Black holes from the dawn of the universe

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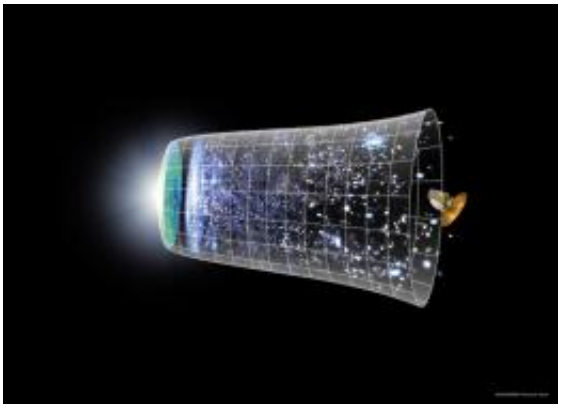

A schematic showing the evolution of the universe from the big bang until today, with time running left-to-right. The "Dark Ages" is the period from the time of recombination (pictured at the left as blue-green) until after the bright band representing the first stars. New results indicate that X-ray emitting black hole binaries from the first stars help power the re-ionization of the gas that ended the Dark Ages. Credit: NASA WMAP

The "Dark Ages" of the universe started about 400,000 years after the big bang, after matter cooled down enough for neutral atoms to form.

This epoch lasted roughly a billion years, until the first stars formed under the influence of gravitational contraction, re-ionized the gas in the cosmos, and the processes of building up mature galaxies began in earnest.

At least this has been the standard picture. But it was a puzzle whether

there was enough effective stellar radiation to re-ionize all of the cosmic material, especially all the gas between the first galaxies.

CfA astronomers Avi Loeb and Jonathan Pritchard, along with three colleagues, have found a solution.

Writing in the latest issues of Astronomy and Astrophysics, they describe a previously overlooked source: black hole binaries that form when the first stars explode as supernovae.

After noting models that show that the first massive stars form mostly in binary pairs, they conclude that many more X-ray binary black holes existed in those early periods of the universe.

The scientists compute the X-ray and ultraviolet flux produced by these black holes as matter accretes onto them.

This highly energetic light is much more effective than stellar ultraviolet in ionizing the neutral gas, and plays a major role in re-ionizing the universe on large scales.

The new results help to resolve an outstanding question, and refine our understanding of processes from the early universe.

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