Report on Mind the Gap Session - Stephan McCandliss

Report on Mind the Gap & UVSTIG Joint Splinter Sessions at AAS 243 New Orleans

Raison d'etre:

There will be a 10-20 year gap between the end of the Hubble Space Telescope (HST) mission and the beginning of a new flagship mission with ultraviolet spectroscopic capabilities.

In the interim, what science should potential small- and modest-sized missions focus on as precursor efforts that advance conceptual and technical readiness and foster core-excellence in early career scientists who will go on to be mainstream uses of future flagship missions?

Three Sessions: Science, Technology and Mission in Development

Archives:https://cor.gsfc.nasa.gov/copag/meetings/AAS_Jan2024/AAS2024-Agenda-MineTheGap-AM.php

Presenters	Mind the Gap Committee	UVSTIG Leadership
Ted Gull – GSFC	Joy Nichols - Harvard & Smithsonian CfA	Stephan McCandliss - JHU
Jeff Linsky - CU	Carol Grady - Eureka Scientific	Jason Tumlinson - STScI
Andrea Dupree - CFA	Ted Gull - NASA/GSFC (Emeritus) & STScI	Sarah Tuttle - University of Washington
Geraldine Peters -USC	Erika Hamden - University of Arizona	Camden Ertley - SWRI
Linda Smith - STScI	Keri Hoadley - University of Iowa	Derek Buzasi - Florida Gulf Coast University
John Hennessy - JPL	Al Holm - Retired; STSci Operations	Kevin France - CU, Boulder
April Jewell - JPL	Geraldine Peters - USC	Allison Youngblood - GSFC
Chaz Shapiro - JPL	Paul Scowen - GSFC/NASA	John Hennessy - JPL
John Vallerga – UCB/SSL	Chris Shrader - GSFC NASA	Erika Hamden - University of Arizona
Keri Hoadly - UIowa	Sarah Tuttle - University of Washington	Emily Witt - CU, Boulder
Manuel Quijada - GSFC		Keri Hoadley - University of Iowa, Iowa City
Sarah Tuttle - UWash		Shouleh Nikzad - JPL
Kevin France - CU		Jason McPhate - UCBerkeley
Alexandre David-Uraz - GSFC/HowardU		
Shouleh Nikzad - JPL		
David Ardilla (for Shkolnik) – JPL/ASU		
Paul Scowen - GSFC		
Emily Witt - CU		

Ted Gull

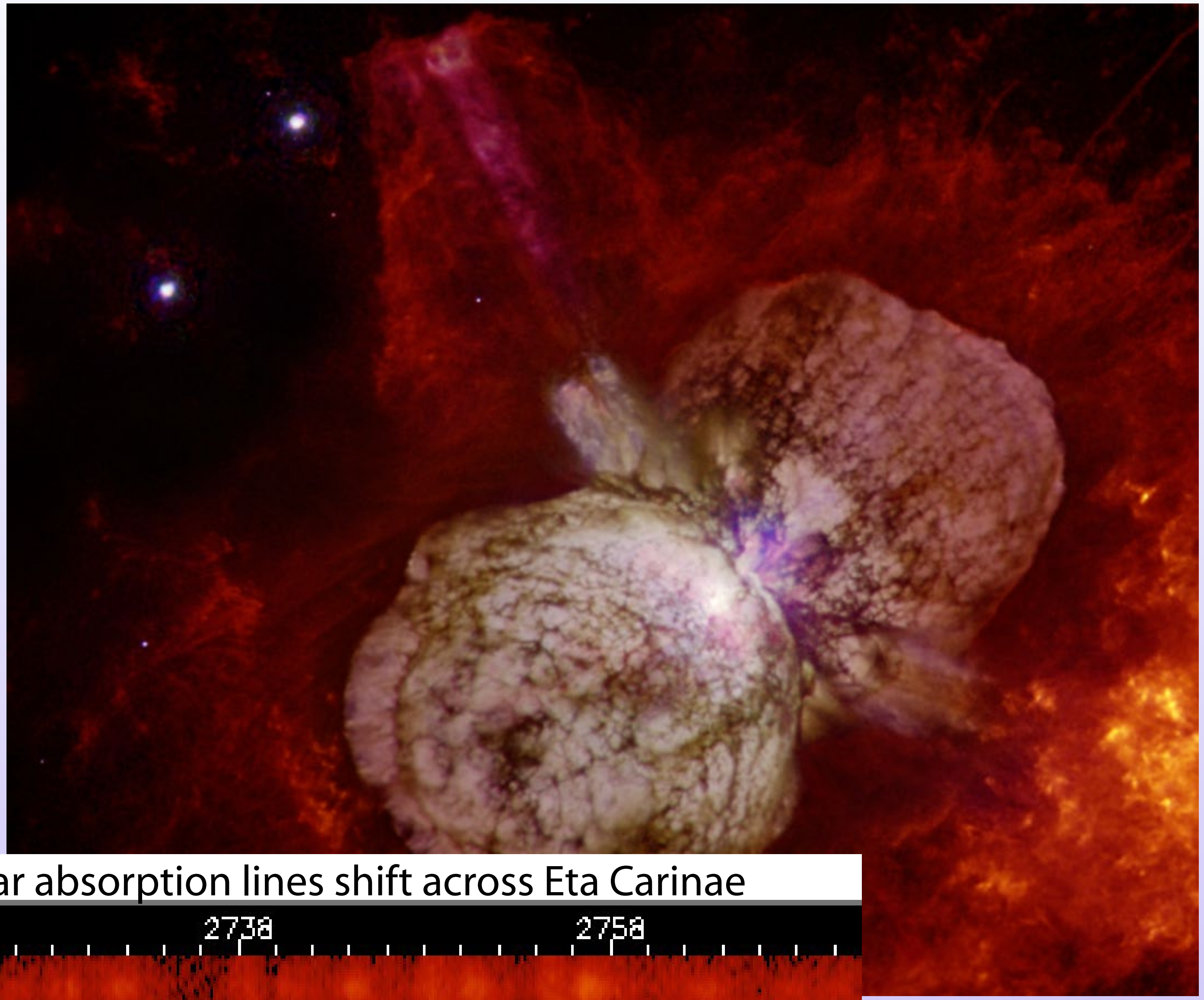
UV spectroscopy requires a selection of spectral resolving powers combined with excellent angular resolution:

