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The interplay of the solar wind electron core and suprathermal populations. Temperature anisotropy instabilities

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Despite the fact that the velocity distribution of electrons observed in the solar wind display a dual structure with a thermal core and a suprathermal halo, the existing studies that parametrized the electron temperature anisotropy and the resulting instabilities are limited to idealized models, which incorporate the core and halo populations in a global bi-Kappa model. Here we present the results from a more realistic study for the temperature anisotropy instabilities conditioned by the interplay of the electron core and suprathermal halo populations, when both these two populations may exhibit temperature anisotropies $A_{c,h} \neq 1$. The analysis is based on the linearized kinetic Vlasov-Maxwell dispersion relation for parallel wave propagation in homogeneous electron-proton plasmas. We assume a bi-Maxwellian velocity distribution for the core (thermal) population, and a bi-Kappa velocity distribution for the halo (suprathermal) population. We calculate the growth rates, real frequency and the instability threshold conditions for different halo-core relative density and various plasma properties. The effects of electron suprathermal populations which are ubiquitous in the solar wind, are found to be particularly important for a realistic characterization of the kinetic instabilities. Important adjustments are obtained for the instability thresholds, which can explain the limits of the temperature anisotropy reported for these populations in the solar wind.