Rubin-LSST Polska 2024

Report of Contributions

https://events.ncbj.gov.pl/e/364

Contribution ID : **2** Type : **not specified**

Knut Olsen (NOIRLab, Arizona), An Overview of Rubin Observatory and LSST

Wednesday, 23 October 2024 11:15 (60)

I will present an overview of the Vera C. Rubin Observatory project and its planned Legacy Survey of Space and Time (LSST), scheduled to start in 2025. The overview will include LSSTs science goals, the status of the construction project, the plans for operations (including the role of the Rubin In-Kind program), and the planned observing strategy.

Session Classification : Opening

Contribution ID : **3** Type : **not specified**

Agnieszka Pollo (NCBJ), Status of Polish participation in the LSST

Wednesday, 23 October 2024 12:15 (30)

I will summarize the current status of Polish participation in the LSST, our in-kind program, agreements, and perspectives.

Session Classification : Opening

Contribution ID : **4** Type : **not specified**

Krzysztof Nawrocki (NCBJ), Status of in-kind programme, astroinformatics and synergies

Wednesday, 23 October 2024 14:00 (15)

In the talk we would like to describe the current status of the Polish IDAC few months before first light. The talk will focus on the solution that we are implementing. We will give a general description of main science cases and how they affects the architecture of our IDAC.

Session Classification : Status of in-kind program, astroinformatics and synergies

Contribution ID : **5** Type : **not specified**

Arkadiusz Hypki (UAM) Distribute data analysis of Big Data and machine learning applied on a large number of detailed MOCCA numerical simulations

Wednesday, 23 October 2024 14:15 (15)

MOCCA code is able to perform detailed numerical simulations of globular clusters of any size within a few days (http://moccacode.net). Because of its speed and a close agreement with N-body codes MOCCA code is perfect to perform a grid of simulations for various initial conditions. It is currently beyond the capabilities of any N-body codes. At this moment our MOCCA database consists of over 2500 models for broad range of initial parameters (200 TBs). To handle such amount of data from numerical simulations I created BEANS - a general purpose web-based software for interactive distributed data analysis with a clear interface for querying, filtering, aggregating, and plotting data (http://beanscode.net). BEANS software relies on software which already proved its value in the industry like Apache Hadoop (distributed processing), Apache Pig (high level language for Apache Hadoop), Elastic (petabyte scale search engine) and more. Recently, a plugin to BEANS was added, which provides simple interface to train machine learning algorithms and then test their predictions. During the talk I will demon- strate how one can query huge amount of MOCCA numerical simulations with Apache Pig to build a training set with some parameters describing the numerical models of GCs (e.g. core half-mass radii, relaxation time, pre/post core collapse phase). Then, using a few different machine learning algorithms, I will show how one can train them and finally test the predictions. More specifically, the BEANS software will be used to show how one can automatically determine the dynamical age of GCs (whether a GC is in pre- or post-collapse phase).

Session Classification : Status of in-kind program, astroinformatics and synergies

Contribution ID : **6** Type : **not specified**

Milagros Colazo (UAM), Developing algorithms for Phase Curve analysis using DP03 Simulated Data in the LSST era

Wednesday, 23 October 2024 14:30 (15)

Asteroids are remnants of planetary formation. Their current physi- cal properties and orbital distribution are related to their initial state in the early Solar System and their subsequent dynamic and physical evo- lution. The phase curves of asteroids relate to the variation of integrated brightness in the disk over the phase angle (the angle between the Sun and the observer, as seen from the object), providing information linked to surface characteristics. By fitting a phase curve, the most important parameters that can be determined are the H, G1, G2, and G12 . With the era of the LSST, a large amount of data will be provided to the sci- entific community, including information about the Solar System. The main objective of this project is to develop software capable of obtaining phase curves for a catalog of the magnitude that LSST will produce. The first goal of this work is to improve our tools for fitting phase curves of asteroids using photometric data obtained by the LSST, and to include the rotational phase. Then, we will construct a catalog of phase curve parameters and perform various statistical analyses. The next step will be to combine the LSST database with other surveys. Finally, we will study the taxonomy of asteroids using the obtained phase parameters, which will allow us to deepen our understanding of these objects. Currently, we have DP0.3, which is a hybrid catalog containing both real and simulated Solar System objects. Based on it, we have generated some tests with the codes we have already developed for analyzing large databases and have compared them with what we obtained for ATLAS survey. In this presentation, we will share these preliminary results.

