II Workshop: ASTROPHYSICS IN YUGOSLAVIA

September 8 - 10, 1987
Beograd, Yugoslavia

PROGRAM AND ABSTRACTS

Edited by: M.S.Dimitrijević

Published by: Astronomical Observatory, Volgina 7, 11050 Beograd, Yugoslavia

BEOGRAD
1987

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is

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II Workshop: ASTROPHYSICS IN YUGOSLAVIA-ASTROFIZIKA U JUGOSLAVIJI

Beograd, September 8 - 10, 1987.

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Be STARS - CHALENGE TO THE OBSERVERS AND THEORETICIANS

J.Arsenijević, A.Kubičela and I.Vince

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The main historical steps in the investigation of the B stars with emission lines, starting with the year 1922 when IAU Comission 29 introduced the name "Be stars" at the first General Assembly of the Union in Rome and closing with the IAU Colloquium No.92 "Physics of Be Stars" organized in August 1986 in Boulder, are briefly reviewed.

The enormous quantity of the existing observational data and their significant characteristics over broad spectral region from X-ray to radio wavelengths are discussed. One of the main characteristics - photometric and spectral time variability - is analysed with a special attention to long-term changes.

The long-term photometric and spectral changes are correlated with the polarimetric ones for the stars from the Belgrade program of long-term polarimetric study of Be stars started in 1974.

Observational results in confrontation with the theoretical interpretations from Struve's hypothesis to the contemporary empirical Be stars models are presented.

THE ANGULAR VELOCITY OF SPIRAL ARMS AND THE SPACIAL DISTRIBUTION OF GALACTIC CIVILIZATIONS

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Abstract:

The gravitational density wave theory of C.C. Lin and his co-workers is currently the most popular of theories which can provide an acceptable quantitative viewpoint from which it is possible to explain the large-scale galactic spiral structure in a coherent way.This contribution makes use of some stellar astronomical results based on Lin's theory and on the galactic distribution of open clusters of various ages. Relying upon the cluster distribution it is possible to determine the geometry and angular velocity of the rigidly rotating spiral pattern. It turns out that the orbit of the Sun is close to the so called co-rotation circle. Consequently, if we assume that the case of mankind is about average and accept the idea that the longevity of a civilization might be limited with high probability by catastrophic events threatening during the crossing of galactic arms, intelligent life is presumably concentrated on a belt in the Galaxy which is a narrow annulus including the co-rotation circle and the galactic orbit of our Sun.

Current estimates of the likelihood, galactic distribution and accessibility of extra-terrestrial civilizations generally contain three shortcomings: They treat our Galaxy as a homogeneous , isotropic and steady-state system and not as an object of specific geometric and kinematic properties with reasonably well understood morphology and path of evolution. If the galactic belt of intelligent life is a reality at least the first and last factors in the "Drake Equation" must be reassessed. (The number of suitable stars in the belt is only of the order of 10^8 and the average longevity of a civilization needs to be judged in comparison with the time which its system spends between two neighbouring spiral arms.) Supposing that intelligent life will develop on the same time-scale, by the same rules wherever the proper surroundings and the needed time are given, it is possible to locate a zone of advanced civilizations where societies at least as old as ours are primarily expected. From heliocentric point of view the distribution of our potential extraterrestrial partners is highly anizotropic: in a small solid angle around the line of sight there are about 10^3 times as many of them in the tangential directions than towards the galactic anticentre.

ON THE ROLE OF SOME SPECIAL TYPES OF STARS IN CONTEMPORANEOUS GALACTIC ASTRONOMY

Slobodan Ninković

Astronomska opservatorija, Volgina 7,
11050 Beograd

The present author tries to point out some special types of stars, distinguished by astrophysicists according to their physical properties, which may be particularly useful to a study of our Galaxy.

SS 433 OBJECT

Tomaž Zwitter

Oddelek za fiziko, Jadranska 19, 61000 Ljubljana

ON THE C IV LINE PROFILES IN THE WHITE DWARFS

Ištvan Vince and Milan S. Dimitrijević
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The equivalent width and the shift of stellar absorption lines depend on the Stark broadening especialy in the case of white dwarfs and early type stars (O, B and A). Even in the cooler star atmospheres Stark broadening may be important for higher members of a spectral series (Vince et al, 1985) or in the wings of the Voigt profile.

In this communication we present the equivalent width calculations within $2s^2S - np^2P^o$ series of C IV lines, using the white dwarf atmosphere model with T_{eff} = 35000 K and log g = 8. (Wesemael et al, 1980). Our aim is (i) to study the behaviour of equivalent widths within 2s - np spectral series of C IV, (ii) to compare the Stark broadening mechanism with other effects influencing line shapes, as well as (iii) to provide new accurate spectroscopic data for important C IV lines in white dwarfs spectra.

Our results for the shift and the equivalent width of C IV spectral lines, for different abundances of carbon ($A = A_{\odot}$, $A = A_{\odot}/100$ and $A = A_{\odot}/1000$, where $A_{\odot} = 3.3113\ 10^{-4}$) are presented in Table. For the Stark broadening contribution, the new semiclassical results (Dimitrijević and Sahal-Bréchot, 1988) have been used. All calculations have been performed using LTE assumption.

Table. Equivalent widths (W) and line shifts (d) for C IV $2s^2S - np^2P^o$ spectral lines, for different carbon abundances A.

Transition	$A = A_\odot$		$A = A_\odot/100$		$A = A_\odot/1000$	
Wavelength (nm)	W(nm)	d(nm)	W(nm)	d(nm)	W(nm)	d(nm)
$2s^2S-2p^2P^o$ 154.9	0.227	-1.11-4	2.159-2	-1.28-4	5.74-3	-1.19-4
$2s^2S-3p^2P^o$ 31.2	0.166	-9.82-5	1.58-2	-1.13-4	4.75-3	-1.13-4
$2s^2S-4p^2P^o$ 24.5	0.349	-9.25-4	3.40-2	-9.87-4	7.91-3	-1.05-3
$2s^2S-5p^2P^o$ 22.3	0.300	-2.79-4	3.85-2	-3.37-3	6.27-3	-3.35-3

Our conclusion is that the Stark broadening is dominant in present case and that W/λ^2 and $|d|/\lambda^2$ increase regularly within C IV $2s^2S-np^2P^o$ spectral series.

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COSMIC SYNCHROTRON RADIATION

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Electromagnetic waves from the cosmic space have their origin in variety of mechanisms The most important contribution in the radio region is resulting from radiation of relativistic electrons moving in magnetic fields. This type of emission, called synchrotron radiation or magnetobremsstrahlung, has been recorded in other spectral regions also but as a minor component.

The synchrotron emission has been recorded from the Sun (some types of bursts), Earth, Jupiter, Saturn, Uranus, (as planetary magnetic belts effects), Galaxy (e.g. spurs, supernova remnants, pulsars, SS433, galactic centre source, galactic background)and extragalactic sources (galaxies, quasars).

The main characteristics of the synchrotron radiation from a typical cosmic source are: a high degree of linear polarization and a decrease of intensity with frequency in the major part of the radio region. These features make it distinctly different from the blackbody radiation at temperatures recorded in the cosmic space; the blackbody radiation is unpolarized and increases with frequency in the radio region.

A typical spectrum of a synchrotron type radio source can be represented by a power law $S \propto f^{-\alpha}$, where S is the flux density, f is the frequency and α is the spectral index. Although a strictly straight logS -logf spectrum is observed only for some radio sources, the spectral index is widely used as a measure of steepness of the spectrum between two frequencies. The straight spectrum sources usually have the value of spectral index close to 0.8 . It can be expected that spectral indices change with time, as it has been found for CasA. Many spectra start to bend down at frequencies near several MHz, but some spectra bend down near several GHz or exhibit even more complex behaviour. The deflections can be explained as due to: (1) variations in the electron energy distribution which may exist either in the initial distribution or occur as a result of energy loss, (2) self-absorption in the relativistic gas, (3) absorption in a HII region, (4) the effect of a dispersive medium in the source.

