



Chandra X-Ray
Observatory Center

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Abell 2029, MS2137.3-2353, and MS1137.5+6624 (left to right): Three galaxy clusters located 1 billion, 3.5 billion and 6.7 billion light years from Earth.

Credit: NASA/CXC/IoA/S.Allen et al.

Chandra's images of these three galaxy clusters are part of a study that used 26 Chandra images of galaxy clusters to study the rate of expansion of the Universe. A galaxy cluster is comprised of hundreds of galaxies embedded in a cloud of extremely hot gas, shown in the images, and dark matter, which is needed to hold the cluster together. X-ray observations were used to determine the ratio of hot gas to dark matter in the clusters. Because galaxy clusters are assumed to be a fair sample of the matter in the Universe, the ratio of hot gas and dark matter should be the same for every cluster. This assumption can be used to make an independent determination of the distances to the clusters. These distances show that the expansion of the universe stopped slowing down about 6 billion years ago and began to accelerate, indicating that the repulsive effects of dark energy are now dominant.

Scale: Each panel is 4.8 arcmin per side.

Chandra X-ray Observatory ACIS Image