Skipper CCDs for Cosmological Applications

Alex Drlica-Wagner

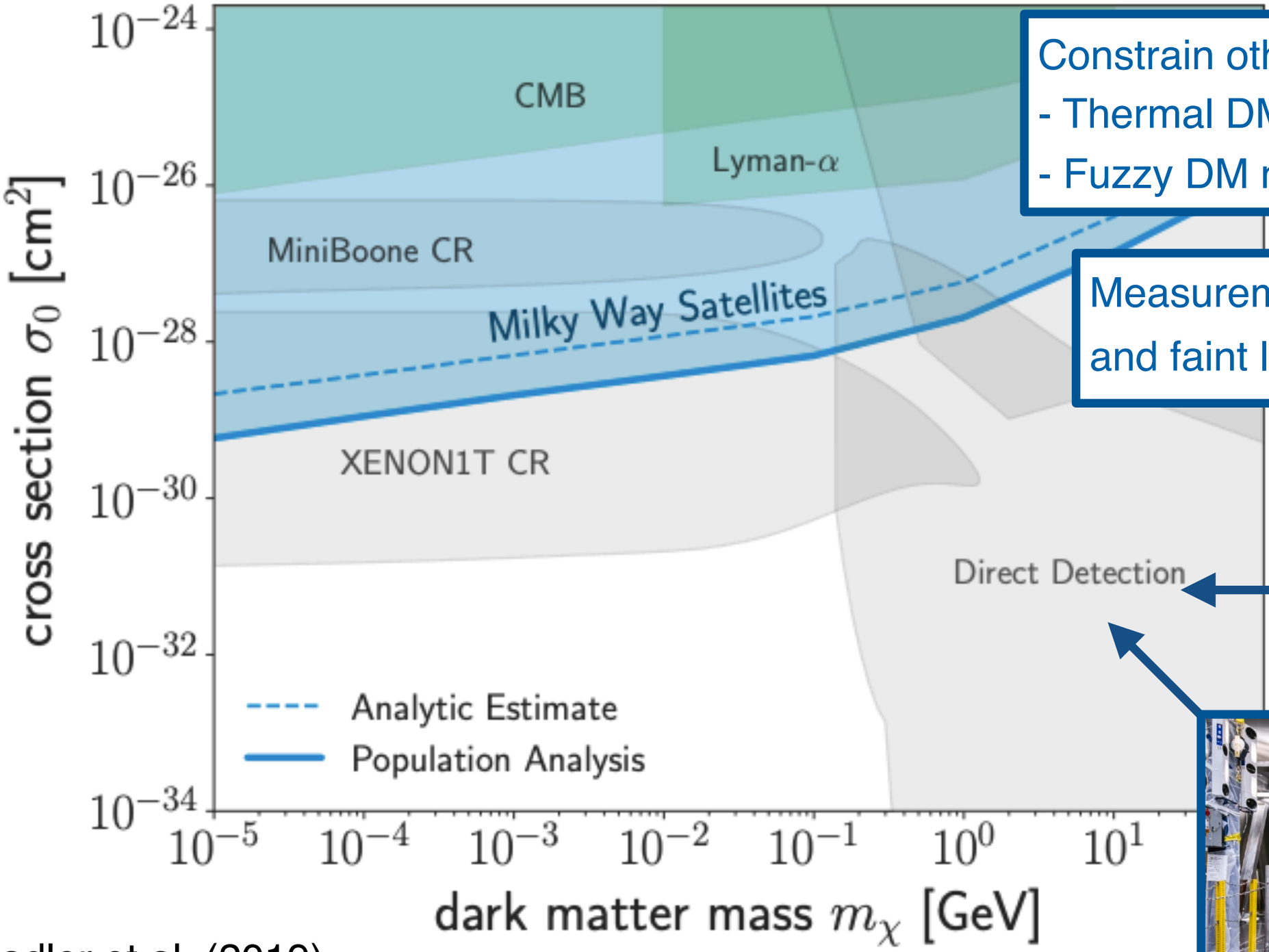
with lots of help from Judah O'Neil, Edgar Marrufo, Noah Kurinsky, Javier Tiffenberg, Guillermo Fernandez Moroni, Juan Estrada, and many others