Several types of models have been developed for interpretation of the observed radio spectra. The simplest one assumes an ensemble of electrons which is homogeneous and isotropic, in a uniform magnetic field, with the energy distribution function $N(E)=N_0E^{-\gamma}$ for a limited energy range. In such a case a simple relation follows: $\gamma=1+2\alpha$. The degree of linear polarization is then $\Pi=(\gamma+1)/(\gamma+7/3)$ with the electric vector being a maximum perpendicular to the projection of the magnetic field. Application of the model to the galactic background spectrum near the galactic poles gave γ close to the value obtained from cosmic ray measurements, implying that many cosmic rays originate in the Galaxy and produce the galactic background radiation. The radio polarization results apart from support to the optical interstellar polarization data can tell about the magnetic field in the source. Both examples show only a part of possibilities to be used in future.

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QUASI-PERPENDICULAR ION-CYCLOTRON INSTABILITY IN PLASMAS CONTAINING IONS WITH TWO TEMPERATURES

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Comparatively recent experimental data obtained from the geostationary satellites[1] led to the conclusion that the presence of ions with different temperatures is of utmost significance for the characteristics of the ion-cyclotron instability excited in the geomagnetically trapped plasma[2,3]. The general problem of the properties of the ion cyclotron waves in multispecies plasmas has received considerable attention[4,5], but the analysis was usually based either on the 'cold' plasma model, or on the hydrodynamic description of the process, in spite of the fact that the necessity of using the kinetic theory in these studies has long been known[6,7]. The kinetic approach allowed to establish that the ion cyclotron waves propagated almost perpendicularly with respect to the external magnetic field may become unstable, due to the presence of the electron drift exceeding some threshold value, also at extremely long wavelengths[8,9], and this situation is of particular interest in both the geomagnetically trapped plasma and many other astrophysical problems.

The present analysis of the phenomenon of spontaneous excitation of ion cyclotron waves by electron drift in a multi-species and multi--temperature plasma is based on the model of infinite, collisional and magnetized current-carrying plasma, with the current flowing along the lines of force of the external homogeneous magnetic field $\vec{B}_o$. This current is accounted for by taking that the ions are at rest, whereas the electrons have a drift velocity of intensity u_e directed along $\vec{B}_o$. Apart from the electrons (steady-state concentration n_e, temperature T_e), the plasma contains only one sort of single-charged ions (for example, H^+ in the geomagnetically trapped plasma), but divided into two groups with different concentrations and temperatures (n_1, T_1 and n_2, T_2). The steady-state distribution functions for all the particles are taken to be Maxwellian with corresponding temperatures, assumed isotropic. The steady-state quasi-neutrality condition reads $n_e = n_1 + n_2$, and the plasma composition is suitably expressed by the dimensionless parameter $\tilde{n} = n_1/n_2$. Although the 'cold' and the 'hot' ions have the same ionic mass m_i, and consequently a common cyclotron frequency $\omega_{Bi} = eB_0/m_i$, they have different temperatures; letting $T_2 > T_1$ one also has $v_{T2}/v_{T1} = (T_2/T_1)^{1/2} > 1$ and $\nu_2/\nu_1 = v_{T2}/v_{T1} > 1$.

The attention is focused here on the long-wave ion cyclotron waves in the vicinity of the rth harmonic ($\omega \approx r\omega_{Bi} \equiv \Omega_r$). The dispersion equation for quasi-perpendicular electrostatic waves is of the form $\delta\varepsilon_e + \delta\varepsilon_i = 0$, where the ionic and the electronic contributions were evaluated previously[9]. Neglecting the exponentially small Landau damping term, which is irrelevant in the domain of very long waves ($\nu_e \gg k_\parallel v_{Te}$ and $\omega\nu_e \ll k_\parallel^2 v_{Te}^2$) where the collisions are dominant, one thus arrives at the following expressions for the spectrum and the condition of marginal instability:

$$\frac{\omega}{\omega-\Omega_r} = \frac{1+\tilde{n}(T_1/T_2)+(1+\tilde{n})(T_1/T_e)}{A_r(\mu_1)+\tilde{n}(T_1/T_2)A_r(\mu_2)}, \qquad \frac{u_e}{v_{T1}} = \frac{\omega}{\omega-\Omega_r}\left(\xi+\frac{Q}{\xi}\right), \tag{1}$$

where $\xi = (\omega-\Omega_r)/k_\parallel v_{T1}$, $A_r(z) = e^{-z}I_r(z)$ (I_r is the modified Bessel function), $\mu_s = k^2 v_{Ts}^2/\omega_{Bi}^2$ ($\mu_2 = (T_2/T_1)\mu_1$ for the case considered), and $Q = (T_e/T_1)^{3/2}(m_i/m_e)^{1/2}(1+\tilde{n})^{-1}\left[1+(T_1/T_2)^{1/2}\tilde{n}\right]$. It is immediately seen from the above expressions that the threshold value of the electron drift is $(u_e/v_{T1})_{min} = 2\,Q^{1/2}\left[\omega/(\omega-\Omega_r)\right]$.

An inspection of the results (1) discloses that, in view of the form of the functions A_r, the influence of the 'hot' ionic component will be particularly prominent for $\mu_1 \ll 1$, provided that μ_2 lies in the vicinity of the maximum of the corresponding A_r-function (this is $\mu_2 = 1.5$ for $r = 1$, or $\mu_2 = 9.6$ for $r = 3$, for example).

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LANDAU DAMPING OF THE TRANSVERSE ELECTROMAGNETIC WAVE IN MULTI-SPECIES PLASMAS WITH POLARIZABLE HEAVY PARTICLES

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In practically all considerations of the transverse electromagnetic waves propagated in both laboratory and astrophysical plasmas, it is taken for granted that these waves undergo no collisionless (Landau) damping, in view of the fact that their phase velocity $\underline{v}_{ph}$ is larger than $\underline{c}$, the velocity of light in vacuum, so that the presence of resonant particles is excluded by the requirements of the theory of relativity. A more careful analysis of this conclusion discloses, however, that the requirement $\underline{v}_{ph} > \underline{c}$ unconditionally holds in plasmas the ions of which are point charges, which is strictly true in fully ionized hydrogen plasma only. In all other cases, including the partially ionized hydrogen, the plasmas actually contain heavy particles with fully or partly preserved electronic envelopes and, consequently, with dynamic polarizability different from zero. The presence of such particles may alter the spectral properties of the plasma transverse waves (and, presumably, of other plasma modes as well). In particular, this may entail the diminishment of their phase velocity which, under certain conditions, may become smaller than $\underline{c}$, so that the Landau damping will become possible.

The effect of the Landau damping of the transverse electromagnetic waves in a homogeneous and non-magnetized plasma containing only one sort of heavy and polarizable particles was already studied to some extent[1]. In this paper a more general case of weakly ionized plasma containing several species of heavy polarizable particles is considered. These particles emit at frequencies $\omega_{ls}^{(\beta)} = (\underline{E}_l - \underline{E}_s)/\hbar$ ($\beta = 1,2,...,\underline{q}$ labels the particle species, and $\underline{l}$, $\underline{s}$ refer to the energy levels of the exterior bound electron in the dipoles pertaining to the heavy particles). It is found here that $\underline{v}_{ph} < \underline{c}$ is possible if:

$$\omega \ll \omega_{ls}^{(\beta)}, \tag{1}$$

for all β and all l and s. It is also established that with $\omega \gg \omega_{ls}^{(\beta)}$ for all β and all l and s, one definitely has $v_{ph} > c$.

