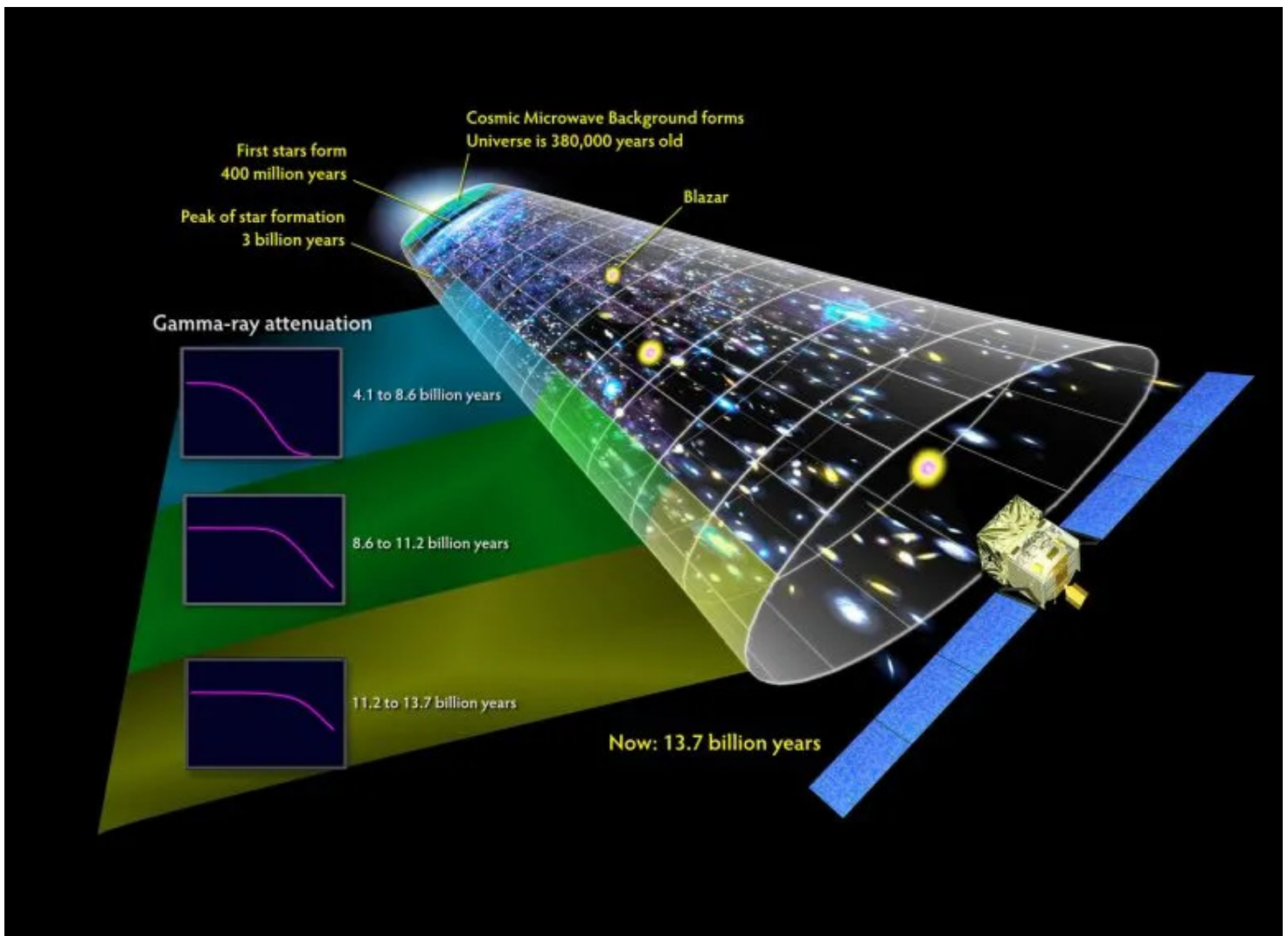


Lecture 32 : The Gamma Ray Universe

One of the new windows to the universe is Gamma Ray Astronomy. This branch of astronomy came of age during the past twenty years. Today, one can detect gamma rays with energies from MeV to TeV. Low energy gamma rays come from the interstellar medium, supernova remnants, etc. High energy gamma rays are associated with very energetic sources, such as Pulsars, Quasars, Active Galactic Nuclei, etc. This lecture discusses various sources of gamma rays, as well as various emission mechanisms, in particular Compton scattering.



