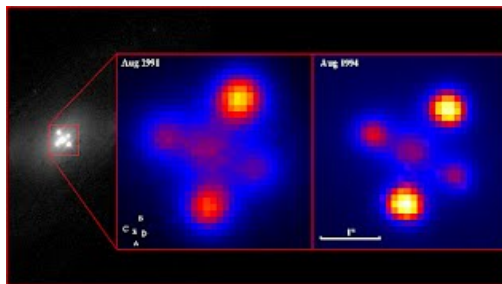
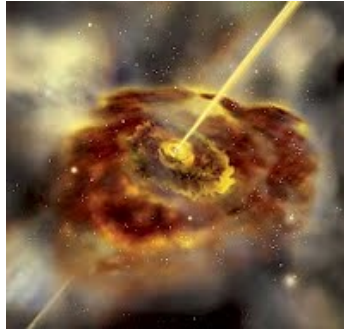


2nd Workshop on Active Galactic Nuclei and Gravitational Lensing

Serbia, Andrevlje April 24-28, 2012.

BOOK OF ABSTRACTS

Eds. Luka Č. Popović, Wolfram Kollatschny and Milan S. Dimitrijević



Society of Astronomers of Serbia, Belgrade 2012

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Organized by Serbian Astronomical Society (<http://www.das.org.rs/>)

Co-organizer: Astronomical Observatory, Belgrade (<http://www.aob.rs>)

Supported by: Alexander von Humboldt Foundation (<http://www.avh.de/web/home.html>)

Ministry of Education, Science and Technological Development of Serbia
(<http://www.mpn.gov.rs>)

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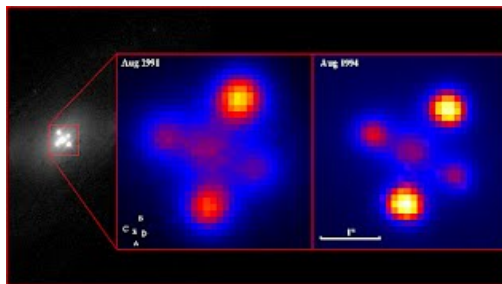
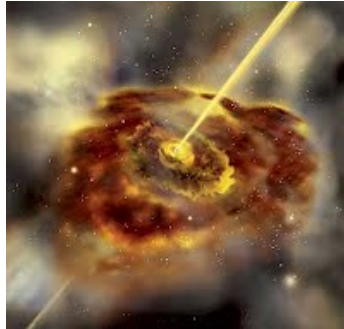
Saša Simić (Faculty of Sciences, University of Kragujevac, Serbia)

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The aim: The investigation of nature of the emitting ionized gas in galactic nuclei is one of important subjects in astrophysics today. Firstly, investigating the processes in the central parts of these objects, we can learn about the innermost parts of other 'normal' galaxies. Secondly, AGN are the most powerful sources, located at different cosmological time-scales, and their investigation is cosmologically important. Finally, a part of emission from these objects (e.g. in the X-rays) has its origin very close to a massive black hole, and investigation of this emission can help us understand the physical processes in a strong gravitational field. On the other side, a number of AGN are affected by gravitational lensing effect. Gravitational lensing is in general achromatic: the deflection angle of a light ray does not depend on its wavelength. However, the wavelength-dependent geometry of the various emission regions may result in chromatic effect. Studies aimed at determining the influence of microlensing on spectra of lensed quasars (hereafter QSOs) ought to account for the complex structure of the QSO central emitting region. Since the sizes of the emitting regions are wavelength-dependent, microlensing by stars in a lens galaxy will lead to a wavelength-dependent magnification.

Many interesting details about the physics of processes that are taking place within AGN can be identified in the signal of their emitting regions (as e.g. Broad Line Region - BLR), but they suffer from a still missing complete picture of the complex kinematical and thermodynamical properties of the line emitting plasma. Since it is not yet possible to directly observe the spatial distribution of the broad line emitting medium, although many important achievements were obtained in the angular resolution of AGN cores at radio wavelengths, spectroscopic data are still the most useful way to investigate physics within the central part of an AGN.

The format of the workshop: The workshop is planned to have five invited lectures, devoted to the special theme based on spectroscopy of AGN and gravitational lenses.

