High resolution solar physics with Solar-B

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SOLAR-B satellite carries three advanced solar telescopes; solar optical telescope (SOT), X-ray telescope and EUV imaging spectrometer. In particular, SOT provides us with continuous (24hrs), high cadence, diffraction-limited (0.2) stable images with fully-calibrated high polarimetric sensitivity. Solar-B will be launched on September, 2006. Current status of the mission preparation is excellent due to hard work of the international Solar-B team including NASA and UK PPARC over 6 years. With SOLAR-B, we are able to reach (or be closer to) the Promised Land of solar magnetohydrodynamics, where elemental magnetic fields, higher convective flows, higher electric-currents, sharp distribution of magnetic and non-magnetic atmospheres, various forms of MHD waves interplay each other. For instance, the Yohkoh and TRACE images show spatially-exclusive hot and cool quasi-steady loops. With ASP, we found clear difference in magnetic filling factor, which was aerial fraction of magnetic atmosphere, between hot and cool loops (Katsukawa & Tsuneta, 2004). With Solar-B, introduction of the filling factor may be no longer needed, and is replaced with observations on real interactions of flow and fields, the result of which would be coronal heating. Parker proposed that coronal heating is due to reconnection of magnetic fields entangled by photospheric motion. Whether this concept is true or not will be observationally answered by the long-term stable Lagrangian tracking of individual magnetic elements (and G-band bright points) from its creation through disappearance. Demography of magnetic elements with different origins such as diffused fields and ephemeral fields would be interesting. Direct detection of various MHD waves from the high time-resolution polarimetric signals is within our reach, and high-frequency MHD waves, if any, may be useful for coronal heating. There are indeed many issues related to emergence and disappearance of sunspots: What is the role of convective collapse (Parker) and flows for the formation of pores and sunspots? Leighton-type diffusion may start with detached spine fields of penumbra in a form of isolated co-polarity MMFs. What is the role of initial inflow and subsequent outflow in the moat region for the formation and disintegration of sunspots? What is the sub-surface magnetic and flow configuration leading to flux emergence and eventual disintegration? What makes such a spectacular flute structure of penumbra?