Session Classification : Solar System

Contribution ID : **7** Type : **not specified**

Edyta Podlewska-Gaca (UAM), A possibility of follow-up observations of Solar System Objects

Wednesday, 23 October 2024 14:45 (15)

I will present the Gaia Ground-based Observational Service for Asteroids (Gaia-GOSA) which was created to facilitate collaboration between amateur observers and professional researchers in order to support asteroid studies. It allows for follow-up observations of objects for which we critically need observations. Here, I'd like to discuss a need, and a possibility of creation of similar alert system for Solar System objects observed by LSST.

Session Classification : Solar System

Contribution ID : **8** Type : **not specified**

Hareesh Thuruthipilly (NCBJ), From DES to HSC: Identifying Low Surface Brightness Galaxies using Transfer Learning on Deep Abel 194 Cluster data

Wednesday, 23 October 2024 15:30 (15)

Low surface brightness galaxies (LSBGs) are crucial for understanding galaxy evolution and cosmology, yet their physical properties remain elusive due to the challenges in detection. Future large-scale surveys, such as LSST and Euclid, will uncover many LSBGs, necessitating automated methods for identification. We explore transfer learning for detecting LSBGs by training eight transformer models on Dark Energy Survey (DES) data. These models were applied to Hyper Suprime-Cam (HSC) data of the deeper Abell 194 cluster, leading to the discovery of 171 LSBGs, with 87 being new. The models achieved a recall rate of 93

Session Classification : Galaxies

Contribution ID : **9** Type : **not specified**

Katarzyna Małek (NCBJ)/Patryk Matera (OAUW/NCBJ), Hidden message: looking for attenuation proxy in optical observations

Wednesday, 23 October 2024 15:45 (15)

Future large sky surveys, such as the Legacy Survey of Space and Time (LSST), will gather optical photometry for billions of galaxies. Dataset obtained from LSST will provide an amazing opportunity to test different theories of galaxy evolution. However, due to limitations in observed wavelength, and the lack of spectroscopic redshifts, modeling physical properties of the LSST galaxies will bring a lot of challenges which we have to solve before the first data release. The most important question is the dust content in a galaxy. Since dust is one of the elements that truly shapes the spectral energy distribution of the galaxy, we have to find a way to estimate the amount of dust which covers stars. Fol- lowing our recent discovery of hidden attenuation proxy retrieved from surface brightness and color using optical only data in the Sloan Digital Sky Survey (SDSS), we try to push the boundaries and look for similar relations in cosmological simulation. We used SIMBA, the state-of-the-art cosmological hydrodynamic simulation, due to its careful dust treatment with a rich chemical evolution of the ISM. Selecting similar samples of galaxies to those used in Maek et al., we are able to obtain similar relation for dust attenuation and optical properties of observed galaxies, but also to go deeper in the surface brightness.

Session Classification : Galaxies

Contribution ID : **10** Type : **not specified**

Oliver Newton (CFT), Constraints on the properties of vMSM dark matter using the satellite galaxies of the Milky Way

Wednesday, 23 October 2024 16:00 (15)

Low-mass galaxies provide a powerful tool with which to investigate departures from the standard cosmological paradigm in models that suppress the abundance of small dark matter structures. One of the simplest metrics that can be used to compare different models is the abundance of satellite galaxies in the Milky Way. Viable dark matter models must produce enough substructure to host the observed number of Galactic satellites. Here, we scrutinize the predictions of the neutrino Minimal Standard Model (MSM), a well-motivated extension of the Standard Model of particle physics in which the production of sterile neutrino dark matter is resonantly enhanced by a lepton asymmetry in the primordial plasma. This process enables the model to evade current constraints associated with non-resonantly produced dark matter. Independently of assumptions about galaxy formation physics we rule out, with at least 95 per cent confidence, all parameterizations of the MSM with sterile neutrino rest mass, Ms1.4keV. Incorporating physically motivated prescriptions of baryonic processes and modelling the effects of reionization strengthen our constraints, and we exclude all MSM parameterizations with Ms4keV. Unlike other literature, our fiducial constraints do not rule out the putative 3.55 keV X-ray line, if it is indeed produced by the decay of a sterile neutrino; however, some of the most favoured parameter space is excluded. If the Milky Way satellite count is higher than we assume, or if the Milky Way halo is less massive than M200=8 10^11 M, we rule out the MSM as the origin of the 3.55 keV excess. In contrast with other work, we find that the constraints from satellite counts are substantially weaker than those reported from X-ray non-detections.

