Fujitsu High Performance Computing Meeting
November 2, 2001

Rose Center for Earth and Space
American Museum of Natural History

The Digital Galaxy Project

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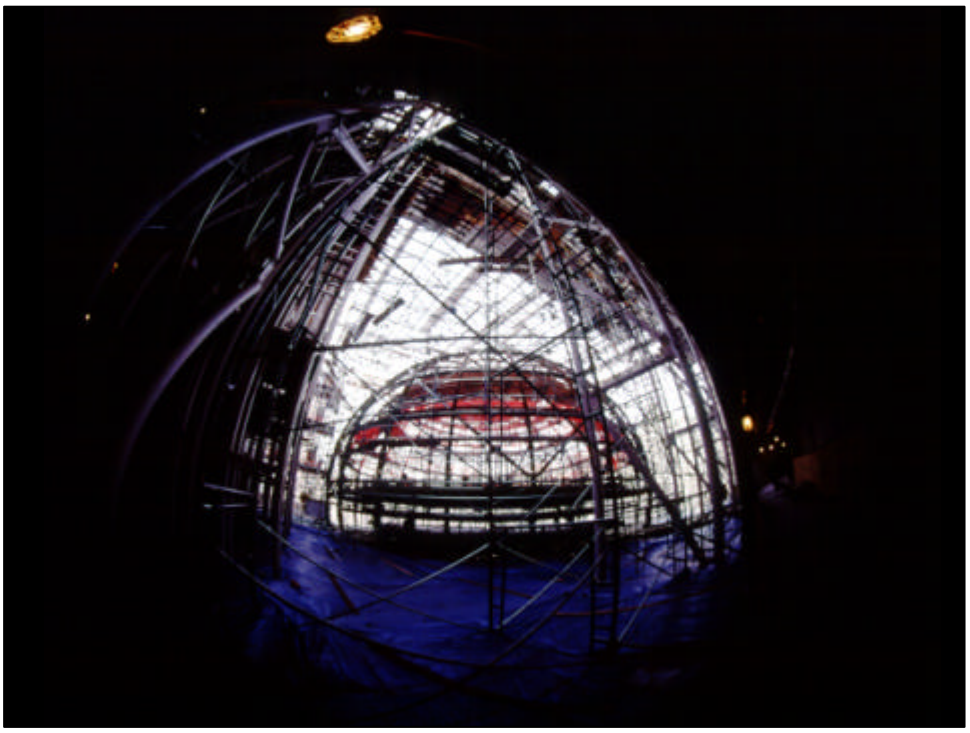
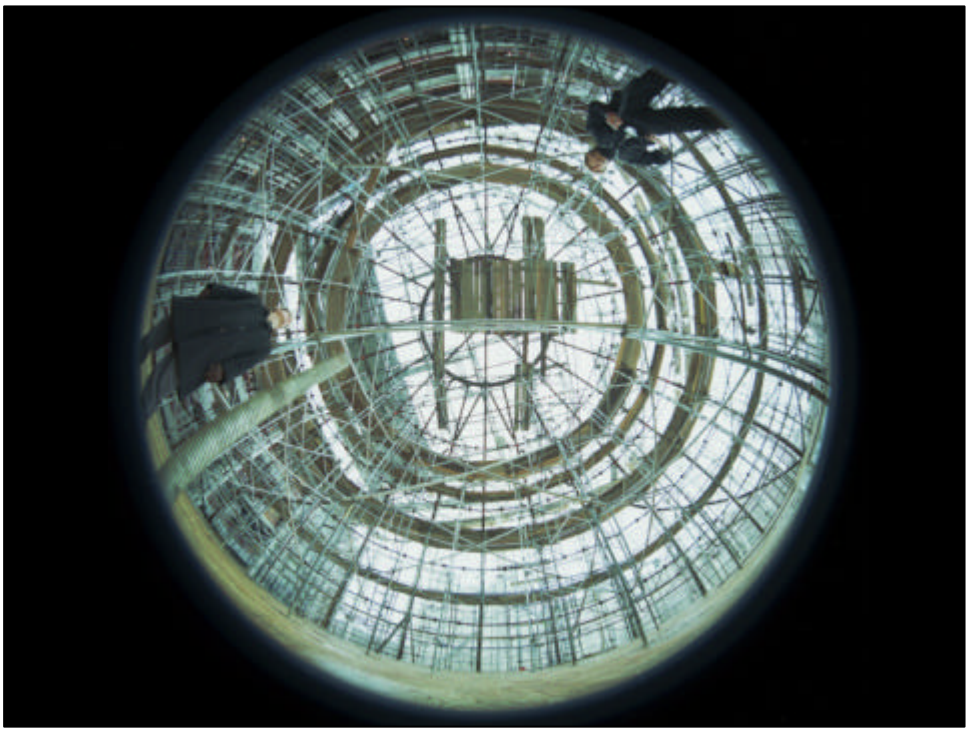
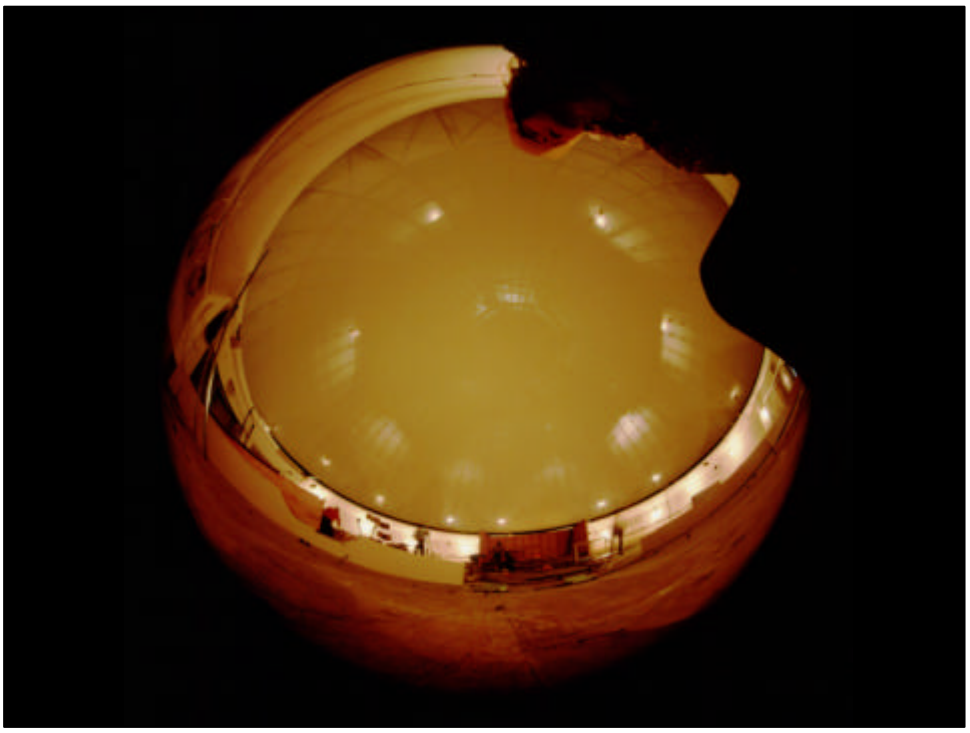
Rose Center Build:

