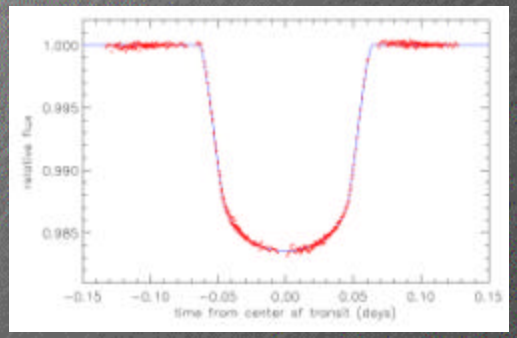
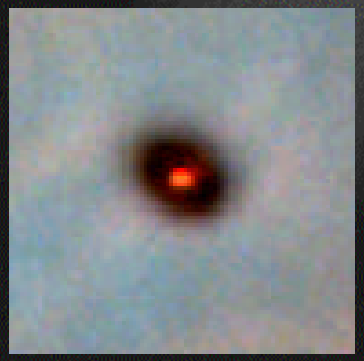
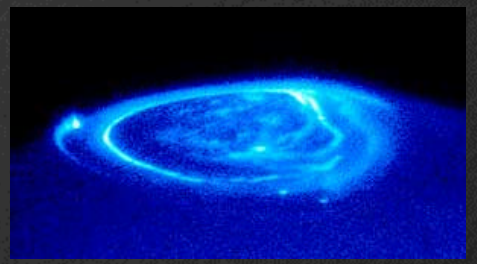


The local universe

Emergence & the Next BIG THING(s)



Steven Beckwith
STScI
Chicago, April 5, 2002



Intellectual trends

- Uncover ("discover") the unseen
  - Catalog the universe
  - Adduce the physical laws
  - Understand the reason for it all
- Local to the distant, minor to major components
  - Solar system → Milky Way → galaxies → recombination
  - Planets → Stars → Galaxies → Structure
- "Local" questions
  - How & why do planets form?
  - What do they look like?
  - What makes planets evolve into habitable worlds

The quest for distance drove us to large light buckets
The need for resolution & dynamic range drives to large apertures in space.

10m optical coronagraph
D.R. > 10^{10}

Terrestrial exoplanets

Exploration

10m optical $\Delta\theta \sim \lambda/D$

CS disks & rings
Exozody clouds

Disk chemistry
H_2 spectra of disks
Disk structure, gaps, rings

~4m UV spectra
$\Delta\theta \sim \lambda/D$

Atmospheres of SS planets
Occultation of stars
Composition of bodies
Ring dynamics

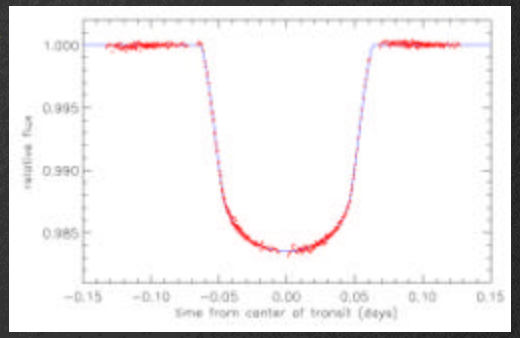
10m optical coronagraph

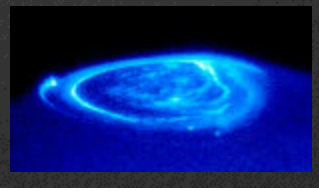
Giant exoplanets
Young exoplanets

Stellar winds
TTS in LMC
Binary stars
Stellar pops
IGM Baryons
Microlensing
$\alpha(z)$ (e^2/hc)

~10m optical light bucket

Census of exoplanets
Exoplanet atmospheres





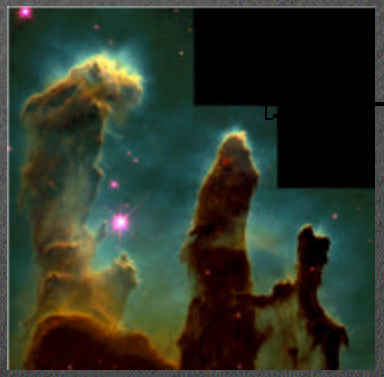
$\Delta x \sim 4$ km
~4m UV
~10m Optical

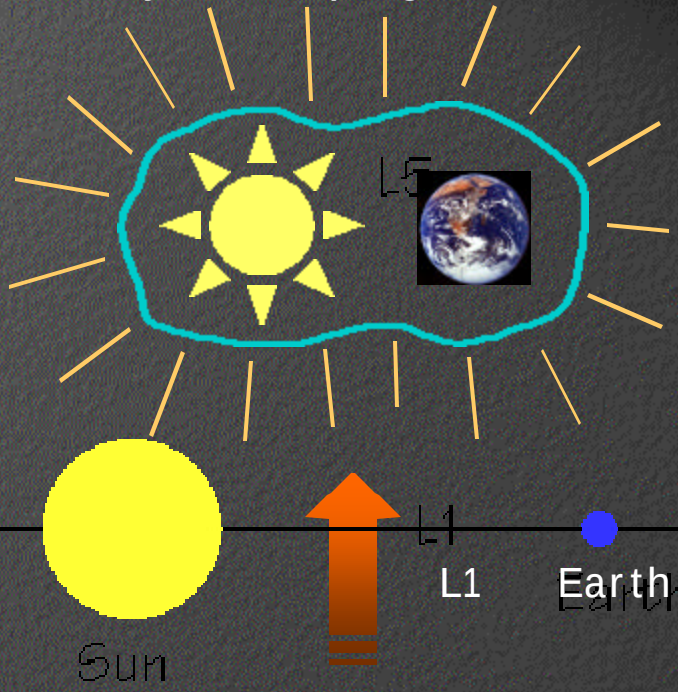
Walk before you run (Angel, this conference)

