Searching for the Lowest Luminosity Companions of the Milky Way

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(DES Collaboration)

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Fermilab

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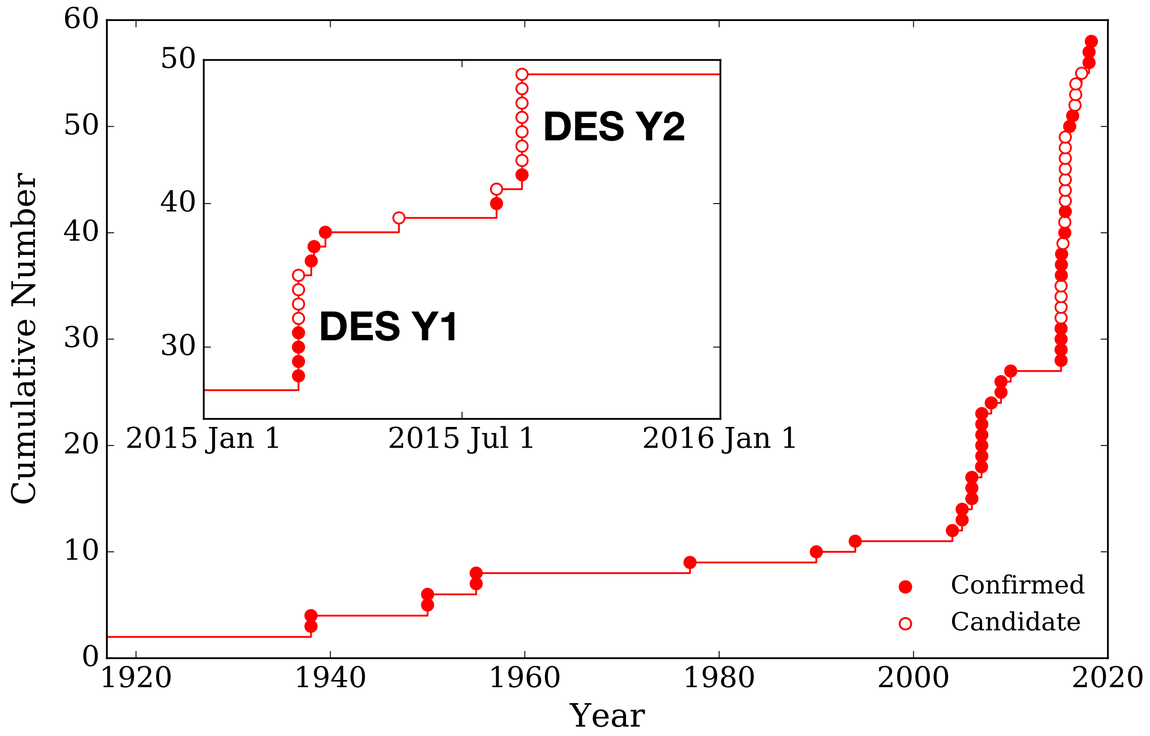
The Least Luminous Satellites

ESO DSS2

Ultra-Faint Dwarf Galaxies

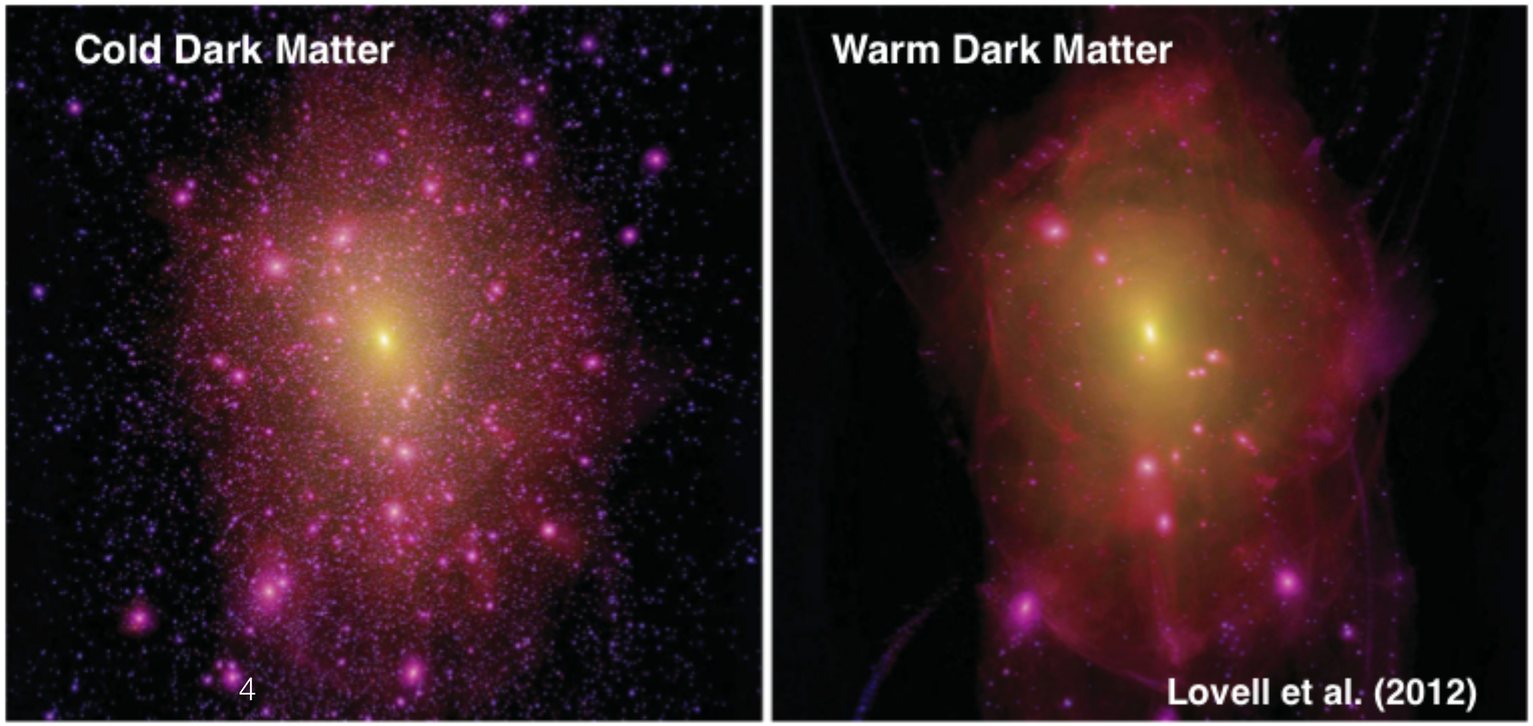
- Satellites of the Milky Way
- Low luminosity and surface brightness
- Old unevolved stellar population
- Most dark matter-dominated systems known
- Currently, ≈50 known dwarf galaxy candidates in the local group
- Population demographics can constrain dark matter



