STScI | SPACE TELESCOPE SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

The ULLYSES Director's Discretionary Program

Charting Young Stars' Ultraviolet Light with Hubble

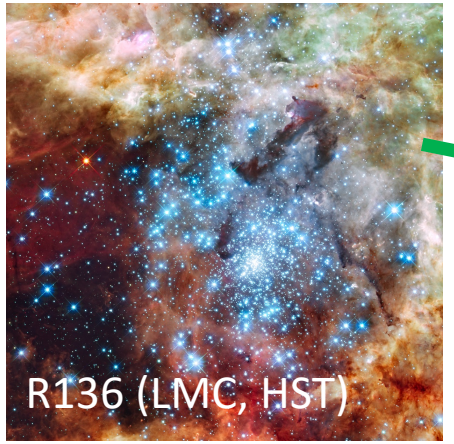
Julia Roman-Duval, Jo Taylor, Rachel Plesha, Alex Fullerton, Will Fischer

& the ULLYSES implementation team

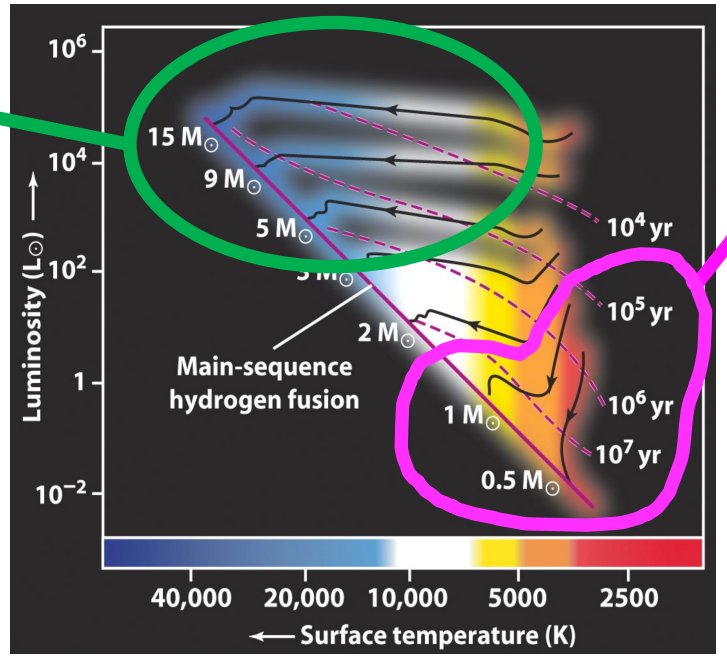
STUC Meeting – May 2023

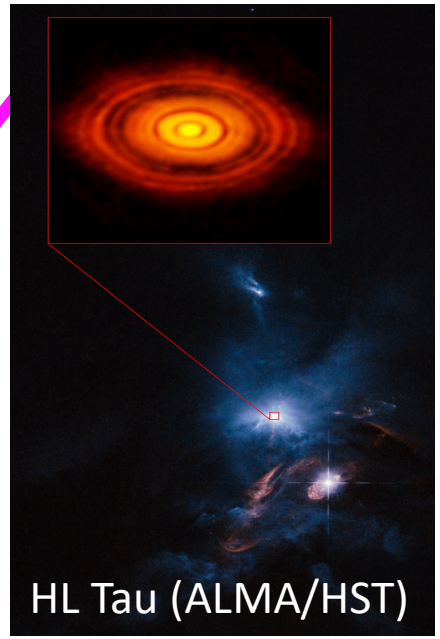
ULLYSES at a Glance

- 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)**
- The scientific framework of the program was designed by the community, via a UV Legacy Working Group and the program is being implemented by a dedicated team at STScI



~500 orbits to extend the spectroscopic library of O and B stars to low metallicity (10% - 50% solar)





~500 orbits to obtain a spectroscopic library and time monitoring of T Tauri stars (younger than 10 Myr, mass < 1 M_o)

Outline

- Program status and miscellaneous updates (Julia Roman-Duval)
- Update on observing (Alex Fullerton, Will Fischer):
  - LMC/SMC massive stars
  - Massive stars in low-metallicity galaxies
  - Single-epoch (“survey”) T Tauri stars
  - “Monitoring” T Tauri stars
  - LCOGT photometric monitoring of T Tauri stars
- Update on data products and data releases (Jo Taylor, Rachel Plesha)
- Plan and status of close-out (Julia Roman-Duval, Jo Taylor)

Program Status and Misc. Updates

Program Status

- As of May 2023, ULLYSES observing is **95% complete**
- **7 data releases**
- **DR6** occurred on March 21, 2023 (see details in Data Products section by Jo Taylor)
  - Advertised on Twitter, web, and by email

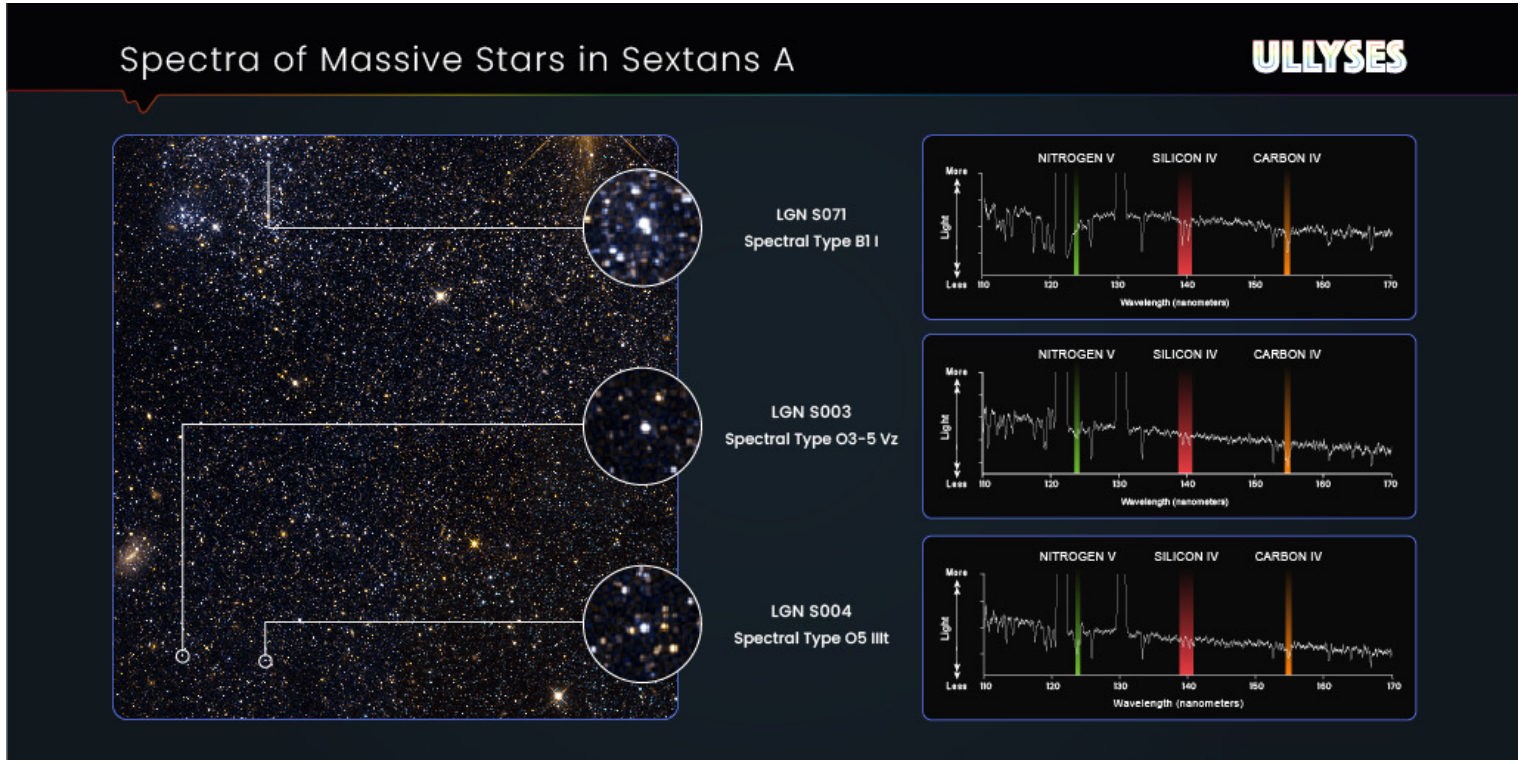


Figure highlighting recent COS spectroscopy of Sextans A

Created by OPO for Twitter announcement of DR6

Program Status (Cont'd)

- **ULLYSES catalog/search form**

https://mast.stsci.edu/search/ui/#/ullyses

- **Public code** for making ULLYSES high-level science data products and **co-adding any COS or STIS spectra**
  - Also merges STIS echelle orders

https://github.com/spacetelescope/ullyses

- Presence at **AAS #241**
  - NASA hyperwall talk
  - Research talk
  - Presentation at STScI townhall
- **ULLYSES survey paper** is well underway

Program Status (Cont'd)

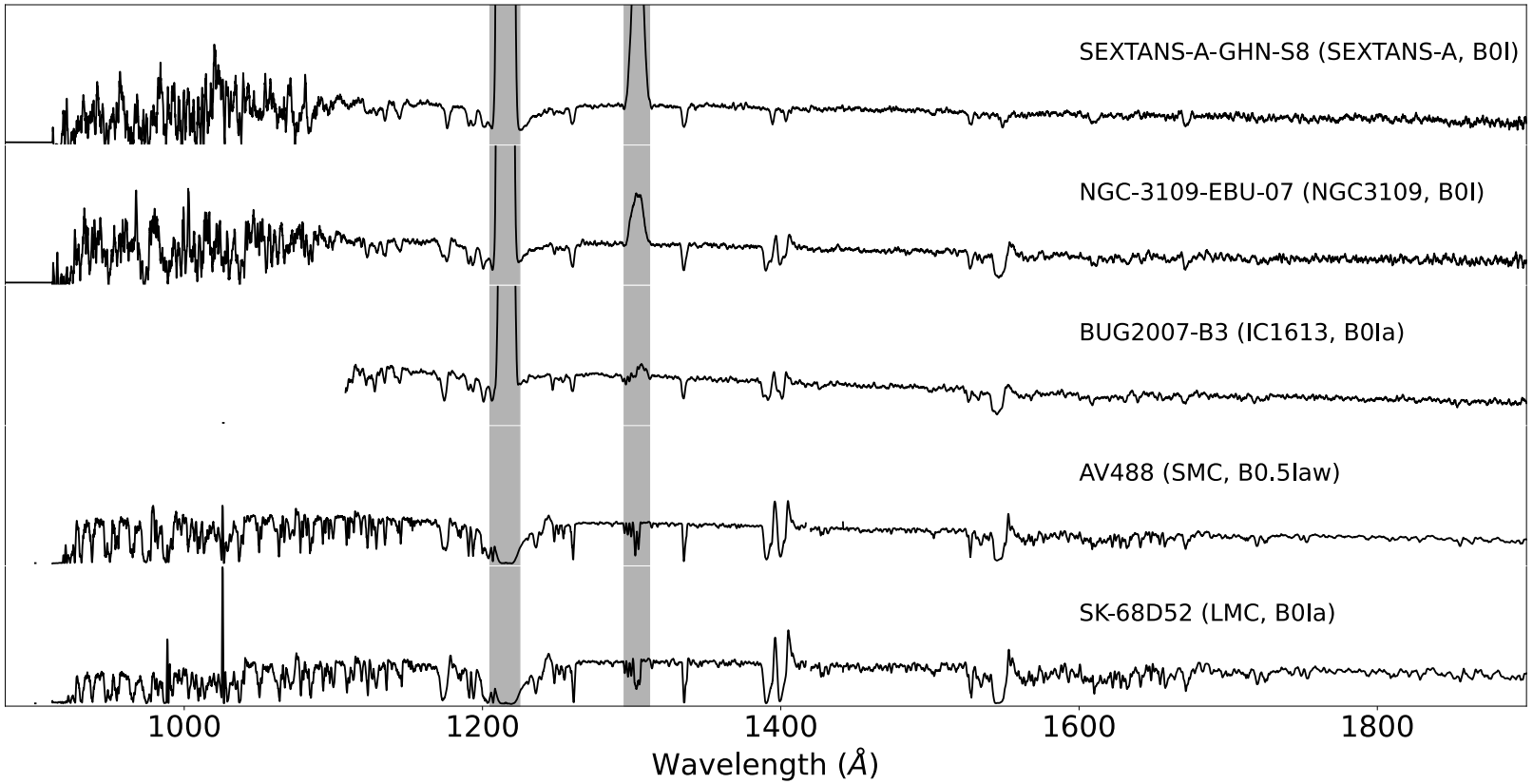
- **Completion of the program expected by the end of 2023**
  - All data products will have their final delivery as part of **DR7 in December 2023**
- **12 peer-reviewed publications** by the community (and counting) – see next slide
- Several ULLYSES-focused workshops and conference sessions (e.g., Lorentz workshop on massive stars organized by IAU-G2 and XSHOOTU collaboration in late 2022; Protostars and Planets VII in 2023)
- ULLYSES workshop at STScI in the planning for late 2023/Spring 2024

