Studying Milky Way Satellites with the Thirty Meter Telescope

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Collaborators:
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Texas A&M University
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Dark Energy Survey

5 year survey over 525 nights
~5,000 sq. degree
~24\textsuperscript{th} mag in g-band
A dramatic improvement in the photometric precision with Blanco+DECam!

And this is just Year 1—deeper, more precise photometry will be produced throughout the five-year survey.
Most satellites discovered in early 2015 involved DECam
Eight Milky Way Satellites Discovered in Year 1 DES data

DES Collaboration
Bechtol et al.
arXiv:1503.02584

Found by non-DES collaboration:
• Gru I (Koposov 2015)
• Kim 2 (Kim 2015a) – Ind I
• Peg III (Kim 2015b) – SDSS DR10
• Hor II (Kim 2015c)
• Hya II (Martin 2015)
• ...

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Spectroscopic follow-up

- Example: Reticulum II

Bechtol et al.
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Spectroscopic follow-up

- Example: Reticulum II

- Velocity dispersion of $3.3 \pm 0.7$ km/s
- Mass-to-light ratio $470 \pm 210 \, M_{\text{Sun}} / L_{\text{Sun}}$
- $\log_{10}(j) = 18.8 \pm 0.6 \, \text{GeV}^2 \, \text{cm}^{-5}$
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400+ hours 8 meter telescope time to follow up all these candidates, in order to confirm whether or not they are dwarf galaxies (~20 stars per dwarf galaxy)

~80 hours for a 30 meter telescope w/ MOS

TMT/WFOS
Eight Milky Way Satellites Discovered in Year 1 DES data

most of the sky will have been covered by combination SDSS + PanSTARRS + DES by 2015

newly discovered systems from now on will be even further away / contain fewer bright stars
Predicted numbers of $L > 10^3 L_{\text{Sun}}$ dwarfs within 300 kpc for LSST

**Prediction:**
18-53 in LSST

Number of $L < 10^3 L_{\text{Sun}}$ dwarfs ~ 3-7x larger

Hargis, Willman, & Peter (2014)
Why TMT?

- Missing Satellite Problem $\rightarrow$ Confirm more ultra faint dwarf galaxy candidates found by current and future imaging surveys
Why TMT?

• Missing Satellite Problem → Confirm more ultra faint dwarf galaxy candidates found by current and future imaging surveys

• Constrain dark matter model with better measured J-factor (related to the indirect dark matter search with Fermi-LAT)
Planning spectroscopic follow-up for Tuc II

Total stars targeted

Expected members

$g \approx 21.5$, 20 expected members
$g \approx 23$, 90 expected members

Constrain the J-factor with more members, or higher RV precision
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- Cusp/Core problem
Cusp/core problem

Density profile $\rho \sim r^{-\gamma}$
- $\gamma = 0$ core
- $\gamma > 1$ cusp CDM

Strigari et al. 2007

5000 stars to get $\delta_{\gamma} < 0.25$
9000 stars to get $\delta_{\gamma} < 0.20$
Fornax-like dwarf galaxy
30+ nights per satellite for Keck/DEIMOS, ~8 nights for TMT/WFOS
Why TMT?

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- Complete picture of hierarchical assembly of galaxy halos $\rightarrow$ dwarf galaxies in the Local Group and beyond
A close pair of satellites around Centaurus A

Pair is projected ~90 kpc from center of CenA. 3 kpc projected separation. Both are at D~3.6 Mpc.
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Going further!

- **TMT/WFOS**
  - Low-moderate resolution
  - Membership/Kinematics

- **TMT/HROS**
  - High-resolution
  - Chemical abundance study
Thanks for your attention and questions?