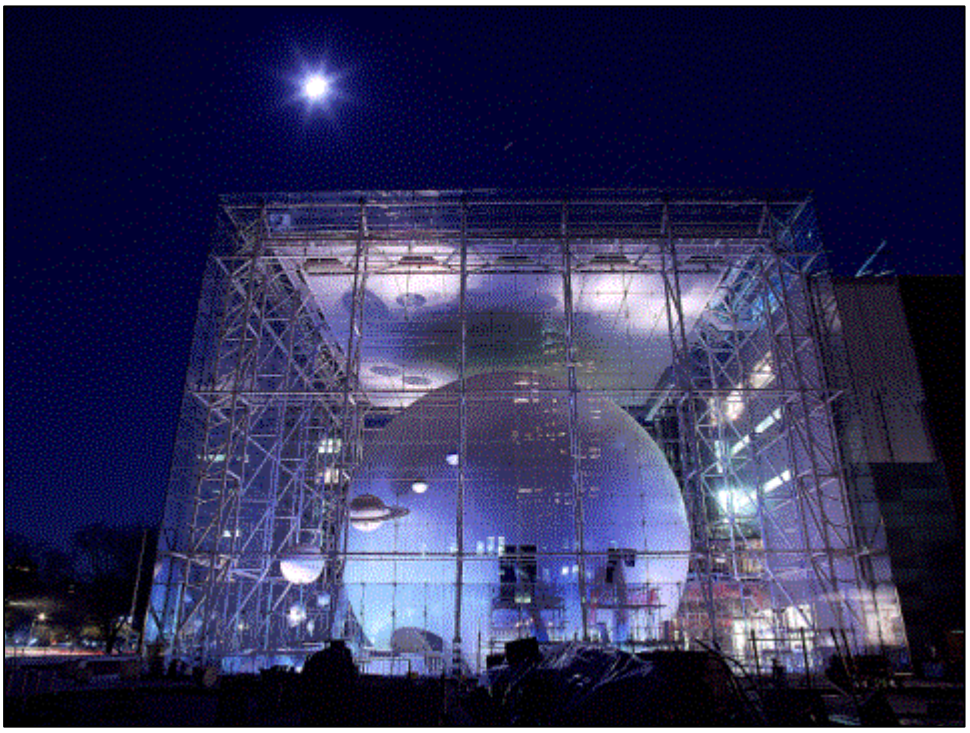
- Modernize the Hayden Planetarium built in 1935
- Complete the north side of the American Museum of Natural History
- Add new science department of astrophysics
- Add new education production department
- Two immersive theaters: Main dome and Big Bang
- $210 million project

