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Eliminating single-band dominance in dual-band pulsar light curve fitting

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The wealth of multiwavelength pulsar data has stimulated the development of emission models that predict light curves (LCs) over multiple wavebands, most notably radio and gamma-ray. Using established statistical methods to fit these model LCs to data can prove ineffectual if the data from one waveband are substantially more precise. This waveband—typically radio—dominates the fit and biases inferred parameters. We re-examine the use of Pearson's chi-squared statistic for joint fits, and introduce a new, derived statistic. The core insight that this statistic encodes is that the component single-band chi-squared values implicitly express goodness of fit in units of the respective LC uncertainties. The resulting implicit weighting the dual-band chi-squared carries is eliminated by expressing these values in a shared unit before calculating their sum, derived by effectively standardizing the scaled pulsar-associated flux across the two wavebands. Importantly, chi-squared and our new statistic converge to the same constraints as the precision disparity dissipates. As a first test, we fit two amalgamated dual-band models to 23 Fermi LAT pulsars and compare the resulting constraints to earlier results derived using the same data and similar models. Our fits consistently show no radio dominance, and our constraints more strongly correlate with those derived by eye.

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