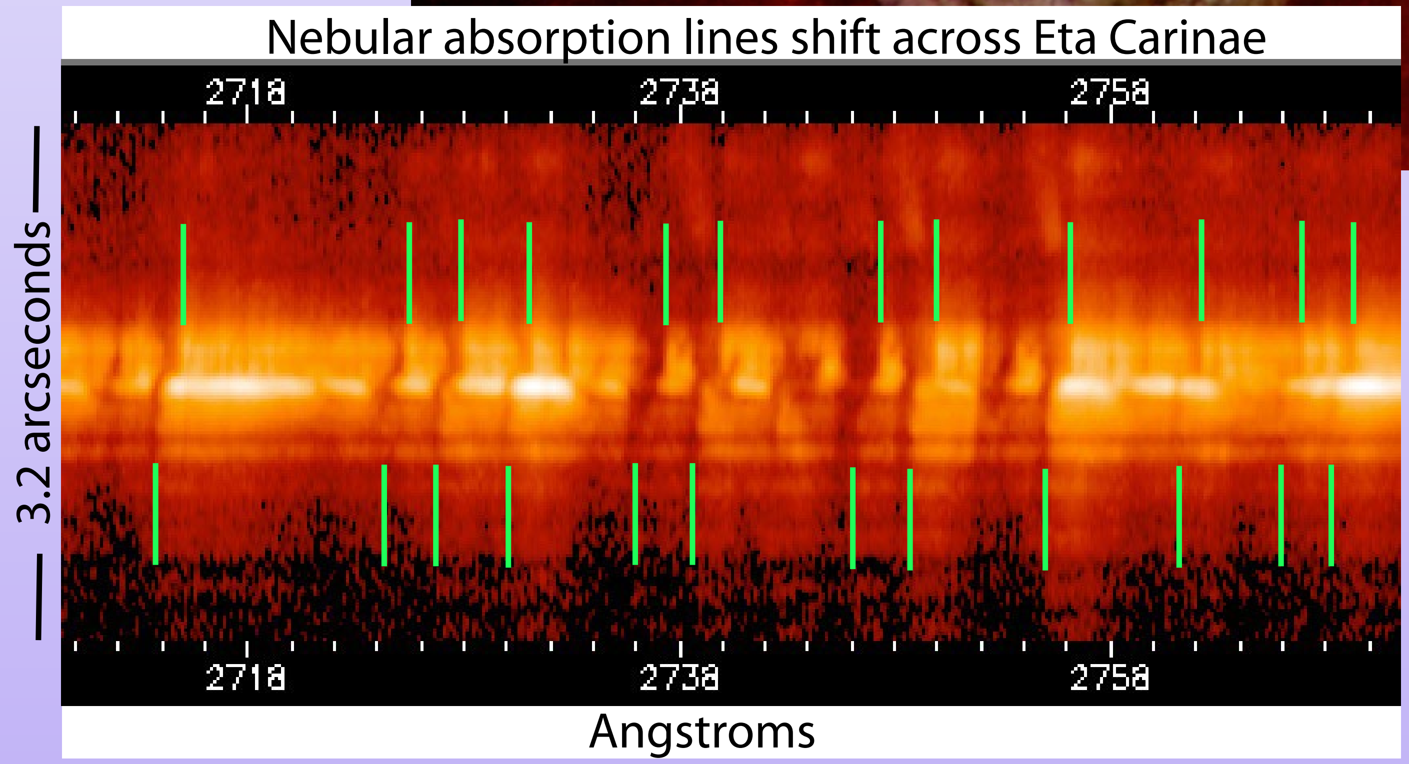
The capability of HST/STIS must be built upon for the HWO

UV spectroscopy needs intermediate steps to get there

A spectrum is worth a thousand pictures ---- Blair Savage

A spectro-image is worth a thousand spectra!