Publications by the Community (so far)

First author	Bibcode	Title
Carlo Manara	2021A&A...650A.196M	PENELLOPE: The ESO data legacy program to complement the Hubble UV Legacy Library of Young Stars (ULLYSES). I. Survey presentation and accretion properties of Orion OB1 and σ-Orionis
Antonio Frasca	2021A&A...656A.138F	PENELLOPE. II. CVSO 104: A pre-main sequence close binary with an optical companion in Ori OB1
Daniel Pauli	2022A&A...659A...9P	The earliest O-type eclipsing binary in the Small Magellanic Cloud, AzV 476: A comprehensive analysis reveals surprisingly low stellar masses
Dirk Froebrich	2022MNRAS.510.2883F	A survey for variable young stars with small telescopes - V. Analysis of TX Ori, V505 Ori, and V510 Ori, the HST ULLYSES targets in the σ Ori cluster
Catherine Espaillat	2022AJ....163..114E	The ODYSSEUS Survey. Motivation and First Results: Accretion, Ejection, and Disk Irradiation of CVSO 109
Caeley Pittman	2022AJ....164..201P	Towards a comprehensive view of accretion, inner disks, and extinction in classical T Tauri stars: an ODYSSEUS study of the Orion OB1b association
Parker Hinton	2022ApJ...939...82H	Far-ultraviolet Flares on Accreting Protostars: Weak and Classical T Tauri Stellar Pair Analysis
Paul Crowther	2022arXiv220708690C	ULLYSES and Complementary Surveys of Massive Stars in the Magellanic Clouds
Calum Hawcroft	2023arXiv230312165H	X-Shooting ULLYSES: Massive stars at low metallicity. III. Terminal wind speeds of ULLYSES massive stars
Nicole Arulanantham	2023ApJ...944..185A	Lyα Scattering Models Trace Accretion and Outflow Kinematics in T Tauri Systems
Jerome Bouvier	2023A&A...672A...5B	Stable accretion and episodic outflows in the young transition disk system GM Aurigae. A semester-long optical and near-infrared spectrophotometric monitoring campaign
Jorick Vink	A&A, in press	X-Shooting ULLYSES: Massive stars at low metallicity. I. Project Description

Sample Additions in DR6 – Low Metallicity Massive Stars

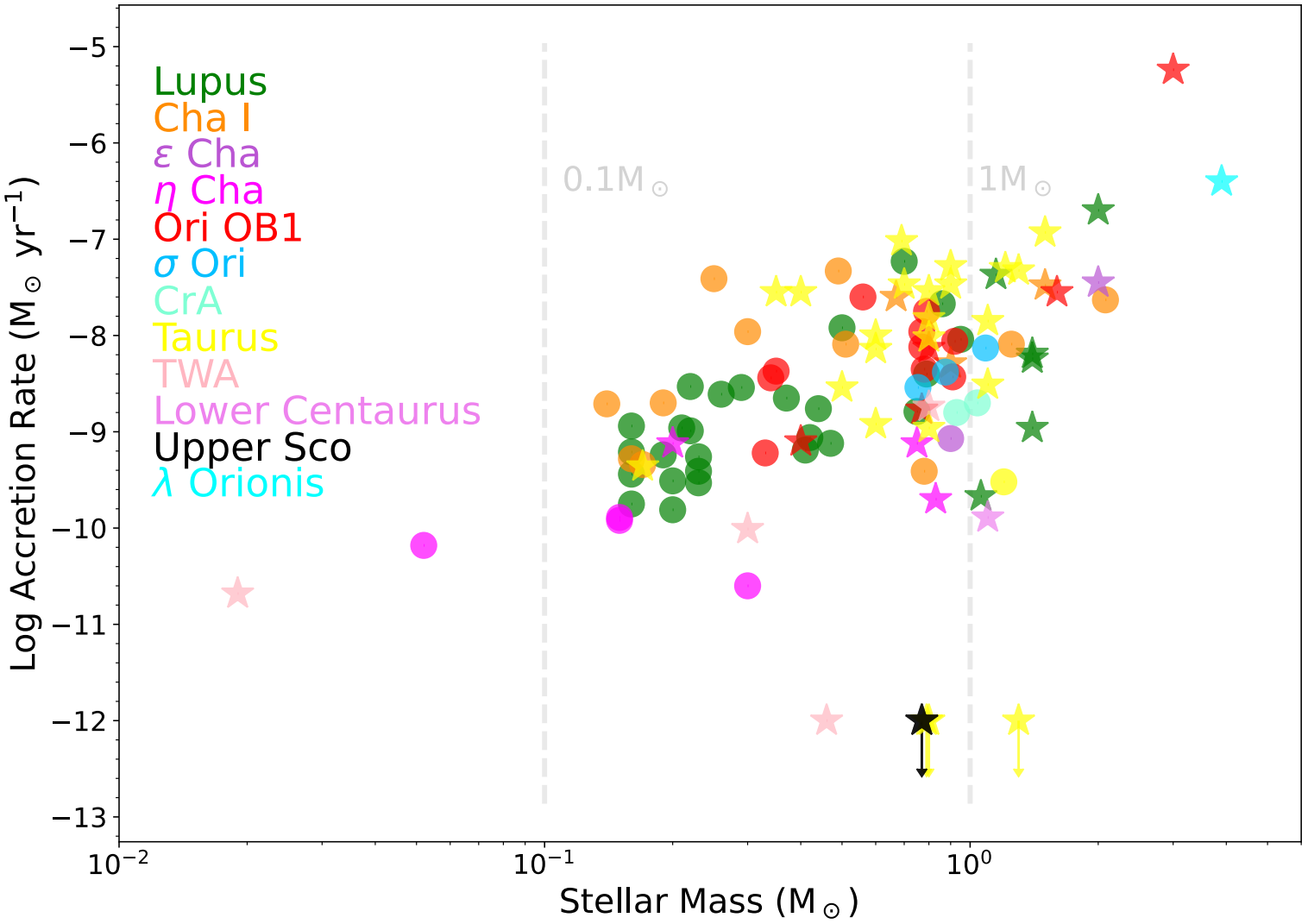
- **All archival targets** in nearby low metallicity galaxies **IC 1613, Sextans A, WLM, and Leo** P were **added to the ULLYSES** sample and database in DR6
  - Metallicity coverage from 50% solar (LMC) down to 3% solar (Leo P)



Sample Additions in DR6 – T Tauri Stars

58 TTS observed by ULLYSES

Additional **8 T Tauri stars a**dded to sample in DR6, bringing total **archival TTS targets to 50**



Technical Observing Updates

Observing Status – 95% complete

LMC	Number	Complete	%
Targets	94	85	90%
Orbits	255	223	87%
Programs	32	26	81%
HOPRs	16	27 orbits repeated (12%)	

Survey TTS	Number	Complete	%
Targets	58	56	97*
Orbits	390	390	100
Programs	24	24	100
HOPRs	9	50 orbits repeated (13%)	

*2 targets dropped after failure

SMC	Number	Complete	%
Targets	60	57	95%
Orbits	210	206	98%
Programs	19	18	95%
HOPRs	19	46 orbits repeated (22%)	

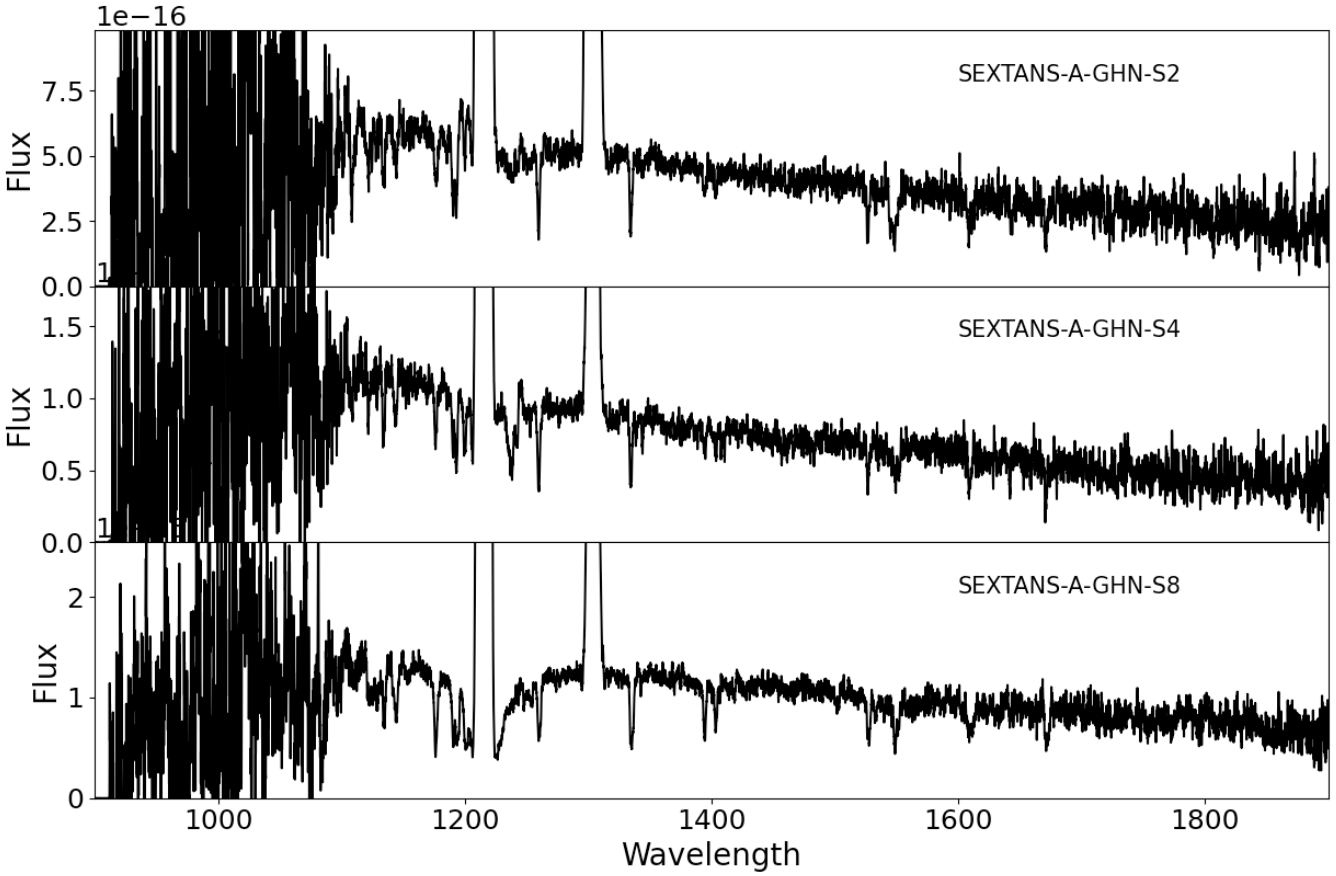
Monitor TTS	Number	Complete	%
Targets	4x2	8	100
Orbits	96	96	100
Programs	8	8	100
HOPRs	7	7 orbits repeated	