The condition (1) is necessary, but not sufficient for $v_{ph} < c$ to hold. The solution of the relevant dispersion equation, with the terms accounting for the polarizability of the heavy particles included, reveals that the sufficient condition for the possibility of existence of the Landau damping of the transverse electromagnetic plasma wave is of the form:

$$\omega_{pe} < ck \left[\sum_{\beta=1}^{q} \sum_{l<s} \left(\frac{\Omega_{ls}^{(\beta)}}{\omega_{ls}^{(\beta)}} \right)^2 \right]^{1/2}. \tag{2}$$

Here, $\omega_{pe} = (e^2 n_e / \varepsilon_0 m_e)^{1/2}$ is the electron plasma frequency, $\omega_{ls}^{(\beta)}$ has the meaning explained above, and

$$\left(\Omega_{ls}^{(\beta)} \right)^2 = \frac{e^2}{\varepsilon_0 m_e} \left(n_l^{(\beta)} - n_s^{(\beta)} \right) f_{ls}^{(\beta)} \tag{3}$$

with $n_l^{(\beta)}$ and $n_s^{(\beta)}$ denoting the population densities of the corresponding energy levels of the atoms of the species β, and $f_{ls}^{(\beta)}$ standing for the associated oscillator strengths. It is readily seen that the condition (2) will be most easily met in the short-wave domain, $\omega_{pe}^2 \ll c^2 k^2$.

The above possibility of Landau (collisionless) damping of the transverse electromagnetic plasma wave in multispecies plasmas is of considerable interest in astrophysics and radio-astronomy, as the condition (2) may be satisfied for a broad class of astrophysical plasmas, and for electromagnetic waves within a large domain of wavelengths, ranging from long radio-waves to the UV part of the spectrum. The predicted effect of the Landau damping seems to be particularly significant for solar and stellar atmospheres, where the role of the resonant particles might be taken over by the very fast particles present in these plasmas due to the corpuscular beams emitted from the stellar surfaces as a result of the processes taking place there.

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ON SOME METRIC PROPERTIES OF TWO ALTERNATIVE THEORIES OF THE GRAVITATIONAL FIELD

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We consider: 1) Rosen's bimetric gravitation theory, [1],[2] ; 2) Logunov's relativistic gravitation theory, [3],[4] (in fact also a bimetric theory). The metric, or gravitational field, tensor in both theories is subject to conformal transformations, and some properties of conformally equivalent metrics are established [5], [6]. The consequences of the conservation law, in the case when that law is satisfied only after the transformation, are discussed for Rosen's theory. For Logunov's theory the extended system of the gravitational field equations is similarly assumed to be satisfied by the metric only after the conformal transformation. The consequences of that assumption are investigated in the case of weak gravitational fields.

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INFLUENCE OF ION-ATOM IMPACT COMPLEXES ON DIFFERENT PROCESSES IN LOW TEMPERATURE WEAKLY IONIZED PLASMAS

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In low temperature plasmas very important rôle have processes where molecular ions are involved. As the first, such processes are fotodissociation processes influencing on the absorption continuum formation and dissociative electron-ion recombination processes, influencing on the excited atomic states population. A certain rôle have also molecular ion dissociation processes during electron-ion collisions. Besides molecular ions, in plasmas exist also corresponding ion-atom complexes. Under special conditions, such complexes may be interpreted as quasi-molecular ions with electronic states similar to electronic states of real molecular ions.

In this communication we demonstrate that in mentioned processes such complexes behave in a similar way as molecular ions, and consequently, must be taken into account in theoretical investigations and experimental data interpretation. Our discussion is based on the example of symmetrical and weakly unsymmetrical two atom systems (A_2^+ and AB^+, and: $A + A^+$ and $A + B^+$).

Our results indicate that processes with collisional complexes participation, play essential rôle in comparison with processes with molecular ion participation, in a wide range of conditions.

ELECTRON-IMPACT BROADENING ALONG HOMOLOGOUS SEQUENCE OF NOBLE GASES

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For the evaluation of physical conditions in stellar atmospheres as well as for abundance determination, the knowledge of the Stark broadening parameters for a large number of elements is of particular importance, as well as the study of similarities and systematic trends which may be used for various interpolations or critical evaluations of existing data.

One of the aims of this communications is to perform the first investigation of Stark broadening of Ar I, Kr I and Xe I lines on higher densities ($5.0 \times 10^{17} cm^{-3} \leq N_e \leq 1.62 \times 10^{18} cm^{-3}$) where is not available the experimental data for the lines examined. We performed also analysis of Stark broadening along homologous sequence Ar I, Kr I, Xe I in order to study regularities within a sequence of homologous atoms.

The plasmas in our experiment are produced in linear flashtubes filled with a noble gas at an initial pressure in the range 50 torrs to one atmosphere. Two spectrographs are used for the measurements of the light emitted: the first one having a low resolution for the continuum, the second one with a high spectral resolution for the line profiles.

An optical multichannel analyzer (O.M.A.II) is used for the light detection, standardization purposes, and for the mathematical treatment of the spectrum.

The electron density ($5.0 \times 10^{17} cm^{-3}$ - $1.62 \times 10^{18} cm^{-3}$) is obtained from continuum absolute measurements and from laser interferometry. The temperature (13000 - 18700 K) is obtained from the intensity of optically thick lines which is the case for strong lines in their centre. The normalized values:

$$W_N = W(10^{17}/N_e)(10^4/T)^{1/6} \text{ and } d_N = d(10^{17}/N_e)(10^4/T)^{1/6}$$

where W is the full width (FWHM) and d the shift are given in the Table 1.

Table 1.

Line	W_N(Å)	d_N(Å)	W'_N(10^{-4} $Å^{-2}$)	d_N
ArI 696.5 nm ($4s'[3/2]^o-4p'[1/2]$)	0.7	0.3	0.92	0.39
KrI 587.0 nm ($5s\,[3/2]^o-5p'[3/2]$)	0.6	0.23	1.13	0.41
XeI 473.4 nm ($6s\,[3/2]^o-6p'[3/2]$)	-	0.22	-	0.64

Using the modified semiempirical theory (Dimitrijević and Konjević, 1980; Dimitrijević and Kršljanin, 1986) as the starting point, we obtained for the sequence of homologous atoms the following expression:

$$W + id \approx A N_e T^{1/6} (0.487 - i1.299)\, F \qquad (1)$$

$$F = \left\{ \left[(E_H - I_o + E_i) 3 (I_o - E_i)^2 (E_s - E_i)^{1/2} \right]^{2/3} + \right.$$
$$\left. + \left[2(E_H - 4I_o + 4E_i)/3 (I_o - E_i)^2 (E_d - E_i)^{1/2} \right]^{2/3} \right.$$

Here, E_s, E_d and E_i are the energies of the (n+1)s', nd', and the initial level, respectively, E_H is the hydrogen ionization energy and I_o the ionization potential. Moreover, we have found empirically a linear relation $E_j = a + bI_o$, so that Eq.(1) depends only on the ionization potential and plasma conditions.

The normalized values

$$W'_N + id'_N = (W_N + id_N)/F\lambda^2$$

are given also in Table 1. A nearly constant ratio (within limits of $\pm$ 50%) indicates that Eq.(1) may be used for rough estimations of Stark broadening parameters in the considered case.

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INFLUENCE OF RADIATIVE PROCESSES ON GRAVITATIONAL INSTABILITY IN HOMOGENEOUS MAGNETIZED FLUID

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It is well known (Chandrasekhar 1961) that a self-gravitating fluid becomes unstable with respect to small perturbations if the related wave length exceeds certain value. In that case the gravitational force overpowers the pressure gradient and the instability sets in. This process clearly plays a basic role in the inital stage of a stallar cluster formation from fragmentation of interstellar matter.

