Particle accelaration seen in microwave and hard X-ray:periodic oscillation of particle acceleration mechanism

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We studied the C7.9 class flare which occured on Nov 10, 1998 UT.It was observed in radio and in hard and soft X-ray.The periodic oscillations were clearly seen in radio hard X-ray source.Furthermore, the oscillations occurred almost synchronously.

We can explain the period of oscillation by Alfven transit timescale of flare loop which was calculated from the soft X-ray images and magnetgrm. It means that the particle acceleration is suffering some influences of the magnetohydro-dynamical enviroment and likely related to loop oscillation.

Non-thermal particles often generate at the first stage of a solar flare in the solar corona, and they are observed as gyrosynchrotron emission in microwave and Bremsstrahlung in hard X-ray. Although some models of the particle acceleration have been thought, the mechanism of particle acceleration is not clear in detail.

We studied the C7.9 class flare which occured on November 10, 1998 UT in the active region NOAA 8375. We make use of the microwave images observed with Nobeyama Radioheliograph, X-ray images observed with the hard X-ray telescope and the soft X-ray telescope aboard Yohkoh, and magnetgram of SOHO/MDI.

There are four peaks in microwave and hard X-ray. In the second peak, periodic oscillation was clearly seen in the light curves of microwave and hard X-ray images.

The features of each images are as follows: (1)In microwave (17 GHz), there are two sources, and the clear oscillation whose period is about 7 sec are well seen in the northern source, (2)In hard X-ray, we can see only one source corresponding to southern microwave source, and it is oscillating so as in 17 GHz, (3)In SXT image, we can see a faint loop structure that connects the both microwave sources and a bright flare loop on the southern microwave source. The microwave oscillation delays about 0.6-1.0 sec from that of hard X-ray. These imply that the site of particle acceleration is near the south source and that the non-themal particles travel from south source to north one along the faint loop.

We estimate the typical timescales of this region, i.e. Alfven transit timescale and acoustic transit timescale. The size, temperature and the emission measure of loop are calculated from soft X-ray images, and the magnetic field of the flare loop is estimated by assuming the potential field.

As a result, we can explain the period of oscillation by Alfven transit timescale of the flare loop. It means that the particle acceleration is suffering some influence of the magnetohydro-dynamical enviroment and likely related to loop oscillation.

The pulsation like this is also seen in terrestrial magnetsphere as (mini-)substorm and Pi2. These are also thought to be caused by oscillation of the magnetic loop, since the period of oscillation are explained by Alfven transit timescale of the loop.