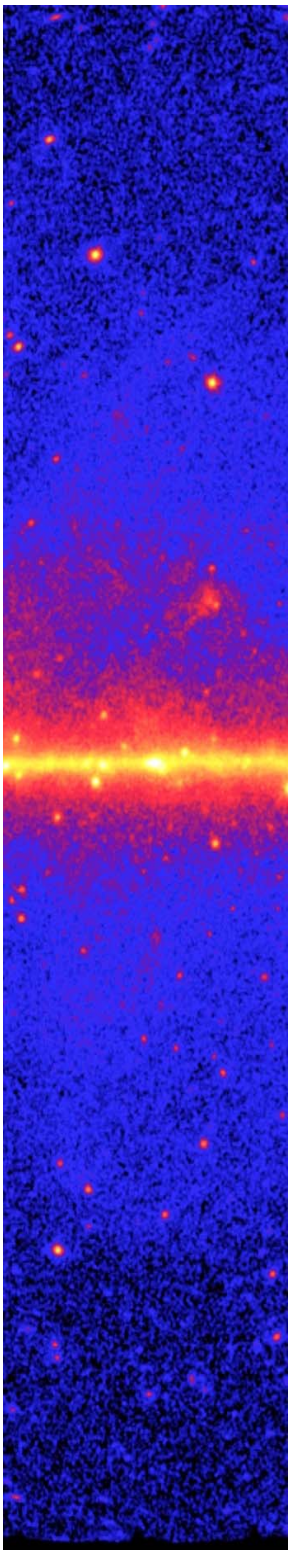
Investigating the Identity of Unknown Objects



This is a portion of the all-sky image constructed from two years of observations by NASA's Fermi Gamma-ray Space Telescope. It shows how the sky appears at light energies greater than 1 billion electron volts. The X-ray light your dentist uses to hunt for cavities have energies of only 20,000 electron volts. Ordinary sunlight has an energy of only a few electron volts!

Brighter colors like red orange and yellow, indicate brighter gamma-ray sources. You can also see that a diffuse glow fills the sky and is brightest along the plane of our Milky Way galaxy (middle).

The point-like gamma-ray 'spots' are pulsars and supernova remnants within our galaxy.

Earlier this year, the Fermi team released a catalog of sources that were detected by the Fermi Satellite, and included 1,873 entries. Many of them were located at the same position in the sky as known supernovae, galaxies and other objects. The sources were classified, and the table below shows what many of the gamma-ray sources are. One of the biggest mysteries was the identity of the 'unknown' sources.

Problem 1 – Suppose that another team of astronomers looked at the positions of 100 of the unknown sources with powerful telescopes to see what might be there. If this sample is statistically identical to the original sample of 1873 sources, how many objects should the astronomers expect to find among the 6 classification types?

Problem 2 – How many unknown objects would remain in the full sample if all 572 unknown objects were searched this thoroughly?

Type of Object	Number
Blazar galaxy	1069
Pulsars	115
Supernovae	77
Active Galaxies	20
Normal galaxies and stars	20
Unknown objects	572

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Answer: First determine the fraction of the known types as shown in column 3 of the table below. Then multiply these fractions by 100 to get the expected number of objects in each category as shown in column 4.

Type of Object	Number	Fraction	Number (N=100)
Blazar galaxy	1069	**0.57**	**57**
Pulsars	115	**0.06**	**6**
Supernovae	77	**0.04**	**4**
Active Galaxies	20	**0.01**	**1**
Normal galaxies and stars	20	**0.01**	**1**
Unknown objects	572	**0.31**	**31**

Problem 2 – How many unknown objects would remain in the full sample if all 572 unknown objects were searched this thoroughly?

Answer: The study of 100 Unknown led to all but 31 being identified, so by scaling to a sample of 572 Unknowns we would expect that 31 x (572/100) = **177 would remain** unidentified by this more detailed study.

Note: That means that P = 100%(1873-177)/1873 = 91% of the gamma ray sources would be identified as known types of objects.