K. Bechtol, A. Drlica-Wagner

Constraining Dark Matter

- Satellite formation suppressed by dark matter models
- Distribution of satellites effected by
  - Dark matter self-interaction
  - Dark matter—baryon scattering



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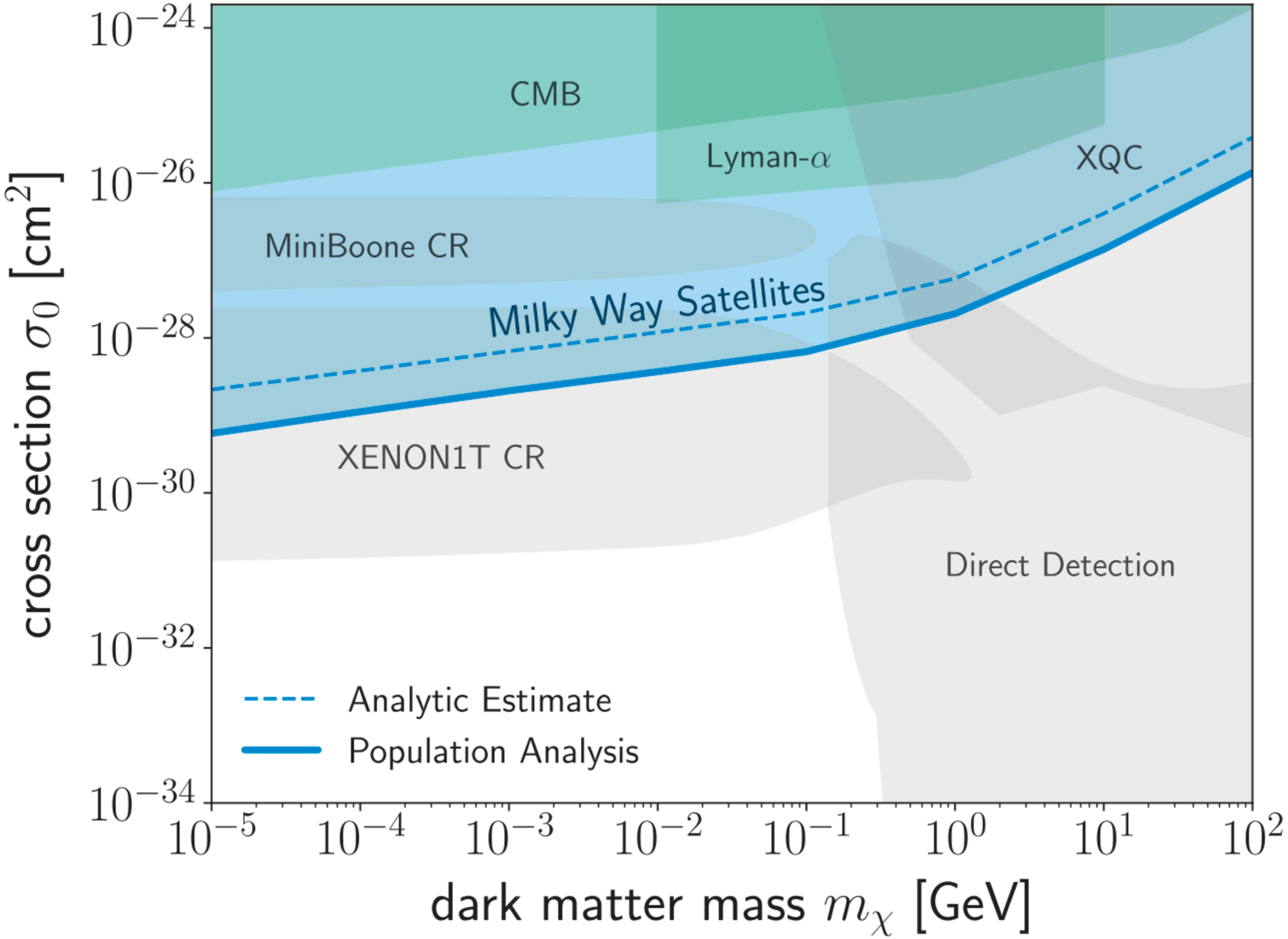

Nadler et al. 2019 [arXiv:1904.10000]

Matched Filter Search

- Four key parameters: RA, dec, color, magnitude
- Filter stars according to stellar evolution model (“isochrone”)
- Identify overdensities of individually resolved stars

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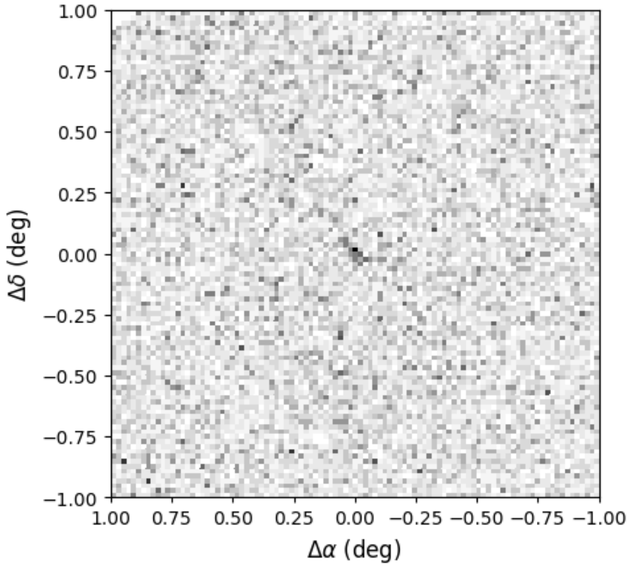

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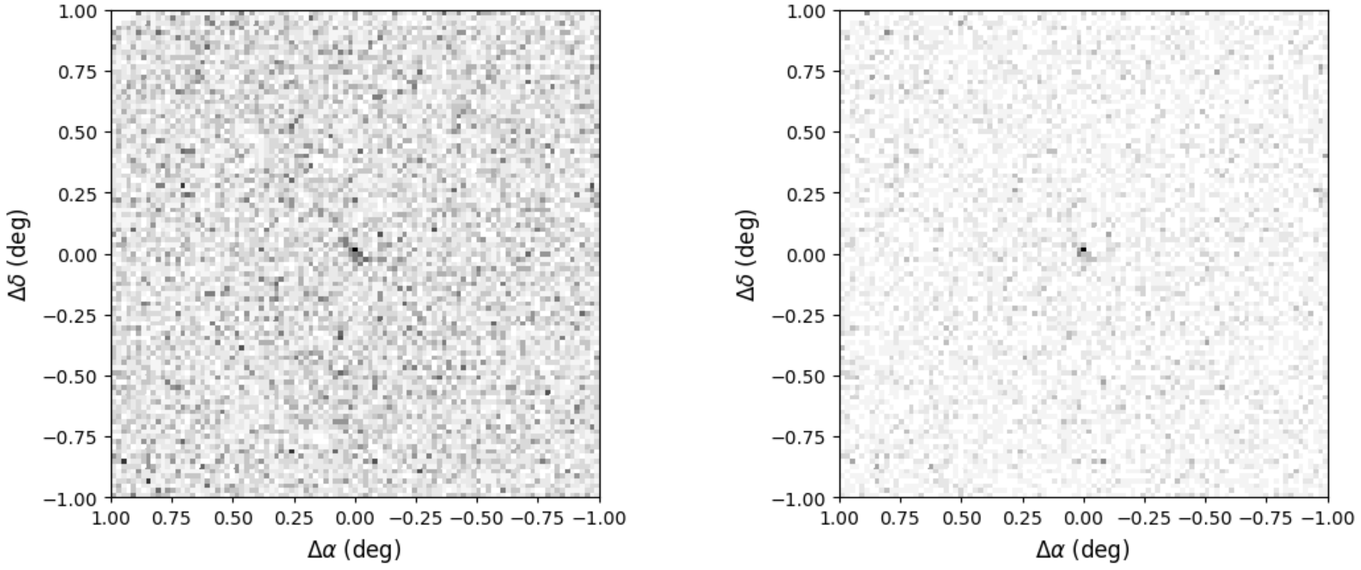