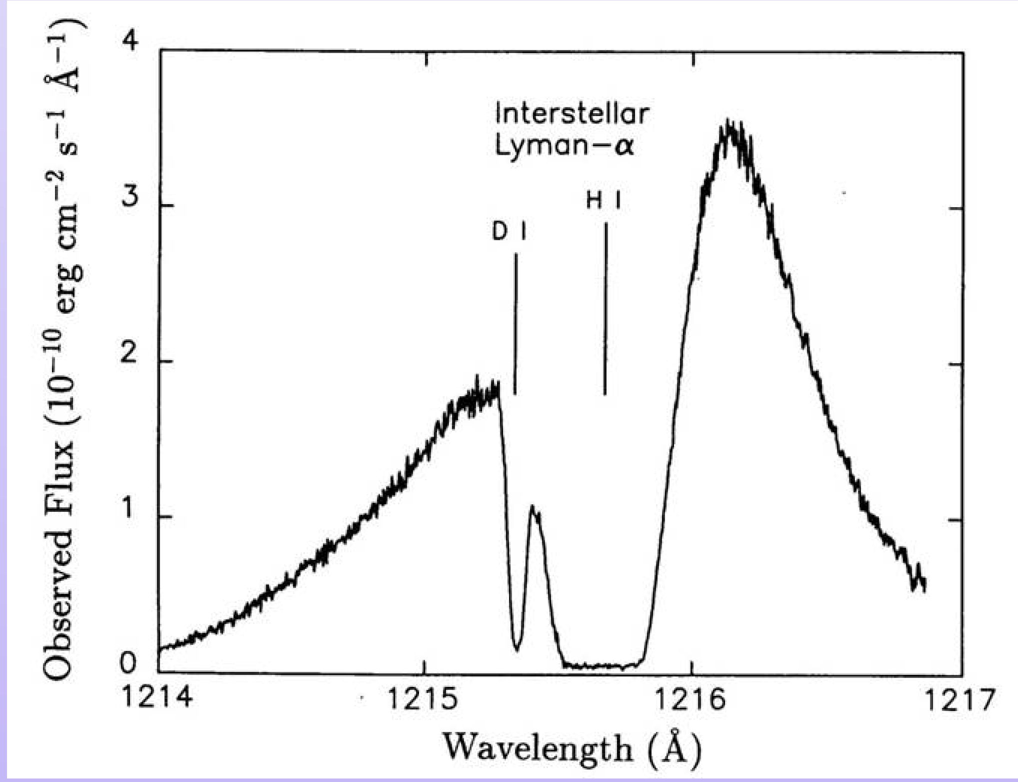


Jeffrey L. Linsky

Science topics requiring high-resolution UV spectroscopy

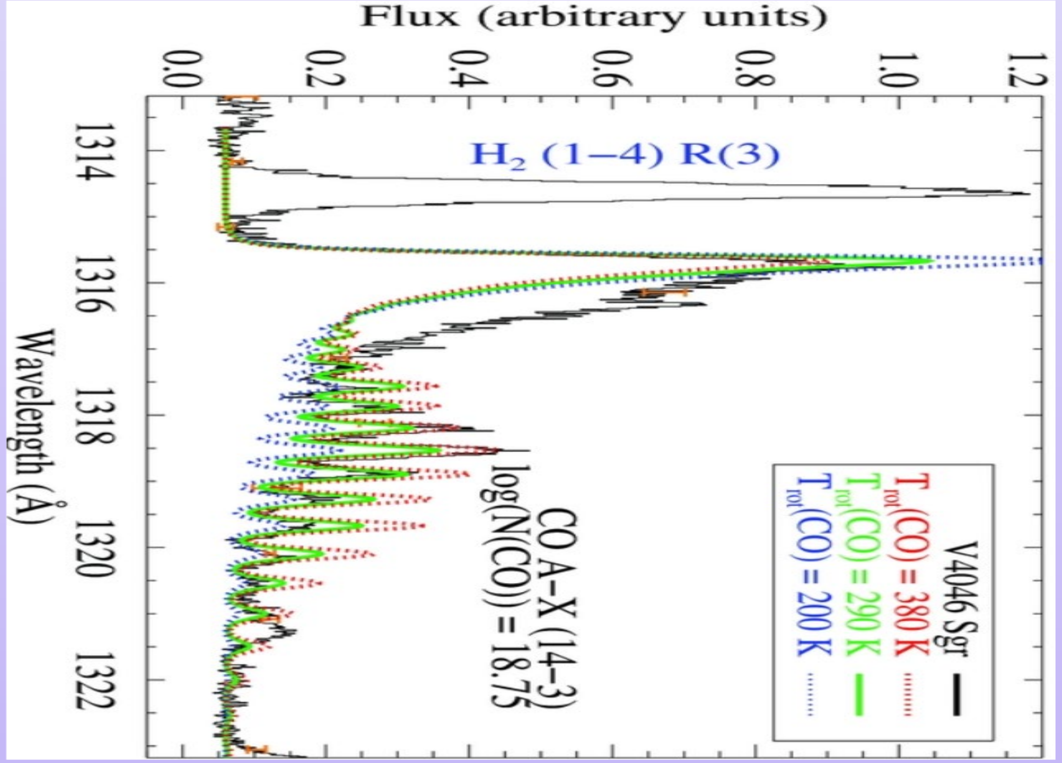
Science Topic	Need R>50,000 (6 km/s)	Need R>100,000 (3 km/s)
ISM kinematics and structure		X
Stellar emission line fluxes	X	
Stellar dynamics (flows, winds, flares)		X
Stellar accretion phenomena	X	
Exoplanet mass loss	X	

