Early Metal Enrichment of Gas-rich Galaxies at $z \sim 5$

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ABSTRACT:
Metal abundances in high-redshift quasar absorbers give constraints on the early star formation and chemical enrichment history of galaxies. The first billion years of the cosmic chemical enrichment history were an especially exciting epoch. 2012-01.5, respectively. Fig. 1 shows an example of the Lyman series line fitting for one of the absorbers. Fig. 2 shows the metal absorption lines and their Voigt profile fits. Table 1 lists the element abundances inferred for the two absorbers. The abundances of O in the z=5.3 absorber appear to be lower than the z=4.8 absorber. For which could indicate unusual nucleosynthetic signatures. Furthermore, C/O and Si/O vary substantially between different velocity components, indicating variations in dust depletion and/or early stellar nucleosynthesis. Similar variations were found in our observations of a z=5 sub-DLA (Morrison et al. 2016).

RESULTS & DISCUSSION:

The H I column densities of the absorbers at z=4.8 and z=5.3 are estimated to be log NHI = 20.90 ± 0.10 and the z=5.3 absorber, [O/H] seems to be lower than [Si/H], which could indicate unusual nucleosynthetic signatures. Furthermore, C/O and Si/O vary substantially between different velocity components, indicating variations in dust depletion and/or early stellar nucleosynthesis. Similar variations were found in our observations of a z=5 sub-DLA (Morrison et al. 2016).

FUTURE WORK: Measurements of undepleted elements in many more high-z DLAs are essential to understand how typical our findings are, and whether or not there is a significant depletion drop in the early metallicity. We plan to increase the sample considerably with our recent and ongoing observations of other high-z absorbers, in order to definitively determine the evolution of metals and dust, and the correlation between metallicity and velocity dispersion. The trends resulting from this work will be compared with predictions of cosmic chemical evolution models.

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Fig. 2. Velocity plots for metal lines for absorbers at (a) z=4.8 and (b) z=5.3. The vertical lines show the centers of velocity components. The data are shown in black and the fitted profiles are shown in green. Unrelated absorption features are shaded in grey.

Fig. 3. Metallicity vs. redshift relation for DLAs. Blue circles show binned data for DLAs at z=4.5 from undepleted elements (Som et al. 2015). The Green squares andagenta triangles show previous measurements for individual DLAs at z > 4.5 based on undepleted and depleted measurements, respectively (Rafelski et al. 2012, 2014). Black circles show result from this work. Solid curve shows mean gas metallicity from Maio & Tescari (2015). Dashed curve shows the prediction of the semi-analytic model of Kulkarni et al. (2011) including population II and III stars.

References