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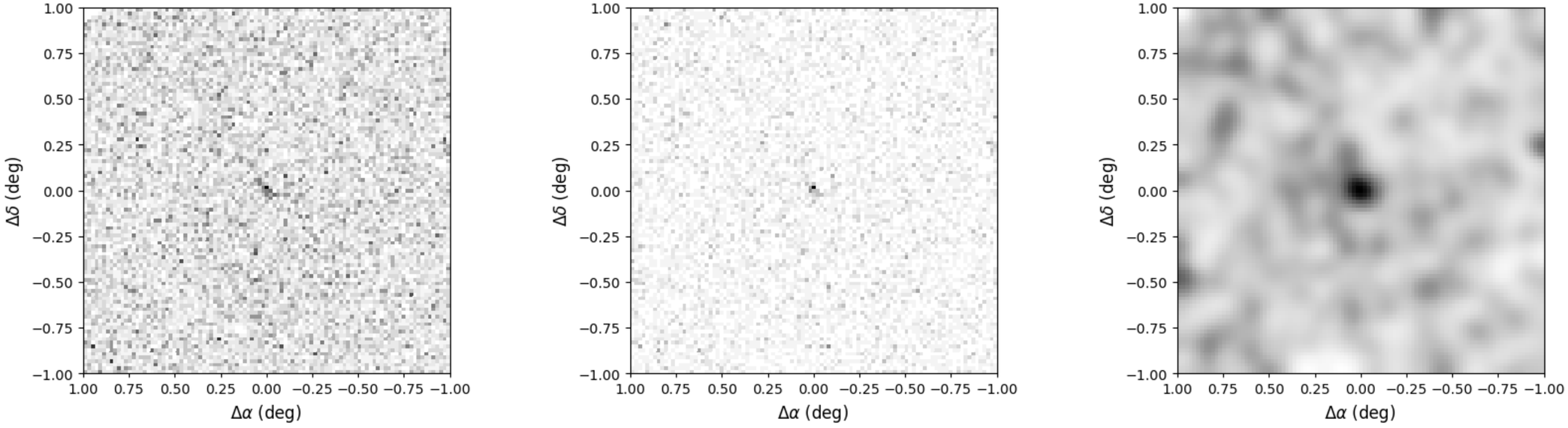
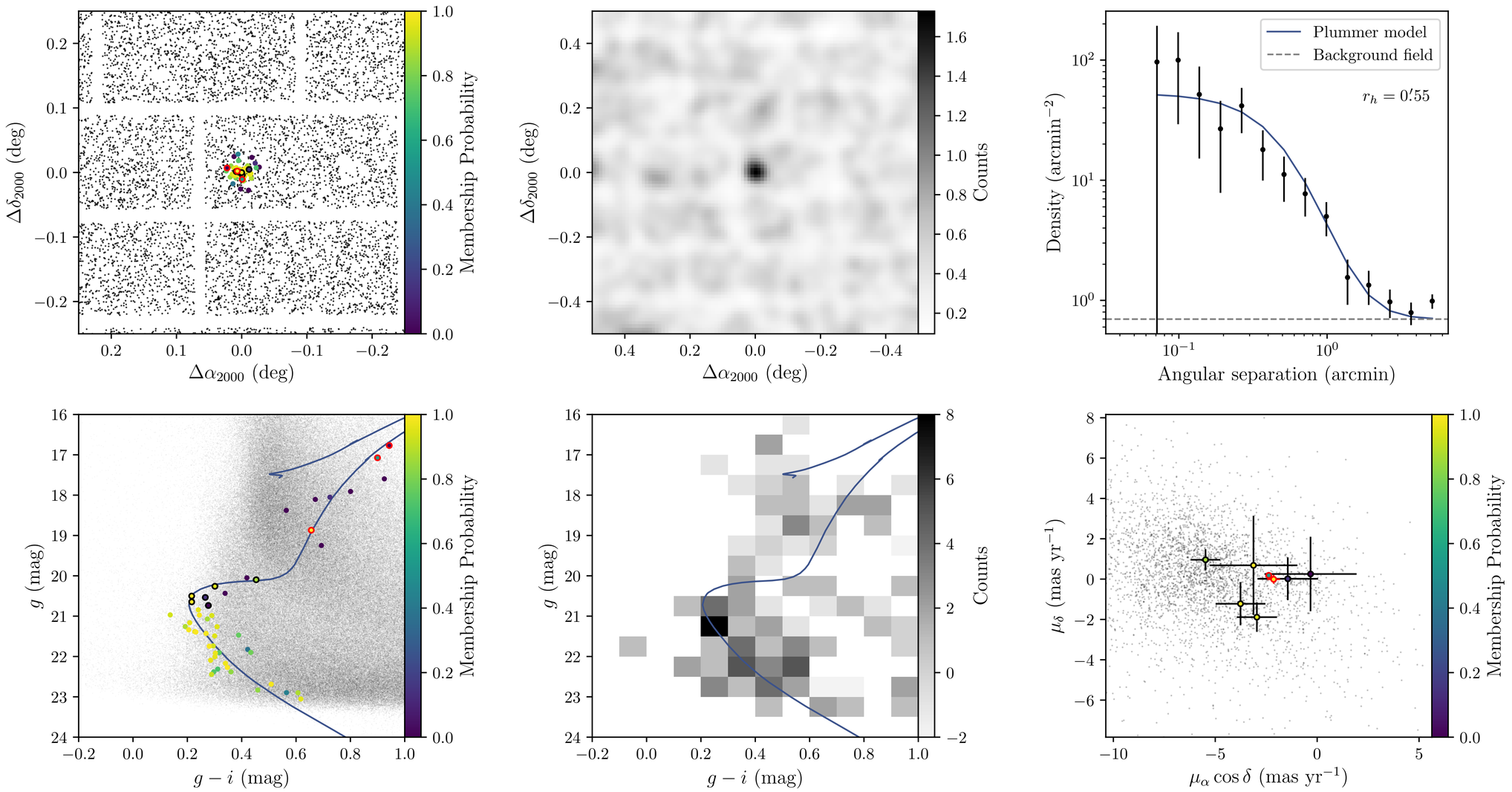


