Kepler Mission Stellar and Instrument Noise Properties

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Kepler Mission results are rapidly contributing to fundamentally new discoveries in both the exoplanet and asteroseismology fields. The data returned from Kepler are unique in terms of the number of stars observed, precision of photometry for time series observations, and the temporal extent of high duty cycle observations. As the first mission to provide extensive time series measurements on thousands of stars over months to years at a level hitherto possible only for the Sun, the results from Kepler will vastly increase our knowledge of stellar variability for quiet solar-type stars. Here we report on the stellar noise inferred on the timescale of a few hours of most interest for detection of exoplanets via transits. By design the data from moderately bright Kepler stars are expected to have roughly comparable levels of noise intrinsic to the stars and arising from a combination of fundamental limitations such as Poisson statistics and any instrument noise. The noise levels attained by Kepler on-orbit exceed by some 50% the target levels for solar-type, quiet stars. We provide a decomposition of observed noise for an ensemble of 12th magnitude stars arising from fundamental terms (Poisson and readout noise), added noise due to the instrument and that intrinsic to the stars. The largest factor in the modestly higher than anticipated noise follows from intrinsic stellar noise. We show that using stellar parameters from galactic stellar synthesis models, and projections to stellar rotation, activity and hence noise levels reproduces the primary intrinsic stellar noise features.

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