Diffuse Media Science with BigBOSS
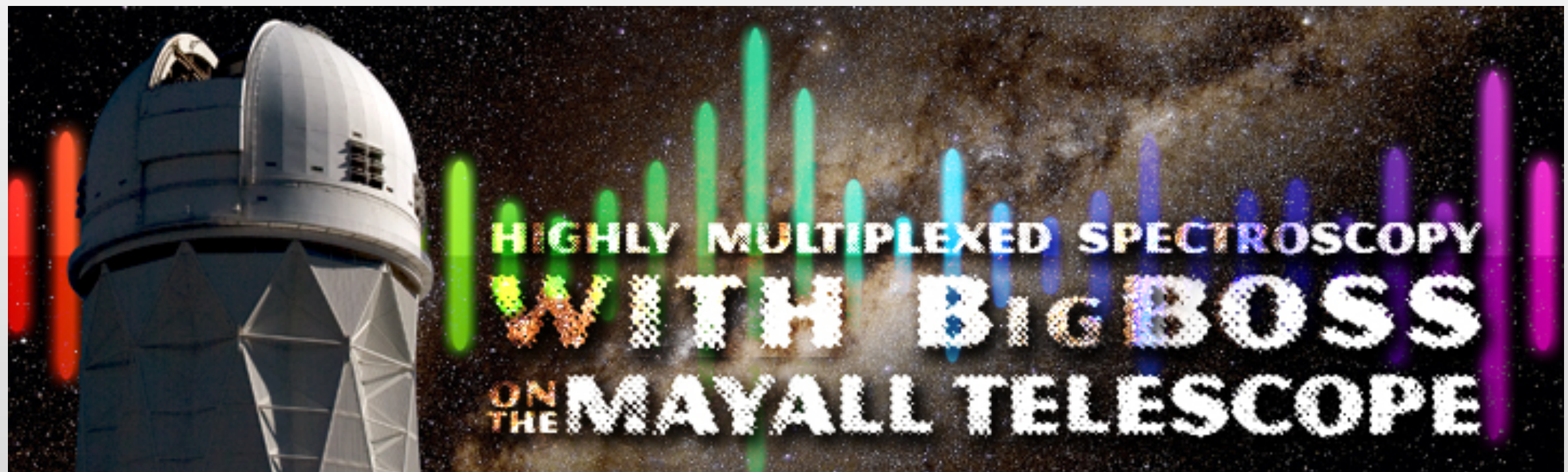

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DM DRM: Survey of z~0.5 SF Galaxies

- **Science Motivations**
  - ▶ <u>**Tracing the processes of how gas flows into and out of galaxies is central to developing the theory of galaxy formation and the evolution of the intergalactic medium.**</u> Beyond the local universe, one requires absorption to trace this diffuse medium. This project aims to trace metal-enriched, cool gas in the environments of SF galaxies to constrain the distribution and motions of the gas on scales of 1-100kpc. It approaches these goals with two thrusts:
  1. Characterize the prevalence of cool gas outflows in 'normal' SF galaxies
     - ✦ Recycling of gas; enrichment of IGM; galactic feedback
  2. Trace the enrichment of the CGM/IGM to several hundred kpc around the <u>same</u> galaxies
     - ✦ This ties, in principle, the gas being driven from galaxies to the material that surrounds them.

- **Observational program**
  - ▶ Use <u>community fibers</u> to obtain low S/N spectra of 10,000+ galaxies at z~0.5 with R<23.5 across the sky (goal 1)
    - ✦ A significant fraction of these may be targeted by the Main survey
    - ✦ More than one 'pass' may be required for sufficient S/N
  - ▶ Restrict targets to lie within 300kpc of known (and previously observed) z<2 quasars to map metals around the galaxies (goal 2)
  - ▶ Analysis
    - ✦ Composite the galaxy spectra to characterize the outflows (function of impact parameter, SFR, mass, etc)
    - ✦ Analyze archived quasar spectra, individual and composite for CGM/IGM absorption

- **Technical requirements**
  - ▶ Sensitivity at blue wavelengths is critical (λ < 3800A)
    - ✦ Key diagnostics are UV transitions (e.g. FeII 2600, MgII)
  - ▶ Ancillary data
    - ✦ Efficient targeting of z~0.5 galaxies; are PTF g+R and WISE sufficient?
    - ✦ Higher quality images (spatial resolution, depth, filters) to better characterize the target galaxies
  - ▶ Data Reduction Pipeline must enable composite spectra (outflows)
    - ✦ Sky subtraction without a 'pedastal'; systematics must average away

