ABTech inc. Pride In Precision

CASE STUDY:

ABTech's Precision Powers NASA's View Into Deep Space

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MISSION CRITICAL: Building a Telescope for the Edge of the Universe

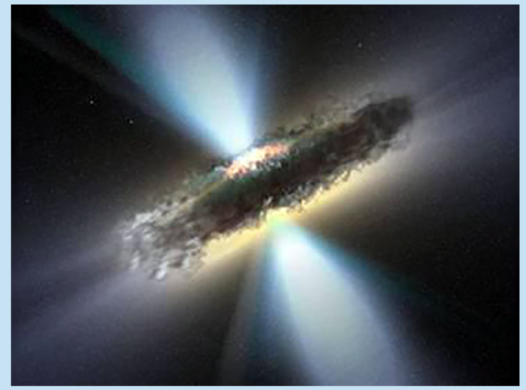
In 2008, ABTech took on one of the most ambitious engineering challenges in the company's history: designing and building a precision motion machine to assemble the lens module for a new NASA telescope.

The project—part of the **Nuclear Spectroscopic Telescope Array (NuSTAR)** mission—would push the boundaries of what ABTech's engineering team had done before.

NuSTAR was developed to focus high-energy X-rays from space, allowing scientists to see some of the most extreme environments in the universe.

"NuSTAR will open up a whole new window into the universe," said Charles Hailey, professor of physics and co-director of Columbia University's astrophysics lab.

To make that window possible, ABTech was asked to deliver a solution as extraordinary as the mission itself.

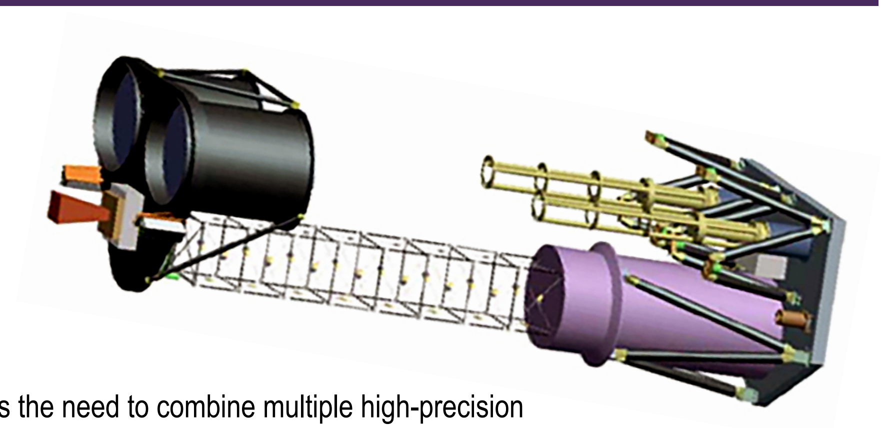


By focusing X-rays at higher energy, NuSTAR will answer fundamental questions about the Universe:

- 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?

THE CHALLENGE: Extreme Precision, Zero Margin for Error

The heart of NuSTAR's optics module comprised **4,680 precisely machined lenses**, each one needing to meet stringent positional and geometrical tolerances. These components would be exposed to the harsh environment of space. There was no room for rework or failure.



What made this project especially complex was the need to combine multiple high-precision operations into a single system: diamond turning, grinding, epoxy assembly, measurement, and repeatable motion; all while adhering to NASA's strict specs.

The solution required more than just a high-performance machine. It demanded a partner capable of engineering at the limits of possibility, with an unshakable commitment to accuracy and schedule.