Snowmass Whitepaper Planning

May 22, 2020

Science Goals: Dark Matter and Dark Energy

Small-Scale Structure and Dark Matter Microphysics

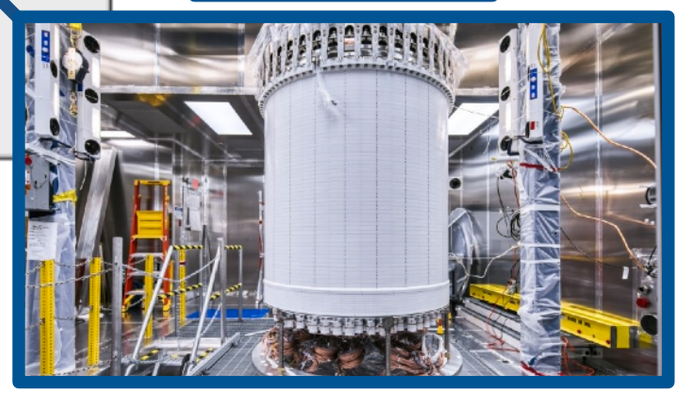


Nadler et al. (2019)

Constrain other DM models:

- Thermal DM mass > 3.26 keV
- Fuzzy DM mass > 2.9 x 10^{-21} eV

Measurements of faint stars and faint lines from Ly-α forest