Aside: Bliss 1

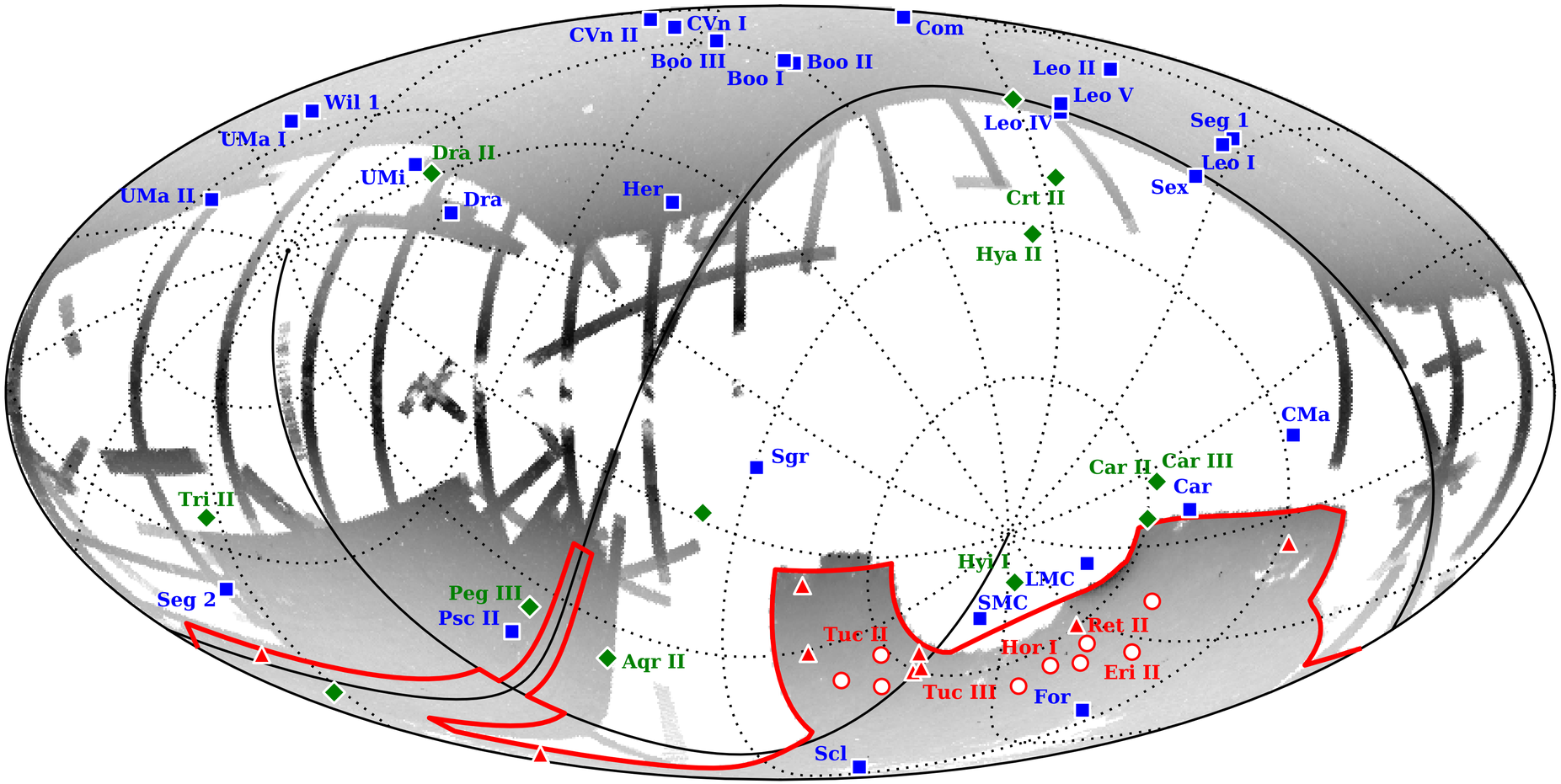


Mau et al. 2019 [arXiv:1812.06318]

Current Satellite Search

- Dark Energy Survey (DES Y3A2) and Pan-STARRS (PS1)
- Combined coverage of ≈30,000 deg^2 (≈70% of the full sky)

