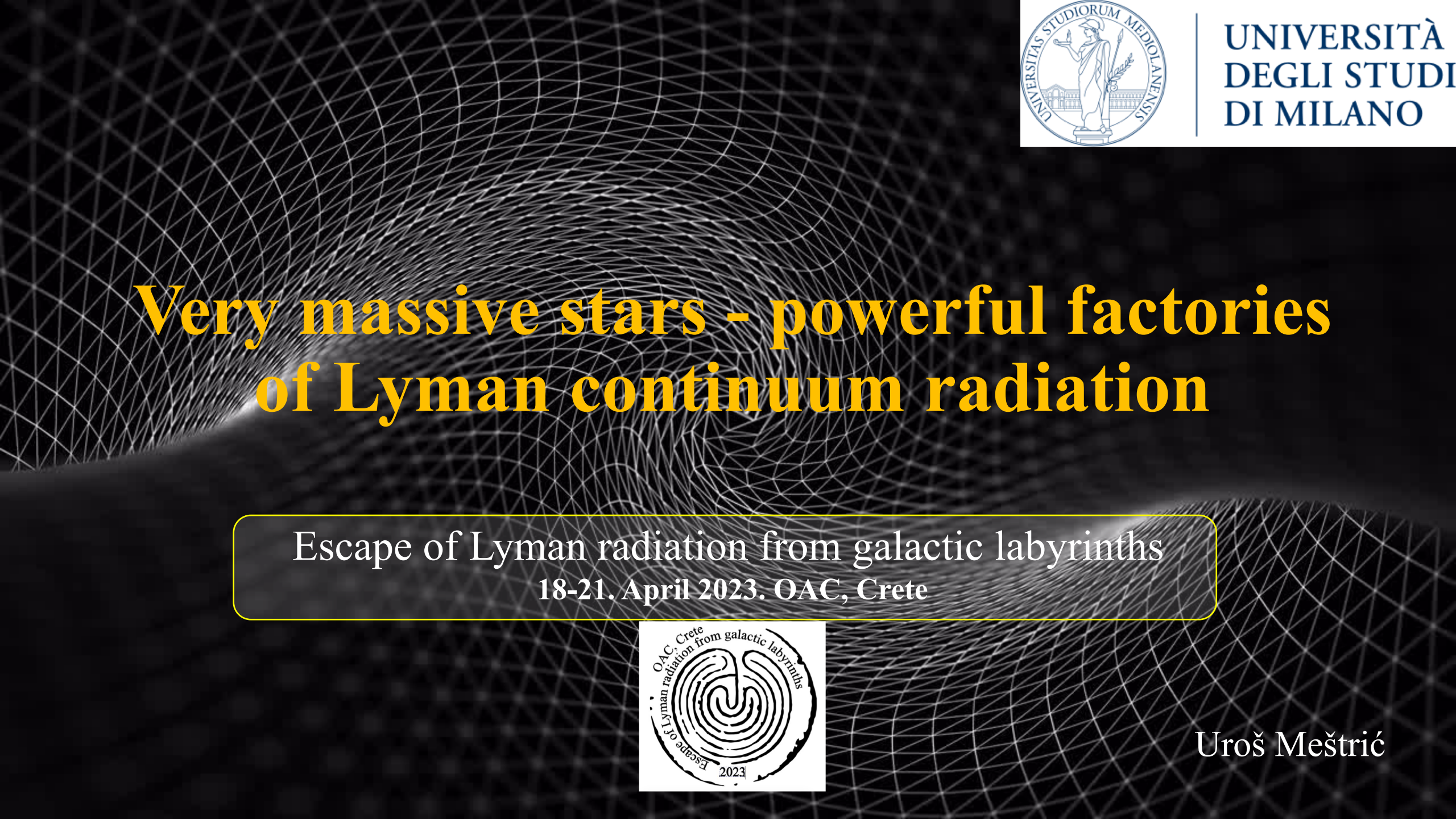


Very massive stars - powerful factories of Lyman continuum radiation

Escape of Lyman radiation from galactic labyrinths

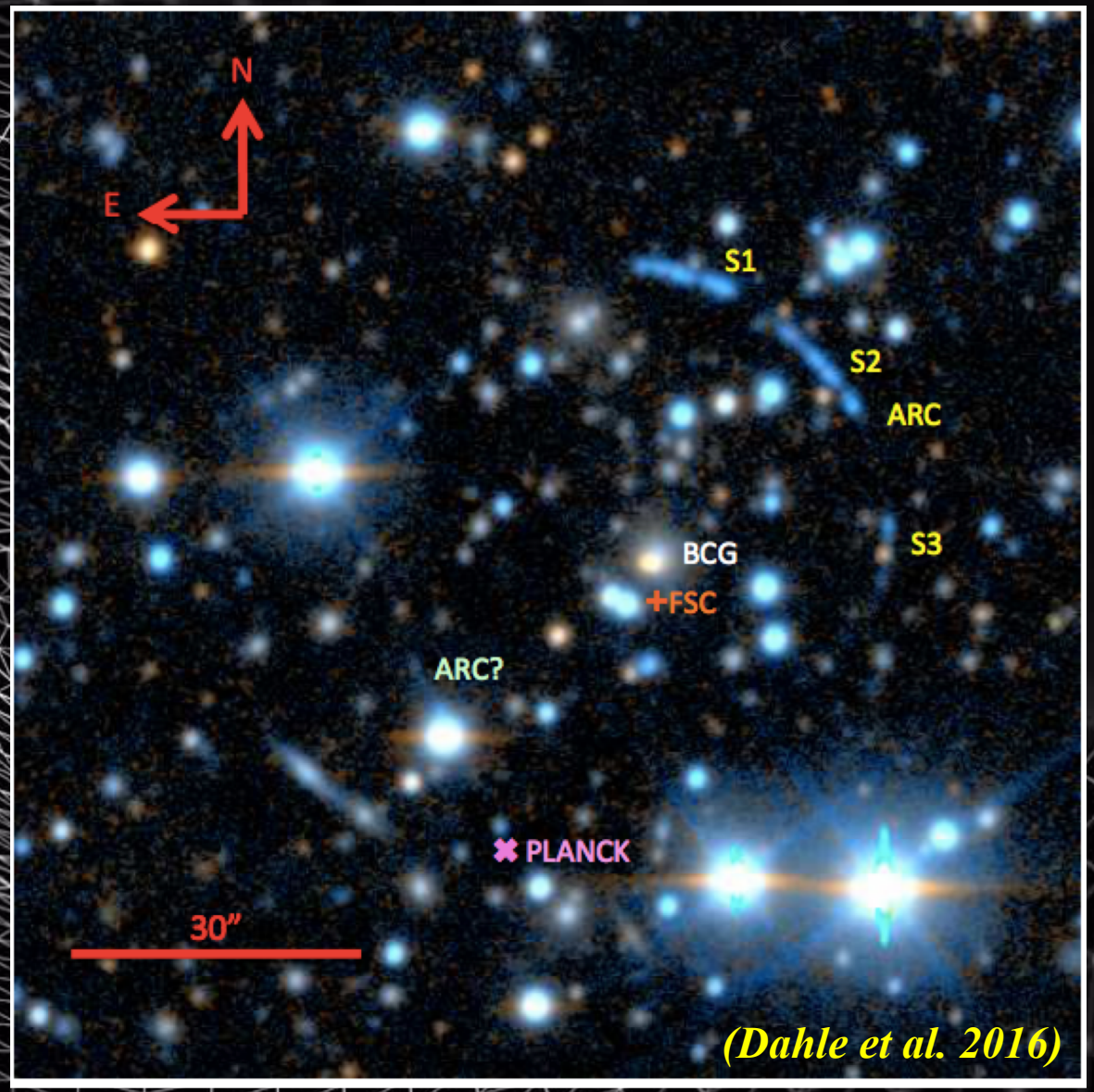
18-21. April 2023. OAC, Crete

Uroš Meštrić

Sunburst Arc

- Planck cluster PSZ1 G311.65-18.48 at z=0.44

(Dahle et al. 2016)



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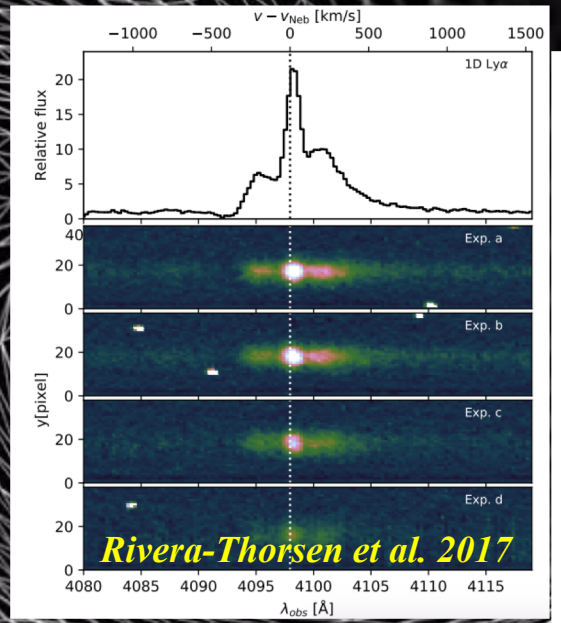
