An Infrared Search for the First Stars

Kevin Schlaufman and Andy Casey
Kavli Fellow, MIT IoA Cambridge

Wide-field InfraRed Surveys:
Science and Techniques
17 November 2014

Schlaufman & Casey (2014), ApJ, in press

Nick Risinger (Photopic Sky Survey)

The High-redshift Universe

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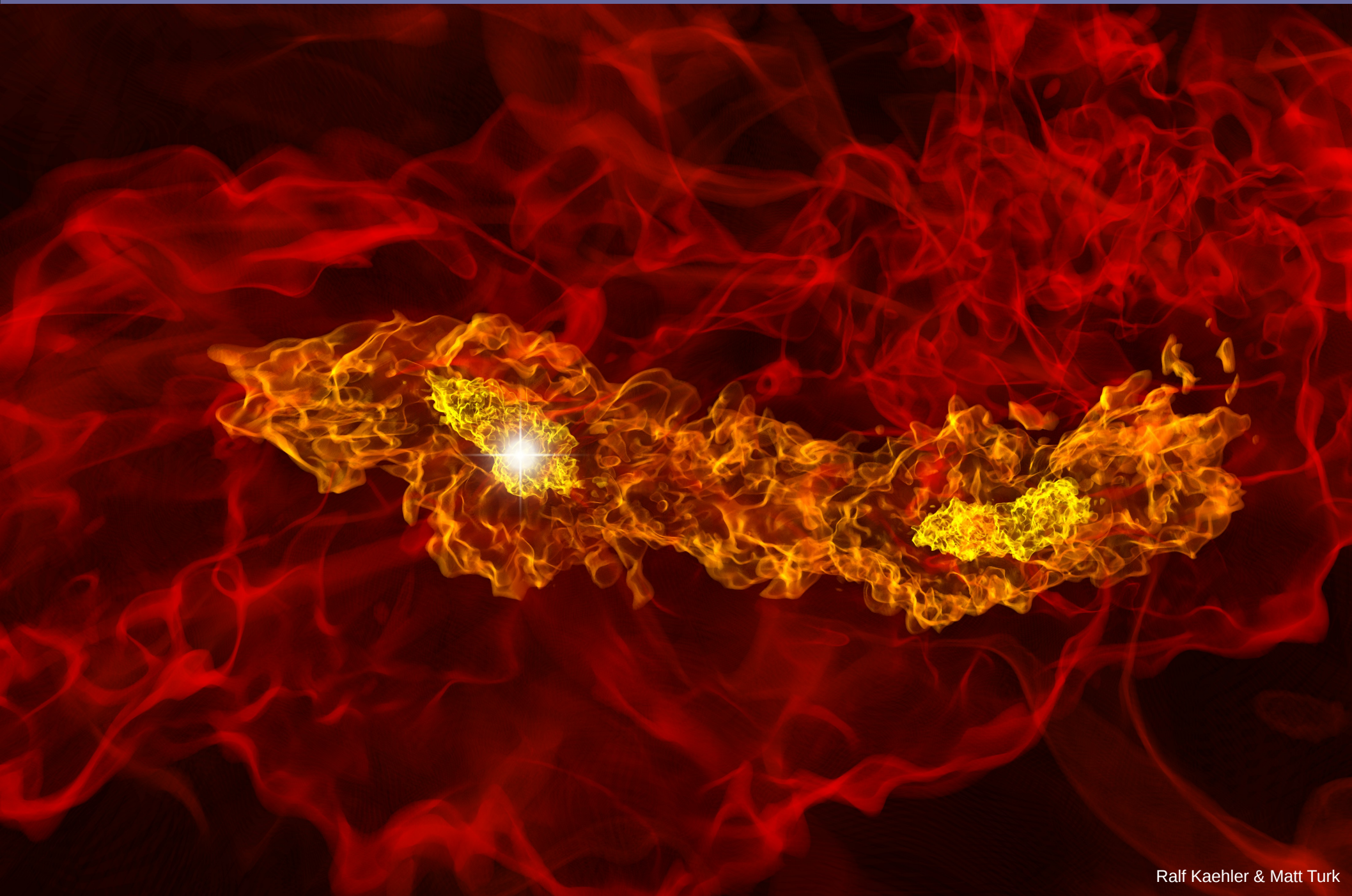

Ralf Kaehler & Matt Turk

Metal-poor Stars != First Stars

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Stars at a given metallicity form over a wide range in redshift, so metallicity alone is an imperfect measure of absolute age.