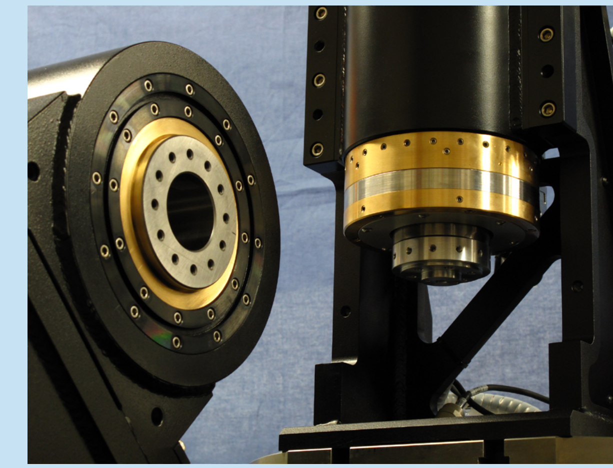
THE SOLUTION: Application-Specific Engineering with Collaboration at the Core

ABTech earned the contract by proposing a fully custom, air-bearing-based CNC system, tailored from the ground up to meet the project's technical demands. At the center of the approach was a belief that collaboration with the customer—especially under intense performance and timeline pressure—was not optional, but essential.

Working closely with Columbia University's Nevis Astrophysics Lab, ABTech launched into its engineering process, which begins with a simple but crucial question:

What does success look like on Day One of operation?

From that end goal, the team worked backward, translating design intent into machine capability with careful attention to every subsystem.



Close up of air bearing spindles

"It's the way it works. If we're putting something together and it's not quite right, we're going to take it apart and make it a better product, regardless of what it does to our cost; customer satisfaction is so important to us." - Ken Abbott, President, ABTech, Inc.

THE FINAL SYSTEM COMBINED:

- Linear stacked air-bearing stages with sub-micron straightness and accuracy
- Air-bearing spindles for work-holding and lathe operations
- A high-speed air-bearing spindle (10,000 rpm) for vertical grinding
- An indexing turret for seamless transitions between machining operations
- A CNC lathe controller integrated with a granite base for exceptional thermal and geometric stability

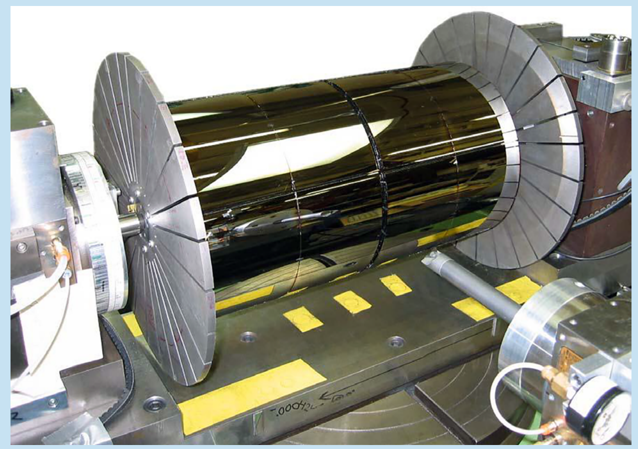
Critically, the system had to maintain 1µm positional accuracy and **1µm straightness over 600mm of travel**, along with near-perfect perpendicularity between axes. These specs are demanding even in an R&D environment; delivering them on a production-ready platform with a hard deadline elevated the challenge.

TWICE THE ENGINEERING: Doubling the Scope, Without Sacrificing Precision

Adding to the project complexity, NASA's launch date was a true deadline; if the lens modules weren't ready on time, the entire project would be delayed by a year. To meet this extreme schedule, NASA required two identical machines to be delivered, enabling simultaneous production of two lens modules.

"They had a hard launch date. And if it was missed, the project went back into rotation for a year later. There's no way they were going to miss it."
- Ken Abbott, President, ABTech, Inc.

Despite the schedule pressure, ABTech boldly agreed to keep the project on track by fabricating two identical machines simultaneously. The team still found room to implement thoughtful performance improvements and functionality enhancements mid-build, without jeopardizing the delivery date.



Prototype optic module during assembly.

