Multi-Object Spectroscopy in the Next Decade: Big Questions, Large Surveys and Wide Fields
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Mapping the High-z Universe in 3D: Lyα Forest Surveys on Future MOS Instruments

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Abstract

The Lyα forest absorption seen in the foreground of $z > 2$ quasars has historically been an important probe of the high-redshift Universe. BOSS has in recent years pioneered 3D clustering measurements of the Lyα forest, allowing important constraints on the expansion rate of the Universe at $z \sim 2.3$. The next generation of MOS surveys will have the ability to observe $m_{AB} > 23$ sources, which will enable us to target UV-bright star-forming galaxies in addition to quasars as background sources to study the Lyα forest. This yields a dramatic increase in source densities to $\sim 10^2 - 10^3\,\mathrm{deg}^{-2}$ from the $\sim 20\,\mathrm{deg}^{-2}$ in BOSS, allowing the Lyα forest at $z > 2$ to be probed at much greater detail than currently possible. For example at $z \sim 2.5$, the average transverse separation of $g \sim 24.5$ galaxies is $\sim 2\,h^{-1}$Mpc, enabling 'tomographic' mapping of the Lyα absorption on similar scales. Since the Lyα forest traces the underlying matter density, maps using this technique will allow us to find galaxy protoclusters, reveal environmental effects on high-redshift galaxy/AGN evolution, study the topology of the early cosmic web, etc. On larger scales, source densities of $\sim 150 - 200\,\mathrm{deg}^{-2}$ across $\sim 10,000\,\mathrm{deg}^2$ areas will allow $< 0.5\%$ measurements of the cosmic expansion rate at $z \sim 2 - 3$ using the baryon acoustic oscillation technique. We will discuss these science cases and the requirements needed to implement these surveys on future MOS instruments, and describe pilot observations exploiting SFGs to study the Lyα forest.