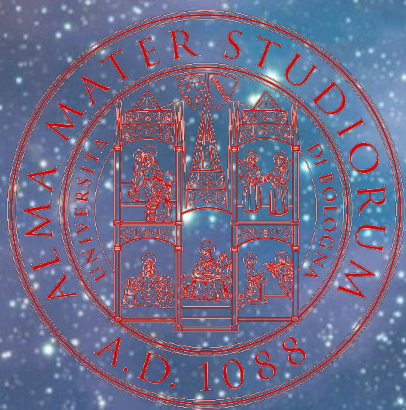


Exploring the Effects of External Photoevaporation in Trumpler 14 using neural networks

Katia Gkimisi

**1st year PhD student
University of Bologna**

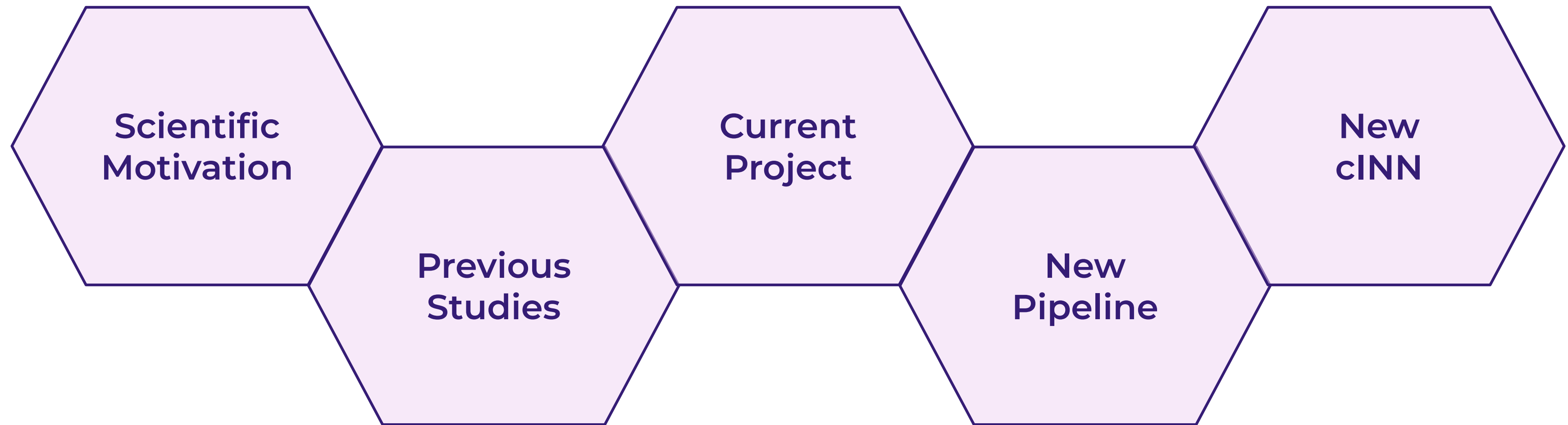
Leonardo Testi, Dominika Itrich, Da Eun Kang, Giuseppe Milazzo



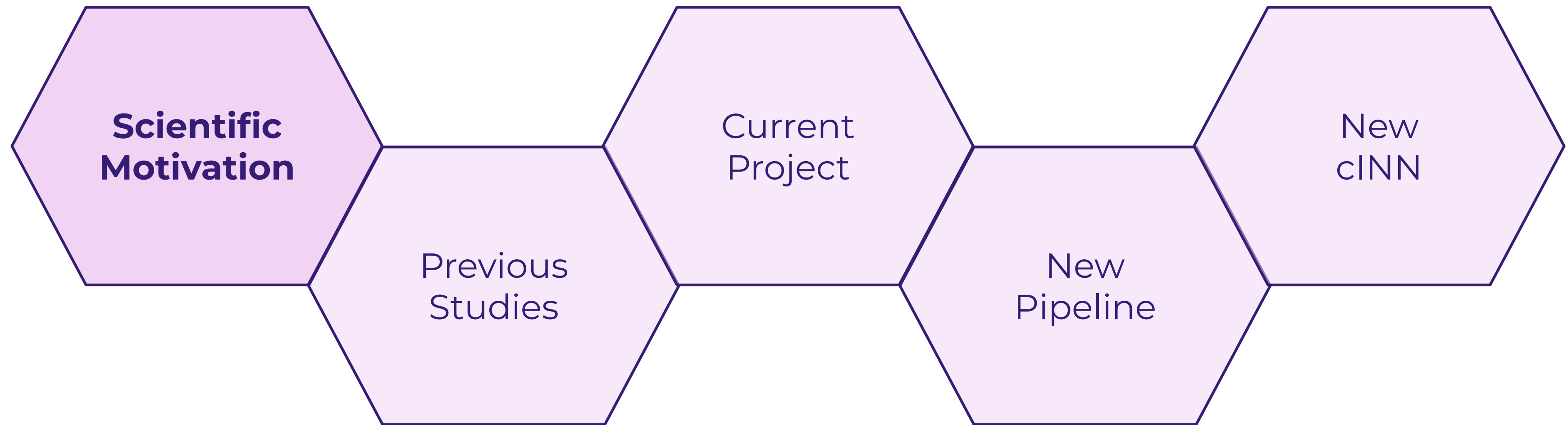
**MACHINE LEARNING
FOR ASTROPHYSICS**
2ND EDITION CATANIA, 8-12 JULY, 2024



Outline

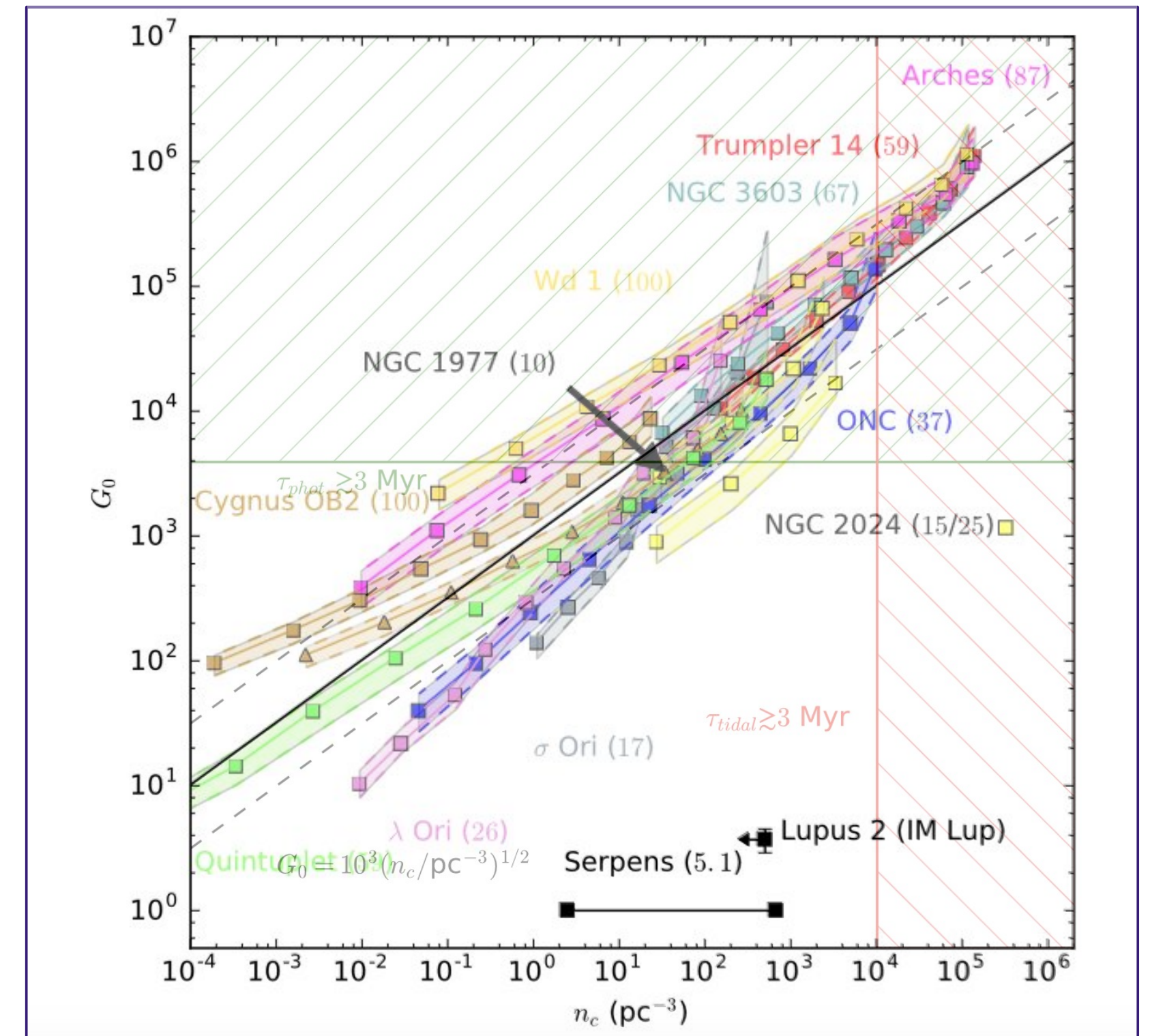
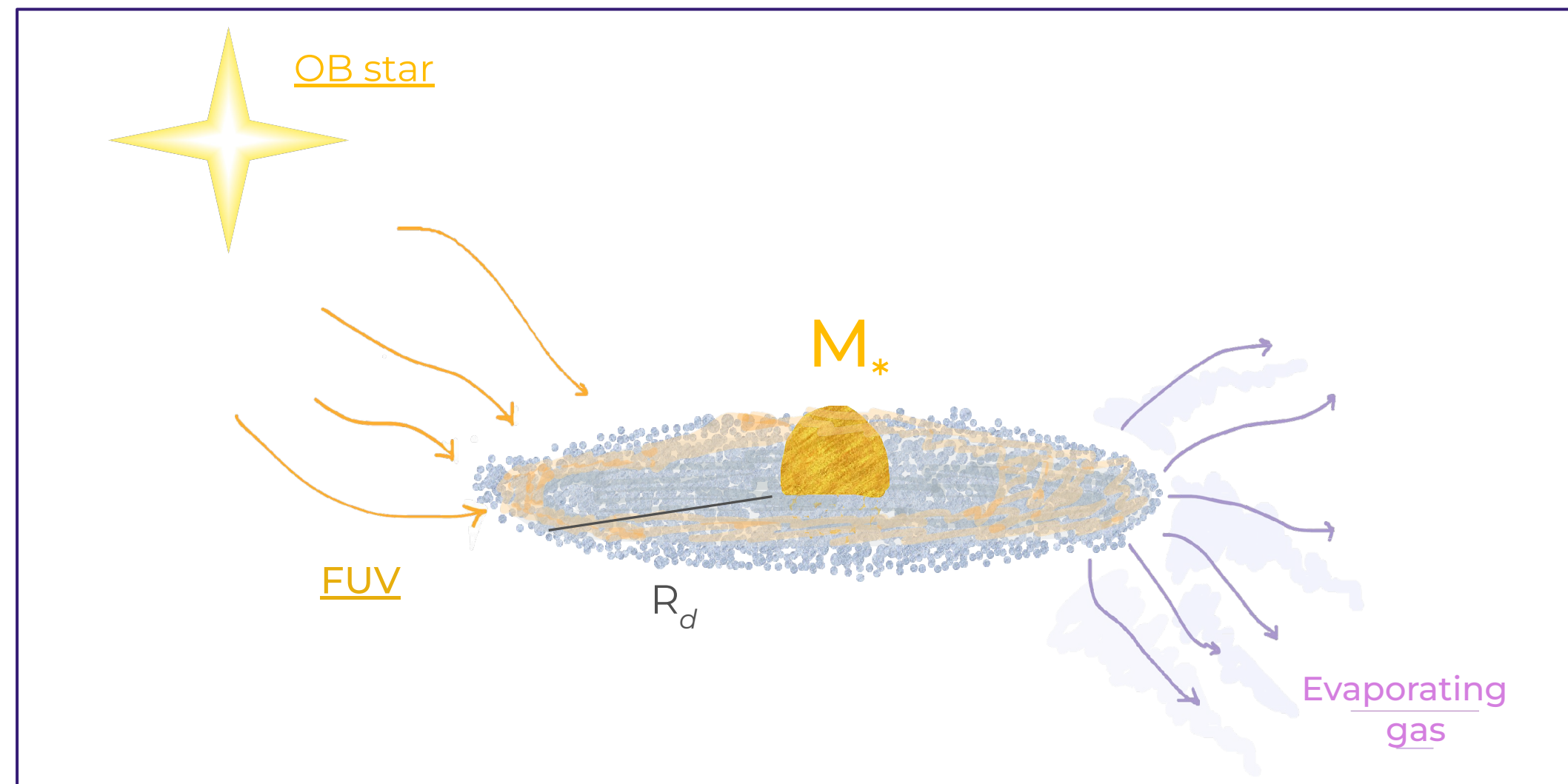


