxies have been published in several catalogs (Mazzarella & Balzano 1986; Markarian et al. 1989, 1997; Bicay et al. 1995; Petrosian et al. 2007). Markarian survey also served as a basis for search for UVX stellar objects (or blue stellar objects, BSOs, including QSOs and Seyferts), late-type stars and optical identification of IR sources. 1103 BSOs, 1471 late-type stars, and some 1600 IRAS sources have been revealed and identified. At present the survey is digitized and DFBS database is created, which also serves as a basis for the Armenian Virtual Observatory (ArVO). SBS was carried out in 1978-1991 by B. E. Markarian, J. A. Stepanian et al. and covers smaller area (965 sq. deg.) but goes deeper to 19^m and has wider wavelength coverage. Both extended (emission-line and UVX galaxies) and stellar (QSOs and blue stars) objects have been revealed, more than 3600 objects in total. Byurakan surveys have played an important role in modern (especially) extragalactic astronomy and the objects revealed from them are being intensely investigated worldwide.

The LAMOST II medium-resolution survey

Chao Liu

LAMOST survey is a Chinese-operated spectroscopic survey using a 4-meter reflective Schimdt telescope. Since 2011, it has collected about 10 million low-resolution spectra, most of which are stellar spectra. The LAMOST survey continuously covering a large fraction of northen sky allows for broad studies about the Milky Way, especially for the Galactic outer disk. I will briefly highlight the achievment of the LAMOST survey in stellar physics and the Milky Way science. Then I will introduce the LAMOST II project for medium-resolution spectroscopic survey started since October 2018. Unlike LAMOST I, the new medium-resolution survey will not only about the Milky Way but more focus on stellar physics. It also conducts a time-domain spectroscopic survey for about 200 thousands stars in the next 5 years. We expect that the LAMOST II survey will have new breakthrough in stellar physics, especially about binaries, pulsators, young stars, and some pecular stars, by providing time-domain spectroscopic data and synergy with Gaia data in the near future.

The RAVE survey - Final Data Release

Matthias Steinmetz

tbd

POSTERS

Monitoring of space objects using Odessa observatory network of telescopes

Nataliya Bazyey

In this paper we are presenting optical telescopes of Astronomical Observatory of I. I. Mechnikov Odessa National University. We are describing technical characteristics and scientific program for each telescope. Here we also present a description of the tools with which the unique collections of astroplates were obtained under the program "The Sky Service". Odessa Observatory (46°.28 N, 30°.45 E, altitude 64 m, observation code 086) its outlying observation posts: Mayaki (46.39° N, 30°.27 E, altitude 25 m, observation code 583) and Kryzhanovka (46°.37 N, 30°.48 E, altitude 40 m, observation code A85) have a good geographical location (south-western part of the territory of Ukraine), as well as a good astroclimate (up to 200 clear nights). Telescopes are equipped with modern CCD and PMT light detectors. Odessa Observatory has its own mechanical and optical workshops which are used to create new telescopes and manufacture and repair of other astronomical equipment.

Astronegative archive of Odessa observatory

Nataliya Bazyey

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Currently, Observatory of I.I. Mechnikov Odessa National University owns collections of astronegatives obtained with its own instruments (about 100000 glass plates), as well as those obtained with instruments from other observatories (about 10000 plates). According to Bulgarian web-page WFPDB (wfpdb.org) Odessa collection of astroplates is second in Europe (after Sonneberg collection) and third in the world (after Harvard and Sonneberg). In this poster we describe the current condition of our collection and consider our plans for how to maintain this important astronomical heritage. We are also discussing our first steps in digitizing part of a collection in accordance with the decision of the world virtual observatory and WFPDB standards.

Balor - A New Large Field of View, High Performance, Fast Readout Detector for Sky Surveys

Colin Coates

Many challenges in modern astronomy require not only high resolution, large field of view and high sensitivity - they also require speed. However, traditional large area CCD technology is very much performance limited in this regard, offering only seconds per frame rather than frames per second fast readout capability. We will present on the development of a new large area sCMOS platform called Balor, designed to address this fundamental application shortfall. Balor 17F-12 is capable of performing at greater than 50 fps at full 16.9 Megapixel resolution, whilst maintaining a low read noise of only 3.5 electrons rms. A 12 μm pixel size ensures large field of view and large well depth. Extended Dynamic Range technology means that the lowest read noise and full pixel well depth can be accessed in a single image, facilitating fast, quantitative capture of both dim and bright objects. This unique combination of specifications will render Balor ideally suited to demanding usages such as Orbital Debris tracking, NEO detection, Solar imaging, Exoplanet detection, high time resolution astrophysics and lucky imaging.