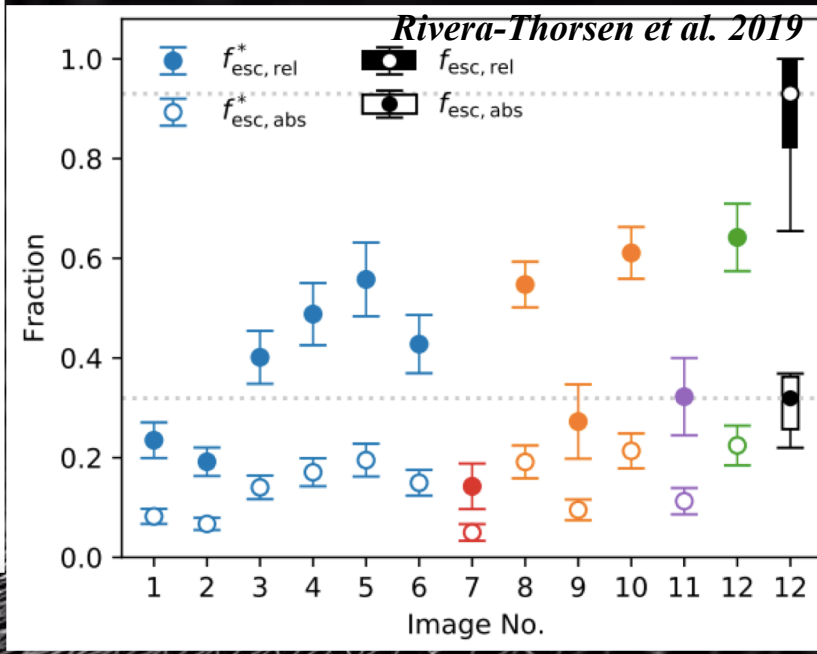
- Planck cluster PSZ1 G311.65-18.48 at z=0.44

(Dahle et al. 2016)

- Triple-peaked Lya and Lyman continuum (LyC) emitter f_{esc}=46 - 93%

(Rivera-Thorsen 2017,2019)





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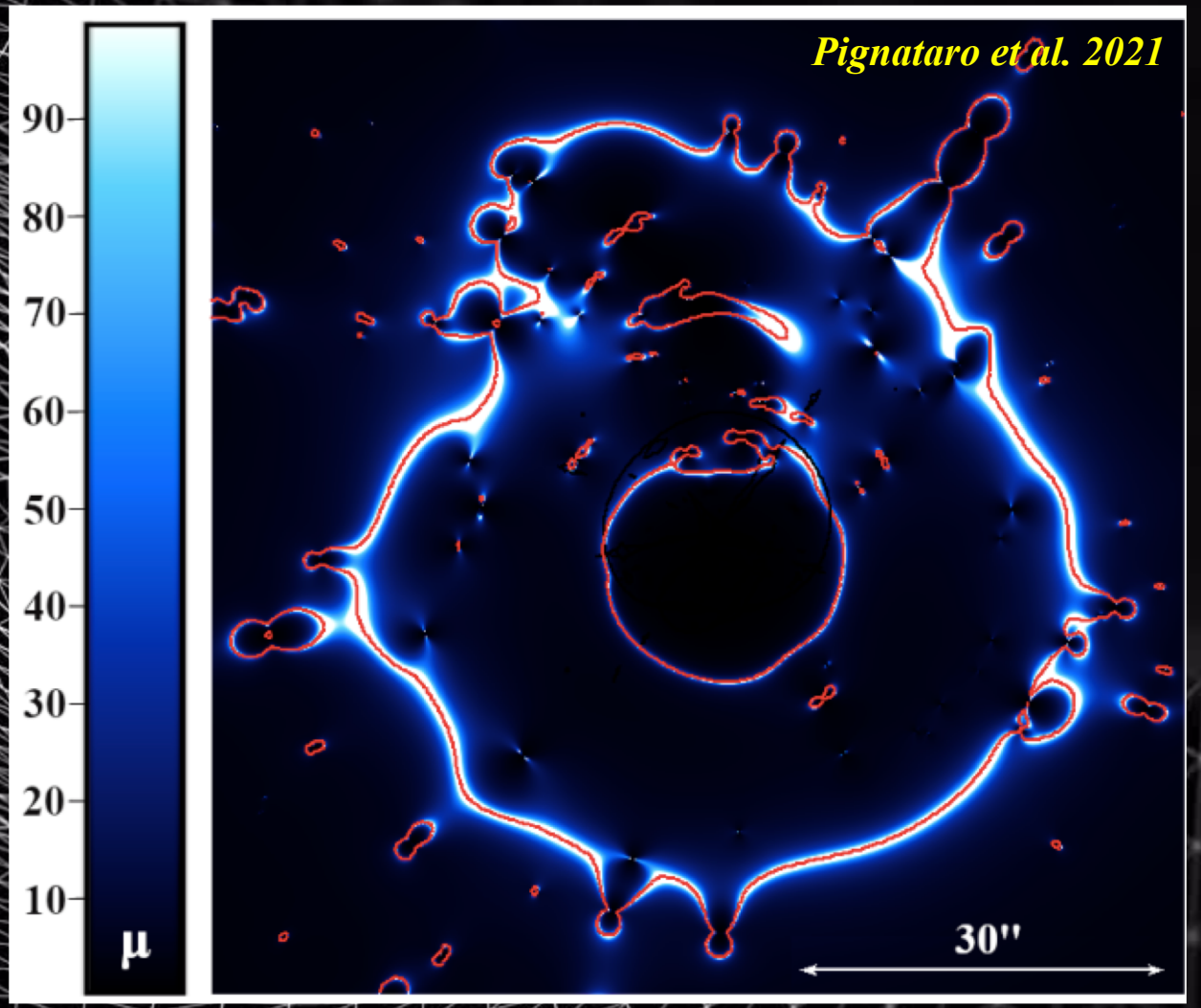
- Lens model - Magnification (tang) of the YMC ~**20-100** (5.1l)