Outline



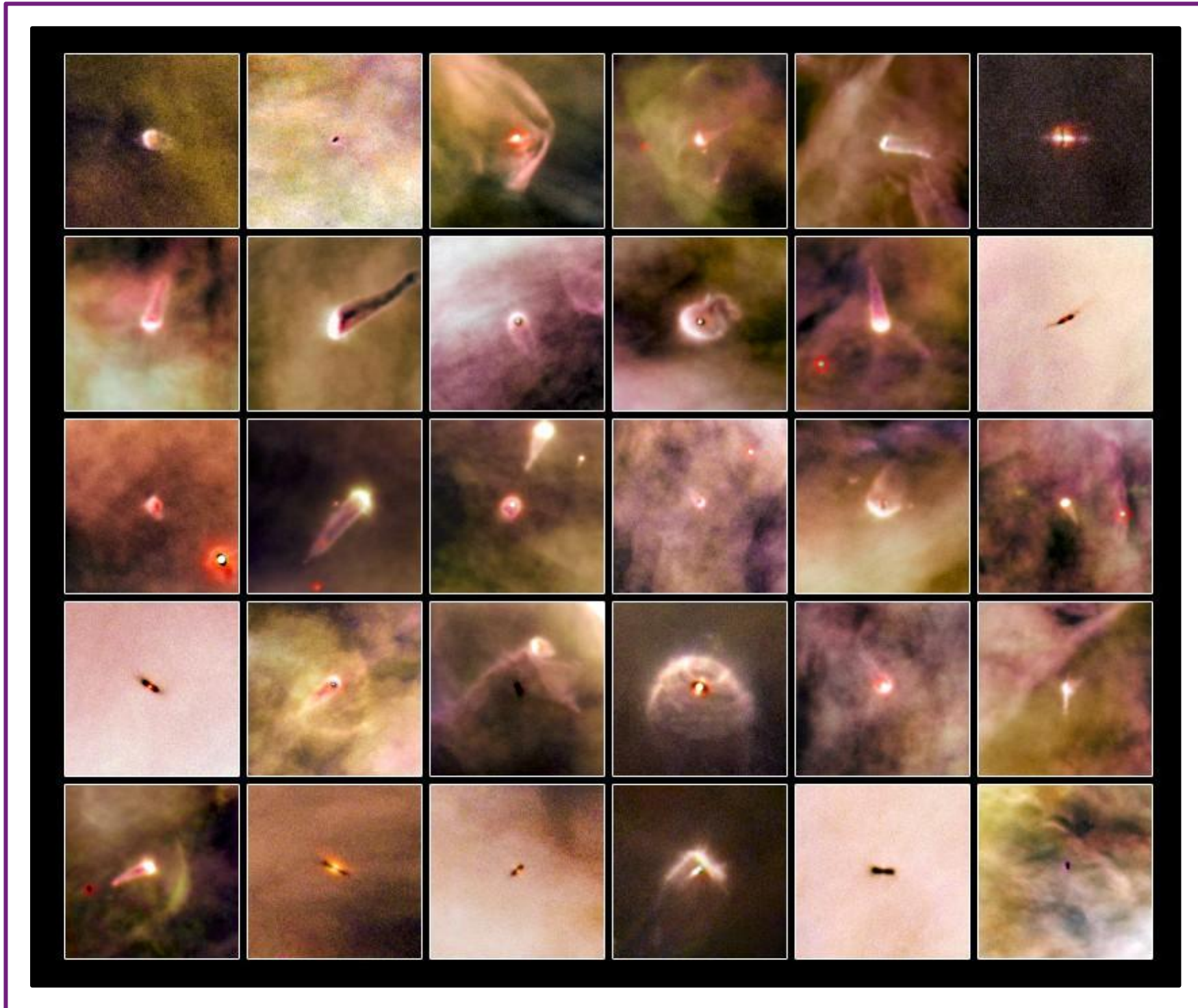
External Photoevaporation

Schematic of the process:

