THE FIRST MEASUREMENT OF CASSIOPEIA A'S FORWARD SHOCK EXPANSION RATE

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We have obtained a second epoch observation of the Cassiopeia A supernova remnant with the Chandra Observatory to measure detailed X-ray proper motions for the first time. Both epoch observations are 50 ks exposures of the ACIS-S3 chip and they are separated by 2 years. Measurements of the thin continuum dominated filaments located around the edge of the remnant (that are identified with the forward shock) show expansion rates from 0.02%/yr to 0.33%/yr. The median value of 0.21%/yr is on par with the median expansion of the bright ring (0.21%/yr) as measured with Einstein and ROSAT. This presents a conundrum if the motion of the bright ring is indicative of the reverse shock speed. The proper motions of knots located in the bright ring and interior of the remnant, as measured with Chandra, show a large range of speeds and directions, including inward motions. We propose that the expansion of the bright ring does not represent the expansion of the reverse shock, but rather represents a brightness weighted average of ejecta passing through the reverse shock. Alternatively, we cannot rule out whether the forward shock has recently encountered a dense shell that has slowed its expansion with no effect on the reverse shock speed. This work is supported under Smithsonian grant number SMITHSONIAN/GO1-2051A/NASA