Look to the Bulge

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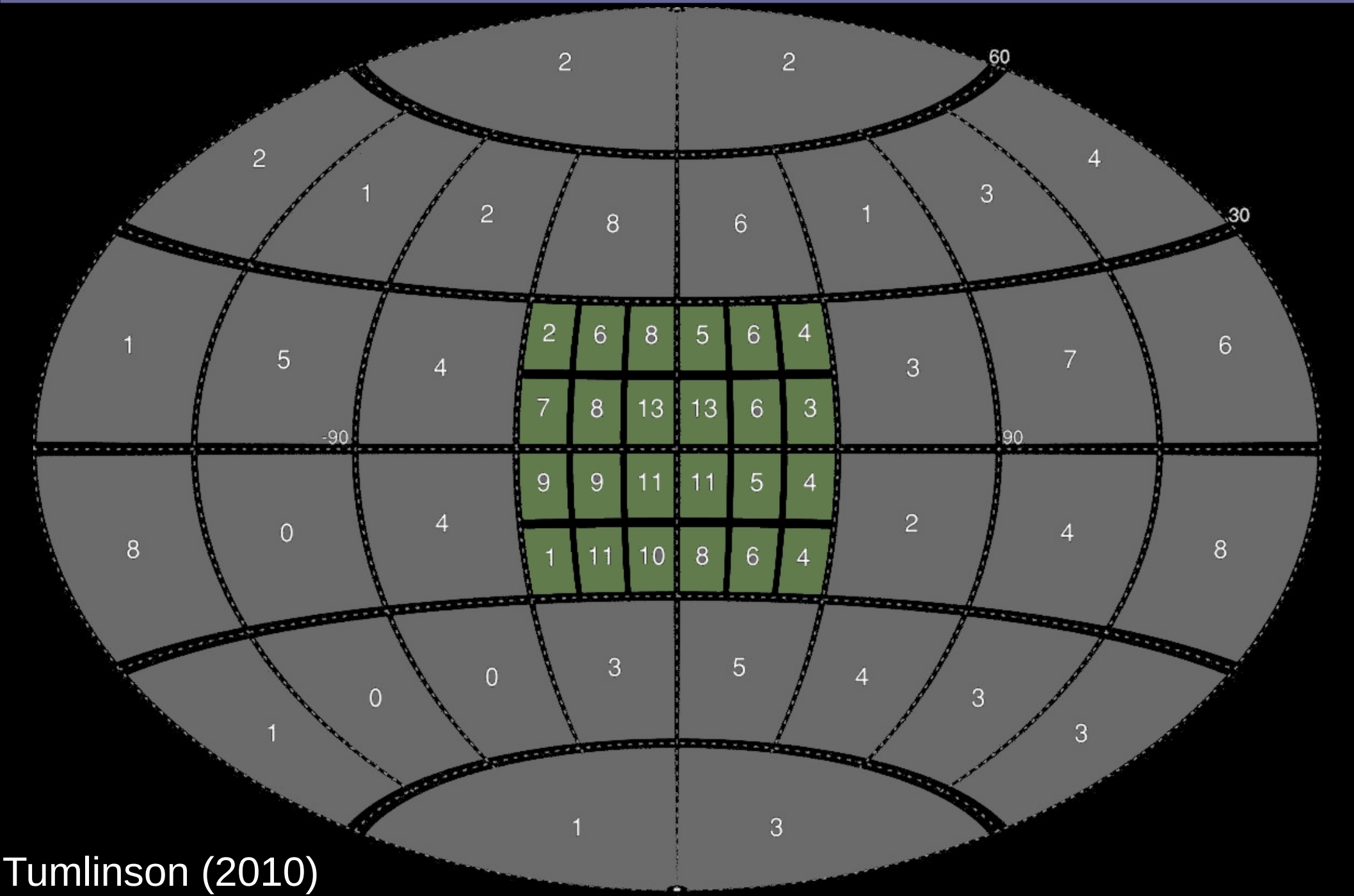

Tumlinson (2010)

Theory of Infrared EMP Selection

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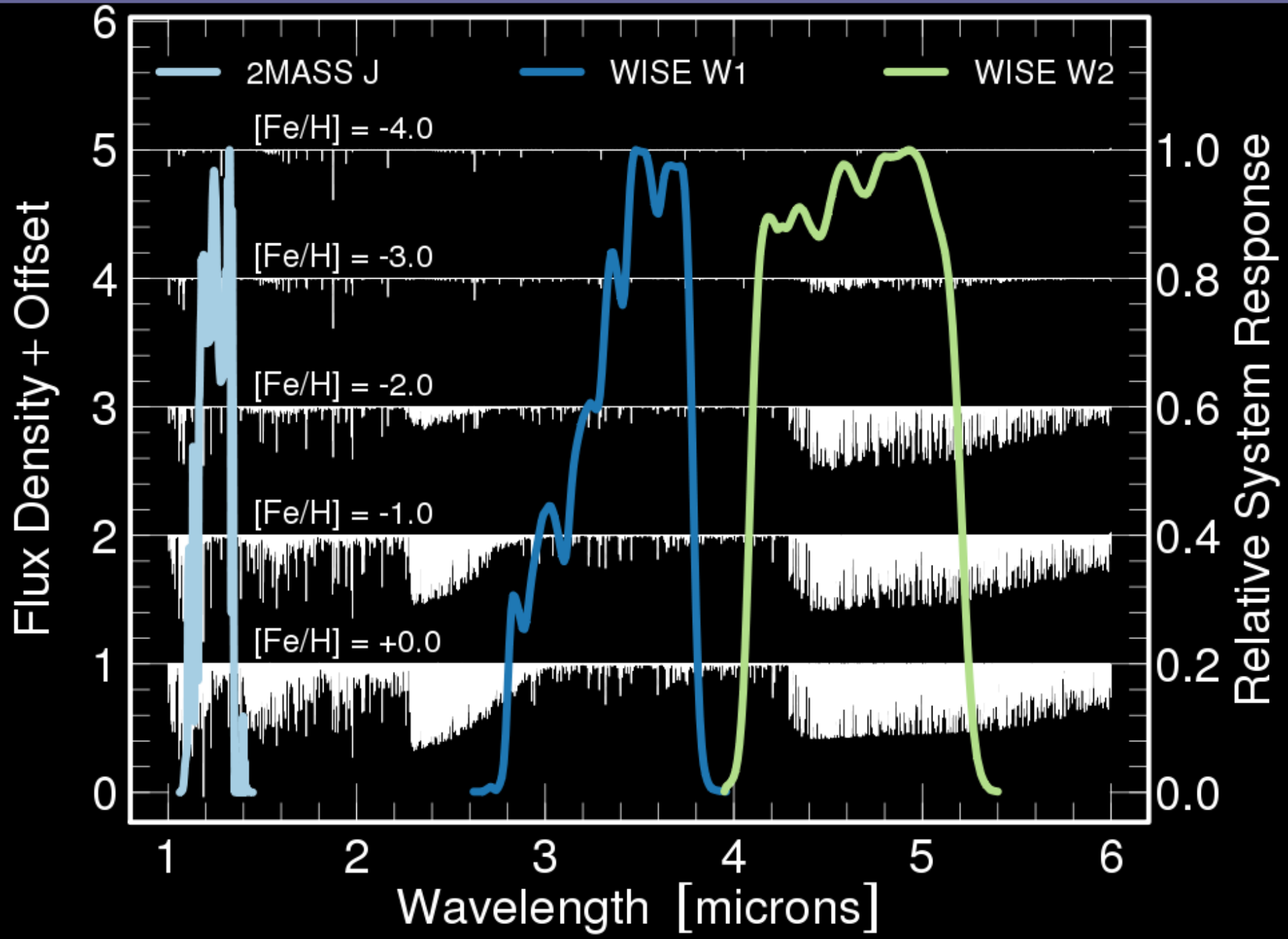
Schlaufman & Casey (2014)