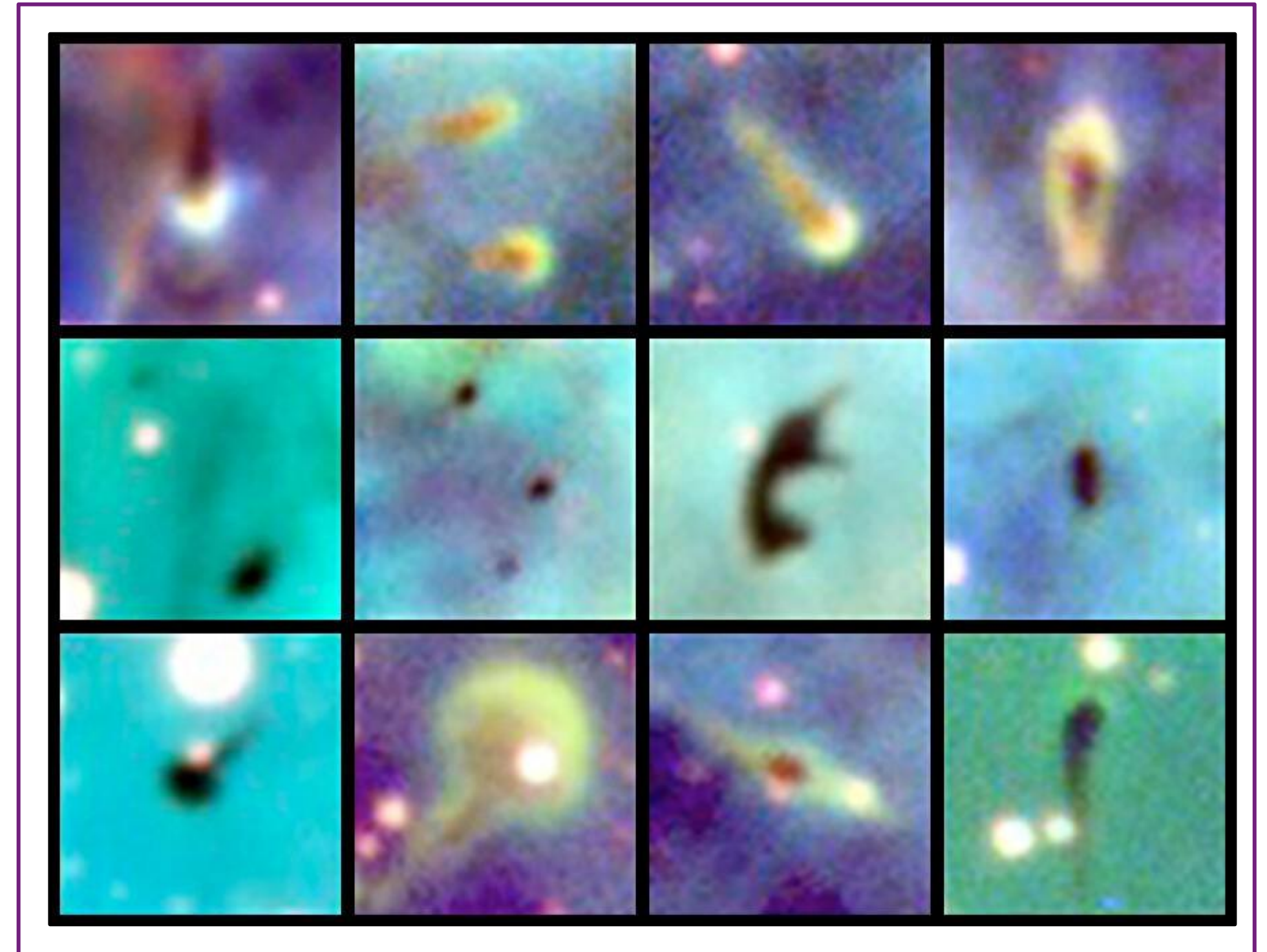


Winter, A. J. et al. 2018

Observational Evidence: Proplyds



Credit: NASA/ESA and L. Ricci (ESO), Hubble Space Telescope

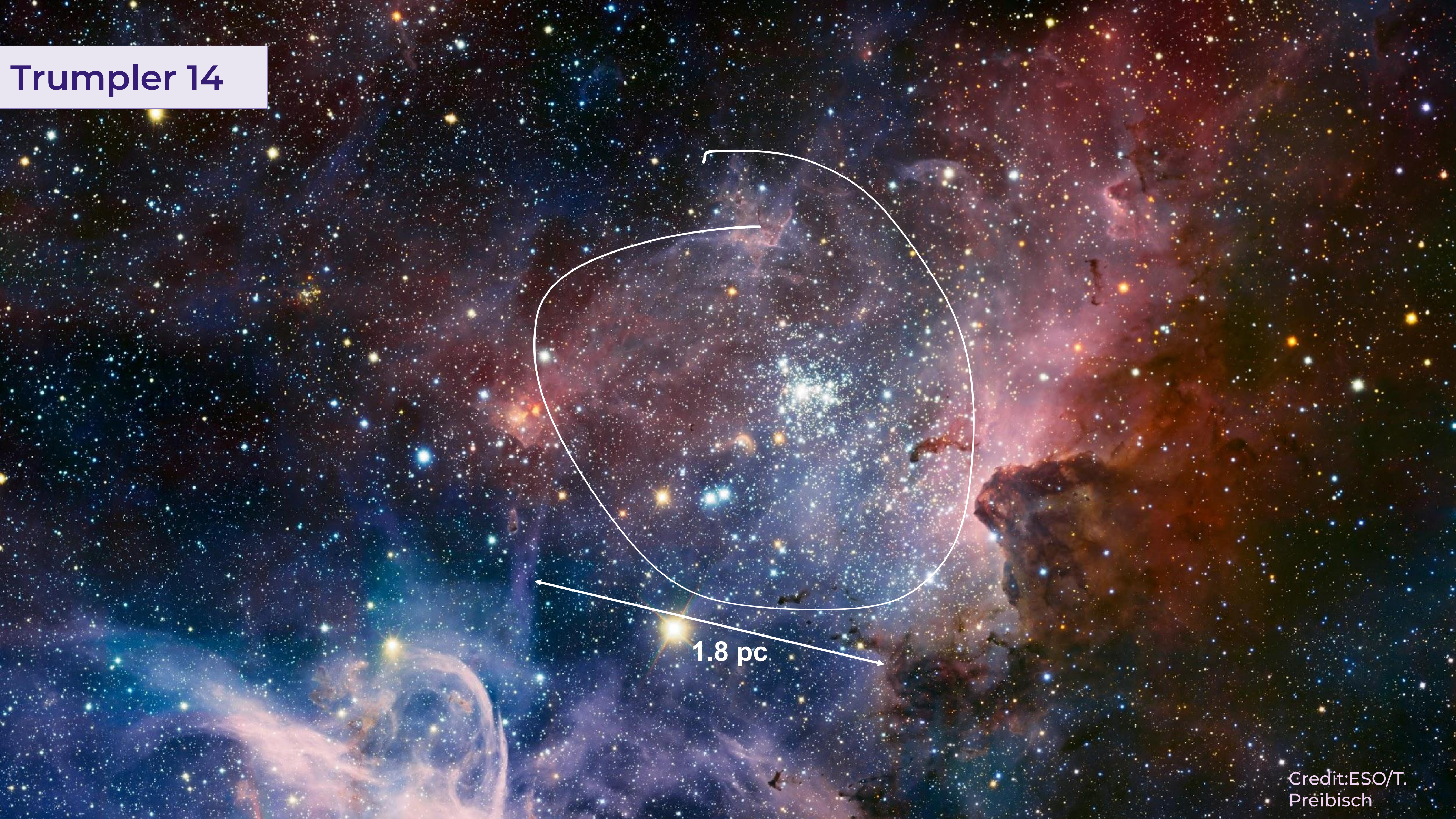


Credit: Nathan Smith, John Bally, Jacob Thiel, Jon Morse U.Colorado/CTIO/NOIRLab/NSF/AURA

Trumpler 14

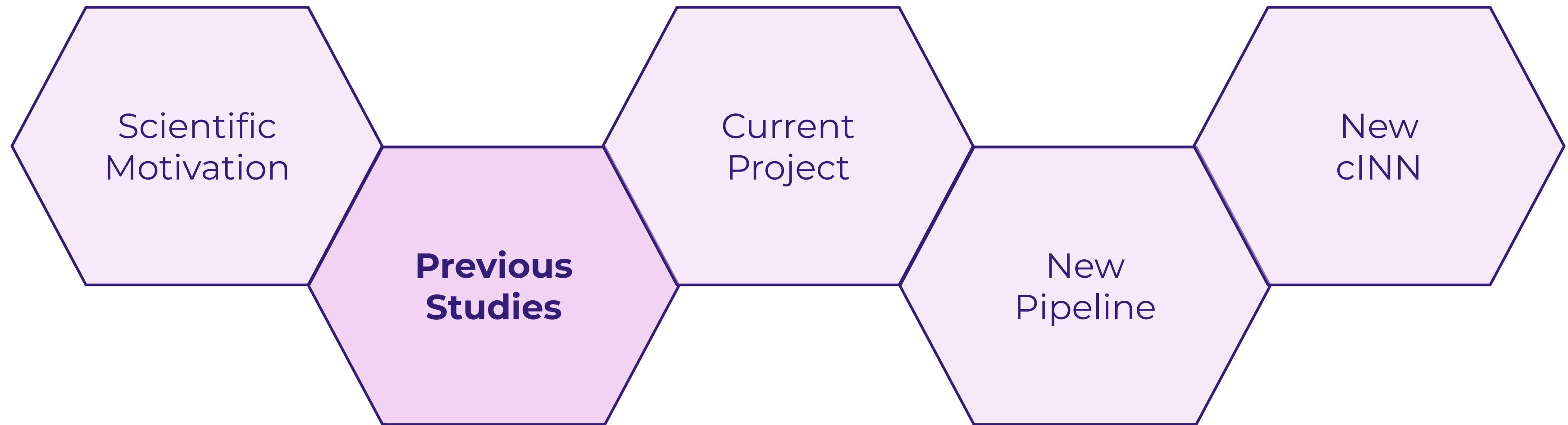


Trumpler 14

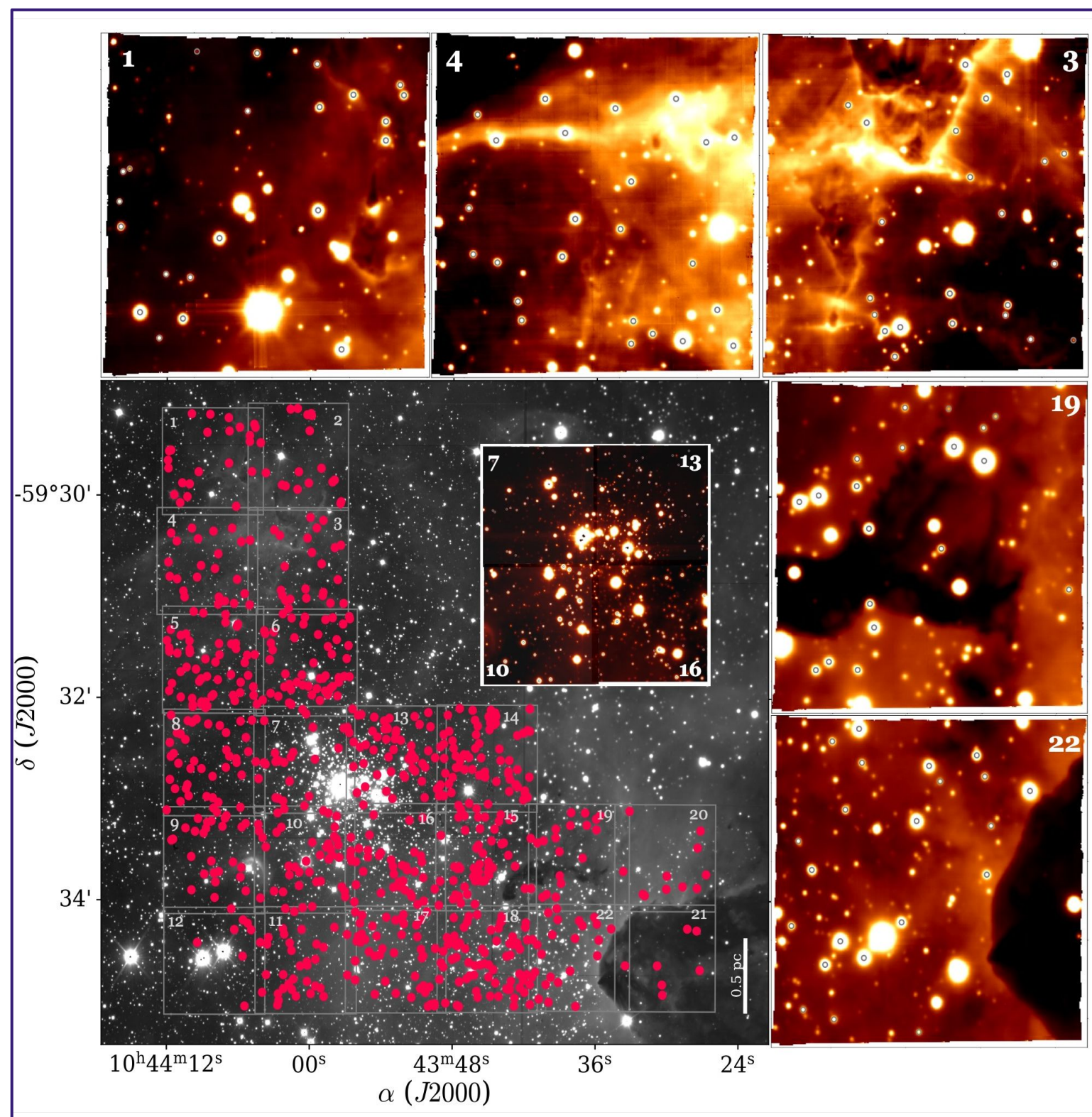


1.8 pc

Outline

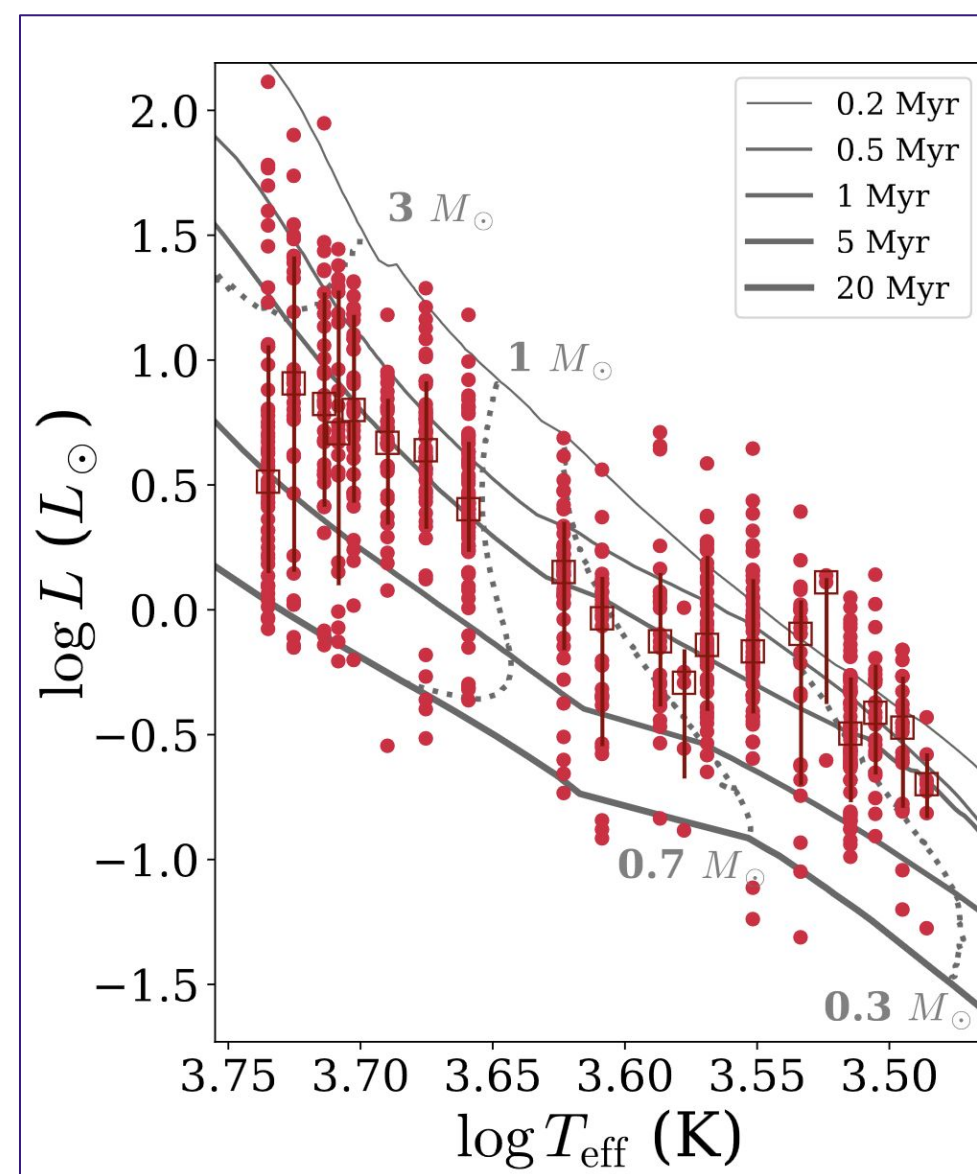


Tr14 by Dominika Itrich, et al. 2024



Itrich D., et al. (2024)