Segmented infrared filters for the 1.3m telescope in the Slovak Tatra Mountains

Thorsten Döhring

Since 2015, the Astronomical Institute of the Slovak Academy of Sciences is operating a modern EU-funded reflecting telescope with a 130 cm primary mirror, located in the Skalnaté Pleso Observatory in the Tatra Mountains at an altitude of 1783 m. The systematic observation of comets and binary systems on the northern hemisphere occurs with this instrument. In 2018, the funding agency BAYHOST (Bavarian Academic Center for Central, Eastern and Southeastern Europe) granted the proposed project SLOBATCO (an abbreviation for Slovak-Bavarian Telescope Collaboration) to Aschaffenburg University of Applied Sciences. The cooperation project pursues the development of astronomical NIR filters, which are designed for the atmospheric transmission windows in the infrared spectral range. In order to avoid a complex cryogenic filter wheel for the NIR CCD camera operated at low temperatures, the observations should be realized through a segmented filter using precise shifts of the image field. The bi-national cooperation project and the specification of the infrared filter combination are presented in this poster contribution.

Wendelstein Observatory - Going from diverse observation programs and hardware to reduced data ready for science

Claus Goessl

Wendelstein Observatory (University of Munich, LMU) offers a wide range of observational capabilities, i.e. a 2m telescope with its three operational imaging and spectroscopic instruments and a 40cm telescope for students lab and monitoring projects. We describe how we schedule observations, monitor and archive science and technical data of the instruments, and how data gets processed to finally extract science from it.

Astronomical plates digitization by digital camera

Rene Hudec

Digitization by transportable device based on digital camera represents alternative technique for astronomical plate archives digitization worldwide. Several plate collections were digitized this way, e.g. Tuorla, Mexico, and Hewitt UK. Digitization of astronomical plate archives in Austria is planned for 2019. The technique is very fast, hence inexpensive, still providing scientific grade accuracy.

Low noise, Large area CCD Cameras in High Precision Exoplanet Projects

Ines Juvan-Beaulieu

Conducting high precision astronomical observations can be challenging when observing faint and/or distant objects in combination with limited sensitivities of the involved instruments. However, Andor's "off-the-shelf" iKon-L and iKon-XL CCD cameras can help maximize a high quality data output due to the cameras high quantum efficiency (>90%), low dark current and read noise. Both iKon-L and iKon-XL's ultimate sensitivity results from utilizing back-illuminated sensors and the low noise levels follow from exceptionally deep TE cooling (-100C).

Andor's iKon CCD series is in high demand especially within the exoplanet community (e.g., exoplanet searches and follow-up studies). This is due to, for example, the cameras perfect suitability to operate in remote observing locations (e.g., no vacuum repumping necessary, in-field replaceable shutter) and the availability of a sensor option with extended sensitivity towards the UV and NIR ('BEX2-DD').

We will highlight the key characteristics of both large area iKon-L and iKon-XL CCD cameras and present examples of on-going astronomy projects involving these camera solutions.

Optical Study of Bright FERMI/LAT Blazars

Omar Kurtanidze

From 1997 we are conducting monitoring of about 70 blazars in BVRI bands using ST6 and Apogee cameras attached to 70-cm meniscus telescope. During nearly twenty years over 300000 images have been obtained (3000 nights of observations). Most dense coverage of selected FERMI/LAT sources was undertaken after lunch of FERMI in 2008. We present optical light curves of most well sampled sources.

Study of Blazars Utilizing CCD Cameras and Medium Size Telescopes

Omar Kurtanidze

Maria G. Nikolashvili, Omar M. Kurtanidze, Sofia O. Kurtanidze, Abastumani Observatory, Mt. Kanobili, 0301, Abastumani, Georgia

The first report on micro-variability in AGNs was announced in the beginning of 60-ies, when a few sources were studied with a single-channel photoelectric photometer and biggest Palomar telescopes. Nevertheless, these variations were received with skepticism due to the instrumental instabilities and the inherent non repeatability of time-critical observations. Availability and utilization of CCD cameras breathed new life to small telescopes. During last decades, the variability time-scales from minutes to years have been studied for many blazars using commercial CCD cameras and small telescopes.A short review of blazar monitoring programs conducted during last 20 years in Abastumani Observatory and future prospects will be presented.

