Hard X-ray Quiescent Emission in Magnetars via Resonant Compton Upscattering

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Non-thermal quiescent X-ray emission extending between 10 keV and around 150 keV has been seen in about 10 magnetars by RXTE, INTEGRAL, Suzaku and Fermi-GBM. For inner magnetospheric models of such hard X-ray signals, resonant Compton upscattering is anticipated to be the most efficient process for generating the continuum radiation. This is because the scattering becomes resonant at the cyclotron frequency, and the effective cross section exceeds the classical Thomson value by over two orders of magnitude. We present hard X-ray upscattering spectra for uncooled monoenergetic relativistic electrons injected in inner regions of pulsar magnetospheres. These model spectra are integrated over closed field lines and obtained for different observing perspectives. The spectral cut-off energies are critically dependent on the observer viewing angles and electron Lorentz factor. We find that electrons with energies less than around 15 MeV will emit most of their radiation below 250 keV, consistent with the turnovers inferred in magnetar hard X-ray tails. Electrons of higher energy still emit most of the radiation below around 1 MeV, except for quasi-equatorial emission locales for select pulse phases. In such cases, attenuation mechanisms such as pair creation will be prolific, thereby making it difficult to observe signals extending into the Fermi-LAT band. Our spectral computations use new state-of-the-art, spin-dependent formalism for the QED Compton scattering cross section in strong magnetic fields.

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