Capella observed with GHRS Ech-A (Linsky et al. 1993)



Lyman-α spectra of Capella at R=100,000 (3 km/s)

V4046 Sgr at COS resolution (R=18,000, 17 km/s) (France et al. 2012)



Andrea Dupree

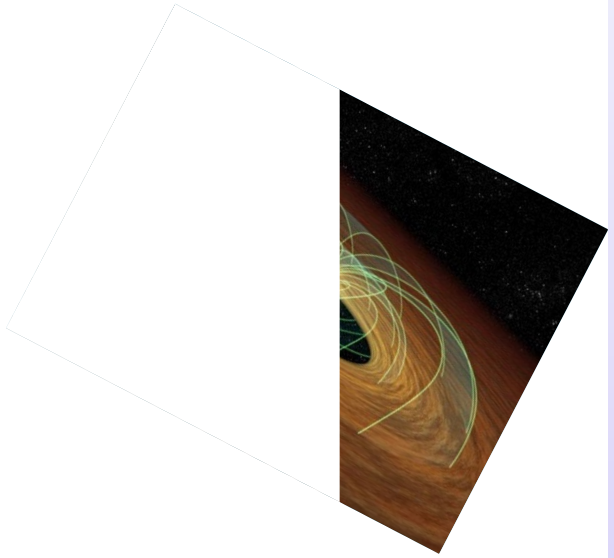
No UV? What will we lose from stellar astrophysics ???

Measures atoms (H I, D I, He I, O I ...), ions (He II, Mg II, C III, O VI...), molecules (H_2)...,

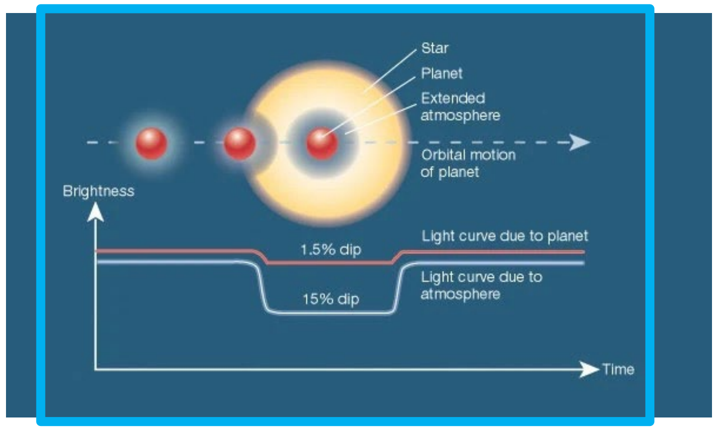
Spans temperatures from $10^2 - 10^6$ K... found in stars, exoplanets, and the ISM

Winds from Young Accreting Stars ....

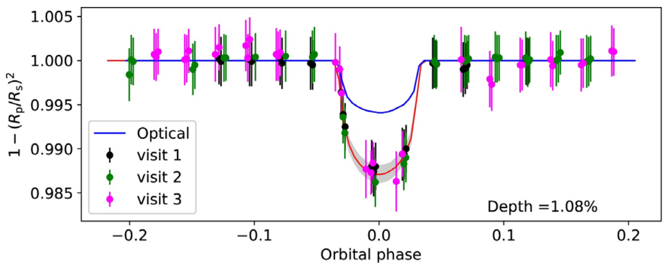
us in many
ion species

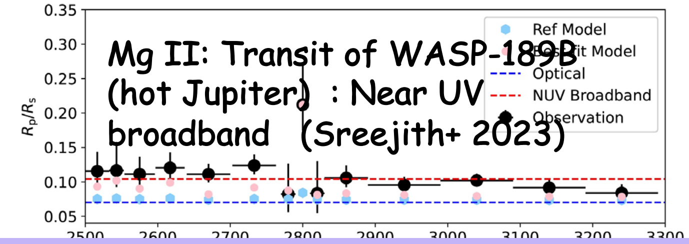


Exoplanets: Transmission spectroscopy of escaping material



Lyman-alpha: escaping hydrogen
HD 209458b (Vidal-Madjar+ 2003)





Mg II: Transit of WASP-189B (hot Jupiter) : Near UV broadband (Sreejith+ 2023)

No gap!!!

