The significance of the largest scale CMB fluctuations in WMAP

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abstract We investigate anomalies reported in the Cosmic Microwave Background maps from the Wilkinson Microwave Anisotropy Probe (WMAP) satellite on very large angular scales and discuss possible interpretations. Three independent anomalies involve the quadrupole and octopole:

1) The cosmic quadrupole on its own is anomalous at the 1-in-20 level by being low (the cut-sky quadrupole measured by the WMAP team is more strikingly low, apparently due to a coincidence in the orientation of our Galaxy of no cosmological significance);

2) The cosmic octopole on its own is anomalous at the 1-in-20 level by being very planar;

3) The alignment between the quadrupole and octopole is anomalous at the 1-in-60 level. Although the a priori chance of all three occurring is 1 in 24000, the multitude of alternative anomalies one could have looked for dilutes the significance of such a posteriori statistics. The simplest small universe model where the universe has toroidal topology with one small dimension of order half the horizon scale, in the direction towards Virgo, could explain the three items above. However, we rule this model out using two topological tests: the S-statistic and the matched circle test. In particular, our results rule out the recently proposed dodecahedron model of Luminet, Weeks, Riazuelo, Lehoucq & Uzan.