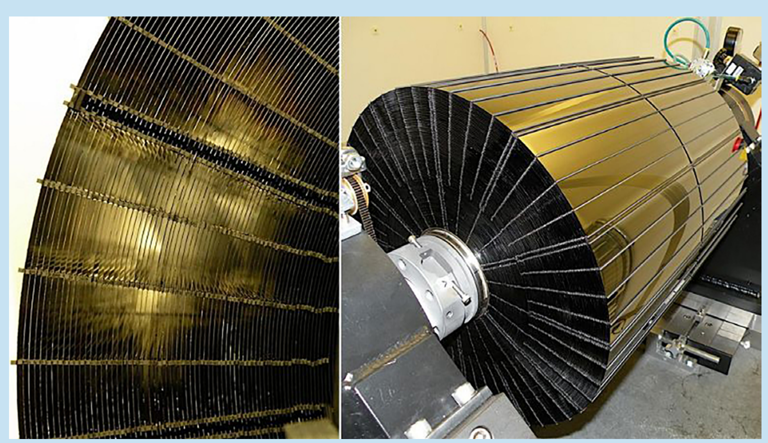
TESTING AND VALIDATION: Meeting the Mission Head-On

Before the machines could be released for production use, they underwent rigorous onsite testing at ABTech and additional offsite validation by the Columbia University team. Consulting engineers spent a full week at ABTech, carefully reviewing test results and verifying repeatability.

Both machines passed every benchmark.

Once delivered and installed at the Nevis Astrophysics Lab, ABTech conducted onsite training and support. Production of the NuSTAR lenses began immediately, and remarkably, **all 4,680 lenses** were assembled in under six months, with both machines performing flawlessly from day one.

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



NASA's NuSTAR satellite complex set of optics.
Image credit: NASA/JPL-Caltech

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LAUNCH AND LEGACY: A Lasting Contribution to Space Exploration

On June 13, 2012, the NuSTAR telescope launched into orbit aboard a Pegasus rocket. Its primary mission—to observe high-energy phenomena like black holes and supernova remnants—was slated for two years, but the telescope continues operating today, expanding humanity's understanding of the cosmos.

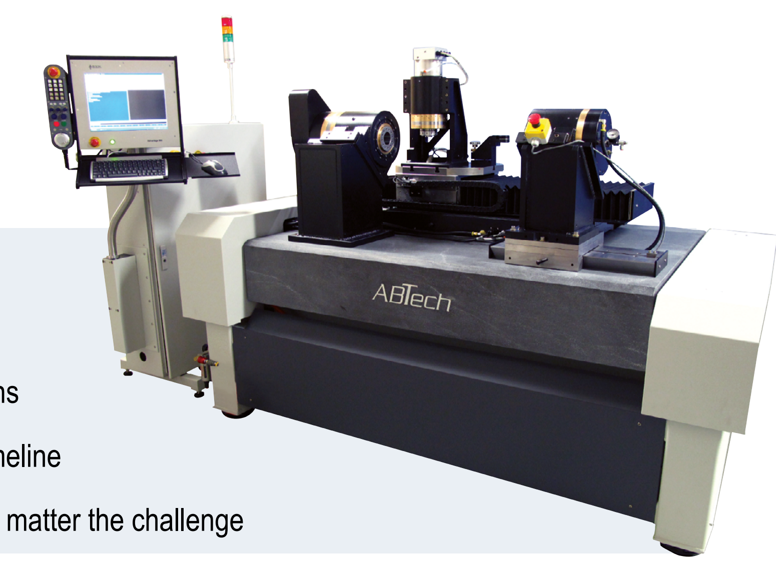
ABTech's machines played a key role in making this mission possible. The precision required to build NuSTAR's optics is still among the most demanding projects the company has ever delivered.

Today, one of the original NuSTAR machines has returned to ABTech's facility, where it's being repurposed for a new application; a testament to the enduring value of high-performance air-bearing technology and modular engineering.

The fairing is installed on the NuSTAR satellite to protect it as it travels through the atmosphere and into space.
Image credit: U.S. Air Force/Doug Gruben

BUILT FOR THE CHALLENGE: A Proven Partner for High-Stakes Innovation

The NuSTAR project demonstrated ABTech's full range of capabilities, from custom design to mission-critical performance. It reflects our collaborative approach and commitment to getting it right, every time.



- Application-specific design from the ground up
- Integration of ultra-precise air bearing components
- Close collaboration with leading research institutions
- Delivery of custom systems on a fixed, high-risk timeline
- A culture committed to engineering excellence—no matter the challenge

As ABTech President Ken Abbott put it, "This was a perfect example of how ABTech listens, adapts, and engineers for the success of the customer. We were proud to be part of NuSTAR's journey into space, and prouder still that the machines we built continue to perform today."