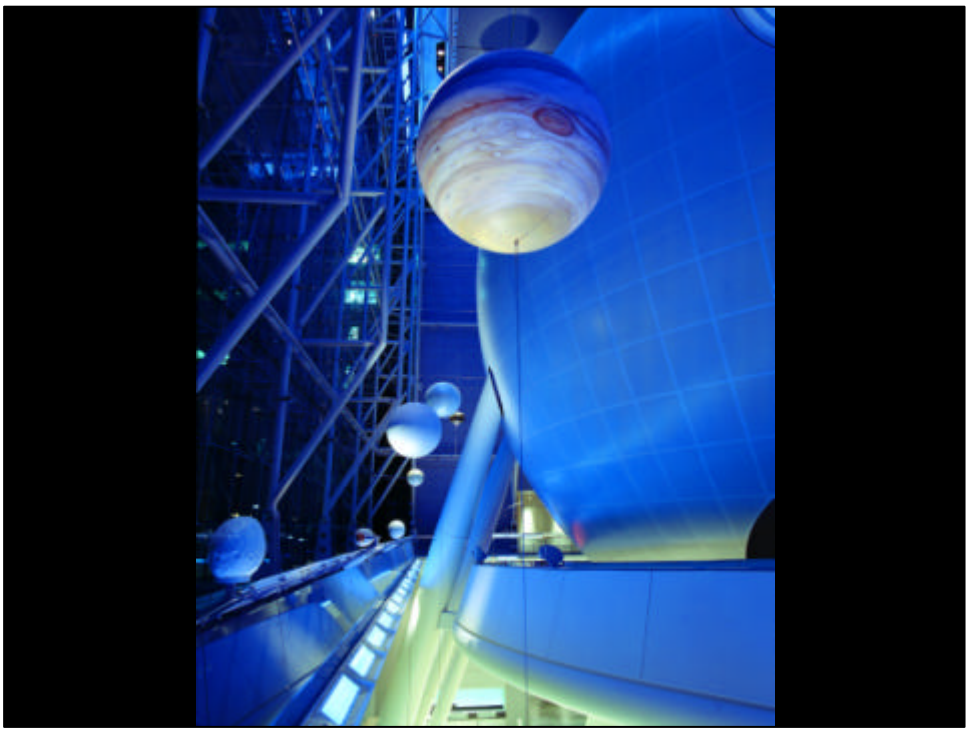
- Modernize the CONCEPT of the “planetarium”





