Current-injection Model for Loop Flares and Active Region Transient Loop Brightenings

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We think that active regions are higher in temperature (and accordingly, in density) due to the presence of magnetic field. But the important thing is not the simple presence of the field itself, but the field into which the current is dynamically leaking in from the part of the field imbedded in the convection-dominated subphotospheric layer. The active region corona, in our view, is the disposing place of such current, or packets of magnetic twists, that can be created, transported, and destroyed magnetodynamically (NOT like the static current in the so-called current circuit model), after leaking out from the subphotospheric layers into the active region corona along the flux tubes (Uchida et al.1998, Yabiku et al.1998). What, then, happens when such a leakage of the magnetic twist from the subphotosphere to the outer layers (chromosphere and corona)? When the twist (a large amplitude torsional Alfven wave) propagates along the flux tube towards the photosphere, the twisted part will emerge to the photosphere rather quickly due also to the magnetic buoyancy of the twisted part, and comes out to the chromosphere- corona. The toroidal and poloidal components that were far from the force-free condition with high gas presure, now go into a new equilibrium (force free state) generally through pinching, and this successively occur along the flux tube dynamically as this finite amplitude torsional Alfven wave propagates. This progressing pinching sets the gas into a spinning hypersonic flow because the front progresses with Alfven velocity. This may correspond to the jetting of the pinch-heated gas to be identified with the active region transient loop brightening. If two of them coming into a loop from both ends (namely, if the second one comes into the loop within the propagation time of the first one), the collision of those two hypersonic flows with fast and slow shocks will occur at a high part of the loop, and a very high temperature region (as high as $10^8 K$) will be resulted. We identify this with the super high temperature region appearing at the start of a loop flare, with the following phenomena, like the evaporation of the chromospheric gas due to heat conduction etc. for the loop flares occurring as the result of the appearance of the superhot region. Details of the 3D MHD simulation with the observed type of dynamical distortion, confinement of the heated gas to the high part of the loop, appearance of over-the-loop-top high temperature source, etc. will be explained at the symposium.