In this work we investigate the influence of radiation on gravitational instability of a magnetized and perfectly electrically conducting fluid. Viscous effects are neglected while the thermal conductivity is taken into account. The medium is taken optically thick and the black body radiation condition is assumed.

The relevant linearized set of equations is as follows:

$$p = \rho_0 RT + RT_0\rho \tag{1}$$

$$\frac{\partial \rho}{\partial t} + \rho_0 \nabla\cdot\vec{v} = 0 \tag{2}$$

$$\rho_0\frac{\partial \vec{v}}{\partial t} = -R\rho_0\frac{\partial T}{\partial z} - RT_0\frac{\partial \rho}{\partial z} - \frac{4}{3}a_R T_0^3\frac{\partial T}{\partial z}\vec{k} + \frac{1}{\mu_0}\nabla\times(\vec{B}\times\vec{B}_0) - \rho_0\frac{\partial \varphi}{\partial z}\vec{k} \tag{3}$$

$$\frac{\partial \vec{B}}{\partial t} = \nabla\times(\vec{v}\times\vec{B}_0) \tag{4}$$

$$\nabla^2\varphi = 4\pi G\rho \tag{5}$$

$$c_p^*\rho_0\frac{\partial T}{\partial t} - 4RR_pT_0\frac{\partial \rho}{\partial t} = \frac{\partial p}{\partial t} + \varkappa^*\frac{\partial^2 T}{\partial z^2} \tag{6}$$

where the initial magnetic field is horizontal, along x-axis. Here: $c_p^*=C_p+12RR_p$ is the effective specific heat, $\varkappa^*=\varkappa+12RR_p\rho_0 D_r$ is the effective thermal conductivity, $R_p=p_r/p$ is the ratio of of two pressures, D_r is Roseland diffusion coefficient.

Assuming the perturbation scale lengths much smaller than the typical scale length for variation of unperturbed quantitities, we can treat the whole problem in a homogeneous medium. Perturbations are taken one dimensional and periodic in z-direction only.

When the Fourier-Laplace transform is applied to the set of equations (1)-(6), the following dispersion equation follows:

$$\omega^3 + iA\omega^2 + B\omega + iC = 0 \tag{7}$$

where:

$$A = -\frac{K^2 \varkappa^*}{\rho_0 (R - C_p)}, \quad B = \rho_0 4\pi G + K^2 \left[\frac{R^2 T_0 (1 + 4R_p)^2}{C_v^*} - \frac{B_0^2}{\rho_0 \mu_0} - RT_0 \right]$$

$$C = \varkappa^* \left[\frac{K^4 B_0^2}{\rho_0^2 \mu_0 C_v^*} - \frac{4\pi G K^2}{C_v^*} + \frac{K^4 RT_0}{\rho_0 C_v^*} \right]$$

The dispersion equation (7) yields the instability criteria and here we consider two special cases: I. Case with negligible heat conduction and II. Case with small heat conduction. The relevant instability criteria are

$$\text{II.} \quad \lambda > \left\{ \frac{\pi}{\rho_0 G} \left[C_A^2 + \frac{C_s^2}{\gamma} \left(1 + \frac{R}{C_v^*} (1 + 4R_p)^2 \right) \right] \right\}^{1/2}$$

$$\text{I.} \quad \lambda > \left\{ \frac{\pi}{\rho_0 G} (C_A^2 + C_S^2) \right\}^{1/2} \tag{8}$$

where C_A is the Alfven speed, $c_v^* = c_p^* - R$, C_s is the sound speed.

Conclusions that follow from (8) indicate that the radiative pressure, as well as the magnetic pressure, stabilizes the instability while the diffusive process of the total heat conduction has the opposite effect.

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RESONANT EXCITATION OF MHD SURFACE WAVES BY STREAMING FLUID.

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It is well known that a localized surface MHD mode can exist and propagate along the boundary separating two fluids with different physical characteristics (Wentzel, 1979). Once created, these surface waves can transport energy in given direction of the discontinuity. If the boundary is not sharp, i.e. if it is taken as a narrow and continuous transition region, then a resonant mode conversion can occur at points where the relevant frequency matching conditions are satisfied. This process dissipates the surface wave energy into resonantly excited bulk waves (Hasegawa, 1982) which propagate away from the boundary. A finite transition region, however, also makes possible a resonant excitation of MHD surface waves by an external driver, a fluid flow in our case.

In this work we consider a perfectly electrically conducting fluid separated by the plane z=0 into two regions with different densities, ρ_1 resp. ρ_2. Let the fluid at $z \geq 0$ (Region 2.) move at speed $U_0(z)$, sharply changing from 0 at $z \leq 0$ to a stationary value U_0 at $z \geq a$. The flow takes place parallel to the boundary, along the x-axis, and also parallel to a homogeneous, stationary magnetic field H_0, permeating the whole space.

Starting from standard linearized MHD equations and applying the Bousinesq approximation we arrive at the following equation for the perpendicular perturbation velocity component w:

$$\frac{\partial}{\partial z}\left[\rho\,\epsilon(z)\frac{\partial}{\partial z}\frac{W}{\omega-K_xU_0}\right]-\frac{(K_x^2+K_y^2)}{\omega-K_xU_0}\rho\,\epsilon(z)\,W=0 \qquad (1)$$

where: $\epsilon(z)=(\omega-K_xU_0)^2-K_x^2V_{A2}^2$

Having solved the equation (1) for the three regions $z < 0$, $z > 0$ and $0 < z < a$ respectively and applying the appropriate boundary conditions at $z=0$ resp. $z=a$, we get the following dispersion relation:

$$D_0(\omega) + D_1(\omega) = 0 \qquad (2)$$

where:

$$D_0 = \rho_1 \epsilon(0) + \rho_2 \epsilon(a) \quad , \quad D_1 = \rho_1 \epsilon(a) \epsilon(0) K \int_0^a \frac{dz}{\epsilon(z)}$$

We see that the first term in (2) alone gives the surface wave frequency spectrum while the additional term D_1, arising from the finite thickness of the boundary, gives a contribution to the instability growth rate at the resonant point z_r where $\epsilon(z_r) = 0$. The resonant condition $\epsilon(z_r) = 0$ in fact indicates the flow energy input into both the MHD surface wave and the bulk Alfven wave at the resonance.

The obtained instability differs from the standard Kelvin-Helmholtz instability which is also present in the case of a shear flow.

The described process is also important from astrophysical point of view as a mechanism for a wave turbulence generation by fluid motions in regions with discontinuities: solar coronal structures, solar wind interaction with the terrestrial magnetosphere etc.

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AN APPROXIMATIVE SOLUTION IN THE FRAME OF KINETIC NON-LTE APPROACH OF LYMAN α LINE TRANSFER IN CHROMOSPHERIC CONDITIONS

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The first completely self-consistent treatment of the non-LTE line transfer problem with convective transport of excited two-level atoms (ie. kinetic approach to non-LTE problem) was developed in the papers of Simonneau (1984) and Borsenberger et al. (1986a,b), by solving the two coupled kinetic equations for photons and excited atoms. Non-LTE line formation is, generally, characterized by three dimensionless parameters ε, ζ and η, measuring, respectively, the importance of inelastic, elastic collisions and streaming of excited atoms, which were taken, in previous papers, as the constants in constant property medium.

In this paper, we present a simplified solution of the two equations with depth variable parameters throughout the Solar chromospheric model (Vernazza, 1981) and for only one (central) frequency in Lyman α line. The behaviour of three parameters with optical depth in Lyman α is shown in Fig.1. Since $\zeta \ll 1$ throughout the entire model, elastic collisions have been neglected. The equations were solved using Feautrier technique applied to "two-fluid model" (Borsenberger et al., 1986).