Power Quality - Evaluation for Safe Operation of Observatories (PQESOO)

Michael Mann

Within the project SLOBATCO the question did arise, to what extend observatories have to rely on adequate power quality, e.g. the perfect sinusoidal shape of supply voltage and current, in order to ensure safe operation and accurate measurement results. International power quality standards are put in perspective with requirement specifications. This contribution describes the motivation, proposes the measurement setup and interprets the first results in 2018. A summary is provided together with an outlook and a motivation for future measurement campaigns.

Surveys with KASI small optical telescopes : SOAO 61cm, BOAO 1.8m, LOAO 1m, OWL 5x0.5m and KMTNet 3 x 1.6m

Eon-Chang Sung

We report survey projects of small optical telescopes of KASI (Korea Astronomy and Space Science Institute). KASI has several telescopes and telescope networks with diameters of less than 2m in the world. Each telescopes and telescope networks have unique survey projects. We will discuss optical surveys of KASI with three small telescopes - SOAO 61cm, LOAO 1m and BOAO 1.8m, and two telescope networks – OWL 5x0.5m and KMTnet 3 x 1.6m.

On the FON astroplate project accomplishment

Iryna Vavilova

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Abstract. The plan for a photographic survey of the northern sky (FON) was proposed at the Golosiiv observatory (Main Astronomical Observatory, NAS of Ukraine, Kyiv, Ukraine) in the late 1970-ies [Pakuliak et al., 2016; Vavilova, 2016; Vavilova et al., 2017]. The last compilation of the final catalog of objects involves 5,700 digitized astroplates of four observatories: MAO NAS of Ukraine (Kyiv, Ukraine) [Andruk et al., 2016], Kitab Astronomical Observatory (Tashkent, Uzbekistan) [Yuldoshev et al., 2017], Gissar Astronomical Observatory (Dushanbe, Tajikistan) [Mullo-Abdolov et al., 2017, 2018], and the observatory in Baldone (Latvia) [Eglitis, 2017]. The consolidated catalog of positions and B-magnitudes of stars will cover the declination range from -20 to +90 degrees [Andruk et al., 2017]. The average epoch of the catalog is approximately 1987, the B-magnitude is 17.5m. Positions of objects will be obtained in the Tycho-2 reference system and B-values in the reference frame of photoelectric standards. The roadmap of compilation includes corrections for the presence of the photometric color equation in B-values. Stellar magnitudes in U and V color bands have been obtaining by processing more than 5,400 plates exposed by the 1.2m Schmidt telescope in Baldone Observatory. The U, B, V magnitudes for stars brighter than V<8.5m will be added from the existing photoelectric star catalogs. To determine the proper motions of stars, it is planned to use the GAIA project data.

To date, the following has been done:
1) On the basis of 2260 processed astroplates of Kyiv part of the FON project the catalog of positions and B magnitudes of 24.7 million objects down to B $\leq$ 16.5m was created. The catalog covers the northern hemisphere with δ from -4 to +90 degrees. The mean epoch of the catalog is 1988.2. The internal accuracy of the catalog for all the objects is $\sigma_{\alpha,\delta} = \pm 0.28$" in positions and $\sigma_B = \pm 0.17$m in

magnitudes (for stars in the range of B = 7m -14m these errors are $\sigma_{\alpha,\delta}$= ±0.13" and σ_B = ±0.08m). The convergence between obtained and reference positions is estimated as $\sigma_{\alpha,\delta}$ = ±0.06". For magnitudes, this value is σ_B = ±0.14m.
2) On the basis of 1963 processed astroplates of the Kitab part of the FON project, the catalog of positions and B-magnitudes of 13.4 million objects down to B ≤ 17.5m was completed. The catalog covers the declination zone from -20.5 to +2.5 degrees. The mean epoch is 1985.0. The internal accuracy of the catalog for all the objects is $\sigma_{\alpha,\delta}$ = ±0.23" in positions and σ_B = ±0.15m in magnitudes. These errors are $\sigma_{\alpha,\delta}$ = ±0.085" and ?B = ±0.054m for stars brighter than 14m. The convergence between calculated and reference positions is $\sigma_{\alpha,\delta}$ = ±0.042". This value is σ_B = ±0.16m for photoelectric B-magnitudes,
3) The FON glass collection of Institute of Astrophysics of the Academy of Sciences of the Republic of Tajikistan includes around 1560 photographic plates. The first results of 130 plates' processing show that the positional errors are $\sigma_{\alpha,\delta}$ = 0.33", and photometric ones are σ_B = 0.12m for the photometric interval of 5m ... 17m. The convergence between calculated and reference positions of Tycho2 is $\sigma_{\alpha,\delta}$ = 0.12", the same value for obtained and reference Tycho2 magnitudes is σ_{BT} = 0.19m. The convergence of photometric estimations with photoelectric values is σ_B = 0.14m. 4). To obtain another two color bands for the enhancement of the photometric system of the created catalog, the digitization and processing of U and V plates from the Baldone glass collection of 1.2m Schmidt telescope are on their way. The collection includes 780 and 4660 astroplates in the appropriate colors.

