Astr 509: Astrophysics III: Stellar Dynamics

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Lecture 4: Potential Theory III

The Milky Way Potential, Numerical Methods

The Milky Way Potential

Already discussed in detail in Lecture 1. The most popular models are double exponential disk (thin and thick in the Z direction), with a power-law or logarithmic halo.

In general, the potentials are constrained using the spatial distribution of stars, or the kinematic information (e.g. the rotation curve).

Some recent good reviews:

Bahcall (1986, ARA&A 24, 577)

Gilmore, Wyse & Kuijken (1989, ARA&A 27, 555)

Majewski (1993, ARA&A 31, 575)

Freeman & Bland-Hawthorn (2002, ARA&A 40, 487)

Numerical Methods

Numerical methods are most efficient for studying N-body gravitational systems: major results in galaxy formation and dynamical evolution, globular clusters, galaxy clusters, stability and evolution of planetary systems, etc.

The key to success is accurate computation of the gravitational force – the limiting factor is the computational expense.

Many different methods, often specialized for a particular problem. The most popular are: Fourier transforms (particle mesh), multipole expansion, hierarchical (tree) codes (also uses multipole expansion), Fokker-Planck methods, Monte Carlo methods, etc.