Wide Field Lyman Alpha Intensity Mapping

- By Jeff Peterson and Zhonghao Luo, CMU
- Uses the sensor ~10^5 times more efficiently than a redshift survey
- A two-inch telescope with a custom imaging spectrometer can map ½ the sky in three-D from redshift 2-4 in one year.
- Foreground removal challenging
- Potential for discovery of new extended emission









Alfalfa 21-cm redshift survey

Ly_{α} Emission

- Characteristics
 - $o n_i = 2 \rightarrow n_i = 1$ $o \lambda = 1216 Å$

•Sources: oSpirals oIrregulars



Lyman Alpha emitters at z~6 found with Subaru



Ouchi etal 2005, Suarez, JP 2012

Brightness Sensitivity is determine by A*omega, not telescope aperture



Fourier Transform Imaging spectroscopy

Rotating Grism CAT scan

Rotate grism to create a CAT scan of cosmic structure





Astronomical Foregrounds



- SDSS find 10 continuum emitters/ square arcminute brighter than 25 mag
- This contributes sky brightness 150 pW/m² nm sr
- We can cut out cylinders at the locations of each SDSS source...requires ~5 arcsec pixels ->1-200 mm focal length

Sky brightness is dominated by the bright end of the magnitude distribution



Precedent: Optical Intensity Mapping of Galactic H-alpha with WHAM

- 15cm aperture
- Tunes in redshift using Fabre-Perot 4 angstrom wide



New class (Ultra Dim Galaxies) discovered with Dragonfly Telescope Array





Summary

- By mapping the 3-d specific intensity due to Lyman Alpha Emission we may be able to efficiently map large scale structure.
- This will allow measurement of BAO scales, allowing tests of dark energy models, as well as velocity distortion, and power spectrum measurement
- Cross correlation with other data sets (CHIME, HIRAX SDSS Quasars) will constrain models of galaxy evolution.
- Large apertures are not needed.
- Efficient use of detector A-omega is needed.
- Simple low cost optics may allow a high volume survey.
- Wide field spectroscopy may uncover new types of emission
- Foreground subtraction will be challenging, but perhaps no worse than for 21-cm Intensity Mapping.