BRIGHT FEATURES IN THE SOLAR PHOTOSPHERE

R. I. Kostik[1], **E. V. Khomenko**[1,2]

[1] *Main Astronomical Observatory, NAS of Ukraine*
27 Akademika Zabolotnoho Str., 03680 Kyiv, Ukraine
e-mail: kostik@mao.kiev.ua

[2] *Instituto de Astrofísica de Canarias, 38205 La Laguna, Tenerife, Spain*

We report thermodynamical properties of so-called "thermal plume" observed near the solar disc centre in 2001. The spectral observations of two iron lines analysed were obtained with the use of the Vacuum Tower Telescope (Tenerife).

We analyse wave and flow motions, thermal structure and other properties of the thermal plume which we observed in August 2001 using the German Vacuum Tower Telescope (VTT) of the Observatorio del Teide (Instituto de Astrofísica de Canarias). The time series of spectral images with a total duration of about 158 min were acquired in two Fe I and Fe II iron lines simultaneously. The observed area was located close to the quiet solar disc centre. The spectrograms were taken every 10 s.

The observations revealed rather stable feature which has been detected during the whole period of the observations. The size of this feature along the slit was 2000–2500 km. The plume shows a compact brightening in comparison with the nearby granulation. At a height of about 200 km, its intensity contrast is twice as large as that for the surrounding area while reaching a factor of 4 at a height of near 500 km (Fig. 1a).

The following items characterize the feature during the whole period of the observations:

- A high-speed downflow of 0.5 km/s was seen at the continuum level. At higher photospheric layers upward flows were observed with the modulus of the velocity increasing with height. The sign change of the velocity occurs at about 170 km (Fig. 1b).
- The velocity-intensity correlation does not exceed 0.25 at all observed heights from 0 km up to 500 km (Fig. 1c).
- The amplitudes of five-minute oscillations of the velocity (Fig. 1d) and intensity (Fig. 1e) are twice lower than outside the plume.
- There is a large difference between spectral line asymmetry observed in the plume and quiet regions (Fig. 1f).

We conclude that the observed phenomenon has a non-convective origin. The thermodynamical properties of the atmosphere where the plume occurred have been recovered from the observed profiles using the SIR inversion code. We used the spatially averaged profiles of granules, intergranular lanes and the plume doing the inversion. The plume is found to be hotter and more dense than the quiet Sun at almost all heights in the photosphere. The average magnetic field is non-zero in the plume. It can be of the order 400 G. The decrease of the amplitudes of oscillations can be attributed to a larger density and stronger magnetic field in comparison with the surrounding atmosphere.

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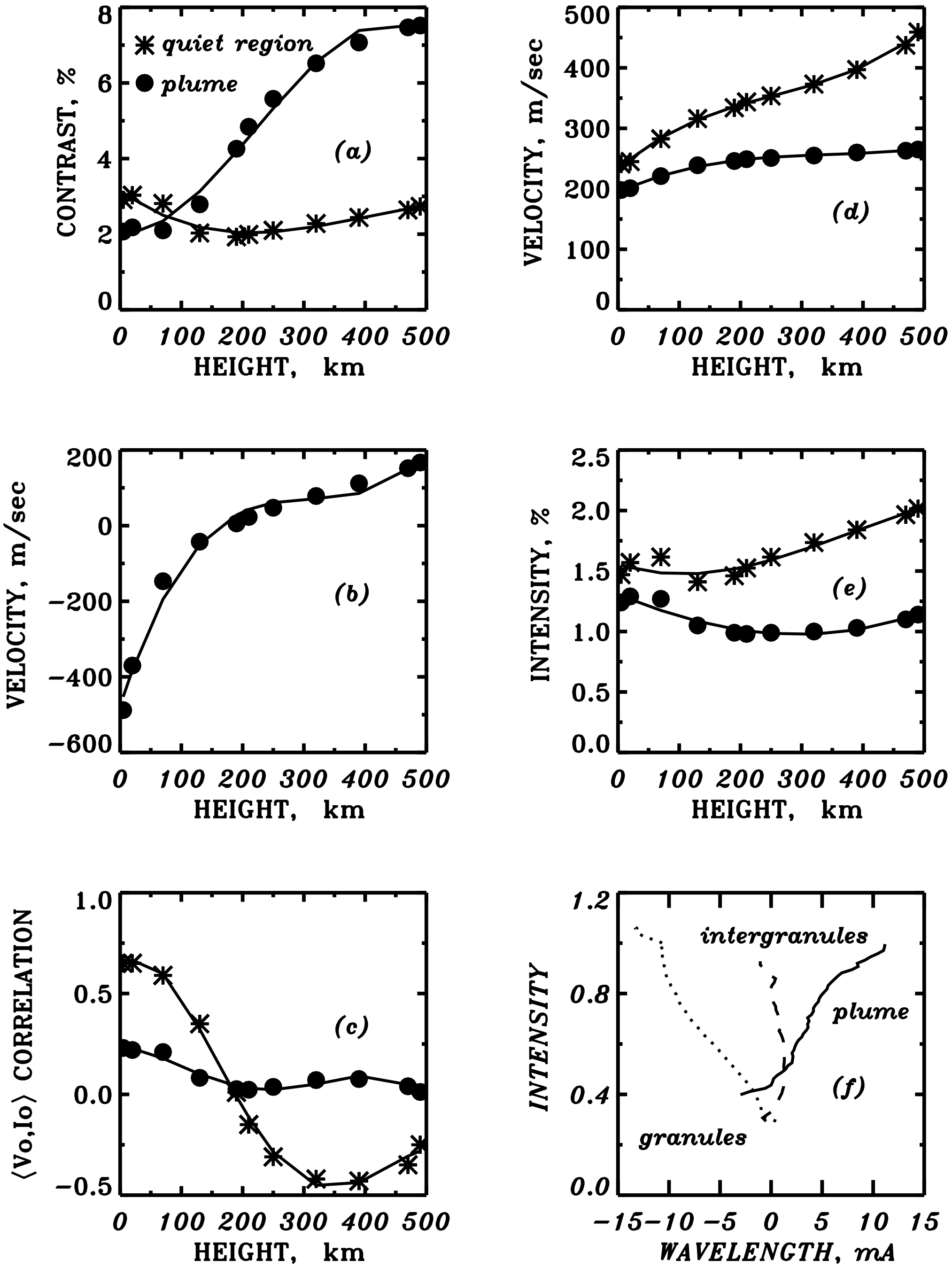

Figure 1. Height dependences in the quiet region and the plume and bisectors in granules, intergranules and in the plume. (a) Observed contrasts; (b) velocity convective amplitudes; (c) velocity-intensity correlations; (d) velocity oscillatory amplitudes; (e) intensity oscillatory amplitudes; (f) temporally averaged bisectors of the Fe I $\lambda\,639.36$ nm line