Practice of Infrared EMP Selection

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Schlaufman & Casey (2014)

(1) Select cool stars
=> $0.45 < J - H < 0.60$

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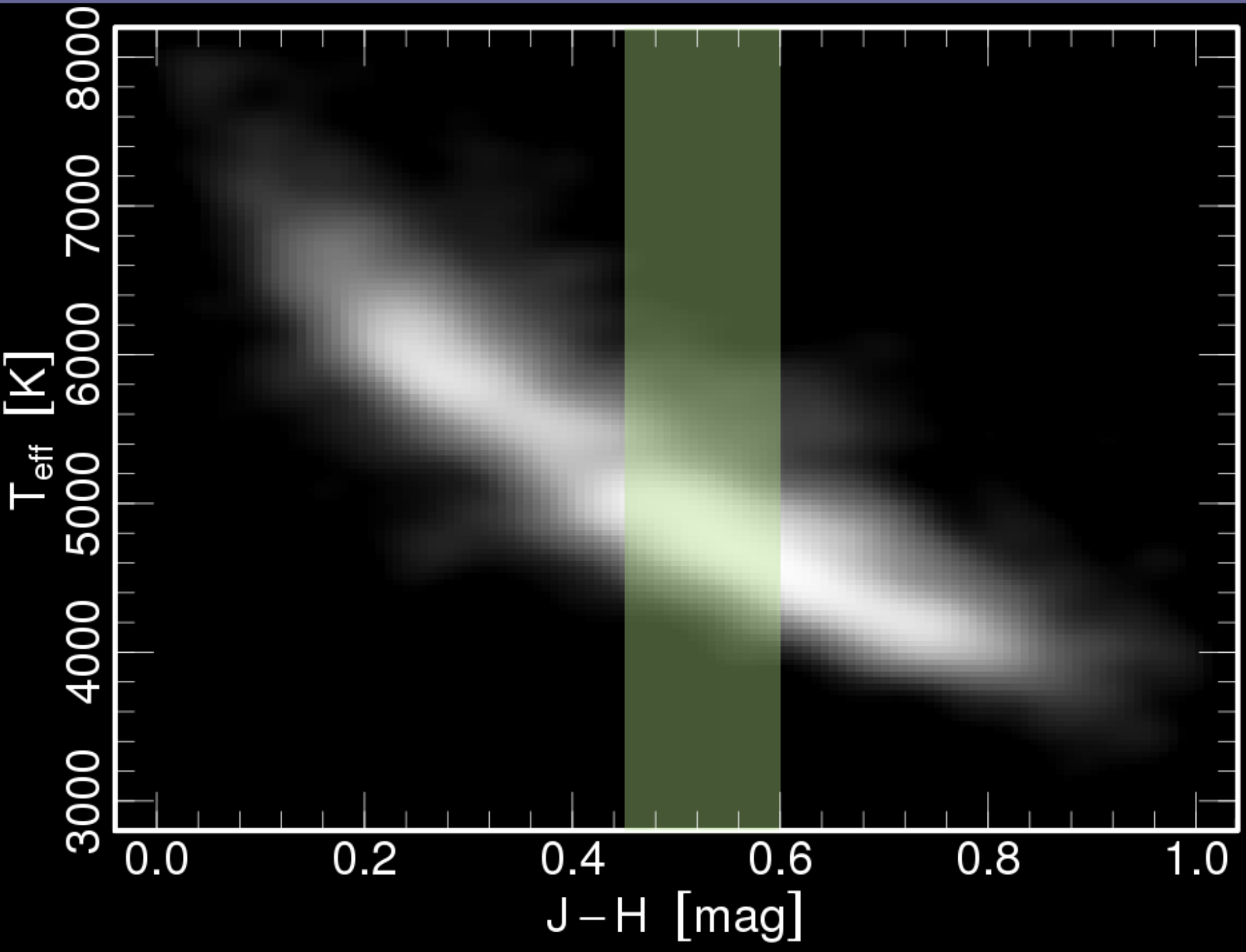

