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A Bayesian approach for counting experiment statistics applied to a neutrino point source analysis

We present a model independent analysis to analyze data obtained from generic counting experiments. The method is based on Bayesian inference and tailored for sources emitting at a steady rate. As an example we apply this model to the search for cosmic neutrinos emitted from Active Galactic Nuclei using the public IceCube-40 data set. A test-statistic based on Bayesian evidence is used and the signal significance is determined following a frequentist procedure. The latter has been used to enable a detailed comparison between our test-statistic and the widely used method developed by Li & Ma. Furthermore, using Bayesian inference allows us to incorporate prior information in our analysis to obtain the full signal and background probability density functions. An upper limit on the neutrino flux from 10 nearby Blazars (a specific type of AGN) is found using the full signal probability density function and compared to the upper limit obtained using frequentist methods developed by Feldman and Cousins. The obtained value is in good agreement with the upper limit for a diffuse particle flux obtained by the IceCube collaboration, using the same data set.

Primary authors: BOSE, Debanjan (Vrije Universiteit Brussel / Sungkyunkwan University); GOLUP, Geraldina (Vrije Universiteit Brussel); DE VRIES, Krijn D (Vrije Universiteit Brussel); BRAYEUR, Lionel (Vrije Universiteit Brussel); CASIER, Martin (Vrije Universiteit Brussel); VAN EIJNDHOVEN, Nick (Vrije Universiteit Brussel)

Presenter: DE VRIES, Krijn D (Vrije Universiteit Brussel)

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