Session Classification : Galaxies

Contribution ID : **11** Type : **not specified**

Discussion

Wednesday, 23 October 2024 16:15 (15)

Session Classification : Discussion

Contribution ID : **12** Type : **not specified**

Bożena Czerny (CFT), Continuum and BLR reverberation mapping of AGN as a tool for cosmology

Thursday, 24 October 2024 10:00 (15)

As our contribution to LSST through in-kind contribution POL- NCB-S6 we developed a software which can use the delay of the broad emission lines from the Main Survey to constrain the cosmological models. This will mostly require 10-yr data due to the long time delays. Now we concentrate on continuum time delays which can be measured from the first year data from DDFs. Light echo from irradiated accretion disk in active galaxies was proposed as a cosmological tool in 1999, allowing to determine the Hubble constant directly but it was never working. The estimated disk sizes were always too large, and the attempted de- termination of the Hubble constant in 2007 gave much too low values. Recently, there was a growing understanding that the problem is caused by the contamination of the accretion disk continuum by the continuum produced in the Broad Line Region (BLR). Using our model of the BLR and combining the mean spectrum and the measured time delays from Swift we were able for the first time to disentangle the two effects for the source NGC 5548. Our rough estimate gave the Hubble constant of 69 km/s/Mpc but more more work is needed to fit the data properly and to estimate the error in the claimed value. We now check if the DDF cadence will be suitable for such measurements, and it seems now that only for very massive black holes the measurement can be done.

Session Classification : Active Galactic Nuclei

Contribution ID : **13** Type : **not specified**

Amit Kumar Mandal (CFT), Dust reverberation mapping in AGN

Thursday, 24 October 2024 10:15 (15)

Session: Extragalactic astrophysics (cosmology, galaxies & AGNs) We analyze the torus size luminosity relationship in Type 1 AGNs using reverberation mapping (RM) of optical and infrared light curves in the W1 and W2 bands of the WISE survey. Our sample includes 446 AGNs for W1 and 416 for W2, covering bolometric luminosities from 10^43.4 to 10^47.6 erg/s, with reliable lag measurements. After correcting for accretion disk contamination, we find a torus size (R_dust) luminosity (L_bol) relation, with best-fit slopes of 0.39 for W1 and 0.33 for W2, both shallower than predicted by the dust radiation equilibrium model. By incorporating K-band data, we confirm that torus size depends on dust emission wavelength, with size ratios R_dust,K:R_dust,W1:R_dust,W2 = 1.0:1.5:1.8 at L_bol=10^46 erg/s, indicating a stratified torus structure. Additionally, we observe a moder- ate correlation between deviations from the R_dustL_bol relation and the Eddington ratio, suggesting that the Eddington ratio may influence the flattening of this relation. Looking ahead, I plan to explore the po- tential of using multi-epoch LSST data for reverberation mapping (BLR RM, dust RM, and accretion disk continuum RM) in conjunction with light curves from other sources, such as SPHEREx and Euclid.

Session Classification : Active Galactic Nuclei

Contribution ID : **14** Type : **not specified**

Anjitha Jon Williams (CFT), Photometric redshifts for Kilo-Degree Survey quasars with deep learning

Thursday, 24 October 2024 10:30 (15)

Redshift is the key quantity in cosmology. In modern wide-angle deep surveys, most of the redshifts are derived indirectly from photometry rather than spectroscopy. In this talk, I will discuss the use of Convolutional Neural Networks (CNN) for photometric redshift (photo-z) estimation of Quasars of the Kilo-Degree Survey (KiDS) DR4. CNNs have recently shown promise in accurately estimating photometric redshifts, leveraging the ability of deep learning algorithms to capture complex patterns in large datasets. I propose a new architecture based on CNN to estimate the photometric redshift of Quasars by training the network with images supplemented with magnitudes. In this talk, I will describe the architecture of our deep learning model and the training process, the effect of model hyperparameters and data preprocessing on photo-z estimation and, highlight the advantages of using a CNN over traditional machine learning algorithms. I will present the results of experiments, comparing the performance of the model to other state-of-the-art photometric redshift estimation methods.

Session Classification : Active Galactic Nuclei

Contribution ID : **15** Type : **not specified**

Paweł Bielewicz (NCBJ), Effect of photometric redshift errors on cross-correlation between LSST and CMB gravitational lensing potential

Thursday, 24 October 2024 11:15 (15)

Cross-correlation of the cosmic microwave background (CMB) gravitational lensing potential with the LSST galaxy survey divided into narrow redshift bins will enable to map the evolution of the cosmological parameters with redshift. We will discuss the effect of the redshift bin mismatch of galaxies, that is due to photometric redshift errors, on cross- correlation measurements and estimation of cosmological parameters.