As result, we obtained the behaviour of the source function in the chromospheric model (Fig.2.). As a consequence of the scattering effects, the line source function S shows a decrease outward and, finally, a drop at the surface to a value some 6-7 orders of magnitude below the local thermal one. At great depth S thermalizes to Planck value B. So, all main features of radiative transfer are clearly marked by this simple example.

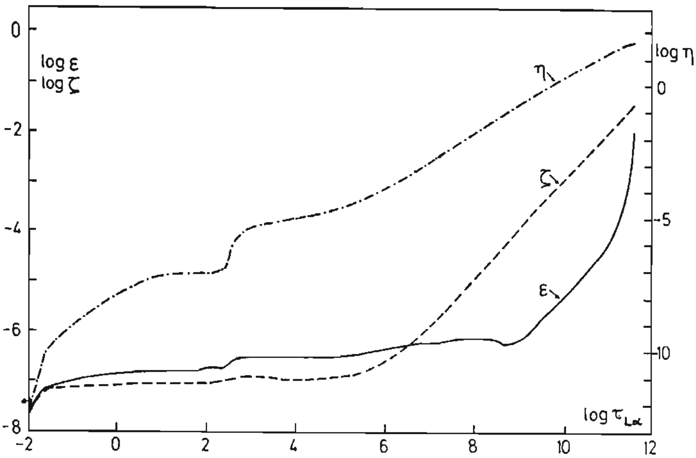

Fig.1. Parameters ε, ζ and η for Lyman α in Solar chromosphere.

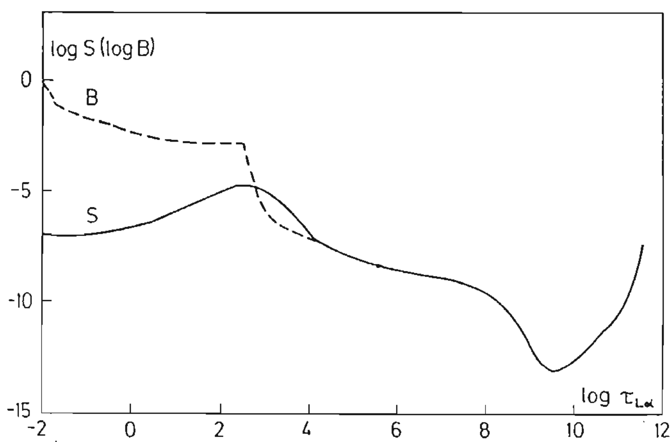

Fig.2. The source function S and Planck function B for Lyman α in the chromospheric model.

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VARIATIONS IN SOLAR CONSTANT

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The past decade brought us new understanding on solar and stellar sciences due to the accumulation of data from long series of ground-based measurements, and especially from space experiments (Skylab, OSO-8, NIMBUS-7/ERB, SMM/ACRIM, IUE, HEAO-2 (Einstein), Spacelab). All these new data enlarge immencely our knowledge on solar and stellar phenomena.

However, some new results shake our faith in one of the basic parameter of our star: stability of solar output. All indirect evidences about past terrestrial climate show high stability over last 8000 years (variation of mean temperature at midlatitude was about 3^{o} C).

Up to 1977. the best solar irradiance data over the visible spectral region have the absolute accuracy of the order of 10 %. Long-term variation (if any) should be less then 0.1 % per year. It is a nontrivial task for present day metrology to access such small variations over period of years. The requirement for absolute solar irradiance determination implies that measurements must be made from space. It was not possible until 1979. Now we have, for the first time, precise monitoring of solar irradiance from maximum to minimum of solar cicle. From 1980 till 1985 several indipendent satellite and high-altitude balloon experiments established a long-term steady downward trend of the average irradiance of 0.017 ± 0.003 % per year. Altrough space measurements have some disadvantages, (data are widely separated in time, need for intercalibrations, inhomogeneousness of independant data etc) nevertheless established monotonous downward trend seems to be real. The fading is however, too-fast for longer period of time. Such decrease could influence climate changes over the Earth. Several papers recently appear with excited ideas as: The Sun is fading out. Are we at the beginning of a new Ice Age? The Sun is expanding.

In this review, using the latest results, one attempt has been made to addres main problems of solar irradiance variability.

Short-term variations, visible as dips in recorded data, are due to sunspot blocking of convection by magnetic field. Storage and redistribution of missing flux is still an open question.

Activity cycle caused variations which are reconstructed from archived date from 1874, till 1981. Solar constant has 0.1 % lower values in maximum than in minimum. In the presented review it was pointed out that although some emission lines show great variation with activity cycles (CaIIK max/min $\approx$ 15 %, Lyman alpha max/min $\approx$ 75 %) their total contribution in bolometric luminosity is less 10^{-6}! This fact has been overlooked by some scientists.

Long-term changes in irradiance may be related to global changes in photospheric temperature, as recent experimental results do not suggest any solar diameter variations. A special attention has been drawn to deep photospheric line CI 538.0 nm which depth and equivalent width show no variation with activity but indicate a long-term decrease in effective temperature. Therefore, temperature and irradiance long-term decrease are consistent, indicating that the photosphere has got a slow varyng component. Sunspot number and area are not indexes for that.

SPECTRAL ANALYSIS OF A WHITE LIGHT FLARE

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We have studied the Stark effect and the continuum emission of a white light flare.

The flare started at 7 U.T. and ended at 8h45 U.T. The flare was observed close to the solar limb (N15, W75) on 26 - IX - 1963 at the Crimean Astrophysical Observatory using an eschelle spectrograph.

Stark effect. The line widths of Balmer series from H10 to H14 were measured on 7 spectrograms taken about 2 minutes apart. The width is very wide for the smaller quantum numbers and decreases to a minimum somewhere around H9 and then increases slowly to higher numbers. By assigning the Stark broadening to higher numbers we derive the values of the electron density.

From our analysis we confirm previous results that electron density from the line width is of the order of 10^{13} cm^{-3}. We also conclude that the electron density remained constant during our measurement (for 10 minutes).

Continuum emission. The continuum emission was analysed by a photometric determination of the contrast $\Delta I(\lambda) / Io(\lambda)$ in the wavelength range 3700 - 4300 A.

The possible mechanisms for the emission were investigated, namely hydrogen Paschen and H^- continua. We show that H^- is unlikely and derive strog constraints on the temperature structure and energy deposition mechanism imposed by the Paschen continuum process.

The site where the continuum emission was formed must be in the chromosphere where the temperature was between 12000 and 14000 K.

We normalized the ratio $\Delta I(\lambda) / Io(\lambda)$ for 5 spectra to the corresponding ratio at a reference wavelength, λr,

$$R(\lambda, \lambda_r) = \frac{\Delta I(\lambda)}{I_o(\lambda)} \Big/ \frac{\Delta I(\lambda_r)}{I_o(\lambda_r)}$$

where λ_r = 5000 Å. We note that between each of the 5 spectra there was no great difference between the corresponding R (λ, λ_r) curves.

These conclusions are reached by comparison of the experimental curves with theoretical ones.

A MANUAL SOLAR SPECTRUM SCANNER

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The need for various research programs at Belgrade equaorial solar spectrograph motivated the construction of a specific spectrum scanner.

It is a photoelectric scanner based on a 1P21 photomultiplier as the radiation receiver. The scanning principle is well known: the rotation of a tipping glass. In this case it is a 17-mm glass cube located in front of an exit slit in the focal plane of the spectrograph. The cube rotates for $\pm 40^{\circ}$ to each side of its mean position. The axis of rotation is parallel to the spectral lines. An analog angle encoder (actually an one-wire potentiometer) at the same rotation axis provides the X-coordinate electrical signal for an X-Y recorder where the photomultiplier signal is recorded along the Y-coordinate. The recording is independent of time and the scanning speed can be to a considerable extent variable. During the experimental stage the scanning is being done manually.