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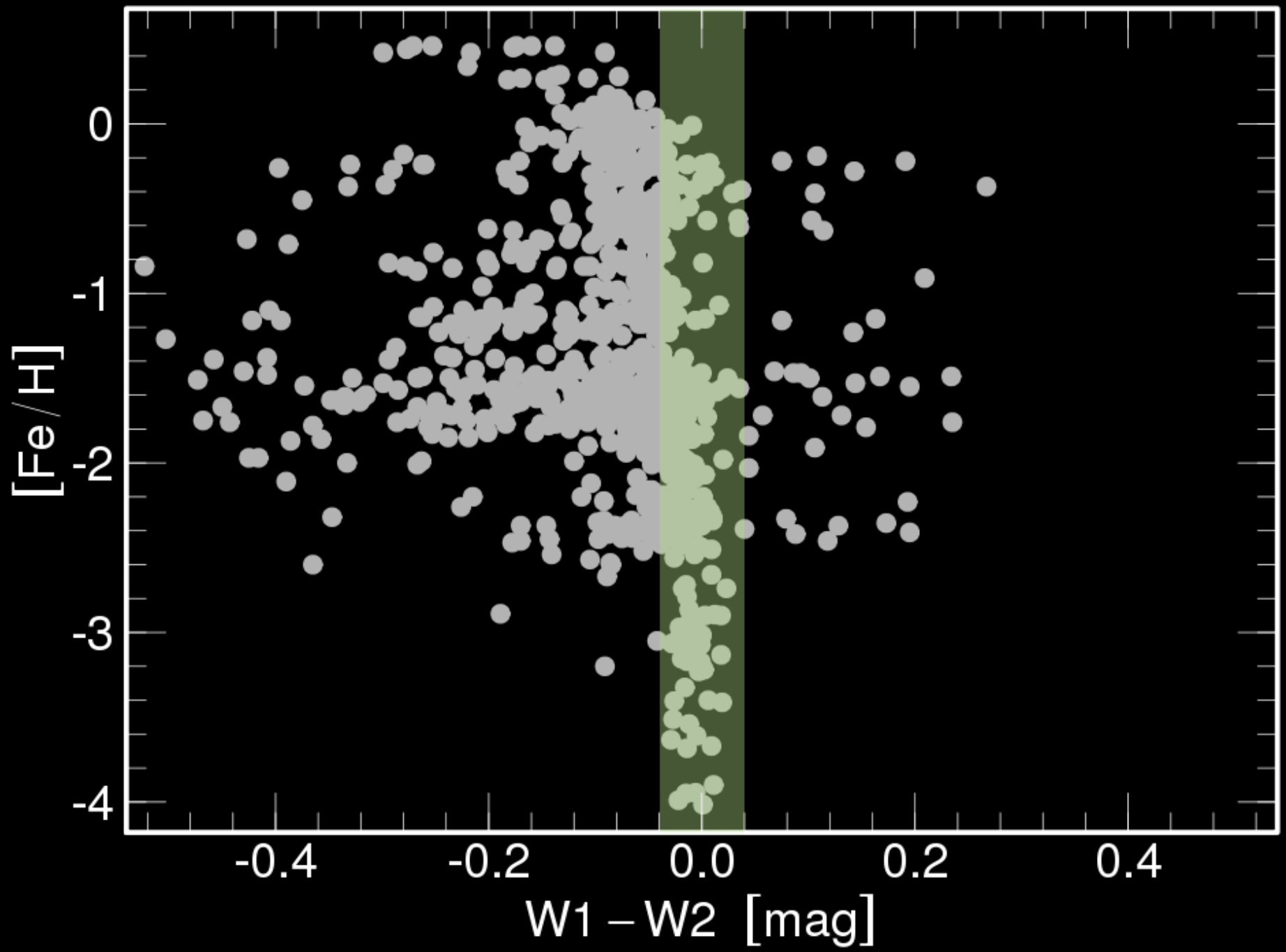

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=> $J - W2 > 0.5$

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RESULTS: >20% of candidates have $-3 < [Fe/H] < -2$
>2% of candidates have $[Fe/H] < -3$

Most Metal-poor Stars in the Bulge

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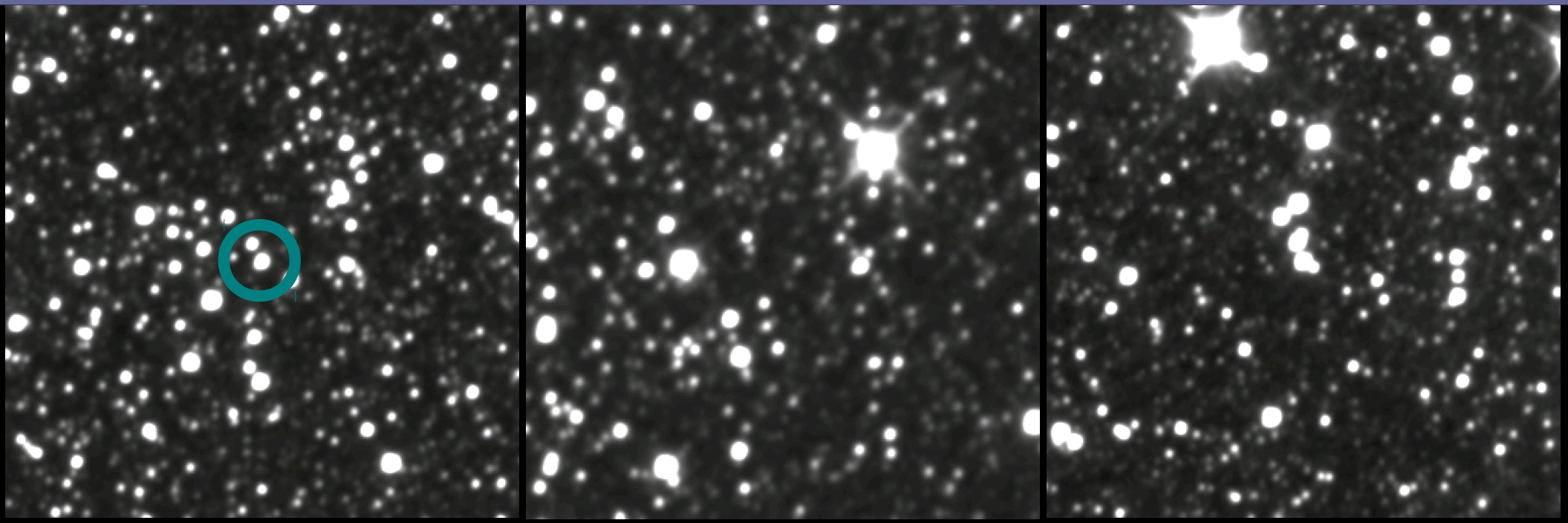

