

ASTROPHYSICS

X-RAY VISION

Thanks to amazing nested mirrors, NASA's NuSTAR telescope is set to reveal hidden phenomena in the cosmos

By Fiona Harrison and Charles J. Hailey

SOME OF THE UNIVERSE'S MOST EXTREME PHENOMENA—BLACK HOLES, NEUTRON STARS and remnants of stellar explosions—emit copious amounts of x-rays. Just as medical x-rays penetrate skin to reveal bone, cosmic versions pierce clouds of gas and dust to reveal hidden objects in our galaxy and beyond.

Until now, no NASA mission has been able to focus high-energy x-rays to make a clear, high-quality image. The Nuclear Spectroscopic Telescope Array (NuSTAR), to be launched in early 2012, will be the first. Made up of two mirrors, including the one at the right, plus a detector and an expandable mast, its pictures will be 100 times more sensitive than those of previous missions, with a resolution comparable to that of the human eye.

Building a camera to capture and record x-ray images is very different from designing one that records optical light. Visible light reflects off a mirror perpendicularly, which is why one holds a mirror parallel to one's face. X-rays, on the other hand, glance off a reflective surface at an angle nearly parallel to it, more like stones skipping off the surface of water. To gather this glancing radiation requires shells of glass, stacked much like plastic cups, one inside the other. Each shell, or layer, intercepts some of the incoming x-rays, and together they work to form a focused image.

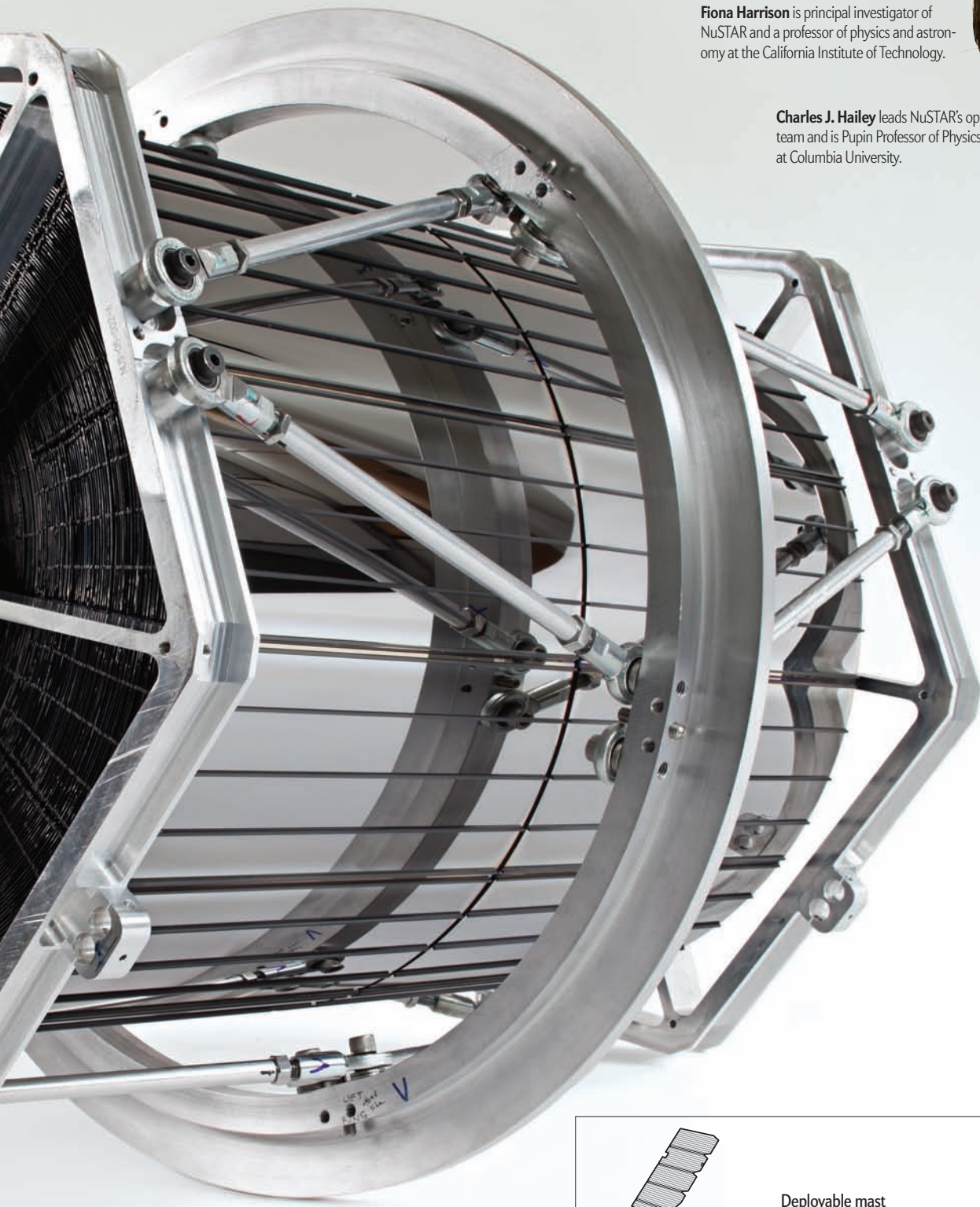
Each of NuSTAR's optics is made up of 133 concentric shells of atomically smooth glass, so smooth that its bumps are no larger than the size of the spaces between its atoms. The glass—the same kind used in laptop and smart phone screens—has been coated with hundreds of alternating layers of metal and either carbon or silicon for reflectivity. Once the glass is prepared, a precision machine fixes each piece in place to a tolerance 20 times as thin as a human hair. Although the telescope may sound fragile, it has been built to withstand a turbulent takeoff onboard a rocket.

What will we find? Perhaps unusual objects that test physical models of celestial phenomena. Until now, astronomers have been poor predictors of the secrets the cosmos holds, but if history is a guide, surprising discoveries lie ahead. ■

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