Study of coronal loops observed by GOES-SXI

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We study the temporal evolution of coronal loops using data from the Solar X-ray Imager (SXI) on board the Geosynchronous Operational Environmental Satellite 12 (GOES-12). This instrument has the advantage of providing continuous soft X-ray observations of the solar corona at a high temporal cadence, which allows us to follow the full lifetime of a set of coronal loops (from their brightening to their decay). From the observed light curves, we can divide the evolution of the loops in three phases: rise, main, and decay. For each of these phases we compute the corresponding evolutionary timescales and, since we have full time coverage, the real loop lifetime. Using data in different filters, we derive temperature and density averages. The values found place SXI loops halfway between the typical ranges of physical parameters for loops observed by the Soft X-ray Telescope (Yohkoh/SXT), and those for loops observed by the Transition Region and Coronal Explorer (TRACE). We compute radiative and conductive cooling times, which turn out to be much shorter than the evolutionary timescales of the loops. These results confirm previous findings (Porter and Klimchuk 1995) based on observations covering partially the loop temporal evolution. Our results can be interpreted in terms of two alternative coronal heating scenarios: quasi-static heating of monolithic (uniform) loop structures or impulsive heating (nanoflaring) of multiple-stranded loops. We present arguments, based on recent observations and loop modelling, that support the idea of impulsively heated multiple-stranded loops. Finally, we derive a relationship between the observed light curves and (1) the evolution of the heating rate for the quasi-static case, or (2) the frequency of nanoflares for impulsive heating. These relationships impose constrains on theoretical models of coronal heating.