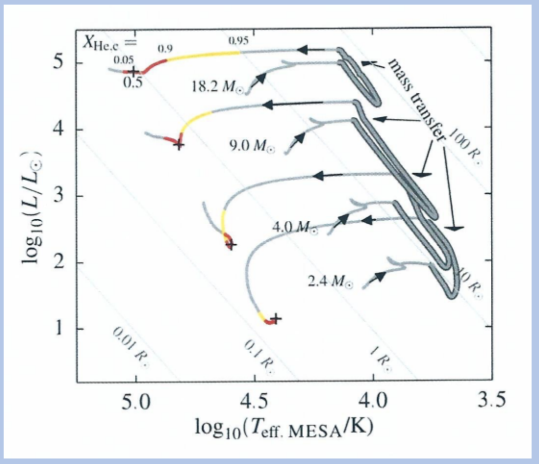
Gerrie Peters

New Perspectives on Stellar Evolution in the Upper Main Sequence

- The degree of mass loss to the ISM by late O/Early B-type interacting binaries is important for galactic evolution studies.
- A FUV/NUV spectropolarimeter with moderate/high spectral resolution can determine the degree of systemic mass and angular momentum loss to calculate evolutionary tracks of close binaries.
- For star cluster evolution the most important number is how many ***close binaries are formed.***

What is Needed Next to Compute Realistic Evolutionary Tracks for OB Interacting Binaries?

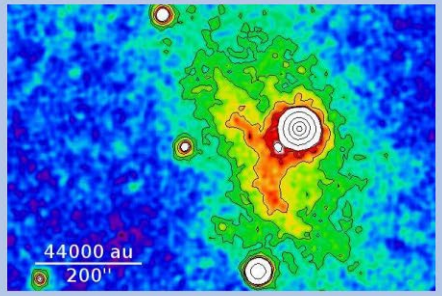
- **State of the art: See Gotberg, et al. 2018, A&A, 615, A78 and references therein.**
- **There is a need for observations to constrain non-conservative calculations of evolutionary tracks.**
- **These observations must be in the FUV.**



From Gotberg, et al. (2018)

The fraction of O-Early B stars in a star cluster that have their evolutionary tracks modified depends on how many close binaries are formed. Their initial separations (may be modified by third body interactions) must be approximately less than 20 AUs (r/a ~log q). Wide binaries will undergo single star evolution.

Evidence for Mass Loss to the ISM by Be + sdO Systems and Other Be Binaries*



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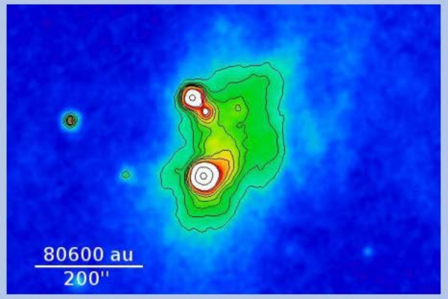
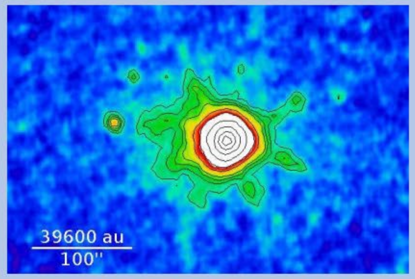
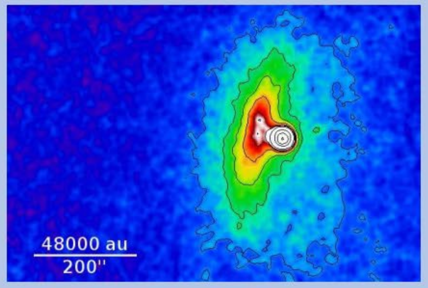


HR 2142 (V696 Mon)

*IR images from WISE Spacecraft (Mayer et al. 2016, A&A 587, A30)

(right) CX Dra (Algol-type, B2.5V + F5III, P= 6.696 d)
(left) π Aqr (well-studied Be star)





