Oct-tree for N-body simulation
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Outline

1 Background and theory

2 Coding

3 Results

Barnes-Hut approach

A hierarchical $O(N \log N)$ force-calculation algorithm

Josh Barnes & Piet Hut

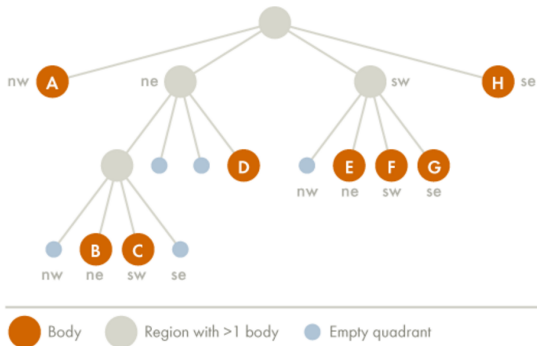The Institute for Advanced Study, School of Natural Sciences, Princeton, New Jersey 08540, USA
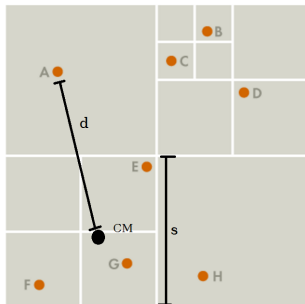
$O(N \ln N)$ instead of $O(N^2)$

Barnes-Hut approach

Source = http://arborjs.org/docs/barnes-hut

Barnes-Hut approach

Source = http://arborjs.org/docs/barnes-hut

Barnes-Hut approach

If $s/d < \theta$, then look at smaller squares.
Source = http://arborjs.org/docs/barnes-hut

Coding - Constructing the tree

- Class divides volume in eight regions.
- Assign particles to their appropriate regions.
- If the region has more than 1 particle; recursively call class to divide.

Coding - Optimalization

- Cython, uses a C compiler.
- For extra speed: Declare all variables and only use lists.

Results - Dataset

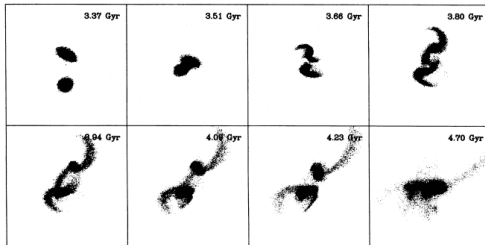## USING TIDAL TAILS TO PROBE DARK MATTER HALOS

John Dubinski, J. Christopher Mihos,[1,2] and Lars Hernquist[3]
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Dataset of Milky Way-Andromeda merger; 81920 particles, every 128th used, so 640 particles. Masses are adjusted.

Results - Potential results

Milky Way−Andromeda Merger − $M_{MW}+M_A = 1.6 \times 10^{12}\ M_\odot$

3.37 Gyr — 3.51 Gyr — 3.66 Gyr — 3.80 Gyr
3.94 Gyr — 4.09 Gyr — 4.23 Gyr — 4.70 Gyr

Milky Way−Andromeda Merger − $M_{MW}+M_A = 5.2 \times 10^{12}\ M_\odot$

2.56 Gyr — 2.71 Gyr — 2.85 Gyr — 3.00 Gyr
3.28 Gyr — 3.57 Gyr — 3.86 Gyr — 4.40 Gyr