LSST-PL Meeting I

Thursday 14 March 2019 - Thursday 14 March 2019

Book of Abstracts

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Overview

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Overview of the LSST-PL collaboration status.

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Photometric Reverberation Mapping using LSST

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An overview of our proposed project - Using a set of prepared AGN templates for a range of AGN parameters that are based on SED broadband modelling, we seek to calculate the contribution of the major lines (Hβ, Mg II, CIV) to the photometric channels, taking into account the Balmer continuum, FeII pseudo-continuum and other lines. The simulations will then be performed for representative objects using several cadences which are now under consideration. This method will improve the current standards of photometric reverberation method – using multi-channel and time-lag estimations from various methods.

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Cosmological Evolution of the Radio-loudness of Quasar Sources

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I will present our (Singal et al. 2011, 2013) approach to the cosmological evolution of the radio-loudness parameter for quasar sources. In particular, I will show how we determine the radio and optical luminosity evolutions for a set of >5,000 quasars combining the SDSS and FORST data, based on the method of Efron and Petrosian (1993), to access the intrinsic distribution of the radio-loudness parameter (defined as the ratio of the radio to optical luminosity), taking into account the truncations and correlations inherent in the data. In this approach, we found that the intrinsic distribution of the radio-loudness is quite different from the observed one, is smooth with no evidence of a bimodality, and that the fraction of the radio-loud quasars increases with inscribing redshift (contrary to several claims presented in the literature).

AGNs / **2**

AGN variability with LSST

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I will discuss what science we can do using the six-color lightcurves from LSST for active galactic nuclei. This includes the power density spectra, structure functions, and time delays. In particular, time delay measurements can be used to do cosmology with quasars.

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In search of CL AGN

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As was claimed in literature, CL AGN do not form the homogeneous sample. They vary widely in their timescale of phenomena or type of transient (from bright-state to dim-state or vice versa). The nature of state changes in CL AGN is still a mystery, however, different scenarios to explain these phenomena are proposed. I will discuss if CL AGN are a unique phenomenon and how we can identify them in the LSST sample.

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Different time-delay measurement methods in reverberating AGN

Michal Zajacek[None] ; Bozena Czerny[None]

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We will provide an overview of different methods how to reliably measure the time delay between the variable AGN continuum and the emission-line light curves in the broad line region (BLR) of active galactic nuclei. In particular, we will also discuss methods how to assess the uncertainties of these methods and how these errors can propagate further to the current models of the BLR.

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Wavelength-dependent time delays in AGN accretion discs

Aleksandra Olejak[1]

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The idea of measuring and using wavelength-dependent time delays between the optical continuum at different EM wavelengths in order to determine AGN

accretion disk structure has been known for many years. For example Sergeev et al. (2005) modelled the lag-luminosity relation with a disc reprocessing model, where time delays were caused by different light travel times from the ionizing source and regions of continuum emission. Collier et al. (1999) gave an idea how AGNs can be used in cosmology as standard candles by measuring the flux and the time delays between the optical/UV continuum in an accretion disc. Right now scientists, for example Cackett et al. 2007 fit the wavelength-dependent time delays of AGNs with a disc reprocessing models, what allows to measure the distances to the AGNs. However this method needs to be improved in order to determine more accurate estimation of cosmological quantities such as the Hubble constant. After that, it could be conveniently applied to six-color AGN lightcuves from LSST.

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Can reverberation-measured quasars be used for cosmology?

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Quasars have been proposed as a new class of standard candles such as Supernovae, their large redshift range and high luminosities make them excellent candidates. Reverberation mapping (RM) method offers to estimate the distance to the source from the time delay measurement of the emission lines with respect to the continuum, since the time delay depends on the absolute luminosity of the source. This radius-luminosity (RL) relation showed a low scatter and was proposed to use for the cosmological purposes. However, in the recent years the increase of the studied sample, and in particular the inclusion of highly accreting QSO has increased the dispersion in the RL relation, with many objects showing time delays shorter than the expected. Using Hb RM measurements for 117 sources with a 0.2<z<0.9 and 41.5<L5100<45.9, we find a correction for the time delay based on the dimensionless accretion rate. With this correction we are able to build a Hubble diagram, which is in a good agreement with the standard cosmological model.On the other hand, using the excess of variability, we find that departure from the RL relation is associated with the variability. Therefore variability is anti-correlated with the accretion rate, indicating that accretion rate is one of main drivers of QSO properties. Large multi-epoch surveys like LSST will be provide variability features, which can be used as a tool in order to derive other AGN physical properties.

