

**Title:**           **X-ray constraints on late decaying dark matter majorons  
(or other soft X-ray emitting candidates)**

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Abstract

An attractive way to generate neutrino masses involves the spontaneous breaking of lepton number, where the resulting majoron might get a mass term and is thereby a candidate for the dark matter. The dominating decay of the majorons into neutrinos allows us to constrain their mass to be approx. 0.15 keV from their effect on structure formation in the case where they are in thermal equilibrium in the early Universe and decouple very early. The majorons can also decay into two photons with energy of half the mass. Observing photons with energies around 0.1 keV is very challenging, but we have nonetheless obtained constraints in the 0.07-4.0 keV interval from Chandra observations. Allowing for non-equilibrium of the majorons etc. shifts the mass constraint from CMB to higher masses, so we have combined the soft x-ray with earlier observations providing constraints for the 0.07-4000 keV interval. This can be compared to realistic particle physics models for the majoron mass and interactions.