The Evolution of Andromeda as Seen by PHAT

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Local Group Astrostatistics, U of M
PHAT

Panchromatic Hubble Andromeda Treasury (Dalcanton+ 2012)

117 million stars (Williams+ 2014)

828 Orbits, 4 years

6 filters
PHAT

Panchromatic Hubble Andromeda Treasury (Dalcanton+ 2012)

117 million stars (Williams+ 2014)

~9000 regions

100pc x 100pc (projected size)
Deriving SFHs
The recent SFH of M31...

100 Myr avg SFR: 0.28 M☉ yr⁻¹

500 Myr ago

Today

Lewis+2015

03 June 2015

Alexia Lewis, UW
The recent SFH of M31... is ring-dominated

The recent SFH of M31...

500 Myr ago

Today

arXiv:1504:03338

Lewis+2015
Kennicutt-Schmidt Relation with direct SFH measurements

Evolution with time  Small dynamic range in gas
How fast is the gas consumed?

HI

CO

HI+CO

Depletion Time [yr]

$10^{11}$

$10^{10}$

$10^{9}$

$10^{8}$
Model flux in other bands

Compare modeled flux maps with observed maps

current agreement within 10%
A 2—4 Gyr Star-Forming Event

Williams+2015

Fig. 1.— Left: Locations in the PHAT footprint of our "reddening-free" samples are overplotted on a map of the width of the red giant branch as measured in the NIR photometry. This width is a proxy for the amount of dust present along the line of sight. The sample comes from the regions of narrowest width, and therefore containing very little dust. Circles of the same color show how we grouped the samples to improve our CMD-fitting statistics.

Right: Locations in the PHAT footprint of our "reddening-free" samples are overplotted on a Spitzer 3.6 µm image, showing the wide range of stellar densities covered by our samples. However, groups are confined to areas with little stellar density variation. Numbers label each group with their region number in Table 1.

Fig. 4.— The cumulative star formation for the past 5 Gyr at 6 different radii. Other regions are not shown for brevity. These correspond to the six radial groupings along the major axis shown in Figure 1. Solid lines with gray shading show the fits to the Padova models along with the total uncertainties described in Section 2.1. Dashed lines show the best fit to the BASTI models, and dotted lines show the best fit to the PARSEC models. Three colored stripes show the 3 epochs used to make the plots in Figure 6, in their respective colors. All of the model sets result in a steep increase of short duration in all locations. The Padova models measure the burst to be 2.0-3.5 Gyr ago (green area of the plots) relative to the neighboring epochs. As in Figure 3, the cumulative fractions refer only to those stars formed in the last 5 Gyr.
A 2—4 Gyr Star-Forming Event

Williams+2015

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Williams+2015

arXiv:1504:02120

also seen in outer disk, halo fields
Bernard+ 2012,2015
Spatially and temporally-resolved recent SFH of significant fraction of M31’s disk

Variety on small scales, coherent pattern of SF on large scales

10-kpc ring: significant contributor to SF

Star-forming episode 2—4 Gyr ago

Shown in dust-free regions, at multiple radii

More complete, extended SFH in progress

M31 cycling quickly through gas supply

SFHs — model flux