1 Introduction

The session was attended by 40 scientists to listen to presentations (see further). Additionally, lively discussions took place about the problems of detection of waves in the transition region (TR) and the corona, including magnetic waves, both from groundbased and with spaceborne experiments on SOHO.

Several topics were already covered at the Special Sessions on chromospheric waves. Here we concentrated on the existing perspective for analyzing oscillatory or quasi-oscillatory phenomena involved in the heating of the chromosphere and the corona and, possibly, in the mass flow in the T.R. Velocities involved in the T.R. and especially in the corona are clearly large. At coronal temperatures, the sound velocity \( c \) is typically 250 km s\(^{-1}\) and the Alfven speed is even higher \( v_A \sim B^{1/2} \). We are dealing with spatial scales, in the range of 10\(^6\) to 10\(^8\) km as demonstrated by the best resolution images see Fig. 1. Accordingly, the range of frequencies which should be considered is between 1 mHzs and 10\(^3\) mHzs, which of course includes the region of 5 and 3 min oscillations.

Among the most promising results reported up to now are those which concern the analysis of network elements, where propagating waves seem to be recorded. This is confirmed by an analysis using the wavelet transforms by Bocchialini et al. 1994-95. Moreover, the network elements are the privileged sites where small-scale ejection phenomena are occurring, see Fig. 2. No doubt they will be intensively observed on the disk in UV and EUV as well as outside the disk, using the SOHO instruments.

Well magnetized regions of the solar atmosphere, like sunspots and plages, are other privileged sites where waves should be analyzed or looked for. At the photospheric levels these regions already showed evidences of propagating magneto-acoustic waves occurring at high frequencies near the chromospheric cut-off. Correct atmospheric models of the extended transition region are desperately needed to interpret waves observed in the high chromosphere up to the 6 to 8 Mm levels where the highly dynamical spicules are also observed. Loops of different sizes, presumably related to their temperatures in case isothermal loops really exist, are known to rise into the low corona, so resonance MHD waves should occur. Different kind of gravity-free waves are predicted by modelors for loops, but a whole range of new models has now to be considered, between those using a stratified hydrostatic atmosphere and those assuming a single thin straight flux tube immersed in an atmosphere with constant physical parameters.

Finally, from the observational side we are waiting after the observations to be performed on SOHO, free of earth atmospheric effects and reaching, thanks to the use of EUV lines, the layers of the T.R. on the disk as well as outside. Joint observing runs should be carefully envisaged to share the resources of the satellite and permit a 2D analysis at 2 or more levels with the best possible temporal resolution. This is possible if the field of view is reduced which is still fine when local phenomena are studied in detail. More global phenomena corresponding to the low order harmonics of the magnetic field are more difficult to analyze although helioseismology experiments could be of use in case MHD waves are detected.

2 Oral presentations and contributions

Results which were presented are described in poster papers presented at the workshop and/or are published elsewhere. Here we give just a very short account of these presentations.

a - Jurgen STAude (Postdam) - Non-adiabatic behaviour of magneto-acoustic waves in sunspot atmosphere with gravity. In this work a special attention is paid to the description of variations of UV line intensities in the external layers (transition region) and realistic stratified models of temperature, densities, etc. are used. The calculations of eigenmodes and visibility functions are used to make a new proposal of space experiment.

A description of a work by Y. Zhugzhda was also given (see his poster paper). It concerns a "generalized" theory of waves in thin, force-free flux tubes. The rotation and twisting are included to deduce the dispersion equations. An effect of both intensification and attenuation of sausage instabilities is worked out.

b - Alexander Kosovichev (Stanford) - A short account of his work, together with A. Andreiev from Crimean Obs., was given. Topic: Non-linear waves and shocks in the chromosphere and coro-
Fig. 1 - The best resolution images of loops made in W.I. Observations done with the 3.6 m aperture CFHT during the July 11, 1991 total eclipse and processed by S. Koutchmy and L. November. Note loops of different sections, different curvatures and different contrasts.

Fig. 2 - Naive drawing to show a cut through a network element and different relevant layers and structures where MHD waves are supposed to propagate. Note the log scale of heights.
na. He emphasized the effect of "wave-wakes" in the corona due to quasi-periodic formation of shocks first described in numerical experiments by Kosovichev and Popov (see the poster paper). New results of numerical simulations of such oscillations were presented. The authors suggest that the resulting perturbations could represent the spicule phenomenon in the high chromosphere, including a ballistic-type trajectory of the chromospheric gas.

c - Roger ULRICH (Univ. of Cal. L.A.) - Some exciting new observational results were presented on the possible detection of Alfven waves at periods near 5 min.

Magnetic field measurements with high temporal resolution were recorded in a plage, over a typical arcsec size area, using a new instrument developed at Mt Wilson for helio-seismology. The D1 line is used.

The plage is near the limb and definite variations of the magnetic "flux" are seen at periods close to 5 min; they could be due to variations of the inclination of the magnetic field at the same period which would be evidence in favour of the occurrence of Alfven waves coherent over the whole aperture. The work is in progress.

d - Alan TITLE (Lockeed-Palo Alto) - Comments were made on the new possibilities which will be offered by the recently approved mission "TRACE". A free policy of dissemination of the collected data is envisioned for this mission which will be orbiting at the same time as SOHO in about 3 years.

3 Discussions

Both the problems of detection of MHD waves and consequences of predicted effects were lively debated.