The access of a digital angle encoder to the rotation axis is provided. However, for the begining, the digitalization of complete analog records is envisaged on the basis of a Mini-MOP digitalizer at the Belgrade Faculty of Sciences.

Besides digitalization, the usual reduction of the recorded data includes the following steps:

1. Dark current reduction. It is done by proper translation of coordinate system at the digitalizer.

2. Flat field reduction. For this purpose a laboratory continuous spectrum is recorded and the necessary coefficients for corrections of systematically different light-losses at various angles of the tipping glas are obtained.

3. Normalization to the continuum level. A suitable wavelength interval near the observed spectral line, not more than one nanometer apart, is chosen and its level taken as the intensity unit.

4. Correction of the X-scale. An empirical relation of various tipping glass positions (angles) and the corresponding spectral line scanning shifts is found. With the known linear dispersion the calibration of the X-scale at the recorder is done. At this stage, it is taken as independent of time.

5. Reduction of the instrumental profile. So far, the instrumental profile has been determined by means of selected telluric lines (red spectral region). Preparations are in progress to evaluate it in the middle visual wavelengths.

6. Scattered light correction. The atmospheric and imaging instrumental scattered light is negligible. A contribution of non-selective light diffusion in front of the exit slit has not been determined yet.

7. Spectrophotometric measurements. As all the measured X and Y data are introduced into a computer, the desired spectrophotometric quantities are calculated automatically.

GAUSSIAN DISTRIBUTION AND TWENTY TWO YEAR CYCLE OF SUNSPOTS

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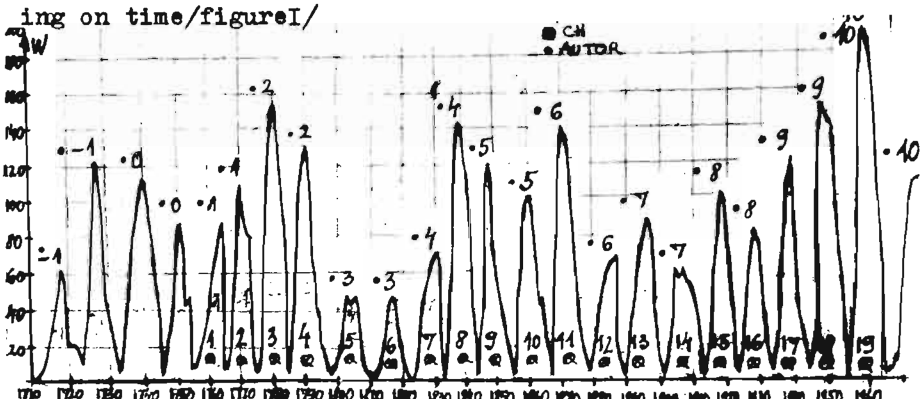
Sanspets are the best, clearly visible, indikaters that determine the intensity of the sum activity.They were alse observed in the ancient times when the enly instrument for ebserving celestial bodies was an eye.Due to the fact that a relatively wide range of infermatien abeut the solar activity can be obtained frem them ,sanspets are used indirectly fer the study ef the selar activity mech-anism itself.

On the basis of the change of Wolf's number /W/depend-ing on time/figureI/



in the interval from I7I0 to I980,we have come to the following conclusions: A 22-year cycle of the solar activity is taben to form the so-called mean Wolf's number for 22 years/$\overline{W}_{22}$/, as the sun of the maximum values of twe censecu tive 11-year cycles divided by 2: $\overline{W}_{22} = \frac{W_{11}^{I\,MAX} + W_{11}^{II\,MAX}}{2}$

$\bar{W}_{22}$ is put on the abscissa of figure2 and the frequency of the occurence of a particular maximum value of a 22-year cycle of the solar activity-on the ordinate.

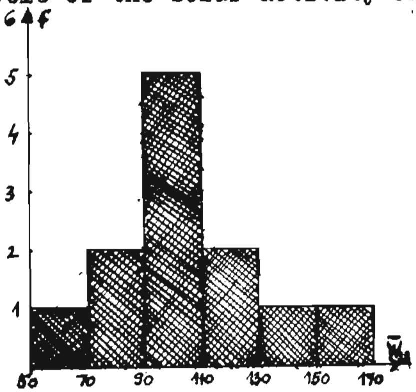


FIGURE II (dII)

t	-1	0	1	2	3	4	5	6	7	8	9	10	
$\bar{W}_{22}$	92	96	96	144	51	100	112	102	75	89	129	151	

INTERVAL	50-70	70-90	90-110	110-130	130-150	150-170
$\bar{W}_{22}$	51	75 89	92 96 96,100 102	112 129	144	151
f	1	2	5	2	1	1

Lets mark it with f and call it frequency.The graph shows a histogram which conforms with a Gaussian distribution, or rather tends to approximate it/dII/.The tables beside the histogram give a more detailed representation of how $\bar{W}_{22}$ and f are obtained.A 22-year cycle of the solar activity has been taken as a physical characteristic of the sun,for in that interval the polarity of sunspots is changed. It is interesting to observe that if the method in question is applied to such two consecutive 11-year cycles that the first one has the leading spots in the northern hemisphere marked with the sign/-/or/S/and the second/+/or/N/,it does not result in a Gaussian distribution.It is necessary to point out that the observed interval of sunspots cycles is relatively small for study of stellar processes of this kind, but it can be taken as a sample for these periods of the solar activity which have no extreme minimums or maximums/such as Maunder's minimum/.

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BEGINING OF A STUDY OF LONG-TERM CHANGES OF SELECTED FRAUNHOFER SPECTRAL LINES

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A number of Fraunhofer lines are known to change some of line-profile characteristics in time as well as accross the solar disk. There is possibility of finding their long-periodic changes with the solar activity cycle. The measurements of the depth, half-width and equivalent width of some selected lines has been started at Belgrade Astronomical Observatory with the solar spectrograph and its new scanner. The integral light of the solar disk is used in order to be close to the usual approach in similar stellar activity studies. The program is aimed to last at least through one 11-year cycle.

The lines to be observed, Table I, are selected according to some indications or expectations of their variability and to the possibility to obtain their profiles by the spectrograph. At the short wavelengths the sample is cut by the convenience of finding a certain line and at the long wavelengths the photomultiplier sensitivity decreases. Various values of exitation potential, E_p, Lande factor, g, and photospheric levels of formation of spectral lines are included in this sample. The equivalent widths, W, are selected within the values that can be measured with higher certainty. This is still a preliminary or working list.

<u>Table I</u>

Element	Wavelength (nm)	W (pm)	E_p (eV)	g	Remarks
Mg I	518.36	158.4	2.72	-	Line depth only
Fe II	519.76	8.0	3.23	0.7	
Cr II	523.73	4.9	4.07	-	
Sc II	523.98	5.5	1.45	-	
Fe I	525.02	6.2	0.12	3.0	
Ca I	526.17	9.9	2.52	-	
Fe I	530.74	8.6	1.61	-	Weak CrI in the wing
Ti II	533.68	7.1	1.58	-	
Mn I	539.47	7.4	0.00	-	Doublet
Fe I	539.83	7.6	4.44	0.3	
Fe II	542.43	4.8	3.20	-	
Fe I	543.45	18.4	1.01	0.0	Distant continuum
Fe I	550.68	12.0	0.99	2.0	
Sc II	552.68	7.6	1.77	1.0	
Fe I	557.61	11.3	3.43	0.0	
Ca I	558.19	9.1	2.52	1.5	
Ca I	560.13	10.0	2.52	-	
Na I	568.26	10.4	2.10	-	
Na I	568.82	12.1	2.10	-	Doublet
Fe I	569.15	3.8	4.3	0.0	Blended with NiI, E_p=4.1

It is expected that at least some of these lines will show certain long-term changes.

