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Boosting the Annihilation Boost: Tidal Stripping and the Subhalo Luminosity

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In the cold dark matter paradigm, structures form hierarchically, implying that large structures contain smaller substructures. These subhalos will enhance signatures of dark matter annihilation such as gamma rays. In the literature typical estimates of this boost factor assume a concentration- mass relation for field halos, to calculate the luminosity of subhalos. However, since subhalos accreted in the gravitational potential of their host lose mass through tidal stripping and dynamical friction, they have a quite characteristic density profile, different from that of the field halos of the same mass. We attempt to quantify the effect of tidal stripping on the boost factor, by developing a semi-analytic model that combines mass-accretion history of both the host and subhalos as well as subhalo accretion rates. We find that when subhalo luminosities are treated consistently, the boost factor increases by a factor 2–3, compared to the typical calculation assuming a field-halo concentration. This holds for host halos ranging from sub-galaxy to cluster masses and is independent of the subhalo-mass function or specific concentration-mass relation.

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