(Pignataro et al. 2021)



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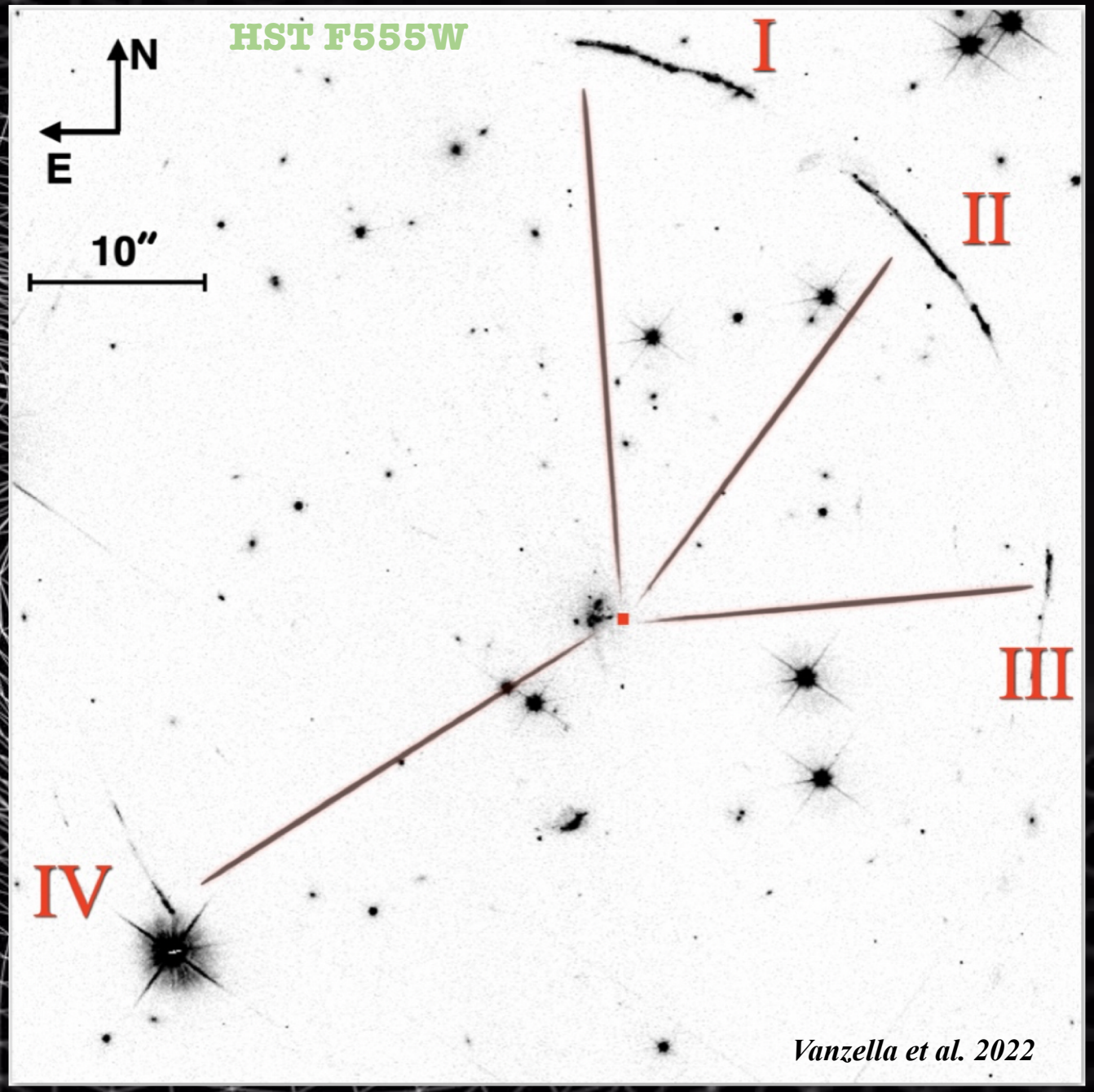