INFLUENCE OF STARK BROADENING ON EQUIVALENT WIDTHS OF Si II VISIBLE LINES IN STELLAR ATMOSPHERES

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Because of its large cosmical abundance, the silicon is of special importance in solar and stellar studies. For stars with effective temperature from 10000 to 20000 K (A0 to B3) the Si II spectrum is dominant, with strong lines in the visible, as well as in the UV where occure the resonance multiplets. In particular the Ap Si stars spectra reveal many Si II lines of high excitation, such as those of the 4d-nf series which are very sensitive to the plasma broadening effects. In this paper the Stark broadening of visible Si II lines is studied and its consequence on the intensity of the stellar absorption is analyzed. A complete set of atomic data concerning the Stark widths is elaborated for 19 multiplets of Si II of astrophysical importance (T.Lanz et al, 1987). Previous available determinations are rewieved and new Stark widths are calculated by means of the semiclassical impact theory (Sahal-Bréchot, 1969a,b).

The new adopted Stark widths are given in Table.

Table: Stark full halfwidths of 4d-nf Si II lines at $N_e=10^{17}cm^{-3}$.

Line (Å) (Mult.)	T=5000 K	10000 K	20000 K	40000 K
4621. (7.05)	22.8	23.3	24.0	24.0
4201. (7.06)	32.3	34.5	36.5	36.8
3955. (7.07)	48.9	52.6	55.8	56.0

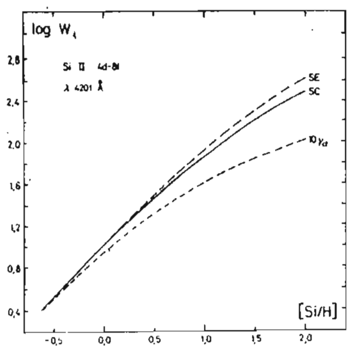

Fig. 1: Theoretical curves of growth of the 4201 Å Multiplet with different estimates of its Stark width (10 γ_{cl}, SC and MSE) for T=10000 K.

These results were applied in several examples to the analysis of stellar absorption lines. Theoretical curves of growth of the λ 4201 Å multiplet with new Stark width data (SC curve) and Stark width calculated using the modified semiempirical theory (Dimitrijević and Konjević, 1981) are compared in Fig. 1 with data obtained using ten times the "classical" damping value (ie 10γ_{cl}).

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CONSTRAINED DECONVOLUTION

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The benefits of physical-realizability constraints in the problem of deconvolution are nowadays well recognized.

When comparing different deconvolution methods their fundamental properties should be compared:

a) Quantity of a priori information that could be implemented. For all correctly founded methods this property determines the quality of deconvolution.

b) Speed, that determines the quantity of data that could be processed in the unity of time.

c) Availability of a priori information used in the method. That information could be easily or hardly obtained, more or less reliably, so this property influences both a) and b). In this sense, general a priori information as positivity, smoothnes, band limitation etc. is more desirable.

d) Accomodability of the method. There is a number of deconvolution methods developed for the intended purpose. These methods works best for the intended purpose. But it is very desirable if a method could be accomodated for the different problems that cold arise.

A deconvolution method constrained to produce only physically realizable solutions, intended to satisfy all the properties listed above is presented in this comunication.

Spectroscopic application is demonstrated.

The spectrometer completely obliterates the information at all Fourier frequencies beyond some finite cutoff. This is specifically true for dispersive optical spectrometers where the aperture determines cutoff.

Similar considerations prevail in Fourier interferometer, where the cutoff is determined by the maximum path difference.

Physical constraints are applied by correcting the components of the signal in the Fourier space.

INDIRECT STELLAR IMAGING
FROM SPECTROSCOPIC AND PHOTOMETRIC OBSERVATIONS

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A technique for reconstructing surface brightness distributions on stars from high quality (signal to niose ratio and resolution) spectroscopic and photometric observations is described. A technique is based on rotational modulation of rotationally-broadened absorption line profiles and photometric light curves.
The methods of image reconstruction from projections are developed for this purpose.

The image reconstruction algorithm should be determined by real observational constraints. The precision of the projection is limited by actual signal to noise ratio and image resolution is limited by spectral and temporal resolution. For this purpose two kinds of image pixels (resolution and projection pixels) are introduced.

Due to the very ill-conditioned nature of this image reconstruction problem, the regularization of the reconstruction should be done. A choice of the specific regularization method depends of the a priori information that is available. Thus the quality of the reconstruction (reality of solutions and image resolution) depends on the a priori information available as well as of the quality of observations (signal to noise ratio, spectral resolution and phase coverage density).

The origins of the ill-conditioning of the problem are disscused as well as regularization methods that should be applied.

The methods, using Doppler imaging technique are illustrated.

For the given surface brightness inhomogenities that produces spectral variability the synthetic spectrums were calculated.

En example of the physically unconstrained (no a priori information) minimum norm reconstruction is shown.

In the cetrain cases (if there are only spots on the stellar surface) the Maximum Entropy Method could be applied. Due to the strong regularization properties of this method better reconstructions are expected.

ON NEUTRAL OXYGEN LINES FORMATION IN γ CAS

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Two intense infrared triplets of neutral oxygen ($2p^3\ 4s\ ^3S^o_1 - 2p^3\ 3p\ ^3P_{0,1,2}$, λ = 13165 Å and $2p^3\ 3d\ ^3D_{1,2,3} - 2p^3\ 3p\ ^3P_{0,1,2}$, λ = 11287 Å) have been recently observed in the emission spectrum of the Be type star γ Cas (Chalabaev, 1984) with the Canada - France - Hawai 3 m 60 telescope. Both multiplets have the same lower term $3p\ ^3P$.

In order to investigate the formation of O I lines observed in the infrared spectrum of γ Cas, the following processes have been considered for populating the $4s\ ^3S^o_1$ level:

- $2p^4\ ^3P - 2p^3\ 3d\ ^3D^o$ photoexcitation by Ly β
- $2p^4\ ^3P - 2p^3\ 4d\ ^3D^o$ photoexcitation by Ly γ followed by cascades towards $4s\ ^3S^o$ (4d - 4p - 4s).
- $3d\ ^3D^o - 4p\ ^3P$ collisional excitation transfer by electrons and protons followed by cascades towards $4s\ ^3S^o_1$.
- $3d\ ^3D^o - 4s\ ^3S^o_1$ direct collisional excitation transfer by electrons and protons.

The results of our analysis, using the model of Poeckert and Marlborough (1978) for the γ Cas envelope model indicate that the considered lines are formed in the initial part of the envelope and that the collisional coupling $3d\ ^3D^o - 4p\ ^3P - 4s\ ^3S^o_1$ is predominant for populating the $4s\ ^3S^o_1$ level.

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CLOSE BINARY SYSTEMS WITH ACCRETION DISK

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The possibility to determine from the curve of luminosity analysis, parameters of close binary systems with accretion disk is considered in this communication. The system's model, giving the synthetic curve of luminosity has been made. This result gives possibility to determine parameters of the system using the developped inverse problem method. In this communication, the model of system, the inverse problem method, as well as the short analysis of results are presented.

THE CHEMICAL COMPOSITION OF THE GALILEIAN SATELLITES

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The chemical composition of celestical bodies can be determined either by remote spectroscopy or within theories attempting to explain their origin and internal structure.According to recent reviews (Encrenaz,1984;Stevenson,1985;Zellner et al.,1985),our knowledge of the chemical composition of the smaller bodies of the solar system is rather limited.

