Portraying the missing baryonic mass at the cosmic noon

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The ratio between dark and baryonic matter as predicted by Big Bang Nucleosynthesis and inferred from density fluctuations of the cosmic microwave background is $f_b=\Omega_b/\Omega_m \cong 0.16$. This primordial mix is expected to persist as large scale structure evolves. In this hypothesis, the baryonic mass of any given cosmological structure would be $M_b=f_b * M_{tot}$.

On the other hand, direct measurements reveal that at z~0 a baryonic fraction of ~30–40 % is missing on cosmological scales and also galaxies are baryon deficient. Moving to higher redshift (z~2), a related missing metal problem is observed, with an apparent discrepancy of 40% between the mass in metals derived from integrating the star formation history of the universe compared to the metal budget at z~2.

The question that we would like to answer with this PhD project is: where are the missing baryons at z~1.5-3?
The PhD student will tackle this problem by using high-resolution spectra of high-redshift quasars (z~2-4) from the archives of the UVES/VLT and HIRES/Keck spectrographs.

She/he will use several probes of the missing baryons/metals tracing in particular the warm-hot intergalactic medium (WHIM) and the circumgalactic medium of high redshift galaxies.

She/he will learn how to use spectroscopic data analysis tools. Furthermore, she/he will be involved in and lead proposals for the request of observing time to the largest ground-based telescopes.

The project is also a preparatory study for one of the science cases of the CUBES spectrograph for the VLT. CUBES is a UV, extremely efficient spectrograph which just started the design phase. INAF, and in particular the Observatory of Trieste, are leading the consortium that will build the instrument. The PhD student will thus have the possibility to be involved in and contribute to the critical phases of the design and construction of this instrument.