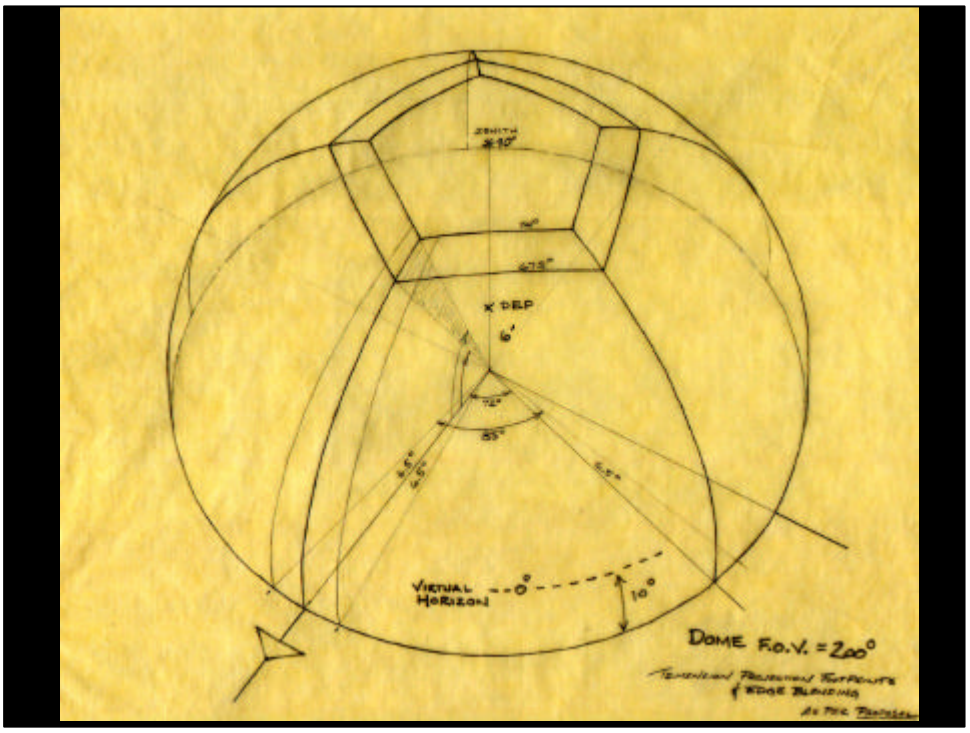


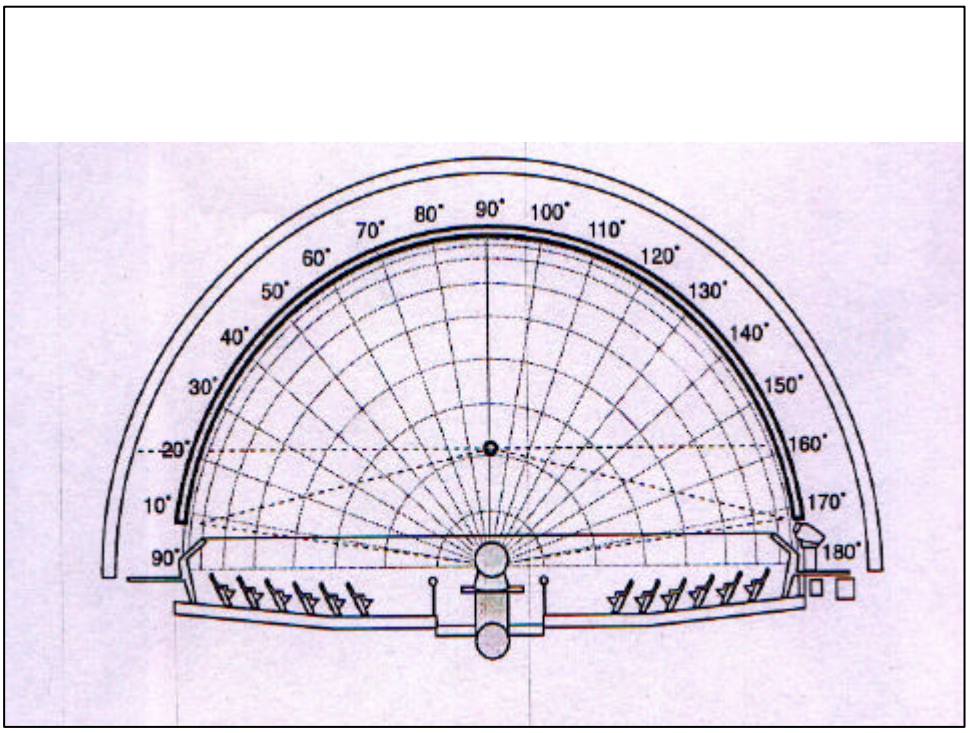


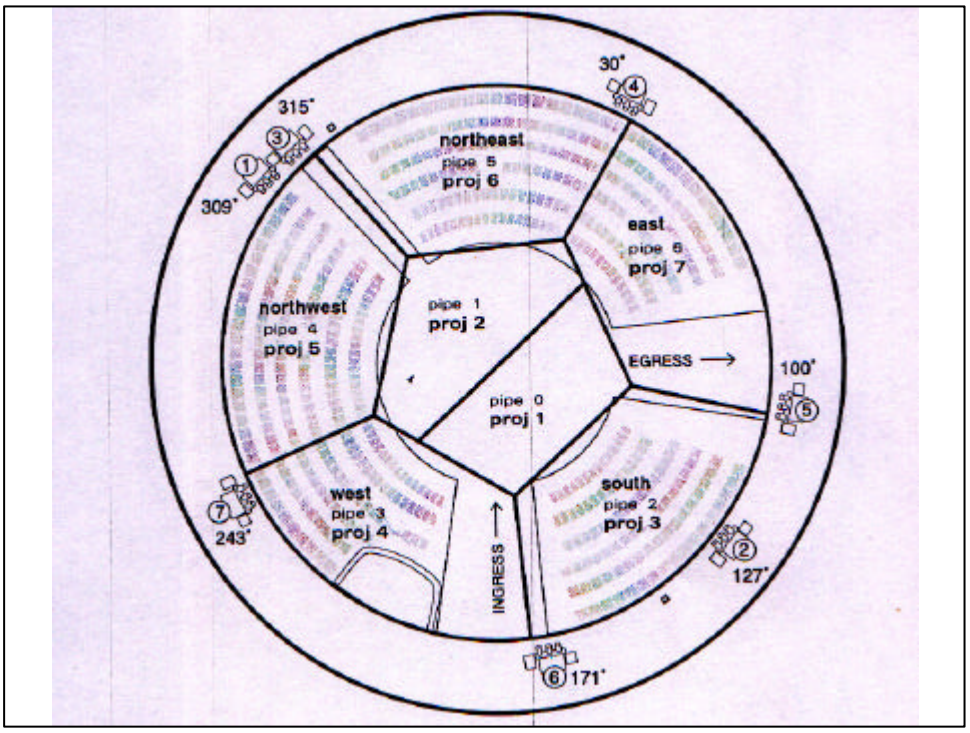


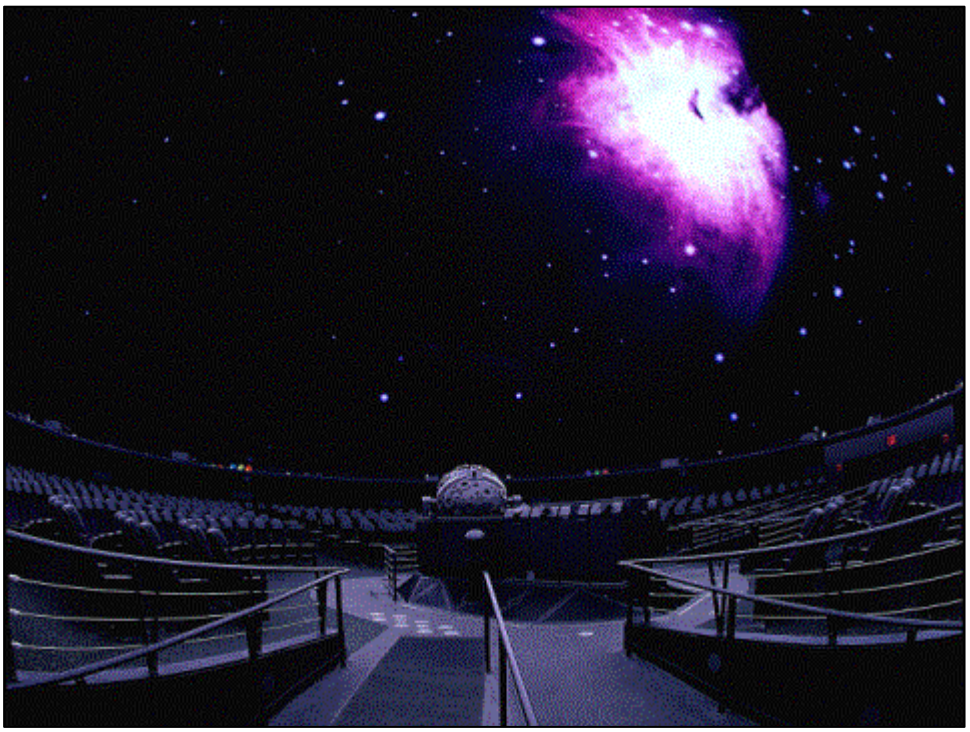
New Concept of the Planetarium

- Precursors: Omnimax, Digistar, Sky Vision, Reality Room
- Use dome as an immersive theater to experience virtual presence within a model of the universe
- Create both movie playback capability and real time operation function across entire dome
- Immersive depth illusion used to present the scale relationships of astronomy, and the behavioral aspects of the universe as simulated with astrophysics
- Started by modeling our Milky Way galaxy in 3D with published data of observed objects


ZENITH
+10°
X DEP
6'
VIRTUAL HORIZON
0°
10°
DOME F.O.V. = 200°


90°
80°
70°
60°
50°
40°
30°
20°
10°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°


30°
315°
309°
100°
243°
127°
171°
northeast
pipe 5
proj 6
east
pipe 6
proj 7
northwest
pipe 4
proj 5
pipe 1
proj 2
EGRESS
pipe 0
proj 1
west
pipe 3
proj 4
south
pipe 2
proj 3
INGRESS



The Digital Galaxy Project

- Model our home Milky Way galaxy
- NASA funded project 1997-2000
- Plot positions for observed objects with published distance
- Create statistical representation beyond that which is currently observed
- Provide basis for meeting our “new concept” objectives
- Provide basis for premier show production capability

Digital Milky Way Model – Observed Data

- Stars: 25k Hipparcos catalog
- Exoplanetary systems: 59 several on-line sources
- Open Clusters: 419 from Lund Observatory catalog
- Globular Clusters: 145 from Harris catalog
- Pulsars: 706 from Taylor and Lyne
- Dark Nebulae: 174 from Lynds catalog
- H II Regions: 261 from Georgelin & Georgelin, Blitz, Fich, Stark, and Gillespie
- Planetary Nebulae: 778 from Strasbourge-ESO catalog
- Local Group of Galaxies: 34 from Brent Tully