Then work on the special mini-projects will be during whole day.

The idea is to start, continue and finish some mini-projects (which will be published in international astronomical journals) during the workshop.

Contents

V. L. Afanasiev AGN spectropolarimetry on 6-meter telescope – Observation and results	5
Giovanni La Mura, S. Ciroi, V. Cracco, A. Frassati, P. Rafanelli Small telescopes and large surveys: the importance of monitoring campaigns in the study of AGNs	6
Martín Gaskell Putting together line and continuum observations of thermal active Galactic nuclei: A unified picture of the accretion disc and Broad-line region	7
E. Bon, P. Jovanović, P. Marziani, A. Shapovalova, N. Bon, V. Borka Jovanović, D. Borka, L. Č. Popović The Orbit of the supermassive binary black hole from radial velocities	8
P. Rafanelli, G. La Mura Nuclear Activity and Star formation in Galaxies	9
D. Ilić, L. Č. Popović, A. I. Shapovalova, A. N. Burenkov, A. Kovačević, J. Kovačević, W. Kollatschny, V. H. Chavushyan Spectral Optical Monitoring of the Narrow Line Seyfert 1 Galaxy Ark 564	10
J. Kovačević, L. Č. Popović, W. Kollatschny, P. Saikia Balmer continuum in the spectra of AGN	11
Marko Stalevski, Predrag Jovanović, Luka Č. Popović and Maarten Baes Gravitational microlensing of AGN dusty tori	12
S. Simić, L. Č. Popović and L. Grassitelli Modelling the GRB light curves using a shock wave model	13
Wolfram Kollatschny, Matthias Zetzl Structure and kinematics of the central BLR in AGN	14
Program	15
Authors' Index	18
Participants	19

Abstracts

AGN SPECTROPOLARIMETRY ON 6-METER TELESCOPE – OBSERVATION AND RESULTS

Afanasiev V. L.

We discuss the reasons of radiation polarization radiation in the spectra AGN. The results of polarization observations in the continuum of a sample QSO and Sy1 are presented. As a result, based on traditional accretion disk models, we have determined the magnetic field strength and distribution, and a number of physical parameters of the accreting plasma in the region where the optical radiation is generated.

For two objects – the galaxies Mkn 6 and 3C390.3 we compare the spectropolarimetry in the spectral coverage of 0.4-0.7 μm for different epoch are to the broadband photometry data.

SMALL TELESCOPES AND LARGE SURVEYS: THE IMPORTANCE OF MONITORING CAMPAIGNS IN THE STUDY OF AGNs

Giovanni La Mura, S. Ciroi, V. Cracco, A. Frassati, P. Rafanelli

Active Galactic Nuclei (AGN) are among the most mysterious and fascinating objects that populate the Universe. In spite of their extremely compact nature, which sees the ultimate source of energy located in a region that is smaller than 1pc across, their power challenges the luminosity of large galaxies, such as the Milky Way. The most widespread interpretation for such a high energy efficiency is the identification of the nuclear power source with the accretion process of matter in the gravitational field of a Super Massive Black Hole (SMBH). The presence of a distribution of dusty molecular gas is responsible for the obscuration of the central energy source, along some specific lines of sight, resulting in a wide variety of observational characteristics.

However, even in the case when a direct line of sight to the central engine is available, the size of the accreting source is so small that we are not able to get resolved images of the nucleus. Therefore, the determination of the nature, the size and the structure of the central engine requires the application of advanced observational techniques.

Basically, it is known that the accretion process results in the emission of a strong and variable continuum of ionizing radiation, which interacts with the surrounding matter, giving rise to the emission of several recombination lines. These spectral features have characteristic profiles, which depend on the dynamics of the line emitting gas. Studying the variability properties of AGN spectra, it was shown that the emission lines actually respond to the light curve of the ionizing continuum with a delay and a behavior that are controlled by the size and structure of the line emitting region. The Reverberation Mapping technique (RM), which reconstructs the continuum and emission line light curves, through regular observations of targets, is able to derive accurate estimates of the source size and kinematical configuration, thus constraining very well the properties of the central SMBH.

