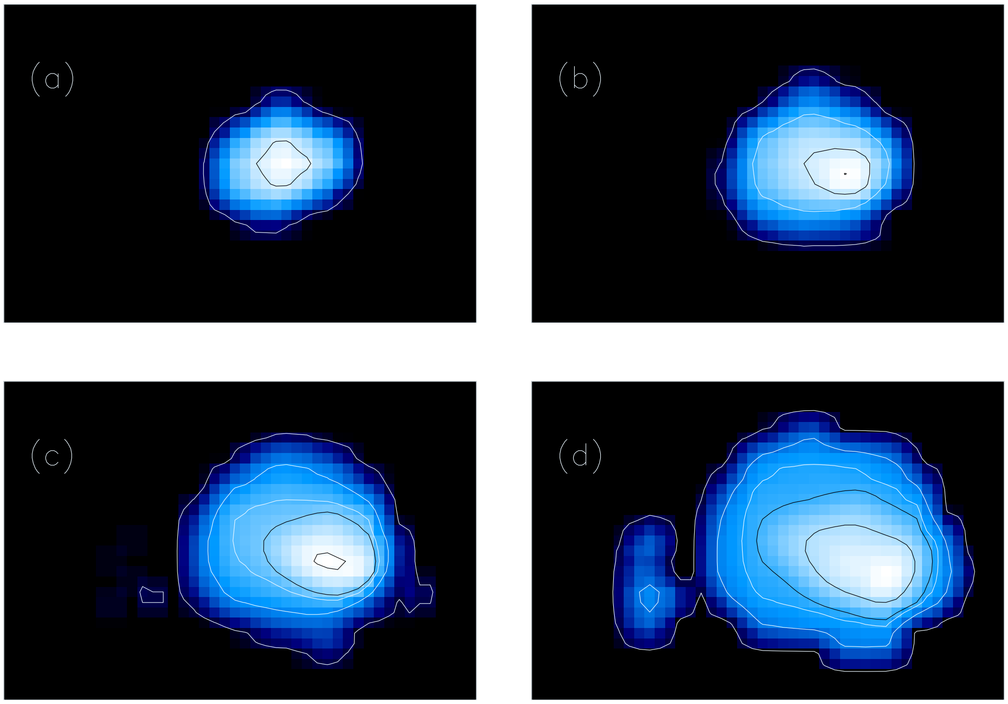
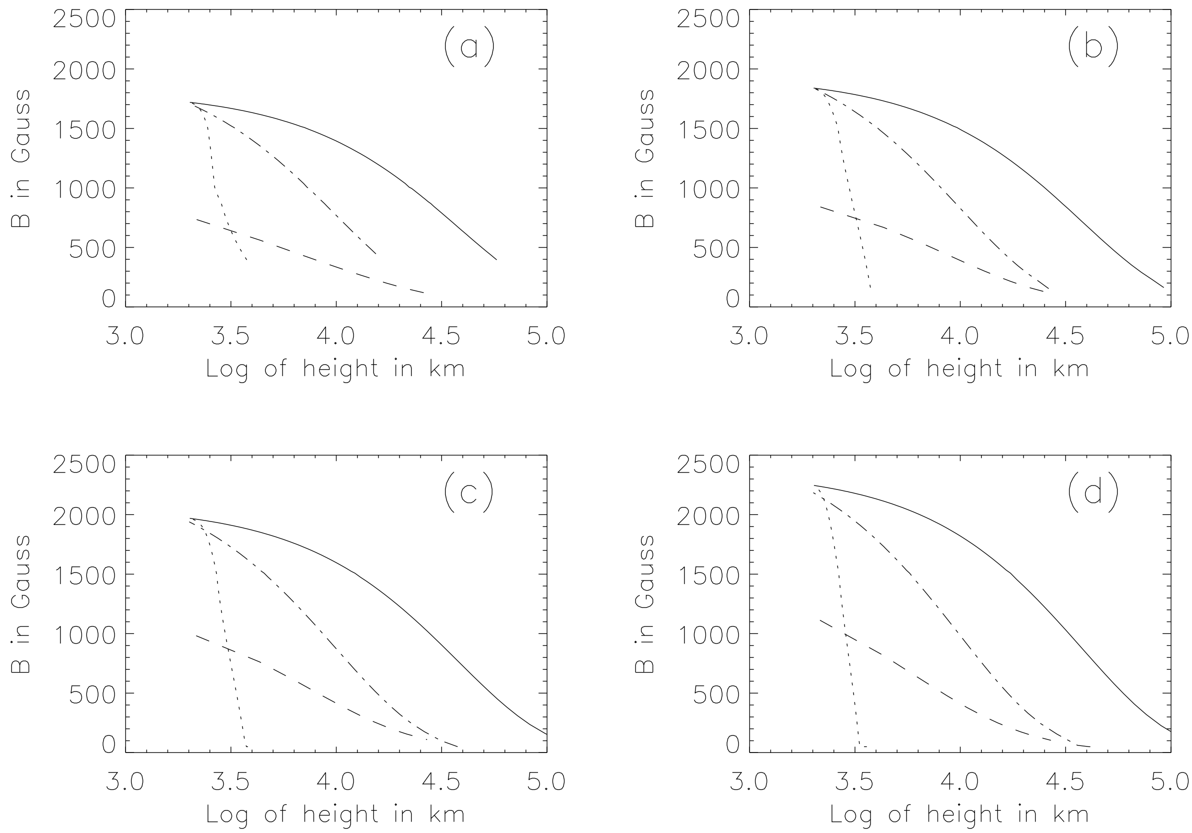
Three-Dimensional Solar Coronal Magnetography: Fig 1



