The Kinematics of Multiple-Peaked Ly-alpha Emission in Star-Forming Galaxies at z~2-3

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(Submitted on 21 Jul 2011 (v1), last revised 15 Nov 2011 (this version, v2))

We present new results on the Ly-alpha emission-line kinematics of 18 z~2-3 star-forming galaxies with multiple-peaked Ly-alpha profiles. With our large spectroscopic database of UV-selected star-forming galaxies at these redshifts, we have determined that ~30% of such objects with detectable Ly-alpha emission display multiple-peaked emission profiles. These profiles provide additional constraints on the escape of Ly-alpha photons due to the rich velocity structure in the emergent line. Despite recent advances in modeling the escape of Ly-alpha from star-forming galaxies at high redshifts, comparisons between models and data are often missing crucial observational information. Using Keck II NIRSPEC spectra of H-alpha (z~2) and [OIII] 5007 (z~3), we have measured accurate systemic redshifts, rest-frame optical nebular velocity dispersions and emission-line fluxes for the objects in the sample. Accurate systemic redshifts allow us to translate the multiple-peaked Ly-alpha profiles into velocity space, revealing that the majority (11/18) display double-peaked emission straddling the velocity-field zeropoint with stronger red-side emission. We compare our data with the predictions of simple models for outflowing and infalling gas distributions around high-redshift galaxies. While popular "shell" models provide a qualitative match with many of the observations of Ly-alpha emission, we find that in detail there are important discrepancies between the models and data, as well as problems with applying the framework of an expanding thin shell of gas to explain high-redshift galaxy spectra. Our data highlight these inconsistencies, as well as illuminating critical elements for success in future models of outflow and infall in high-redshift galaxies. [Abridged]

Comments: 18 pages, 12 figures, ApJ in press
Subjects: **Cosmology and Extragalactic Astrophysics (astro-ph.CO)**
Cite as: **arXiv:1107.4367 [astro-ph.CO]**
(or **arXiv:1107.4367v2 [astro-ph.CO]** for this version)

Submission history

From: Kristin Kulas [view email]
[v1] Thu, 21 Jul 2011 20:00:27 GMT (386kb)
[v2] Tue, 15 Nov 2011 20:33:59 GMT (665kb)

Which authors of this paper are endorsers?