VII Serbian Conference on Spectral Line Shapes in Astrophysics

15-19 June 2009, Zrenjanin, Serbia

BOOK OF ABSTRACTS

Eds. Luka Č. Popović, Milan S. Dimitrijević,
Darko Jevremović and Dragana Ilić

Serbian Astronomical Society and Astronomical Observatory

Belgrade, 2009

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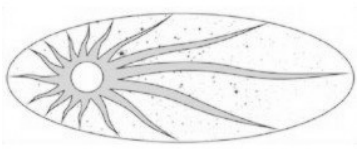

Serbian Astronomical Society and Astronomical Observatory

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Invited lecture

A NEW VIEW ON THE ISM OF GALAXIES: FAR-INFRARED AND SUBMILLIMETRE SPECTROSCOPY WITH HERSCHEL

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The far-infrared and submillimetre window is amongst the least explored spectral regions of the electromagnetic spectrum. It is, however, one of the most interesting regions to study the interstellar medium of both the Milky Way and other galaxies. Roughly 30% of the bolometric luminosity of galaxies is emitted in the FIR/submm region. Moreover, the FIR/submm region contains important spectral diagnostics, including many rotational lines from molecular gas (CO, H_2O,...) and fine structure lines from atomic gas.

The European Herschel Space Observatory, to be launched in April 2009, will be the first ever instrument to cover the entire range between 60 and 600 μm. Onboard will be three instruments: PACS and SPIRE are two imaging spectrographs, HIFI is a high-resolution submillimetre spectrograph. In this talk we will discuss the enormous science potential of the Herschel mission and the main extragalactic key programs planned. We will focus on the wealth of spectral lines in the FIR/submm region and what they can teach us about the interstellar medium in nearby galaxies.

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Invited lecture

AB INITIO CALCULATIONS OF STARK BROADENING PARAMETERS

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We need energy levels and oscillator strengths for calculating Stark broadening parameters. Generally we use recent theoretical or experimental data; we can also use one of the atomic databases as NIST or TOPBase.

For some emitters there is a big discrepancy between the different atomic data from different sources which influence the Stark broadening results.

In a recent paper (Hamdi et al., 2007) have been calculated ab initio impact line widths and shift for 26 Ne V multiplets using SUPERSTRUCTURE code for energy levels and oscillator strengths and the semiclassical approach for the Stark parameters.

In an other recent work, (Milovanović and Dimitrijević, 2007) have been calculated ab initio Stark broadening parameters of 5 multiplets of S II, 3 multiplets of S III and 2 spectral lines of S IV using Cowan code for the atomic data (energy levels) needed and the modified semi-empirical approach (MSE) for the width calculations. Results are compared with those calculated using energy levels taken from NIST atomic spectra database.

The ab initio methods are interesting because they do not need any additional data; the atomic data necessary to the Stark broadening parameters (energy levels and oscillator strengths) are calculated using SUPERSTRUCTURE or Cowan codes or any other atomic packages.

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Invited lecture

PLASMA OF NOBLE GASES AND THEIR MIXTURES AT ATMOSPHERIC PRESSURE

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A common characteristic of most technological applications of plasmas today is that the plasmogen gas is made up of a gas mixture. Several applications, such as metal surface nitriding, medical instrument sterilization and chemical analysis have been developed or improved in this way.

Research carried out on these subjects covers the aspect of knowing the processes that take place in the plasmas which depend on the densities of the different plasma particles and their energy values. Because of this it is important to measure the values of plasma parameters (densities and temperatures) in order to comprehend the physical behaviour of plasmas used with the purpose of their practical applications.

Emission spectroscopy techniques are non-invasive and allow us to obtain information about the plasma parameters analyzing the radiation emitted by the discharge. In this way, starting from the intensities and broadenings of the spectral lines, which appear in these spectra, we obtain information regarding the plasma parameters.

Nevertheless, spectroscopic diagnosis methods usually consider the case of single gas discharges, but when more than one kind of gas is present in a discharge the interaction among the different particles can have an important influence over the profiles of the plasma spectral lines. Therefore, research on the application validity of the methods developed for single gas plasmas to gas mixture plasmas is necessary.

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Invited lecture

HIGH VELOCITY WINDS FROM NARROW AND BROAD ABSORPTION LINE QUASARS

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The current paradigm for the AGN phenomenon is a central engine that consists of an inflow of hot material accreting in the form of a disk onto a supermassive black hole. Observations in the UV and optical find powerful and high velocity ionized material outflowing from the black hole. I will present recent X-ray observations of AGN that suggest the presence of near- relativistic outflows of ionized absorbing material with velocities of up to 0.7c. These studies indicate that these winds may be important in regulating the growth of the supermassive black hole, controlling the formation of the host galaxy, and enriching the intergalactic medium. Based on our recent X-ray and optical observations of AGN with highly blueshifted narrow and broad absorption lines I will present a unified picture to describe the outflow properties of most quasars.

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Invited lecture

THE SEARCH FOR ^{6}Li IN ACTIVE LATE-TYPE STARS

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We have been investigating if ^{6}Li can be produced by spallation by stellar flares in accordance with model predictions. ^{6}Li enhancement has been unexpectedly found in several dwarf halo stars, for energetic solar events, and intriguingly during a flare for one chromospherically active binary. We observed a sample of EUV-selected active late-type stars with the VLT and UVES and found a $\frac{^6Li}{^7Li} = 0.03 \pm 0.01$ for active K dwarf GJ 117 (Christian et al. 2005). Other stars in our sample, GJ 182, EUVE J1145-53.5, and EUVE 2056-17.1 had lower signal-to-noise and larger rotational velocities, and only upper limits of a few percent were found for their ^{6}Li fraction. We recently confirmed the result for GJ 117 with high signal-to-noise (>1000) high spectral resolution observations taken with the McDonald Observatory's 2.7m. Our analysis has used PHOENIX model atmospheres code and we have taken care to include other lines that may effect the lithium line profile, such as Ti I. We have also recently expanded our sample with VLT UVES observations of two X-ray selected T Tauri stars and will present these results along with the other stars in our sample. We will discuss if the measured ^{6}Li in these objects is consistent with their activity levels and production in spallation reactions.

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Invited lecture

MULTIPLE PERTURBER EFFECTS DUE TO H-He COLLISIONS IN THE FAR RED WING OF Lyα LINE

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In Allard and Kielkopf (2009) we presented a temperature and density dependence of the Lyman α line wing in DA white dwarfs atmospheres. In that paper we pointed out that the importance of close collisions of many perturbers leads to the formation of a series of satellites in the far red wing of Lyman α. Our study was restricted to H-H collisions but other perturbing species are also present in cool white dwarf atmospheres. We have now included the effects of He on the Lyman α profile. Multiple-perturber effects due to the $X \rightarrow C$ transition of H-He profiles appear in the blue wing. We will present our new study of the red wings of Lyman α perturbed by H and He.

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Invited lecture

INTERPRETING THE COMPLEX LINE PROFILES IN THE STELLAR SPECTRA

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One of the most important phenomena in the spectra of hot emission stars and some quasars is the appearance of Discrete Absorption Components (DACs) and Satellite Absorption Components (SACs). In order to explain the complex structure of the density regions of hot stars, where the spectral lines that present SACs or DACs are created, our team proposed a new model, named GR model (Gauss-Rotation model). The main hypothesis of this model was that in the stellar envelop, we can detect a number of independent and successive absorbing or emitting spherical density regions of matter. In this study we present a new approach of the GR model that supposes a number of independent but not successive absorbing or emitting spherical density regions of matter. Finally, we present an explanation of the very large line broadening that we detect in the spectra of hot emission stars (Be and Oe stars), which is not possible to explain with the classical theory.

