— G. ELSTE:

The Michigan arguments don't refer to this deep level.

— J.-C. PECKER:

Yes, all the observations do not refer to the same level.

— E. SPIEGEL:

Does that mean a correlation was measured or is this just a qualitative judgment?

— R. B. LEIGHTON:

At the present time it is qualitative, but clearly by measuring the contrast of the two pictures, which we plan to do, one can make it quantitative.

A. B. SEVERNY: **The motions and magnetic fields in the undisturbed solar atmosphere (outside active regions).**

The regular records of line-of-sight velocities with the aid of the solar magnetograph have been available at the Crimean Observatory since 1957, and a set of papers was published in *Publ. Crim. Observ.* since then. The method consists in recording the rotation of a plane-parallel plate before the slits of the magnetograph. This plate keeps the image of the line rigidly on these slits by equalizing the photocurrents from both slits, (the principle of the image follower). *The records of line-of-sight velocities* are always obtained *simultataneously* with the records of *magnetic field* because the principal aim of this image follower is to compensate automatically Doppler shifts of the line and to eliminate their influence on the measurements of magnetic fields. (To calibrate magnetic field in velocities of solar rotation we must switch off this compensator.) We found that there is no practical need to use a magnetic insensitive line (*e.g.* 5123.7) to record radial velocities, because of symmetrical change in Zeeman pattern at the modulation $(0, \frac{1}{4}\lambda)$ and high frequency of ADP modulation (120 Hz^{-1}). But most records were made in a magnetic insensitive line, 5123.7 [1].

The main sources of error are 1) the turbulence in the *spectrograph* itself producing accidental errors, and corresponding to display of r.v. from ± 50 up to ± 100 m/s; 2) *the trembling of images* across the slit of the spectrograph producing at *bad seeing* accidental deviations up to 1 km/s. But this error is reduced (by repeating scans) to an amount which is less than the display owing to the turbulence in spectrograph.

A brief summary of our results relating to undisturbed disk is the following (the results were chiefly obtained by STEPANOV and partly by SEVERNY [2, 3]).

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1. – Photosphere.

a) The velocity fields in the undisturbed photosphere are extremely complicated and as yet *we have failed to establish some regularity in them as well as to find any connection with magnetic fields.* The maps of velocities show no sign of regularity and stationarity (except active regions). The changes of magnetic polarity are not accompanied by changes of line-of-sight motions, as if the solar plasma were able to move freely across magnetic fields. This was confirmed also in the paper of STESHENKO [4], who tried to investigate the magnetic fields of granules, and also failed to detect the separate fields of granules exceeding 50 gauss, which is of the order of error of the best photographic measurements of Zeeman splitting with Rochon prism.

b) Some quasi-regularity still exists; and it consists in the existence of predominant ascending or descending motions over big areas reaching sometimes $(2\div5)\cdot10^5$ km in size. In these big zones we can find separate small regions with the sizes varying from 4 000 to 20 000 km, and of *opposite* direction of motion.

c) The maximal velocity observed in the photosphere (outside sunspots) may be estimated as ± 450 m/s. The mean square velocity was estimated as ± 76 m/s.

2. – Chromosphere (outside active regions).

a) The records were made in H and K-lines of Ca^+ (by STEPANOV) and in H_β-line (by myself). They showed also complicated structure and the existence of big zones with predominant motions of one sign. The size of these regions is comparable with those of the photosphere, but a little smaller (~ 2 times).

b) On the background of these zones there exist separate regions with sizes ranging in the same limits as in the photosphere, and showing comparatively high velocities, exceeding sometimes ± 3 km/s. STEPANOV found that these regions are also moving irregularly *across the line of sight* with velocities reaching 5 km/s. The mean lifetime of these elements is $\sim 7^h$.

Above undisturbed regions with weak fields $H < (5\div7)$ G, STEPANOV also found that the mean flux for ascending motions is equal to that of descending, and for these particular regions the mean velocities are -0.96 km/s and $+1.25$ for ascending and descending motions respectively.

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Summarizing these results, we can provisionally conclude that in the undisturbed solar atmosphere there exist two characteristic sizes, and characteristic velocities of motions: large scale $((2 \div 5) \cdot 10^5$ km) and small scale (of the order of $(5 \div 20) \cdot 10^3$ km).

REFERENCES

[1] N. Nikulin, A. Severny and V. Stepanov: *Publ. Crim. Astr. Obs.*, **19**, 3 (1958); *Astron. Circ. USSR*, no. 183 (1957).
[2] V. Stepanov: *Publ. Crim. Astroph. Obs.*, **20**, 52 (1958); **24**, **25** (1960), in press.
[3] A. Severny: *Publ. Crim. Astroph. Obs.*, **24**, 288 (1960).
[4] N. Steshenko: *Publ. Crim. Astroph. Obs.*, **22**, 49 (1960).

— R. B. Leighton:

I am not sure I understand what velocities correspond to the very large structures, the intermediate structures, and the granulation.

— A. B. Severny:

The big structure corresponds to velocities of about 100 km/s, and the small structure to ~ 1 km/s.

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