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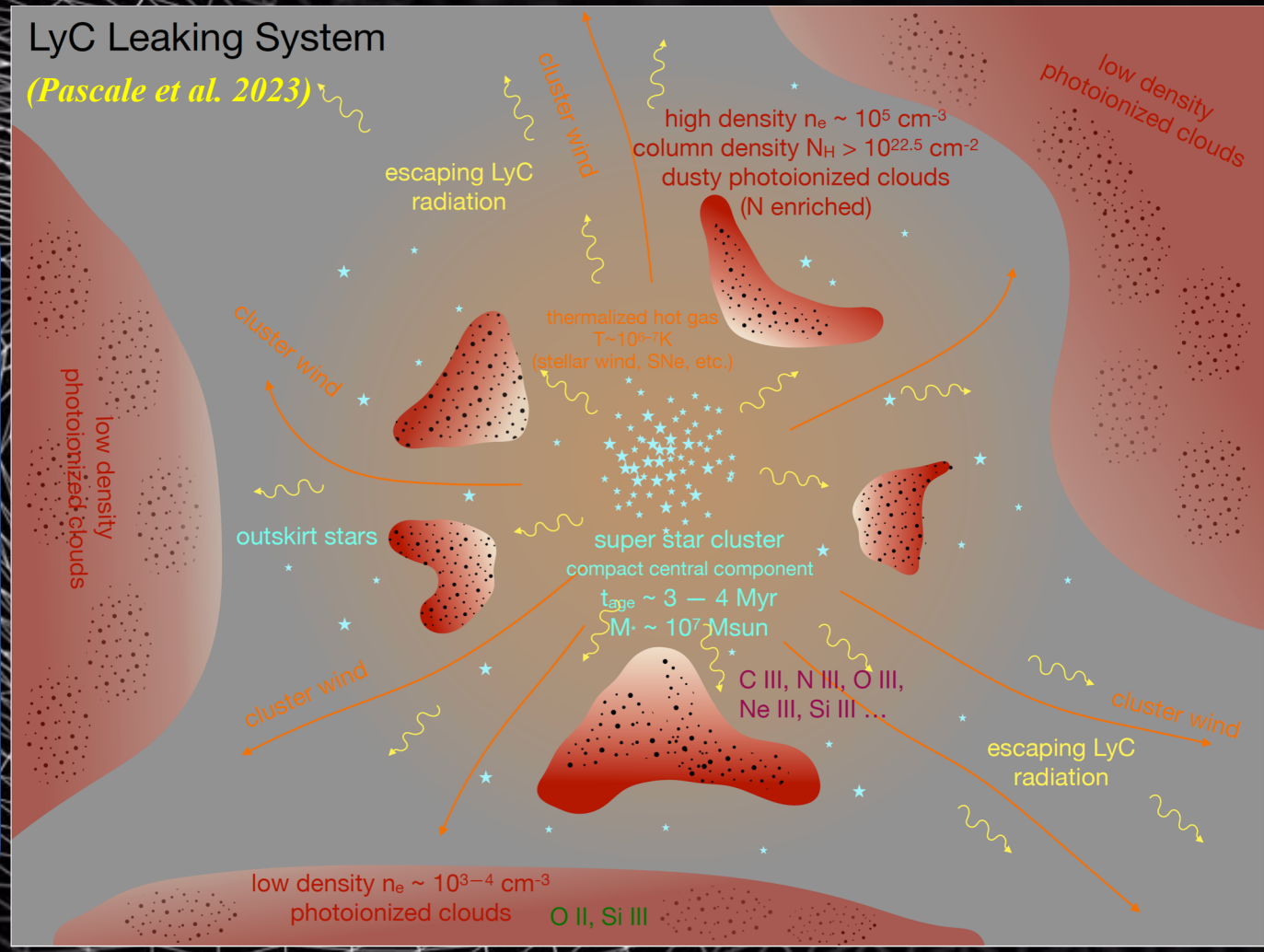
- Young massive star cluster (YMC) physical properties ~**3Myr** age, ~**3-20pc** size, ~**$10^7 M_\odot$** mass, sub-solar metallicity **$0.5 Z_\odot$**

(Chisholm et al. 2019, Vanzella et al. 2020a, Vanzella et al. 2022

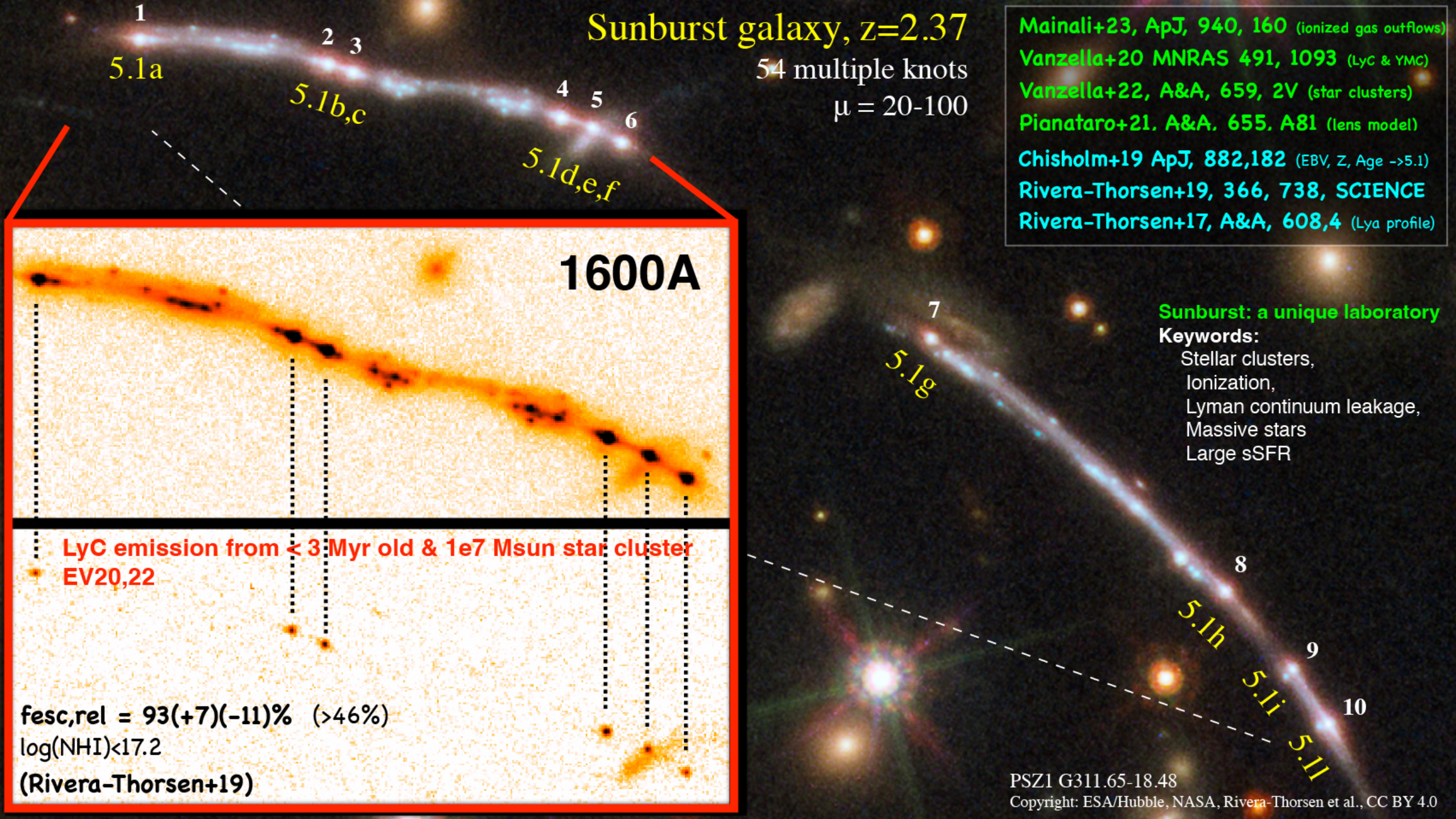
Mainali et al. 2022, Pascale et al. 2023)



