

# EFFECTS OF SOLAR ACTIVITY ON AMPLITUDE OF ACOUSTIC OSCILLATIONS

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ABSTRACT

Active processes and structures observed on the solar surface may significantly affect the excitation and damping of solar oscillations resulting in inhomogeneous distributions of the amplitude of the oscillations at the surface. Strong localized acoustic sources and sinks such as flares and sunspots produce propagating waves. We discuss theoretical modeling of the effects of solar activity and their observational consequences with particular attention to the observational effects near antipodes.

## 1. Model

We have applied a normal-mode approach by Dziewonski & Gilbert (1983) to compute the seismic response to an impulsive acoustic source. We assumed that the total momentum of the impulse source is  $10^{22}$  g cm/s, that corresponds to an impulsive energy release such as a solar flare in the lower chromosphere (Kosovichev & Zharkova, 1995).

In our model, all the solar modes with frequencies below the acoustic cutoff frequency and of angular degree up to 1000 were included in the computations. The effect of the high-frequency modes was taken into account using an asymptotic theory. The amplitude of individual oscillation modes excited by the impulsive source is shown in Figure 1.

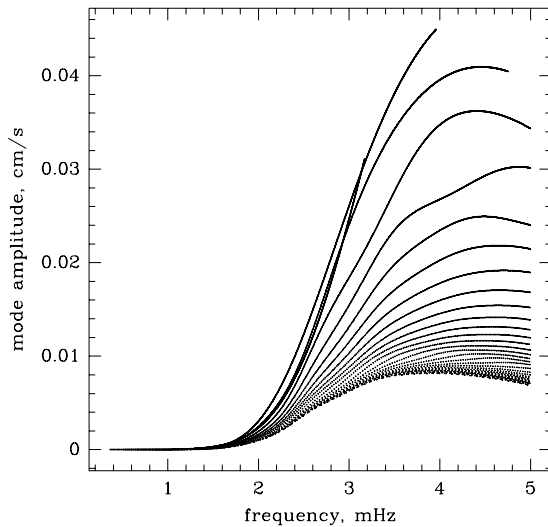


Figure 1: The amplitudes of individual modes excited by an impulsive source as a function of mode frequency.

## 2. Results

Figure 2 shows the wave amplitude at different angular distances  $\theta$  from the source. The top curve shows the wave amplitude at the antipodal point  $\theta = \pi$ . The maximal wave amplitude at the antipode is approximately 1/5 of the maximal amplitude in the source. The focusing effect is evident. The main focusing occurs approximately 7 hours 15 min after the excitation event.

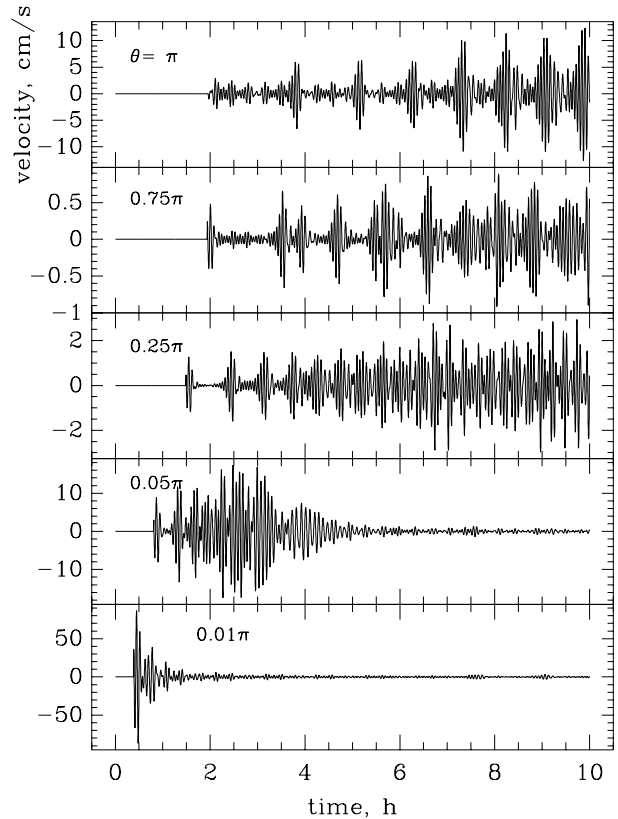


Figure 2: Velocity as a function of time at different angular distances from an impulsive acoustic source of total momentum  $10^{22}$  g/cm/s.

