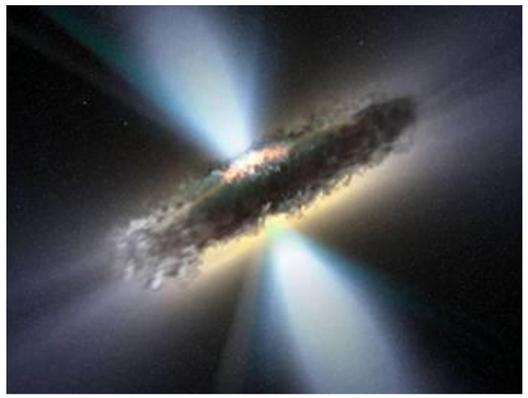
NASA's NuSTAR (**Nu**clear **S**pectroscopic **T**elescope **AR**ray) is a partnership of many of the most prominent research facilities in the world led by California Institute of Technology (Caltech), Columbia University and NASA's Jet Propulsion Laboratory (JPL) and is defined as "a pathfinder mission that will open the high energy X-ray sky for sensitive study".

By focusing X-rays at higher energy, NuSTAR will answer fundamental questions about the Universe:

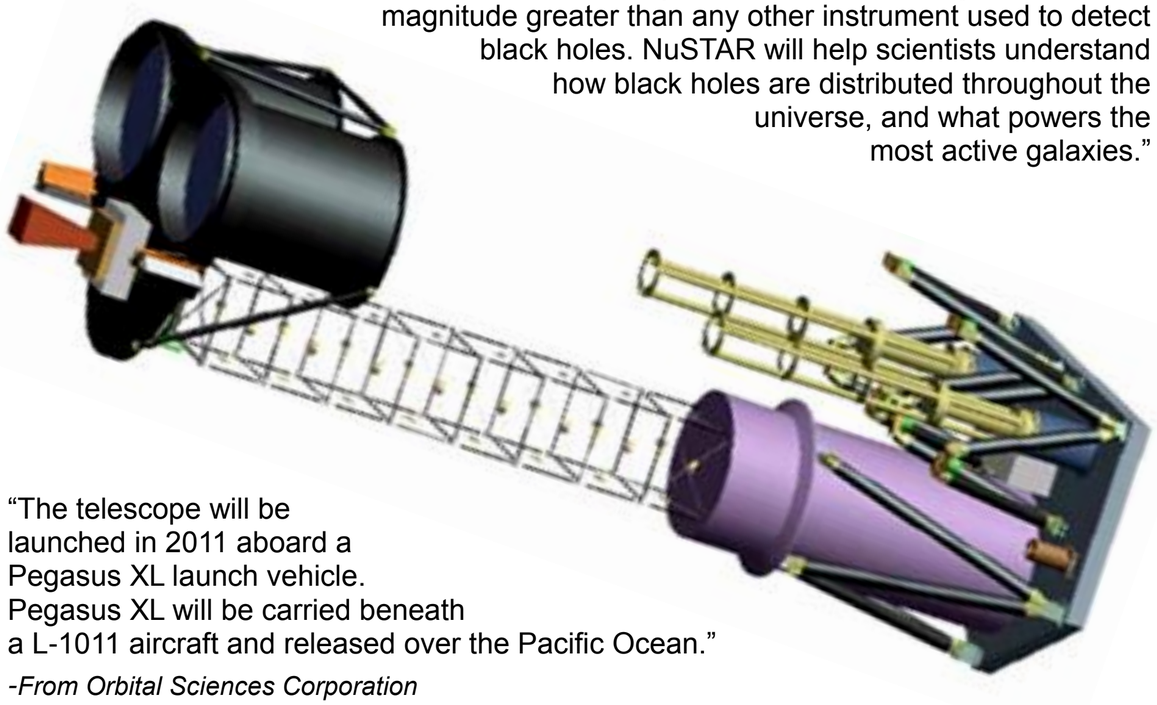
- How are black holes distributed through the cosmos?
- How were the elements that compose our bodies and the Earth forged in the explosions of massive stars?
- What powers the most extreme active galaxies?



Perhaps most exciting is the opportunity to fill a blank map with wonders we have not yet dreamed of: NuSTAR offers the opportunity to explore our Universe in an entirely new way.