Sunburst galaxy, z=2.37

54 multiple knots

μ = 20-100



Mainali+23, ApJ, 940, 160 (ionized gas outflows)

Vanzella+20 MNRAS 491, 1093 (LyC & YMC)

Vanzella+22, A&A, 659, 2V (star clusters)

Pianataro+21, A&A, 655, A81 (lens model)

Chisholm+19 ApJ, 882,182 (EBV, Z, Age ->5.1)

Rivera-Thorsen+19, 366, 738, SCIENCE

Rivera-Thorsen+17, A&A, 608,4 (Lya profile)

Sunburst: a unique laboratory

Keywords:

Stellar clusters,
Ionization,
Lyman continuum leakage,
Massive stars
Large sSFR

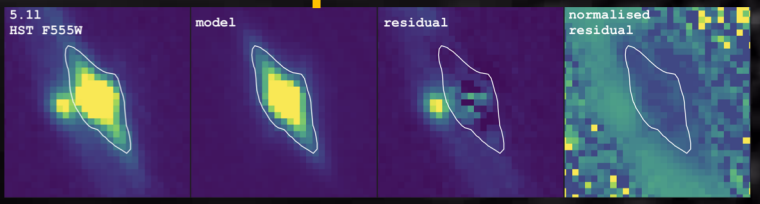
PSZ1 G311.65-18.48

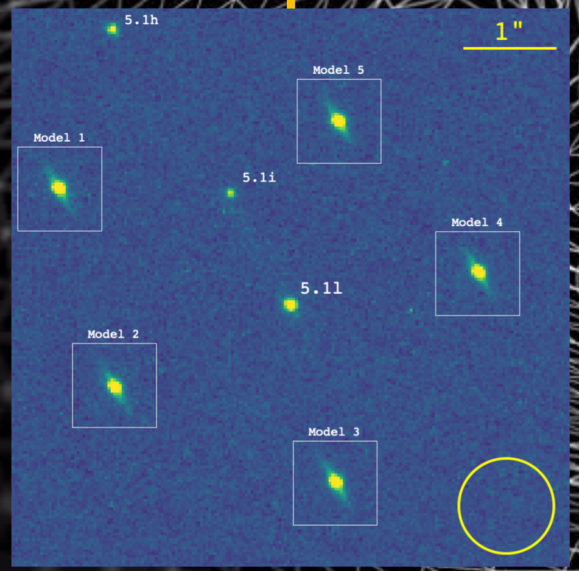
Segregation of the VMSs

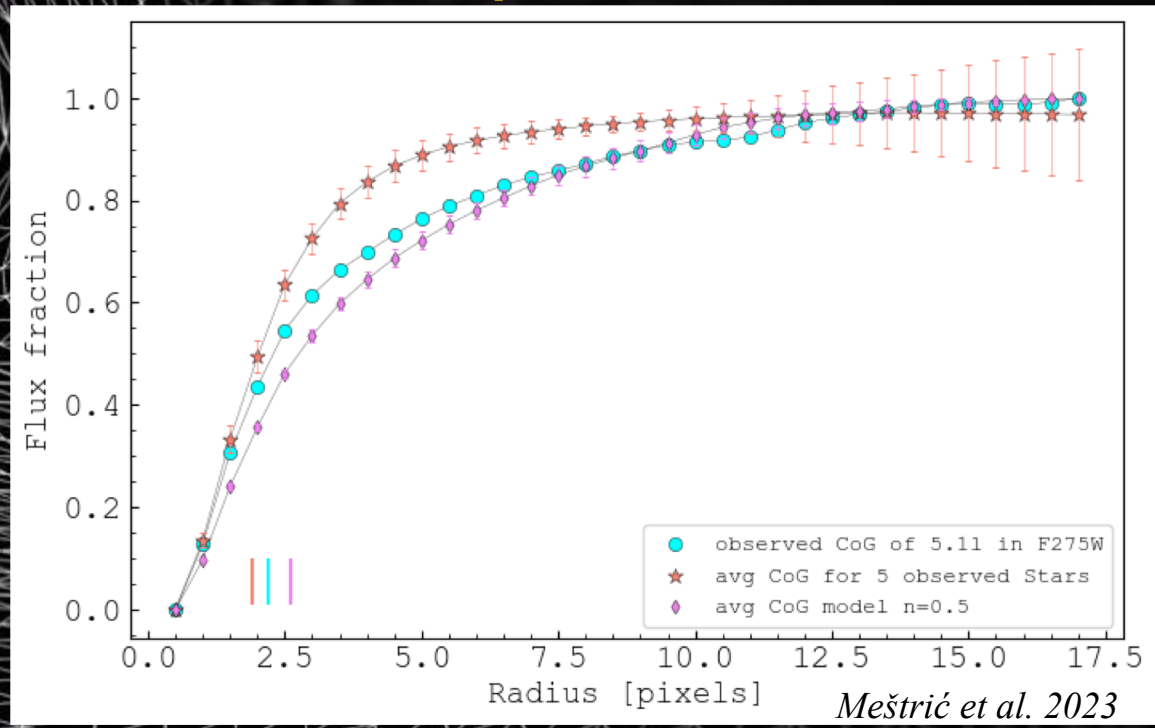
5.11 Galfit model on HST F555W, PSF F275W (two component model)

5.11 model injected in HST F275W image

CoG measuring and R_{eff} estimates







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Very Massive Stars (VMSs)

- Masses **>100M$_\odot$** with predicted upper mass cut-off **150 - 200M$_\odot$**