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Invited lecture

DOUBLE-PEAKED EMISSION LINES AS A PROBE OF THE BROAD-LINE REGIONS OF ACTIVE GALACTIC NUCLEI

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Broad, double-peaked, Balmer emission lines are found in the optical spectra of a relatively small fraction of active galactic nuclei. They can be an extremely useful diagnostic for the structure and dynamics of the "broad line region" (the medium that emits the broad emission lines). In general terms the rarity and shapes of their profiles provide strong constraints on universal models of the broad-line region. A series of observational tests and basic physical considerations suggest that these lines are emitted from a flat, rotating disk, very likely the outer parts of the accretion disk that fuels the black hole. In the context of models for accretion disk winds, double-peaked emission lines originate in disks with feeble winds of low optical depth, therefore, they provide evidense that the outer accretion disk and its associated wind as the source of the broad emission lines. Within this framework, double-peaked Balmer emission lines and corresponding high-ionization lines in the near-ultraviolet allow us to study the conditions under which the winds become dense and the onset of significant outflows. Moreover, double-peaked emission lines give us a direct view of the dense material of the disk proper and allow us to study dynamical perturbations and other transient behavior though the long-term variability of their profiles.

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Invited lecture

WHAT SPECTRAL LINE SHAPES TELL US ABOUT HOW AGNs WORK

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Two necessary steps in understanding how AGNs work, and using them to probe the cosmic evolution of supermassive black holes, are knowing what AGNs look like, and knowing how the material in them is moving. The total and polarized fluxes of the broad emission lines of AGNs give our most important probe of the structure and kinematics of the material around the central black holes. Thanks to these studies, a fairly consistent picture of the structure and kinematics of the broad-line region gas is emerging. Single-epoch, time- averaged, or root-mean-square profiles all show that the widths of broad lines increase with ionization potential, and that the profiles of high-ionization lines are systematically blueshifted with respect to the low-ionization lines. The profiles of low-ionization lines probably all have a component with displaced double peaks, which indicates Keplerian motion in the equatorial plane. Time variability of the total fluxes of broad emission lines gives responsivity-weighted radii of the emitting regions. These radii are correlated with the velocity of the gas and with ionization potential. Time variability of the line shapes shows that the bulk of the gas responsible for the observed broad emission lines is virialized, and that there is also a net inflow of this gas. The blueshifting of the high-ionization lines shows that there is increasing scattering in the inner regions. Energetic considerations, and the lack of observed absorption from the broad-line region, require the gas to have a flattened distribution with a covering factor similar to that of the dusty torus. This high covering factor, and the statistics of the shapes of the broad lines, require there to be a substantial component of motion perpendicular to the equatorial plane. Despite the consistency of this overall picture of the broad line region and torus, a large number of fascinating questions remain that require further observational and theoretical study.

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RYDBERG ATOMS IN ASTROPHYSICS

Yuri N. Gnedin[1], Mikhail Yu. Piotrovich[1], Anatolij A. Mihajlov[2], Ljubinko M. Ignjatović[2], Mikhail Yu. Zakharov[3], Nikolay N. Bezuglov[3] and Andrey N. Klyucharev[3]

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We present the results of spectropolarimetric and photometric observations of isolated magnetic white dwarfs made at 6-m telescope of the Special Astrophysical Observatory of the Russian Academy of Sciences (spectropolarimetry) and at $1.1-mAZT-24$ telescope of the Pulkovo Observatory, located in Campo-Imperatore, Italy (infrared photometry). The observed effects - rotation of the polarization plane and depression of the IR radiation of white dwarfs with strong magnetic fields are explained by the absorption of radiation by collisionally-excited Rydberg atoms in the strong magnetic field. By analogy with well-known collision-induced absorption (CIA) in cool dwarfs we call this effect in magnetic white dwarfs by "magnetic CIA". These and other new experimental results require an improvement a known constant of elementary processes (with Rydberg atoms) experimental data.

Rydberg's atoms give a significant contribution to the kinetics of the solar atmosphere, taking a part in chemi-ionization/recombination atomic collision processes, as well as in the processes of (n-n')-mixing. It has been shown that both type of processes have an important role in the large region of the Solar atmosphere, where they are comparable, or even dominant, to the other relevant processes. Because of that the chemi-ionization/recombination and (n-n')-mixing processes in symmetric atom-Rydberg atom collisions have to be included in any modeling of the weakly ionized layers in the Solar atmosphere, especially in the region of the temperature minimum in the Solar photosphere. In a stochastic ionization model interesting moments arise in the presence of highly excited states when collision complexes with multiple level crossings and overlapping dynamic resonances are formed, which evolve to fragmentations through various channels. Such evolution is associated with random, stochastic changes of the energy state of Rydberg electron, and they are likely to influence the nuclear dynamics. An important feature of kinetics coefficients of the corresponding Fokker-Plank equations consists of their dependence on dipole matrix elements of optical transitions. This allows manipulating and even blockading the regime of chaotic

dynamics du to changes of interatomic potential by external fields in the vicinity of Foster resonance. Foster resonance corresponds to the double photon resonance, i.e. a Rydberg l-state should be situated exactly in the middle between two neighbor l'=l+1-states (or l-1-states). Quantitatively, this situation occurs when the difference between quantum defects of the states equal to 1/2 and is known as Seaton criterion for suppressed the corresponding dipole matrix elements. The latter can be realized in astrophysical samples (plasma, or dust, for instance) containing alkalis neutral atoms due to the Stark or Zeeman shifts of levels under the presence of electrical/magnetic fields. Experimentally, it is manifests itself as an anomalous weak fluorescence of the radiation escaping from a star/planet atmosphere or as a reduced ionization channel output in chemiionization reactions.

Invited lecture

ACCURATE COLLISIONAL BROADENING PROFILES FOR ALKALI RESONANCE LINES IN SUBSTELLAR ATMOSPHERE MODELS

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The optical and far red (up to 1 μm) spectral energy distribution of the coolest substellar atmospheres is shaped by prominent absorption features due to the alkali resonance lines of Na I and K I. Broadening by collisions with neutral perturbers, predominantly molecular hydrogen and helium, can extend the far wings of these lines out to several 1000 Å. In the dense and mostly dust-free and clear atmospheres of T dwarfs these lines, together with the weaker features of the less abundant alkalis Li, Rb and Cs, probe the photosphere over many pressure scale heights. The resulting spectral profile is a product not only of interactions with perturbers at far and near distances, but as well of thermal structure and the distribution of neutral alkali gases as a function of height. It allows thus to test models for convection-driven energy transport and vertical mixing extending into the overshoot region, and for the efficiency of condensation. Observations of such lines in brown dwarf spectra provide an important test case for the understanding of these same processes in extrasolar gas giant planets, including the more complex case of irradiation in hot Jupiters.

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Invited lecture

THE CHEMI-IONIZATION PROCESSES IN THE SOLAR PHOTOSPHERE

Ljubinko M. Ignjatović[1], Anatolij A. Mihajlov[1], Nenad M. Sakan[1], Vladimir A. Srećković[1], Milan S. Dimitrijević[2], Darko Jevremović[2]

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In this work it is examined the role of the chemi-ionization processes in symmetric atom-Rydberg atom collisions from the aspect of the influence on the hydrogen Rydberg atom populations in the solar photosphere. Here we keep in mind the processes:

$$H^*(n) + H(1s) \rightarrow H(1s) + H^+ + \overrightarrow{e},$$

where principal quantum number $n \gg 1$, and $\overrightarrow{e}$ denotes the free electron. By now such and similar chemi-ionization processes were considered in connection with the atmospheres of some M red dwarfs and some DB white dwarfs. However the conditions in plasma of the solar photosphere should also provide the possibility of the occurring of the described chemi-ionization processes. Because of its importance, examination of any new process which could influence on its properties deserves an especial research. In this work the intensivities of the described chemi-ionization processes were determined as the function of the temperature T and the hydrogen atom densities $N(n)$, where $n \geq 1$, within the solar photosphere on the base of the existing standard non-LTE model. Than intensities were compared with the intensities of the processes of the ionization of $H^*(n)$ atoms by electron impact. It was shown that in the especially important region $n \leq 10$ intensities of described chemi-ionization processes are dominant, or at list are comparable with the intensities of mentioned electron-Rydberg atom ionization processes. Consequently the results obtained in this paper suggest the necessity of the including of the described chemi-ionization processes in future models of the solar photosphere.

