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In Situ Magnetic Field Generation and Plasma Structures as Constituents of Astrophysical Jets*

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Ion acoustic modes [1] are shown to cease being electrostatic, contrary to what is commonly assumed [2], and to have finite magnetic fields associated with them when the relevant fluctuating electron distribution (in momentum space) is not a Maxwellian and the resulting electron pressure tensor is not isotropic.

This finding is used to advance the theory of the plasma structures that were proposed [3] to be the constituents of astrophysical jets. In fact, these structures had been associated with ion-acoustic modes emerging from the "swept torus" [1] in the circumbinary disk sustained by a pair of black holes. The observed magnetic field filaments [4,5] characterizing these structures are explained as resulting from strings [6] of magnetic islands sustained by slowly evolving and large amplitude ion-acoustic electromagnetic modes. An alternative option, that does not require the formation of a non-Maxwellian electron distribution, is the generation of a magnetic field by the non-linear coupling [1] of modes involving density and electron temperature slow fluctuations, a special case of a "Cosmic Alternator" [6].

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References

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