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Characterising the interstellar and intergalactic medium surrounding a gamma-ray burst at z~6.3

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When the neutral hydrogen of the intergalactic medium (IGM) started to ionise, the Universe entered its latest major transition: The Epoch of Reionisation (EoR). Gamma-ray bursts (GRBs), the violent cosmic explosions signaling the death of a star with more than 30 times the mass of our Sun, can via their immense brightness make it possible to perform detailed studies of the IGM during the EoR, in particular the degree of ionisation at this epoch. Further, the imprinted absorption features from specific elements in the interstellar medium (ISM) on the GRB afterglows provide unique insights into these properties, which are impossible to study otherwise but also important ingredients in the overall recipe for galaxy evolution. In my thesis, I am examining a good-quality high-S/N optical/near-infrared spectrum taken with the VLT/X-shooter of a recently detected afterglow of the Swift GRB 210905A at redshift z~6.3, when the Universe was less than 10% of its current age. Using Dynamic Nested Sampling methods, I find evidence for a positive neutral fraction of 20% at this epoch, which allows me to put a strong constraint on the reionisation history. I compare this and my results for the host galaxy metallicity to recent models and observations of the ISM in galaxies and the overall IGM at a similar epoch and find that their predictions are in agreement with what I have found.

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Field of study

Astrophysics

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