Current Satellite Search

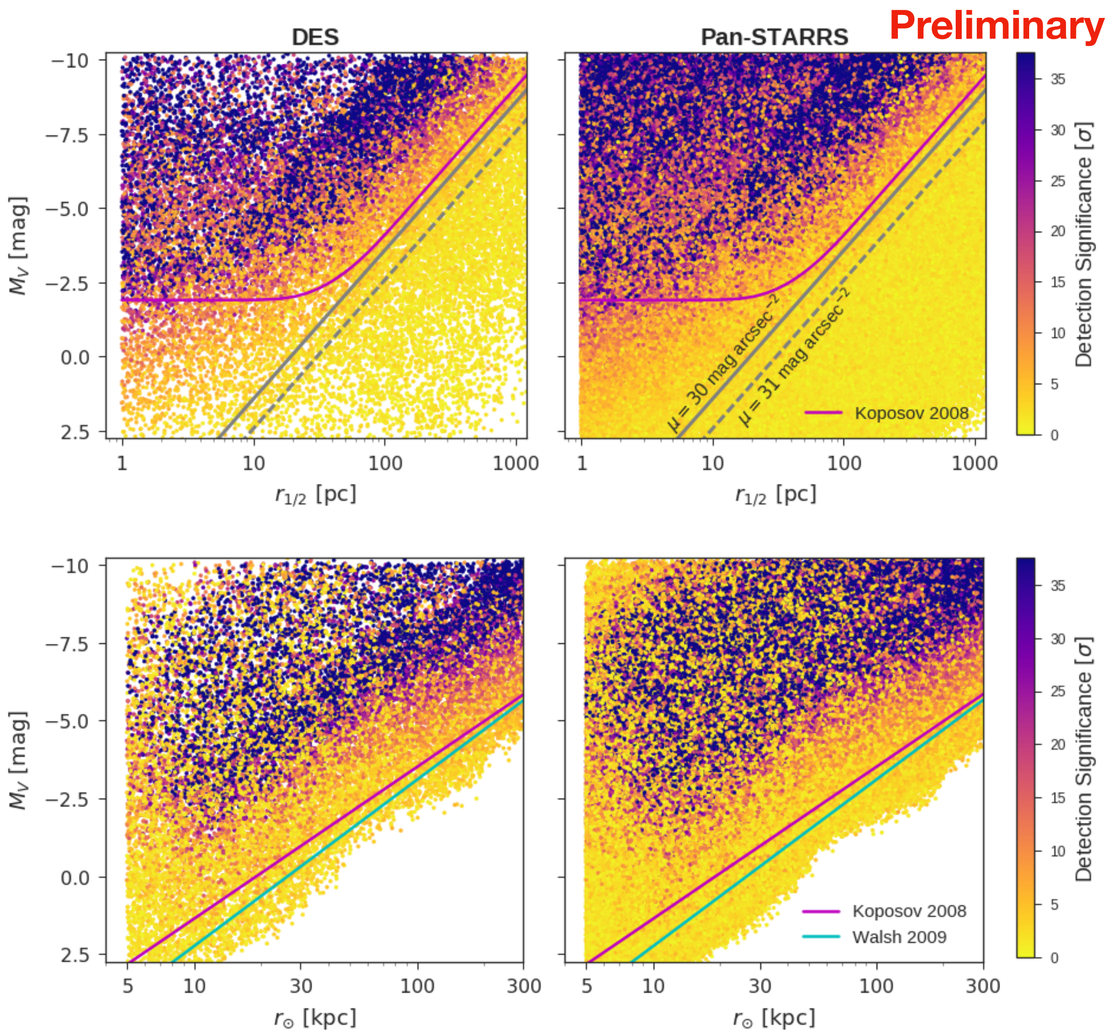


Current Satellite Search

- Real satellite search: no new candidates
- Simulated satellite search over parameter space
  - 100,000 DES Y3A2 simulated satellites
  - 1,000,000 PS1 simulated satellites

Luminosity Function

- Efficiency of search algorithms
- Account for limiting factors of observational surveys
- At what significance do we recover known satellites?
- What's our significance threshold for detection?



DES Collaboration (in prep)

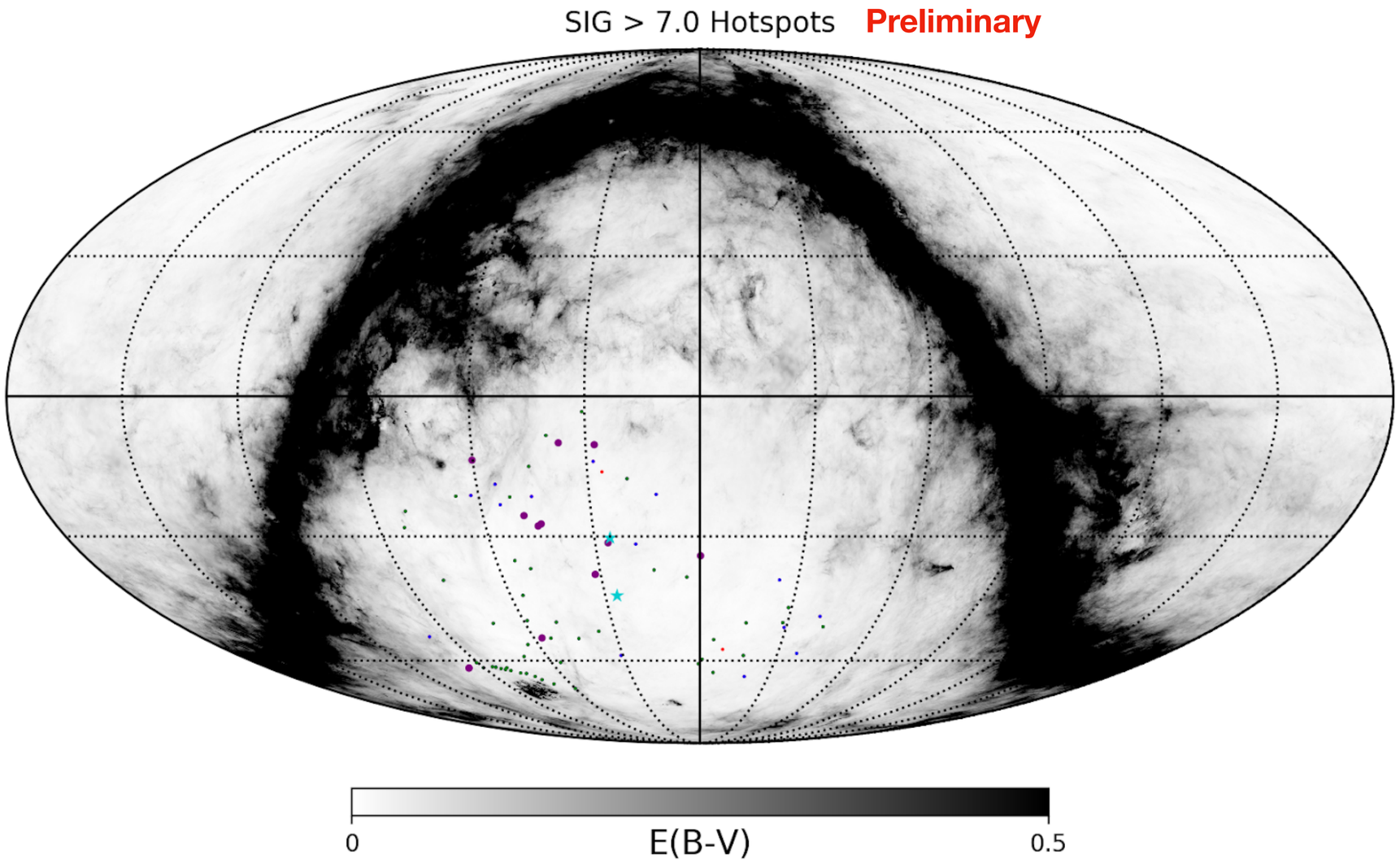
Conclusions

- Smallest and most dark matter-dominated galaxies
- Population of ultra-faint dwarf galaxies can be used to probe fundamental characteristics of dark matter
- World-leading constraints on dark matter particle properties (with 10 year old data!)
- Analysis with modern data underway

Thank you!

