Magnetic fields in spicules

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Broadened profiles

- Stokes I
- Stokes Q
- Stokes U
- Stokes V
Broadened profiles
Aproach to inversion

1. Get an (empirical) description of the anomalous broadening:
   A convolution of Doppler-shifted profiles each one given a weight by a gaussian distribution
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2. Investigate how much magnetic information is still available in the so-broadened profiles:
   Create synthetic profiles, broaden them and try to invert
Model theory

- Quantum theory of polarized line formation (Landi Degl’Innocenti, 1983)
- Spectrally flat incident radiation (CRD)
- No collisions
- Includes level-crossing and coherence effects within each atomic term
Synthetic broad profiles inverted
Aproach to inversion

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3. Try with the real data and see what happens!
Error bars are not always just white noise.
Inversion of real data: Distribution of inferred field strengths
Not yet done!

ASP Data, D₃ spectropolarimetry
5/28/2 at 13:54:2 UT
The 90 degrees ambiguity

\[ Q \approx \frac{3}{8} \omega (3 \cos^2 \vartheta_B - 1) \sin^2 \Theta_B \cos 2\Phi_B \]
A few conclusions

• Broadened profiles are well reproduced by subpixel velocity distribution (either real or arisen from projection effects)

• Magnetic field in spicules appear to be either ALIGNED or TRANSVERSAL to the visible structure

• Field strengths of up to 40 G are present. No much higher than that though.
Scattering Geometry
He I atomic model

- 5 atomic terms
- L-S coupling

\[ 2^3S_1 \rightarrow 2^3P_{0,1,2} \quad \text{5876 Å} \]

\[ 3^3S_1 \rightarrow 3^3P_{0,1,2} \quad \text{7065 Å} \]

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\[ 2^3P_{0,1,2} \rightarrow 3^3S_1 \quad \text{10830 Å} \]
Subpixel velocity distributions
Global magnetic structure

The solar coronal magnetic field

16 February 1980: White Light

Near cycle maximum

Source: High Altitude Observatory Archives
Global magnetic structure

18 March 1983: White Light

Source: High Altitude Observatory Archives