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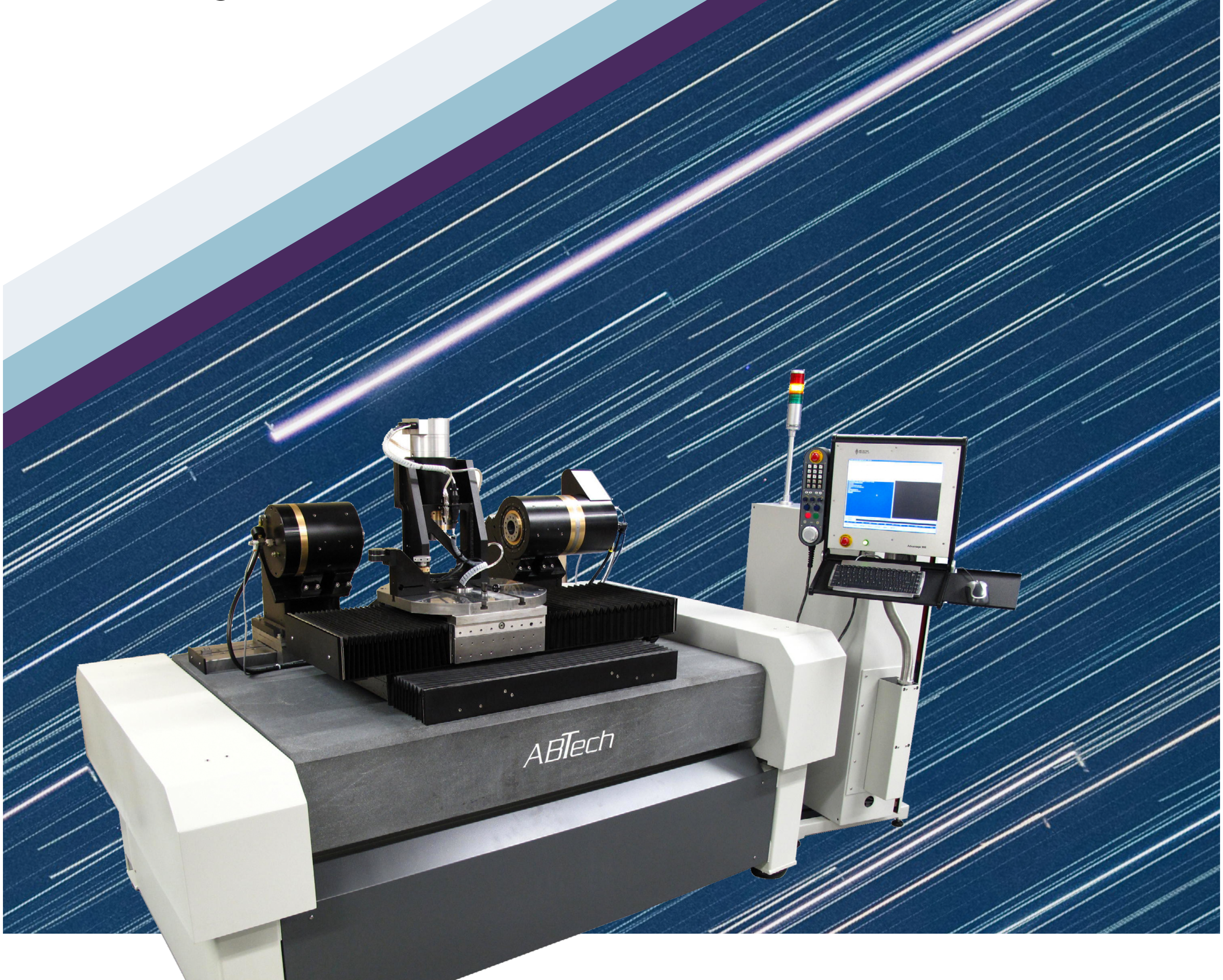
Pride In Precision

When precision matters and standard solutions won't do, ABTech designs systems that are purpose-built for your application.

Let's talk about what we can build together.



Contact a Precision Motion Expert

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