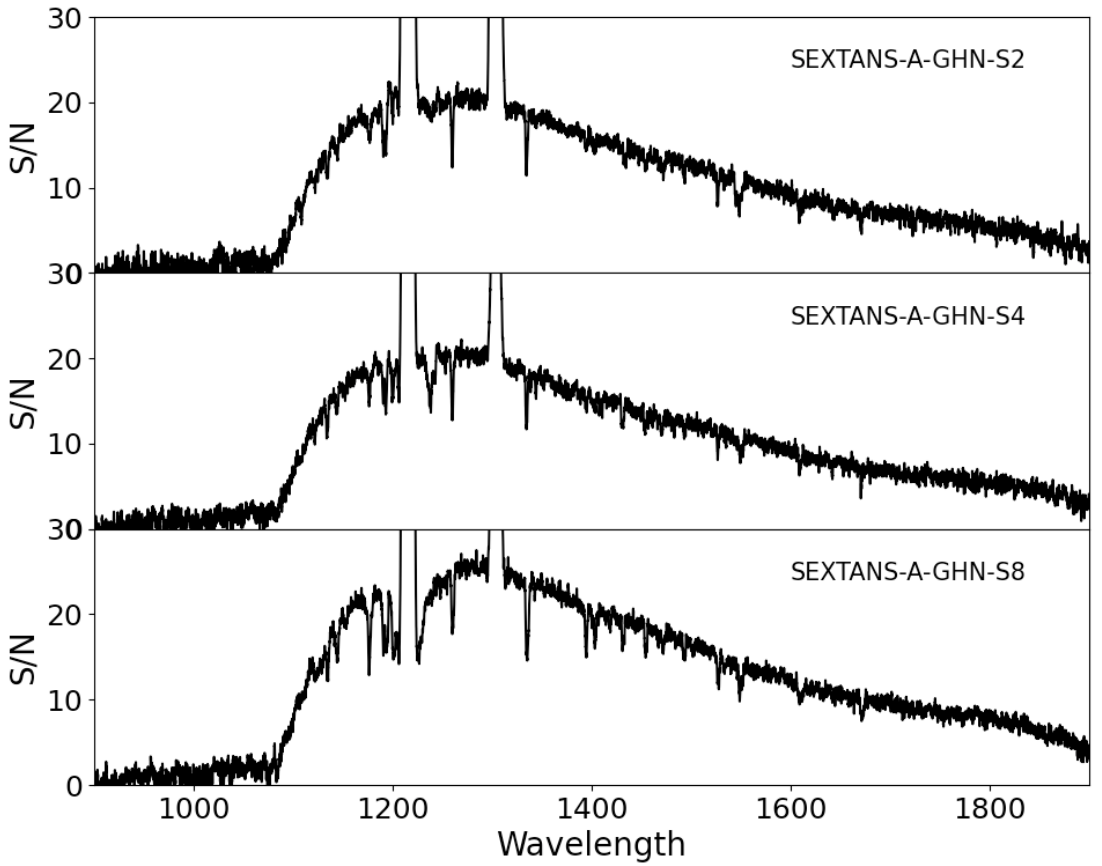
Galaxy	Metallicity	WFC3 Pre-Imaging *		COS G140L/800 Spectroscopy		
		Orbits	Status	Targets	Orbits	Status
NGC 3109	0.1 – 0.2 $Z_\odot$	4	Complete	3	9	Complete
Sextans A	< 0.1 $Z_\odot$	2	Complete	3	20	Complete

*F225W, F275W, F336W, F475W, F814W

Observing Status for Massive Stars in Low-Metallicity Galaxies

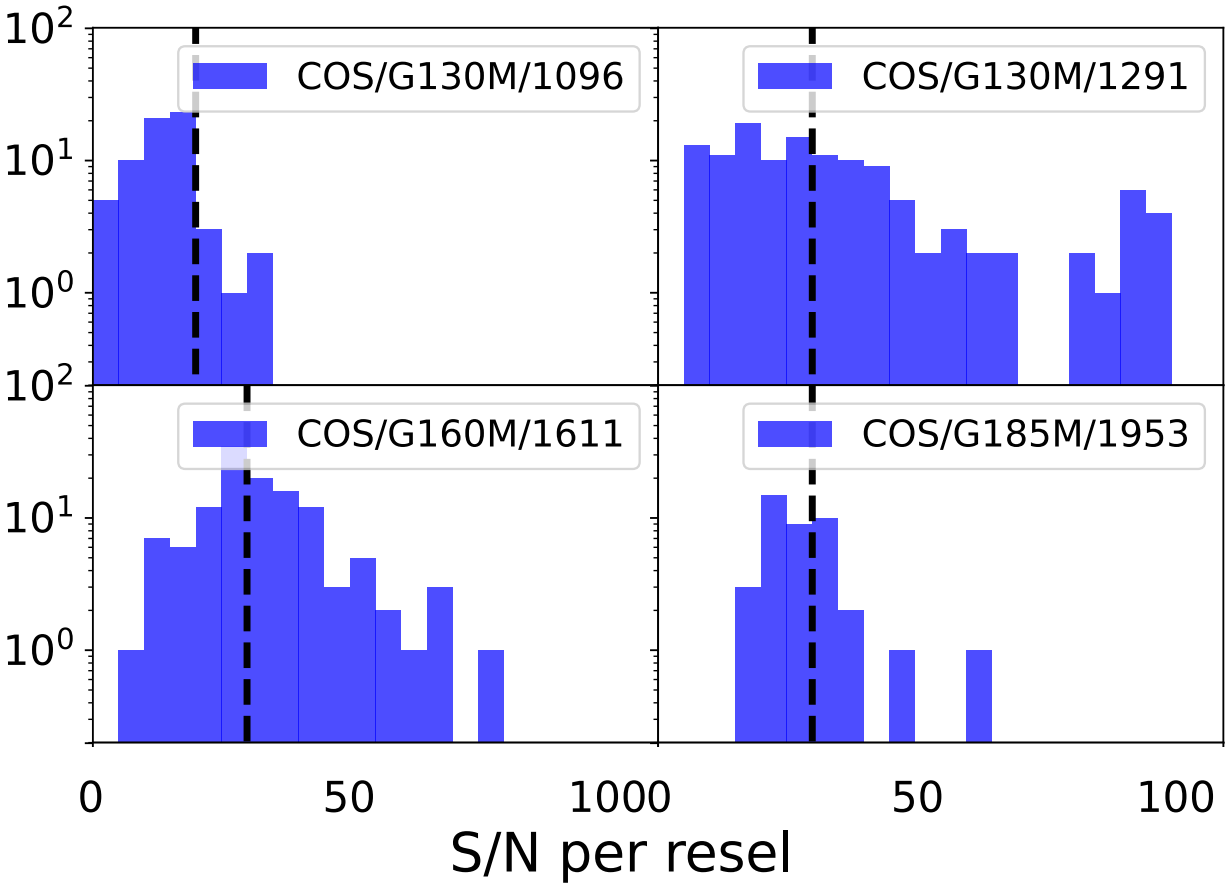
- NGC3109 spectroscopy completed in December 2021, included in DR5
- Sextans A spectroscopy completed in December 2022, included in DR6

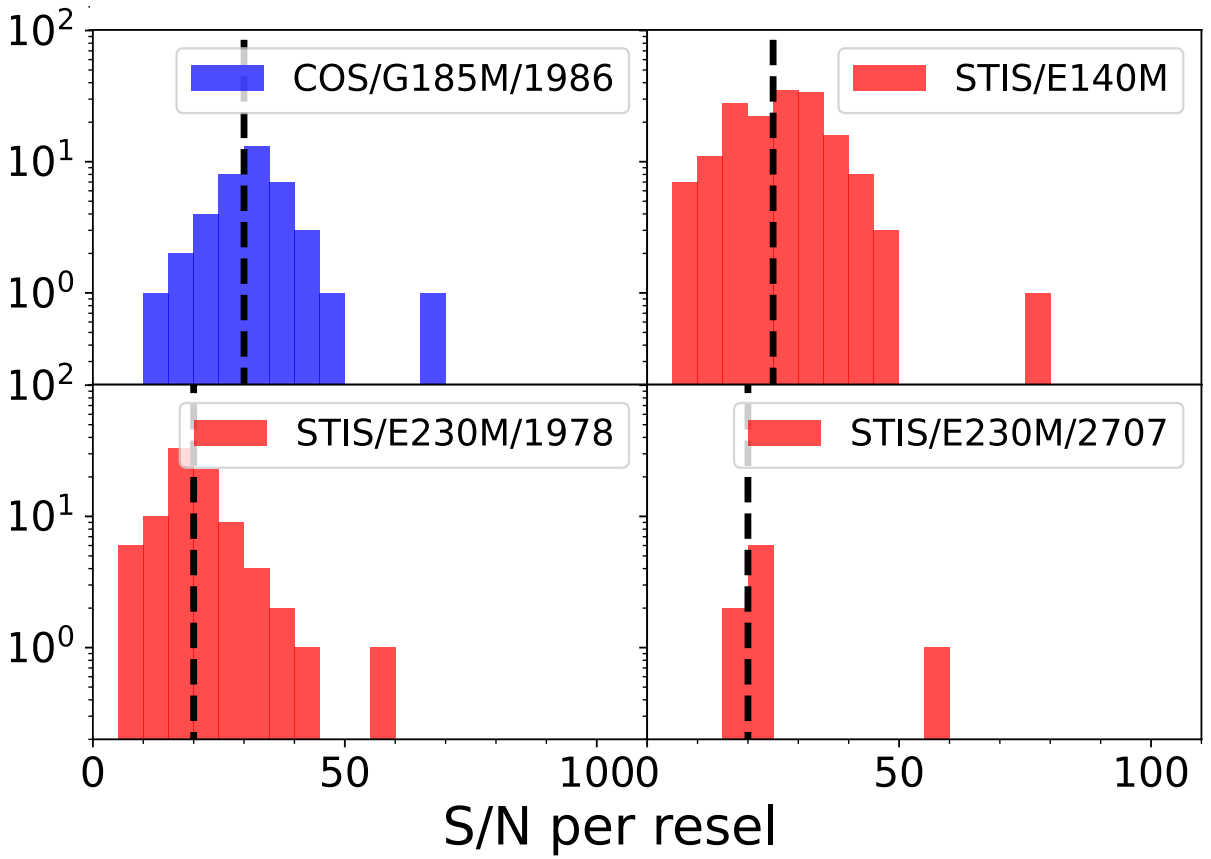




Top-ups for COS/G130M/1096 Observations of Massive Stars

- The COS/G130M/1096 observations of LMC/SMC massive stars tend to fall low in S/N
- Observations with other mode are achieving the target S/N





Top-ups for COS/G130M/1096 Observations of Massive Stars

- We have implemented "top-up" 1096 observations for 11 stars
  - 6 already observed with known low S/N (< 16 @ 1070 Å)
  - 5 not yet observed (but expected to fall low due to orbit packing and underestimation of UV flux from B or V band)
- The top-up observations will allow us to reach S/N = 16 @ 1070 Å, in line with the S/N achieved for the other 23 stars observed with this setting
  - Two new PIDs created to top-up stars already observed
  - Visits added to existing PIDs for stars not yet observed