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Invited lecture

THE CONNECTION BETWEEN SPECTROSCOPY OF LABORATORY AND ASTROPHYSICAL PLASMAS

Milorad M. Kuraica[1,2], Bratislav M. Obradović[1,2], Nikola Cvetanović[2,3], Ivan P. Dojčinović[1,2] and Jagoš Purić[1,2]

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In this paper the results of polarization Stark spectroscopy and Doppler measurements in several types of electric gas discharges and plasma sources are described. Methods were developed for measuring the static electric field in hydrogen and helium discharges using Stark polarization spectroscopy. Special technique has been developed for electric filed strength measurement based on line shift and intensity ratio of forbidden and allowed HeI lines in the range of 5-100 kV/cm. Also, as an example, spectrum in the vicinity of these lines recorded in a fast-fluctuating field is presented. In addition, results are presented of plasma electron density measurement in the range of 10^{14}-10^{17} cm^{-3} applying the same method, but in the presence of Holtzmark field. Doppler spectroscopy has been used to obtain results for H atom velocities in the range from 100 km/s (Grimm type discharge) to 400 km/s (1 keV) in the electrostatic confinement discharge. A Monte-Carlo code for transport of high energy hydrogen atoms and for generating Doppler profiles is developed. In the separate experiment (MPC) plasma jets are generated where plasma is accelerated to velocities up to 100 km/s. Careful interpretation of spectra is needed in the conditions where several effects are present simultaneously: electric and magnetic field, both with Doppler effect. Several examples are shown where these mentioned methods may be directly applied on plasma dynamics in astrophysics.

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3D SPECTROSCOPIC STUDY OF GALACTIC RINGS: FORMATION AND KINEMATICS

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Different types of ring structures hosted in galaxies are considered. Rings are an interesting problem on galaxy morphology related to the some fundamental aspects of evolutions and dynamics of galaxies: a dark matter distribution, galactic interactions, an internal secular evolution. A significant fraction of rings formed in a disk under the action of gravity torques from a bar-like pattern. In contrast with this internal origin, a phenomenon of polar-ring galaxies is closely connected with processes of interactions and merging. A more rare class of colliding rings represents density waves triggered in a disk after a strong bulls-eye collision with a companion. I briefly review the problem of gas kinematics in rings of different origin. An ionized gas velocity field taken with Fabry-Perot interferometer at the SAO RAS 6-m telescope provide an important information for this study.

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Invited lecture

SPECTRAL LINE SHAPES IN COOL STARS

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Accurate pressure broadened profiles of alkali resonance doublets are needed for modelling of the atmospheres of late M, L and T type brown dwarfs and for generating their synthetic spectra in the region 600 - 900 nm. In the solar spectrum, many transitions in sodium have been observed for which atomic hydrogen is the main perturbing species.

When the usual impact theory of line broadening is used, the profile is simply Lorentzian and the widths and shifts of the lines can be calculated, provided that interaction potentials for the emitter-perturber system are available. However when the lines utterly dominate their region of the spectrum, it becomes important to be able to obtain complete profiles in which the line-wing profiles are accurately represented where the impact theory is no longer valid. The original development of line broadening theory as presented in the papers by Baranger (1958a-c) is reexamined and calculations have been carried out in which it is shown that it is not necessary to invoke the impact approximation. Allowance is also made for a varying dipole moment which can be important for the line-wing shapes.

Results will be presented at the Conference.

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Invited lecture

NUCLEAR ACTIVITY AND STAR FORMATION PROPERTIES OF SEYFERT GALAXIES

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In the light of the recent results in literature and thanks to the growing availability of spectroscopic data from very large and homogeneous surveys, the search for a possible link between nuclear activity and nuclear star formation in galaxies has become a rapidly evolving topic. In order to achieve a better understanding of the correlations between the presence of young stellar populations in the nuclei of galaxies and the presence of AGN-driven activity, we have extracted two samples of $\sim$ 1300 starburst galaxies and $\sim$ 2000 Seyfert 2 galaxies respectively from the DR7 SDSS spectroscopic dataset using the classical spectroscopic diagnostic diagrams. Then we have investigated the continuum distribution of both samples of galaxies and determined the mixtures of stellar components responsible for their shapes and compared these results with those obtained for a sample of normal galaxies. In this communication we present the preliminary results obtained using this procedure.

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Invited lecture

COLLISIONAL LINE BROADENING VERSUS COLLISIONAL ATOMIC DEPOLARIZATION AND ASTROPHYSICAL APPLICATIONS

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As well known, interpretation of spectral line shapes is essential for spectroscopic modeling in laboratory and in astrophysics. Line broadening by collisions offers a tool for spectroscopic diagnostics of scalar physical quantities, especially densities of perturbers. Thanks to the growing accuracy and sensitivity of spectrpolarimetric observations and to the progresses of MHD modeling, interpretation of all the Stokes parameters of spectral lines nowadays becomes crucial and new tools leading to determination of vectorial (or anisotropic) physical quantities have been created and are of increasing interest. In particular, interpretation of atomic polarization enables to determine magnetic field vectors, velocity field vectors, and also to interpret anisotropic excitation of the atomic levels by collimated beams of energetic particles.

Atomic polarization leads to a global polarization of the observed line. It is a consequence of a departure from LTE between the Zeeman sublevels, and is due to an anisotropic excitation of the atomic levels. This anisotropic excitation is often the result of the incident radiation field absorption. However, isotropic collisions between Zeeman sublevels try to restore LTE and to destroy this atomic polarization. So, a quantitative interpretation of these spectropolarimetric observations must take into account collisional depolarization (and also the possible polarization transfer between levels). In some cases, collisional depolarization can also be used for determining densities of perturbers.

In fact, collisional line broadening and collisional depolarization are two complementary aspects of the same basic theory: the density matrix theory in the impact approximation. For collisional widths and shifts, we have the pioneering work by Baranger created in the end of the fifties, and followed by many fruitful developements. For atomic polarization, we have the theory of the master equation, created in the end of the sixties and seventies in the pioneering works by Cohen-Tannoudji and coworkers. It has also been followed by many fertile developments, in particular for astrophysics. The main aspects will be presented in parallel and astrophysical results, especially for solar physics, will be given.

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Invited lecture

EVOLUTION OF THE BROAD EMISSION LINE PROFILES IN SOME AGN

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An important question in the study of active galactic nuclei (AGN) is the nature of the "central engine". A popular assumption is that the nuclear activity is caused by accretion of gas onto a supermassive black hole. The Broad Line Region (BLR) where broad emission lines form consists of gas obviously linked with the accretion process onto a supermassive black hole and enormous energy fluxes are generated and radiated in this region. It is therefore important to know its structure and kinematics in order to get an insight into the "central engine". However, even for nearby objects, the typical angular size of the BLR corresponds to < 0.001 arcsec, hence we will have to wait for the availability of more sensitive optical interferometers to resolve it. That is why to study BLRs only indirect methods are used. At present the main method for defining quantitative characteristics of the "central engine" including BLR is the spectral and photometrical monitoring of the active galactic nuclei (AGN) by the "Reverberation mapping". It is well known that AGNs vary in luminosity on time scales from years to hours, over the whole wavelength range from radio to X-rays or γ-rays. In particular, the flux in the broad emission lines varies in response to changes in the ionizing continuum with short time delays (days to weeks for Seyfert galaxies), due to light-travel time effects within the BLR. If the BLR gas has systematic motions such as infalling, outflowing, circular motions, etc., then the profiles of the broad

emission lines must vary in a way related with geometry and kinematics of gas in this region and with the processes of gas relaxation that follow the changes in the ionizing flux. In this lecture we present results of the long-time variability ($\geq$10 years) between the flux changes in continuum and in the broad emission line profiles for three Seyfert galaxies - 3C 390.3, NGC 4151, NGC 5548. High quality spectra (S/N$>$ 50 in continuum near Hα and Hβ) were obtained in the spectral range $\sim$ 4000 to 7500 Å, with a resolution between 5 and 15 Å, using the 6-m and 1-m SAO's telescopes (Russia), and the GHAO's 2.1-m telescope (Cananea, México). We analyze line profile variations during the monitoring period, using profiles of the Hα and Hβ lines, study different details (bumps, absorption bands) in the profiles of lines, compare variations of the core and wings of the line profiles and investigate different correlations between the broad line flux and continuum flux, and define time lags between the broad lines and continuum, using different CCFs. Also we analyze the Balmer decrement both for the whole line and for line segments. The line profiles were strongly changing during the monitoring period, indicating a complex BLR with 2-3 kinematically distinct regions. We apply different models to fit the complex broad line profiles in order to explain the BLR geometry.

