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# The universal model of cosmic ray production

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It seems to be a striking coincidence that all putative cosmic ray sources which are dynamically able to fill the universe with the observed extragalactic cosmic ray density can produce the same maximum confinement energy, eBR ˜ 10ˆ20 eV, while being spread in scale R over 10 orders of magnitude - the most impressive representation of this coincidence is the famous Hillas plot, in which all “interesting” sources of extragalactic cosmic rays fall on one line. We present here a potential explanation for this, by assuming that cosmic ray production is a byproduct of the generation of turbulence during the gravitational contraction of the Universe, i.e. structure formation. The model naturally explains why the maximum confinement energy is scale invariant, while reproducing BOTH the value of the maximum energy (˜10ˆ20 eV) and the overall extragalactic production rate, ˜10ˆ47 erg / Mpcˆ3 / year for a production spectral index of Eˆ-2.3, from known cosmological parameters plus ONE free parameter, which is the fraction of gravitational energy transformed into turbulence and found to be close to its canonical expectation value. While the generic approach presented here can certainly not compete with detailed modeling of specific cosmic ray sources, it predicts the fractional energetic contribution of sources acting at different scales, and can thus serve as a theoretical prior for extragalactic cosmic ray production in Bayesian modeling of the large scale Galactic Magnetic Field from UHECR arrival directions.

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