SEEING AND EXPLORING THE UNIVERSE

Imagine that you are in your kitchen. You're thirsty, so you pour yourself a glass of water. Relaxing, you lean against the oven to take a drink.

Unfortunately, you have forgotten that you just turned off the stovetop a few minutes ago after cooking dinner, and it has not had time to cool. It doesn't look hot, because it isn't glowing red, but it's still hot enough to burn you. Ouch!

Too bad. The stovetop looks dark to your eye, but if you only had infrared vision, you'd see it as the brightest thing in the room. You would have paid better attention, and avoided a nasty burn. Unfortunately, the human eye is essentially blind to infrared, and you paid for that deficiency.

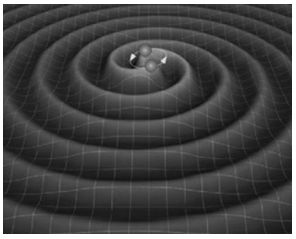

Image courtesy NASA JPL

Astronomers, too, have suffered in a similar way. They had to be content for centuries to view the Universe in visible light only, the type of electromagnetic radiation detectable by the human eye. It gave astronomers a beautiful vision of the Universe, but an extremely limited one. In visible light, the Universe is a fairly quiet, unchanging place. Stars shine with a relatively steady light, galaxies glow softly and space itself is vast and dark.

But the Universe has secrets it keeps from observers stranded in the visible range of light. To those who can see outside this limited range, the Universe isn't peaceful at all. It is a place of unimaginable violence, where distant objects explode in fury, pouring out more energy in a single second than our own Sun will over its entire lifetime. Giant black holes, a billion times the mass of the Sun, greedily eat surrounding gas. As the gas falls into this bottomless pit, jets of highly focused energy and matter are emitted which can stretch for hundreds of thousands of light years. The fires of the formation of the Universe even glow feebly all these billions of years later, and, like the stove in our example above, that heat is invisible to us unless we stretch our vision to include microwaves.

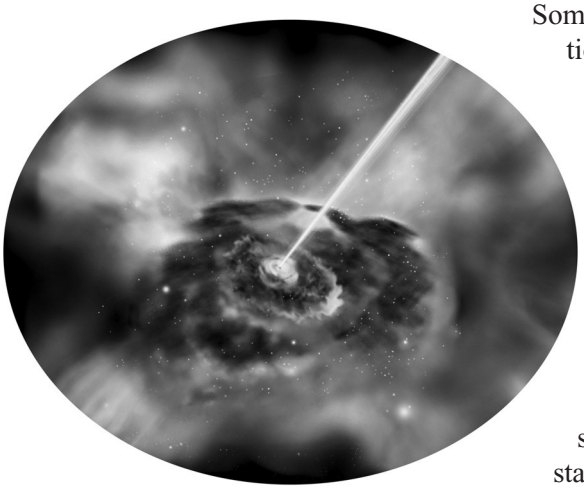

Image courtesy GLAST EPO

Sometimes cosmic events don't emit electromagnetic radiation; they announce their presence in ways more exotic. Smaller binary black holes dance to the tune of gravity, slowly drawing each other in. They finally merge in an event so sudden and dramatic it bends the fabric of space and time itself. These coalescing black holes send out ripples of gravity detectable only to the most finely tuned instruments. Giant stars which dwarf the Sun can explode, tearing themselves apart, accelerating subatomic particles to a hair's-breadth below the speed of light. These cosmic ray particles pack an enormous punch, and, even though they are sub-microscopic, they can reveal the life stories of giant stars and the Milky Way Galaxy.