Chromospheric Internetwork Oscillations: Comparing IRIS Observations with Simulations

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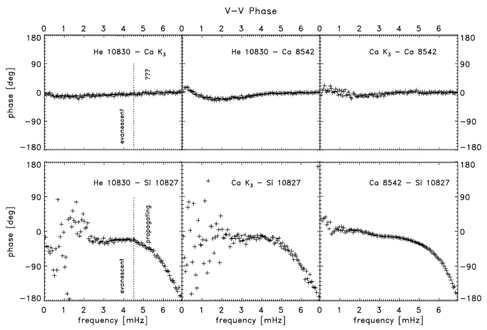
Motivation

- Late 80s and 90s increasing evidence that chromospheric wave field is dominated by non-propagating, i.e. standing waves, presumably resulting from wave reflection at transition region



- Ca II 8542, Ca K, He 10830 all seem to oscillate in phase, in particular also waves above the cut-off frequency (Fleck et al. 1994)
- Radiation-hydrodynamics simulations of propagating shock waves in the solar atmosphere by Carlsson & Stein (1993) on the other hand showed an impressive agreement with Ca K observations
- "other observational facts are actually conflicting with the theoretical picture ... because even the most advanced simulations still neglect essential properties of the real solar atmosphere: magnetic fields, transition region, 3D, etc." (Hofmann, Steffens, Deubner 1996)
- **Now: much more advanced numerical simulations including B, TR, 3D and new observational insight from IRIS**

