

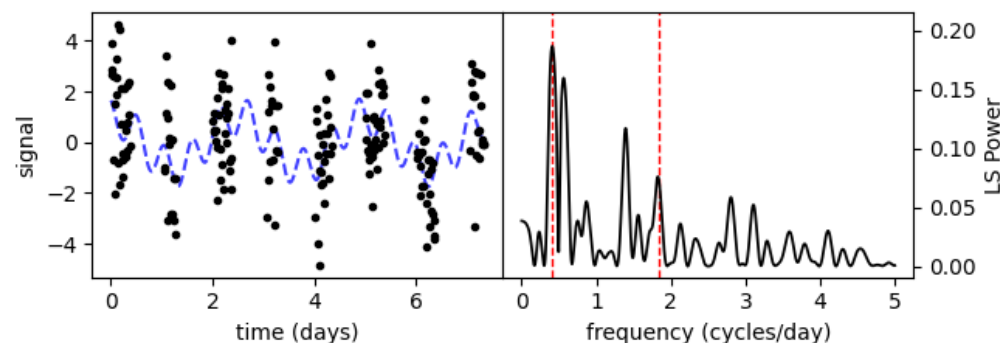
Physics Colloquium

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Multiple Period Searching in Astronomical Time Series with the Generalized Lomb-Scargle Periodogram

ABSTRACT

Many phenomena in astronomy exhibit periodic behavior. Several examples include the orbital periods of binary stars, waves in accretion disks, and gravitational effects of exoplanets on their host star. This translates to a need for methods that extract these periodicities from time series data. Time series in astronomy are complicated by inherent nonuniform sampling, which makes discrete Fourier analysis difficult to interpret. This nonuniform sampling is caused by many factors, such as the day/night cycle, seasons, weather, and technical issues. The generalized Lomb-Scargle periodogram (GLS) is a method designed to extract the frequencies present in a time series under such circumstances. This method is derived from least-squares fitting to a sinusoid but shares many similarities with discrete Fourier analysis. Since it is assumed that the time series can be modeled by a single sinusoid, the GLS is not a rigorous method for multiperiodic data. However, it is commonly used for this purpose and an understanding of the limitations of the GLS under these conditions will be useful. We generated simulated time series data containing noise, multiple sinusoids, and realistic sampling. We then attempted to detect frequencies and compared the observed results with the configuration parameters. The results show that the GLS can be an effective tool for period searching and a good starting place for time series analysis. Ideally, additional observational, theoretical, or statistical evidence should be used to verify the periodogram results.



3:00-3:30 p.m., Friday, March 7th, 2025

In-person in McLane Hall 162