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Invited lecture

SPECTRAL LINE SHAPES MODELING IN LABORATORY AND ASTROPHYSICAL PLASMAS

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Astrophysicists share with laboratory plasma physicists an interest for the details of line shapes emitted in plasmas. Many studies have demonstrated that an exhaustive analysis of spectral line shapes provides invaluable informations on the emitters environment. Ongoing progresses in observations drive a parallel effort in the modeling, since there can be no accurate diagnostic without a deep understanding of the emitter interaction with the plasma. We will illustrate with several examples some of the tools used in our laboratory for modeling the line shapes emitted in weakly coupled plasmas. An old problem concerns the many body dynamic interactions with the emitter occuring in a large range of plasma conditions. We will present some of the tools which are useful, on the one hand for an accurate and ab-initio type description of the line shape, and on the other hand for obtaining a large amount of profiles by a computer efficient model for a real time diagnostic. Interesting application conditions of these models concern magnetized plasmas found in astrophysics or magnetic fusion plasmas. For multi tesla magnetic fields, there can be a complex interplay of Stark and Zeeman effect, and line shape models in plasma conditions of interest in astrophysics and magnetic fusion will be discussed. A more recently studied problem of general interest is the modeling of spectra observed in a plasma with spatially and temporally fluctuating parameters, a common situation in astrophysical conditions. Magnetic fusion plasmas and some laboratory experiments also experience such conditions due to drift wave turbulence. We have identified plasma conditions for which a simple statistical model can be applied for a calculation of the apparent line shape in such plasmas. Results will be shown for both Doppler and Stark dominated profiles.

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Invited lecture

FOLLOWING H_β TO Z∼3

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Studies of broad emission line profiles provide insights into the geometry and kinematics of the central regions of quasar. They also allow direct estimates of the central black hole mass and source Eddington ratio. For all of these studies H_β has been the line of choice both because it can be studied over such a wide z range and because it is thought to arise from a virialized cloud distribution. We have been using VLT ISAAC to follow H_β into the infrared (to $z \sim 3$) providing intermediate z line profile measures in unprecedented numbers (n>50) and high s/n. We report on these measures and compare line profile properties, BH masses and Eddington ratios over a 6dex source luminosity range.

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Progress report

EMISSION LINES AS A TOOL IN SEARCH FOR SUPERMASSIVE BLACK HOLE BINARIES AND RECOILING BLACK HOLES

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Observational paucity of supermassive black hole binaries (SBHB) in centers of galaxies seems to suggest that black hole pairs, created as a natural product of galactic mergers, coalesce on time scales shorter than a Hubble time. More recently, numerical relativistic simulations showed that in certain cases emission of gravitational radiation during a black hole coalescence can produce a kick which can expel a remnant supermassive black hole (SBH) from the center of its host galaxy. Discovery of statistically significant sample of SBHB and recoiling SBH has important astrophysical implications for a range of questions, from understanding the demographics and role of SBH in hierarchical structure formation to their cosmological spin evolution. I will review the observational signatures that are expected to accompany SBHB and runaway black holes along with some of the challenges associated with their modeling. Finally, I will talk about the existing observational evidence for recoiling SBH and SBHB candidates, and comment on models that attempt to explain unusual optical emission-line spectra of these objects.

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Progress report

COMPLEX LINE PROFILES OF AGN – GEOMETRY OF THE BROAD LINE REGION

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The Broad Emission Lines (BELs) in spectra of some Active Galactic Nuclei (AGN) can be very complex indicating a complex BLR geometry. According to the standard unification model one can expect an accretion disk around a supermassive black hole in all AGN. Therefore a disk geometry is expected in the BLR. However, a small fraction of BELs show double-peaked profiles which indicate disk geometry. Here, we discuss a two-component model, assuming an emission from the accretion disk and one additional emission from surrounding region. We compared the modeled BELs with observed ones (mostly broad Hα and Hβ profiles) finding that the model can well describe one-peaked and two-peaked observed profiles.

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Progress report

THE LINE PARAMETERS AND RATIOS AS A PHYSICAL PROBE OF THE LINE EMITTING REGIONS IN AGN

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Here we discuss the physics conditions in the emission line regions (ELR) of active galactic nuclei (AGN), with the special emphasize on the unresolved problems, e.g. the stratification of the Broad Line Region (BLR) or the failure of the photoionization theory to explain the strong observed optical Fe II emission. We use here different line fluxes in order to probe the physics of the ELR, such as the hydrogen Balmer lines (Hα to Hε), the helium lines from two subsequent ionization levels (He II λ4686 and He I λ5876) and the strongest Fe II lines in the wavelength interval $\lambda\lambda 4400-5400$ Å.

In order to estimate the physical conditions (such as the temperature and hydrogen density) of the BLR we use the Balmer and helium line ratios obtained in two ways: (i) using the photoionization code CLOUDY, a spectral synthesis code designed to simulate conditions within a plasma and model the resulting spectrum, and (ii) extracting a sample of AGN from the Sloan Digital Sky Survey (SDSS) database. We investigate these line ratios in order to find conditions in the BLR where so-called Boltzmann-plot (BP) method is applicable. For these special cases, we found correlations between average temperature, hydrogen density and He II/He I line ratio.

Moreover, we present an investigation of the optical Fe II emission in AGN, for which we have used a selected sample of 111 AGN from the SDSS database. The strongest Fe II lines are identified and classified into four groups according to the lower level of the transition: ^{4}F, ^{6}S, ^{4}G and ^{2}D1. We found that kinematical parameters of the Fe II lines suggest the origin of the Fe II lines in an intermediate line region (ILR), i.e. that the Fe II emission is mostly emitted from a region probably located between the NLR and BLR.

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Progress report

THE PROJECT OF SERBIAN VIRTUAL OBSERVATORY AND DATA FOR STELLAR SPECTRA MODELLISATION

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Serbian virtual observatory is a new project whose funding was approved through a grant TR13022 from Ministry of Science and Technological Development of Republic of Serbia. The project objectives are:

-establishing SerVO and join the EuroVO and IVOA;

-establishing SerVO data Center for digitizing and archiving astronomical data obtained at Belgrade Astronomical Observatory;

-development of tools for visualization of data.

Main aim is to publish data obtained by Serbian astronomers as well as to provide astronomers in Serbia with VO tools for their research. In the first three years of the project the main goals are:

-digitization and publishing in VO photo-plates from the archive of AOB (Protić-Benišek et al., 2006);

-publishing, together with Observatoire de Paris, STARK-B - Stark broadening data base containing as the first step Stark broadening parameters obtained within the semiclassical perturbation approach by two of us (MSD-SSB) in VO compatible format;

-make a mirror site for DSED (Darthmouth Stellar Evolution Database - Dotter et al. 2007, 2008) in the context of VO

The digitization and publication in VO of around 15000 photo plates archived on Belgrade Astronomical Observatory, as well as stellar catalogues produced in Serbia, and digitization of astronomical publications, is in progress. Also, together with french colleagues, in progress is the development of the database STARK-B with Stark broadening data of interest for stellar spectra analysis and modeling, produced during more of 30 years of French-Serbian collaboration. It will enter in VAMDC - Virtual Atomic and Molecular Data Center, MOLAT and SerVO.

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Progress report

INFLUENCE OF GRAVITATIONAL MICROLENSING ON BROAD ABSORPTION LINES OF QSOs

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Here we give a brief overview of some investigations of the gravitational microlensing influence of spectral lines of lensed QSOs. Especialy, we consider the microlensing influence on broad absorption lines using a model of an accretion disk covered by an absorbing region. Gravitational microlensing is modeled by ray shooting method which enables us to obtain realistic microlensing patterns. We obtain that microlensing can affect both emission and absorption component of line that depends on dimensions on emission and absorption line regions. Here we give detailed analyses of emission and absorption line shape variations due to gravitational microlensing.