This work describes progress in our ongoing effort to perform 3-d solar coronal magnetography. Coronal magnetic fields are important because they are widely believed to drive phenomena like solar flares, coronal mass ejections, coronal heating, and the solar wind. We observed Active Region 8108 on 1997 Nov 18 with the Very Large Array (VLA) and three instruments (CDS, EIT, MDI) aboard *SOHO*. We used the right-hand (R) and left-hand (L) circularly polarized components of the 4.9 and 8.5 GHz radio observing frequencies, along with the coordinated EUV observations, to derive the 3-d coronal magnetic field above the region's sunspot and its immediate surroundings. Mathematically this was done by placing the largest possible harmonic (hence the smallest possible magnetic field strength) for each component of each radio frequency into appropriate atmospheric temperature intervals such that the calculated radio brightness temperatures at each spatial location match the corresponding observed values. The *temperature* dependence of the derived coronal magnetic field, B(x,y,T), is insensitive to uncertainties on the observed parameters. The images above display the derived total magnetic field strength at temperatures of (a) 2×10^6 K, (b) 1.5×10^6 K, (c) 1×10^6 K, and (d) 5×10^5 K. Contour levels are 100, 579, 868, 1005, and 1508 G, where the last four values correspond to 3rd harmonic at 4.9 GHz, 2nd harmonic at 4.9 GHz, 3rd harmonic at 8.5 GHz, and 2nd harmonic at 8.5 GHz.

Three-Dimensional Solar Coronal Magnetography: Fig 2



Unlike B(x,y,T), the *height* dependence of the derived coronal magnetic field, B(x,y,h), is very sensitive to uncertainties on the observed parameters. The plots above show the total magnetic field strength as a function of log height at four different locations in the active region: (a) the R centroid at 4.9 GHz, (b) the L centroid at 4.9 GHz, (c) the R centroid at 8.5 GHz, and (d) the L centroid at 8.5 GHz. Each frame displays B *vs* log h derived from a constant density model, using magnetic scale height $L_B = 38{,}000$ km (solid), $L_B = 10{,}000$ km (dash-dot), and an emission measure method (dotted). The dashed curve shows the potential magnetic field strength extrapolated (using the Sakurai code) from a photospheric longitudinal magnetogram. The magnitudes of the potential field strengths are factors of two or more smaller than those derived from our method. This indicates that the sunspot field is not potential, and that electric currents must be present in the corona. Alfven speeds between 25,000 and 57,000 km s^{-1} are derived for the 1×10^6 K plasma at the centroids of the radio observing frequencies. [From J. W. Brosius, E. Landi, J. W. Cook, J. S. Newmark, N. Gopalswamy, & A. Lara, *The Astrophysical Journal*, vol. 574, p. 453 (2002 Jul. 20).]