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Signatures of Big Bang turbulence and Plasma Epoch Turbulence are observed in the Cosmic Microwave Background by the Planck Collaboration

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Abstract

Spectral forms in the CMB observed by the Planck Collaboration are interpreted as fossils of big bang turbulence at the largest scales (not as noise) and fossils of plasma epoch turbulence at supercluster scales (not as baryon oscillations).

Introduction

When turbulence is defined narrowly by inertial vortex forces, the conventional wisdom that it cascades from large scales to small is contradicted.

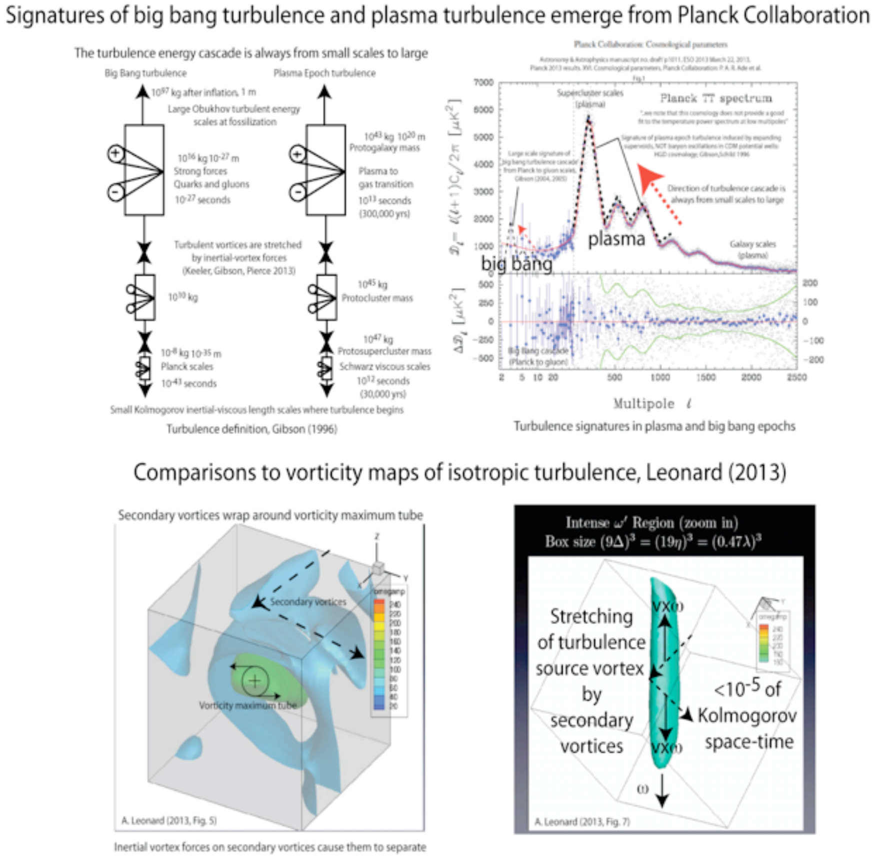

Figure JC2014.23.1(CHG): Planck collaboration acoustic peaks of "baryon oscillations" in CDM potential wells must be reinterpreted as the signature of plasma turbulence forming on gravitationally expanding SuperSuperVoids triggered by fossil big bang turbulence vortex lines. A similar signature reflects fossils of big bang turbulence formation at large scales (small l values).

Observations

As shown by Fig. JC2014.23.1, the turbulence cascade from small scales to large is supported by theory, observations of the cosmic microwave background, and direct numerical simulations of turbulent flows. At top left the characteristic pattern of turbulence evolves for big bang Planck-Kerr turbulent combustion starting at Planck scales. At top right, the largest scales of the Planck CMB collaboration spectrum shows the turbulent signature of one large and two smaller bumps from the source and two secondary vortices, both at the largest scales for big bang turbulence, and intermediate scales for plasma turbulence.

The Leonard (2013) analysis of the Johns Hopkins collection of direct numerical turbulence simulations is shown at the bottom of JC2014.23.1, compared to the present vortex stretching model with secondary vortices.

Theory

Figure 2 shows how turbulence and fossil vorticity turbulence have evolved with time.

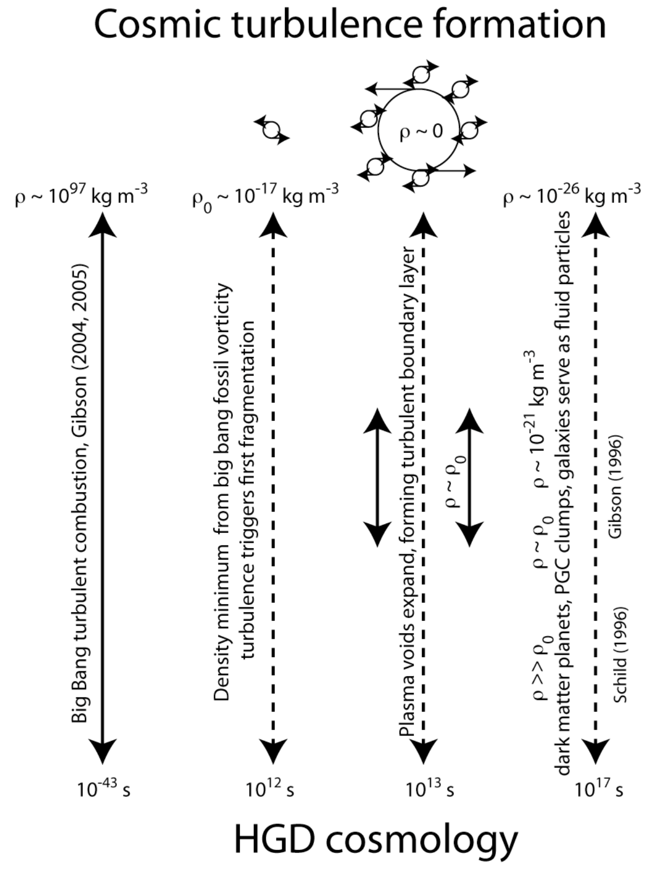

Figure 2. Gibson (2004, 2005) describes the big bang as the first turbulent combustion and the first fossil turbulence.

Fossil vorticity turbulence (dashed vortex lines) density minima trigger fragmentation at 10^12 seconds (30,000 years). The voids expand at nearly light speed during the plasma epoch forming a turbulent boundary layer, until transition to gas at 10^13 seconds. Because the voids expand as rarefaction waves at sound speeds that are nearly the speed of light in the plasma, these completely empty voids are quite enormous, as observed. Turbulence develops at the boundaries, as shown, until the plasma cools to about 3,000 K and gas forms. The gas fragments at Earth mass planet scales, as observed by Schild (1996), in proto-globular-star-cluster (PGC) clumps of a trillion such dark matter planets, Gibson (1996).

Conclusions

Turbulence should be defined in terms of the inertial vortex force **vxw**, so that the direction of the turbulence cascade is always from small scales to large, as observed. The Leonard (2013) analysis of the vorticity field of the Johns Hopkins catalog of direct numerical simulations provides the turbulence patterns observed in the Planck collaboration cosmic microwave background observations. The revised interpretation of the "sonic peaks" is that they reflect turbulence formed on fossil big bang turbulence vortex lines rather than baryon oscillations in cold dark matter potential wells.

References

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