Figure 3 shows the maximum of the oscillation amplitude as a function of distance from the source. The focusing occurs within approximately 50 Mm from the antipodal point.

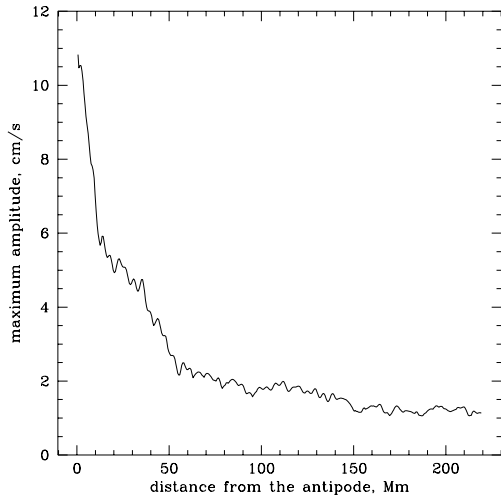


Figure 3: Maximal amplitude as a function of the distance from the antipode of the acoustic source.

Figure 4 shows the wave amplitude on the solar surface in the vicinity of the antipodal point near the moment of the main focusing. The amplitude may reach 10 cm/s.

### 3. Conclusions

We have found that the solar oscillation signal significantly increases near the antipode of an acoustic source. The main focusing occurs approximately 7 hours 15 min after the excitation event. The characteristic size of the focusing area is 50 Mm. Observations of seismic focusing could provide interesting information about active processes on the back side of the Sun.

### REFERENCES

1. Dziewonski, A.M. & Woodhouse, J.H., 1983, in *Proc. Intern. School Phys. "Enrico Fermi"*, Amsterdam, North-Holl. Publ.Co.
2. Kosovichev, A.G. & Zharkova, V.V., 1995, in: *Proc 4th SOHO Workshop, Helioseismology*, ESA SP-376, ESTEC, Noordwijk, vol.2, p.341.

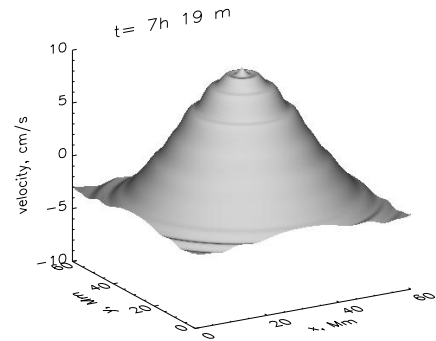
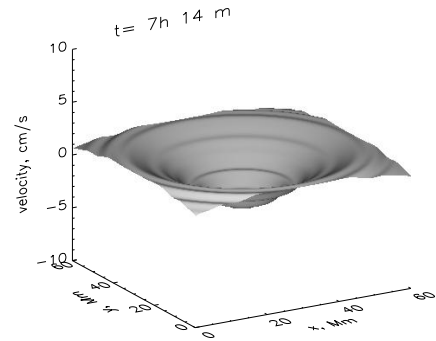
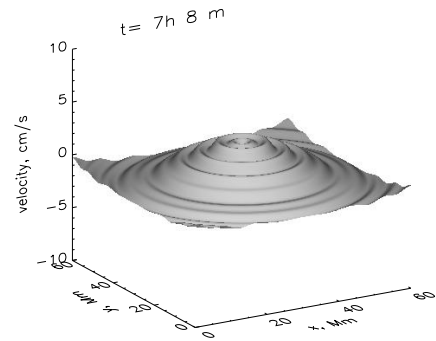
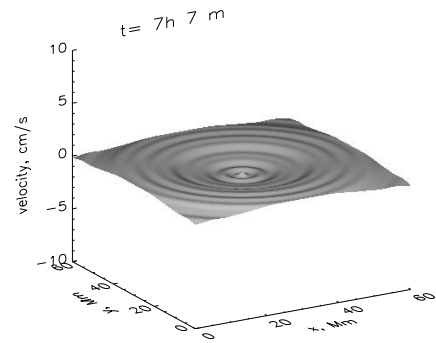


Figure 4: The velocity amplitude in the vicinity of the antipode near the moment of the main focusing.