Here we report on the contribution brought by small observatories in providing the appropriate coverage for regular target observations. The application of RM to several objects represents our next step in the interpretation of AGN physics. Extending the source monitoring campaigns over long periods of time and on a wide sample of targets is fundamental to improve the accuracy of the method, to investigate the broad band properties of sources detected in other wavelengths, and to provide a reliable calibration framework to understand the role of AGNs throughout the Universe.

**PUTTING TOGETHER LINE AND CONTINUUM OBSERVATIONS OF THERMAL
ACTIVE GALACTIC NUCLEI: A UNIFIED PICTURE OF THE ACCRETION DISC
AND BROAD-LINE REGION**

Martín Gaskell

I will demonstrate that the radial structure of the accretion disc in thermal active galactic nuclei (AGNs) is well constrained by observations of the UV–optical spectral energy distribution. The observed optical flux therefore gives the scale of the accretion disc. The scale factor is consistent with the outer edge of the disc being the dust sublimation radius measured by near IR reverberation mapping. Since reverberation mapping observations also show that the dust sublimation radius is the outer edge of the broad-line region (BLR), the accretion disc and the BLR must occupy the same radius. All observations of the BLR are consistent with it being a turbulent disc. The covering factor and vertical component of velocity are well constrained. Observations of continuum and line variability require continuum variations in thermal AGNs to be highly non-axisymmetric. A unified picture of the accretion disc and BLR is sketched where a significant fraction of the gravitational potential energy released by accretion is stored in the magnetic field and released in magnetic reconnection events. These produce the observed, strong, off-axis flares, expel broad-absorption-line clouds, and provide the particle acceleration needed for the corona. Furthermore, magnetic loops offer the possibility of explaining the confinement, vertical velocities, height, filling factor, and survival of the broad-line region.

THE ORBIT OF THE SUPERMASSIVE BINARY BLACK HOLE FROM RADIAL VELOCITIES

**E. Bon, P. Jovanović, P. Marziani, A. Shapovalova, N. Bon, V. Borka Jovanović,
D. Borka, L. Č. Popović**

We used optical spectra of over 20 years of observations of NGC 4151, observed from 1986 to 2006, and found periodicity of the flux variations of about 5700 days, in the lines, continuum and some parts of the line profiles. Using Gaussian decomposition of line profiles we obtained orbital elements from each component velocity curves and found that they could correspond to the binary system of supermassive black holes on eccentric orbit of sub-parsec scale, with a period of 5780 days.

NUCLEAR ACTIVITY AND STAR FORMATION IN GALAXIES

Rafanelli P., La Mura G.

The existence of correlations among nuclear properties of galaxies, such as the mass of their central black holes, and larger scale features, like the bulge mass and luminosity, represent a fundamental constraint on galaxy evolution. Although the actual reasons for these relations have not yet been identified, it is widely believed that they could stem from a connection among the processes that lead to black hole growth and stellar mass assembly. The problem of understanding how the processes of nuclear activity and star formation can affect each other became known to the literature as the Starburst-AGN connection. Despite years of investigation, the physical mechanisms which lie at the basis of this relation are known only in part. In this communication, we analyze the problem of star formation and nuclear activity in a large sample of galaxies. We study the relations among the properties of the nuclear environments and of their host galaxies. We find that the mass of the stellar component within the galaxies of our sample is a critical parameter, that we have to consider in an evolutionary sequence, which provides further insight in the connection among AGN and star formation processes.

**SPECTRAL OPTICAL MONITORING OF THE NARROW LINE SEYFERT 1
GALAXY Ark 564**

**D. Ilić, L. Č. Popović, A. I. Shapovalova, , A. N. Burenkov, A. Kovačević,
J. Kovačević, W. Kollatschny, V. H. Chavushyan**

We will talk about the analysis and results of a long-term (1999-2010) spectral optical monitoring campaign of the AGN Ark 564. This active galactic nuclei shows a strong Fe II line emission in the optical, typical of a special group of AGNs called the narrow line Seyfert 1 (NLS1) galaxies. Even though we found that this NLS1 galaxy is not varying much during the monitoring period, there are some interesting results regarding the H α and H β emission lines, as well as the Fe II emission, which will be presented here.