- ★ 1 My old
- ★ Relatively close
- ★ Low extinction
- ★ High FUV field from the OB type stars

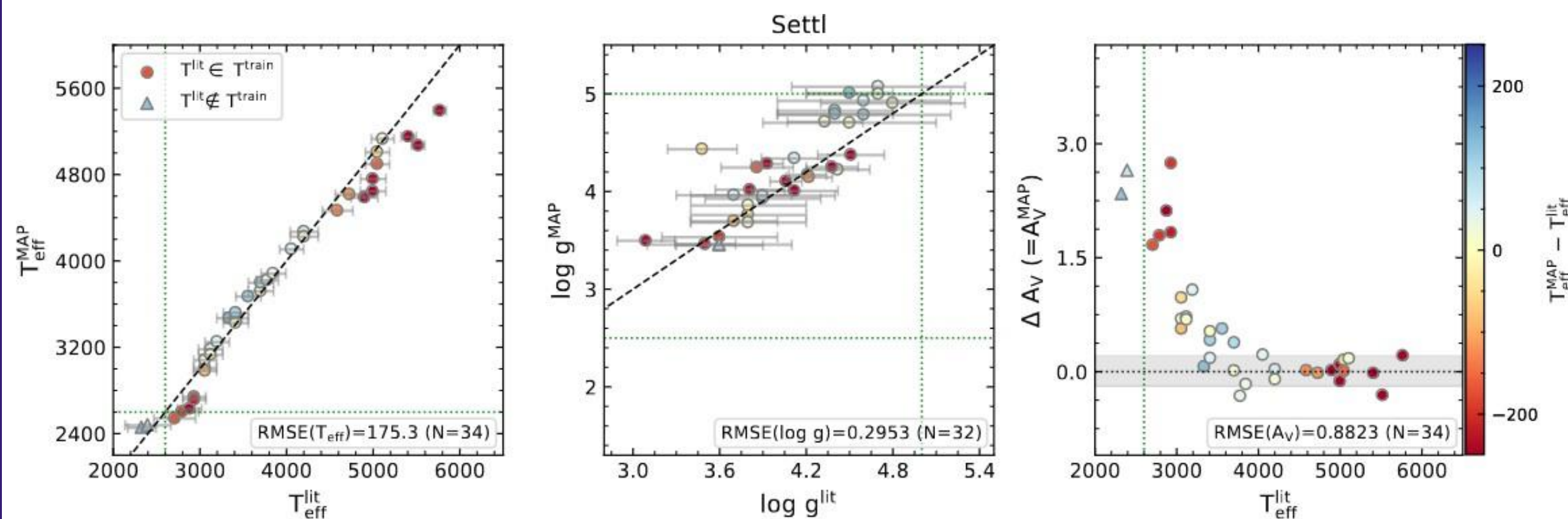


Itrich D., et al. (2024)

- ★ Itrich et al. (2023)
~700 stars manually characterized and classified with Manara et al. (2013, 2017) templates

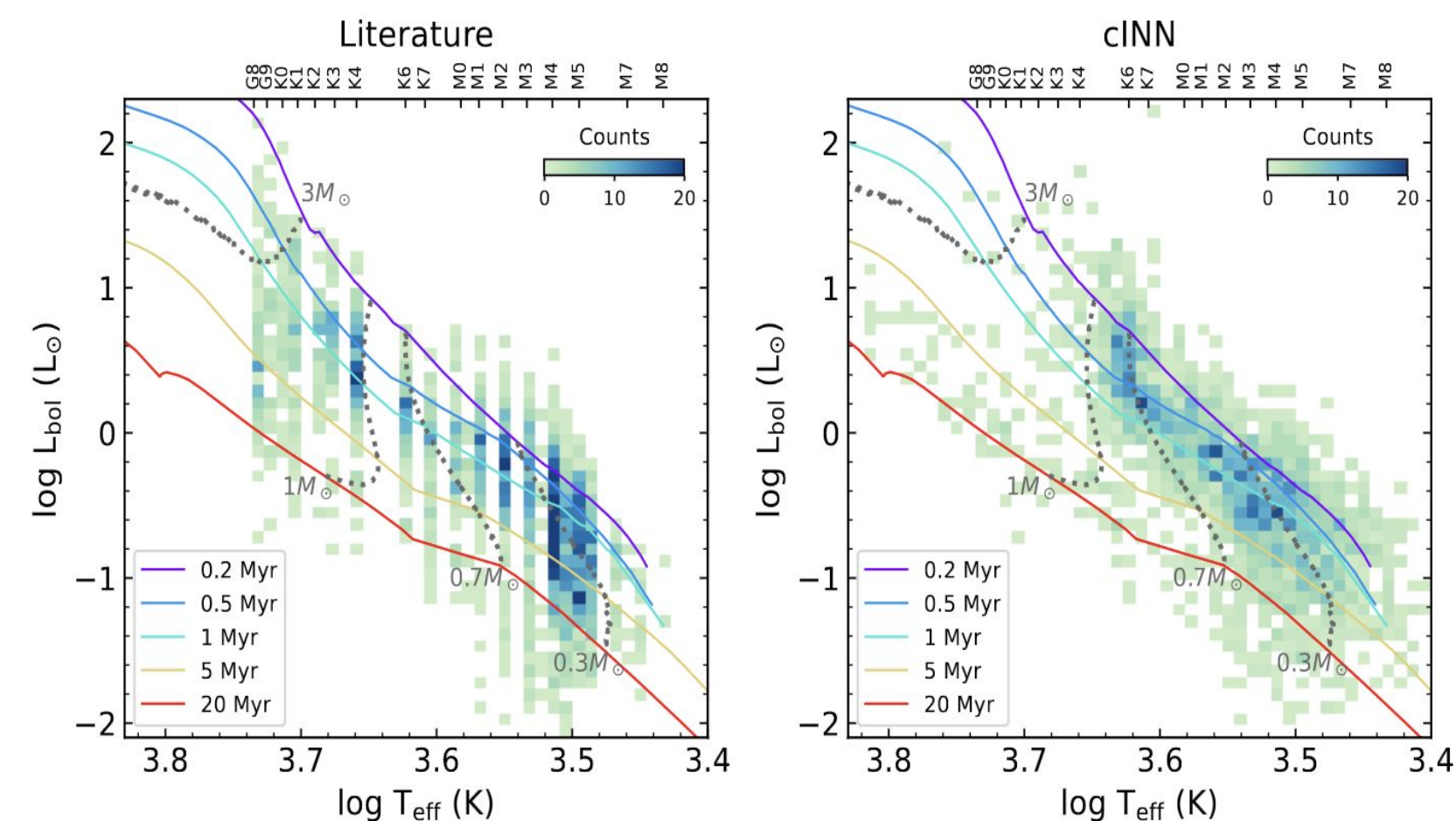
Conditional Invertible Neural Networks (cINN), Da Eun Kang et al. 2023, 2024

Kang et al. (2023, 2024 submitted)

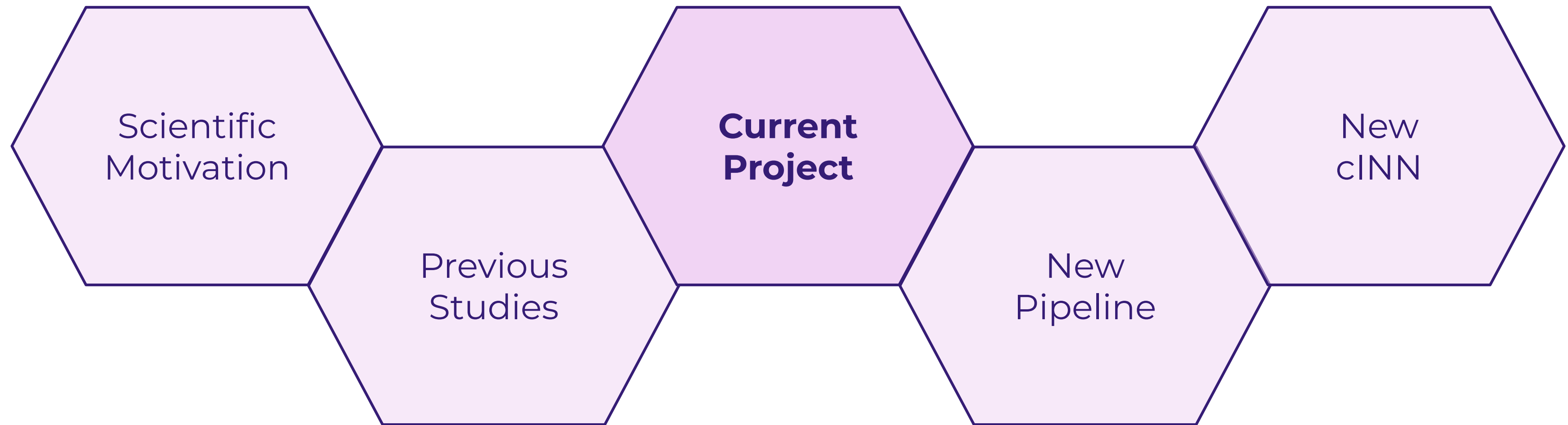


- Network trained on Settl synthetic spectra
- Validated on 36 real class III spectra (Manara et al. 2013, 2017)
- Prediction of T_{eff} , A_V , $\log g$, r_{veil}

