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The photoionization by galaxy cluster photons and its impact on the faint and extremely tenuous plasma in the cluster vicinity

ABSTRACT

The physical properties of the faint and extremely tenuous plasma in the far outskirts of **galaxy clusters**, the **circumgalactic media** of normal galaxies, and **filaments of the cosmic web**, remain one of the biggest unknowns in our story of large-scale structure evolution. Modeling the spectral features due to emission and absorption from this very diffuse plasma poses unique challenges, as both collisional and photo-ionisation processes must be accounted for. In this paper we study the **photoionisation by galaxy cluster photons** in addition to the photoionisation by the cosmic UV/X-ray background and its impact on the **ionisation balance**. We model more realistic spectra by taking into account the cosmic UV/X-ray background together with the emission from three different cool-core galaxy clusters: A262, A1795 and A2029, and illuminate the photoionised gas in the galaxy cluster vicinity. We assume the gas has temperatures between 10^{-3} –1 keV (10^4 – 10^7 K), densities between 10^{-6} – 10^{-1} cm $^{-3}$ and can be located between r_{500} and ~ 13 Mpc from the cluster center. We find that depending on the distance from the galaxy cluster and the plasma properties, **the total photoionisation rate can be from 10% up to 100% of the total ionization rate**. We show how this affects the ionisation fractions of O VI, O VII, O VIII, Ne IX, Fe XVII, N VII, C V and C VI ions and compare it with the emission by cosmic background only as well as with plasma that is in the collisional ionisation equilibrium. We assume a simplified model of the cosmic web filament and predict the column densities for different lines of sights.

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Stay tuned!
On arXiv this summer.

Credit (background picture): Franco Vazza