Linda Smith

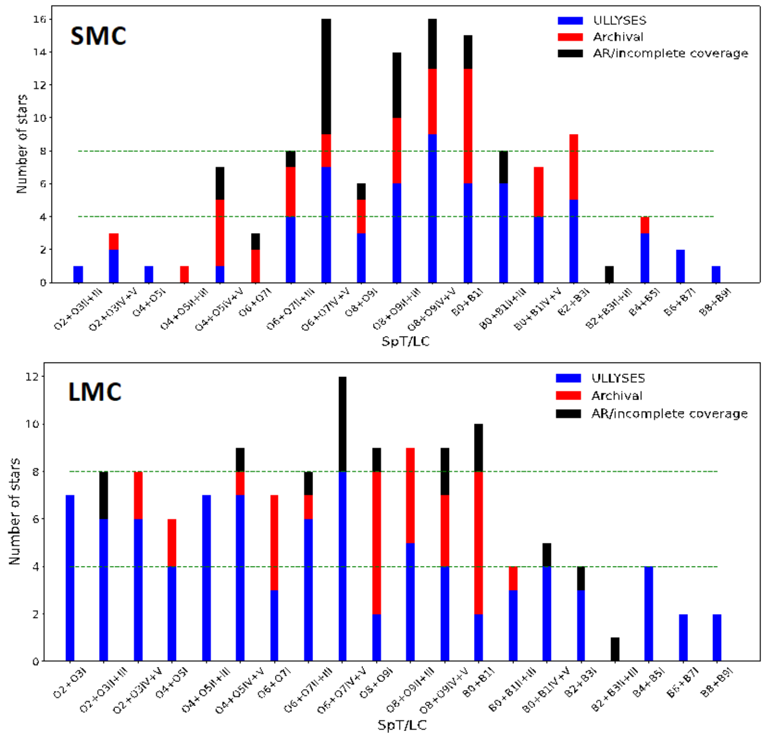
Spectroscopy of Massive Stars in the Nearby Universe: Lessons from ULLYSES for HWO

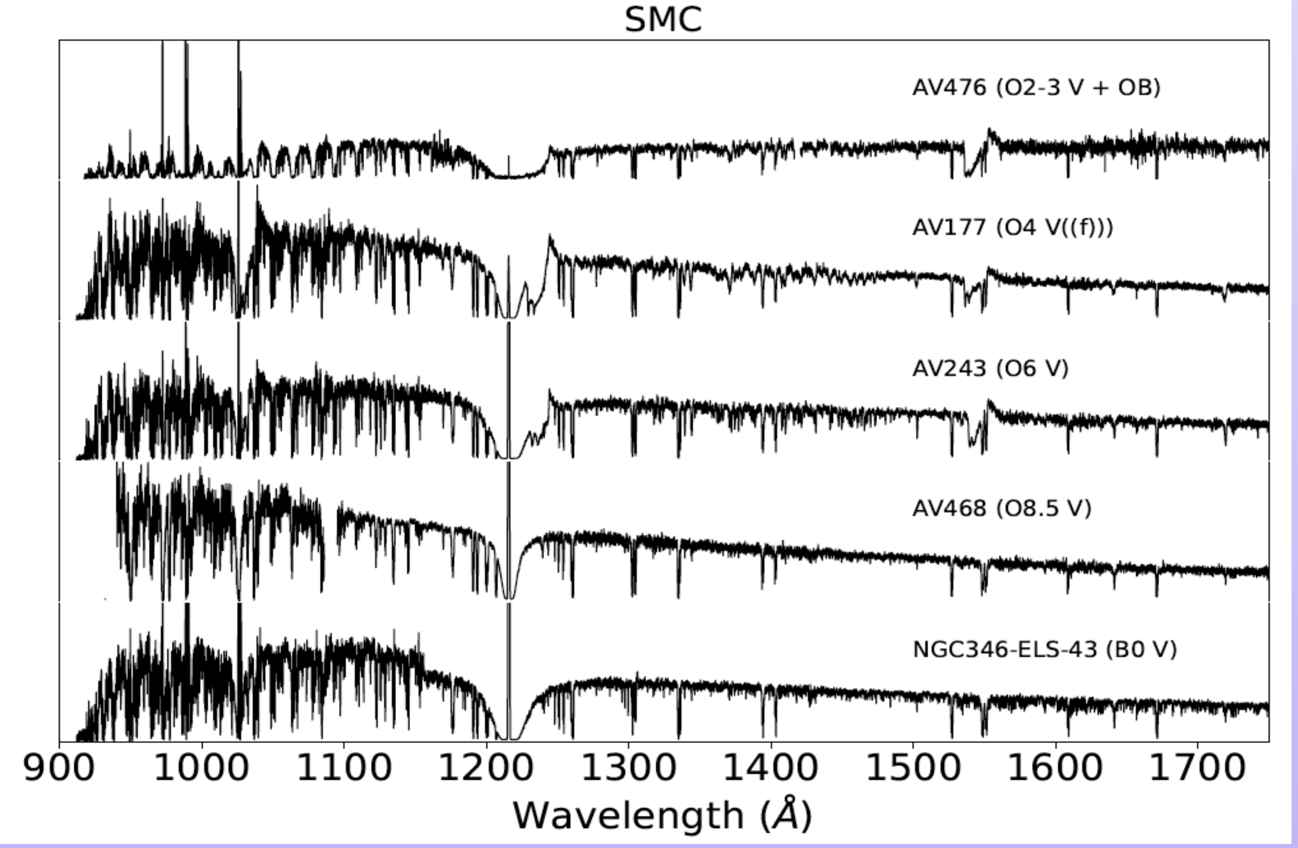
- ULLYSES = Ultraviolet Legacy Library of Young Stars as Essential Standards
- Director’s Discretionary Hubble program to obtain a spectroscopic reference sample of young low and high mass stars – Largest HST program ever executed (~1000 orbits)
- Designed by community
- Multi-object UV spectroscopy with HWO needed beyond the Milky Way and Magellanic Clouds to build a statistical sample of low Z OB stars