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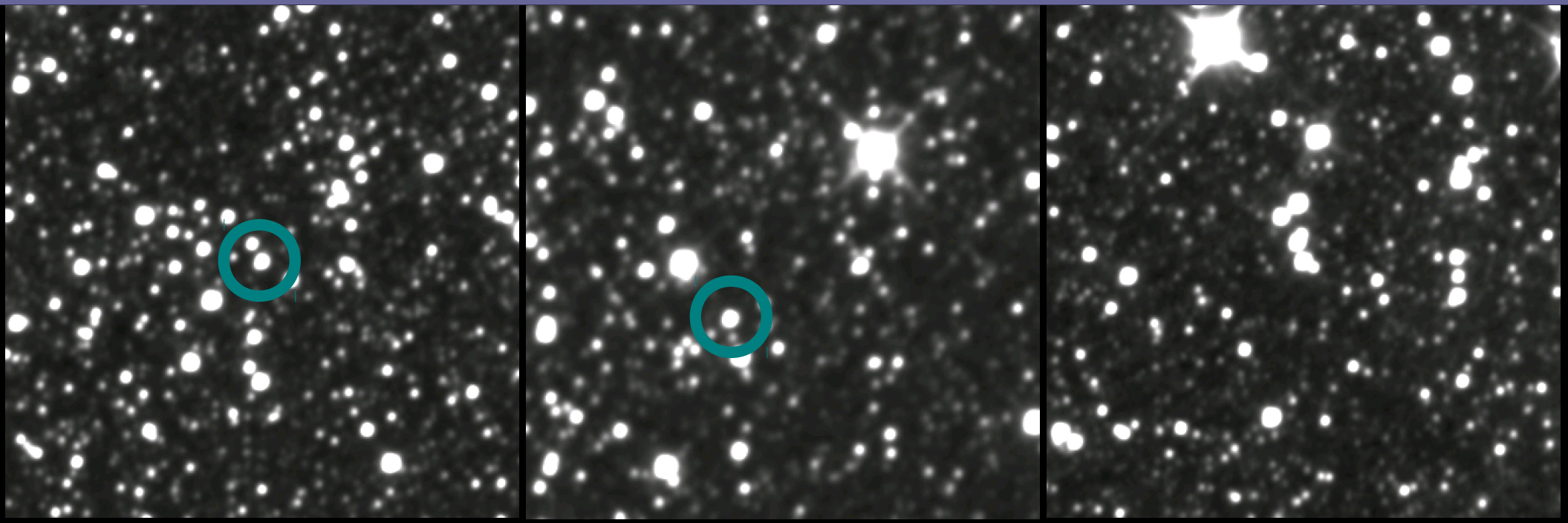

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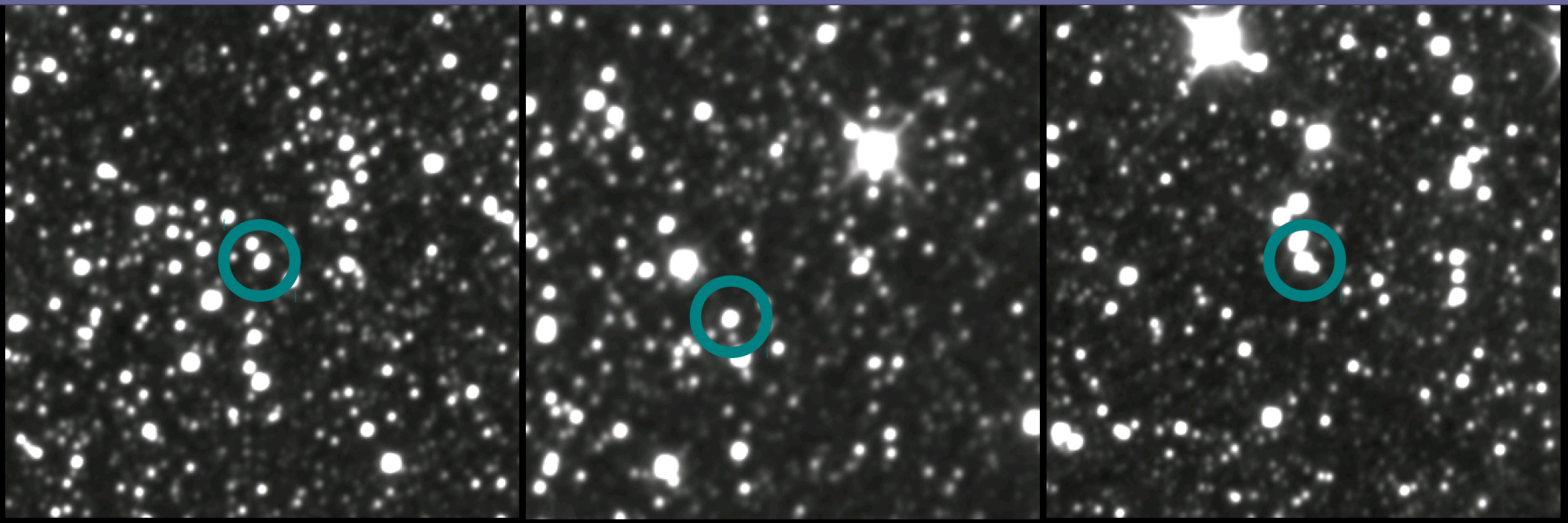

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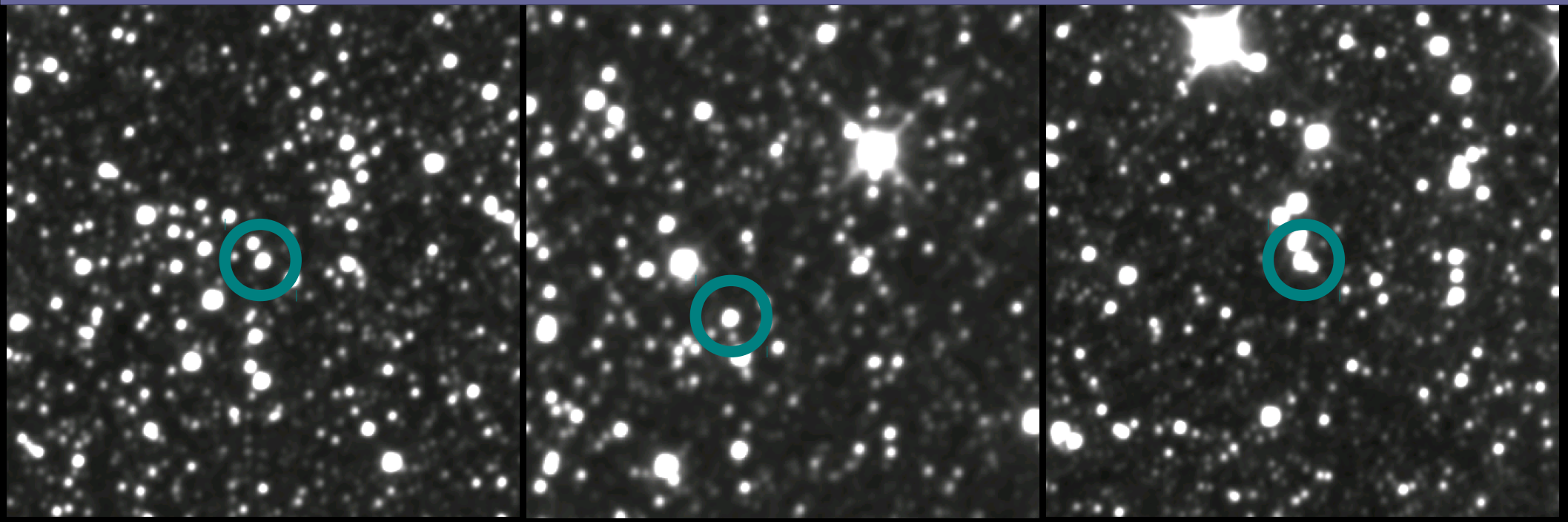

