Thermal corrections to dark matter annihilation cross sections

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Infra-red corrections are known to be more acute in thermal field theories than at zero temperature. We use the generalised approach of Grammer and Yennie to show that the cancellation of IR divergences occurs, as in the case of zero temperature field theory, between real and virtual contributions to the cross section, order by order, to all orders in perturbation theory. We use this technique to calculate the NLO thermal cross sections to dark matter annhilation cross sections in a simple manner. While computing the $calO(T^2)$ corrections at NLO, we find that the soft IR divergences cancel straightforwardly, but the case of the collinear divergences is more subtle.

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