NEUTRAL COMPONENT OF THE OUTERSTELLAR MEDIUM IN THE VICINITY OF THE SUN

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Optical observations of the solar radiation resonance scattering in the hydrogen and helium lines (λ1216Å and 584Å) provide a unique opportunity for determining numerous parameters of the local interstellar medium closest to the Sun (LISM). The distance exceeds 10 to 10^2 AU where the interstellar medium is no longer perturbed by the gravity field, and the hard and corpuscular radiation of the Sun.

Such observations took place in 1976/77y aboard the Soviet Prognoz-5 and -6 satellites and in 1978/79 aboard the Venera-11, -12 interplanetary stations. Both experiments were fulfilled by Soviet-French groups. The first experiment employed a photometer with narrow-band filters and a hydrogen absorption cell, the second, a diffraction spectrometer with 10 detectors to record bright lines of scattered radiation in the range 300÷1600Å.

The observational results were compared with the theoretical intensity value and, by way of optimization in terms of the "hot model", the following parameters of the unperturbed interstellar medium were determined: the density of hydrogen and helium atoms, their temperature, the velocity (its value and direction) of the Sun's motion relative to the interstellar gas, the mean ionization time of helium and hydrogen atoms. One more parameter was derived for hydrogen, which characterizes the ratio of the light pressure force (L_α-line) to the gravity force - μ. Assuming the normal abundance of helium relative to hydrogen (0.1 to 0.06) it was possible to estimate the degree of hydrogen ionization x_H from the measured quantity n_{He}/n_H, and, thus, the value of electron density n_e. The radius of the HI zone near the Sun (or near any cold

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dwarf star) differs from the classical radius of the Stromgren zone, and the reasons for this is the absence of stability since the ionization time is by a factor of $5 \cdot 10^7$ shorter than the recombination time - over 1 A.U. During the recombination time $5 \cdot 10^6$ yr the Sun shifts over 100pc in the interstellar medium.

The measurements described made it possible to obtain

- Sun's motion velocity relative to LISM 24 ± 2 km/s
- direction of this motion $\alpha = 254 \pm 3^\circ$, $\delta = -17^\circ \pm 3^\circ$
- helium density, $n_{He} = 0.015 \div 0.020$ cm^{-3}
- temperature $T_{He} = 12000^\circ \div 16000^\circ K$
- ionization time $_{He} = (1 \div 2) \times 10^7$ sec
- hydrogen density $n_H = .06 \div .03$ cm^{-3}
- temperature $T_H = 7000^\circ - 9000^\circ K$
- $\mu = F_A/F_G = .75 \pm .1$

Data on the hydrogen distribution within the Solar system are in better agreement with the anisotropy in the solar wind flow which obeys the law $(1 - A \sin^2 \lambda)$, where $A = .4 \pm 0.1$, while λ is the heliographic latitude. The hydrogen ionization degree is $X_H = .3 \pm .3$ which corresponds to $n_e = 0.035 \pm 0.035$ cm^{-3}. The values derived in measurements in hydrogen and helium lines agree well; except for temperature, where the difference reaches 5000 to $10000^\circ K$.

The data from the four experiments may be found in the following references:

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