

X-ray astronomy, like many other fields in astronomy, is all about good mirrors. Modern technology has enabled the production of some really powerful mirrors, making enormous strides in the capacities of X-ray observation. Sounds good, right? Well, the problem isn't in the quality of the mirrors anymore—it's in the cost. The super mirror system atop NASA's Chandra X-ray Observatory, for example, would cost almost one billion dollars to reproduce. So the major goal in X-ray astronomy now is to significantly reduce costs while still achieving the exquisite angular resolution of systems like Chandra. Professor [Melville Ulmer](#) and his team have set out to do exactly that.

Professor Ulmer, along with Mechanical Engineering Professor [Jian Cao](#), Material Science faculty Michael E. Graham and [Semyon Vaynman](#), graduate students Xiaoli Wang and Rui Zhou, and undergraduate Bridget Bellavia, is investigating the potential use of a magnetic smart material (MSM) applied as a coating around traditional mirrors in order to enhance their angular resolution. The idea is that the patented material, called "KelvinAll®," is applied in an incredibly thin coating around a mirror—a coating only one-two microns thick (the width of an average human hair is approximately fifty microns). This process is extremely slow and delicate; the application of a two micron coating takes over six hours to complete because the KelvinAll® is laid out atom by atom.

In the presence of the magnetic field (which is created in combination with the mirror), KelvinAll® expands and contracts approximately 1,000 times more strongly than ordinary magnetic materials would—an effect we all know well from the low humming noise often produced by transformers, such as those in TVs, when the iron inside expands and contracts. Programmed expansion and contraction produces stresses, which when strategically implanted into the mirror with a magnetic write-head, will cause the shape of the mirror to be favorably altered—making it more powerful.

So far this process has only been tried in very small areas. The plan is to slowly increase the size of the trials as the precise correlation of stress and coating is better understood and the desired effect more readily predictable. This process has been studied before, but never applied to x-ray mirrors, placing this project at the cutting edge of research in the field. Professor Ulmer and his team could be on track to make momentous progress not only in x-ray astronomy observation, but also in medicine, as this technology could prove very useful in harnessing next-generation x-ray beams that are capable of exposing the atoms in proteins and opening the doors to all kinds of revolutionary drugs and medicines.