Backup Slides

Search Results: DES Y3A2



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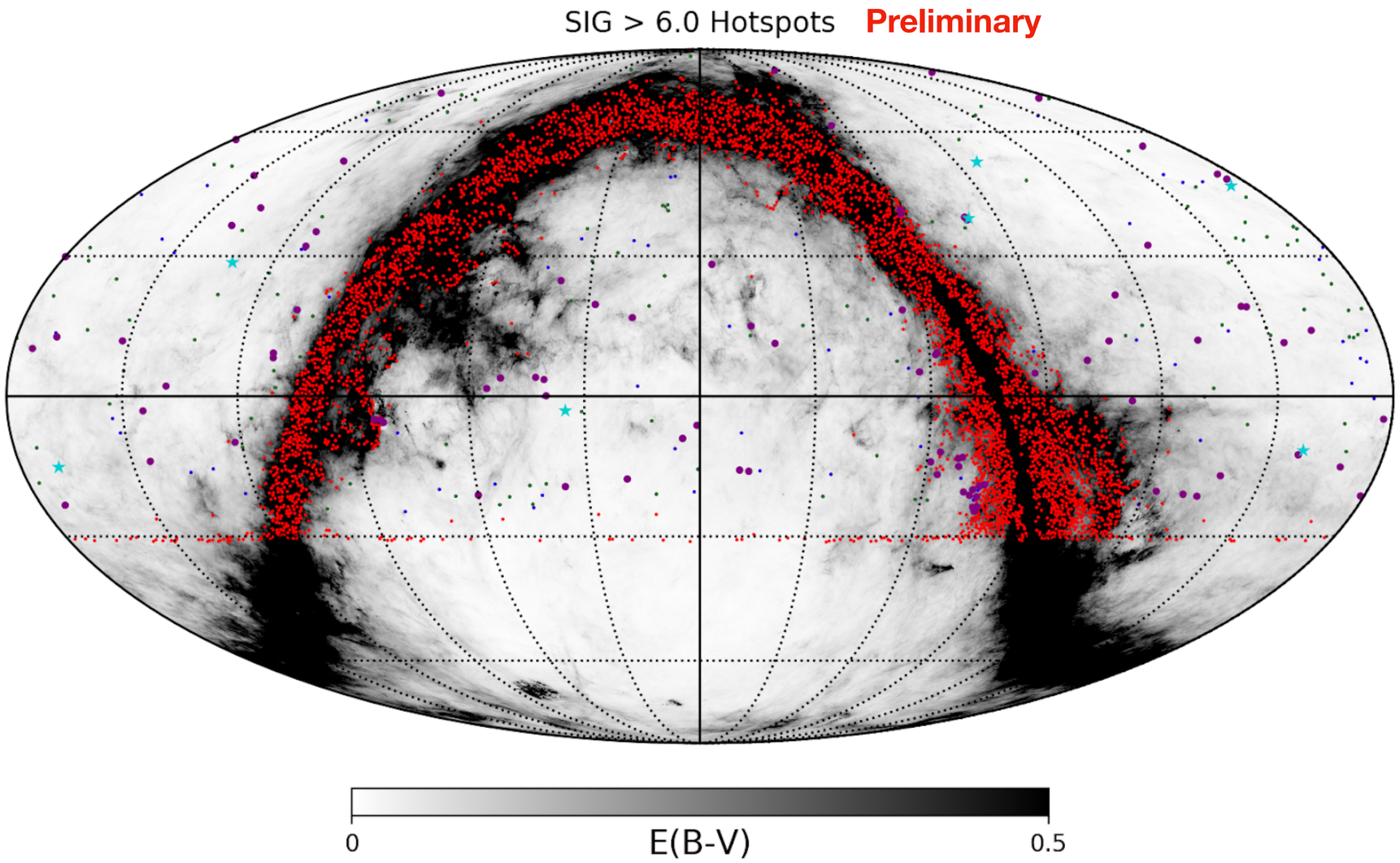
Search Results: PS1



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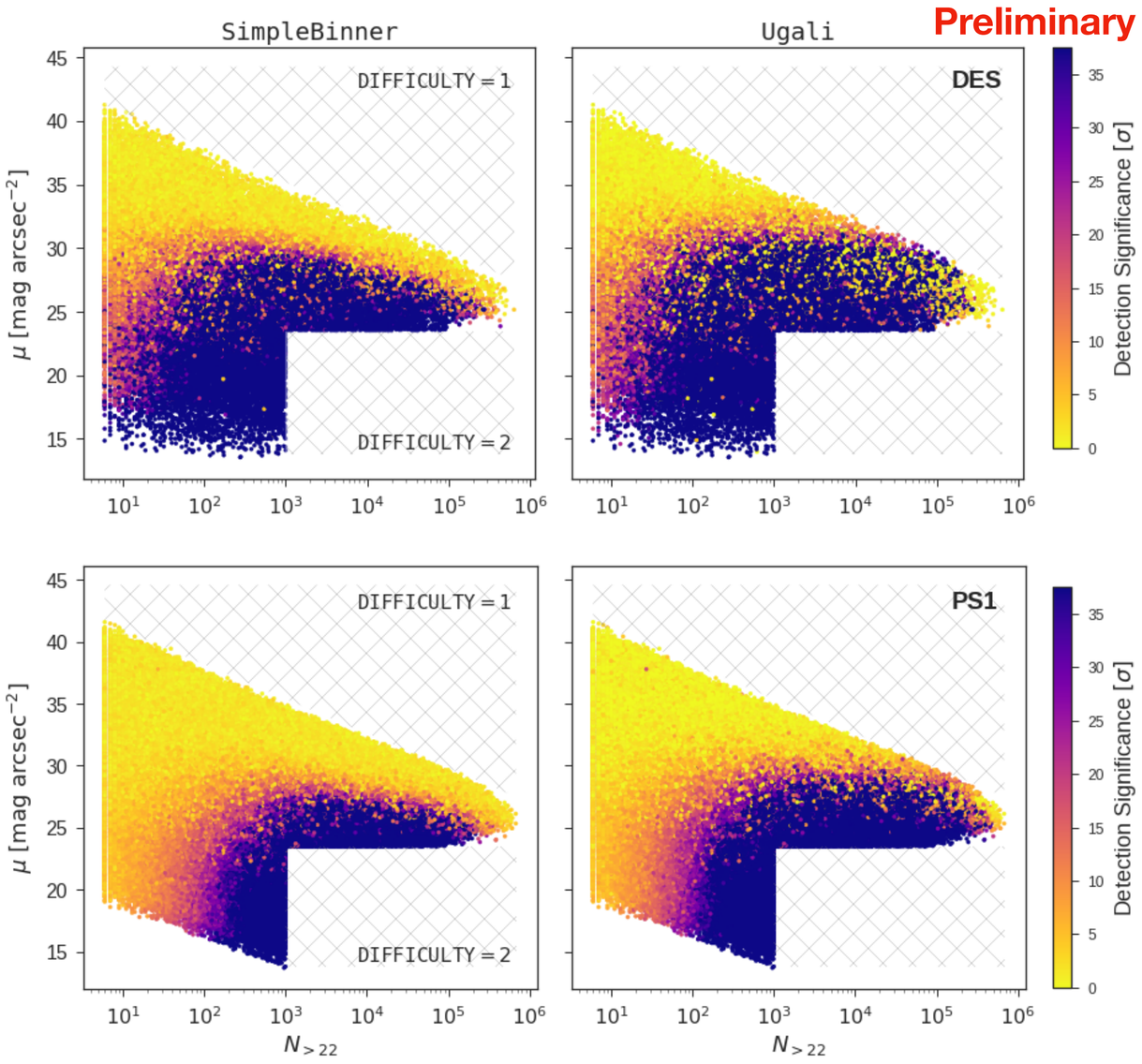
Simulation Search



