confirm an earlier prediction that galaxy clusters containing up to several thousand Milky Way-size galaxies each are still accumulating material from the surrounding space, and, in the process, are boosting particle energies high enough to produce a faint gamma ray glow.

The Compton Gamma Ray Observatory (GRO), which ended its mission in a fiery (but controlled) plunge into the Pacific in June of 2000, collected energetic gamma rays reaching Earth from space, forming the database. Each little packet of this radiation contained more than 10 billion times the energy present in the light our eyes can see. Much of this radiation emerged from the densest, hottest, and most violent regions of the cosmos—the surfaces of neutron stars and the vicinities of supermassive black holes. But Schafar and Mukherjee have now concluded that a significant portion of the gamma rays originated in the cold, dark regions of intergalactic space. Their discovery appears to confirm a prediction by Avi Loeb of Harvard and Eli Waxman of the Weizmann Institute in Rehovot, Israel that intergalactic matter, drawn together through its mutual gravitational attraction, can produce copious quantities of gamma-ray emission.

We know, for instance, from observations of the uniform glow of microwaves suffusing space that the universe was born with a remarkably smooth distribution of matter. By the time it was half a million years old, the biggest bumps on the smooth sea of cosmic material were no larger than an ant compared to the height of the Empire State Building. Fourteen billion years later, however, we live in a galaxy that is, on average, more than a million times denser than the universe as a whole. Today’s universe is sprinkled with such dense galaxies surrounded by vast voids, and the problem of explaining how we got from such a smooth to such a lumpy distribution of matter is a central problem of modern cosmology.

A rather successful model constructed over the last two decades for this evolution from a smooth to a lumpy distribution points that the tiny, ant-like bumps slowly accumulated more and more of their surrounding material simply as a result of gravitational attraction. Bigger and bigger lumps formed, embedded in filaments of gas connecting and flowing toward them, forming a pervasive cosmic web. As such gas falls together, however, it reaches speeds of several thousand miles per second and, working with the weak magnetic fields of intergalactic space, this process can accelerate electrons to extremely high energies. Loeb and Waxman calculated the rate at which such electrons would collide with the microwaves left over from the Big Bang and, hence, emit gamma ray energies. From this, they concluded that the largely invisible web of cosmic matter was accelerating as expected, the majority of the sky’s gamma ray glow could arise from this process.

Schafar and Mukherjee’s new research compared a catalog of 100,000 galaxy clusters in the local universe with Compton GRO database. Using sophisticated statistical techniques, they showed that the sky surrounding the most massive clusters was systematically brighter than other regions of the sky. This result was very similar to that predicted by the model.

This result not only resolves a fundamental question of where all these gamma rays are coming from, Scharf said, “but provides a new probe of the gravity-driven picture of structure formation in the Universe.”

Mukherjee added: “This discovery also gives us one of the first estimates on how magnetized intergalactic space must be, something that will need to be included in future models for how galaxies and clusters form.”

The authors predict that future observations will see glowing gamma-ray halos 30 million light years across surrounding galaxy clusters. The GLAST mission, due for launch in 2006, will now add to its target list many of the nearest large agglomerations of matter in order to watch the formation of structure in the universe through its gamma-ray eyes. For more information, visit http://www.columbia.edu/cu/news/02/08/gamma_ rays.html.

NYC Residents More Content Despite Lingering Concerns

(Continued from Page 1)

housin conditions remained unchanged. A majority of the city’s population, however, noted an improvement in the city’s crime rates.

“These reported improvements in indicators of well-being suggest that New York City families have been very resilient despite a downturn in the U.S. economy and the emotional scars of September 11,” said Social Work Professor Julien Teifler, who co-authored the survey report. “The improvement in perceptions of the city as a place to live also confirm reports that the spirit of New Yorkers remains strong.”

However, other findings from the survey show negative effects in several areas after September 11. Twelve percent of interviewed adults reported that either they or a family member lost work because of the World Trade Center attacks. In addition, 14 percent reported new health problems. Thirty-one percent of New York City adults reported sleeping poorly, compared to 6 percent of adults. Forty percent of the adults surveyed reported having problems concentrating at work and 38 percent said they preferred to stay at home. Twenty-three percent reported doing more work to work or other places as a result of the attacks on the World Trade Center.

The survey report did not address the emotional scars caused by the September 11 tragedy—scars that may be addressed with health and social service interventions. The New York Social Indicators Survey (SIS) is conducted every two years. The 2002 data for the survey was collected from March through June.

The survey collects information about health, financial, and social conditions; economic and social living conditions; and perceptions of the city and its services. The survey also measures the sources and extent of external support from govern-ment, family and friends, community and religious programs, and employers. SIS is conducted in four languages.

For more information about the September 11 survey, visit the New York Social Indicators Survey website: www.sixcenter.org. A full report on the 2002 SIS will be released later in the fall of 2002.