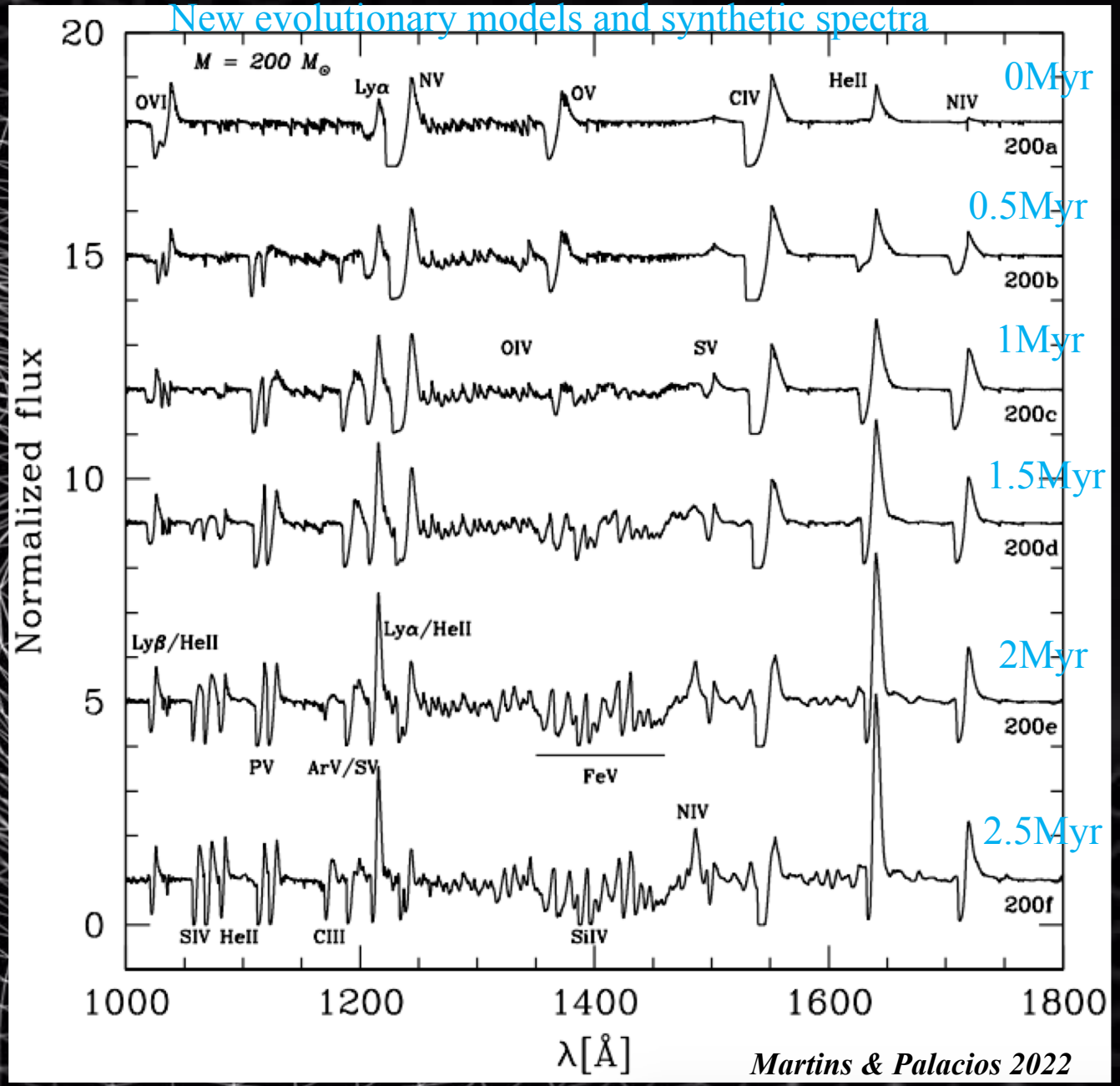
(e.g. Vink et al. 2015, Weidner & Kroupa 2004)

- Short-lived stars **2-3Myr**

(e.g. Yusof et al. 2013)

- Populate the central regions of the young massive star clusters (YMC) → r_c **~ 0.1 – 0.2pc**

(e.g. Portegies Zwart et al. 2010)