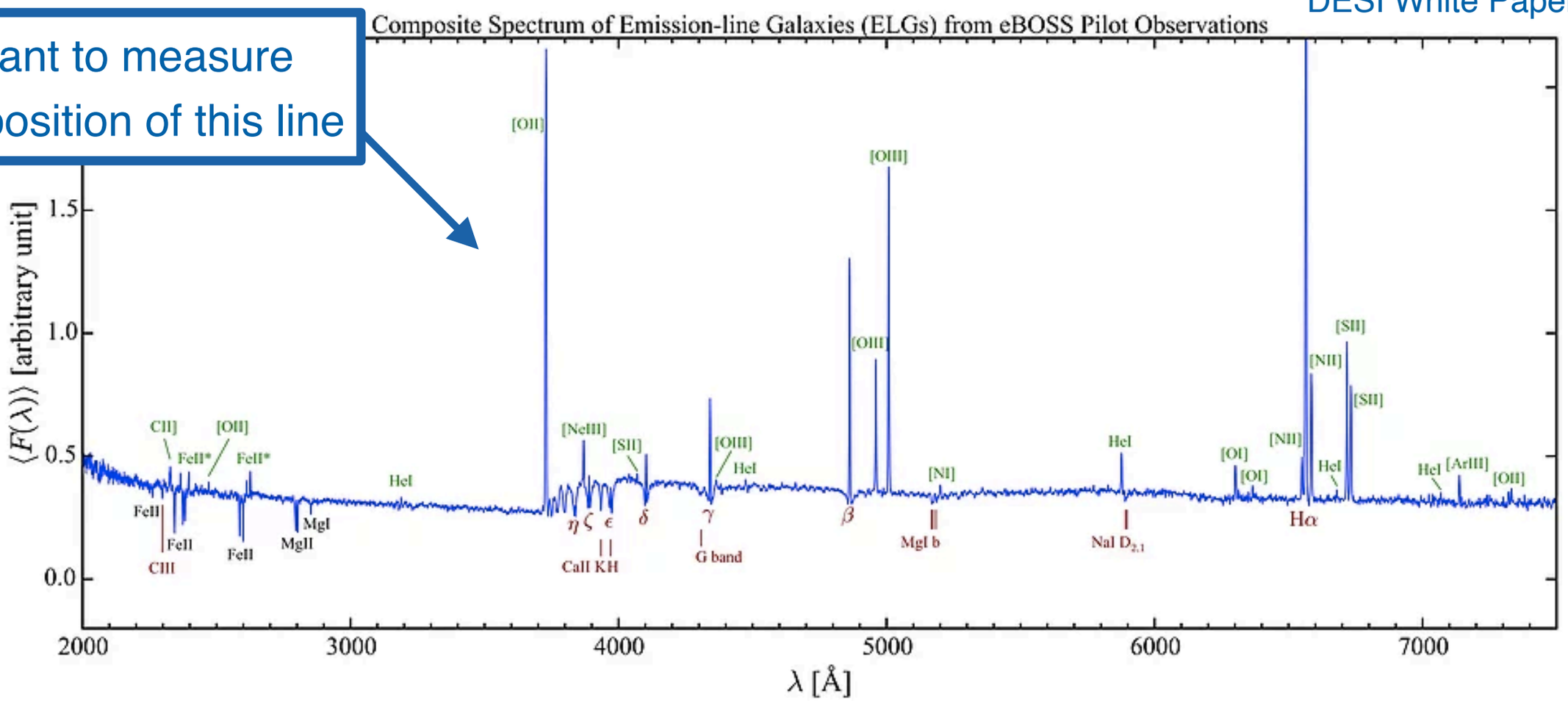


Fermilab

Faster Readout: Targeted Readout

DESI White Paper

Want to measure
the position of this line

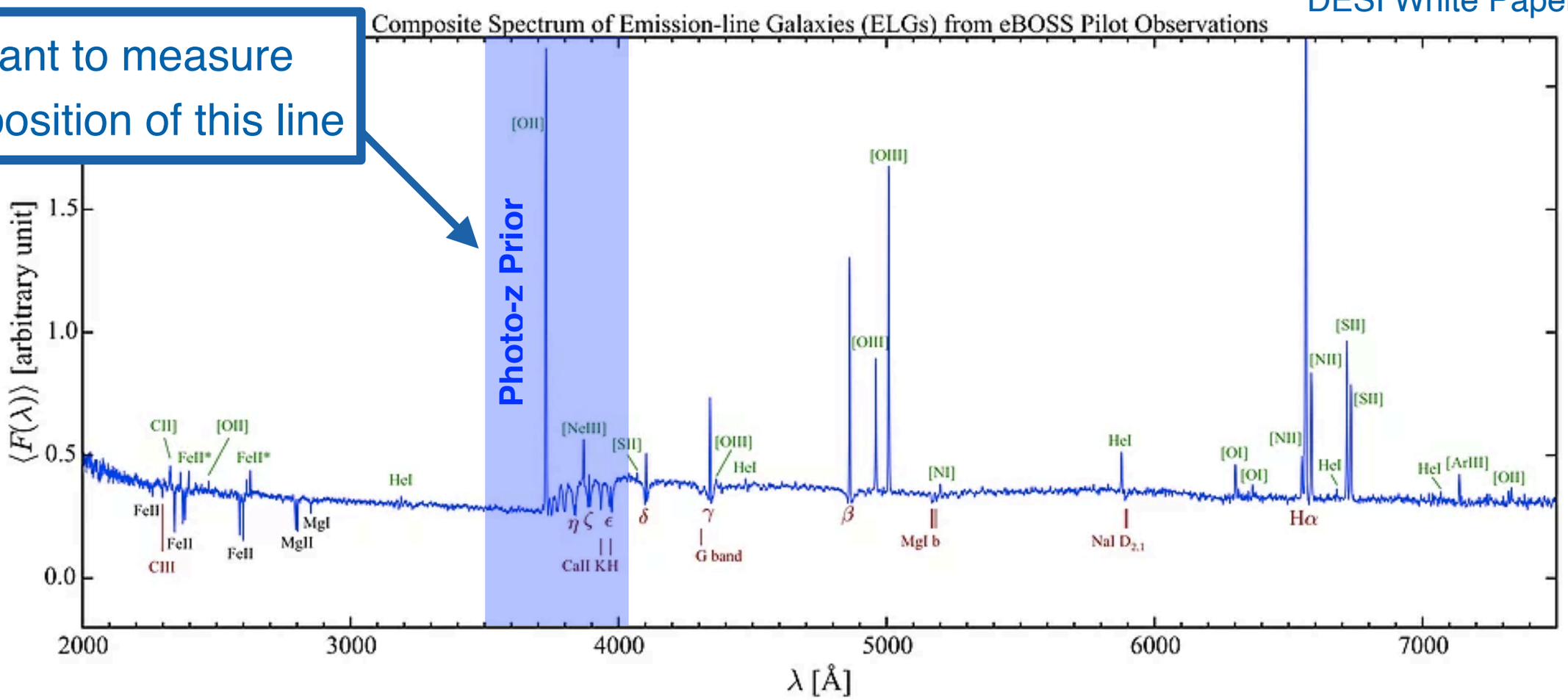


Fermilab

Faster Readout: Targeted Readout

Want to measure the position of this line

DESI White Paper

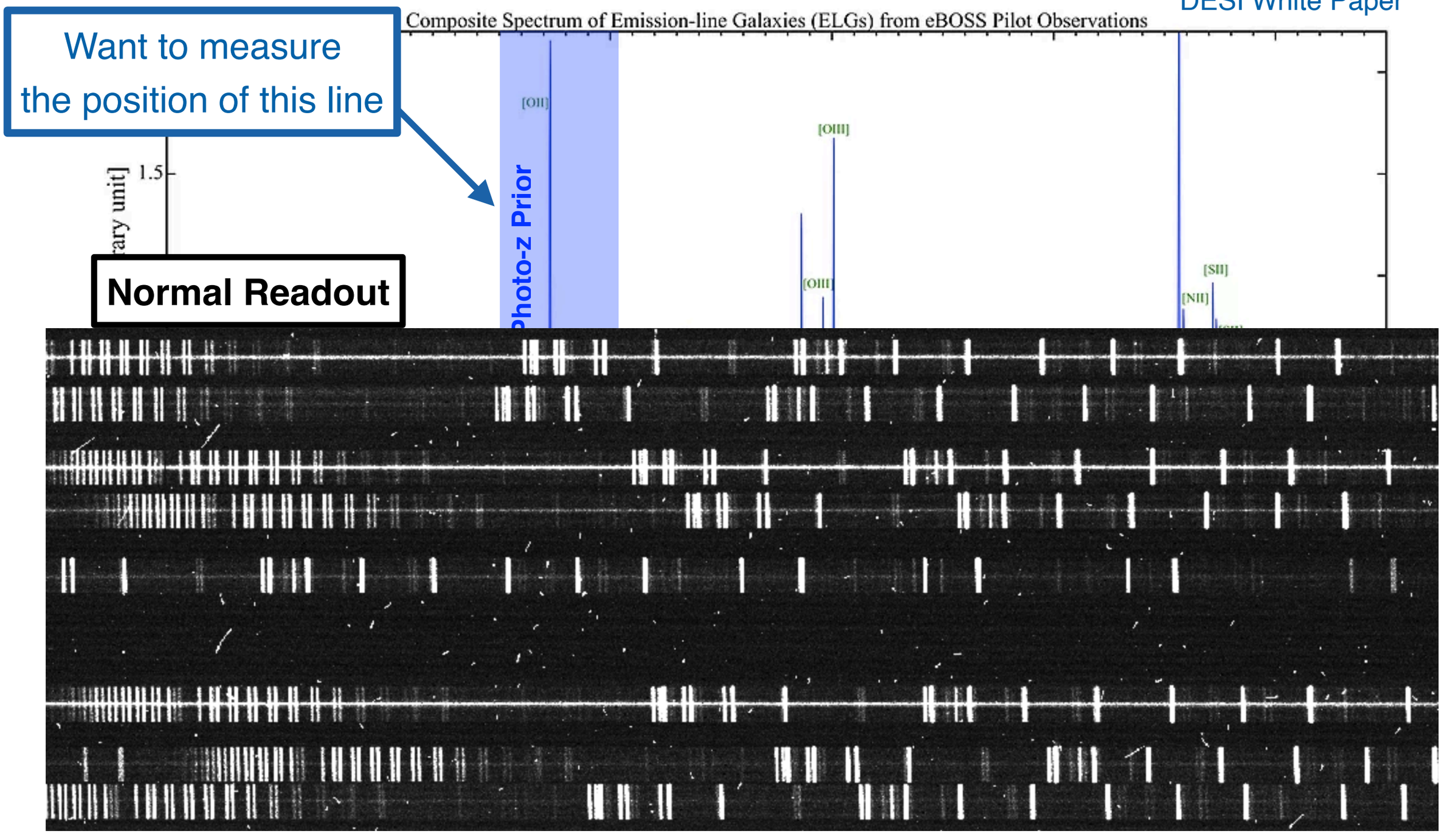


Fermilab

Faster Readout: Targeted Readout

Want to measure the position of this line

DESI White Paper



IMACS Spectra

Faster Readout: Targeted Readout

DESI White Paper

Want to measure the position of this line

Composite Spectrum of Emission-line Galaxies (ELGs) from eBOSS Pilot Observations

[OII]

[OIII]

[SII]

[NII]

