Influence of particle acceleration on the heating of the solar coronal plasma and a data-driven model on nanoflares in solar active region loops.

C. Gontikakis

Research Center for Astronomy and Applied Mathematics, Academy of Athens

The solar coronal plasma is heated to more than one million Kelvin, which is 2 to 3 orders of magnitude higher than the solar surface temperature. The heating is caused by the diffusion of electromagnetic energy, a process still not fully understood despite many decades of research. Many works suggest that accelerated particles and the formation of suprathermal particle distributions are important for the heating of the solar corona. The nanoflare model, described by E. Parker (1972,1988), suggests that coronal heating is caused by eruptive energy releases, each one being of the order of 1.E24 ergs, corresponding to 1.E-9 times the energy released in a typical solar flare. A large number of such nanoflares, taking place on all the solar surface may explain the high coronal temperatures and the steady coronal emission in X-rays. The energy release in nanoflares is triggered by magnetic reconnection which accelerates particles, connecting, in such a way, suprathermal distributions with coronal heating.

In this presentation, we give a brief review on the topic of suprathermal particles, kappa distributions and their connection with nanoflares and coronal heating. This include the presentation of numerical models and observations.

Secondly we introduce a data-driven model of coronal heating based on nanoflares (Gontikakis et al 2013). The model is applied to observations of a solar active region which had not an important flaring activity. The Poynting flux generated from photospheric motions and supplied to the coronal plasma is calculated using measurements of photospheric magnetic fields and photospheric plasma velocities. Coronal loops, composing the active region, are represented by magnetic field lines, anchored on the solar surface and computed by the extrapolation of the photospheric magnetic field measurements. Using analytic calculations, the model computes the transformation of the photospheric Poynting flux into accelerated electrons and protons and then into plasma heating.

Finally the calculated heating is introduced into a time dependent hydrodynamic calculation to model the coronal loop plasma response to that heating. With this model we estimate the accelerated electron and proton kinetic energies. Finally, we compute X-rays emitted by accelerated electrons when they interact with the dense chromosphere.

[l] C. Gontikakis, S. Patsourakos , ApJ **771**, 126 (2013).

[2] E. Parker, ApJ **174**, 499 (1972).

[3] E. Parker, ApJ **330**, 474 (1988).