An ionised bubble before the epoch of recombination

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A proto-cluster of Lyα emitting galaxies, spectroscopically confirmed at redshift 6.5, produces a remarkable number of ionising continuum photons. We find that the sources in the proto-cluster are capable of ionising a large bubble, indeed larger than the volume occupied by the proto-cluster.

- Re-ionisation was produced by low luminosity sources
- These low-luminosity sources had no power beyond its surrounding
- Groups of galaxies could however do the job
- Thus, Reionisation was likely facilitated by low luminosity galaxies in groups

- We computed the number of ionising photons from the Lyα emission
- We corrected for the number of sources not detected
- We used an escape fraction of Lyman Continuum Photos $f_{esc,LyC}$= 0.053, derived from the AMIGA model
- Then we derived the full emissivity (Ṅ) of the sources in the proto-cluster

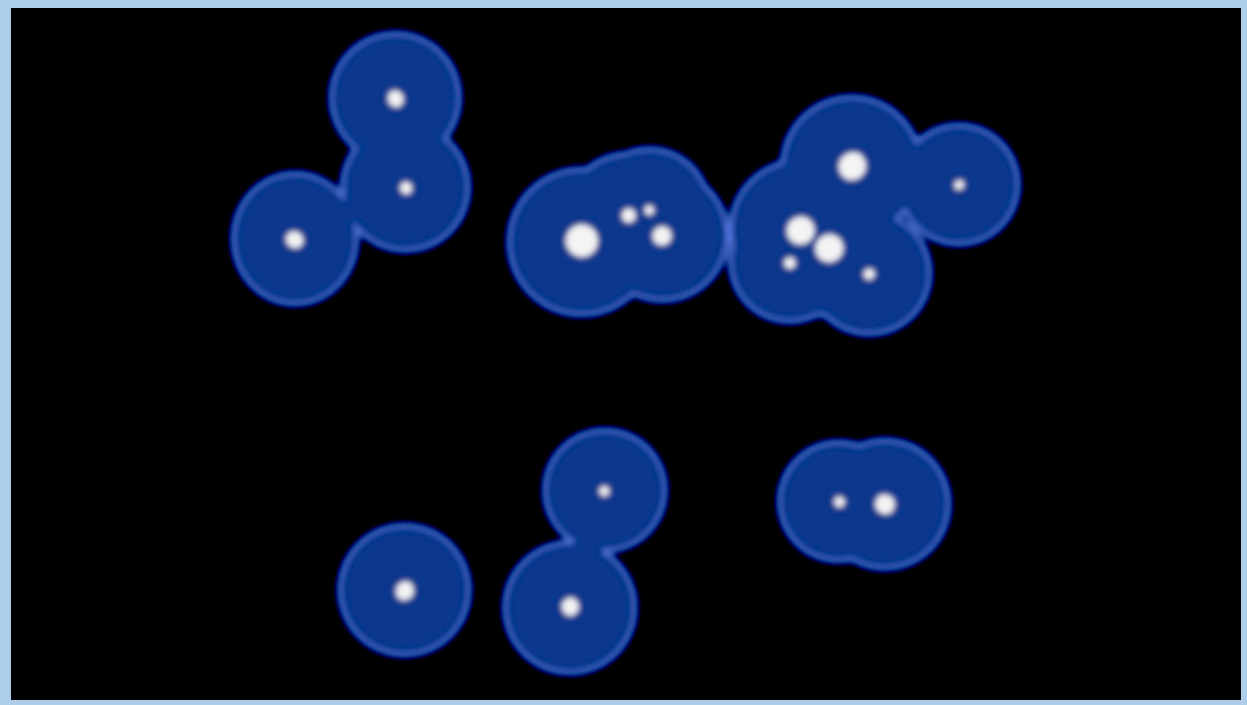
$$\dot{N}ion \sim 9.53 \times 10^{50}\ s^{-1}\ Mpc^{-3}$$

- We accounted for the overdensity in terms of requiring more photons for reionisation

- The minimum emissivity required to reionised the Universe is

$$\mathcal{N} = 4.2\ 10^{50}\ s^{-1}\ Mpc^{-3}$$

Thus the output from the sources in the proto-cluster is more than double the required emissivity to reionise the Universe



The reionisation process

- Reionisation was likely achieved by low luminosity sources in groups or proto-clusters
- These form bubbles, which coalescing were able to re-ionise the Universe
- We are studying the BDF proto-cluster to check whether it can form an ionised bubble.

Impact or Future developments

- It all looks as if ionised bubbles represent an important way towards re-ionising the Universe
- Studying the size and distribution of these bubbles will help establish the history of the universe's re-ionisation
- We have also shown another bubble at z=7 that form a huge bubble
- This is an example of the bubbles that through percolation achieved the re-ionisation of the universe