Photo-z Prior

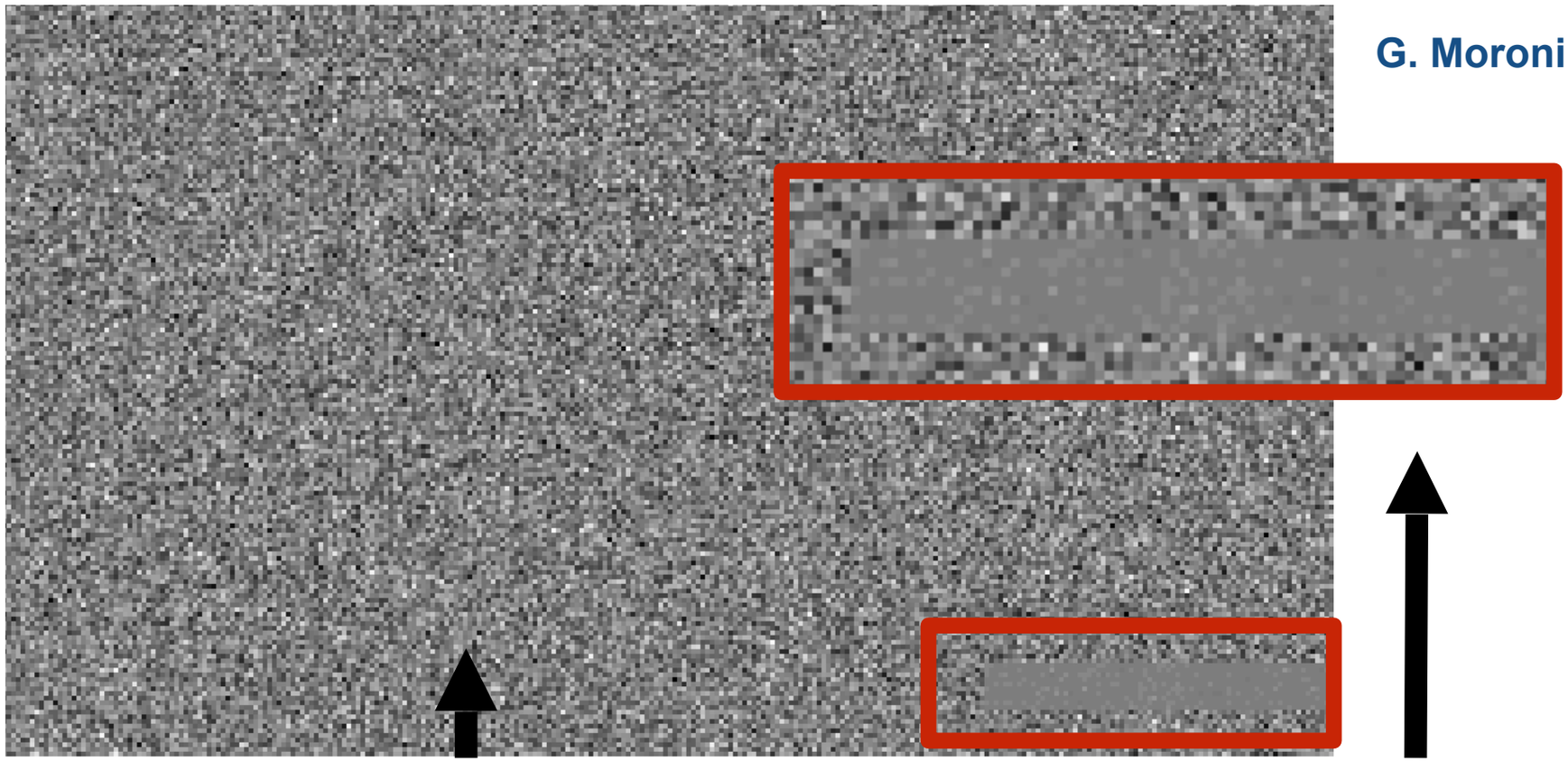
Normal Readout

Skipper Readout

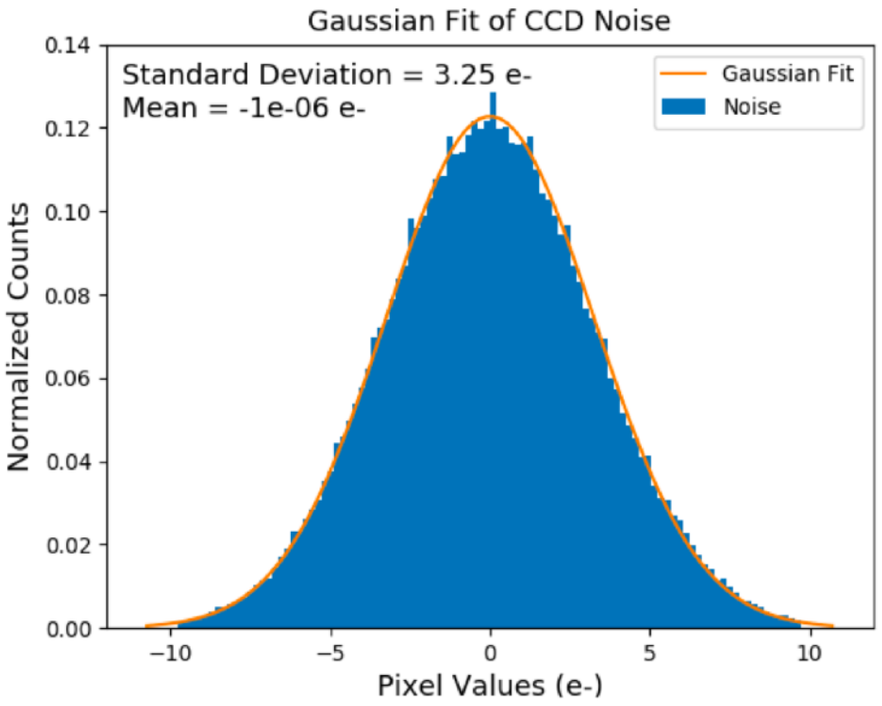
IMACS Spectra

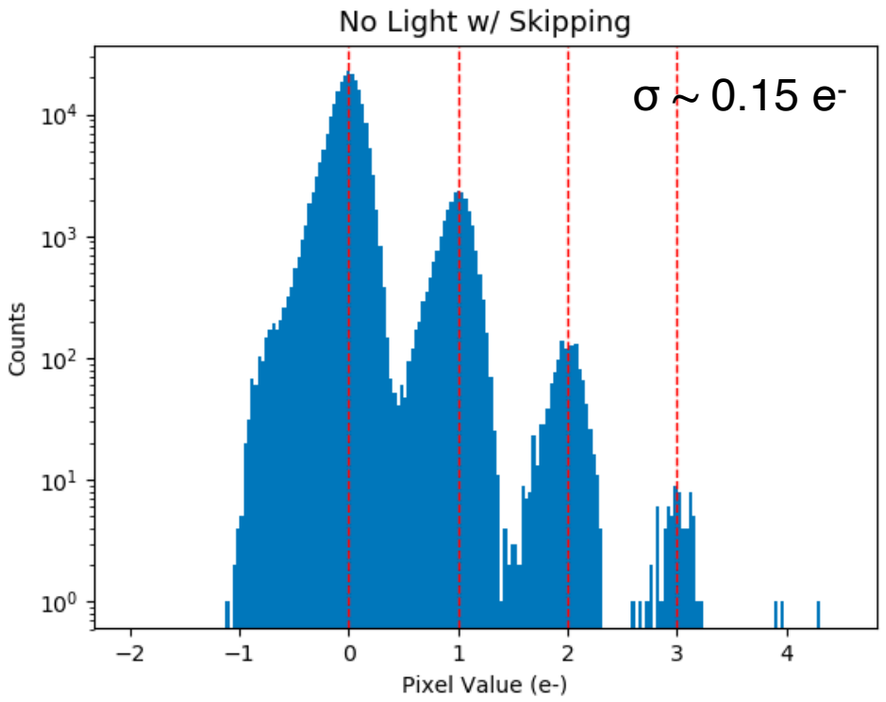
Faster Readout: Smart Skippers

G. Moroni & J. O'Neil



G. Moroni & P. Simbeni





Fermilab

White Paper Outline

- **Dark Energy:**
  - High redshift ELGs
  - More S/N on Lyman-alpha forest
- **Dark Matter:**
  - faint stars for near-field cosmology
  - Lyman-alpha forest
- **Observations:**
  - faster observations (10%-20% for DES ELGs; 2x for faint stars)
  - more volume (higher S/N for faint sources)
  - flexibility (adjust noise source-by-source for single fixed exposure time)
- **Technology**
  - Strategies for faster readout time
  - As a component of Germanium CCDs
- **Collaborators**
  - SiDet: Javier, Juan, Guillermo, Gustavo?
  - Cosmologists: Tom, Huan Lin, Steve Kent?
  - Others: Steve Holland (LBNL), David Schlegel (LBNL), Jen Marshall (TAMU)