Lyα wide-field surveys at z=2-3 and matched Lyα - Hα: what does Lyα really tell us?

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Abstract: Many studies rely on the Hydrogen Lyα (Lyα) emission line to survey, study and understand the distant Universe (z>2-3), as it is often the only feature available to spectroscopically confirm/study such galaxies. However, its escape fraction (f_escape) is highly uncertain at z>2, and much is unknown about what Lyα actually traces. How much are we missing in/how biased is our current view of the very high redshift, almost completely based on Lyα? In order to answer such questions, the student will conduct and work on very large (~5-10 deg^2) Lyα surveys at z~2-3 (the likely peak of the star-formation history). This includes a perfectly matched Lyα-Hα survey at z=2.23 by using a costume-made narrow-band filter specifically designed for this project (delivered to the INT in May 2013). By measuring Lyα/Hα ratios for a sample of hundreds of galaxies at z=2.23, the student will robustly measure f_escape and the Lyα/Hα ratio as a function of mass, colour, environment and SFR and empirically calibrate Lyα for the first time, with very important applications/consequences for z>2 studies.

Furthermore, while deep Lyα (Lyα) surveys at 3<z<7 have been extremely successful at detecting a relatively high number of Lyα emitting sources, and show that there is little evolution at 3<z<6 at faint luminosities, there are big discrepancies at the bright end, as surveys simply lack the volume to constrain it. By conducting by far the largest survey (>2-4 orders of magnitude larger in volume than any other) for the most luminous Lyα emitters at z~2-3, the student will also detect >3000 powerful Lyα emitters and >100 Lyα "blobs" (the largest ~contiguous objects found in the Universe, many times the size of a single galaxy), determine their Luminosity Function for the first time and measure their correlation function and evolution. This will provide the first robust sample that can be directly compared with the highest redshift samples, to directly test whether there is evolution in the bright end of the Lyα luminosity function. This project will allow the student to observe on large telescopes to obtain the data directly (~20 nights over the first years), but also to do follow-up studies with e.g. VLT or ALMA to unveil and detail the nature of Lyα blobs.

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