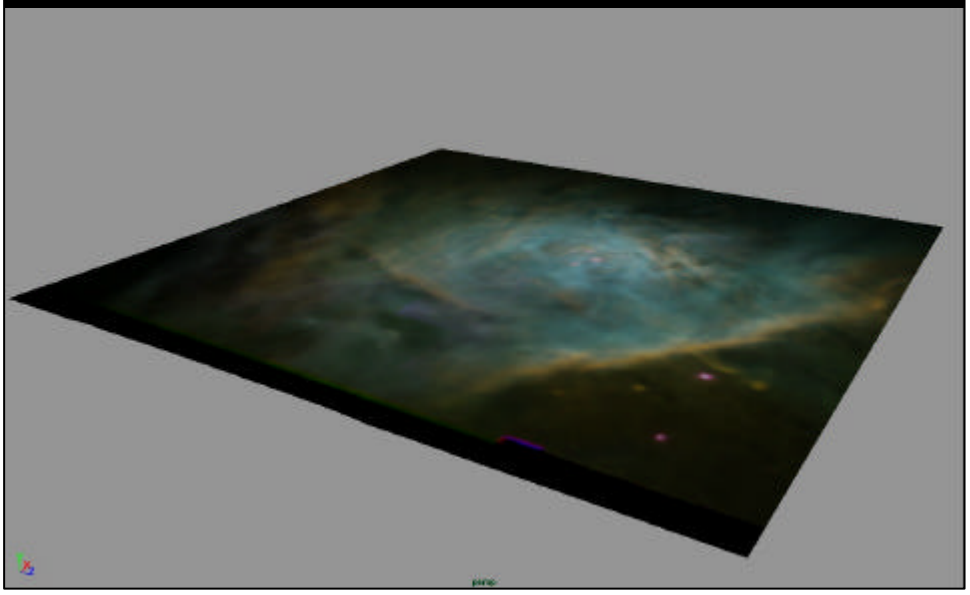
Passport to the Universe

- Premier dome show in new Hayden Space Theater
- Migration from “Sky Show” to “Space Show”
- Objective: Experience your “Cosmic Address”
- Immersive fly through a range of scales from home planet to observable extent of our universe
- Techniques for rendering nebulae and flight beyond the Milky Way galaxy required partnering with:
- San Diego Supercomputer Center
- National Center for Supercomputing Applications
- Astronomers: C. Robert O’Dell, Brent Tully and J. Ostriker

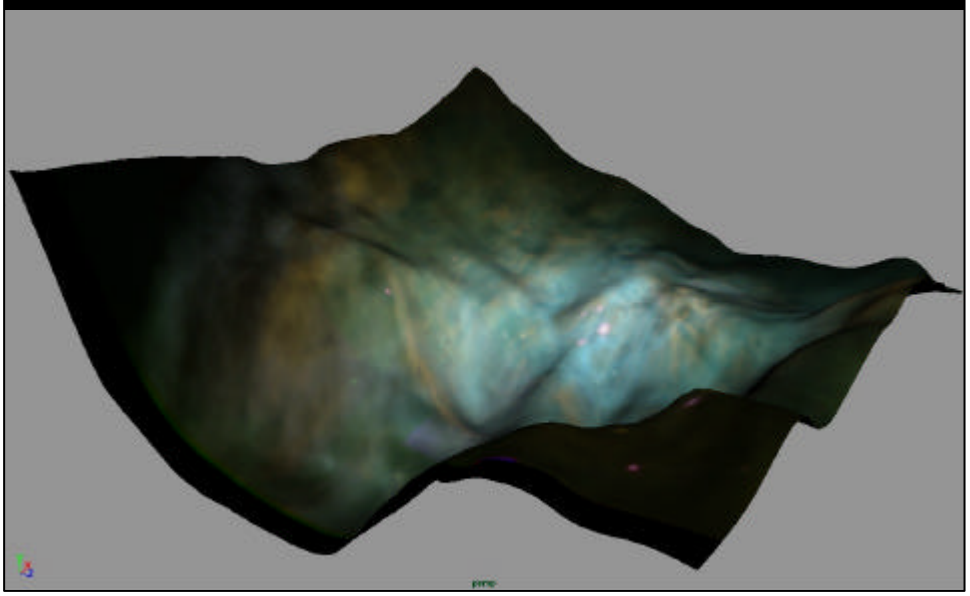
Supercomputing Collaborators

- Continuing on after our first show
- National Center for Supercomputing Applications:
  Donna Cox, Robert Patterson, Stuart Levy
- San Diego Supercomputer Center:
  Dave Nadeau and Jon Genetti

