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The Plasma Physics of TeV Blazars

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Constraints on the primordial intergalactic magnetic field from the non-observation of inverse Compton cascades around extragalactic very high energy sources, i.e., the TeV blazars, assume that inverse Compton scattering is the dominant physical mechanism by which dilute ultrarelativistic pair beams lose their energy. Over the last few years, we have considered the effect of plasma instabilities on these ultrarelativistic beams. We argue that the linear growth rate of these instabilities, and in particular the oblique instability, are so fast that these instabilites may dominate the cooling of these pair beams leading to an order of magnitude or more suppression in the inverse Compton cascade. We review the relevant physics of these plasma instabilities and discuss the linear instability of these pair beams. We also discuss recent work on the various nonlinear aspects of this instability and the effect of density gradients on the instability. We highlight the effect of this instability on the constraints of the intergalactic magnetic field, arguing that these constraints are precluded in the presences of these instabilities. We also discuss the implication of these instabilities on the population of TeV blazars, and the intergalactic gamma ray background. Finally, we close with a discussion on the effect of these extra blazar heating on cosmological structure formation, in particular, the temperature-overdensity profile and the Lyman-alpha forest.

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