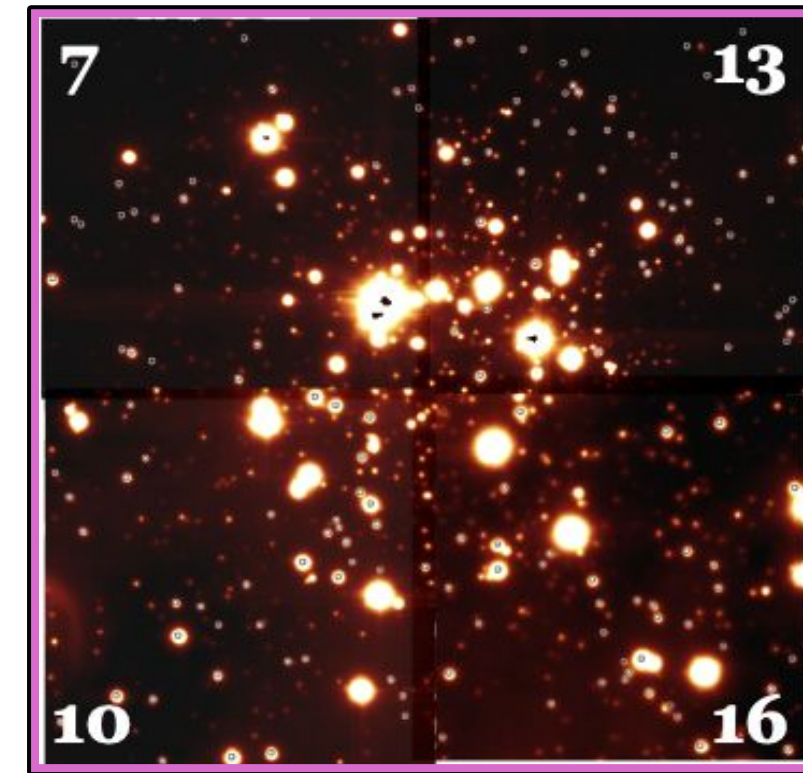
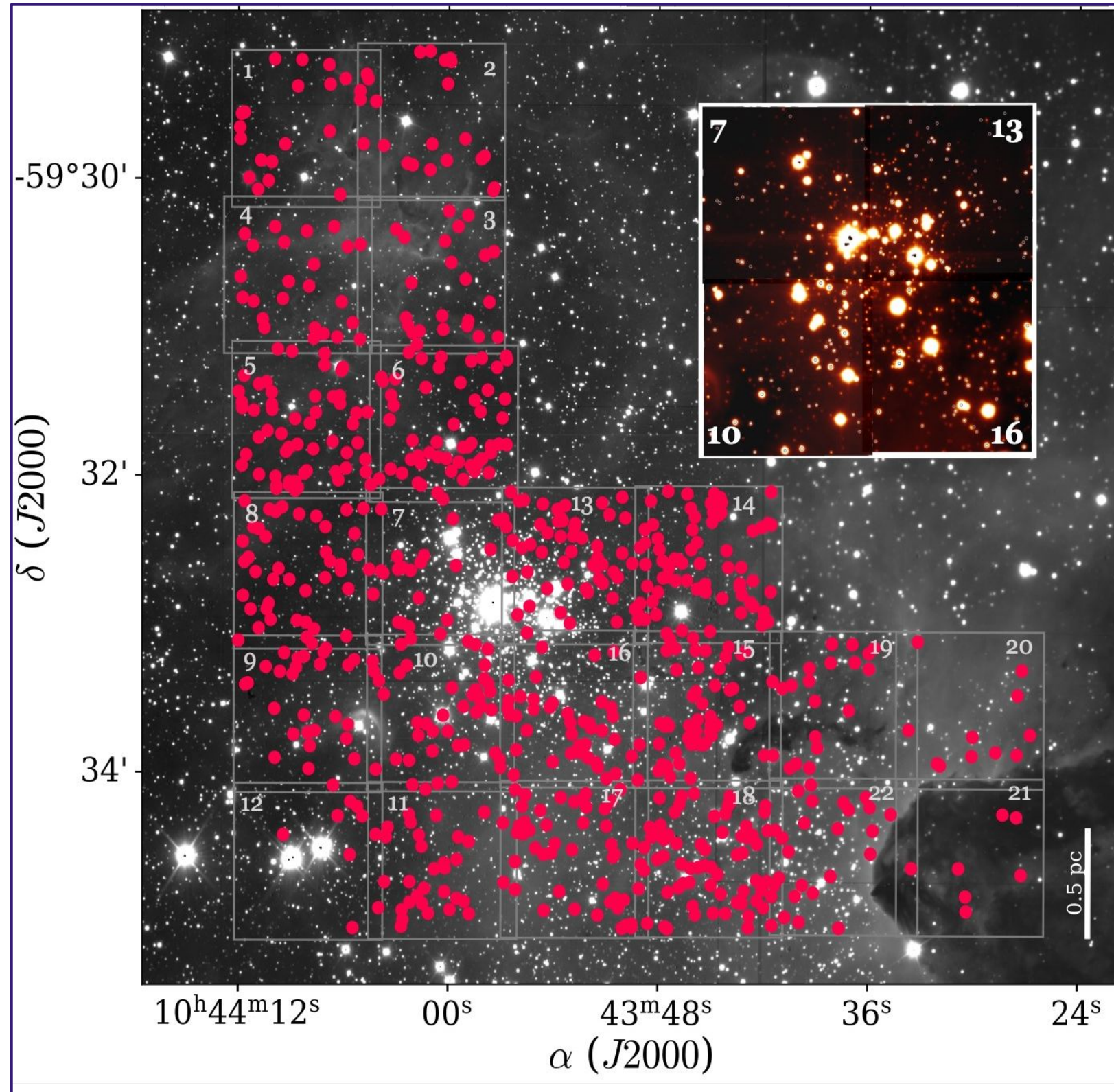
- Accurate predictions of the parameters on stars with $T_{\text{eff}} < 4200^\circ\text{K}$
- Very good performance for all of the stars in Tr14
- The network relies on the $H\alpha$ and Na lines for the classification



Outline



Central Part of Tr14

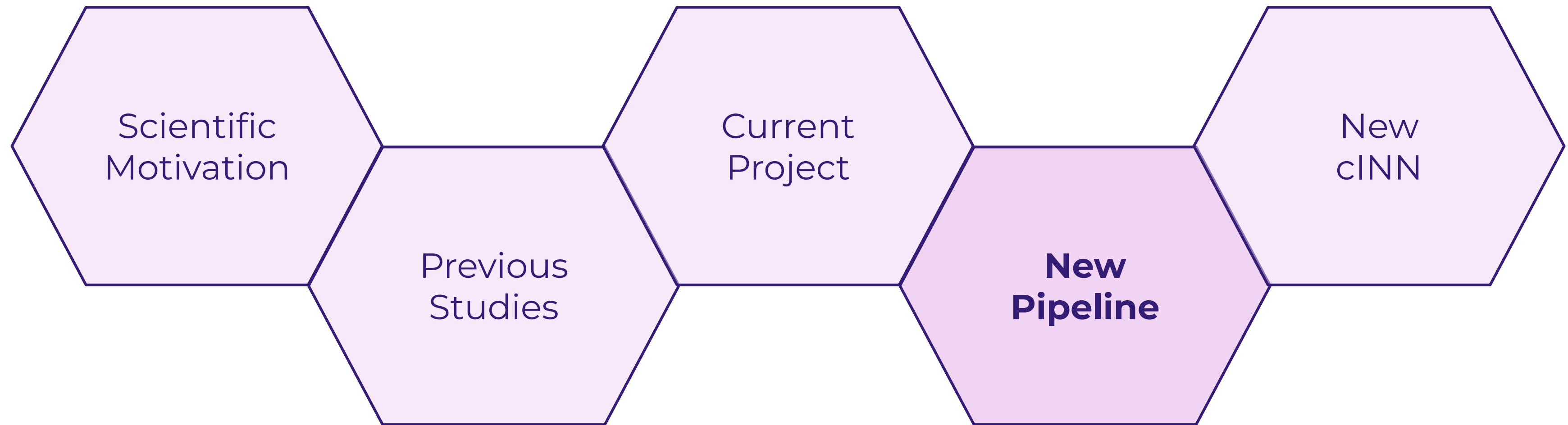


New Pipeline

New cINN

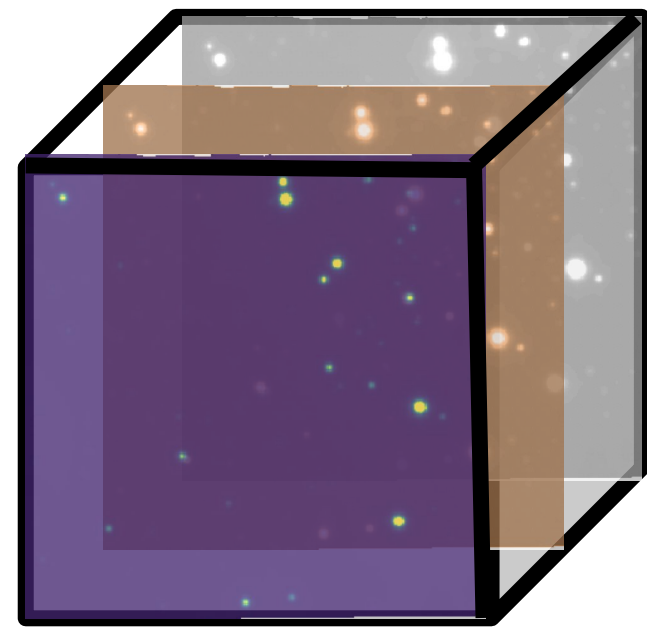
Itrich D., et al. (2024)

