Summer 2008

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Summer 2008 (cont.)

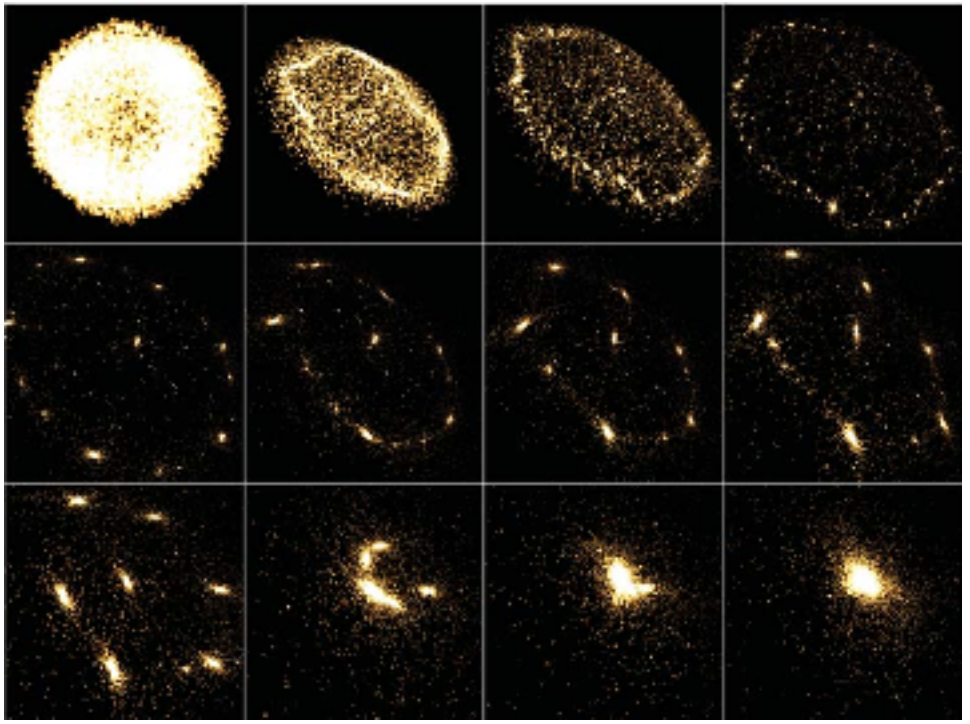
- SCOUT
  - Volume Renderer
  - Lyman-alpha visualization
- Particle Mesh N-Body Simulation

N-Body Simulation

- Motivation
  - study the evolution of star clusters
  - study dark matter
  - tool to test theory against observation
    - Millenium Simulation

N-Body Simulation (cont.)

- Isn't there already an CUDA N-Body simulator?
- And isn't it cool?
  - Limitations exist



Lyland et al, GPU Gems 3

Particle Mesh N-Body Simulation

- Gauss' Law
  - $\nabla \cdot g = -4\pi * \rho$
- But we know...
  - $g = -\nabla \Phi$
- Thus...
  - $\nabla^2 \Phi = 4 * \pi * \rho$
  - Poisson's equation
  - easily solved in the frequency domain

PM N-Body Simulation

1. Assign particles to mesh
2. Fourier Transform on density mesh
3. Calculate potential using poisson's eq.
4. Inverse Fourier to solve for Φ
5. Calculate the next position of each particle

PM N-Body Sim (cont)

- Speedup?
  - $N_g \log N_g \; where \; N_g \; is \; the \; grid \; size$
  - $instead \; of \; N^2 (where \; N^2 \; is \; the \; number \; of \; particles)$
- Drawbacks?
  - short-range interaction is not good
    - Particle-Particle Particle Mesh

PM N-Body Sim (cont.)

- Quad Core 2.4 Ghz ~2 sec (TBB)
- GeForce 8800 GTS ~0.3 sec (CUDA)
  - CUDA implementation unoptimized

Questions?