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75% chance that at least one of these stars formed at $z > 15$

Spectra Comparison

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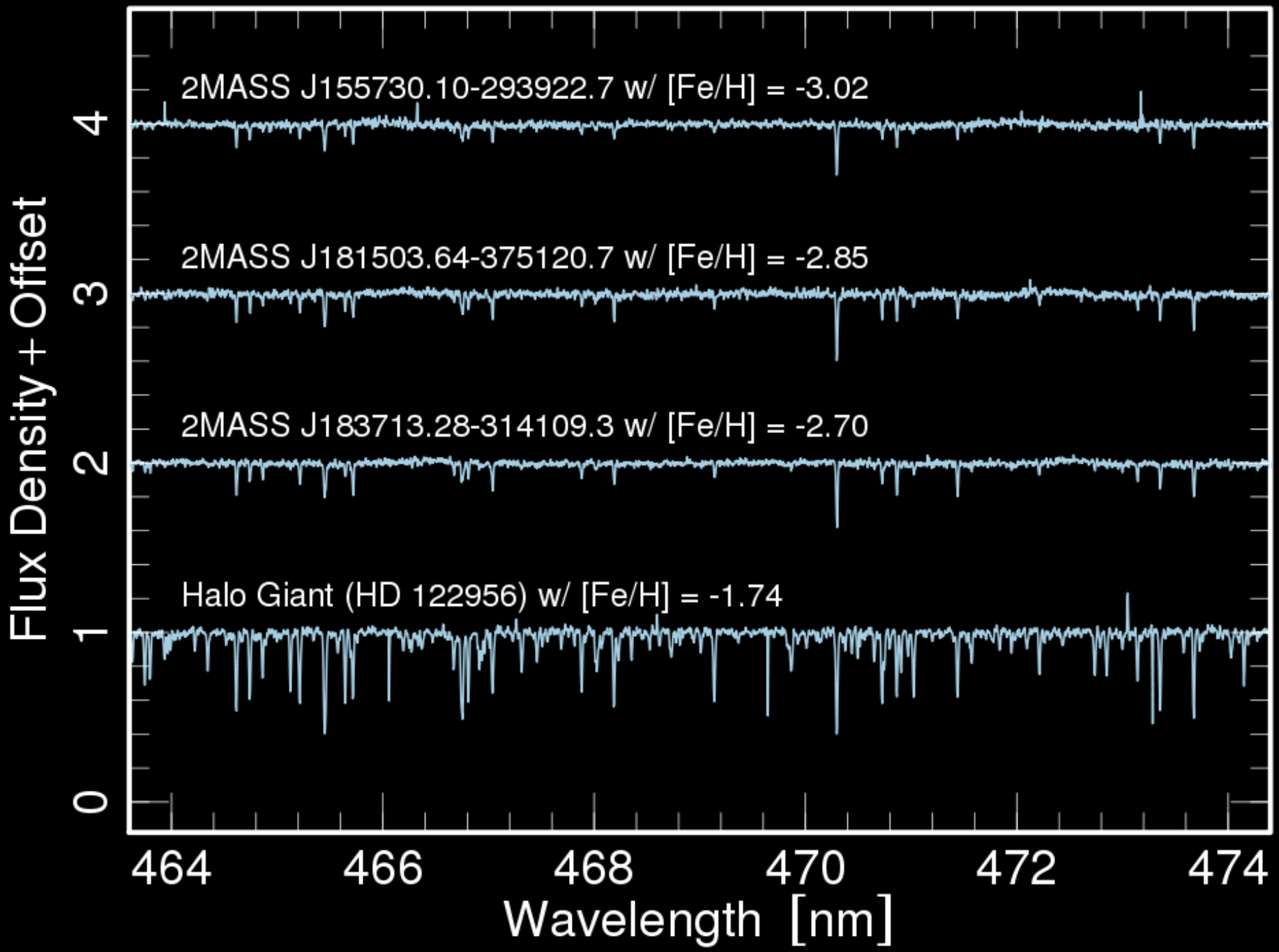

AAT/AAOmega Follow-up Program

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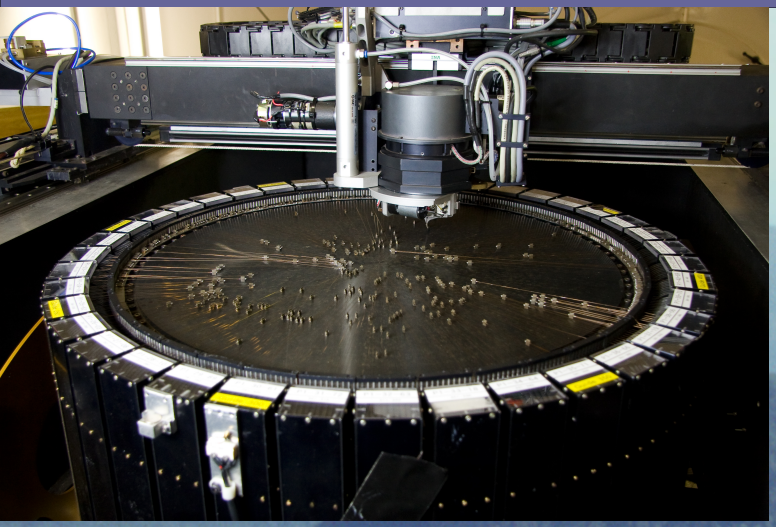

