Behavior of Neutral Line associated Source at 17 GHz and deduced spatial model

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Data provided by the Nobeyama Radio Heliograph (17 GHz) were used in studying the evolution of the active region NOAA 7321 (October 25–November 2, 1992). This active region (AR) produced a series of X-ray flares whose origin is associated with the continued presence in its magnetosphere of microwave sources which are called Neutral Line associated Sources (NLS). Two types of NLS of substantially different behavior correspond to the growth and the maximal phases of the NOAA 7321. Both of them appeared over the inversion line of the photospheric magnetic field where new bipolar magnetic fluxes emerged. Their subsequent existence is connected with substantial extension of the entire magnetosphere of the active region upwards.

The lifting NLS. This source appeared on October 26 and was evolving during the growth phase of the AR. Its images in intensity $I = RCP + LCP$ had a single maximum. In the circular polarization $V = RCP - LCP$, it was invariably accompanied by two components: right- (RCP) and left-handedly polarized (LCP). All this moves upward as a whole increasing in size ($T_b = 5 \times 10^5$ K). NLS was no longer projected onto the photospheric inversion line, in whose vicinity it appeared. However, it is easily recognized because its intensity maximum is typically located between the RCP and LCP. Here, the intensity peak of the NLS manifests two types of motion along the RCP—LCP line. These are fast displacements to one of its polarized components and its subsequent return to the initial place (in particular, during bursts), and its smooth movement from one component to the other one during the daytime. The brightness of each of the polarized components linearly depended on its closeness to the intensity peak. Almost all the bursts observed during October 26–28 (which accompanied class C and M flares) occurred in this NLS. When its height increased, NLS lost its burst activity and disappeared. Juxtaposition of the microwave and the X-ray images reveals that the moving 17 GHz NLS was located under the rising peak of X-ray emission. Analysis of the observational data suggests that this

NLS and its polarized components were located in the upper parts of extended loops tapering upwards. It is anticipated that all this structure was formed after the rising Y-point. The contour of the X-ray loop with an X-ray emission maximum at its top corresponded in this case to the position of the Y-separator. The X-ray and microwave sources appeared to be partly inserted into each other.

The stationary NLS. This NLS consisted of some intensity components which were located along the main inversion line of the magnetic field. Its presence in the AR was accompanied by the powerful long-duration flares X1.7 (W61) and X9.0 (W90). Unlike the lifting NLS, the brightest ($T_b = 8 \times 10^5$ K) intensity component of this source

unchangeably remained below. There were a well-defined X-ray jets in the X-ray images prior to the flares. Its bright footpoint was located over the low-lying component of the NLS. A chain of faint radio sources existed along the X-ray jet prior to the X1.7 flare. The kernel of the post-flare ejection moved in the same direction. The X-ray jet corresponded, probably, to the electric current jet, with a stationary NLS being located in its footpoint. The separator system accompanying the current jet manifested itself by X-ray loops prior to the X9.0 flare. The main component of the NLS and the maximum of X-ray emission above it was located under the inner X-point where the reconnection process went on. The flare seems to start in this same place. We believe that the stability of the position of the low-lying NLS was due to new boundary conditions which did not manifest themselves in the growth phase of the AR's area. A factor that changed the conditions may be a "cancellation" when the magnetic flux submerged in the vicinity of the photospheric inversion line immediately beneath the NLS.

Notable is the polarization reversal of the limb NLS which occurred during 24 hours with persisting of the same location, intensity

($T_b = 8 \times 10^5$ K) and the degree of polarization (23%) inherent for this source. The polarization reversal is well-known for sunspot-associated microwave sources. In our case, it took place for a limb loop-top source.