

Measurements of Broad Gamma-Ray Lines from Heavy-Ion Interactions in Solar Flares

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We present broad-line γ -ray spectra derived from observations of the intense June 1991 solar flares obtained with the OSSE instrument on *CGRO*. Broad γ -ray lines are produced by interactions of accelerated ions heavier than He with ambient hydrogen and helium. The large widths of these lines ($\sim 25\%$ FWHM) are due to the recoil velocity of the heavy excited nuclei that have lost little of their original velocity in the interaction. In contrast, γ -ray lines produced by accelerated protons and alpha particles interacting with ambient nuclei produce narrow lines ($\sim 2\%$ FWHM). Implications on the accelerated-particle composition are discussed and the results are compared with results from a similar analysis of flare data obtained with the SMM/GRS. Such broad γ -ray line observations provide the only direct measurement of the composition of particles accelerated at the Sun and can be compared with measurements of energetic particles escaping from the Sun with instruments on spacecraft such as ACE.