WFIRST-AFTA+JWST

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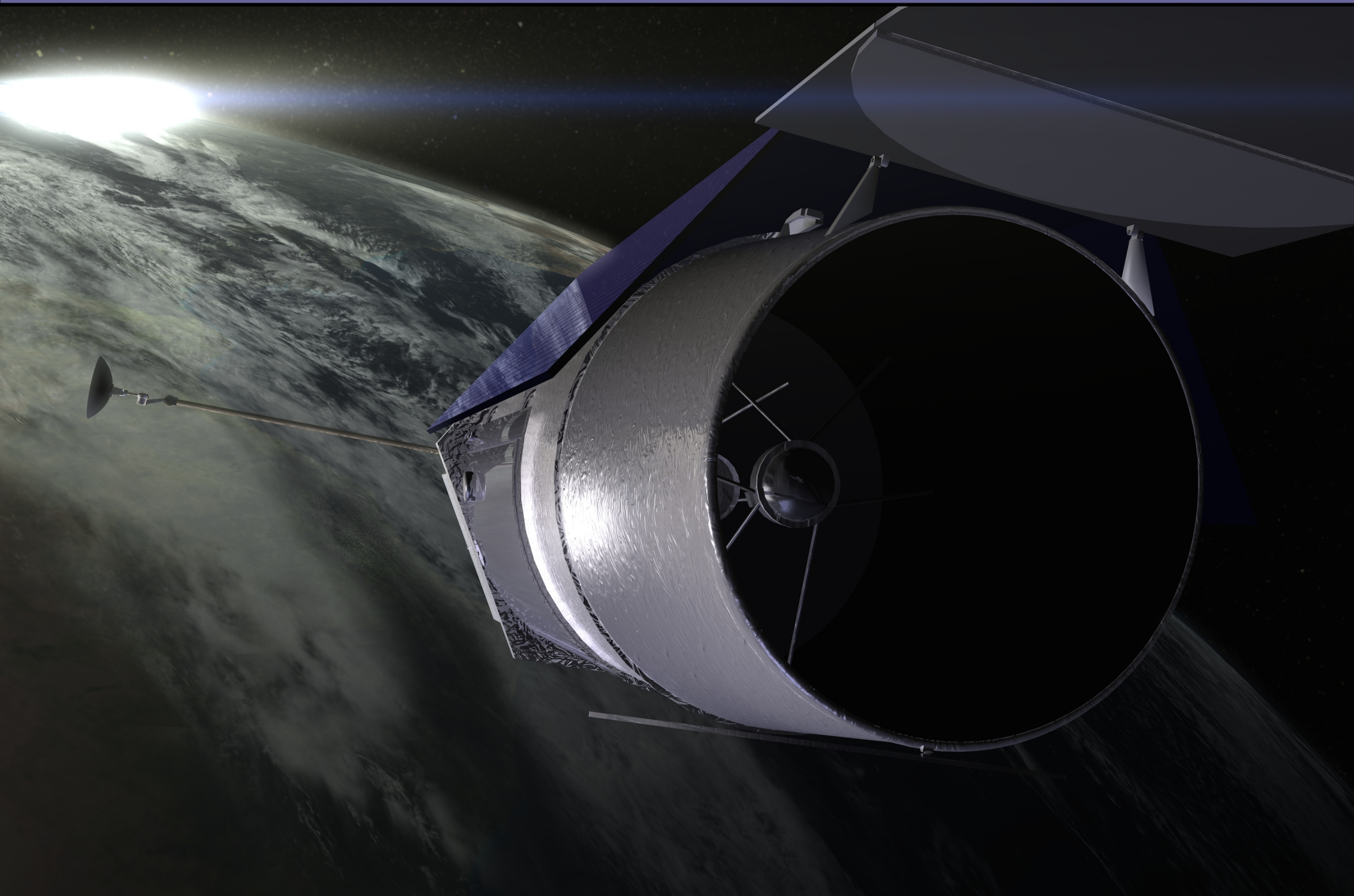

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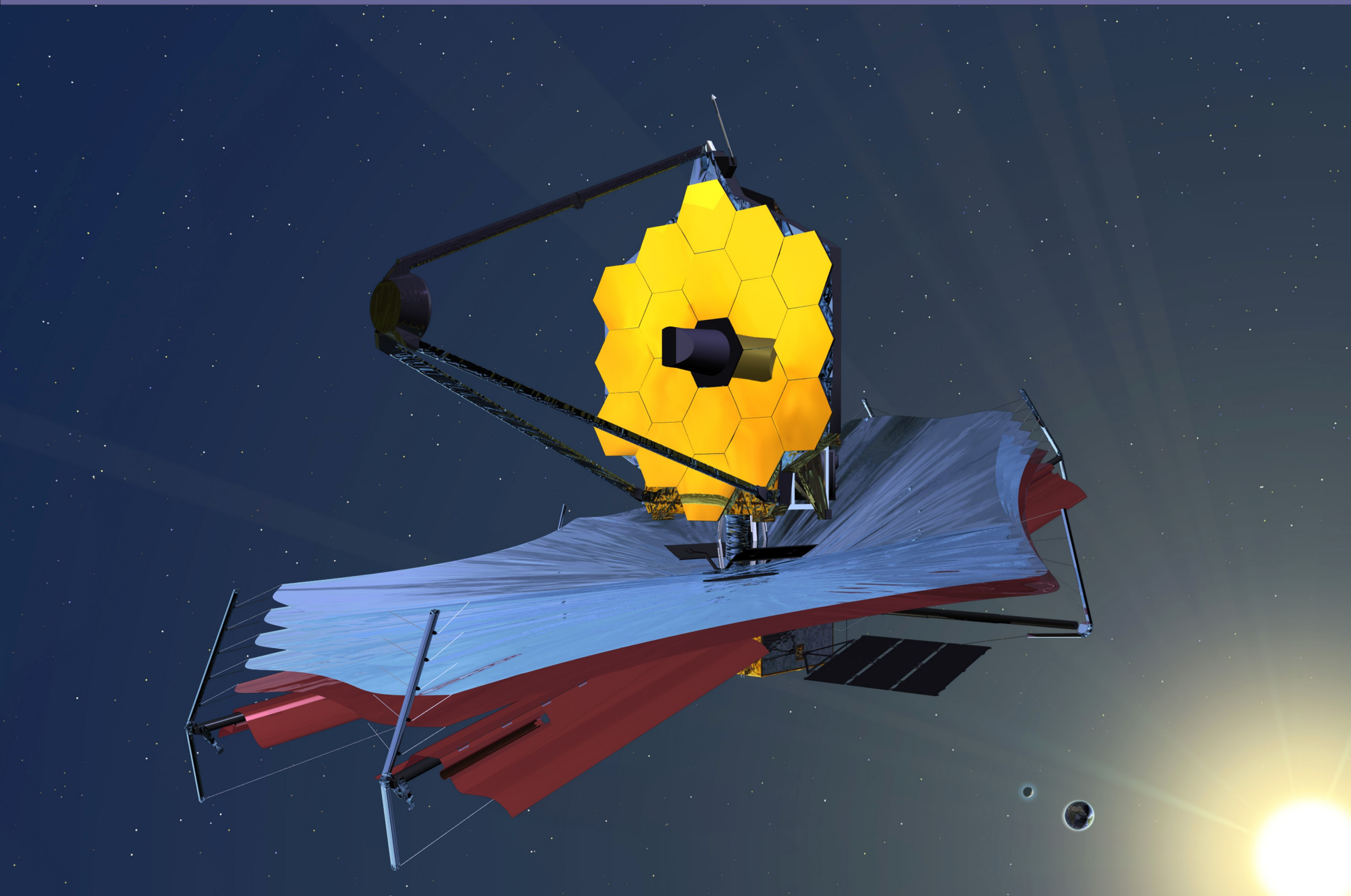