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Progress report

HYDROGEN BALMER EMISSION LINES AND THE COMPLEX BLR STRUCTURE

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Very close to the center of Active Galactic Nuclei (AGN), we can detect the presence of a photo-ionized plasma, that emits a spectrum of several recombination lines, whose profiles, broadened by the Doppler effect of velocity fields largely exceeding $10^3\,\mathrm{km\,s^{-1}}$, led us to introduce the name of Broad Line Region (BLR). Looking at the properties of the broad emission lines, we are now fairly aware about some of the fundamental BLR physics: we know that the plasma is charcterized by a high particle density, where the emission of lines coming from forbidden transitions is suppressed by the large rate of collisions, and that it has an optically thick component, for the ionizing radiation, which accounts for the presence of both high and low ionization stages in the gas. Since this component may only cover a small fraction of the sky, as seen by the central source, we infer that the broad line emitting plasma is arranged in a large number of small emitting clumps. At present, we know very little about the complex kinematical configurations which could support such a scenario. Since we accept that AGN are powered by matter accretion into the gravitational field of Super Massive Black Holes (SMBH), it is likely that this may occur through an accretion disk and that the BLR itself might be considerably flattened. Although there were several attempts to connect the BLR properties with models based on accretion disks, many of them have large difficulties in reproducing the observed spectra. In order to improve our understanding of the physical processes, which occur in the AGN central engines, here we describe the results that we obtained from our analysis of the broad Balmer emission line components. Adopting a technique for kinematical investigation, we show that the emission line broadening functions place some constraints, onto the BLR geometry and orientation, that are in good agreement with a two-component structural model. Therefore, we develop a modified scheme to estimate the mass and accretion rate onto the SMBH and we discuss the intriguing possibility to estimate their influence on the BLR gas thermodynamics.

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Progress report

WAYS OF CREATION OF SACs AND DACs IN THE PLASMA AROUND QUASARS

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In the spectra of some quasars, like PG 0946+301 we can detect clearly the DACs and/or SACs phenomenon. We have explained the observed complex profiles with GR model (Gauss-Rotation model) that has as main hypothesis that in the stellar envelop we can detect a number of independent and successive absorbing or emitting spherical density regions of matter. As the area that contains these spherical density regions is much extended, it is possible that these regions are not successive. However, if this is true, then the GR model must be modified. In this study, we apply the GR model to some spectral lines of quasars in two ways. First, with the classical way of GR model that supposes successive regions and second with a new approach, which supposes independent but not successive regions. Finally, we compare the results of the two methods and try to conclude to the best one in the case of quasars.

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Progress report

STUDYING THE SPECTRAL PROPERTIES OF ACTIVE GALACTIC NUCLEI IN THE JWST ERA

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The James Webb Space Telescope (JWST), due to launch in 2013, shall provide an unprecedented wealth of information in the near and mid-inrared wavelengths, thanks to its high-sensitivity instruments and its 6.5 m primary mirror, the largest ever launched into space. MIRI, the Mid-InfraRed Instrument onboard JWST, equipped with two Integral Field Units (for medium-resolution 2D spectroscopy) and a low-resolution spectrograph, will play a key role in the study of the spectral features of Active Galactic Nuclei in the 5-28 micron wavelength range. This talk aims at presenting an overview of these possibilities, in order to prepare the astronomical community for the JWST-era.

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Progress report

MODELLING OF MERCURY ISOTOPES SEGREGATION IN CP STELLAR ATMOSPHERES: RESULTS AND PROBLEMS

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An essential topic of our investigations during more than last decade has been study of evolutionary segregation of heavy metals and their isotopes due to light-induced drift (LID) in the atmospheres of HgMn stars. A Fortran 90 software SMART for modelling of stellar atmospheres, computation of stellar spectra and study of different physical processes in stellar atmospheres has been composed and used by us. It has turned out that formation of anomalous isotope abundances in stellar atmospheres, including the dominance of the heaviest isotope (we made computations for Hg), cannot be explained without including LID mechanism. To carry out LID computations for asymmetrical partly overlapping spectral line profiles, very high resolution computations and precise data on hyperfine and isotopic splitting of spectral lines and better cross-sections of different physical processes are needed. We report some results about the evolutionary scenario of segregation of mercury and its isotopes and discuss some problems on the way of further studies. The problems of LID modelling in these quiescent non-rotating CP star atmospheres involve the computation of line strengths, formation of line profiles due to different microphysical interaction processes, but also formation of microturbulence and weak stellar winds as the phenomena, reducing the LID. In addition, presence of entangled magnetic field can play definite role in the formation of anomalous isotope abundances, giving also Zeeman splitting of spectral lines.

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Progress report

STARK BROADENING OF SPECTRAL LINES IN CHEMICALLY PECULIAR STARS

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With the development of astronomical observations from space, trace elements can now be identified in stellar spectra. Here, we investigated theoretically the influence of collisions with charged particles on heavy metal spectral line profiles for neutral emitter Te I, singly charged emitters Cr II, Mn II and Au II and doubly charged emitters Cu III, Zn III, Se III, In III and Sn III in spectra of chemically peculiar stars, especially in A stars and white dwarfs. By using the semiclassical perturbation method (Sahal-Bréchot, 1969ab), Stark widths and shifts have been obtained. When it can not be applied in an adequate way, due to the lack of reliable atomic data, modified semiempirical method (Dimitrijević and Konjević, 1980; Dimitrijević and Kršljanin, 1986) was used. For the considered spectral lines, we analyzed our theoretical results with the available experimental and other theoretical data. Also, here we considered the contributions of different collision processes to the total Stark width in comparison with Doppler one.

Cr is one of the most peculiar element in the atmospheres of magnetic chemically peculiar stars. Stark broadening parameters for Cr II spectral lines of seven multiplets belonging to 4s-4p transitions were applied to the analysis of Cr II line profiles observed in the spectrum of Cr-rich star HD 133792. We found that Stark broadening mechanism is very important and should be taken into account, especially in the study of Cr abundance stratification.

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Progress report

STUDY OF NARROW LINE REGION IN SEYFERT GALAXY Mrk 1066

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Mrk 1066 is a Seyfert galaxy with an extended narrow-line region (NLR) and a bipolar radio jet. HST images of nuclear part show jet-like structure in the narrow-band filters in that emission lines [OIII] and $H_\alpha + [NII]$ are included. In H_α and [NII], jet is observed on both sides of the nucleus while [OIII]-emitting gas is concentrated into a bright narrow structure extending 1.4" NW of the nucleus. We present a detailed study of this galaxy using 3D spectroscopy data taken on the SAO RAS 6-m telescope. We analyse simultaneously the kinematics and ionization state of the gas and check the role of shocks in the formation of the NLR.

Progress report

GRAVITATIONAL LENSING: FROM MICRO TO NANO

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We discuss different regimes of gravitational lensing depending on gravitational lens masses, in particular, mass scale $M_\odot$ corresponds to micro, mass scale $M_\odot 10^{-6}$ corresponds to nano regimes respectively. Therefore, detections of observational features of gravitational (nano-)lensing provide an opportunity to discover objects with Earth and (sub-) Earth masses. We discuss a possibility to discover a low mass planet in Andromeda galaxy with pixel-lensing. Thus, at the moment, gravitational lensing is the only way to find low mass exoplanets in other galaxies. We note an importance to introduce new selection criteria including temporal variability features for continuum and spectral lines to analyze event candidates in details.

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Progress report

QSO/AGN ENVIROMENTS AT DIFFERENT REDSHIFTS

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With the availability of large data sets like the Sloan Digital Sky Survey (SDSS) is it now possible to study a huge amount of galaxy spectra in a statistical manner. The spectroscopical data set of the 7th SDSS data release covers 9380 deg^2 ($\approx$ 23 % of the whole sky). We selected nearly 100 000 objects from the SDSS data release 7 that were classified spectroscopically as quasars to investigate their environment. We developed a dedicated software-pipeline to process this huge amount of data. We classified all galaxies within the quasar-neighborhood of 1 Mpc according to Kauffmann et al. (2003) and Kewley et al. (2006) into a diagnostic BPT diagram. For doing this we had to measure out manually the narrow Balmer lines using the IRAF task "splot". Furthermore, we studied the distribution of these objects and their spectroscopical properties such as the absolute magnitudes and the 4000 Å-break. I will give an overview of my work and present recent results.