Galactic Science / **10**

Milky Way black hole population from lensing with the LSST

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Microlensing is the only tool to discover and study a population of hidden dark compact objects, including neutron stars, black holes and even the primordial black holes which could form part of the dark matter. We will show how LSST will contribute to this topic, with long-term whole sky observations and depth. We will discuss the lessons learned from Gaia and OGLE surveys which can be applied to LSST.

Galactic Science / **16**

Tracking the nature of DM in the Local Universe

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I shall describe some promising features of our Local Universe that can help reveal some feature of a particle DM candidate. Simulations of galaxy and DM structure formation of warm, cold and self-interacting DM candidates indicate that features of the Galactic and M31 halo like: tidal streams gaps, satellite galaxies orbit parameter distribution and their internal properties can differ significantly in different DM candidate scenarios. Observations that the LSST will foster will allow us to use these features as potential DM tale-tell.

Galaxies and cosmology / **13**

LSST supernovae Ia and the turnaround epoch

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Galaxies form from primordial density perturbations that stop expanding and pass through a turnaround epoch, at which curvature is strongly positive: about five times as strong as density, when both are expressed as domain-averaged Ωs. Moreover, a tight relation is expected between curvature and the domain-averaged expansion rate prior to turnaround. The high number density of LSST supernovae of type Ia that are followed up by spectroscopic redshifts should offer many opportunities for testing these two predictions of general relativity.

Galaxies and cosmology / **4**

SED fitting as a tool for searching peculiar galaxies

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I would like to use the SED technique for selection of galaxies which do not follow the energy balance like super dusty galaxies or possible lensing objects.

Galaxies and cosmology / **11**

General LSS studies with LSST

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I envisage to use LSST data for general large-scale structure studies, in particular within the LSST Dark Energy Science Collaboration (DESC). Particular applications may include: photometric redshift derivation, application of resulting catalogs for such studies as tomographic angular clustering, galaxy-galaxy lensing, cross-correlations with CMB lensing etc. Other possible topics of interest are related to peculiar motions (large-scale flows etc.) using appropriate photometry-based techniques (e.g. Nusser et al. 2011) and/or transverse motions.

Machine learning / **12**

AI methods developed / under development for TOROS that might be use for LSST

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In a talk I would like to present methods developed or currently under development for TOROS project that have potential to be useful for LSST. Most important methods developed be me for TOROS is background rejection using Convolutional Neural Networks (with 99.5 % accuracy). The other methods currently under development involves galaxy subtraction using GANs, scheduling using reinforcement learning and image subtraction using neural networks.

Machine learning / **15**

machine learning based quasar detection in photometric surveys

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Broad spectroscopic lines, large redshift range and variety of properties make quasar detection in photometric surveys a particularly difficult task, and estimation of their photometric redshifts is even more challenging. I will present a quasar detection method based on photometric ugri data in Kilo-Degree Survey (KIDS) - an imaging deep and wide field survey covering 447 sq. deg. on the sky (Nakoneczny et al. 2019). The KiDS third data release contains 49 millions of sources among which, however, a vast majority does not have any spectroscopically confirmed identification. We successfully trained a Random Forest classifier based on the KIDS data and a set of known quasars identified by the SDSS spectroscopic survey. Our final catalog consists of 190,000 quasar candidates and its training purity equals 91%. Additional validation of the catalog was made by the means of comparison with GAIA second data release, other already existing quasar catalogs and WISE

photometric data. Our method can be easily applied to the future LSST data, and developed further to make use of the LSST time domain data.

Machine learning / **5**

Machine learning application to the LSST data

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I am planning to apply different machine learning methods to broad range of tasks, such as object classification based on both flux measurements and raw images, novelty detection and correction of the distorted images.

Solar System / **14**

Minor Body Science in the LSST Era

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Cataloging the Solar System is one of the main science themes that drive the LSST project. LSST is expected to discover ten times more objects from every minor body population than currently known, and provide hundreds of flux and color data for individual bodies. This will be a total game changer. On the one hand, transformative research will be done by the LSST community, but on the other hand, small body science will quickly fade in the communities having no access to these new discoveries and data. Our team wishes to join the LSST family and explore LSST data on every level. We will discuss examples of LSST-enabled minor body science based on (i) realtime alerts, (ii) daily orbit releases, (iii) annual catalog releases, and (iv) our own, customized deep stacks.