Simulated NIRCam Grism Spectra

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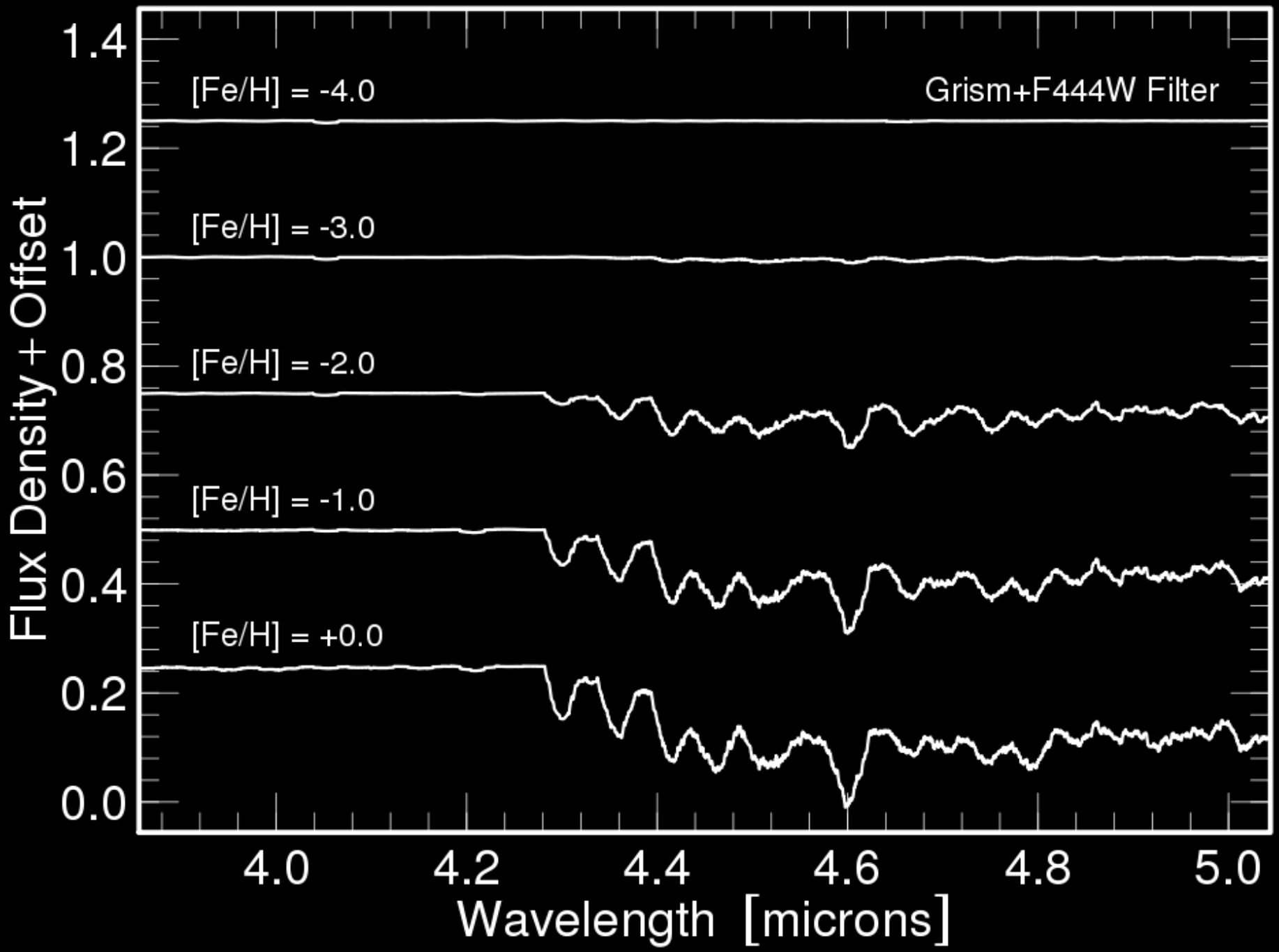

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(2) Our approved AAT/AAOmega program will identify >100 EMP giant stars, 10 of which should have formed before $z = 15$

(3) *WFIRST-AFTA* J & H photometry and *JWST*/NIRCam grism spectroscopy will identify >1,000 EMP dwarf stars