The aim of this paper is to determine theoretically the chemical composition of the Galileian satellites.All the calculations have been performed within the theory of behaviour of materials under high pressure,proposed by P.Savić and R.Kašanin (Savić and Kašanin 1962/65;Čelebonović,1986;Savić and Teleki,1986 and references given there).This study has been undertaken with the idea of testing the applicability of the theory to planetary satellites and,in case of satisfactory agreement, extending it to the determination of the composition of the asteroids.

As input data we have used the masses and radii of the satellites (Masson,1984).The results are presented in the following table,in which A denotes the mean molecular weight of mixtures which can approximate the composition of different satellites.

SATELLITE	A	MIXTURE
Io	70	$22\%FeSiO_3 + 20\%FeS + 28\%SO_2 + 30\%N_2H_4H_2O$
Europa	71	
Ganymede	18	$85\%SiO_2 + 7\%H_2O + 8\%H_2$
Callisto	19	

A detailed comparison of our results with observational data (Dollfus,1975;Masson,1984 and many other references) reveals that the mixtures by which we have described the composition of the satellites contain most of the actually observed elements.

As for the origin of the distribution of values of A shown in the table,it can be explaind by the depletition of the inner parts of the circum-jovian accretion disk in light elements,due to the excess luminosity of proto-jupiter (Graboske et al.,1975; Masson,1984).

In conclusion,it has been shown that the theory proposed by Savić and Kašanin can be used in studies of planetary satellites, and that it seems reasonable to attempt using it in studies of asteroids.

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ASTROPHYSICS IN THE NINETEENTH CENTURY SERBIAN LITERATURE

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The first Serb to mention astrophysical instruments and methods was Atanasije Stojković in his Physics (1801-1803). They are next spoken of by V. Marinković in 1851.

The dilemma as to whether our Sun was an incandescent or a dark body was shared by the Serbian authors of the day. In 1783 Z. Orfelin wrote that Sun was a fiery and dense body whereas A. Stojković adopted some newly-appeared interpretations and claimed it was dark. The works of his contemporaries A. Bolarić (1804) and G. Lazić (1822) are in the same vein. Along with some others - including V. Varinković in 1851, they adhere to the views propounded by W. Herschel and other foreign astronomers. G. Popović, however, questioned this view in 1850 and the theory of the dark sun was completely abandoned in the latter half of the century when the debate focused on its chemical composition, energy and how it is sustained and Sun's "life-span". The subject of interest of Dj. Stanojević was the solar nature and he published some works about it in France. He also went to Siberia to watch the solar eclipse in 1887.

The moon was written about much less. The attention was drawn to its surface and its possible changes. A. Stojković referred to its volcanoes also seen by W. Herschel. Most authors believed the existence of water and air on the moon impossible.

Information about the planets is largely found in calendars announcing invariable the ruling planet of the year, with often lengthy articles about it, based on the then knowledge about its size, movement, appearance, physical properties, spectrum and atmosphere.

The first authors peaking of comets dwell mostly on their descriptions and paths. At a somewhat later date more attention is attached to their nature, composition, whether they glow with their own light or reflect it. Yet, in 1888 M. Andonović admitted that very little was known about the comets' physical properties. There is also information about the disintegration of comets and origin of meteorite swarms.

The notorious doubts regarding the origin of meteor phenomena found their reflection in the works of Serbian authors. Chladni's view was known to V. Bulić who, in 1824, explained the falling stars as a product of particle ignition due to the electricity of the air or some unknown chemical reaction. V. Marinković tackled them also saying that the falling stars were small bodies revolving around Sun, which could fall on Earth because of the force of gravity. Bolides are larger bodies which can fall as stones of different chemical composition. Two rather large meteorite had fallen in Serbia and scientific papers about them were published by J. Pančić, S. Lozanić, J. Žujović and A. Stanojević in 188o,189o and 1891. The public wanted know about life in the outer space and the papers included information about the organic matter found in the meteorites.

The physical properties of the stars were not mentioned until the latter half of the 19^{th} century. V.Marinković wrote about variable and new stars, and Dj. Stanojević about Secchi's division of the spectrum in 4 classes. More about stars can be found in M. Andonović:their spectra, atmospheres, composition, old and young stars. J. Mihailović wrote about star temperatures, their differences and variations in 1895-96.

Information about the Milky Way and nebulae was scant. Some mention can be found in V. Marinković saying that a nebula branches out as the Milky Way. It is also noted that one hundred nebulae were known before Herschel and that he discovered about 25oo of them. Some authors distinguish resolvable, semi-resolvable and irresolvable nebulae.

The above shows that most of the relevant astrophysical phenomena were written about but in a popular way, accessible to pupils and readers of average education.

ON THE ASTRONOMY TEXTBOOKS AND THEIR REPRESENTATION OF CONTEMPORARY SCIENCE

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Report on last 25 astronomical years. Problems of the reflection of the present scientific moment on educational literature have been considered and systematic analysis of scientific methods and procedures and their adaptation to different educational levels has been postulated. Typical tematic distribution of general astronomy textbooks in our country and in the world since 1962 up to now, was presented. One point out on the digestion of scientific papers and reviews and on their contents classification.

One establish the value of a complex problem exercise as the closest reflection of the scientific method. Further, the rôle of new computer helping devices in education, and different forms of educational technology has been considered. The virtual existence of modern Yougoslav terminology was established as a critical moment in the educational literature. Moreover, the urgent need for the terminology and dictionary elaboration, primarily on the basis of M.sc. and Ph.d theses was pointed out.

DEVELOPEMENT OF AMATEUR RADIO ASTRONOMY AS AN IMPROVEMENT OF ACTIVITY OF ASTRONOMICAL SOCIETY AND PEOPLE'S OBSERVATORY

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Intensive developement of electronics in last years, made possible that astronomical societies, and even individuals can provide with professional electronic equipements. Consequently, by using modern radioamateur receivers, used up military devices and similar, by adaptation and selfconstruction of corresponding structures, by construction of special antenna systems and so on, one can obtain a reliable radio telescope with a modest financial source.

Besides the improvement of activities, developement of radio astronomy attract to astronomical societies attention of individuals interested for other scientific disciplines as radio technique, electronics, automatics, computer science etc.

Education of skilled workers and developement of radio astronomy equipements is the first stage for data receiving from scientific satellites, orbital telescopes et similar.

SOME CHARACTERISTICS OF THE SKY BRIGHTNESS IN BELGRADE

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The sky brightness over Narodna opservatorija was determined with original photographic procedure. On the series of photos were derived some other characteristics of astro-climate too.

ON THE PHOTOGRAPHIC OBSERVATION OF DOUBLE STARS

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The possibility of optimal treatment by photographical observation of the double stars will be considered.

ON THE PHOTOGRAPHIC DETERMINATION OF LUNAR LIBRATIONS

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The processing of determination of the Lunar librations from photos was hurried with some modifications. The accuracy of the method was analyzed. The determination of possible physical libration for the Belgrade and Sarajevo photos will be discussed.

THE LIMITING STELLAR MAGNITUDE OF THE SARAJEVO SKY ATLAS

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Stellar fields with star clusters - the photographic standards were analyzed. The limiting stellar magnitude in blue and red colour was determined. Corresponding the determined values on theoretical formulas are derived some parameters of astro - climate.

PHOTOELECTRIC PHOTOMETRIC OF ECLIPSING BINARY STARS

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Method of observing with 0.3 m Cassegrain telescope and photoelectric photometer is described. Reduction to standard Johnson system and transformation coefficients is presented. Results of observations of eclipsing variables are shown - times of minima, heliocentric correction, O - C and complete light curve of W UMa and 44 Boo.

PHOTOGRAPHY OF SUPERNOVA 1987A

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Photography of supernova 1987A in Great Magellan Cloud made in South America – Peru is shown. Magnitude and color index estimation from photographic photometry are presented.

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