Outline



New Methods of Extraction

MUSE data cube



Long and Short Exposures



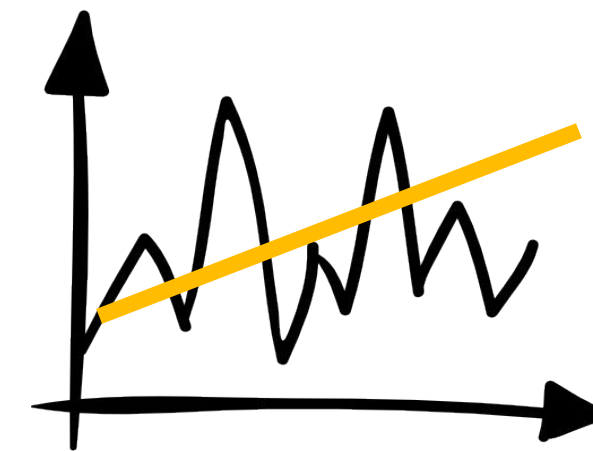
pySpecMUSE



By: Giuseppe Milazzo, Leonardo Testi



λ - dependent correction



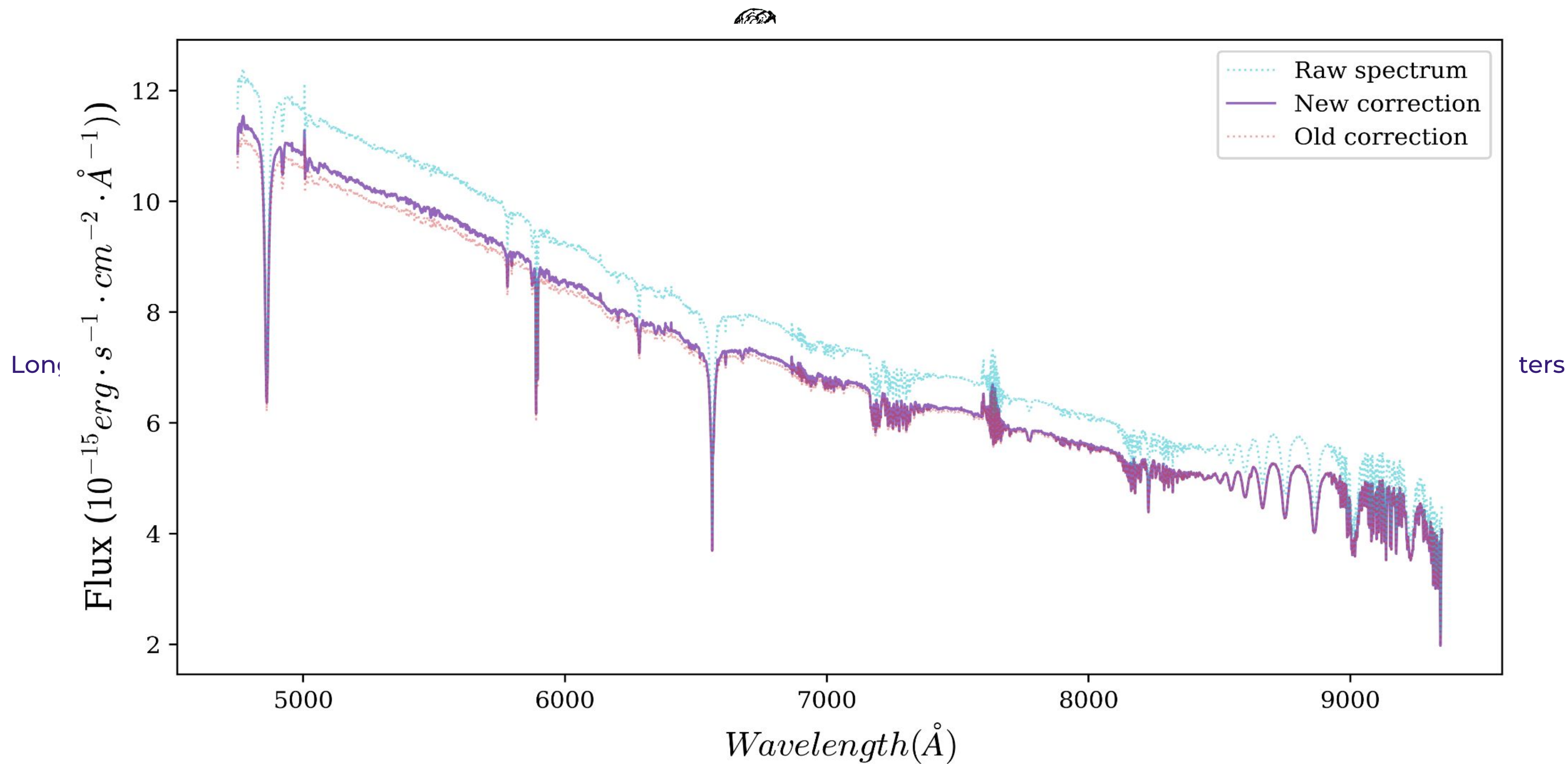