BALMER CONTINUUM IN THE SPECTRA OF AGN

J. Kovačević, L. Č. Popović, W. Kollatschny, P. Saikia

In order to investigate the correlations between AGN spectral properties in optical and UV range, we first need to subtract well continuum emission as well as pseudocontinuum (Balmer continuum) in the AGN spectra. We analyzed the shape of Balmer continuum in the sample of 100 AGN spectra, obtained from SDSS (DR7). We found that model which consists of power law + Balmer continuum (for $\lambda < 3646 \text{ \AA}$), but also high order Balmer lines ($n < 400$), describes well continuum and pseudocontinuum in UV/optical range.

GRAVITATIONAL MICROLENSING OF AGN DUSTY TORI

Marko Stalevski, Predrag Jovanović, Luka Č. Popović and Maarten Baes

We investigated gravitational microlensing of AGN dusty tori in the case of lensed quasars in the infrared domain. The dusty torus is modeled as a clumpy two-phase medium. To obtain spectral energy distributions and images of tori at different wavelengths, we used the 3D Monte Carlo radiative transfer code SKIRT. A ray-shooting technique has been used to calculate microlensing magnification maps. We simulated microlensing by the stars in the lens galaxy for different configurations of the lensed system and different values of the torus parameters, in order to estimate (a) amplitudes and timescales of high magnification events, and (b) the influence of geometrical and physical properties of dusty tori on light curves in the infrared domain. We found that, despite their large size, dusty tori could be significantly affected by microlensing in some cases, especially in the near-infrared domain (rest-frame). The very long timescales of such events, in the range from several decades to hundreds of years, are limiting the practical use of this method to study the dusty tori properties. However, our results indicate that, when studying flux ratios between the images in different wavebands of lensed quasars, one should not disregard the possibility that the near and mid-infrared flux ratios could be under the influence of microlensing.

MODELLING THE GRB LIGHT CURVES USING A SHOCK WAVE MODEL

S. Simić, L. Č. Popović and L. Grassitelli

We discuss main topics of Gamma Ray Burst (GRB) phenomena with special attention on the mechanisms for gamma-ray creation and observed temporal variability of GRB light curve. We have demonstrated the applicability of modified internal shock wave model to fit the GRB light and spectral curves of 30 GRBs observed with BATSE. From the best fitting, we obtain basic parameters of the relativistic shells. It is shown that calculated parameters are in good agreement with predictions given earlier. We compare measured GRB parameters with those obtained from the model and discuss connections between them in the frame of the physical processes laying behind GRB events.

STRUCTURE AND KINEMATICS OF THE CENTRAL BLR IN AGN

Wolfram Kollatschny, Matthias Zetzl

We will present recent results based on spectral variability campaigns of selected AGN taken with the 10m Hobby Eberly Telescope. Based on the variability of integrated line intensities with respect to variations of the continuum we deduce the distances of the line emitting regions from the central ionizing source. In combination with the line widths we derive the masses of the central black holes. Line profile variations give us information on kinematics and structure of the line emitting broad line region.

Finally we will present a newly detected trend of emission line widths with respect to their shapes in a sample of dedicated AGN line profiles. This general trend can be explained by the existence of different rotational velocities in the AGN broad line regions in combination with turbulent velocities belonging to the emission line regions of the individual lines.

Program

Tuesday, April 24

10:00 – 11:00 Arrival, registration and opening ceremony

11:00 – 11:30 “Overview of present status of investigation of AGNs and GLs by the Group for Astrophysical Spectroscopy”

L. Č. Popović, M. S. Dimitrijević

11:30 – 12:15 “AGN spectropolarimetry on 6-m telescope: observation and results”

V. Afanasiev

12:15 – 13:00 Discussion: Polarization in spectra of AGNs – perspective for investigation

13:00 – 15:00 Lunch break

15:00 – 15:45 “Small telescopes and large surveys: the importance of monitoring campaigns in the study of AGNs”

G. La Mura

15:45 – 18:00 Work on mini-projects

19:00 Cocktail

Wednesday, April 25

10:00 – 10:45 “Nuclear Activity and Star formation in Galaxies”

