Kinematics and Scalings of M31 dSph Satellites

Erik Tollerud
UC Irvine

Rachael Beaton\textsuperscript{1}, James Bullock\textsuperscript{2}, Raja Guhathakurta\textsuperscript{3}, Marla Geha\textsuperscript{4}, Michael Boylan-Kolchin\textsuperscript{1}, Jason Kalirai\textsuperscript{5}

\textsuperscript{1}UVa, \textsuperscript{2}UCI, \textsuperscript{3}UCSC, \textsuperscript{4}Yale, \textsuperscript{5}STScI

Thursday, August 11, 2011
Why M31 Satellites?

• We can get resolved star spectra!

• Data point #2 for MSP, MFs, Strigari plot, etc: Are the M31 satellites different from MW sats?
M31 Satellites

M31 Environs

ΔM31Dec [°] vs ΔM31RA [°]

E. Tollerud

Thursday, August 11, 2011
Velocities from Keck/DEIMOS Spectroscopy
Member Selection

[Graphs showing member selection criteria for And XVIII, with plots of $(M-T)_0$ vs. $T_0$ and $\Delta Dec$ vs. $\Delta RA$.]
Member Selection

Contamination from MW or M31 Halo

dSph Members

E. Tollerud

Thursday, August 11, 2011
Member Selection

Coherent Velocities

And XVIII

$T_0$

(M-T)$_0$

And XVIII

$\Delta$Dec ['']

$\Delta$RA ['']

Thursday, August 11, 2011
M31 dSph Kinematics

And XVIII $\sigma = 11.0$, $\mu = -332.5$

$N$ vs. $v_{\text{helio}}$ [km s$^{-1}$]
M31 dSph Kinematics

Dispersion of cold peak -> MRL Scaling Relations

\[ M_{1/2} = 3 \left< \sigma^2 \right> \frac{r_{1/2}}{G} \]

(Wolf+ 10)

\[ r_{1/2} = \frac{4R_{\text{eff}}}{3} \]

\[ L_{1/2} = L/2 \]
MW vs. M31 (Size-Lum)
MW vs. M31 (Size-Lum)

PanDAS (M31) Limits

SDSS (MW) Limits
MW vs. M31 (Size-Lum)

MW and M31 are statistically consistent in L-size (Brasseur+ 11)
MW vs. M31

\begin{figure}
\centering
\includegraphics[width=\textwidth]{MW_M31.png}
\end{figure}

\begin{itemize}
\item M31 dSphs
\item MW dSphs
\end{itemize}
MW and M31 overlap in both M-r and M-L
MW vs. M31

A few low M/high r outliers?
Massive Failures 2: The Sequel
Massive Failures 2: The Sequel

Massive Failures Still Missing from M31!

Thursday, August 11, 2011
Conclusions

• M31 dSphs scale much like MW sats: “uniqueness” of MW sats is not a silver bullet for problems.
  • (A few low M/high r outliers?)
  • Is this odd, given different MW/M31 accretion histories/masses?

• Massive Failures are still a problem.
Backup Slides
MW vs. M31 w/ names
MW vs. M31 w/ names

log(\(M_{1/2}/M_\odot\)) vs. log(\(L_{1/2}/L_\odot\))

log(\(M_{1/2}/M_\odot\)) vs. log(\(r_{1/2}/kpc\))

E. Tollerud
Massive Failures in MW
DDO51 Pre-Selection

And VII/Padova Isochrones

And VII/Padova Isochrones

RGB
Main Sequence
$$L_{1/2} = L/2$$

$$r_{1/2} = \frac{4R_{\text{eff}}}{3}$$

Wolf+ 10:

$$M_{1/2} = \frac{\langle \sigma^2 \rangle r_{1/2}}{G}$$
MRL Space

Tollerud+ 2011a
Fundamental Plane

\[ \log(I_e/L_{\odot pc^{-2}}) \quad \log(\sigma/\text{km/s}) \quad \log(I_e/L_{\odot pc^{-2}}) \]

\[ \log(R_e/kpc) \quad \log(R_e/kpc) \quad \log(I_e/L_{\odot pc^{-2}}) \]

- CSph
- dE
- dSph
- GC
- UCD
- E

E. Tollerud

Thursday, August 11, 2011