1. **New Cycle 29 Programs**

PID	Visit	Target	Orbits	Previous PID	Previous Visit
17295	ULLYSES Supplemental FUV Exposures for SMC O Stars - COS				
	1C	NGC346-ELS-31	2	16372	3C
	2C	AV296	1	16802	1C
	3C	2DFS-2553	1	16803	1C, 1D
	4C	SK183	1	16808	1C
17296	ULLYSES Supplemental FUV Exposures for LMC O Stars - COS				
	1C	VFTS-355	2	16814	2C
	1D	VFTS-355	2	16814	2C
	2C	N11-ELS-020	1	16817	1C

2. **Additions to Existing Cycle 29 Programs**

PID	Visit	Target	New Top-Up Visit	Top-Up Orbits
16811	1C	N11-ELS-026	1D	1
16813	2C	SK-68D133	2D	1
16816	1C	BI 265	1D	1
16816	2C	SK-69D212	2D	1
16822	1C	LH58-496	1D	1

Plan Windows for Upcoming LMC/SMC Observations

- Latest planned windows are July 10, 2023
- Most observations have planned windows ending in June 2, 2023
- All observations should be completed well before the DR7 data freeze in October 2023

ULLYSES ABOUT TARGETS ANNOUNCEMENTS DATA RELATED PROGRAMS ULLYSES TEAMS

2dFS 3747	SK 173	**SK173**	01h 25m 38.23s	-73d 07m 39.35s	B0.7 IIe	13.57	0.07	16101	COS/FUV	Aug 29 2020	Completed
2dFS 3780	2dFS 3780	**2DFS-3780**	01h 26m 35.29s	-73d 15m 16.30s	O9.7 IV	14.37	0.01	16809	COS/FUV & STIS/FUV	Sep 13 2022	Completed
SK 179	SK 179	**SK179**	01h 28m 27.99s	-72d 46m 55.58s	B6 I	13.06	-0.03	16375	COS/FUV & COS/NUV & STIS/NUV	Aug 28 2021	Completed
SK 183	SK 183	**SK183**, SK-183	01h 29m 24.55s	-73d 33m 16.37s	O3 V((f*))z	13.82	0.05	15837, 16808, 17295	COS/FUV & STIS/FUV	Apr 27 2020	In Progress

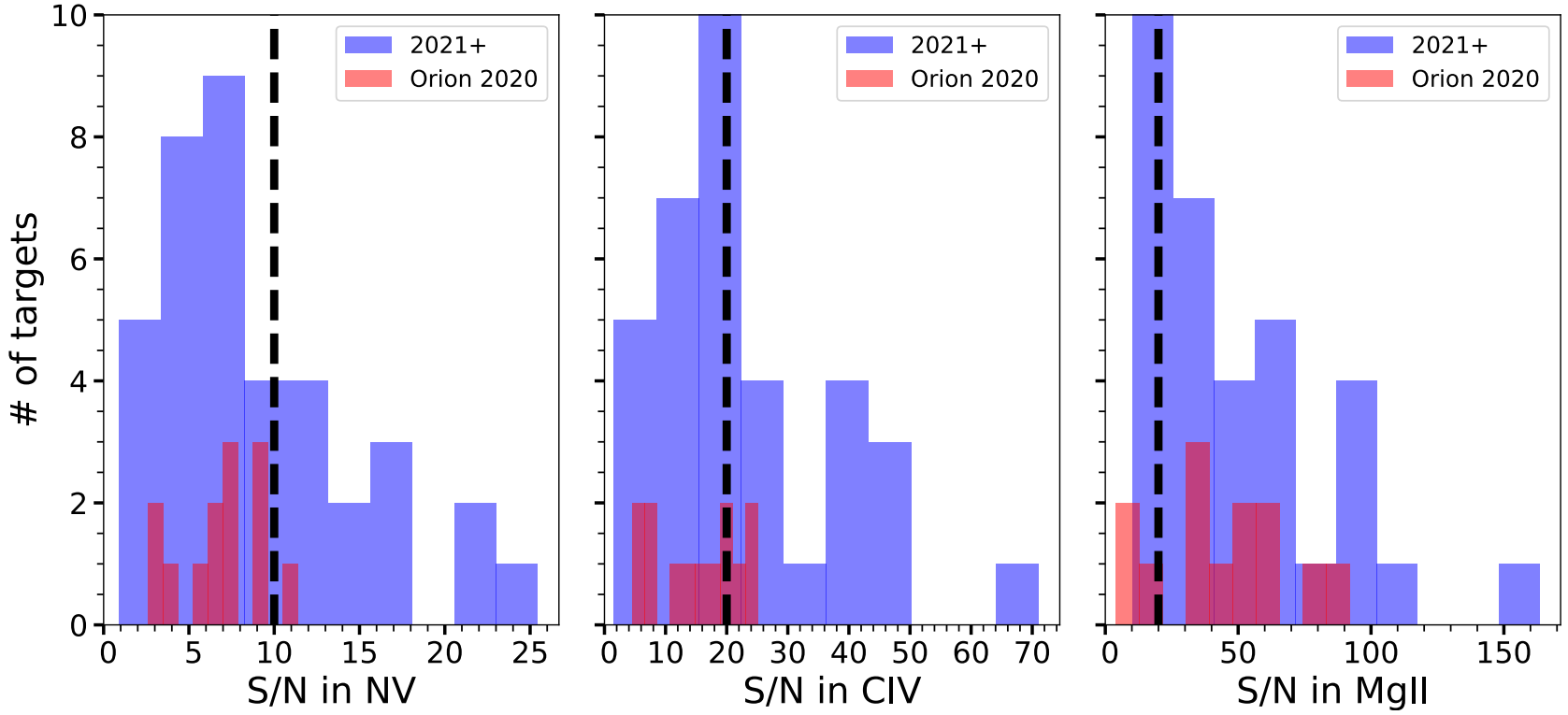
Proposal ID	Visit ID	Visit Status	Science Configuration	Observation Date
15837	01	Completed	STIS/FUV-MAMA: E140M/1425	Apr 27 2020
16808	1C	Completed	COS/FUV: G130M/1096	May 30 2022
17295	4C	Scheduling	COS/FUV: G130M/1096	May 01 2023 - May 29 2023

2dFS 3947	2dFS 3947	**2DFS-3947**	01h 30m 37.19s	-73d 25m 14.39s	B1.5 IV	14.99	0.02	16373	COS/FUV	Sep 07 2021	Completed
2dFS 3954	2dFS 3954	**2DFS-3954**	01h 30m 43.11s	-73d 25m 04.14s	O6 V((f))z	15.27	0.02	16370	COS/FUV	Aug 02 2021	Completed

Observing Status for ”Survey” T Tauri Stars

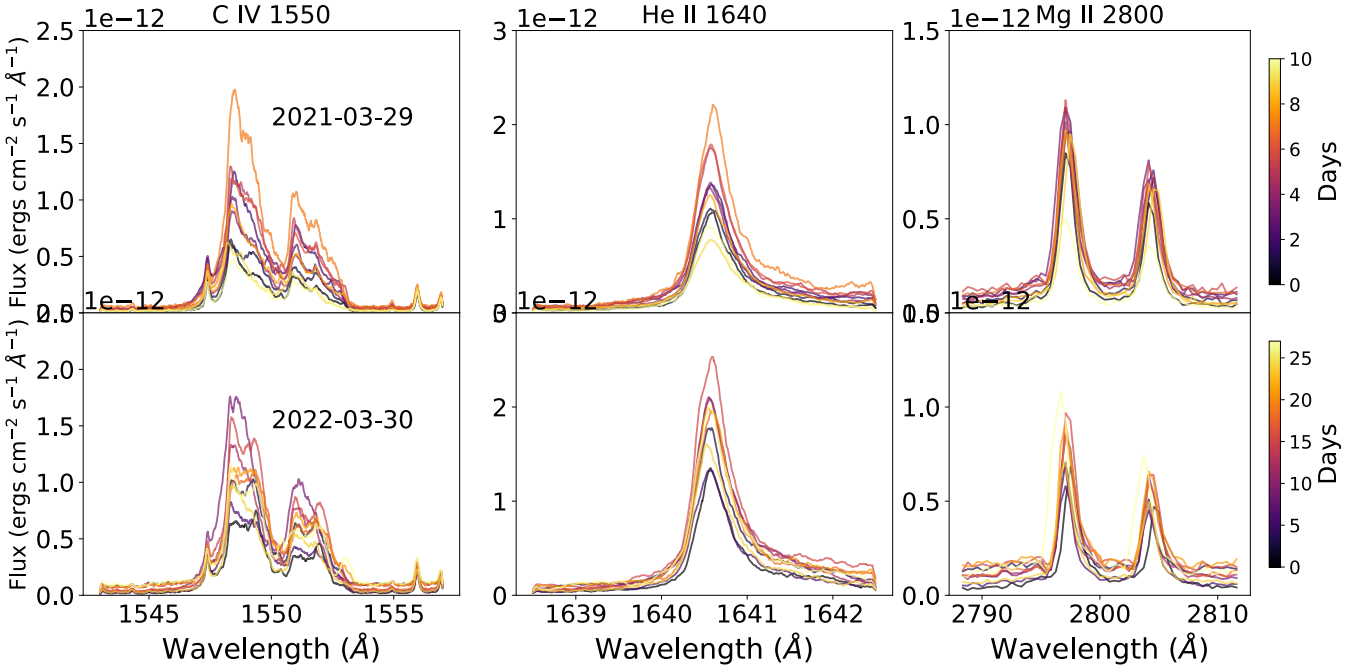
Execution is complete for all survey T Tauri stars (as of July 2022)

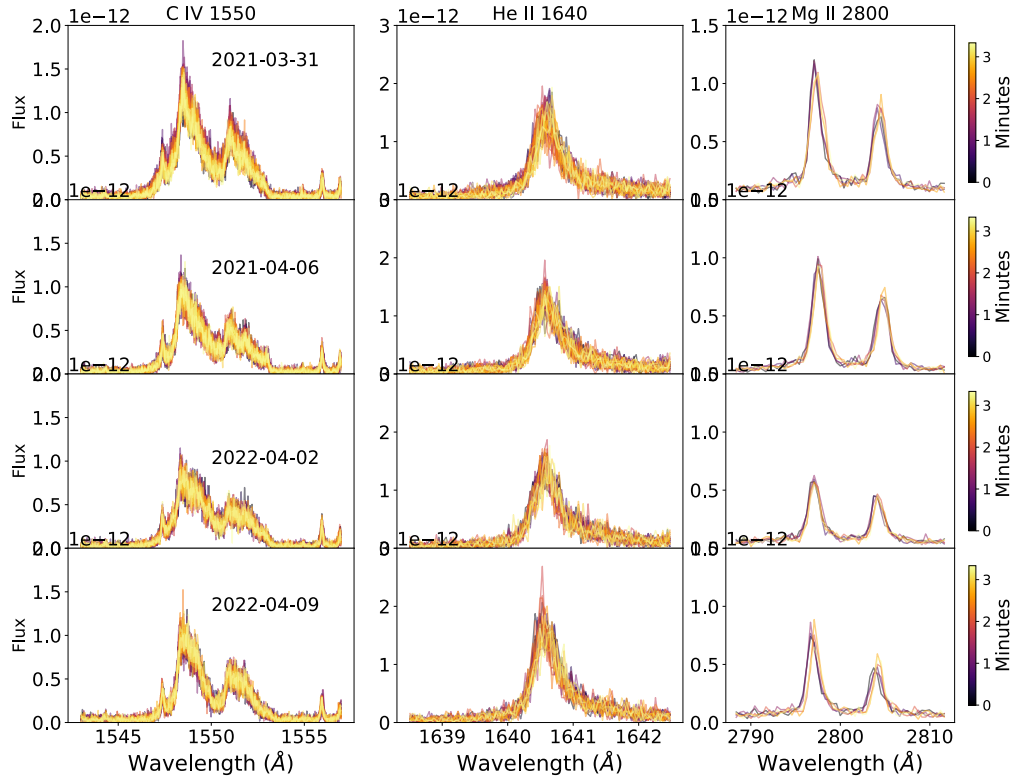
S/N is on target after adjustment on extinction performed after the Orion observations in December 2020