Session Classification : Cosmology

Contribution ID : **16** Type : **not specified**

Boudewijn Roukema, IA, NCU, Detecting cosmic voids via maps of geometric-optics parameters

Thursday, 24 October 2024 11:30 (15)

Can individual cosmic voids be detected in deep photometric surveys without spectroscopic data or photometric redshifts? The curved- spacetime geometric-optics maps of a deep survey should, in principle, contain information about voids present in the intrinsic three-dimensional dark matter distribution. A heuristic algorithm for detecting voids this way will be presented, with results indicating that blind searches should be able to make predictions of void locations and sizes that are falsifiable by spectroscopic followup. This should lead to characterising voids both by wall galaxies and by the straight paths of light through the voids that reveal the voids' spacetime curvature (which in the weak lensing formalism is approximated as the "bending" of light in a fictitious uncurved spacetime).

Session Classification : Cosmology

Contribution ID : **17** Type : **not specified**

Boudewijn Roukema (UMK), Detecting cosmic voids via maps of geometric-optics parameters

Can individual cosmic voids be detected in deep photometric surveys without spectroscopic data or photometric redshifts? The curved- spacetime geometric-optics maps of a deep survey should, in principle, contain information about voids present in the intrinsic three-dimensional dark matter distribution. A heuristic algorithm for detecting voids this way will be presented, with results indicating that blind searches should be able to make predictions of void locations and sizes that are falsifiable by spectroscopic followup. This should lead to characterising voids both by wall galaxies and by the straight paths of light through the voids that reveal the voids' spacetime curvature (which in the weak lensing formalism is approximated as the "bending" of light in a fictitious uncurved spacetime).

Session Classification : Cosmology

Contribution ID : **18** Type : **not specified**

Łukasz Wyrzykowski (OAUW), Alerts in LSST - a challenge of the depth and volume

Thursday, 24 October 2024 13:30 (15)

Vera Rubin Observatory is going to flood the community with mil- lions of alerts every day. These will be due to supernovae and other exotic extragalactic transients, as well as local Galactic transient events such as cataclysmic variables, microlensing events and many others. The unprecedented depth of the survey, reaching around 25 mag per single epoch, will pose a huge challenge for any follow-up facility, both photometric and spectroscopic. I will discuss the difficulty and possible solutions to how are we going to tackle this issue. I will present the global telescope network, BHTOM.space, which is getting ready to pick and observe selected alerts from LSST.

Session Classification : Stellar astrophysics & transients

Contribution ID : **19** Type : **not specified**

Tomasz Kamiński (CAMK), Chances for observing red novae with LSST

Thursday, 24 October 2024 13:45 (15)

I am going to review what are our chances of observing transients from mergers of non-compact stars and common-envelope systems.

Session Classification : Stellar astrophysics & transients

Contribution ID : **20** Type : **not specified**

Joanna Molenda-Żakowicz (UWr), The LAMOST Facility and Its Database of 20 millions Star Spectra

Thursday, 24 October 2024 14:00 (15)

The Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST) is a quasi-meridian Schmidt telescope located at the Xinglong Station of the China Astronomical Observatory. I will present the current status of the LAMOST spectroscopic survey and the possibility of accessing its database, which already contains more than 20 million low- and medium-resolution spectra, including time-series observations.

Session Classification : Stellar astrophysics & transients

Contribution ID : **21** Type : **not specified**

Suhani Gupta (CFT), Bending the web: exploring the impact of modified gravity on the density field and halo properties within the cosmic web

Thursday, 24 October 2024 15:00 (15)