Final ULLYSES sample of massive stars

ULLYSES sample (including archival targets) covers massive star parameter space:

- At least 4 stars per bin of SpT/LC for O and early B stars
- 1-2 stars/bin for late B super-giants
- COS/G130M and G160M, or
- STIS /E140M
- Late O, B stars: NUV





Alexandre David-Uraz

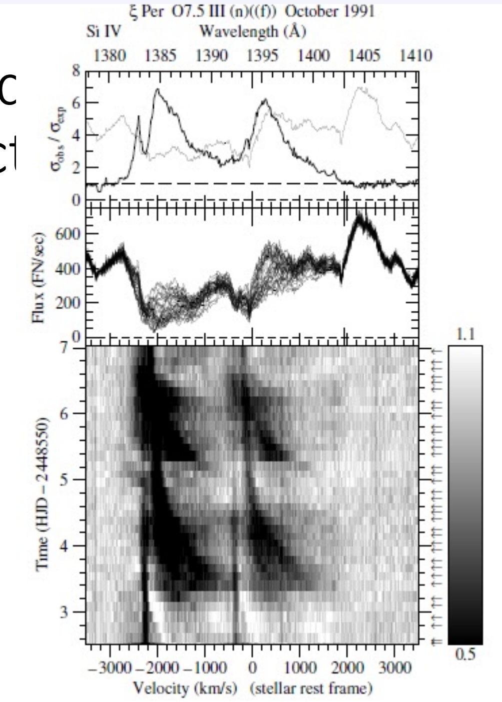
Star Wind Variability in the Ultraviolet

- The name of the game…

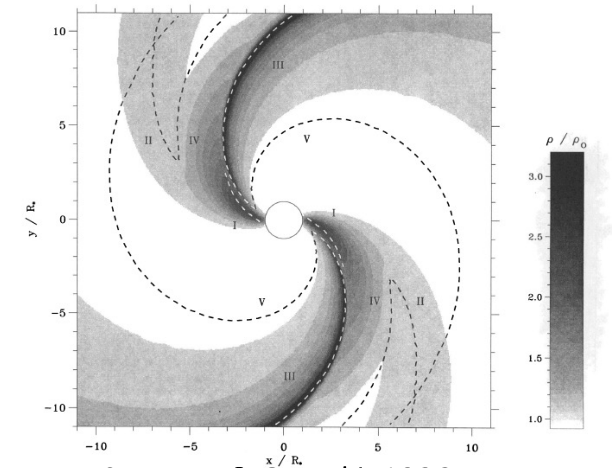
… is time-domain.

- To probe the multi-scale spatial and temporal properties of massive star winds, we must develop an agile suite of observing tools that can deliver *precision*, short *cadence*, and a long *temporal baseline*.

