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Massive and Refined. II. The statistical properties of turbulent motions in massive galaxy clusters with high spatial resolution

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We study the properties of chaotic motions in the intra cluster medium using a set of 20 galaxy clusters simulated with large dynamical range, using the Adaptive Mesh Refinement code ENZO (e.g. Norman et al.2007). The adopted setup allows us to study the spectral and spatial properties of turbulent motions in galaxy clusters with unprecedented detail, achieving an maximum available Reynolds number of the order of R=500-1000 for the largest eddies. The correlations between the energy of these motions in the Intra Cluster Medium and the dynamical state of the host systems are studied, and the statistical properties of turbulent motions and their evolution with time support that major merger events are responsible for the injection of the bulk of turbulent kinetic energy inside cluster. Turbulence is found to account for a 20-30 per cent of the thermal energy in merging clusters, while it accounts for a 5 per cent in relaxed clusters. A comparison of the energies of turbulence and motions in our simulated clusters with present upper-limits in real nearby clusters, recently derived with XMM-Newton (Sanders et al.2010), is provided. When the same spatial scales of turbulent motions are compared, the data from simulations result well within the range presently allowed by observations. Finally, we comment on the possibility that turbulence may accelerate relativistic particles leading to the formation of giant radio halos in turbulent (merging) clusters. Based on our simulations we confirm previous semi-analytical studies that suggest that the fraction of turbulent clusters is consistent with that of clusters hosting radio halos.

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