Dependence of the properties of galaxies and dark matter halos on the hosting environment is one of the central issues in cosmology. Also, owing to the large-scale cosmological data from present and future surveys, it is of paramount importance to model non-linear measures associated with both underlying dark matter density fields, and halos which can help forecast various large-scale structure properties. In this work, we study the relative importance of different cosmic web (CW) environments in influencing the dark matter density and halo properties in two modified gravity (MG) models: namely Hu-Sawicki f(R) gravity model, and normal branch of Dvali-Gabadadze-Porrati (nDGP) gravity model. Both these models exhibit an enhanced structure formation scenario w.r.t. standard CDM case, at different cosmic scales and epochs. This is a result of an additional fifth force in these models, which acts on top of the Newtonian gravitational force on the cosmological scales. The effect of the fifth-force is reflected in large-scale cosmic density fields, and in the halo properties. We study the hierarchical clustering properties of dark matter in different CW environments in these MG models. The clustering statistics in each environment exhibit a different trend from the overall density. Similarly, each environment in MG models has a distinct departure from CDM, and MG signatures persist over a range of length scales and epochs. The difference of higher-order dark matter clustering statistics in these MG models w.r.t. CDM, and its dependence on the environment shows that the reduced cumulants can be used as cosmological probes of these beyond-GR models. We also focus on the halo properties, such as the halo mass function, halo spin and alignment, and how the change in MG results is influenced in each CW environment. The formation and evolution of DM halos, which are sites of galaxy formation, is also influenced by the underlying theory of gravity, and we show that the change in halo properties w.r.t. standard CDM is impacted by the hosting CW environment. Such environmental dependence in the change of dark matter and halo properties in MG scenarios will play an important role in future cosmological and galaxy formation studies, and for disentangling MG effects from the environmental impact in these large-scale structure properties.

Session Classification : Cosmology

Contribution ID : **22** Type : **not specified**

Marek Biesiada (NCBJ), Strong lensing in the LSST: new opportunities for cosmology and fundamental physics

Thursday, 24 October 2024 15:15 (15)

Strong gravitational lensing is one of the basic predictions of General Relativity. By now it has become a mature research field and brought many important results in extrgalactic astronomy and cosmology. However, the potential in this field is much bigger and not sufficiently explored yet. I will review some yet unexplored topics in which strong lensing systems discovered by the LSST may bring a breakthrough, in particular focusing on the experience of LSST Poland team.

Session Classification : Cosmology

Contribution ID : **23** Type : **not specified**

Shuaibo Geng (NCBJ), Investigating the redshift Evolution of Lensing Galaxy Density Slopes via Model-Independent Distance Ratios in the Era of LSST

Thursday, 24 October 2024 15:30 (15)

Strong lensing systems, soon to be widely detected by LSST, serve as powerful tools for exploring cosmology and galaxy structure. Com- bined with stellar kinematics, the Einstein radius measures the lens's total projected mass and helps constrain lens mass profiles. However, its observed angular size also varies with the cosmological model, specifically through the distance ratio D_ls/D_s, entangling cosmology with galaxy structure. Addressing this, our study uses 161 strong lensing systems to evaluate the power-law (PL) mass distribution slope and its redshift evolution without relying on a specific cosmological model. We employ non-parametric regression via Artificial Neural Networks and Gaussian Processes on data from cosmic chronometers and Type Ia supernovae to reconstruct distance ratios. Our analysis differentiates between the total mass and luminous matter density slopes, revealing that the total mass concentration increases towards the present. While we observe only marginal increases in the density slope of luminous matter as redshift decreasing. The study provides a basis for using strong lensing to constrain cosmological parameters and to understand galaxy evolution, with ongoing potential applications being investigated.

Session Classification : Cosmology

Contribution ID : **24** Type : **not specified**

Agnieszka Kryszczyńska (UAM), Status of LSST@Europe7

Thursday, 24 October 2024 15:45 (15)

Session Classification : Discussion

Contribution ID : **25** Type : **not specified**

Antonio Vanzanella (NCBJ) ”Detection of Slow-moving objects with LSST”

Thursday, 24 October 2024 11:45 (15)

We aim at detecting Solar System slow-moving objects (SMOs) in LSST images using a Three-Dimensional Convolutional Neural Network (3D-CNN). Since no preexisting dataset is available, we created a dataset containing samples able to condense exhaustively the characteristics of the SMOs. We used small (15x15 pixel) cut-outs of LSST DP0.2's simulated images in which we painted a simulated SMO. This simulated object is modeled on Trans-Neptunian objects from the Jet Propulsion Laboratory Catalog but re-scaled to large distances. We further populated the dataset and increased its dimension, using data augmentation techniques, and obtained over 5000 samples. During the training process, regularization and normalization techniques are applied to prevent overfitting. We evaluated the network performance on a new test set of 200 samples and achieved an accuracy of 90%. In this talk, we will present the model and discuss the details of how the pipeline works. Moreover, we will show how the network's performance varies as a function of the apparent speed of the SMOs.

Session Classification : Stellar astrophysics & transients