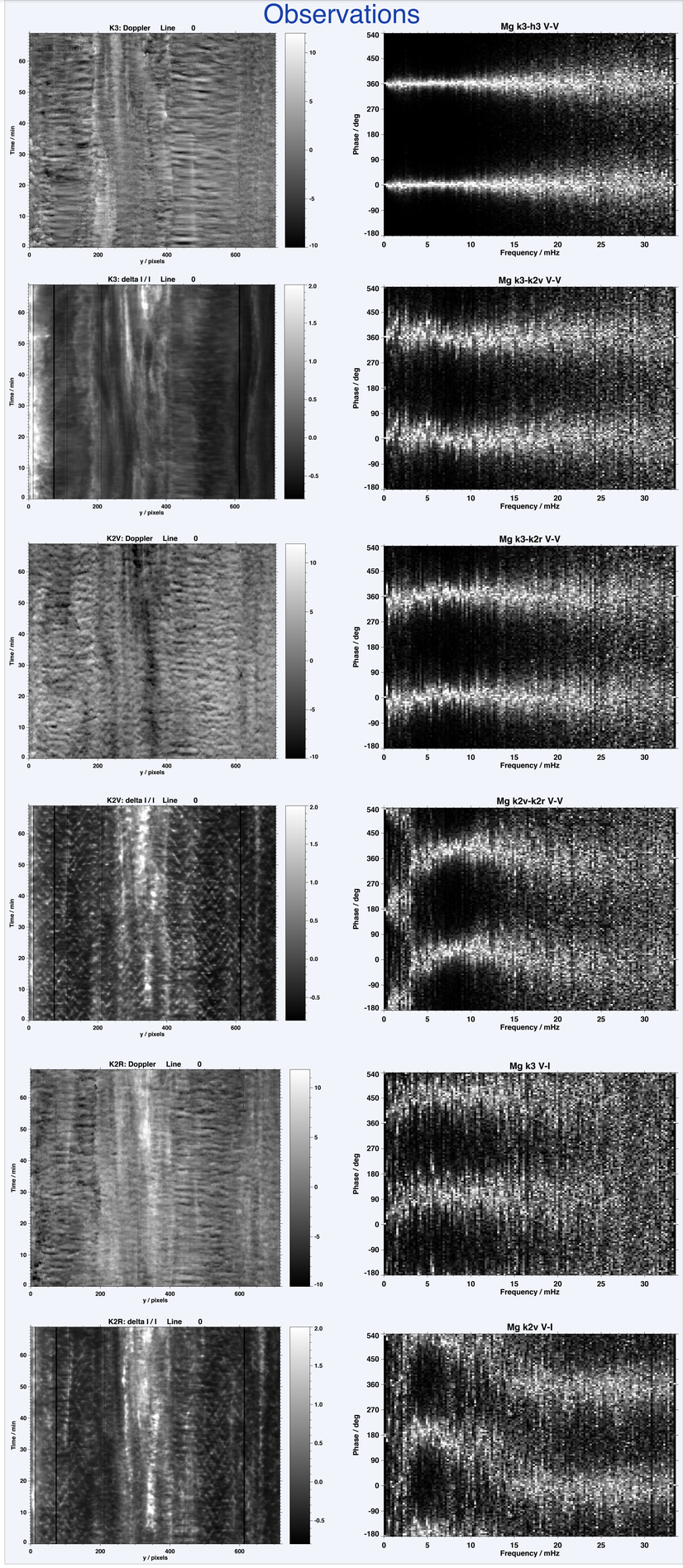
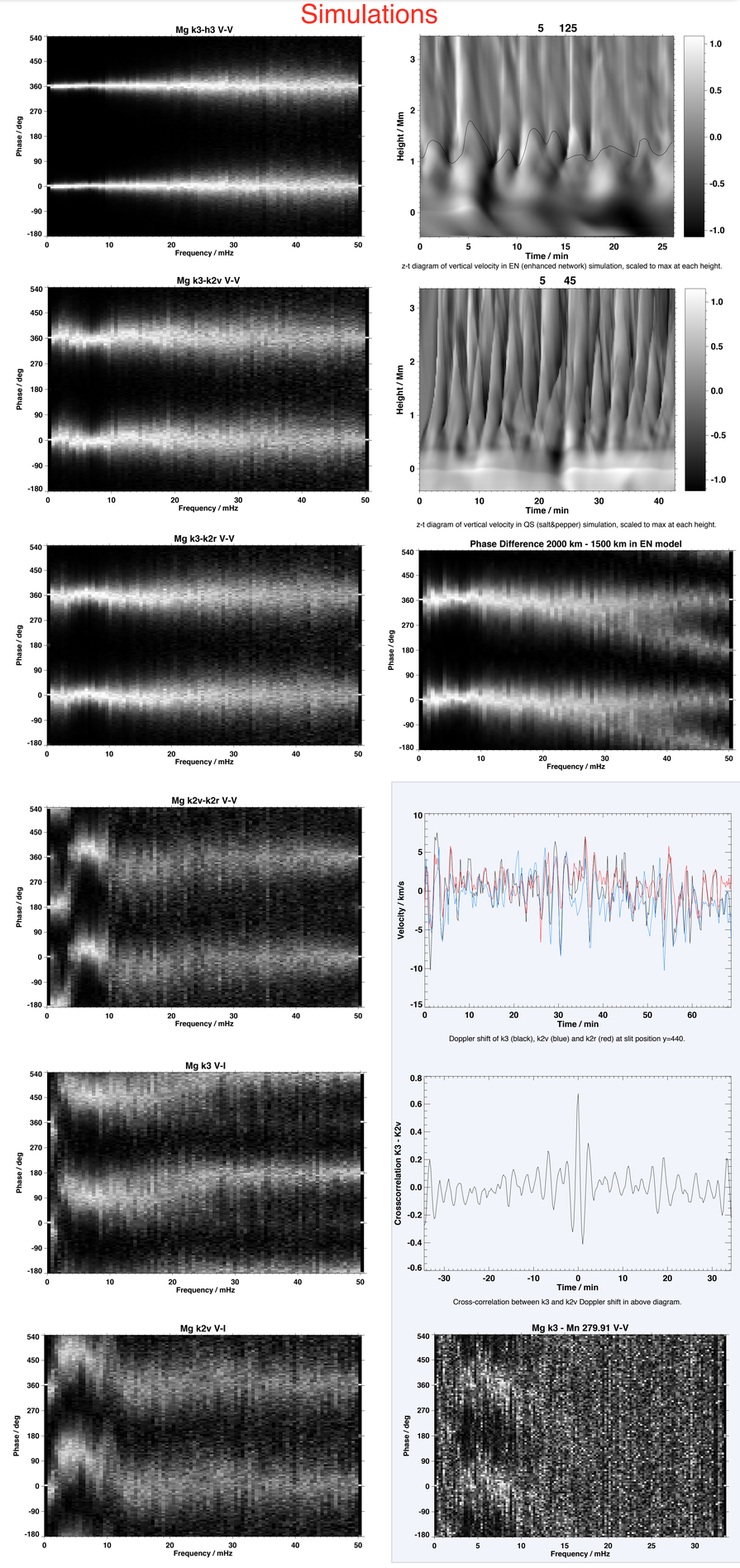
Data

- Sit-and-stare time series of Mg II h&k spectra
- Date: 2014-02-27T05:39:28
- Cadence: 15 s
- Duration: 69 min (276 frames)
- Pixel size: 0.166"
- Position: quiet Sun, x=5.8", y=5.8" (μ=1.0)
- Mg II k_3, k_{2v}, k_{2r} Dopplershift (Vel) and Intensity (Int) using "iris_get_mg_features" described in the IRIS User's Guide
- same for Mg II h line; results not shown here, but very similar to Mg II k, confirming results shown here
- Simulations: BIFROST, model en024048_ion, available at Hinode SDC in Oslo
- 182 snapshots, cadence 10s, duration ~ 30 min
- Synthesized Mg spectra spatially and spectrally convolved + pixelated to IRIS resolution

Results

- Mg II h&k lines show strong oscillatory signal, both in intensity and Doppler shift
- Complex spatio-temporal behavior, which strongly depends on magnetic field topology
- Shocks not ubiquitous in observed Doppler shift data
- Good, perhaps even surprisingly good agreement between observations and simulations
- Doppler shifts of k3 and k2v (k2r) in phase, both in observations and simulations, *providing further evidence for an apparently dominating non-propagating component of the chromospheric wave field*
- Reflected waves visible in simulation z-t diagram

Observations



Simulations