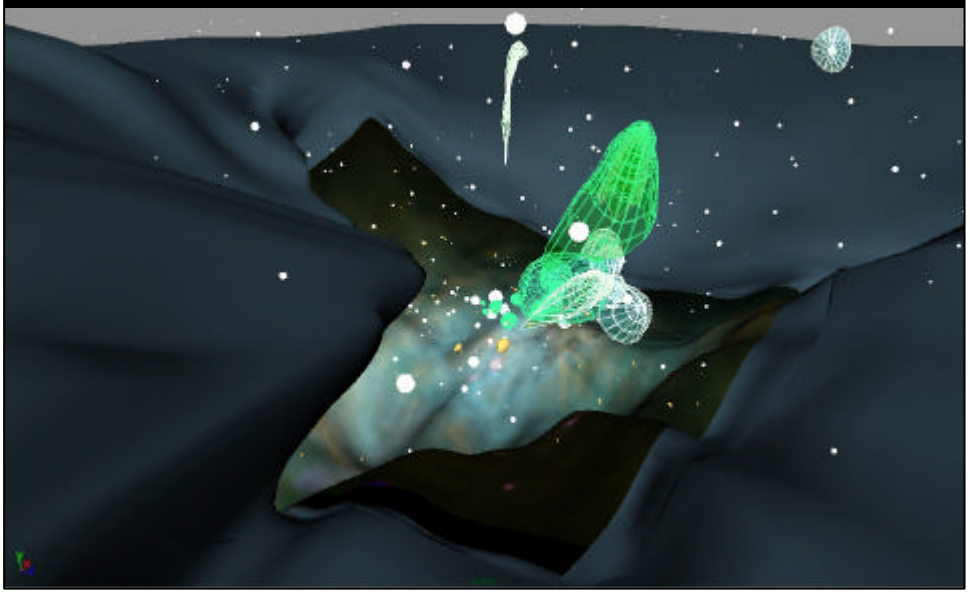
Orion model: Hubble Space Telescope image with dark bay removed



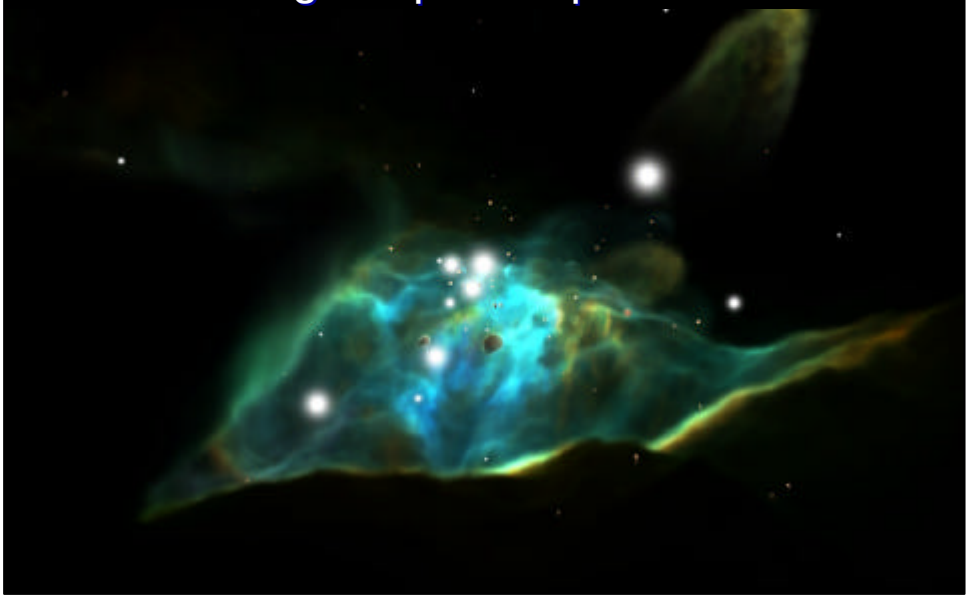
Orion model: HST image mapped on terrain model derived by O'Dell and Wen



Orion model: terrain extrapolation, dark bay over hang, stars, shocks and proplyds



