Stellar Disk Kinematics and Rare Stars in M31

Raja GuhaThakurta

UNIVERSITY OF CALIFORNIA OBSERVATORIES
UNIVERSITY OF CALIFORNIA SANTA CRUZ

Spectroscopic and Photometric Landscape of Andromeda's Stellar Halo

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Subaru Telescope 20th Anniversary, Waikoloa, HI

Optical & Near Infrared Astronomy for the Next Decade — LGNG Science Parallel Session
Outline

❖ Using stellar kinematics to trace the formation and evolutionary history of galactic disks

❖ Using large galaxies as laboratories to study stellar evolution
Zooming into the Hubble Space Telescope mosaic image of M31
Spectra of 11,000 red giants in the inner region of M31

![Graph showing distribution of PHAT-selected and CFHT-selected RGBs and PHAT-selected younger objects](image)

- **PHAT-selected RGBs**
- **CFHT-selected RGBs**
- **PHAT-selected younger objects**
M31 Stellar Disk Kinematics as a Function of Stellar Age
Disentangling bulge, disk, and halo of M31

Simultaneous fit to integrated SB, stellar kinematics, and LF

Kicked-up disk stars in M31’s halo!
M31 disk kinematics using stellar tracers of different ages

Longer lived stars display more irregular disk kinematics

Claire Dorman
(UCSC, PhD 2015)
Long lived stars have a larger asymmetric drift with respect to atomic and molecular gas than short lived stars.
Rare Stellar Populations in the Disks of M31 and M33
Spectra of Carbon Stars and “Weak CN” Stars

Carbon Stars

Katie Hamren
(UCSC, PhD 2016)

C₂

CN

Relative Flux (offset for clarity)

S/N = 17.72

S/N = 1

S/N = 9

6000 6

9000

Katie Hamren
(UCSC, PhD 2016)

Anika Kamath
(Crystal Springs Uplands School)

Alyssa Sales
(Castilleja School)

Atmika Sarukkai
(Castilleja School)

Arya Maheshwari
(Harker School)

Alex Masegian
(Branham High School)

Antara Bhattacharya
(Navy Children School)

Jon Hays
(Cabrillo College)

Rachel Raikar
(UCSC)
"Weak CN" stars appear to be evolved stars in the mass range $4 \text{–} 10 M_{\odot}$
“Weak CN” stars appear to be evolved stars in the mass range $4-10 \, M_{\text{sun}}$. UV Colors Separate Massive MS from Blue Loop.
Comparison of Detailed Spectral Features: Carbon, “Weak CN”, and Normal (O-rich) Stars

The “weak CN” spectral feature can be used to identify evolved massive stars in M31
"Weak CN" stars are consistent with being more massive than carbon stars.
Summary

- Stellar velocity dispersion and asymmetric drift show a monotonic increase with stellar age from < 0.1 to ~10 Gyr.
- Discovery of "weak CN" stars that appear to be associated with evolved stars in the mass range ~4–10 $M_{\odot}$.

PFS on Subaru is a potential game changer for this kind of science!