Flux calibration using WFI filters

New Methods of Extraction

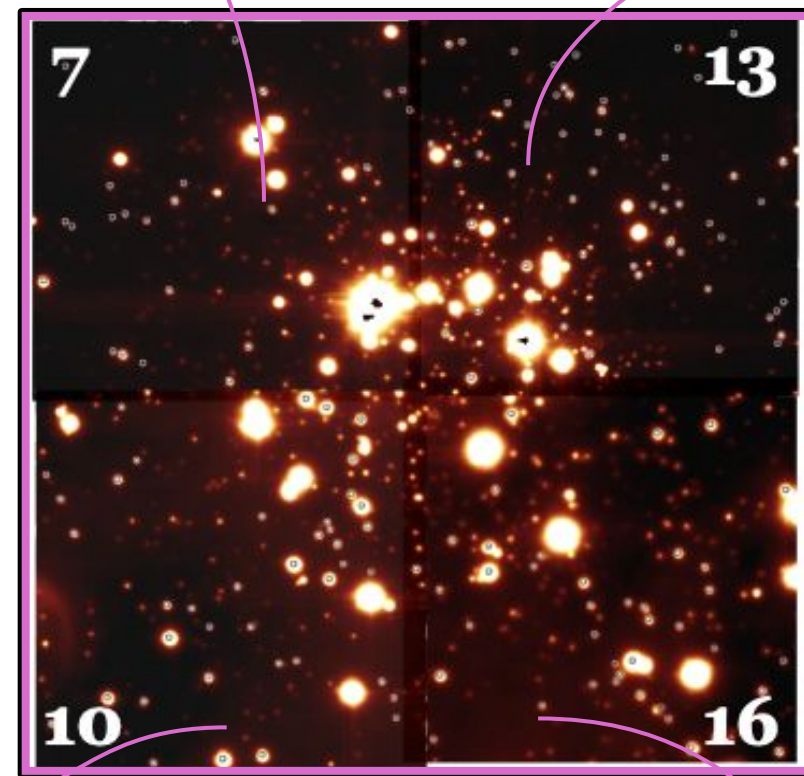
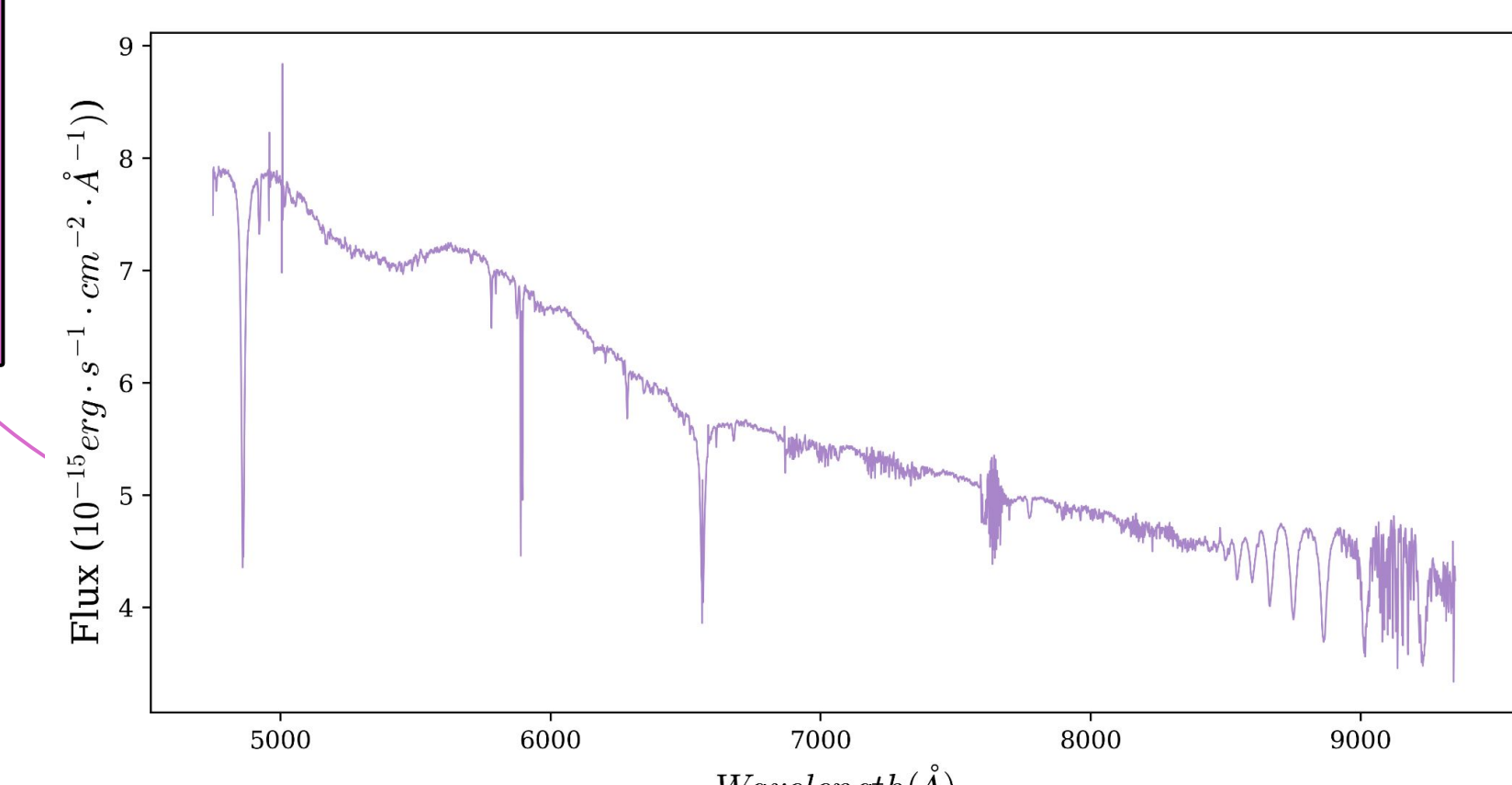
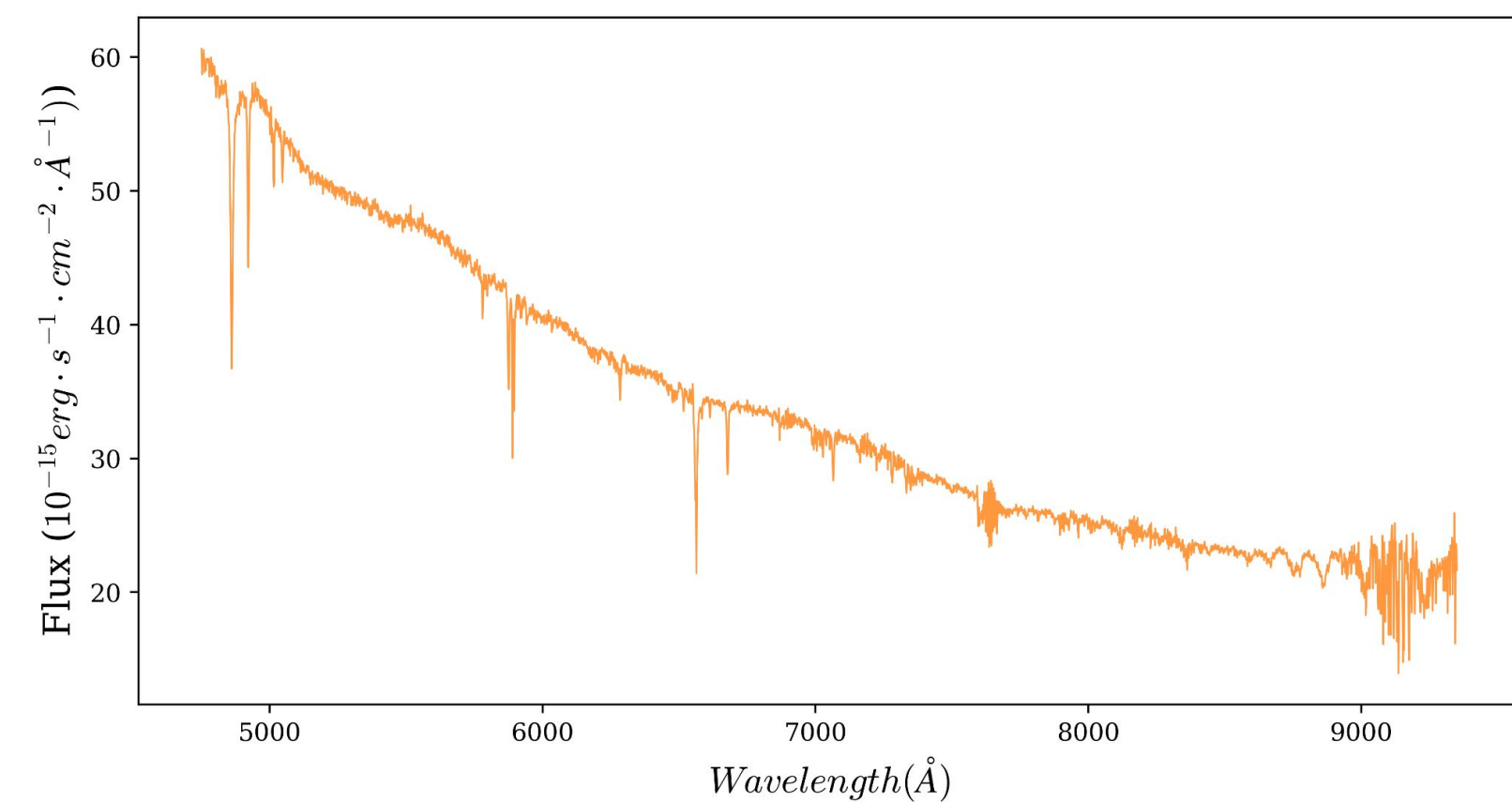
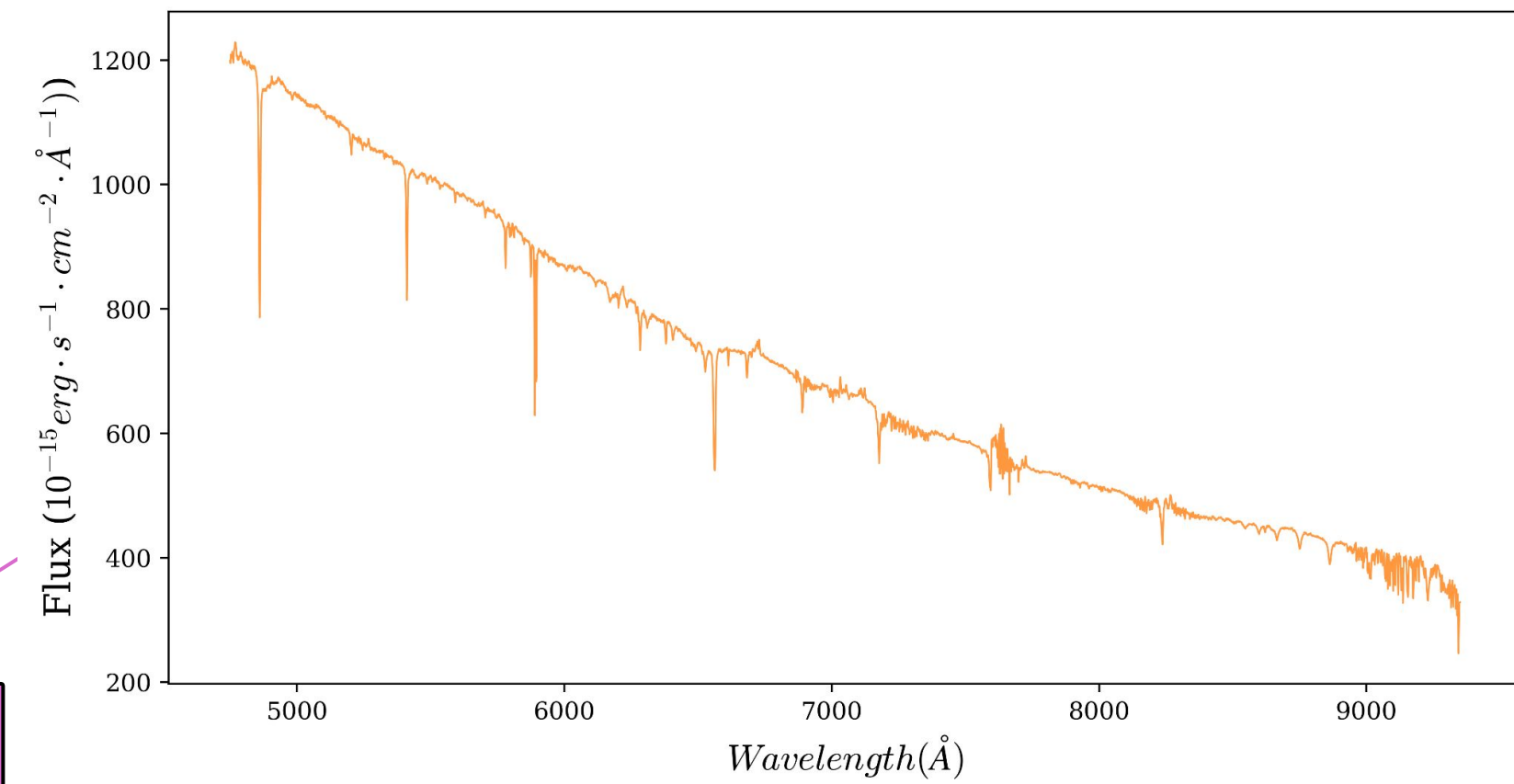
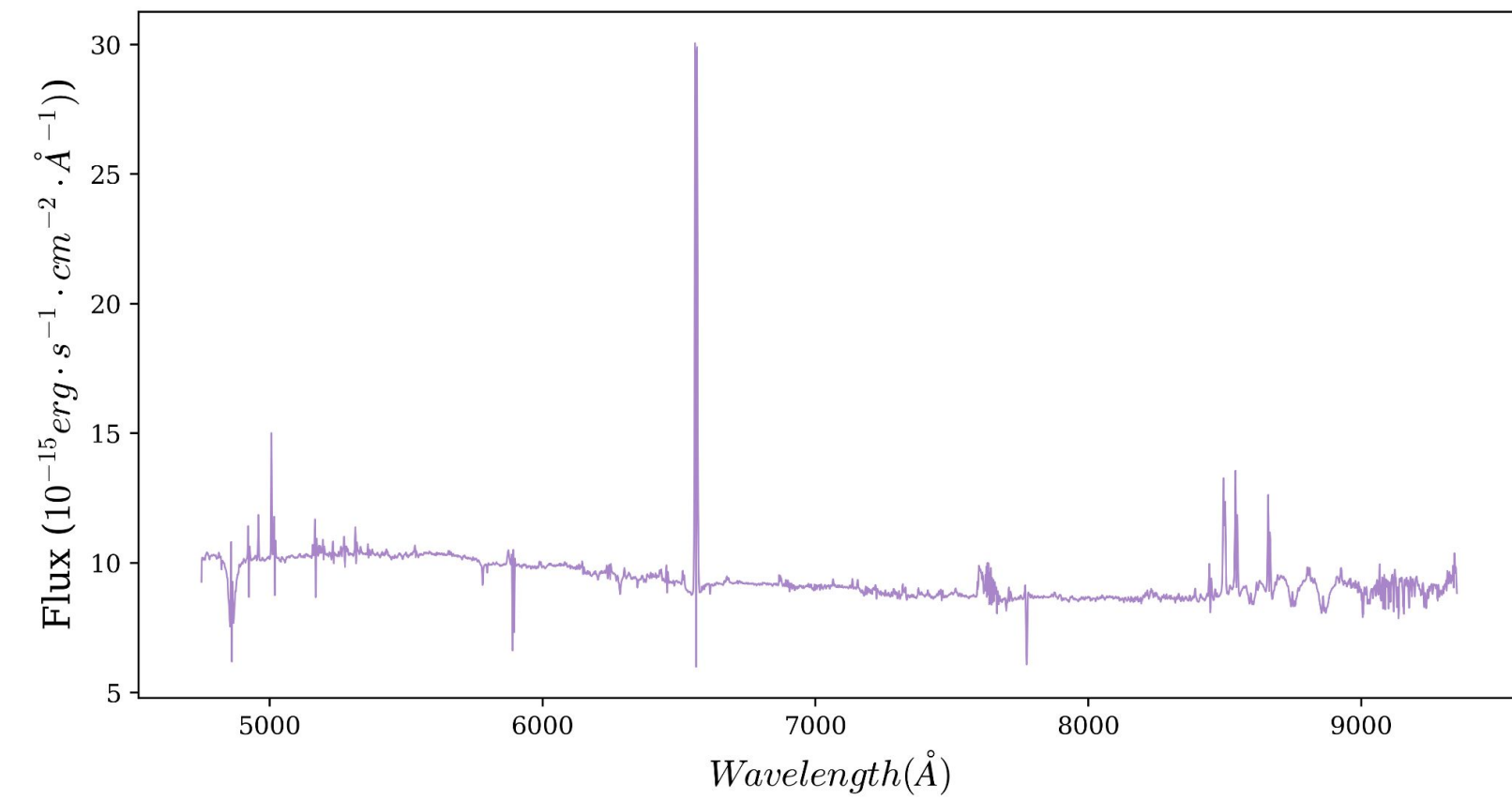
MUSE data cube

