The clusters of monster stars that lit up the early universe

April 22 2015, by Dr Robert Massey

An artist's impression of some of the first stars in the early Universe. Five protostars are seen here forming in the centre of disks of gas. Credit: Shantanu Basu, University of Western Ontario.

The first stars in the Universe were born several hundred million years after the Big Bang, ending a period known as the cosmological 'dark ages' – when atoms of hydrogen and helium had formed, but nothing shone in visible light. Now two Canadian researchers have calculated what these objects were like: they find that the first stars could have clustered together in phenomenally bright groups, with periods when they were as luminous as 100 million Suns. Alexander DeSouza and Shantanu Basu, both of the University of Western Ontario in Canada, publish their results in a paper in *Monthly Notices of the Royal Astronomical Society*.

The two scientists modelled how the luminosity of the stars would have changed as they formed from the gravitational collapse of disks of gas. The early evolution turns out to be chaotic, with clumps of material forming and spiralling into the centre of the disks, creating bursts of luminosity a hundred times brighter than average. These first stars would have been at their brightest when they were 'protostars', still forming and pulling in material.

In a small cluster of even 10 to 20 protostars, the ongoing bursts would mean the cluster would spend large periods with enhanced brightness. According to the simulation, every so often a cluster of 16 protostars could see its luminosity increase by a factor of up to 1000, to an extraordinary 100 million times the brightness of the Sun.

The earliest stars lived very short lives and produced the first heavy elements, like the carbon and oxygen that the chemistry of life depends

upon.

Light from these stars has travelled towards us for almost 13 billion years, so to observers on Earth they look very faint and also have their light stretched out into infrared wavelengths by the expansion of the universe. This makes these stars very hard to observe, but the next generation James Webb Space Telescope (JWST) will survey the skies to look for them. Although the luminosity of an individual first star is probably too faint for JWST to spot it, the new work suggests that clusters of the first protostars could be prominent beacons in the early universe.

Dr Basu commented: "Seeing the very first stars is a key science goal for JWST and part of astronomers' quest to track the history of the cosmos. If we're right, then in just a few years' time, we could see these enigmatic and dazzlingly bright objects as they came into being, and lit up the universe around them."

More information: "The luminosity of Population III star clusters" *MNRAS* (June 11, 2015) Vol. 450 295-304 DOI: 10.1093/mnras/stv523

Provided by Royal Astronomical Society