Preface

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Published online: 22 March 2012
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Emergence of magnetic flux into the solar atmosphere defines the magnetic face of the Sun and is a driver of activity across a range of spatial and temporal scales. The long-awaited onset of Solar Cycle 24 gave us an opportunity to study the mechanisms and consequences of flux emergence throughout the solar atmosphere with a suite of high-resolution telescopes. Thus, a Flux Emergence Workshop was held from 22 to 26 March 2010 at UCL's Mullard Space Science Laboratory, organised by Lucie M. Green and David R. Williams with financial support from the Science and Technology Facilities Council (STFC) and University College London (UCL).

The broad aim of the workshop was to combine recent theoretical advances with the latest space and ground-based observations, in particular the high spatial resolution data taken with the *Hinode* spacecraft and the spectral capability afforded by the Extreme-ultraviolet Imaging Spectrometer onboard. To achieve a scientific output during the workshop, three flux emergence events were pre-selected for study: two flux emergence events which occurred in pre-existing active regions (NOAA regions 10926 and 11024) and flux emergence

Flux Emergence in the Hinode Era
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that occurred in a quiet Sun region. Most of the papers discussed in the resulting Topical Issue, *Flux Emergence in the Hinode Era*, represent work carried out at the workshop.

Open questions related to the physical processes which allow flux to emerge and its consequences in the solar atmosphere were addressed at the workshop using studies that involved the smallest scales currently observable up to the size scale of an active region. Previously unseen mini-arch filaments were observed to emerge into active region 11024 using Ca II H data. These small-scale filaments represent elementary flux emergence episodes where the structures were seen to rise up through the photosphere and chromosphere and then disappear as they were heated during reconnection events (Vargas Domínguez, van Driel-Gesztelyi, and Bellot, 2012). Valori *et al.* (2012) showed how these small-scale features are re-organised in their study of active region 11024, which used observations and a nonlinear force-free reconstruction of the coronal field to identify the magnetic connectivity of the flux and identify the link between the small-scale flux emergence and the large-scale evolution of the region. Their results have shown that successive reconnections in the serpentine field built up the large-scale structure in the corona. Three-dimensional (3D) numerical models were used to investigate the observational signatures that are produced at the photospheric level associated with the bodily emergence of a flux rope (Vargas Domínguez *et al.*, 2012) and also to study the coronal response as newly emerged flux interacts with pre-existing field, leading to magnetic reconnection and compression of field lines that drives plasma outflows (Harra *et al.*, 2012). Sunspot rotation during and after flux emergence was also studied, and although it was found that rotation is strongly linked to the flux emergence phase, sunspots were still observed to rotate after the emergence phase had ended, suggesting the continued propagation of twist into the corona (Zhu, Alexander, and Tian, 2012). Finally, Hood, Archontis, and MacTaggart (2012) reviewed a range of 3D numerical models and discussed current successes and future directions.

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