P. Rafanelli

10:45 – 13:00 Discussion and work on mini-projects

13:00 – 15:00 Lunch break

15:00 – 15:30 “Modelling the GRB light curves using a shock wave model”

S. Simić

15:30 – 18:00 Work on mini-projects

Thursday, April 26

9:00 – 9:45 “Structure and kinematics of the central BLR in AGN”

W. Kollatschny

9:45 – 10:00 “Balmer continuum in the spectra of AGN”

J. Kovačević

11:00 – 19:00 Excursion (with lunch)

Friday, April 27

10:00 – 10:30 “Spectral Optical Monitoring of the Narrow Line Seyfert 1 Galaxy Ark 564”

D. Ilić

10:30 -11:00 "The Orbit of the supermassive binary black hole from radial velocities"

E. Bon

11:00 – 13:00 Discussion and work on mini-projects

13:00 – 15:00 Lunch break

15:00 – 15:30 „Gravitational microlensing of AGN dusty tori in infrared“

M. Stalevski (part of investigation in PhD thesis)

15:30 – 16:30 Progress in MSc theses, present status and problems will be reported by Payaswini Saikia, Zahra Alvi, Luca Grassitelli and Nemanja Rakić (Astromundus students)

16:30 – 18:30 Work on mini-projects

20:00 Conference dinner

Saturday, April 28

10:00 – 12:00 Round table „Perspective in investigation of AGNs and GLs“

12:00 – 12:15 Closing ceremony

13:00 Departure to Belgrade

List of mini-projects

MP1. Spectroscopy of gravitational lenses (Moderator: L. Č. Popović)

MP1.1. Spectro-photometric variability of quasars caused by microlensing:
Consequences on Gaia measurements

Participants: L. Č. Popović, S. Simić, M. Stalevski

MP2. Long term variability of AGN: spectroscopic observations (Moderator:
W. Kollatschny)

Participants: W. Kollatschny, D. Ilić, A. Kovačević, J. Kovačević, L. Č.
Popović, V. Afanasiev, N. Rakić

MP3. The physics and structure of the Broad Emission (Absorption) Line Region in Active Galactic Nuclei (Moderator: M. Gaskell)

Participants: M. Gaskell, L. Č. Popović, J. Kovačević, E. Lyrtzi, E. Danzis

MP4. Stellar population in AGN and connection between X-ray and optical emission in AGNs (Moderator: P. Rafanelli)

Participants: P. Rafanelli, L. Č. Popović, G. La Mura

MP5. Atomic data for astrophysics: VAMDC & SerVO (Moderator: M. S. Dimitrijević)

Participants: Nenad Milovanović, Magdalena Hristova, Andjelka Kovačević, Zoran Simić, E. Danzis

MP5.1. Stark broadening of B IV and S II lines (Moderator: Milan S. Dimitrijević)

Participants: Magdalena Hristova, Andjelka Kovačević, Zoran Simić, Nenad Milovanović

MP6. Gamma ray bursts (Moderator: S. Simić)

Participants: S. Simić, L. Č. Popović, L. Grassitelli

MP7. Astronomy in Serbian culture

Participants: M. S. Dimitrijević, Jovan Aleksić

Authors' Index

- | | |
|----------------------|-----------------------------------|
| Afanasiev V. L. 5 | Jovanović Predrag 8, 12 |
| Baes Maarten 12 | Kollatschny Wolfram 10, 11, 14 |
| Bon E. 8 | Kovačević A. 10 |
| Bon N. 8 | Kovačević J. 10, 11 |
| Borka D. 8 | La Mura Giovanni 6, 9 |
| Borka Jovanović V. 8 | Marziani P. 8 |
| Burenkov A. N. 10 | Popović Luka Č. 8, 10, 11, 12, 13 |
| Chavushyan V. H. 10 | Rafanelli P. 6, 9 |
| Ciroi S. 6 | Saikia P. 11 |
| Cracco V. 6 | Shapovalova A. I. 8, 10 |
| Frassati A. 6 | Simić S. 13 |
| Gaskell Martín 7 | Stalevski Marko 12 |
| Grassitelli L. 13 | Zetzi Matthias 14 |
| Ilić D. 10 | |

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