Observing Status for “Monitoring” T Tauri Stars

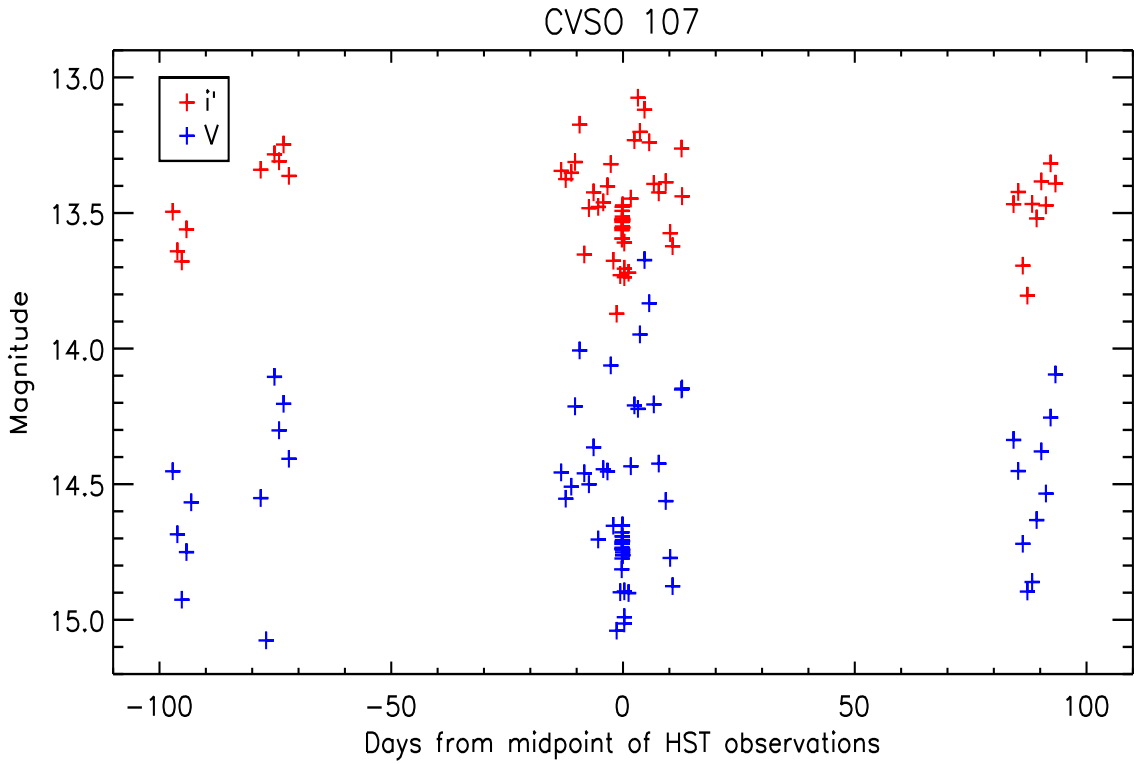
- Execution is complete for all monitoring T Tauri stars
- BP Tau and GM Aur observations executed in December 2022 – January 2023 in coordination with TESS
  - BP Tau – Visit 1G failed and was repeated only 2 days after the end of the chain
  - GM Aur – All visits successful





Status of LCOGT Photometric Monitoring

- LCOGT photometric data collection is complete for survey and monitoring TTS
- 11,066 images were obtained in the u', V, and i' bands to provide context for the HST spectroscopy.



ULLYSES Data Products

ULLYSES Deliverables

WEBSITE
ullyses.stsci.edu

Program information
Observing status and schedule
Data product description
List of coordinated programs
Data release (DR) notes

PUBLIC CODEBASE
github.com/spacetelescope/ullyses

Custom calibration routines and config files Photometry
Spectral coaddition and splicing
Spectral time-series
COS vignetting correction
Target metadata, alias information
Automatic webpage generation
Product data quality checks

INTERNAL DATABASE

Target metadata
Observational metadata

ULLYSES SEARCH FORM
mast.stsci.edu/search/ui/#/ullyses

Built on Missions MAST framework
Uses database and custom API

ULLYSES HLSPs

High level science data products
See next slide

Description of Data Products

- **Flux-weighted co-added spectra** obtained with the same grating
  - E.g., different exposures with the same or different cenwaves and FP-POS
- **Spliced (abutted) spectra** between different gratings and instruments
  - E.g., FUSE + HST, COS + STIS
- Vetted **FUSE spectra** for LMC/SMC massive stars
- **Custom calibrated STIS G230L and CCD spectra** of T Tauri stars
  - In particular, **de-fringing of G750L** spectra, improved hot pixel flagging, and re-extraction of targets (as needed) and companions
- Photometric (LCOGT) and spectroscopic (HST) **time-series**
  - Spectroscopic time-series from HST only for T Tauri stars monitored over time
- **Drizzled WFC3 images** of NGC 3109 and Sextans A

Data Dissemination Platforms

Data can be downloaded from 3 different platforms

NEW!

ULLYSES SEARCH FORM (HLSPs only)

Built on Missions MAST framework
Uses database and custom API

MAST DISCOVERY PORTAL (HLSPs and contributing data)

See instructions at the MAST HLSP collection

MAST ULLYSES HLSP COLLECTION (HLSPs only)

Uses MAST portal interface

DR5b Contents

- **DR5b occurred on November 15, 2023** and included:
  - COS and STIS spectra for 17 ”survey” T Tauri stars observed after DR5
  - Release of ULLYSES search form (https://mast.stsci.edu/search/ui/#/ullyses)

Image of the Lupus cloud taken with the MPG/ESO 2.2-metre telescope at the La Silla Observatory in Chile. ULLYSES targets overlaid. Credit ESO/F Comeron.

Twitter announcement of DR5b

DR6 contents

- Latest data release (DR6 on March 21, 2023) includes:
  - **COS and/or STIS data for 286 massive stars in the LMC, SMC, and low-metallicity galaxies NGC 3109, Sextans A, IC 1613, WLM, and Leo-P.** NEW!
  - **FUSE spectra** for 146 LMC/SMC stars, including new **re-calibration** for 23 stars NEW!
  - COS and STIS spectra for **108 "survey" (single epoch)** T Tauri stars
  - COS FUV and NUV spectroscopic time series for four T Tauri stars monitored over time
    - ✓ **Now includes archival data** NEW!
  - **LCOGT photometric time series** in the u', V, and i' bands for the four T Tauri stars monitored with HST
  - Drizzled WFC3 images of NGC 3109 and Sextans A obtained as part of the ULLYSES program
  - Calibrated STIS spectra for 9 non-ULLYSES targets that are present in STIS long-slit observations of T Tauri stars
  - Public code to generate ULLYSES HLSPs and co-add COS or STIS spectra
    - ✓ Includes merging echelle orders for STIS spectra
    - ✓ Co-add code was made generic to be used with any non-ULLYSES COS or STIS data NEW!

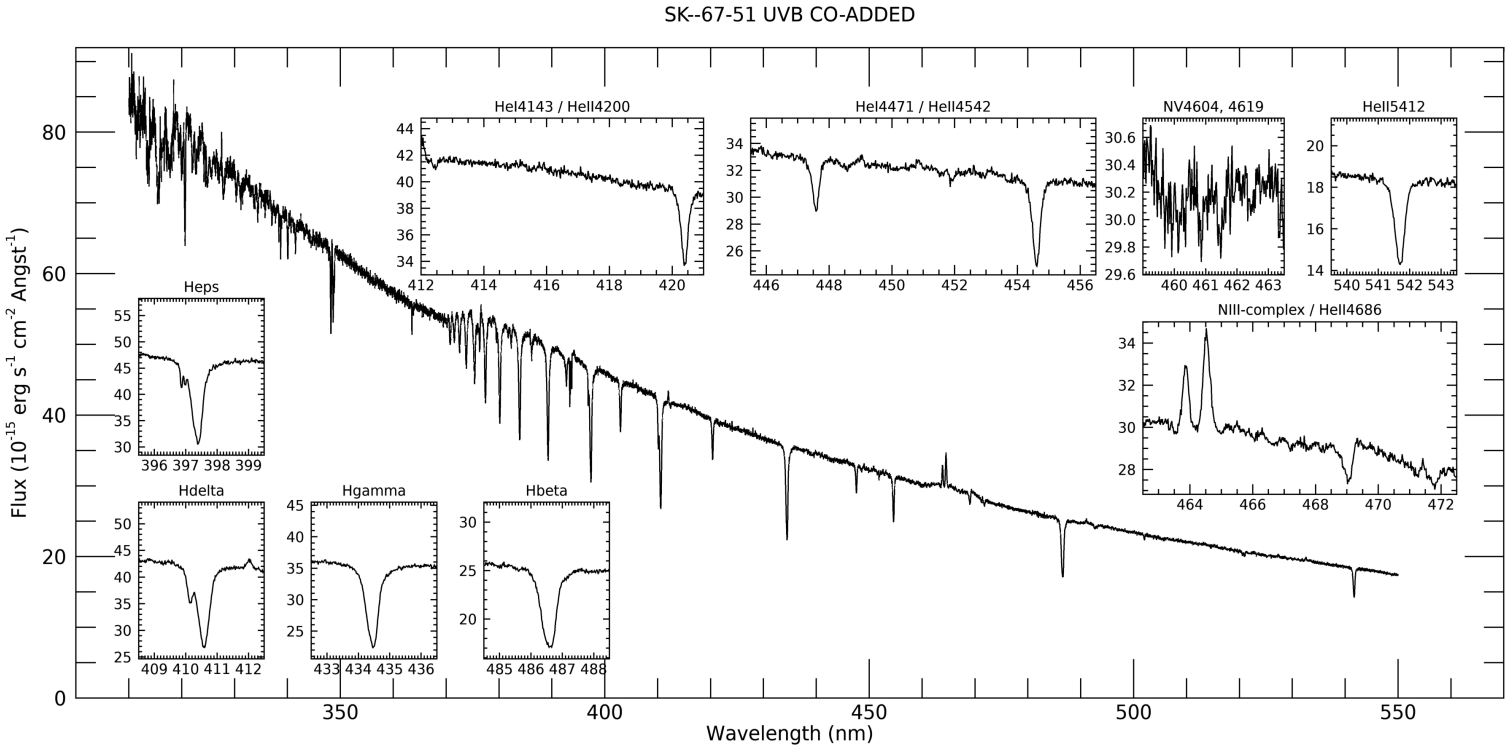
Plan and Status of Close-Out

Plan and Status for Close-out

- All products (HLSPs, website, database + catalog, HLSP code) will have their **final delivery as part of DR7, planned for December 2023**
  - **DR7 will be the final ULLYSES DR**
  - We will time DR7 to include important instrument calibration updates
    - ✓ STIS blaze shift coefficients and flux calibration
    - ✓ COS walk and geometric corrections
- We will not re-process HLSPs beyond DR7
  - ➢ The HLSPs will live statically in MAST (like all other HLSP collections)
  - ➢ The associated HST calibrated data in MAST will continue to be re-processed in the coming years
  - ➢ Users may re-generate HLSPs from re-processed products in the long term by using public HLSP-making software

Plan and Status for Close-Out – Community HLSPs

- Ingest community-provided HLSPs into ULLYSES/MAST collection
  - ➢ XSHOOTU (VLT/XSHOOTER complement of HST for massive stars)
    - ✓ Discussions with collaboration are concluded; plan is set; technical implementation started
  - ➢ PENELLOPE (VLT/XSHOOTER complement of HST for TTS)
    - ✓ Discussion with collaboration just started



