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Ridgelines and Catastrophes: Analysis of LISA signals reveals how source parameter estimates sharpen non-linearly as observed signal duration increases JAMES GRABER — We have used a grid search technique to analyze simulated LISA gravitational wave signals to extract source parameters. We present parameter space graphs that illustrate the highly non-Gaussian nature of the probability distributions, and the high degree of correlation among various parameters. These correlations show up as "ridgelines" in the multidimensional parameter space. These graphs also illustrate the highly nonlinear rate with which the accuracy of the parameters extracted increases as a function of the duration of signal observed. The accuracy levels show plateaus followed by sudden jumps, which mathematicians call "catastrophes." These extracted parameters can be used to perform the Ryan* test of the black hole uniqueness theorem. Results obtained to date support estimates that the Ryan test may be performed to an accuracy of better than 10% if favorable cases of extreme-mass-ratio inspirals are observed for periods exceeding one year. Analysis of simulated LIGO cases suggests much less precise results for parameter extraction and much weaker limits on black hole non-uniqueness.

* Ryan, F. D., *Phys. Rev. D* **52**, 5707 (1995).

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