(excerpted from the NuSTAR website: www.nustar.caltech.edu)

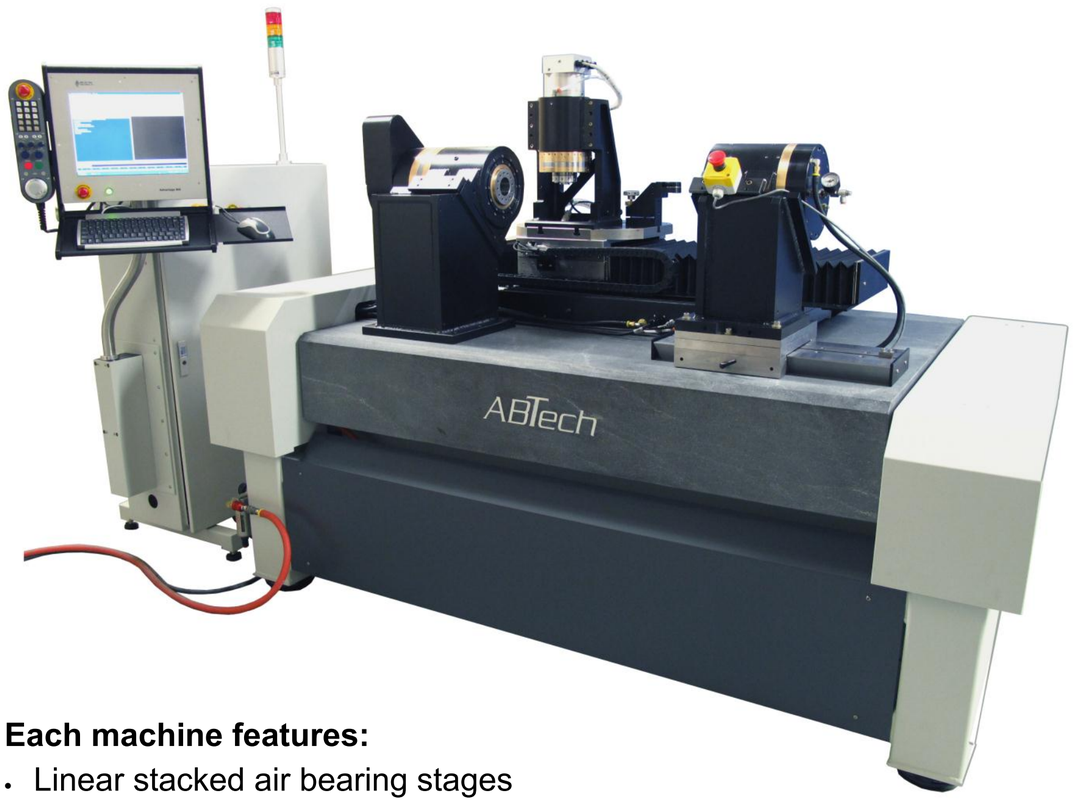
"The NuSTAR telescope will have a sensitivity two orders of magnitude greater than any other instrument used to detect black holes. NuSTAR will help scientists understand how black holes are distributed throughout the universe, and what powers the most active galaxies."



"The telescope will be launched in 2011 aboard a Pegasus XL launch vehicle. Pegasus XL will be carried beneath a L-1011 aircraft and released over the Pacific Ocean."

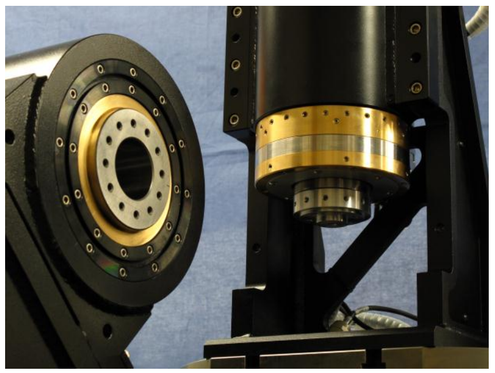
-From Orbital Sciences Corporation

ABTech was awarded the contract to design and manufacture two air bearing based machines for Columbia University's Nevis Astrophysics Lab. The machines will be used to produce the cylindrical optics modules for the NuSTAR telescope project.