Plan and Status for Close-Out – Database and Catalog Updates

- Fix a few known issues in DB files (star names mostly) – in progress
- Incorporate all archival data and meta-data for massive stars and T Tauri stars
  - Massive stars in Leo A – not started
  - STIS archival data and target metadata of TTS in the Milky Way – in progress
  - Archival data of monitoring TTS not included in DR6 – not started
- Add new fields to the DB/catalog
  - Intrinsic colors of massive stars
  - Gaia parameters (ID, photometry)
- Link previews to ULLYSES targets in the catalog – in progress (static previews generated)

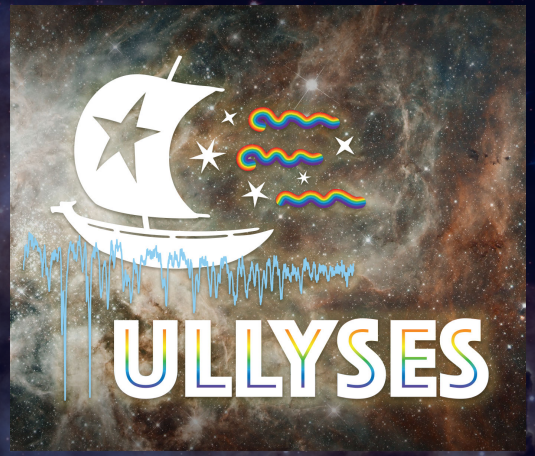
Plan and Status for Close-Out – Code Updates

- Fix one known issue (documented in data release notes)
- Improve the ULLYSES software packages
  - Documentation – in progress
  - Jupyter notebooks – not started
  - Versioning – in progress
  - PypI – in progress
  - Regression tests – in progress
- Implement the *stisblazefix* tool into the HLSP generation script – not started

Plan and Status for Close-Out – Data Product Updates

- Download and ingest x1d spectra from SNAP program 16230 (STIS/CCD NUV-optical spectra of LMC and SMC massive stars) – in progress
- Re-process all HST and FUSE ULLYSES data with latest instrument calibrations – not started (will be done after October)
- Deliver all LCOGT photometric time-series (some were taken after DR6) – in progress
- Investigate vignetting correction for archival COS/NUV data – in progress
- Vet and (re-)calibrate archival STIS data for 100 TTS – in progress
- Expand and improve documentation on website

Questions and Feedback



Acknowledgements

ULLYSES Core Implementation Team (CIT)


Julia Roman-Duval
(CIT Lead)

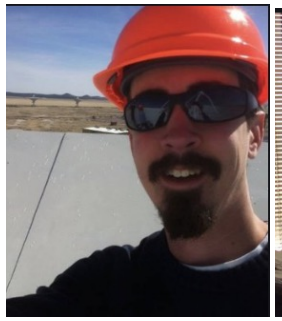

Jo Taylor
(DP Lead)


Rachel Plesha
(DP Deputy Lead)


Will Fischer
TTS Observing Lead


Alex Fullerton
(OB star Observing Lead)


Alessandra Aloisi
(Pre-imaging)

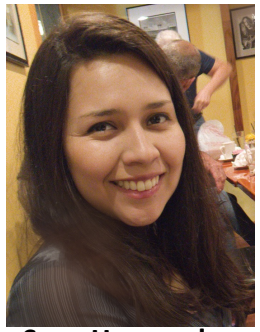

Chris Britt
(Public Outreach)


Ivo Busko
(DP/software)


Van Dixon
(Observing, DP)


Travis Fischer
(DP)


Elaine Frazer
(DP)


Svea Hernandez
(DP)


Alec Hirschauer
(Observing)


Robert Jedrzejewski
(DP, software)


Sean Lockwood
(ETC, Obs)


TalaWanda Monroe
(Observing)


Tyler Pauly
(DP)


Charles Proffitt


Adric Riedel
(Targets, DP)


David Sahnow
(Observing)


Richard Shaw
(DP)

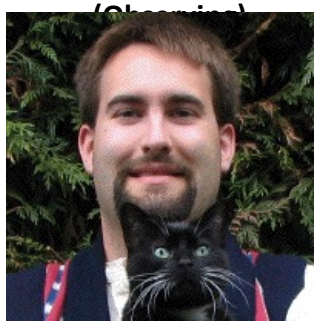

Ravi Sankrit
(Observing)


Linda Smith
(Targets, Observing)


Debopam Som
(Observing)


Leonardo Ubeda
(Website)


Dan Welty
(Targets, Obs, DP)


Brian York
(DP)

Other STScI staff involved

- Tricia Royle (Program Coordinator)
- Dave Adler and scheduling team
- Scott Fleming, Peter Forshay, David Rodriguez and Brian Erickson (MAST)
- OPO team

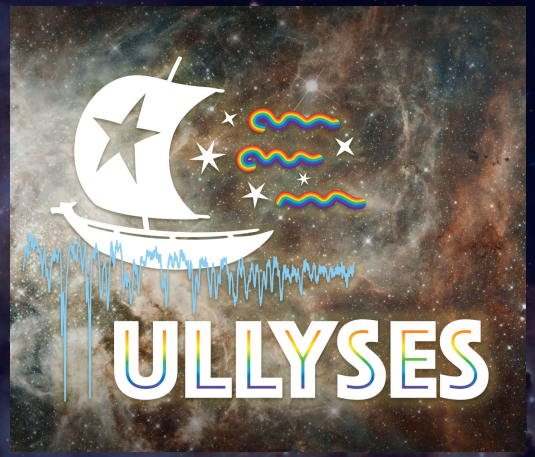
Science Advisory Committee (SAC)

- SAC composition (Massive stars/T Tauri stars)
  - Jean-Claude Bouret (Laboratoire d'Astrophysique de Marseille)
  - Catherine Espaillat (Boston University)
  - Chris Evans (ESA@STScI, formerly UK Astronomy Technology Centre)
  - Kevin France (University of Colorado Boulder)
  - Miriam García (Instituto Nacional de Técnica Aeroespacial)
  - Chris Johns-Krull (Rice University)
  - Derck Massa (Space Science Institute)
  - Joan Najita (National Optical Astronomy Observatory)

Other community members

- Carlo Manara (ESO) for providing updated accretion rates and extinction values
- Jesus Hernandez and Javier Serna (UNAM) for providing TESS-based rotational periods
- ODYSSEUS team (led by Greg Herczeg) for interesting discussions about targets and coordination
- IAU G2 (massive stars) for useful feedback on implementation
- Derck Massa for providing vetted observations of SNAP program 16230

Thank you



Back-up Slides

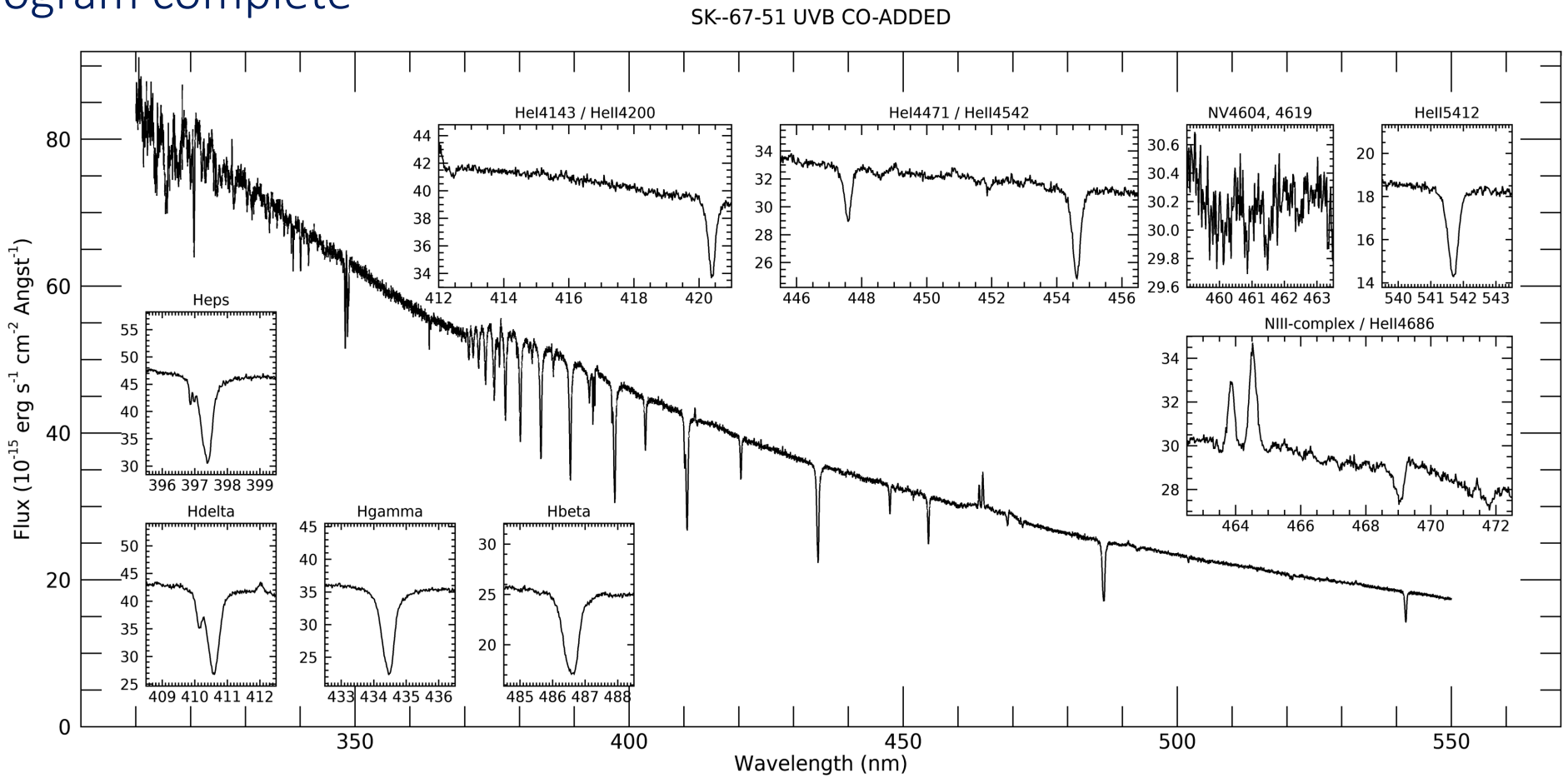
Scheduling updates

- Scheduling information is included on the ULLYSES website (https://ullyses.stsci.edu/ullyses-targets-ttauri.html)
- Scheduling updates are forwarded to a specific email distribution that includes PIs of coordinated observations (ullyses_ctts_scheduling@maillist.stsci.edu)

Status of coordinated programs

Coordinated programs for massive stars

- X-ShootU program led by IAU-G2
  - VLT X-Shooter for all ULLYSES targets
  - Program complete