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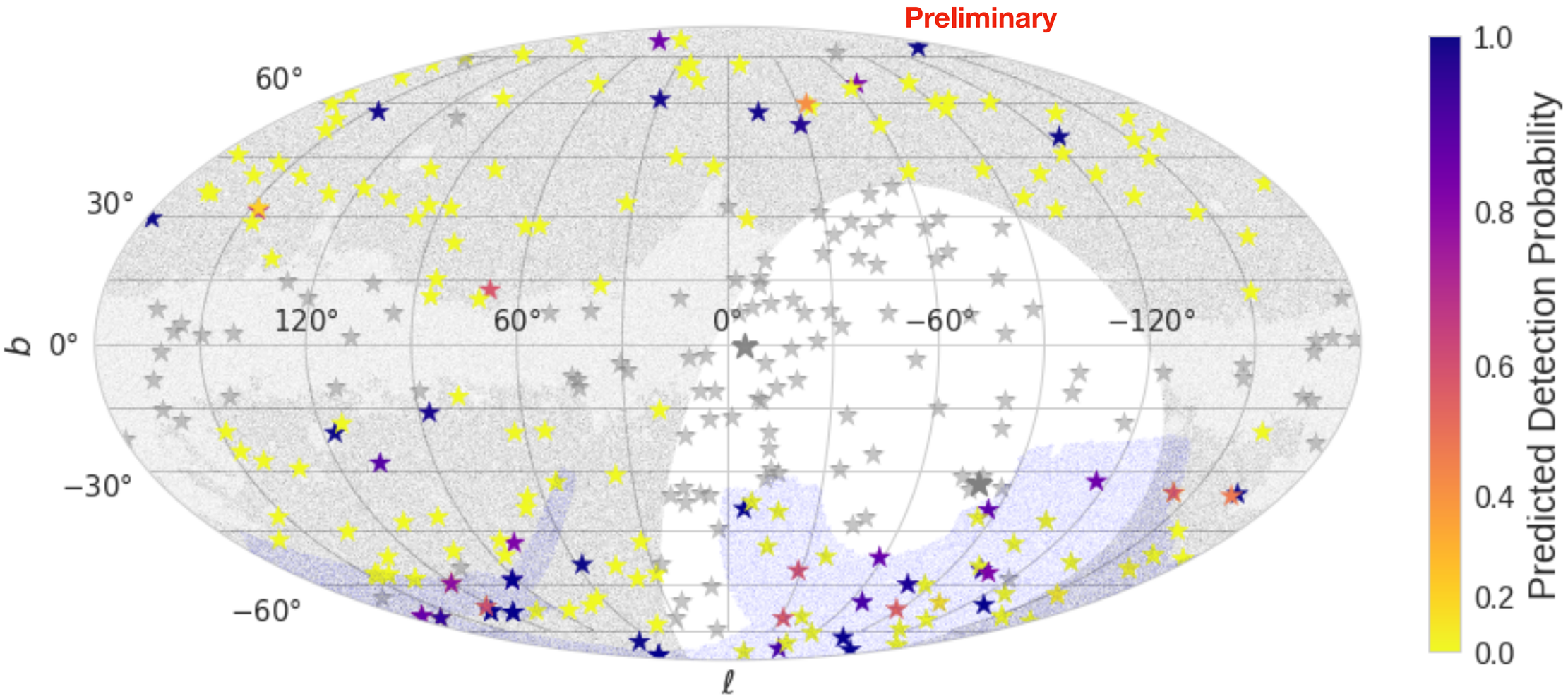
Luminosity Function



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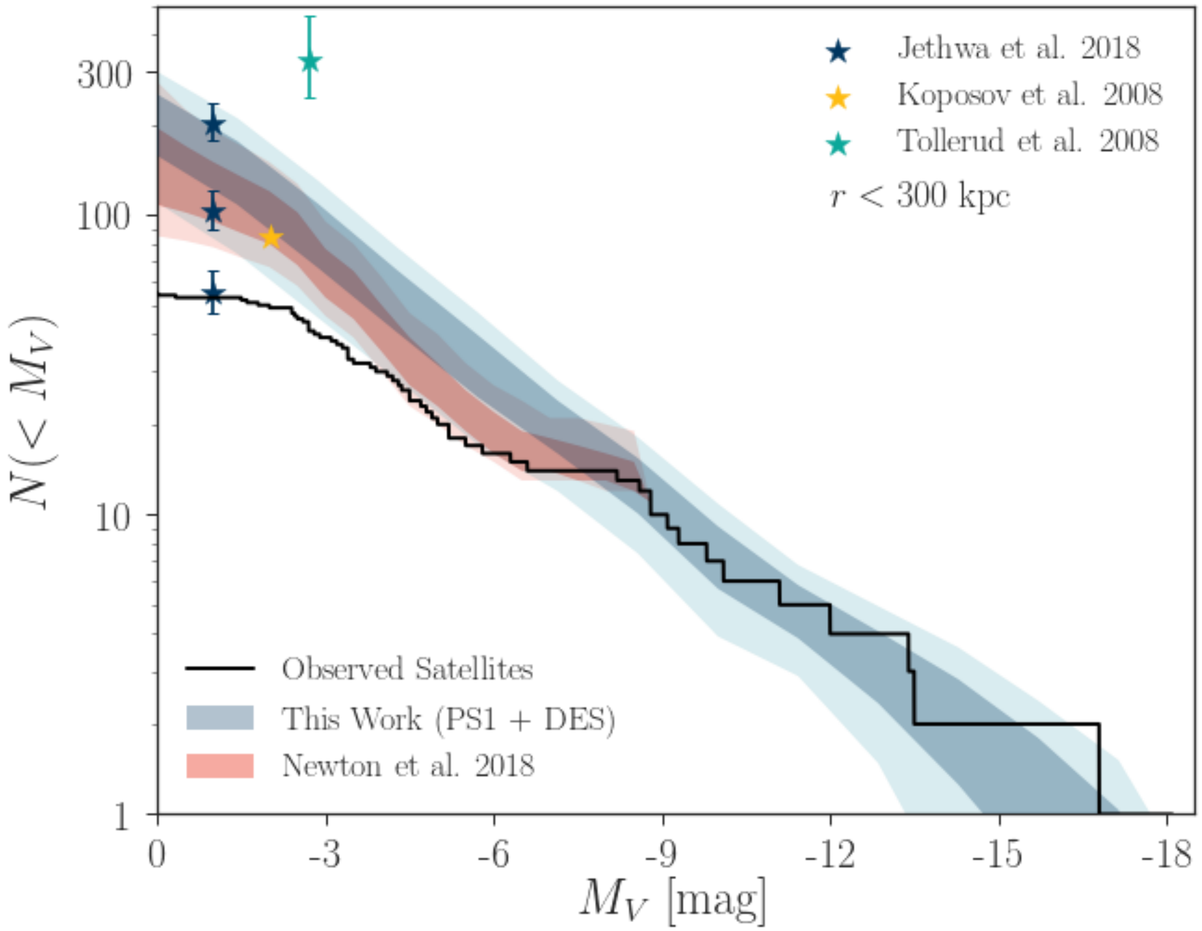