Winc … d from dynamic
spect

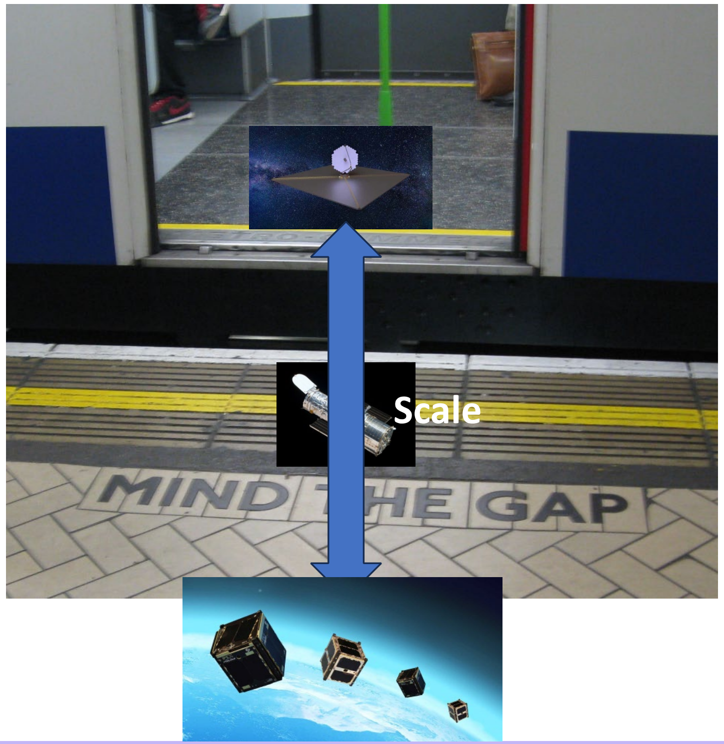


Kaper et al., 1997



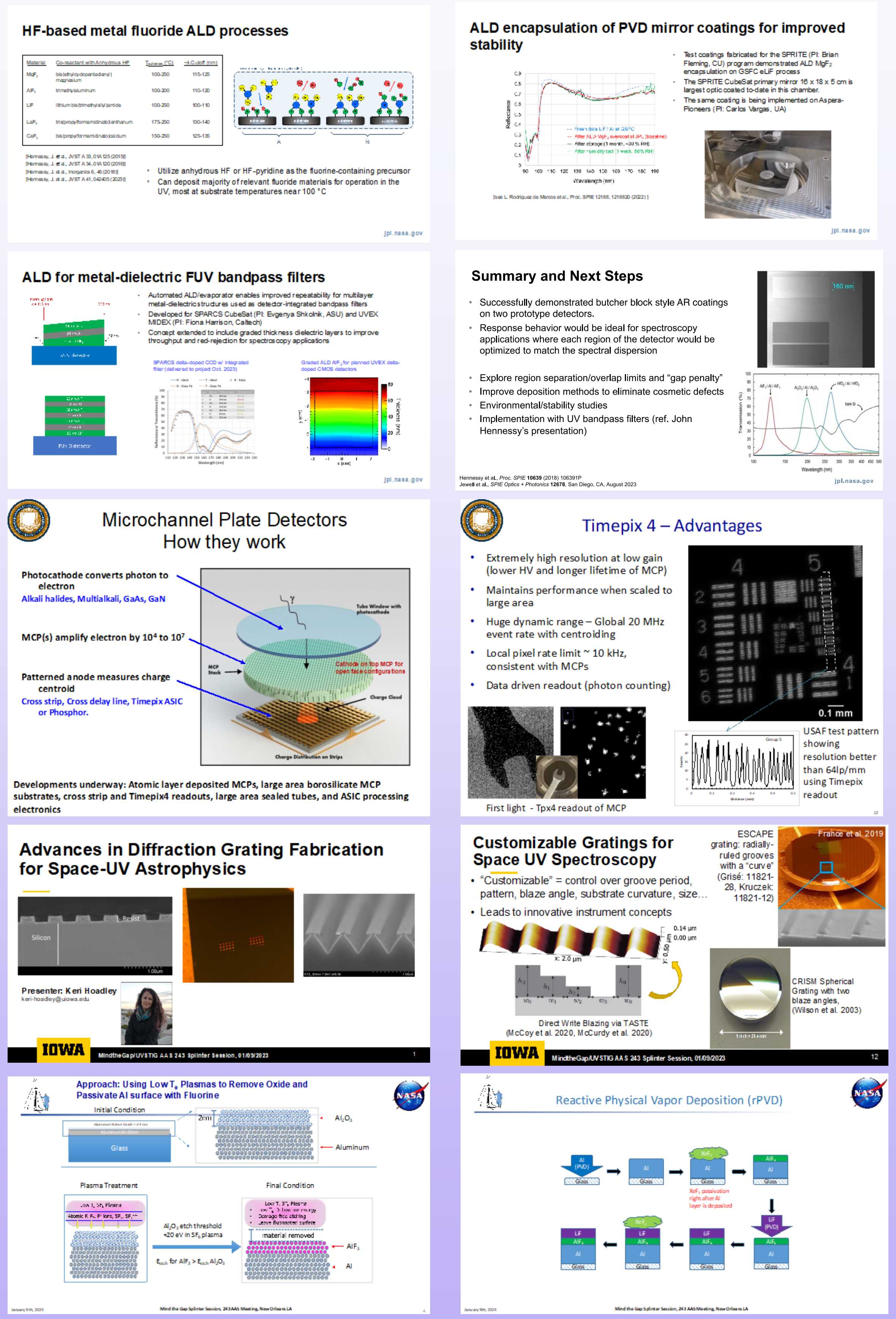
Cranmer & Owocki, 1996

Mind the gap



Tech Presentations

John Hennessy	UV Mirror and Detector Coatings by Atomic Layer Processing
April Jewell	Detectors for UV/Visible Spectroscopy
John Vallerga	Latest developments of MCP detectors at Berkeley
Keri Hoadly	Advances in Diffraction Grating Fabrication for Space-UV Astrophysics
Manuel Quijada	Emerging Coating Technologies for Realizing High-Reflectance and Stable Mirror Coatings for Observations in the FarUV
Sarah Tuttle	UV Technology White Paper: Getting Ready for HWO



Mission Presentations

Charz Shapiro	CASTOR – Cosmological Advanced Survey Telescope for Optical and uv Research
Kevin France	ESCAPE – Euv Stellar Characterization for Atmospheric Physics and Evolution
Shouleh Nikzad / Evgenya Shkolnik	SPARCS CubeSat - NUV & FUV photometry of 20 low-mass stars, young and old.
David Ardilla / Evgenya Shkolnik	UV-Scope - Science Drivers & Spectroscopic Capabilities for (MIDEX Concept)
Paul Scowen	POLSTAR - FUV Spectropolarimetry Mission (SMEX)
Keri Hoadly / Allison Youngblood	SNOUT - SmallSat for EUV stellar flare effects on exoplanets
Emily Witt	Efficient Spectral Multiplexing for Habitable Worlds Observatory - INFUSE: First FUV IFS Flown