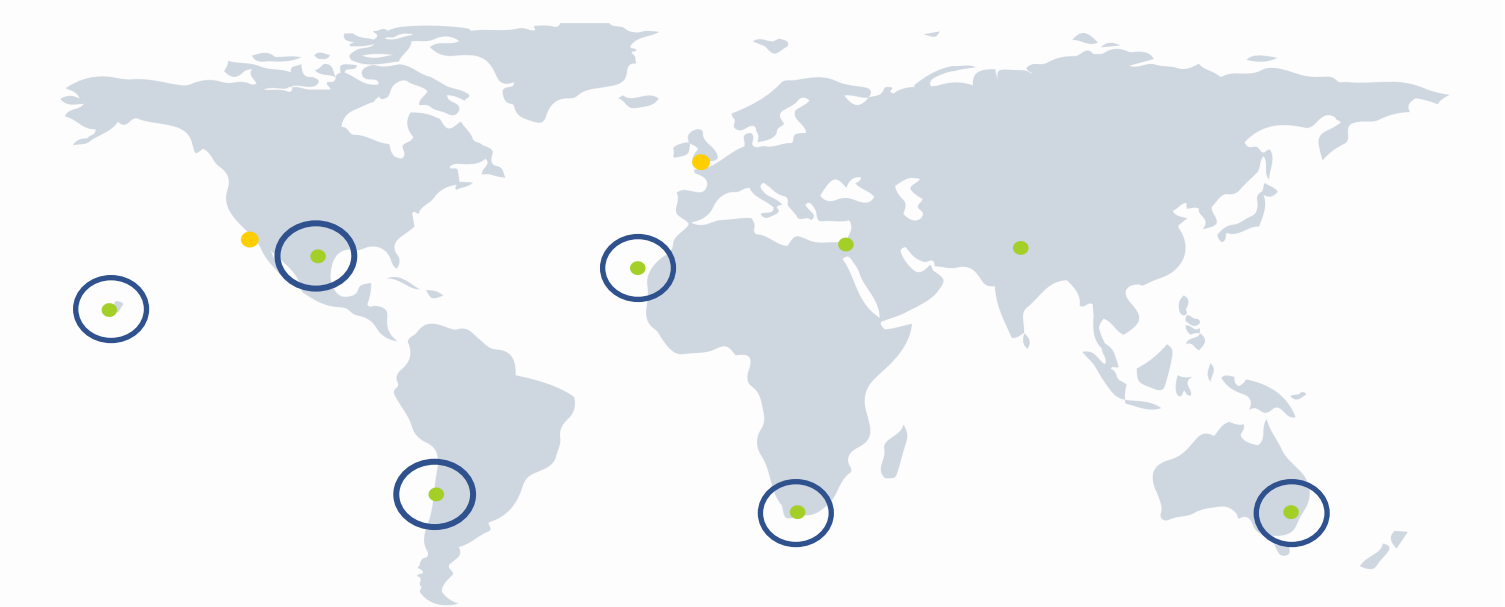


Coordinated programs for T Tauri stars

- Monitored stars only
  - Chandra/XMM-Newton (X-ray; accretion)
  - CFHT/SPIRou spectro-polarimetry (magnetic field mapping)
- Survey and monitored stars
  - VLT X-Shooter, ESPRESSO, UVES (accretion, extinction, stellar properties, kinematics)
  - IRTF (calibration of MIR accretion diagnostics in preparation for JWST observations of deeply embedded protostars)
  - LCOGT photometric monitoring (variability context)
  - TESS (high cadence variability context, March-June 2021 only)
- All programs executing successfully
  - Some coordination with TESS and LCOGT lost when programs got bumped due to July 2021 safing

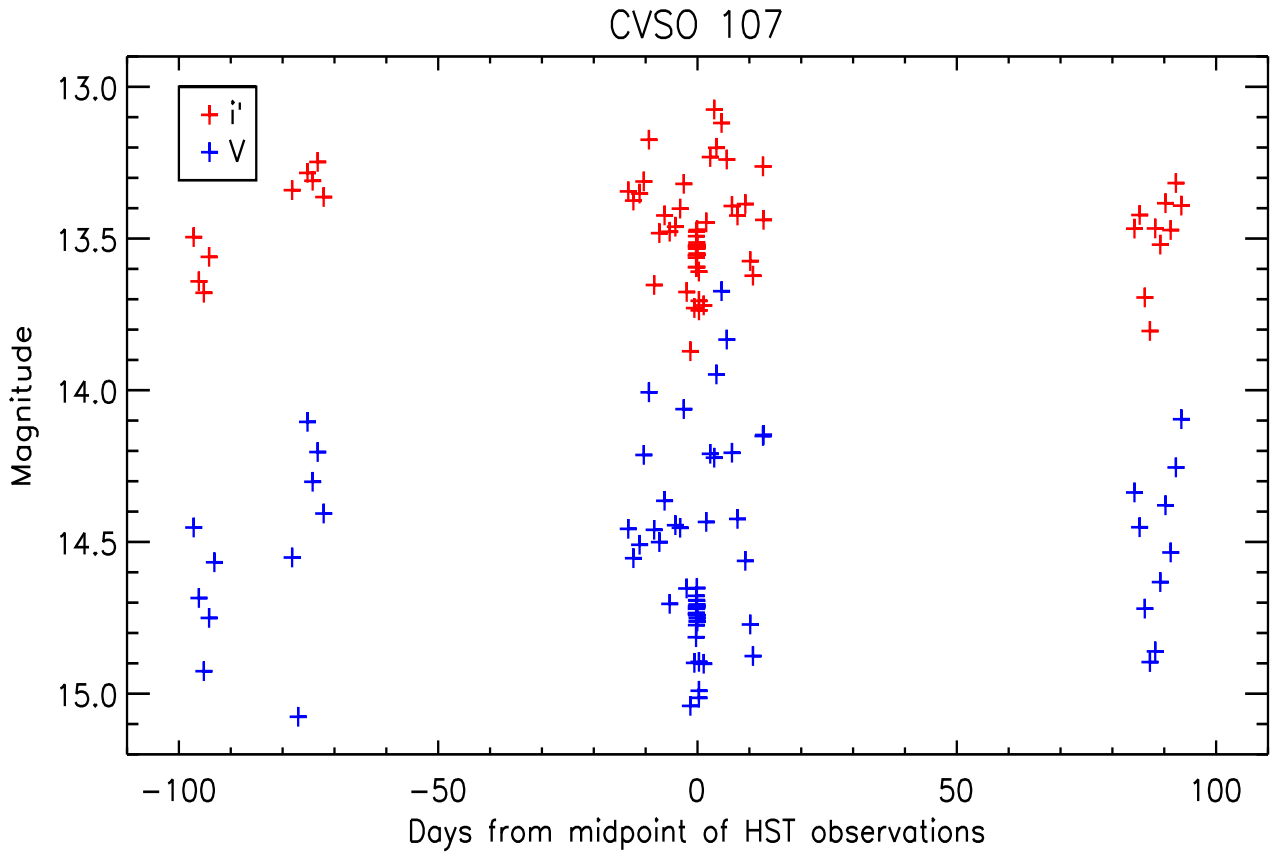
LCOGT Photometric Monitoring

- STScI implementation team designed a large LCOGT program to perform photometric monitoring in V, i' for survey and u', V and i' for monitoring T Tauri stars
  - Program was accepted and started late August 2020
  - 545h approved in 2020B, 2021A, B, 2022A so far
- LCOGT has 0.4m robotic telescope network around the World (almost continuous longitudinal coverage)



LCOGT Photometric Monitoring

- Cadence:
  - 1x/day 3 months before/after HST epoch
  - 1x/day 10 days before/after HST epoch
  - 10x/period of the 1 (3) periods centered on the HST observations for the survey (monitored) stars
  - 15 min cadence during the HST observations
- S/N > 10 for all targets/bands



Observing strategy for the massive star observations

FUSE (900-1150 Å) or COS/G130M/1096

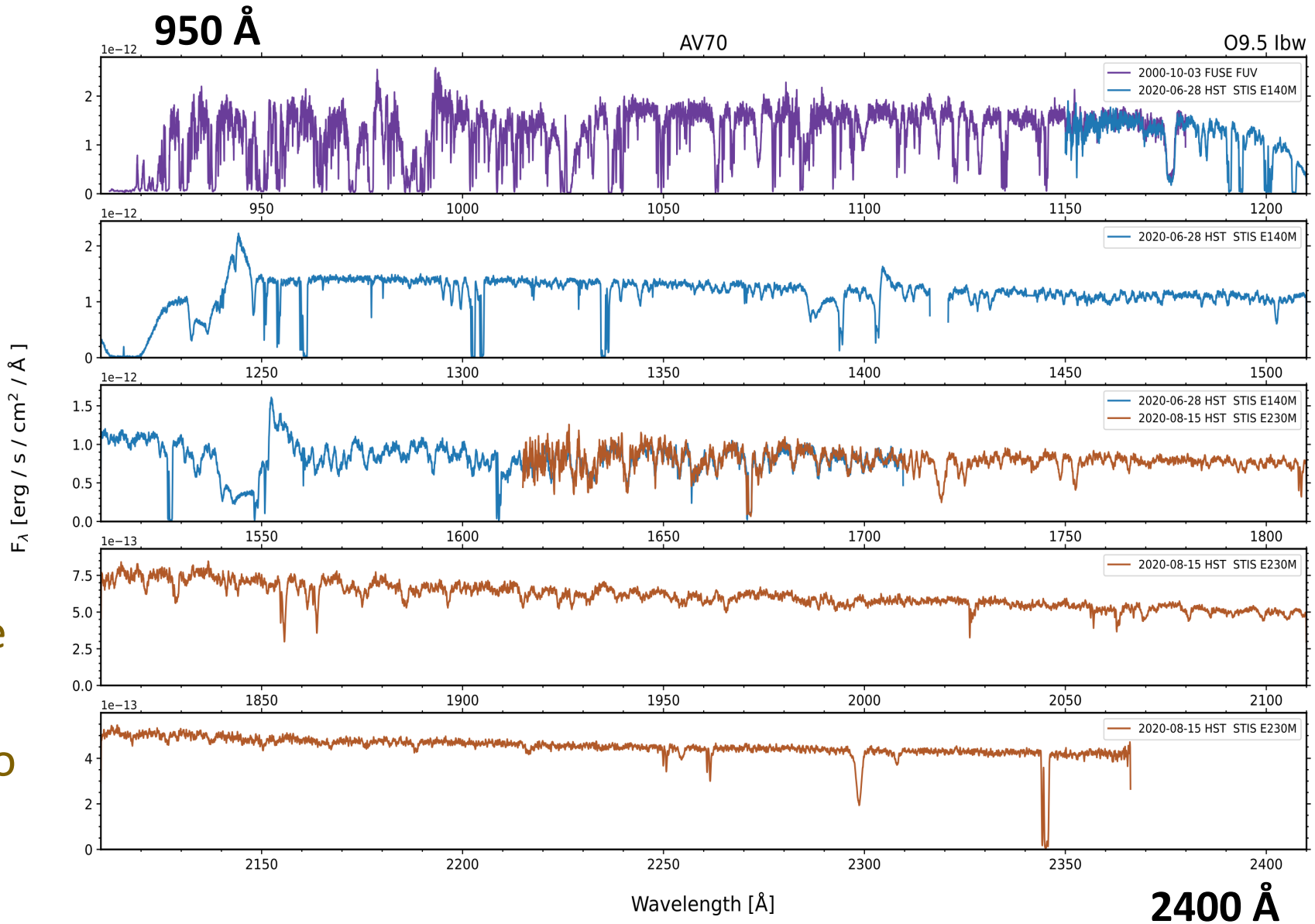
- Bright O stars only

COS G130M+G160M or STIS/E140M (1150-1750 Å)