Exploration

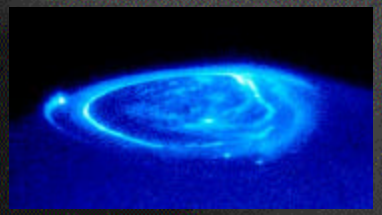
Space-based lasers

Interferograms





Beautiful pictures



Optical coronagraph D.R. > 10^{10}

Optical coronagraph D.R. > 10^{8}

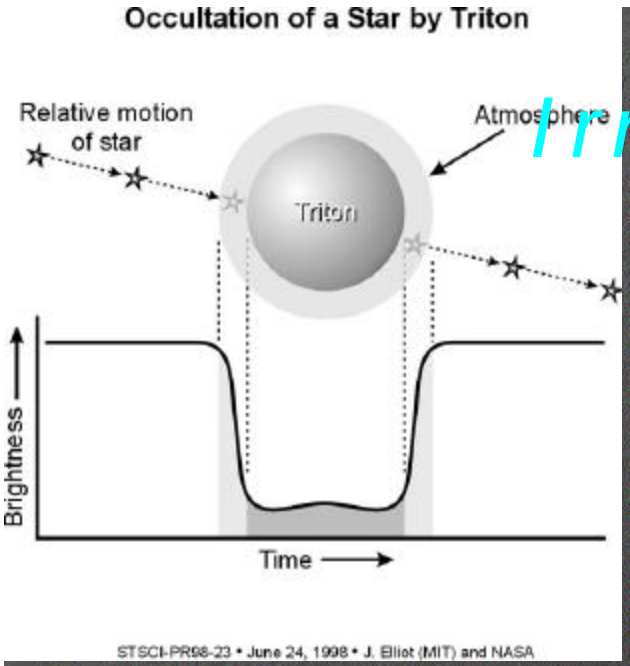
Optical resolution: $\Delta\theta \sim \lambda/D$

Optical light bucket

UV spectral light bucket

Planetary images
Deep field images
Nebulae, clouds
Exo-planet images

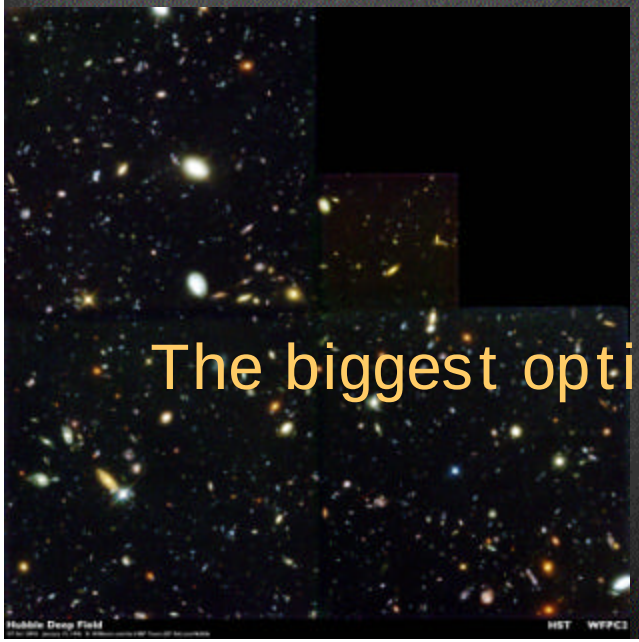
Heritage
Engineering challenge
Military/industry interests



Irrational exuberance

MCAO w/ n x LGS

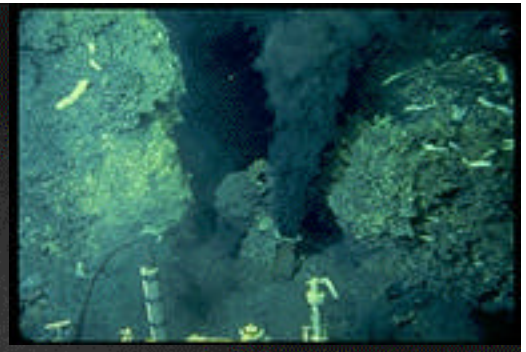
- λ/D with $\lambda < 1\ \mu m$
- dynamic range
- faint fuzzy things
- sky coverage
- wide fields
- photo stabilty



The biggest optical systems will eventually be in space.

$10\ kg\ m^{-2} \rightarrow 1\ kg\ m^{-2}$

Emergent phenomena



- Life is an emergent phenomenon
  - Self-reproduction arose from inorganic elements
  - The vector of life has increased complexity
- Intelligence is an emergent phenomenon
  - Intelligence appears to be a new property
  - It took a long time and many accidents to emerge
- Life, intelligence & emergent phenomena are the new fundamental questions
  - Shift in emphasis to the microscopic, rare constituents of the universe
  - Stretch our view from the Solar System to local star systems and the solar neighborhood: the new frontier

naysayers, conservatives, realists, optimists, visionaries