

Upping the Ante on Dante with Photoionized Plasmas

Recreating celestial infernos helps physicists study gas in the death-grip of black holes and neutron stars

Dante didn't know the half of it when he wrote *The Inferno*. Around a typical black hole or neutron star swirls a disk-shaped cloud of superheated gas, caught by gravity in a spiral of death as it flows down into the black hole or neutron star. Compressed and heated by the irresistible gravity, the infalling gas in this accretion disk glows red hot, white hot, and then x-ray-hot. These x-rays are so intense that they rip to shreds the molecules and atoms in the gas around the star, which is then said to be photoionized. For decades, X-ray astronomers have been watching these photoionized celestial infernos, but they couldn't reproduce the same kind of conditions in their labs, so they interpreted their observations using complex computer models.

Today that is all changing. Three years ago, physicists began learning how to use the X-rays from a device known as the Z-pinch to mimic the photoionized inferno surrounding neutron stars and black holes. Each of these experiments lasts for less than one millionth of a second, but it produces an intense X-ray burst packing more power than the entire U.S. power supply. That X-ray burst flies through a wispy patch of iron sitting on a plastic foil less than one millionth of an inch thick, and in the iron the X-rays recreate the photoionized environment of the black hole or neutron star. And now, by creating controlled conditions, the physicists are able to check the astrophysical computer codes. At this year's annual meeting of the American Physical Society's Division of Plasma Physics, Mark Foord and Robert Heeter of Lawrence Livermore National Laboratory will present their new experimental understanding of photoionized iron, and describe the progress made by an international collaboration which is forming to ensure that the astronomer's computer models are correct.

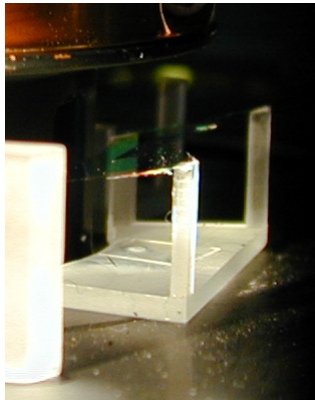
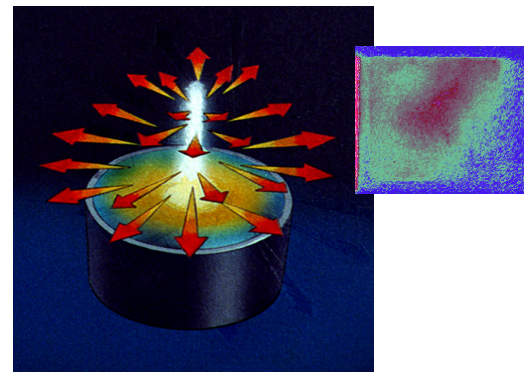


Figure 1: Before the experiment, an iron foil stretched across a plastic frame awaits its destruction by the heart of the Z-pinch device standing to the left and behind.

Figure 2: During the experiment, an x-ray camera with an effective shutter speed of less than a billionth of a second takes a snapshot of the photoionized iron foil. An artist's rendering of the pinch is shown alongside.



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on behalf of an international "Photoionization Collaboration"