Magnetic Field Lines and Coronal Loops – A Difficult Relation

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In a 3D MHD model of an emerging active region we study the relation of the magnetic field to coronal loops. At any given time, loops seen in synthesized coronal extreme UV (EUV) emission follow field lines. However, the temporal evolution of magnetic field and EUV loops is different. While the field lines are expanding during flux emergence, the EUV loops are almost stationary--the field lines move through the loops! This can be compared to a traffic jam: while all cars move, the construction site causing the jam, and thus the high car density remains at the same location. The cars would be the markers of the structure (i.e. fieldlines), while that traffic jam is the pattern we see (i.e. loops in AIA). We find that the coronal loops form due to increased Poynting flux at the outer edge of the sunspots which is caused by magnetic elements moving into the sunspots. Because fieldlines move through these regions of enhanced Poynting flux, the heating on each fieldline changes in time. In the end this is the reason why the fieldlines seem to move through the loops seen in EUV emission.