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A needlet-based approach to the data analysis in the ARGO-YBJ experiment

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The ARGO-YBJ experiment, located at the Yangbajing Cosmic Ray Laboratory (Tibet, 4300 m asl, 606 g/cm2), is an EAS-array exploiting the full coverage approach at high altitude. The large field of view (~ 2 sr) and the low energy threshold (few hundreds of GeV) result in a trigger rate of ~ 3.6 kHz and ~ 10^{11} EAS collected per year. Such a dataset contains signals laying on different angular scales: point-like and extended gamma-ray sources, as well as large and intermediate scale cosmic-ray anisotropies. The separation of all these contributions is crucial, mostly when they overlap with each other.
Needlets are a new form of spherical wavelets that have recently drawn a lot of attention in the cosmological literature, especially in connection with the analysis of CMB data. Needlets enjoy a number of important statistical and numerical properties which suggest that they can be very effective in handling cosmic-ray and gamma-ray data analysis. An unprecedented application to astroparticle physics is shown here. In particular, we focus on their use for background estimation, which is expected to be optimal or nearly-optimal in a well-defined mathematical sense, and for point-source detection. This technique is applied here to the whole ARGO-YBJ dataset, stressing its advantages with respect to standard methods.

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