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On the "solar system small bodies" astroplate project of the Ukrainian Virtual Observatory

Iryna Vavilova

A new approach for creation of the catalogs of astrometric and photometric characteristics of small bodies of the Solar system

We obtained from digitized photographic observations of the UkrVO Joint Digital Archive and newest digitized data processing services:

- Catalogs of coordinates and magnitudes of asteroids
- Catalog of positions and B-values of Pluto
- Catalogs of the satellites of Saturn, Jupiter, Uranus, and Neptune

Showing the possibility of N(ear)R(eal)T(ime) creation of WCS solutions with solvefield for a complete sky survey

Mario Ennes, Walter Fürtig

The detection of fast moving or new objects on sky surveys with small cameras depend largely on the creation of a valid WCS solution for each image. A short time for detecting these objects on images is crucial for subsequent time critical actions to be taken. For comparing found sources with online catalogs a valid WCS is neeeded. The more time spent for getting an initial or iterative wcs solution the less time for other tasks is left over. Experiences with solvefield applied to single field images in the past showed different parameter sets as an optimum for each field. Getting th optimum parameters for solving each field of a survey cant't be done manually if n(ear) r(eal) t(ime) processing should be achieved. An automated process needs a near optimum parameter set to be used for all fields of the survey to minimize overall solving time for all images but not only for some.

This work focusses on the possibility of getting duration minimized parameter sets for an (initial) astrometric solving of a sky survey.

Several sets are checked on real images and are evaluated for being possible candidates for an automated detection process. The criteria choosen to be satiesfied is that the duration of getting a WCS solution should no longer last than one third of an exposure time of one image. The other two thirds should be sufficient for improving the WCS, retrieving the online/offline catalog data, doing the comparison and some kind of alerting. The fullfillment of this criteria is considered to be valid for a n(ear) r(eal) t(ime) creation of a WCS solution.

In the first part about 65 randomly choosen digital images of different sky areas are solved with 36 parameter sets. Characteristics of the solutions like duration and found sources are compared. Some hints for getting a good parameter set is given.

The second part takes a detailed look on the parametrisation of several solvefield runs. Possible enhancements are discussed and an outlook for further investigations is given.

Sonneberg Observatory PHotographic Image Archive

Peter Kroll

Sonneberg Observatory harbours approx. 275,000 astronomical glass plates and films taken with different instruments and at different sites between 1923 and 2010. More than 85% (237,000 plates) have been digitized in the last years forming **SOPHIA** – **S**onneberg **O**bservatory **PH**otographic **I**mage **A**rchive with 25 TB of raw image data. Currently effort is taken to find WCS solutions for all digitized plates of the Sky Patrol as these form a homogeneous sub collection (about 150,000 plates) of more or less equal scale (825"/mm), limiting magnitude (14.5^m in pg (blue); 13.5^m in pv (yellow/red)), emulsions and time coverage (1954 – 2010).

Sonneberg Observatory Digital All-Sky Survey

Sergej Schuhmacher

Sonneberg Observatory's traditional Sky Patrol (see SOPHIA poster) with photographic plates is continued by digital monitoring using different types of instruments. The cascade starts with all-sky cameras using fish-eye lenses. We have set up to cameras, one from the consumer market, the other as in-house development. An almost continuous monitoring from dawn to dawn is achieved by 20-seconds exposures with just 2.5 seconds read-out time, reaching stars of 6^m and 7^m in the zenith. The survey runs since four years with the main goals of bright star monitoring, detection of bright transients and fireballs, besides statistics of unusual atmospheric phenomena.

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