Each machine features:

- Linear stacked air bearing stages
  - straight and flat to less than 20 μ" over the full 600mm travel
- Air bearing work holding and tailstock spindles
  - for lathe operation or holding position of the optic during assembly and grinding
- High-speed air bearing spindle for grinding graphite optic mounting surfaces
- Indexing turret assembly
  - to easily transition between diamond turning, grinding and LVDT measurements
- Granite surface plate and base frame
- CNC lathe controller and electrical control cabinet



Images from:
NuSTAR's official Website www.nustar.caltech.edu,
Lawrence Livermore National Laboratory Presentations, and ABTech archives

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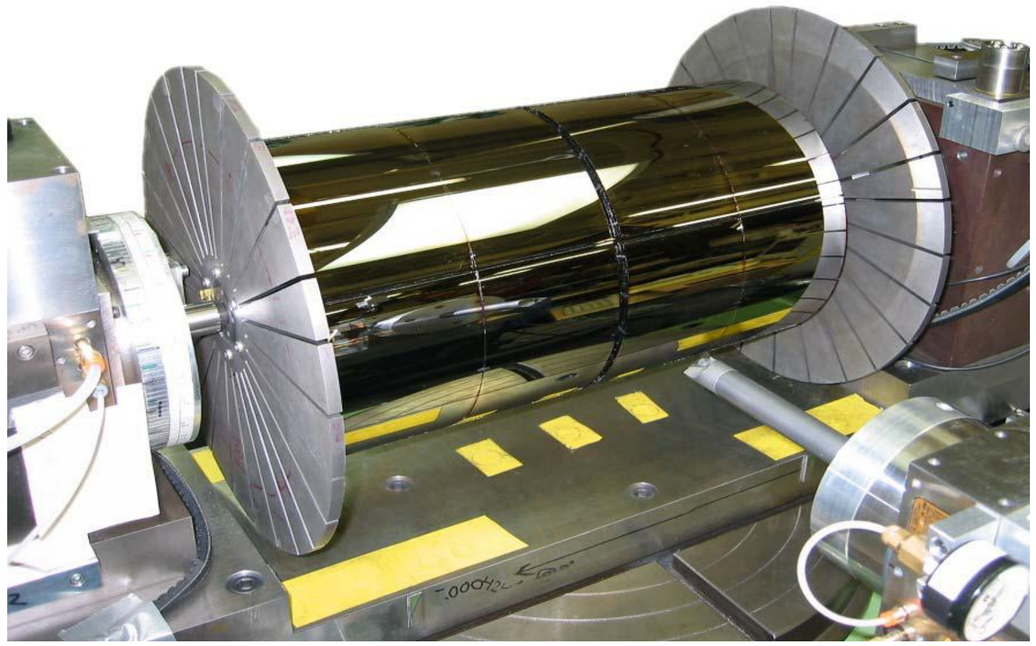
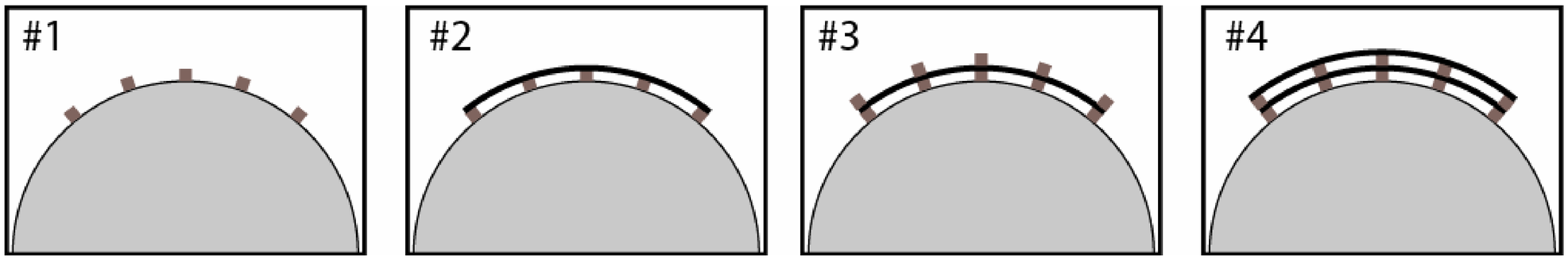
NuSTAR Optics Modules



Prototype optic module during assembly

End view of completed prototype optic



Epoxy graphite spacers onto a mandrel and machine to correct radius & angle

Epoxy slumped glass substrates to spacers

Epoxy next layer of spacers to previous layer of glass

Machine spacers, epoxy another layer of glass into place, repeat for all layers

- Individual Mirror Thickness: 0.2 mm (0.00787 in)
- Total layers Per Module: 130
- Total Mirror Segments (2 telescopes): 4680

Images taken from:
NuSTAR's official Website www.nustar.caltech.edu
And Lawrence Livermore National Laboratory Presentations

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