- All stars

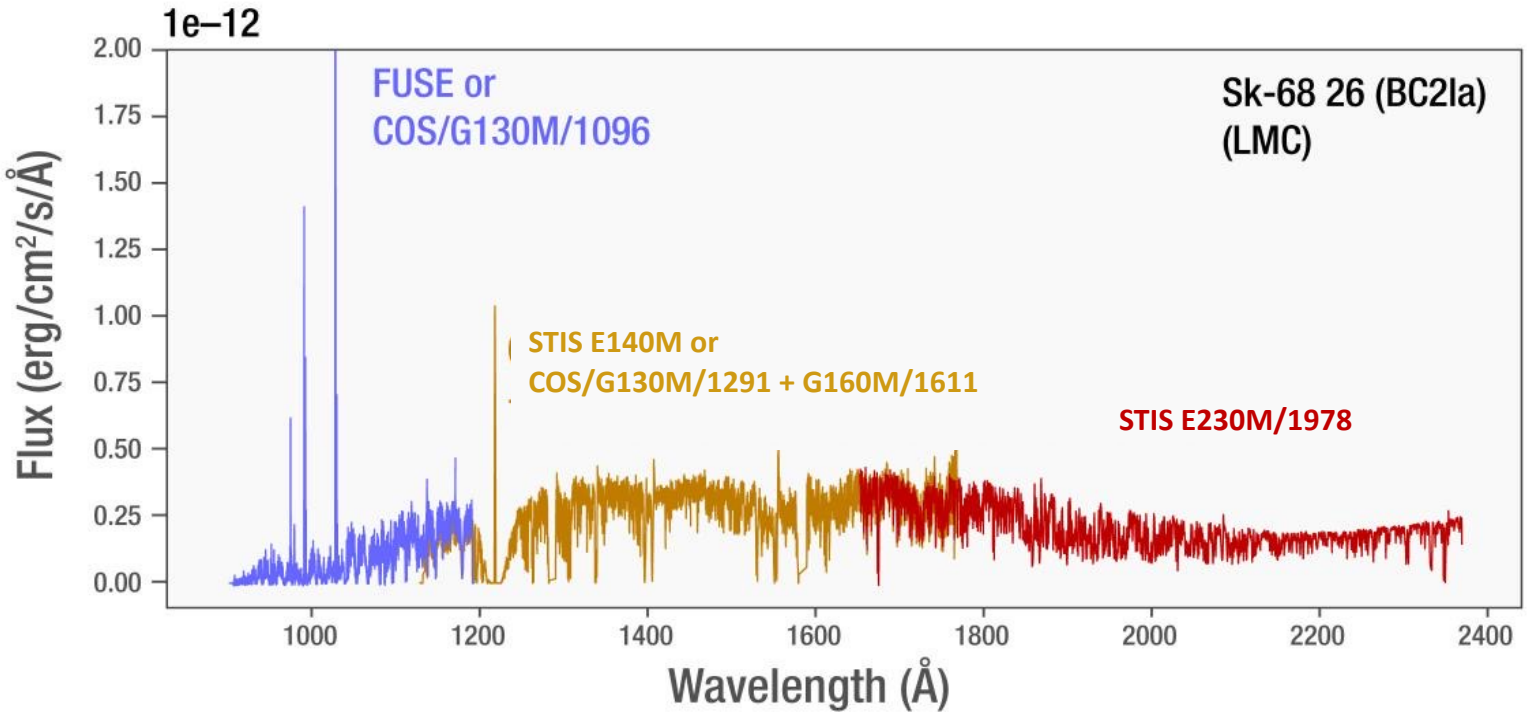
STIS/E230M (1650-2350 Å)

- Super-giants of temperature class O9 and later only
- B5 and later supergiants also get coverage up to 3100 Å with COS or STIS



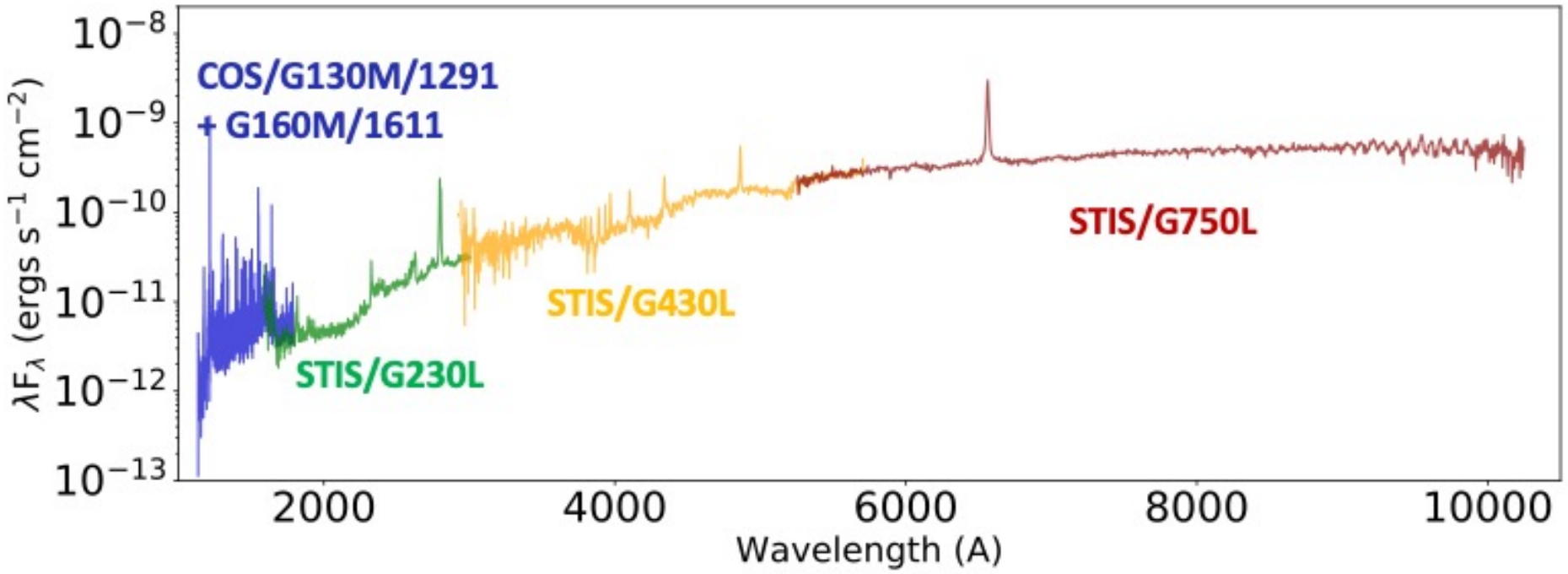
Observing Strategy – LMC/SMC Massive stars

- **FUV coverage from 1140 Å to 1800 Å** with COS/G130M/1291 + COS/G160M/1611, or STIS/E140M for brighter stars
  - Coverage includes Ly-α
- Coverage below 1150 Å with archival **FUSE** data, or COS/G130M/1096 if cost is reasonable
- O9-B9 I stars will also be observed with the E230M/1978, extending coverage to 2400 Å (Al III, Fe III)
- B5-B9 I stars will be observed with STIS/E230M/2707 or COS/G185M/1953+1986 (Mg II)
- FUSE or COS/G130M/1096 for:
  - 70/92 O stars in LMC
  - 54/54 O stars in SMC
- Stars observable in < ~8000s with E140M offloaded to STIS (longer COS lifetime, better spectral resolution)



Observing Strategy – T Tauri Stars

- Survey stars:
  - Medium-resolution UV coverage 1140-1780 Å with COS/G130M/1291 + COS/G160M/1589+1623
  - NUV coverage at low resolution with STIS/G230L
  - Optical-NIR with STIS G430L and G750L
- Monitoring stars:
  - COS/G160M/1589+1623 + COS/G230L/2950



ULLYSES S/N Requirements

- Massive SMC/LMC Stars
  - COS/G130M/c1096: S/N = 20 / nine-pixel resel at 1080 Å continuum
  - COS/G130M/c1291: S/N = 30 / six-pixel resel at 1150 Å continuum
  - COS/G160M/c1589+1623: S/N = 30 / six-pixel resel at 1590 Å continuum
  - COS/G185M/c1953: S/N = 30 / three-pixel resel at 1860 Å continuum
  - COS/G185M/c1986: S/N = 30 / three-pixel resel at 1980 Å continuum
  - STIS/E140M/c1425: S/N = 20 / two-pixel resel at 1200 Å continuum
  - STIS/E230M/c1978: S/N = 20 / two-pixel resel at 1800 Å continuum
  - STIS/E230M/c2707: S/N = 20 / two-pixel resel at 2800 Å continuum
- Massive Low Z Stars in Sextans A and NGC 3109
  - COS/G140L/c800: S/N = 15 / six-pixel resel at 1600 Å continuum
- T Tauri Stars
  - COS G130M/c1291 S/N = 15 / six-pixel resel in peak of N V 1239 Å
  - COS G160M/c1611 S/N = 20 / six-pixel resel in peak of CIV 1549 Å
  - STIS G230L/c2376 S/N = 20 / six-pixel resel in peak of Mg II 2800 Å
  - STIS/G430L S/N=20 / two-pixel resel in continuum at 4000 Å
  - STIS/G750L S/N= / two-pixel resel in continuum at 5700 Å

Technical Implementation: BOP procedures for T Tauri stars

- Estimates for UV accretion flux based on published relations scaling emission line and continuum flux with accretion rate.
  - For Bright Object Protection (BOP) screening allow for 4X variability above baseline accretion scaling
  - Bright object magnetic flare rules for M dwarfs will also be applied to M-type T Tauri stars
    - Comparison of active T Tauri stars and main-sequence stars shows magnetic activity and flares scale with bolometric luminosity, and not with accretion. It is the nature of the underlying star that matters.
    - To apply existing flare rules, which depend on U magnitude of target, we use a U value inferred from the spectral type and V magnitude rather than the observed U flux, which is typically dominated by the accretion rather than the spectrum of the underlying star
    - Extinction is applied to the modeled flare spectrum

Community Engagement

Community Engagement

- Several talks/presentations to large collaborations and workshops early on in the project
  - IAU G2 (massive stars, October 2020)
  - NUVA workshop (December 2020)
  - AAS (townhall, NASA hyperwall, webinars)
  - STUC meetings
  - Princeton Bahcall lunch (March 2021)
  - Science with HST and JWST (Stockholm, summer 2022)
- Email communication with community members (ODYSSEUS, IAU-G2 teams, other community members)
- Lorentz workshop on massive stars (December 2021 – Alex Fullerton participated)
- AAS 240 splinter session
- AAS 241 – 3 talks
- STScI workshop or symposium in late 2023/early 2024
- ULLYSES survey paper (in prep)

13 AR, parallel, or complementary GO programs related to ULLYSES

Cycle	PID	Orbits	Title	Topic
27	GO-15967 PI Chisholm	49	Constraining the Stellar Astrophysics Powering Cosmic Reionization: Spectral Templates of Extremely Low-metallicity Main-sequence O-stars	Low-Z massive stars
27	Multiple PIDs PI C Murray	500	Scylla (PI C. Murray, multiple PIDs) – Scylla: A pure-parallel, multi-headed attack on dust evolution and star formation in ULLYSES galaxies	Parallel to LMC/SMC
28	GO-16233 PI Schneider	17	Jets and disk scattering – Spatially resolved optical and FUV observations of AA Tau	CTTS
28	SNAP-16239 PI Massa	200	A NUV SNAP program to supplement and enhance the value of the ULLYSES OB star legacy data	LMC/SMC STIS CCD spectra
28	AR-16148 PI Senchyna		Painting the first empirical picture of massive stars below the metallicity of the SMC with ULLYSES	Low-Z stars
28	AR-16129 PI Herczeg		Outflows and Disks around Young Stars: Synergies for the Exploration of ULLYSES Spectra (ODYSSEUS)	CTTS
28	AR-16131 PI Hillier		CMFGEN: A key spectroscopic tool for astrophysics	LMC/SMC/low-Z
28	AR-16133 PI Jenkins		A comprehensive investigation of Gas-phase element abundances and extinction by dust in the LMC and SMC	ISM LMC/SMC

13 AR, parallel, or complementary GO programs related to ULLYSES

Cycle	PID	Title	Topic
29	AR-16616 PI Howk	Interstellar tomography of highly ionized gas in the MW thick disk with ULLYSES	CGM
29	AR-16623 PI Leitherer	Feasting on the Riches of Odysseus' voyage	Population synthesis
29	AR-16640 PI Zheng	Braving the storm, quantifying the effects of Ram Pressure and Stellar Feedback in the LMC	ISM/CGM
29	AR-16602 PI Barger	The LMC's Galactic Wind through the eye of ULLYSES	ISM/CGM
29	AR-16635 PI Tchernyshyov	The first direct measurement of CO/H2 in subsolar environments using ULLYSES data	ISM