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A Stringent Limit on Primordial Magnetic Fields from the Cosmic Microwave Background Radiation

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Primordial Magnetic Fields (PMFs), being present before the epoch of cosmic recombination, induce small-scale baryonic density fluctuations. These inhomogeneities lead to an inhomogeneous recombination process which alters the peaks and heights of the large-scale anisotropies of the Cosmic Microwave Background (CMB) radiation. Utilizing numerical compressible MHD calculations, and a Monte Carlo Markov Chain analysis, which compares calculated CMB anisotropies with those observed by the WMAP and Planck satellites, we derive limits on the magnitude of putative PMFs. We find that the total remaining present day field, integrated over all scales, cannot exceed 47 pG for scale-invariant PMFs and 8.9 pG for PMFs with a violet Batchelor spectrum at 95% confidence level. These limits are more than one order of magnitude more stringent than any prior stated limits on PMFs from the CMB which have not accounted for this effect.

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