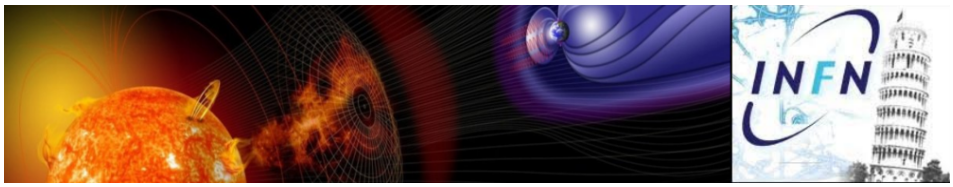

Contribution ID: **62** Type: **not specified**

Quasi-periodic energy release in a three-ribbon solar flare

Thursday, 8 July 2021 19:30 (30 minutes)

Quasi-periodic pulsations (QPPs) are found in solar flares of various magnetic morphologies, e.g. in two-ribbon or circular-ribbon flares, and mechanisms of their generation are not yet clear. Here we present the analysis of QPPs with a period P = 54±13 s found in RHESSI observations of a three-ribbon M1.1 class flare SOL2012-07-05T06:49. QPPs are manifested in the time profiles of temperature (T) and emission measure (EM) of superhot (Ts ~ 30-50 MK) plasma, but are almost invisible in the profiles of hot (Th ~ 15-20 MK) plasma parameters when approximating the X-ray spectrum of the flare with the bremsstrahlung spectrum of a two-temperature thermal plasma (the one-temperature approximation gives a poor approximation with a much higher residual). In addition, QPPs with a similar period are found in the time profiles of the flux and spectral index of nonthermal electrons if the observed X-ray spectrum is approximated by a combination of the bremsstrahlung spectra of a single-temperature Maxwellian plasma and nonthermal electrons. In this case, the power-law spectrum of nonthermal electrons is very soft, with an index from -7 to -10, and shows the known soft-hard-soft dynamics for each pulsation. QPPs are not expressed in the X-ray flux according to RHESSI and GOES data, as well as in radio data. Remarkable, QPPs are accompanied by apparent systematic movement of a "single"X-ray source at a speed below 120 km / s (average speed ~ 35 km / s) along the central flare ribbon over a narrow (<5 Mm) "tongue"of negative magnetic polarity, elongated (~ 20 Mm) between two areas of positive polarity. The results of magnetic extrapolation in the nonlinear force-free field (NLFFF) approximation show that the X-ray source could "move"along a separator and/or magnetic flux-rope in the corona. It is worth noting that in the homologous three-ribbon M6.1 flare SOL2012-07-05T11:39 that occurred in the same region about five hours later, X-ray sources "moved"much less systematically and did not produce similar QPPs. We interpret the observed QPPs as a result of successive episodes of energy release in different magnetic tubes (loops) of the flare region. In each pulsation approximately (4-7) x 10 ^ 29 erg is released in the form of thermal energy of hot and superhot plasmas (or accelerated electrons). The total energy release during all pulsations is ~ (3-6) x 10 ^ 30 erg, which is less than the value of the magnetic energy (~ 8 x 10 ^ 30 erg) released in the flare region. We discuss possible triggers of the "propagating"front of energy release (slow and fast magnetoacoustic waves, flapping oscillations and thermal instability of a reconnecting current sheet with strong guide-field formed around the separator, asymmetric eruption of a magnetic flux-rope, etc.), and argue that the detected QPPs are not an instrumental effect.

Email

ivanzimovets@gmail.com

Primary authors: ZIMOVETS, Ivan (Space Research Institute of the Russian Academy of Sciences (IKI RAS)); Dr SHARYKIN, Ivan (Space Research Institute of the Russian Academy of Sciences (IKI RAS)); Dr MYSHYAKOV, Ivan (Institute of Solar-Terrestrial Physics, Siberian Branch of the Russian Academy of Sciences (ISTP SB RAS))

Presenter: ZIMOVETS, Ivan (Space Research Institute of the Russian Academy of Sciences (IKI RAS))

Session Classification: Working Group 1: Flare thermal response

Track Classification: Working Group 1: Flare thermal response