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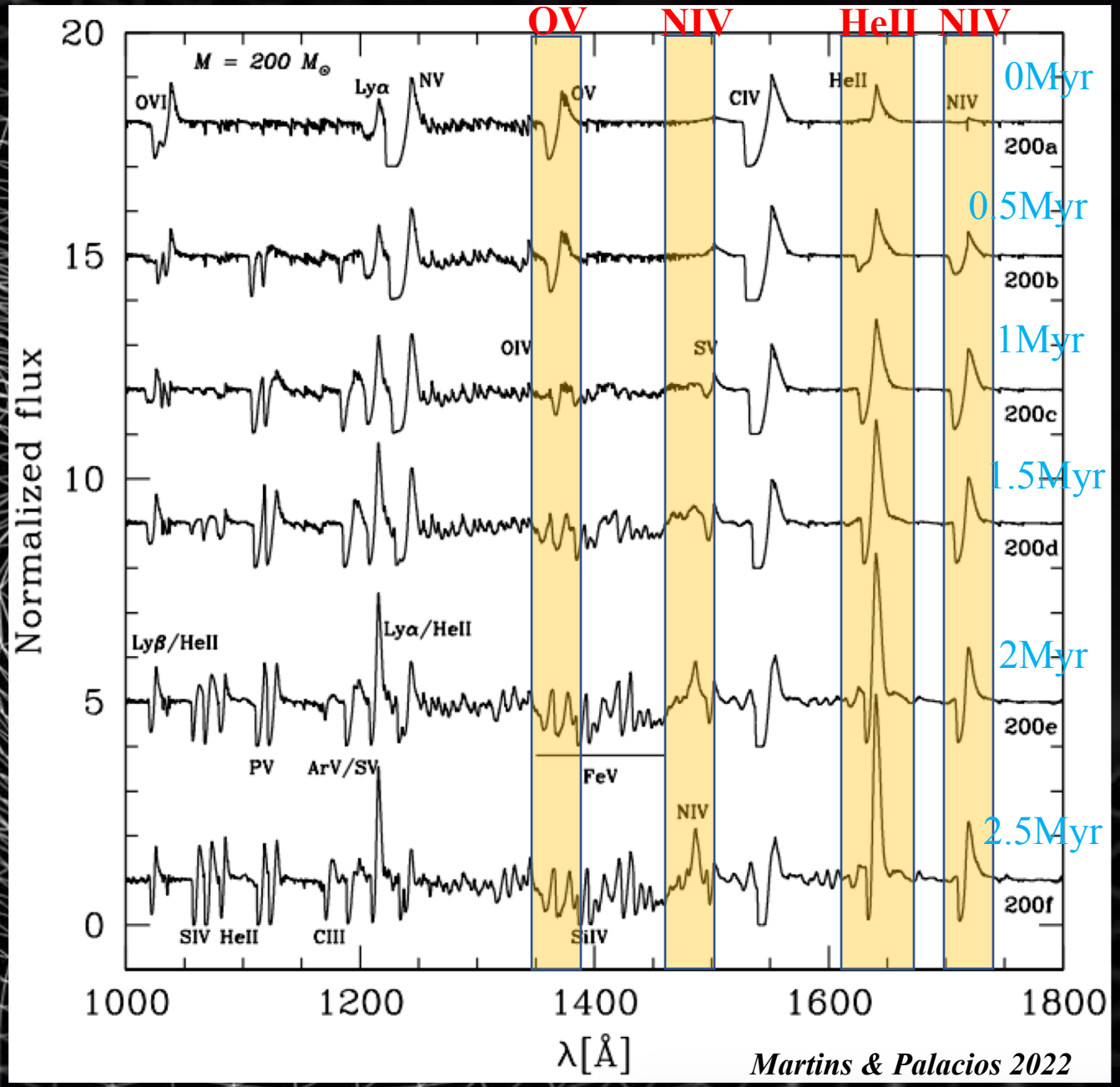
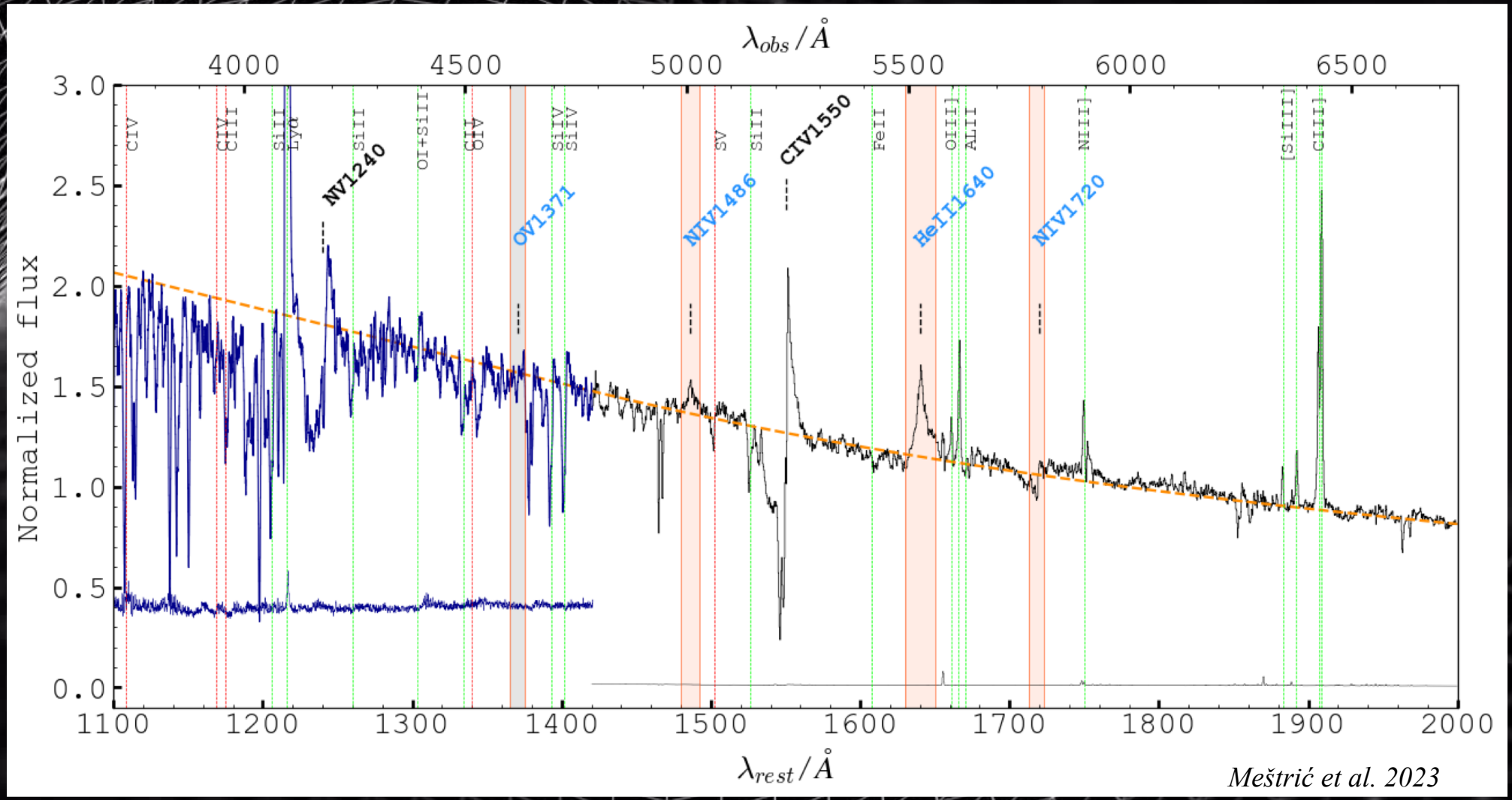
(e.g. Portegies Zwart et al. 2010)

- **Spectroscopic signatures of VMSs:**
  - OV 1371Å
  - NIV 1486Å
  - **HeII 1640Å**
  - NIV 1720Å



Presence of the VMSs (observed spectrum)

- X-Shooter + MUSE
- MUSE ~ 16.000h!
- **β**= -1.71
- Age < 3Myr



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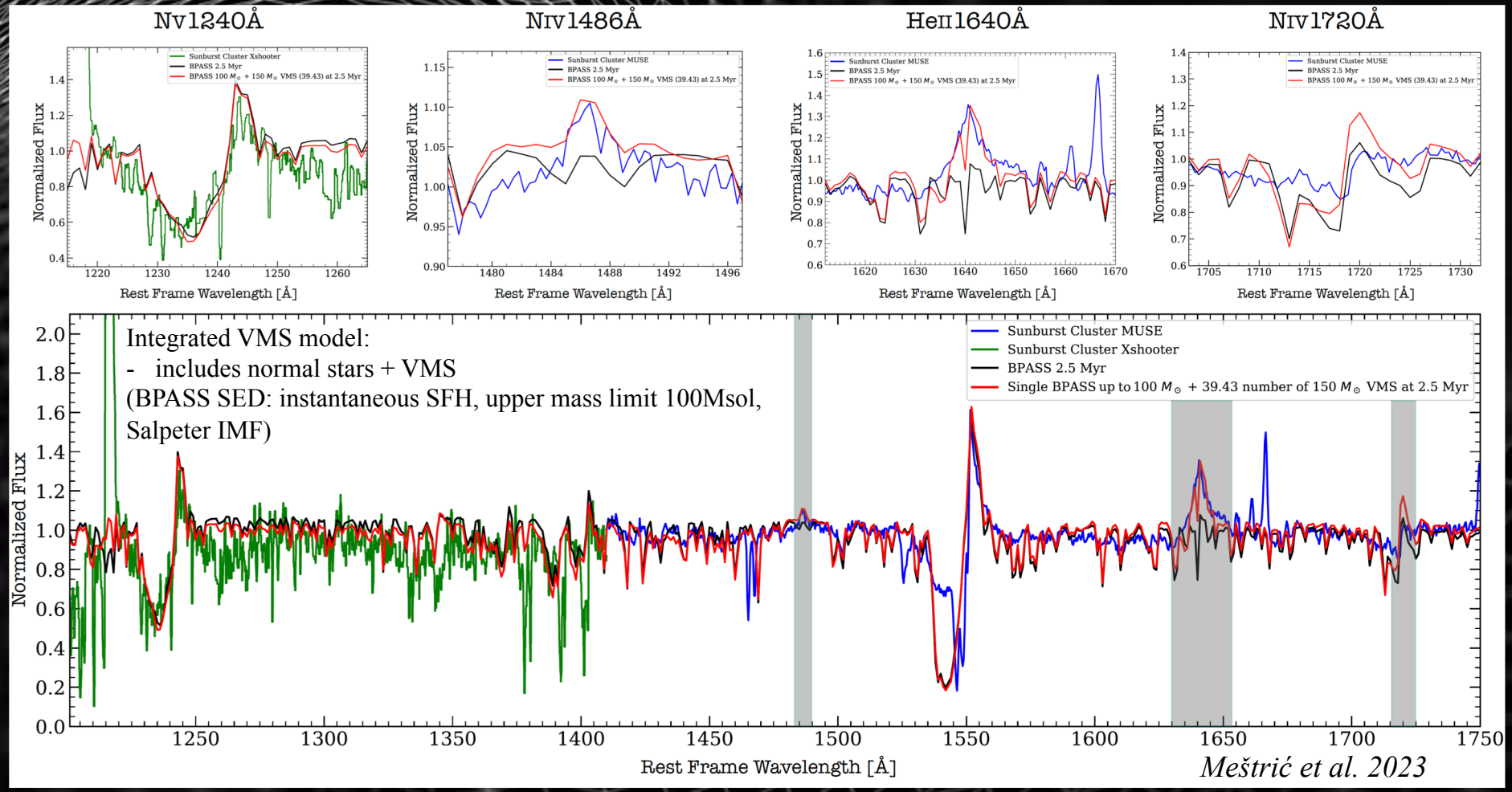
Presence of the VMSs (observations vs models)

