

# The Universal Initial Mass Function (IMF)

## Deep Subaru H $\alpha$ Observations of M83 XUV Disk

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**ABSTRACT & CONCLUSIONS:** We report Subaru deep H $\alpha$  observations of the extended ultraviolet (XUV) disk of M83. Combining Subaru and GALEX data with a stellar population synthesis model, we find that (1) the stochastic stellar initial mass function (IMF) is preferred rather than the truncated IMF, because some low mass stellar clusters ( $10^{2-3} M_{\odot}$ ) have massive O type stars; and that (2) the standard Salpeter IMF and a simple aging effect explain the counts of FUV-bright and H $\alpha$ -bright clusters. The new data, model, and previous spectroscopic studies provide overall consistent results with respect to the internal dust extinction ( $A_V \sim 0.1$  mag) and low metallicity ( $\sim 0.2 Z_{\odot}$ ). After the extinction correction and background subtraction, virtually all clusters in the XUV disk are blue FUV-NUV  $< 0.0$  mag (Koda et al. 2012, ApJ, 749, 20).

### OBSERVATIONS & DATA

- Subaru 8.2m Observations
  - Suprime-Cam: Prime Focus Camera
  - Large Field-of-View (34' x 27')
  - Entire M83 XUV disk with TWO pointings
  - NA659 (H $\alpha$ ) & Rc bands
- Archival GALEX Data (Bigiel et al. 2010)
  - FUV & NUV bands
- Sensitivities (AB mag, 1sigma)
 

NA659	Rc	FUV	NUV
24.90	25.56	26.34	26.20

### SAMPLE SELECTION

Inside HI disk (IN objects)

Outside HI disk (OUT objects)

Example NA659 Images

HII regions around clusters are clearly detected.

### CONSTRAINING THE IMF

- Basic Idea
  - UV and H $\alpha$  trace stellar clusters with different stellar populations
  - GALEX UV  $\rightarrow$  with B (& possibly O) stars
  - Subaru H $\alpha$   $\rightarrow$  with O stars
- Counts of clusters bright in UV and H $\alpha$  should constrain the IMF at high-mass end.
  - $N_{UV}$ : # of UV-bright clusters
  - $N_{H\alpha}$ : # of H $\alpha$ -bright clusters
  - Practically, we can use color criteria to count them (FUV-NUV<0mag & NA659-Rc<1mag)
- Taking into account the cluster aging effect, we would expect:
  - $t_{UV}$  := timescale that cluster is UV-bright
  - $t_{H\alpha}$  := timescale that cluster is H $\alpha$ -bright

### NUMBER COUNTS

- Low-mass clusters ( $10^{2-3} M_{\odot}$ )
  - NA659-Rc<1mag  $\rightarrow$  O stars exist, though no O star expected if IMF is truncated.
- STOCHASTIC IMF
- Higher-mass clusters ( $> 10^3 M_{\odot}$ )
  - NA659-Rc<1mag:  $N_{H\alpha} = 9 \pm 3$  (Poisson noise)
  - FUV-NUV<0mag:  $N_{UV} = 88 \pm 9$

### MODEL

Assumptions: (1) instantaneous cluster formation and (2) constant cluster formation rate

# of clusters w/ NA659-Rc<1mag (hosting O stars)	Duration that clusters have NA659-Rc<1mag	$t_{H\alpha} = 5.8 \text{ Myr}$
$\frac{N_{H\alpha}}{N_{UV}} = \frac{t_{H\alpha}}{t_{UV}} \approx 0.08$		

# of clusters w/ FUV-NUV<0mag (hosting O and/or B stars)

# of clusters w/ FUV-NUV<0mag (hosting O and/or B stars)	Duration that clusters have FUV-NUV<0mag	$t_{UV} = 71 \text{ Myr}$
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### OBS

Number ratios – MODEL and OBS are CONSISTENT  
→ The standard IMF in the M83 XUV disk.

IN objects

OUT objects

Background-subtracted IN objects (IN – OUT objects accounting for area ratio)

$\frac{N_{H\alpha}}{N_{UV}} = 0.10 \pm 0.03$

Note: assume 0.22sun from previous spectroscopy (Gil de Paz et al. 2007)