Gamma rays are the most energetic form of light. Since the launch of Fermi in 2008, its Large Area Telescope (LAT) observes the entire sky in high-energy gamma rays every three hours, creating the most detailed map of the universe ever known at these energies. The above illustration placing the Fermi measurements in perspective with other well-known features of cosmic history. Star formation reached a peak when the universe was about 3 billion years old and has been declining ever since. [NASA's Goddard Space Flight Center]

9 December 2022

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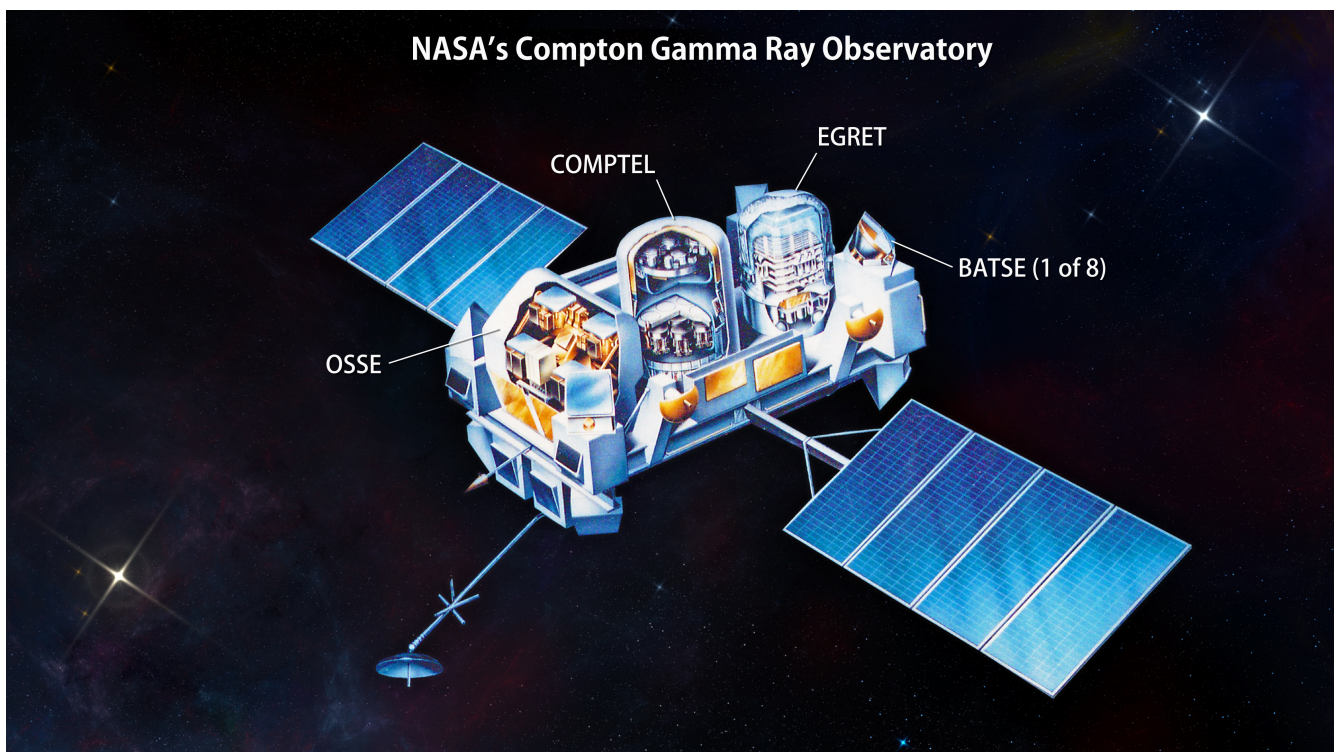
Lecture 32 : The Gamma Ray Universe

[Supplementary Material : Dr. Sushan Konar]



Resource Material : *Text Books & Popular / Technical Articles*

1. F. K. Richtmyer, E. H. Kennard, N. Cooper, 1977, *Introduction to Modern Physics*, McGraw-Hill Inc.
2. S. Weinberg, 2021, *Foundations of Modern Physics*, Cambridge University Press
3. L. Spitzer, 1978, *Physical processes in the interstellar medium*. John Wiley & Sons, Inc.
4. R. Hillier, 1984, *Gamma ray astronomy*, Oxford University Press
5. P. V. Ramana Murthy & A. W Wolfendale, 1986, *Gamma-ray astronomy*, Cambridge University Press
6. V. Schönfelder (Ed.), 2001, *The Universe in Gamma Rays*, Springer-Verlag
7. D. Finkbeiner, M. Su, D. Malyshev, 2015 (Jan.), Scientific American
Giant Bubbles Soar over the Milky Way
8. S. Funk, 2015, Annual Review of Nuclear and Particle Science, 65, 245
Ground and Space Based Gamma Ray Astronomy



The Compton Gamma Ray Observatory (CGRO), launched on April 5, 1991, helped open up a new window to the cosmos during its 20 year long lifetime. CGRO was placed in an orbit some 450 kilometers above Earth's surface to avoid atmospheric drag and steer clear of the hazardous radiation in the Van Allen belts. The above illustration shows the locations of its four instruments, the Burst And Transient Source Experiment (BATSE), the Oriented Scintillation Spectrometry Experiment (OSSE), the Imaging Compton Telescope (COMPTEL), and the Energetic Gamma Ray Experiment Telescope (EGRET). [Goddard Space Flight Center, NASA]