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Poster

STUDDING THE ORIGIN OF SACs AND DACs IN THE SPECTRA OF HOT EMISSION STARS

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In the spectra of hot emission stars (Oe and Be stars) we observe the appearance of complex spectral line profiles, which are due to the existence of DACs and/or SACs phenomenon. In order to explain and reproduce theoretically these complex line profiles we use the GR model (Gauss-Rotation model). This model presupposes that the regions, where the spectral lines are created, consist of a number of independent and successive absorbing or emitting density regions of matter as the area that contains these spherical density regions is near the star and thus is limited. In this study we are testing a new approach of GR model, which supposes that the independent density regions are not successive. We use this new approach in order to study the density regions that produce the C IV, N V resonance lines of a number of Oe stars and the Mg II and Si IV resonance lines of some Be stars. Comparing the results of this method with the classical way of GR model that supposes successive regions we try to conclude to the best one in the case of hot emission stars.

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Poster

THE ROLE OF SPECTRAL LINES SELF-ABSORPTION IN THE DETERMINATIONS OF THE PLASMA PARAMETERS

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Self-absorption of a spectral line leads to deformation of its shape. Therefore, diagnostics of plasma properties by optical emission spectroscopy techniques become more complicated. The aim of this work is to estimate the influence of spectral lines self-absorption on the determinations of plasma properties. The electric arc discharge was used as the origin of spectral line emission. The arc was operated at atmospheric pressure in different experimental modes. The arc image was focused on the entrance slit of monochromator. The emission of spectral line was recorded by linear CCD image sensor. The plasma temperature was determinated by relative intensities or Boltzmann plot techniques. To determine the radial profile of electron density we investigated the shape of several copper spectral lines broadened by the dominating quadratic Stark effect. The Fabry-Perot interferometer (FPI) was used to study the broadening of these lines in different points of the plasma volume. Self-reversal spectral lines were observed. The effect of this phenomenon on the determinations of the plasma parameters was estimated.

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Poster

THE VARIABLE STAR ONE-SHOT PROJECT (VSOP): GOALS, TOOLS, STATUS AND SCIENCE HIGHLIGHTS

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There are more than 38 000 known variable stars listed in the latest edition of the General Catalog of Variable Stars. Almost 4000 of these have no spectral type assigned and nearly 2000 are listed with an uncertain variability type, often because of lack of spectroscopic characterisation. The rate of inclusion of new variables is currently around 500 per year. To handle this continuous influx of new variable stars in a straightforward and automatic way, the Variable Star One-shot Project (VSOP), was set up. The goal of VSOP is to obtain the first spectroscopy of all unstudied variable stars in both hemispheres, using the world's leading observatories. VSOP processes incoming data, determines or revises spectral and variability type, and makes the data available to the public – all automatic, all fast. In this talk we present the philosophy and approach of VSOP, describe the tools used for automatic classification of high-resolution spectra and describe some science highlights.

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Poster

STUDY OF He LINES FROM CORONA DISCHARGE

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In this report, we have initiated a systematic spectroscopic investigation of gas helium which is excited by corona excitation. Here are the results of this phenomena observation occurring for point electrode (both negative and positive corona discharges) at 300K as a function of external hydrostatic pressure. An intensity of the visible light emitted from the zone closed to the tip was sufficient for its spectroscopic analysis. The shift and width of the spectra observed were measured as a function of the applied pressure. Additional features were assigned to 'satellites' which were observed to contribute much stronger to atomic lines and molecular bands in positive corona discharges than with negative polarity. Theoretical profiles are calculated in a unified line shape semi-classical theory using ab initio molecular potentials and are compared with experimental lines.

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Poster

GAS ORIGIN IN THE EXTENDED NARROW LINE REGION OF NEARBY SEYFERT GALAXIES

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Ionization cones are one of the most important evidence supporting the Active Galactic Nuclei (AGN) unified model (Antonucci and Miller, 1985; Antonucci 1993; Urry and Padovani, 1995). Until now, the physical processes involved in the cones are not completely understood. A still open question concerns the origin of the ionized gas, which could be a part of the host galaxies ISM or material ejected by the nucleus in strong interactions with the radio-jet, or it may be acquired from outside through gravitational interactions. To study the origin of the gas in the ionization cones, we selected a sample of nearby ($z<0.03$) Seyfert 2 galaxies showing an extended [OIII]λ 5007 emission. Currently, we are analyzing their kinematical and physical properties by means of spectroscopic and photometric data. Here we present preliminary results for the Seyfert-2 galaxy NGC 7212 observed at the 6-m telescope of the Special Astrophysical Observatory (Russia) with the MultiPupil Fiber Spectrograph (MPFS).

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Poster

STARK BROADENING OF Ar XV SPECTRAL LINES WITHIN X-WAVELENGTH RANGE

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With the development of satellite born spectroscopy, the spectral lines of trace elements become astrophysically significant and for example, far UV lines of Ar VII were discovered recently in the spectra of very hot central stars of planetary nebulae and white dwarfs (Werner et al. 2007). The interest for X-range of the wawelengths for trace element spectra increases also with the space born instruments observing within this domain, like X-ray space observatory "Chandra". In order to provide Stark broadening data within the X-ray wavelength range, of interest for modelling and analysis of astrophysical plasmas in extreme conditions, we have performed semiclassical calculations of Stark broadened line widths and shifts for 8 Ar XV multiplets with wavelengths less than 100 Å. Stark broadenig parameters for Ar XV lines are determined by using the semiclassical-perturbation formalism (Sahal-Bréchot, 1969ab). This formalism and the corresponding computer code have been updated and optimized several times (see e.g. Dimitrijević and Sahal-Bréchot, 1996). A brief review of the calculation procedure, with discussion of updatings and validity criteria is given by Dimitrijevic (1996).

Electron-impact (Stark) line width W (FWHM - Full Line Width at Half Maximum) and shift d for 8 fourteen times charged argon ion lines have been calculated within the semiclassical-perturbation approach. The atomic energy levels needed for the calculations were taken from Bhatia and Landi (2008) and the energy of ionization of Ar XV from NIST database. There are no other experimental or theoretical results for comparison.

The obtainedned Stark broadening parameters for prominent sectral lines of Ar XV within the X wawelength range, could be useful for analysis and modelling of X ray radiation from hot and dense astrophysical plasmas but also for inertial fusion research, where Ar and other trace elements could be added to modify characteristics of fusion plasma, and for laboratory plasma research in X-ray domain.

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Poster

AB INITIO STARK BROADENING CALCULATIONS FOR Ca V SPECTRAL LINES

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Using semiclassical perturbation approach, we have obtained ab intio Stark broadening parameters for 7 Ca V multiplets. Energy levels and oscillator strengths are calculated using SUPERSTRUCTURE code.

Results are obtained as a function of temperature, for perturber density of 10^{17} cm^{-3}. In addition to electron-impact full halfwidths and shifts, Stark broadening parameters due to proton- and ionized helium-impacts have been calculated. Thus, we have provided Stark broadening data for all the important charged perturbers in stellar atmospheres.

This work is a reference for Ca V ion because there is no other previous data. New Stark parameters calculations and measurements for this ion will be interesting to check the validity of our calculations.

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Poster

QUANTUM AND SEMICLASSICAL STARK BROADENING OF *3s-np* AND *nd-5f* TRANSITIONS IN C IV, N V, Mg X AND Al XI

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Diagnostic of stellar and laboratory plasmas, atomic abundances, opacity calculations, particles densities can be determined through knowledge of Stark broadening of isolated spectral lines of multicharged ions in plasmas.

In this work, we apply our quantum-mechanical expression (Elabidi *et al.* 2004) to the calculations of electron impact Stark widths of the $3s-np$ and $nd-5f$ $(n=3,4)$ transitions in C IV, N V, Mg X and Al XI. This method has been used several times for the $2s3s-2s3p$ transitions in Be-like ions and for the $3s-3p$ transitions in Li-like ions. This method gives a good agreement with experimental results especially for highly charged ions (Elabidi *et al.* 2007, 2008). Calculations are made in the frame of the impact approximation and for intermediate coupling, taking into account fine structure effects.