Orion model: final volumetric render by San Diego Supercomputer Center



Computer Hardware

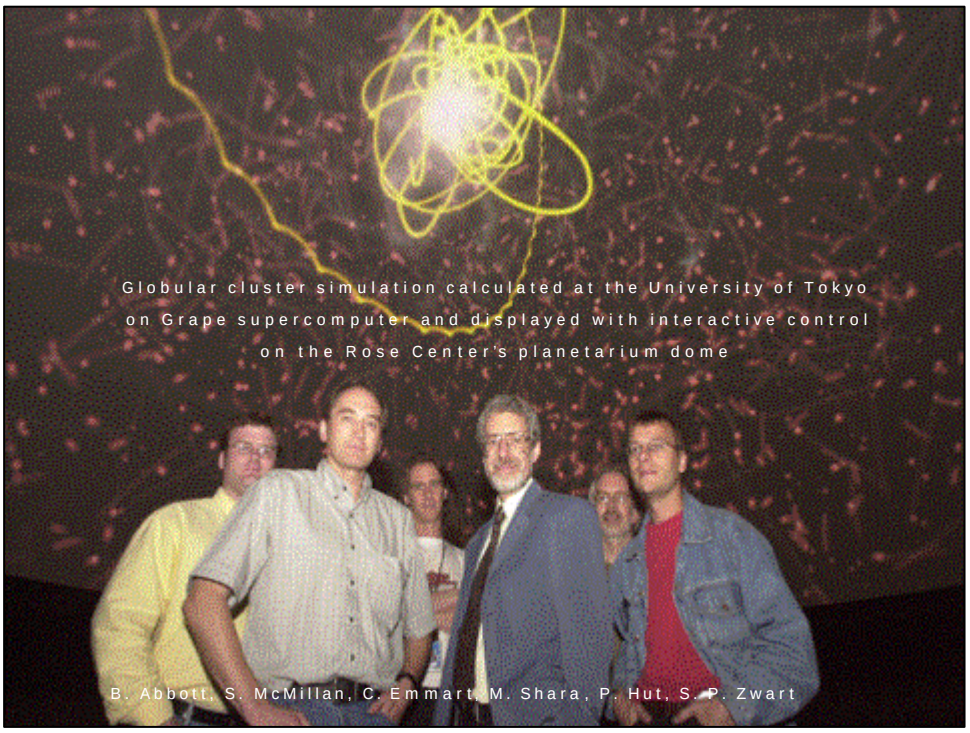
- Two SGI Onyx2 Infinite Reality 2 computers:
- For Dome: 7 graphics pipes, 28 processors, 16GB ram, 90GB internal drives, 2TB external storage on Ciprico-7000's (16 min. show approx 1TB)
- For Production testing: 3 graphics pipes, 12 processors, 6GB ram, 45GB internal drives, 550GB external Ciprico raid arrays for HD video editing, and 270GB for development work
- Both conduct RT applications, movies from disk arrays, rendering, and astrophysics simulations
- Three SGI Octanes
- Ten SGI O2's
- New DDR NT system for show playback

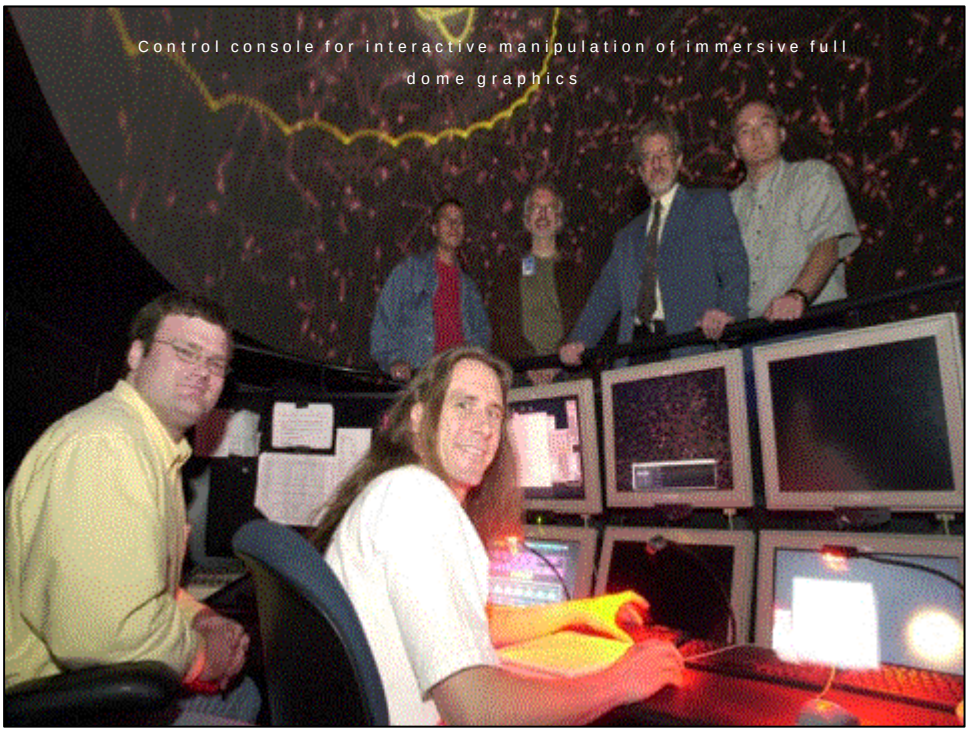
Real Time Software

- Virtual Director and Partiview, NCSA
- Viz (formerly Everest), Peak
- C-Galaxy, Aechelon Technology Inc.
- Silicon Conductor, Trimension Inc.
- Performer, SGI
- Starry Night, Space.com

Production Software

- Maya, Alias/Wavefront – our glue between RT and final render
- Photorealistic Renderman, Pixar
- MPIRE volumetric renderer, SDSC
- SPOT star renderer, AMNH
- Composer, Alias/Wavefront
- Fishcaster and dome translation ware, AMNH




Control console for interactive manipulation of immersive full dome graphics