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Building an Acceleration Ladder with Tidal Streams and Pulsar Timing

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We analyze stellar streams in action-angle coordinates combined with local acceleration measurements to provide joint constraints on the potential of the Milky Way (MW). The stream methodology uses a combination of the Kullback-Liebler divergence (KLD) and likelihoods calculated using the two-point correlation function. Accurate potential models are expected to produce highly clustered actions for the stream members. The KLD is used for measuring the clustering of a set of actions, while the likelihoods are calculated for combining methods and estimating the uncertainties on our potential parameter estimates. We use Fisher matrix analysis to combine the local measurements with the stream results and to perform our error analysis. This work can be thought of as an “acceleration ladder”, where direct local measurements that are currently limited to the solar neighborhood are combined with indirect techniques that can access a much larger area of the MW. We consider the Nyx, Palomar 5, Orphan, GD1 and Helmi streams in our analysis. This combination of streams features spatial overlap with the local measurements from the Nyx stream and extends to other areas of the Galaxy using the other streams. Utilizing this data we then constrain several common models for the MW potential. In addition to typical MW potential models, we also include a model used with the local measurements, which was found to provide a good fit to the direct acceleration data.