pySpecMUSE

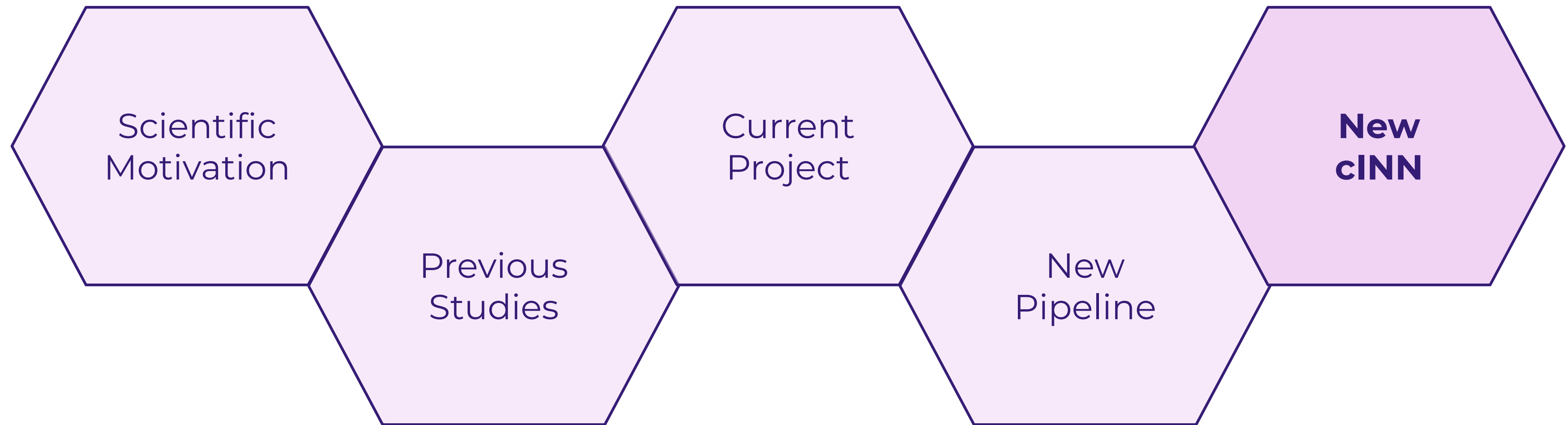
λ - dependent correction



Extracting the Central Spectra

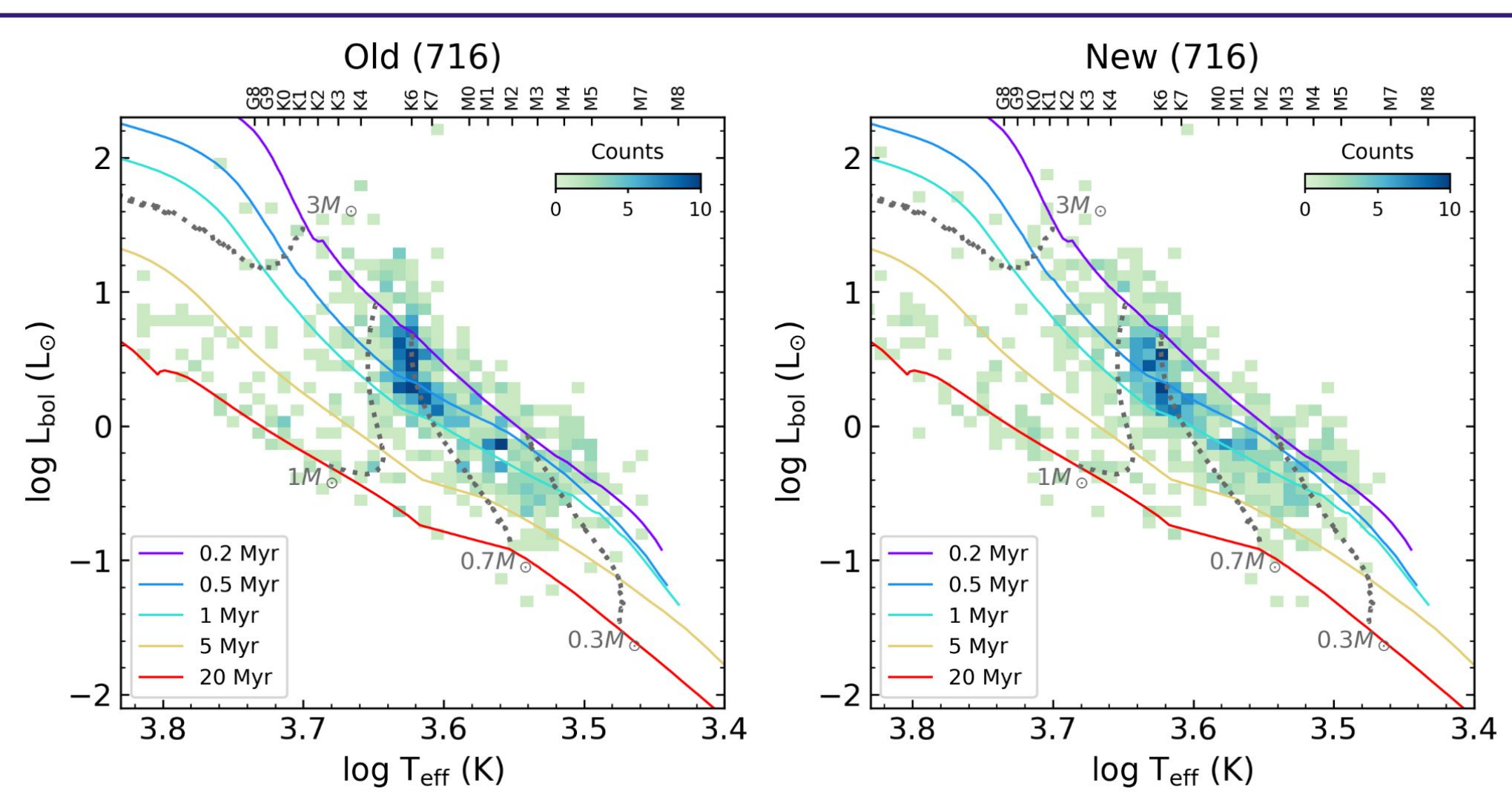


Outline

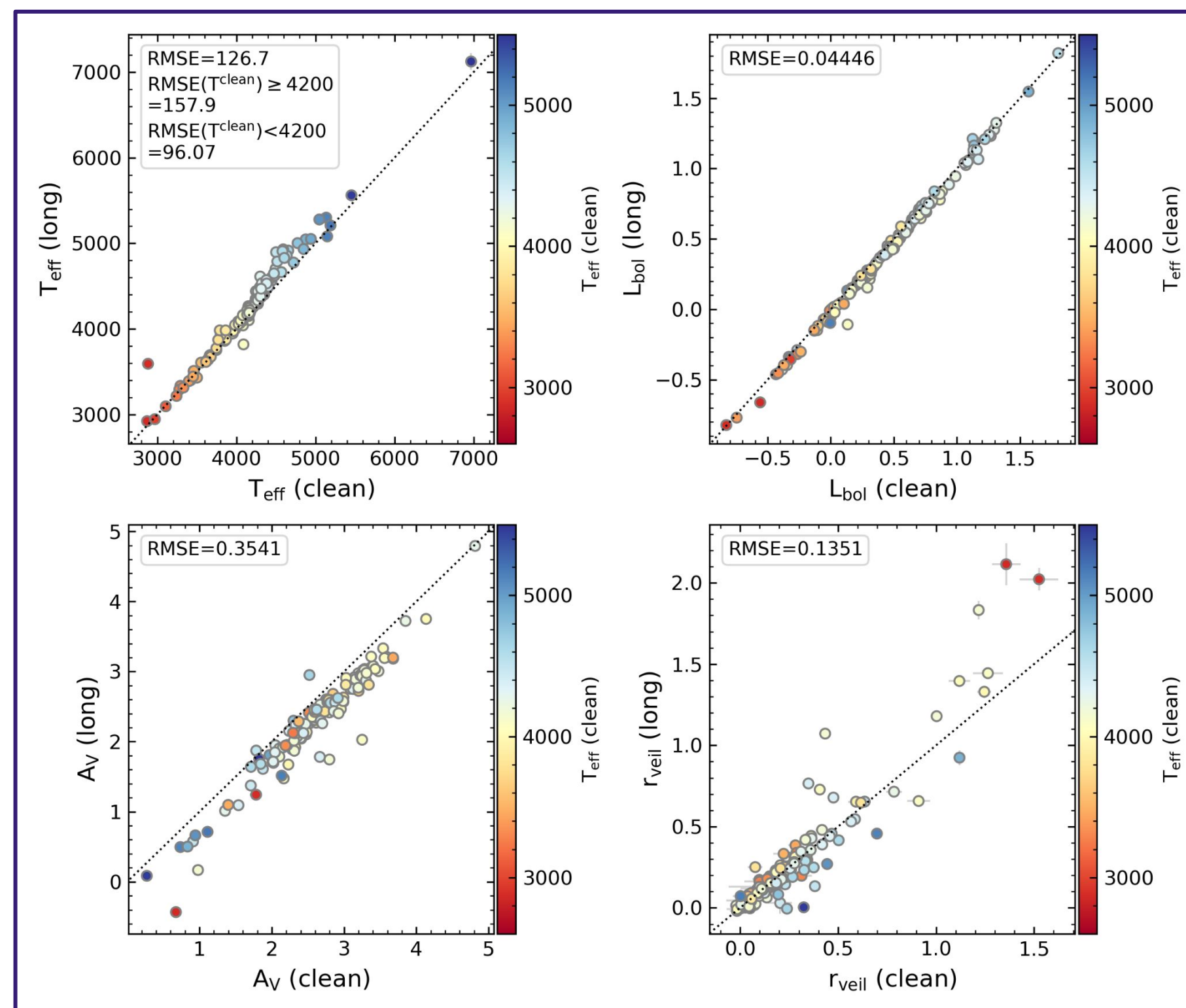


Parameter changes with the new spectra

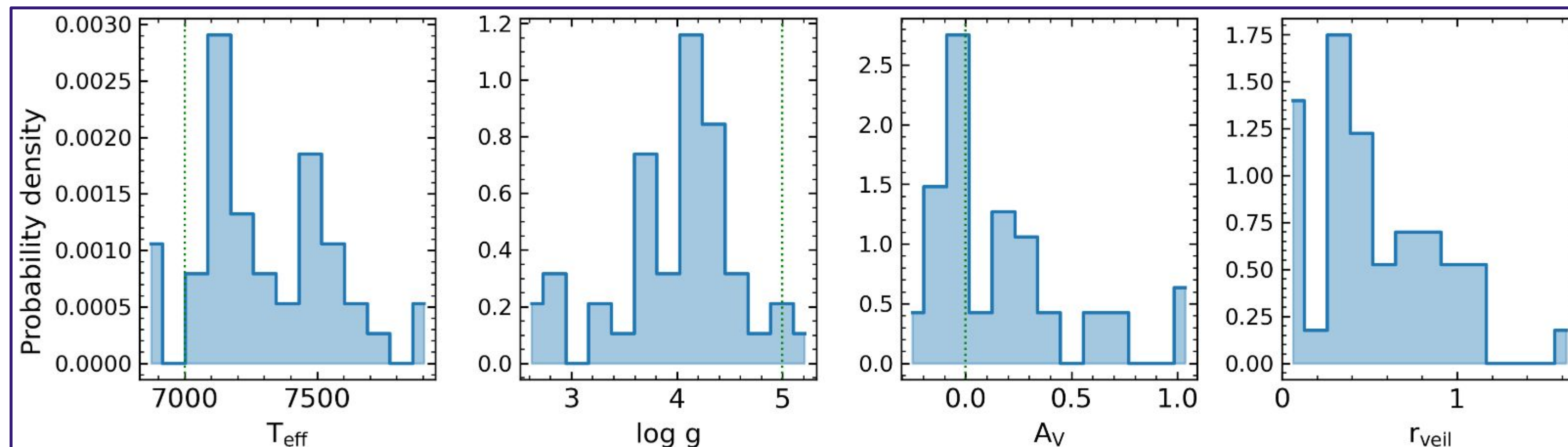
★ Full Cluster



★ cINN parameter comparison between new and old spectra

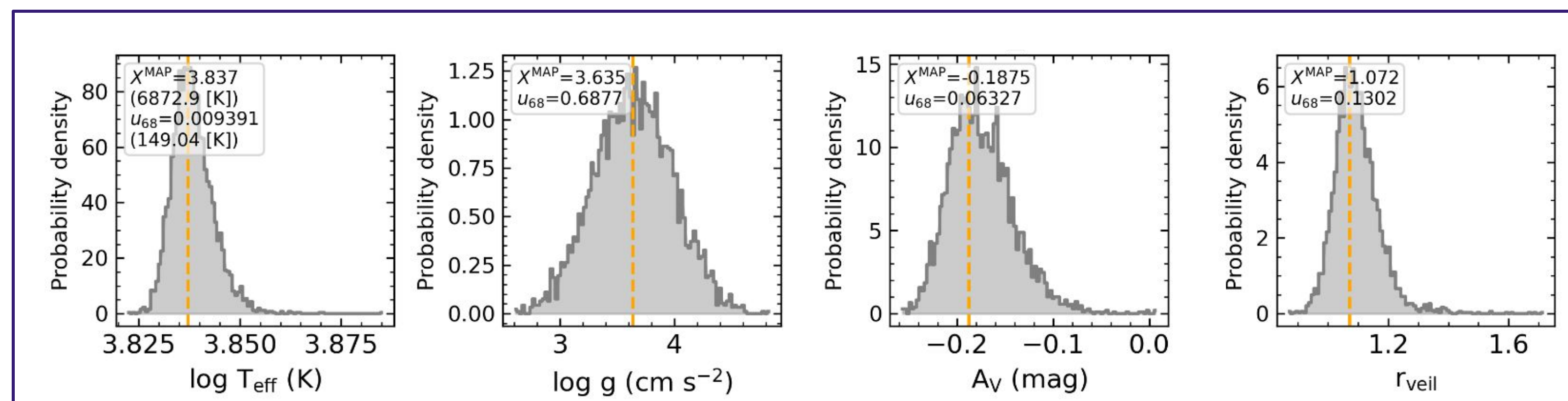


Applying the cINN to the hotter stars (Preliminary)



★ Predicted Parameters for central sources

★ Posterior Distribution for one source with $T_{\text{eff}} < 7000^\circ\text{K}$



Summary and Future Work

We now have a complete sample from the center of Tr14!

- Train a cINN using synthetic spectra of hot stars ($T_{\text{eff}} > 4500^{\circ}\text{K}$)
- Create modules on the cINN that take into consideration the NIR excess and the accretion disk
- Train a cINN on spectra containing the contribution of the disk
- **Main goal:** Classify the stars of Trumpler 14 and their disc accretion properties with the new cINN

Credit: NASA & ESA, Jesús Maíz Apellániz



Thank you!