A comparison between our calculations (quantum and semiclassical) and experimental results shows an improved agreement for the $3s-np$ transitions. But we report here a significant disagreement for the nd-5f transitions. This discrepancy was also reported for these transitions in C IV and N V ions (Dimitrijević and Sahal-Bréchot 1991, 1992).

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Poster

SPECTROSCOPIC CHARACTERIZATION OF ULIRG CIRRUS

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The Cosmic Infrared Background (CIB) has shown that half of the light generated in the history of the universe has been absorbed and reprocessed by dust in far-IR luminous objects. Spitzer, and especially the SWIRE survey, the largest legacy project performed with Spitzer, provide our best census of such far-IR luminous objects currently available. Among these objects lie two intriguing populations of ultra-luminous infrared galaxies (ULIRG): (1) cool luminous infrared galaxies which appear to require an extended optically thick interstellar medium, (2) luminous infrared 'ellipticals', galaxies with elliptical-like spectral energy distributions (SEDs) in the optical and high infrared luminosities, probably very dusty starbursts. We have carried out a systematic spectroscopic survey of the 50 brightest SWIRE examples (in the optical) of these sources using EFOSC-2 in multi-object mode on the 3.6m ESO telescope in order to characterize and fully model these powerful sources. We will present broad-band SEDs and optical emission line diagnostics for all sources with available spectra. These sources represent the brightest far-IR examples of a much larger population that future more sensitive far-IR surveys will unveil (e.g. HerMES, ATLAS).

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Poster

STELLAR KINEMATICS OF AGN HOST GALAXIES

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Emission gas in the disks of Seyfert galaxies often reveals strong non-circular motions which does not allow to determine in a correct way the circular velocity of a galaxy and its mass. We present the results of data processing of long-slit spectral observations of some AGN host galaxies which were carried out at the SAO RAS 6m telescope. The observed radial profiles of stellar velocities and stellar velocity dispersion were used to compose the mass models of the galaxies. A comparison of the models of galaxies with the masses of their SMBHs is also discussed.

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Poster

SEMI CLASSICAL IMPACT STARK BROADENING OF COMPLEX TRANSITIONS IN FeXIV

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Using the semi-classical approach by Sahal-Bréchot, including both dipole and quadrupole contribution in the expansion of the electrostatic interaction between the optical electron and the perturber, and the new diagonal multiplet factor formulae for more complicated configurations such as $(n_1 l_1^n(L_n S_n)\ n_2\, l_2^m(L_m S_m)\ \ n_3 l_3^p(L_p S_p))$, in LS coupling, calculated by Mahmoudi et al., we have calculated Stark broadening widths of Fe XIV, such as ($n_1 p n_2 d n_3 f$, $n_1 p n_2 d n_3 d$, $n_1 s n_2 d n_3 p$, $n_1 p n_2 d n_3 s$, $n_1 s n_2 p n_3 d$...), in order to test the applied method and the accuracy of the obtained results, for interpreting the new data.

In fact Stark broadening impact theory data are needed to solve various problems in astrophysics and physics. Fe XIV is especially important due to its presence in stellar envelopes, and Stark broadening plays a role in the stellar structure and evolution calculations (Alecian et al., 1993).

The aim of this work is twofold. To provide new Stark broadening data for astrophysically important FeXIV lines and to test the the new diagonal multiplet factor formulae for complicated configurations in the semi-classical approach for multicharged atoms. Therefore new Stark width values (experimental and other theoretical results in particular quantum mechanical ones) would be welcome to check our results.

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Poster

VAN DER WAALS BROADENING IN ATMOSPHERIC PRESSURE SURFACE WAVE DISCHARGES SUSTAINED IN RARE GASES

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Research on van der Waals broadening has become one of the most important issues in recent spectroscopy studies since the values of this parameter can be easily related by means of the Lindholm-Foley theory to that of the gas temperature, being the knowledge of the later determining on the heavy particles kinetics.

In the present study, the profiles of several rare gas atomic lines arising from an atmospheric pressure microwave ($2.45 GHz$) surface wave discharge have been studied in order to determine the most suitable lines for measuring gas temperatures.

Special attention has been paid to the contribution of the Stark broadening to the Lorentzian width, from which the van der Waals broadening is obtained. The comparison with previous methods (namely OH and N_2^+ ro-vibrational bands) is also provided.

Poster

VELOCITY ELLIPSOID - IMPORTANCE OF LINE-OF-SIGHT VELOCITIES

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After the Hipparcos Mission a lack of data concerning line-of-sight velocities has appeared. As a result a number of surveys have been undertaken. This has contributed that now space velocities are available for many stars from the Solar Neighbourhood. Consequently, methods of determining velocity ellipsoid from space velocities have become important. They should offer significant improvements in our knowledge of motions of stars in the Solar Neighbourhood.

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Poster

OBSERVATIONS OF SUB-MILLIMETRE OF HYDROGEN RECOMBINATIONS LINES TOWARDS ηCARINA AND NGC253

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I summarize the observational results of the recent APEX observations of sub-millimetre hydrogen recombination lines towards the southern evolved star ηCarina and starburst galaxy NGC253.

In ηCarina, evidence of strong variation has been found in the H29α and H27α (maser) lines. This variation is probably associated to 5.5 yr period periastron passage predicted for last January. In addition, the line profiles of the new higher frequency H26 and H27α detections support previously found evidence ηCarina contains a recombination line maser.

In NGC253, the H29, H27 and H26α lines have been detected towards the active nucleus of this galaxy. These detections are consistent with previous multi-component starburst models previously derived from centimeter lines.

VII SERBIAN CONFERENCE ON SPECTRAL LINE SHAPES IN ASTROPHYSICS
15-19 June 2009, Zrenjanin, Serbia
Book of Abstracts, Eds. L. Č. Popović, M. S. Dimitrijević, D. Jevremović and D. Ilić
Serbian Astronomical Society and Astronomical Observatory, Belgrade, 2009

Poster

LINE PROFILE VARIABILITY DUE TO PERTURBATIONS IN AGN ACCRETION DISK EMISSIVITY

Marko Stalevski[1], Predrag Jovanović[1], Luka Č. Popović[1] and Alla I. Shapovalova[2]

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In this paper we analyzed the observed variability of the broad double-peaked spectral lines of some Active Galactic Nuclei (AGN). We assumed that such lines originate from outer part of accretion disk around massive black hole of AGN, and that line variability is caused by perturbations in disk emissivity. The disk emissivity was studied using numerical simulations based on relativistic ray-tracing method, assuming a modification of power-law emissivity which allows us to introduce the perturbations in form of the bright spots. Our results show that this model of disk emissivity perturbations can satisfactorily reproduce the observed Hβ line variability in 3C 390.3 between 1995 and 1999.

Poster

LANGMUIR WAVES STATISTICS AND TYPE III BURSTS OBSERVED BY WIND SPACECRAFT

Sonja Vidojević[1], A. Zaslavsky[2], Milan Maksimovic[2], Olga Atanacković[1], S. Hoang[2] and Q. N. Nguyen[2]

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A beam-plasma system, produced by CMEs and flares, is unstable to the generation of Langmuir waves at the local plasma frequency or its harmonic. Radio observations of Langmuir waves in range ≈ 4 kHz-40 kHz from the WAVES experiment onboarded the WIND spacecraft have been statistically analyzed. A subset of 10 events has been selected for this study. The background consisting of the thermal noise and the type III signal has been removed and the histogram of the remaining flux density spectra has been fitted by model distributions. We discuss the results of this analysis, in particular the comparison of the mean values of the Langmuir waves histograms with the type III bursts radio power emitted in the same time.

Poster

DUST ATTENUATION IN STARBURST GALAXIES

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Dust obscuration in starburst galaxies relative to face-on (intrinsic value) is determined using a sample of optical and IR photometric data. Large sample (about 42 000 galaxies) enable us to divide them into bins of stellar masses and star formation histories and analyze attenuation as a function of these two parameters. The result is compared to intrinsic attenuation (without highly edge-on galaxies) obtained with different method for the same sample.