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DM DRM: Mining for Close QX Pairs

- **Science Motivations**
  - ▸ Trace the distribution of gas and metals around quasars and galaxies on very small scales (10kpc) across cosmic time
  - ▸ Constrain the processes of
    - ✦ Gas accretion, outflows, formation of extended HI disks, chemical enrichment
- **Observational program**
  - ▸ Use <u>community fibers</u> to obtain redshifts for thousands of sources within 5" of a known z<2 (or z>3.3) quasars
    - ✦ Emphasis on z>1.6 quasars to have access to Lya absorption from the ground
    - ✦ Also preference to z>1 galaxies and quasars
  - ▸ Assuming 50 quasars per sq deg and 30,000 sources per sq. deg to R=23.5, one predicts ~10 per sq. deg.
    - ✦ Restricting to higher priority targets may imply 3-10 fibers per tile
  - ▸ Analysis is both statistical from SDSS/BOSS dataset and through follow-up 10m-class observations
- **Technical requirements**
  - ▸ Wavelength coverage
    - ✦ Maximize for redshift determination
  - ▸ Ancillary data
    - ✦ Efficient targeting of sources very close (few arcseconds) to bright quasars

DM DRM: Extinction Mapping at z~0

- **Science Motivations**
  - ▸ Trace the distribution of dust around individual, nearby galaxies
    - ✦ Constrains the galactic fountain process; dust formation/destruction
    - ✦ Complements deep 21cm emission maps for HI gas
    - ✦ Probe galaxies with a range of inclination, mass, SFH, etc.
- **Observational program**
  - ▸ Use the full instrument to obtain spectra of Galactic stars and background galaxies/quasars to the virial radius around a sample of local galaxies
    - ✦ Background sources with well established SEDs (quasars; early-type galaxies)
    - ✦ 'Foreground' sources are important to assess Galactic extinction
    - ✦ Match nearby galaxy to the BB field-of-view
  - ▸ Deep exposures with several pointings (~1 night per target)
  - ▸ Measure differential reddening versus impact parameter
    - ✦ Map to beyond the virial radius to properly assess the no-reddening signal
- **Technical requirements**
  - ▸ High precision spectrophotometry
    - ✦ Relative fluxing is most critical
  - ▸ Blue sensitivity is highly desired to maximize reddening signal
  - ▸ Ancillary data
    - ✦ High precision photometry would be ideal to complement the spectra (bluer the better)

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DM: A few thoughts on BAO design

- We suggest that when BB has a targetable galaxy within ~10-15" of a BAO QSO, it should take 1 of the ~5 repeats and put the fiber on the galaxy instead of the QSO. This has two purposes:
  - ‣ Establish the redshift of the galaxy. One can then mask metal-line transitions at that redshift and perform an assessment of the systematics of metal-line transitions on the BAO signal.
  - ‣ It also reduces the BAO-QSO footprint on the ELG galaxy window function. At 65 QSOs/sq. deg, that compromises ~10% of the field.

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DM: Summary of Key Tech. Requirements

- Instrumental
  - ▸ <u>Maximize throughput at the bluest wavelengths</u>
    - ✦ Density of valuable UV transitions *rapidly* increases with energy
    - ✦ Every Angstrom of additional coverage has a major science gain
    - ✦ This is just as true (maybe more so) for the Main survey
  - ▸ If R=5,000 were achieved (at blue wavelengths), this would be a qualitative leap in science (EWs -> column densities)
  - ▸ <u>Relative spectrophotometry to better than 5% precision</u>
    - ✦ Most critical to avoid systematics that prohibit composite spectra
- Data Reduction
  - ▸ <u>Achieve sky subtraction to a proper zero level</u>
  - ▸ Achieve Poisson limit away from bright sky lines

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DM: Summary of Key Tech. Requirements

- Archiving
  - ‣ Archive all of the targeting criteria for every object in the main sample to properly establish the selection function
  - ‣ Monitor seeing (may be critical for spectrophotometry)
- Community access
  - ‣ The main survey will enable significant diffuse media science on its own
    - ✦ i.e. Quasar spectroscopy across the sky
  - ‣ <u>Maximize access via community fibers (more than PI mode)</u>
  - ‣ <u>Full access to the targeting data and tools of BB</u>

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