Ankur Upadhyaya
MSc Astrophysics 2022
University of Geneva, Switzerland

- Number of VMS ~ 40
- Mass = 150$M_\odot$
- Age = 2.5Myr
- $Mass_{YMC} = 10^6 M_\odot$



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Ankur Upadhyaya
MSc Astrophysics 2022
University of Geneva, Switzerland

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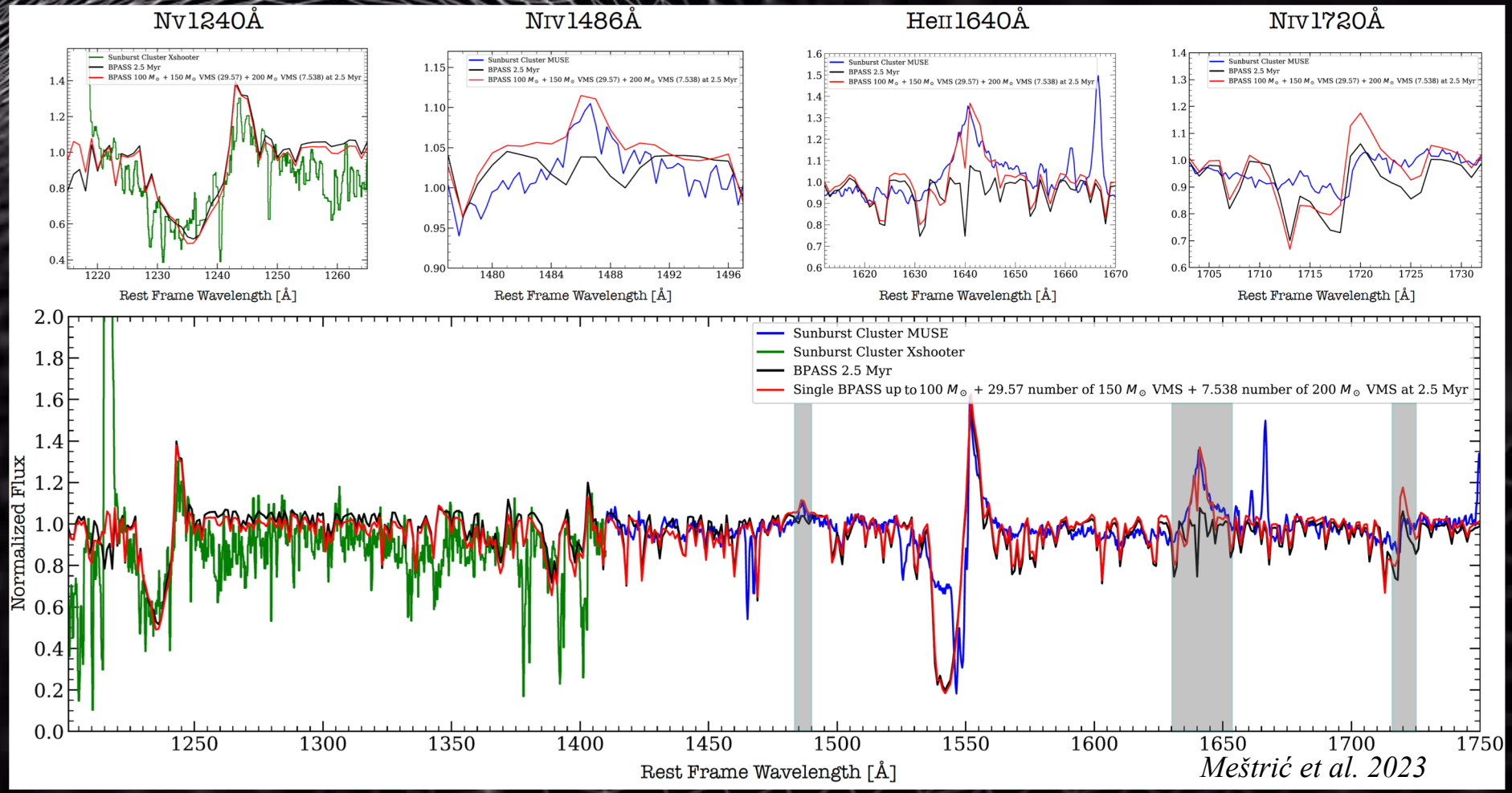
- Mass = 150$M_\odot$
- Age = 2.5Myr
- $Mass_{YMC} = 10^6 M_\odot$

- Number of VMS ~ 38
- Mass = 150$M_\odot$ (~30) and 200$M_\odot$ (~7)
- Age = 2.5Myr
- $Mass_{YMC} = 10^6 M_\odot$

- **15% of LyC from VMS**



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Final conclusions and Summary

- We detected the spectroscopic features which indicates the presence of the VMSs hosted by 5.1 YMC.
- Comparing the observations with the models reveals that most plausible age of the YMC is **~2.5Myr** and estimated number of VMSs is **~375 – 400.**
- **In the 730Å – 900Å range 15% of the LyC flux is produced by VMSs.**
- Morphological analysis reveals the size of LyC region of $\mathbf{R_{eff}}$**=4.7±1.5pc** while non-ionizing region is $\mathbf{R_{eff}}$**=7.8±1.4pc.**