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Poster

STARK BROADENING CALCULATIONS OF NEUTRAL COPPER SPECTRAL LINES

Besma Zmerli[1], Nebil Ben Nessib[1] and Milan S. Dimitrijević[2]

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The aim of this work is to provide calculations of Stark broadening parameters of neutral cooper spectral lines. The neutral cooper CuI is often used in electrical industry as electrode materials. Therefore, diagnostic techniques of this element is of particular interest in industrial laboratories.

In a previous paper (Zmerli et al., 2008), we investigated temperature dependence of Stark width for neutral atom spectral lines in order to find a method for scaling with temperature. For analysis of this dependence, we used lines of neutral helium HeI.

In the present work, we extend this analysis to the neutral cooper spectral lines. We focused our studies on the CuI 324.75, 327.39, 510.54, 515.32, 521.82 and 578.21 nm spectral lines. Our results are compared with different available experimental and theoretical data.

References

Zmerli, B., Ben Nessib, N., Dimitrijević, M. S.: 2008, *European J. Phys.* D, **48**, 389.

CONFERENCE PROGRAMME

Sunday, June 14, 2009

Arrival of participants

Monday, June 15, 2009

08:30-09:00 *Registration*

09:00-09:30 *Opening ceremony*

	Chair: Gillian Peach	
09:30-10:10	Sylvie Sahal-Bréchot	Collisional line broadening versus collisional atomic depolarization and astrophysical applications (IL)
10:10-10:50	Roland Stamm	Spectral line shapes modeling in laboratory and astrophysical plasmas (IL)
10:50-11:30	Martin Gaskell	What spectral line shapes tell us about how AGNs work (IL)

11:30-12:00 *Coffee break*

	Chair: Sylvie Sahal-Bréchot	
12:00-12:40	Maarten Baes	A new view on the ISM of galaxies: far-infrared and submillimetre spectroscopy with Herschel (IL)
12:40-13:00	Darko Jevremović	The project of Serbian virtual observatory and data for stellar spectra modellisation (PR)

13:00-15:00 *Lunch break*

	Chair: Martin Gaskell	
15:00-15:40	George Chartas	High velocity winds from narrow and broad absorption line quasars (IL)
15:40-16:00	Predrag Jovanović	Influence of gravitational microlensing on broad absorption lines of QSOs (PR)
16:00-16:20	Alexandrina A. Smirnova	Study of narrow line region in Seyfert galaxy Mrk 1066 (PR)
16:20-16:40	Giovanni La Mura	Hydrogen Balmer emission lines and the complex BLR structure (PR)

16:40-17:10 *Coffee break*

	Chair: Roland Stamm	
17:10-17:50	Gillian Peach	Spectral line shapes in cool star (IL)
17:50-18:10	Evaggelia Lyratzi	Ways of creation of SACs and DACs in the plasma around quasars (PR)
18:10-18:30	Theodoros Nakos	Studying the spectral properties of AGN in the JWST era (PR)
18:30	*Visiting the center of Zrenjanin (after that welcome cocktail in the Municipality of Zrenjanin)*	

Tuesday, June 16, 2009

	Chair: Piero Rafanelli	
09:30-10:10	Jack Sulentic	Following H_β to z~3 (IL)
10:10-10:50	Milorad M. Kuraica	The connection between spectroscopy of laboratory and astrophysical plasmas (IL)
10:50-11:20	*Coffee break*	
	Chair: Jack Sulentic	
11:20-12:00	Emmanouil Danezis	Interpretating the complex line profiles in the stellar spectra (IL)
12:00-12:40	Alla I. Shapovalova	Evolution of the broad emission line profiles in some AGN (IL)
12:40-13:20	Derek Homeier	Accurate collisional broadening profiles for alkali resonance lines in substellar atmosphere models (IL)
13:20-15:00	*Lunch break*	
	Chair: Michael Eracleous	
15:00-15:40	Piero Rafanelli	Nuclear activity and star formation properties of Seyfert galaxies (IL)
15:40-16:20	Alexei V. Moiseev	3D spectroscopic study of galactic rings: formation and kinematics (IL)
16:20-16:40	Dragana Ilić	The line parameters and ratios as a physical probe of the line emitting regions in AGN (PR)
16:40-17:00	Matthias Zetzl	QSO/AGN environments at different redshifts (PR)
17:00-17:30	*Coffee break*	

	Chair: Emmanouil Danezis	
17:30-18:10	María Dolores Calzada Canalejo	Plasma of noble gases and their mixtures at atmospheric pressure (IL)
18:10-18:50	Magdalena Christova	Multiple perturber effects due to the H-He collisions in the far red wing of Lyα line (IL)
	Chair: Nebil Ben Nessib	
18:50-20:00	Poster presentations	

Wednesday, June 17, 2009

Excursion

Thursday, June 18, 2009

	Chair: George Chartas	
09:30-10:10	Michael Eracleous	Double-peaked emission lines as a probe of the broad-line regions of active galactic nuclei (IL)
10:10-10:30	Tamara Bogdanović	Emission lines as a tool in search for supermassive black hole binaries and recoiling black hole (PR)
10:30-10:50	Edi Bon	Complex line profiles of AGN - geometry of the broad line region (PR)
10:50-11:20	*Coffee break*	
	Chair: María Dolores Calzada Canalejo	
11:20-12:00	Andrey N. Klyucharev	Rydberg atoms in astrophysics (IL)
12:00-12:40	Damian J. Christian	The search from ^{6}Li in active late-type stars (IL)
12:40-13:00	Zoran Simić	Stark broadening spectral lines in chemically peculiar stars (PR)
13:00-13:20	Arved-Ervin Sapar	Modeling of mercury isotopes segregation in CP stellar atmospheres: results and problems (PR)
13:20-15:00	*Lunch break*	
	Chair: Jagoš Purić	
15:00-15:40	Anatolij A. Mihajlov	The chemi-ionization processes in the solar photosphere (IL)
15:40-18:00	Poster presentations (the competition for the best poster)	
19:00	*Conference dinner*	

Friday, June 19, 2009

Chair: John Danziger

10:30-11:10	Nebil Ben Nessib	Ab initio calculations of Stark broadening parameters (IL)
11:10-11:30	Alexander Zakharov	Gravitational lensing: from micro to nano (PR)
11:30-12:00	*Coffee break*	
12:00-12:20	*Closing ceremony (L. Č. Popović, M. S. Dimitrijević)*	

List of posters

Maarten Baes	The Variable Star One-shot Project (VSOP): goals, tools, status and science highlights
Nelly Bonifaci	Study of He lines emitted from Corona discharge
Viacheslav. F. Boretskij	The role of spectral lines self-absorption in the determinations of the plasma parameters
Valentina Cracco	Gas origin in the extended narrow line region of nearby Seyfert galaxies
Milan S. Dimitrijević	Stark broadening of Ar XV spectral lines within x-wavelength range
Haykel Elabidi	Quantum and semiclassical Stark broadening of 3s-np and nd-5f transitions in C IV, N V, Mg X and Al XI
Rafik Hamdi	Ab initio Stark broadening calculations for Ca V spectral lines
Eleni Kalfountzou	Spectroscopic characterization of ULIRG Cirrus
Ivan Y. Katkov	Stellar kinematics of AGN host galaxies
Evaggelia Lyratzi	Studding the origin of SACs and DACs in the spectra of hot emission stars
Walid F. Mahmoudi	Semi classical impact Stark broadening of complex transitions in FeXIV
José Muñoz	Van der Waals broadening in atmospheric pressure surface wave discharges sustained in rare gases
Slobodan Ninković	Velocity ellipsoid - Importance of line-of-sight velocities
Rodrigo Parra	Observations of sub-millimetre of hydrogen recombinations lines towards etaCarina and NGC253
Marko Stalevski	Line profile variability due to perturbations in AGN accretion disk emissivity
Sonja Vidojević	Langmuir waves statistics and type III bursts observed by wind spacecraft
Oliver Vince	Dust attenuation in starburst galaxies
Besma Zmerli	Stark broadening calculations of neutral copper spectral lines

Legend:

IL - Invited Lecture (40 min); **PR** - Progress Report (20 min); **P** - Poster (the panel size: 1 x 1.2 m).

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