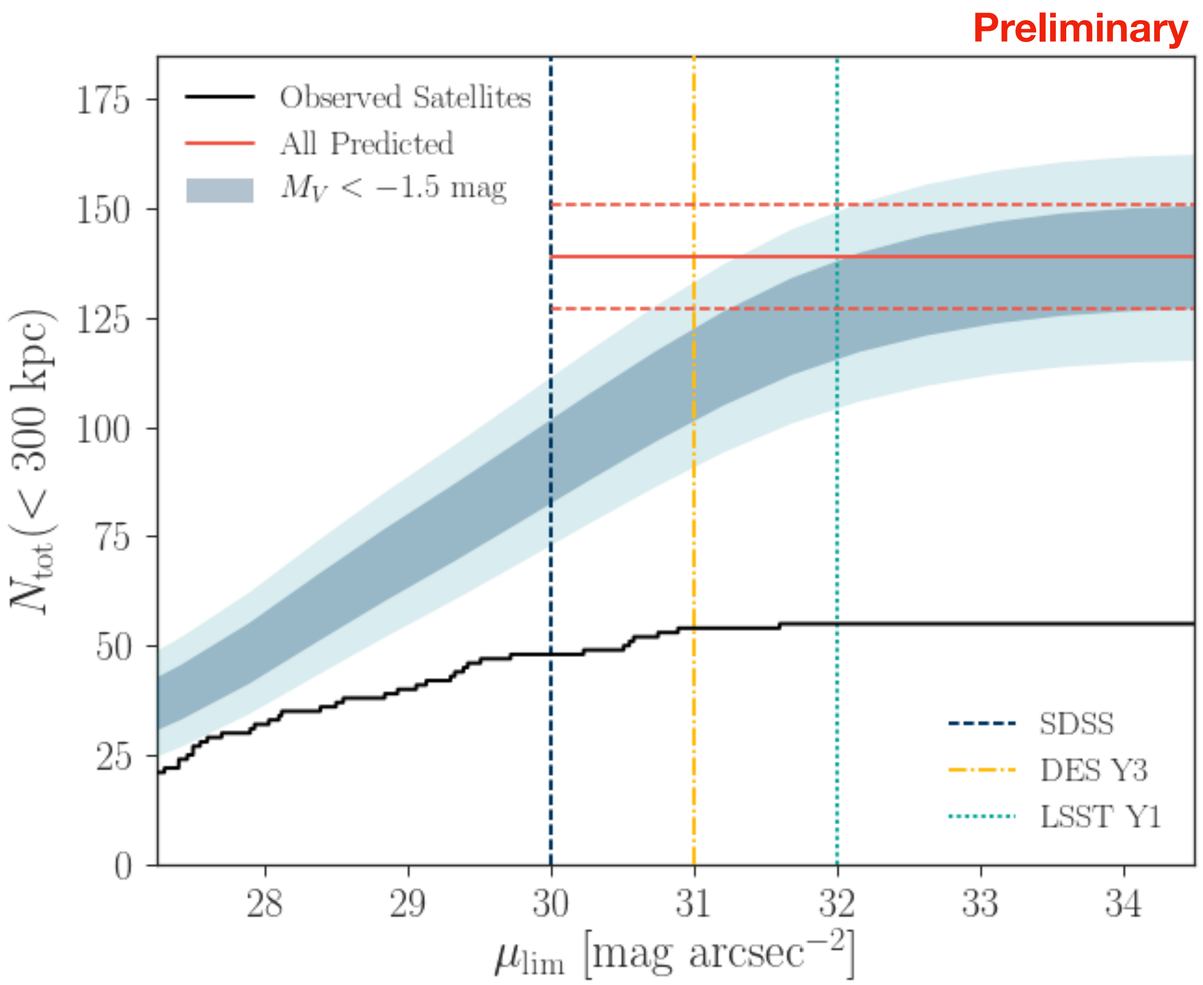

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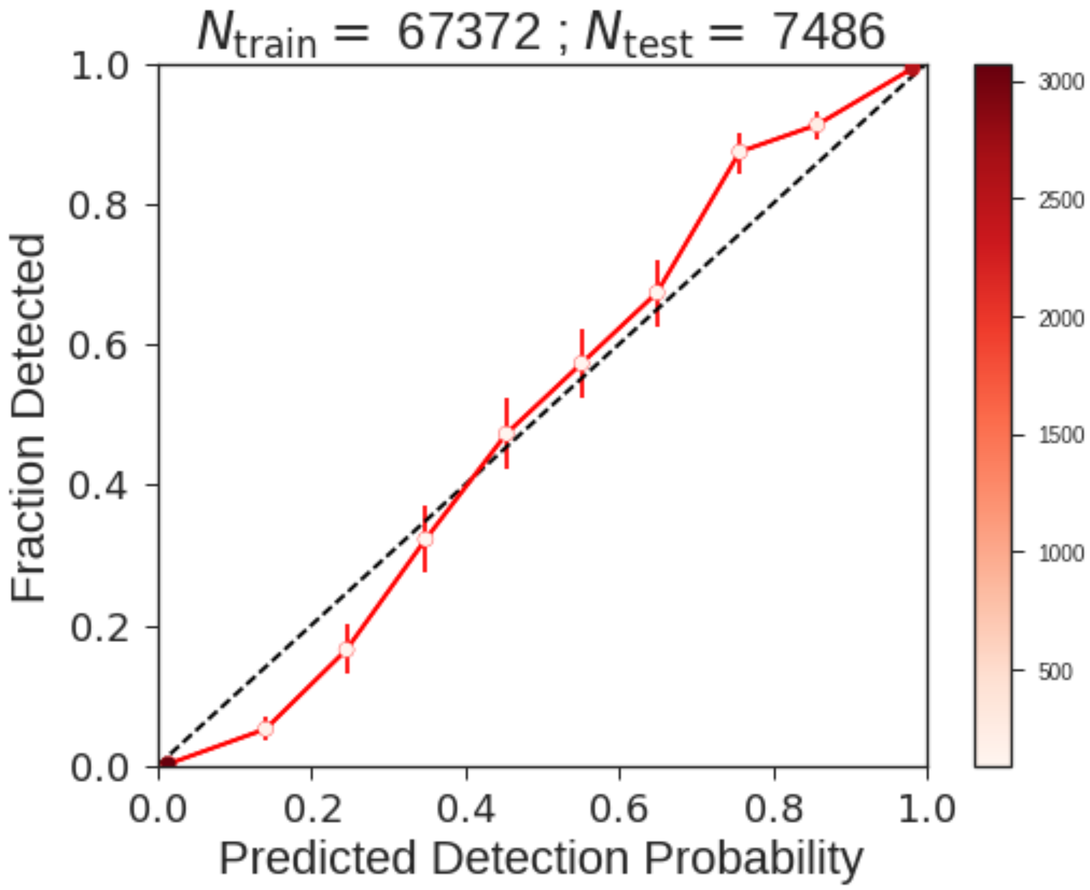
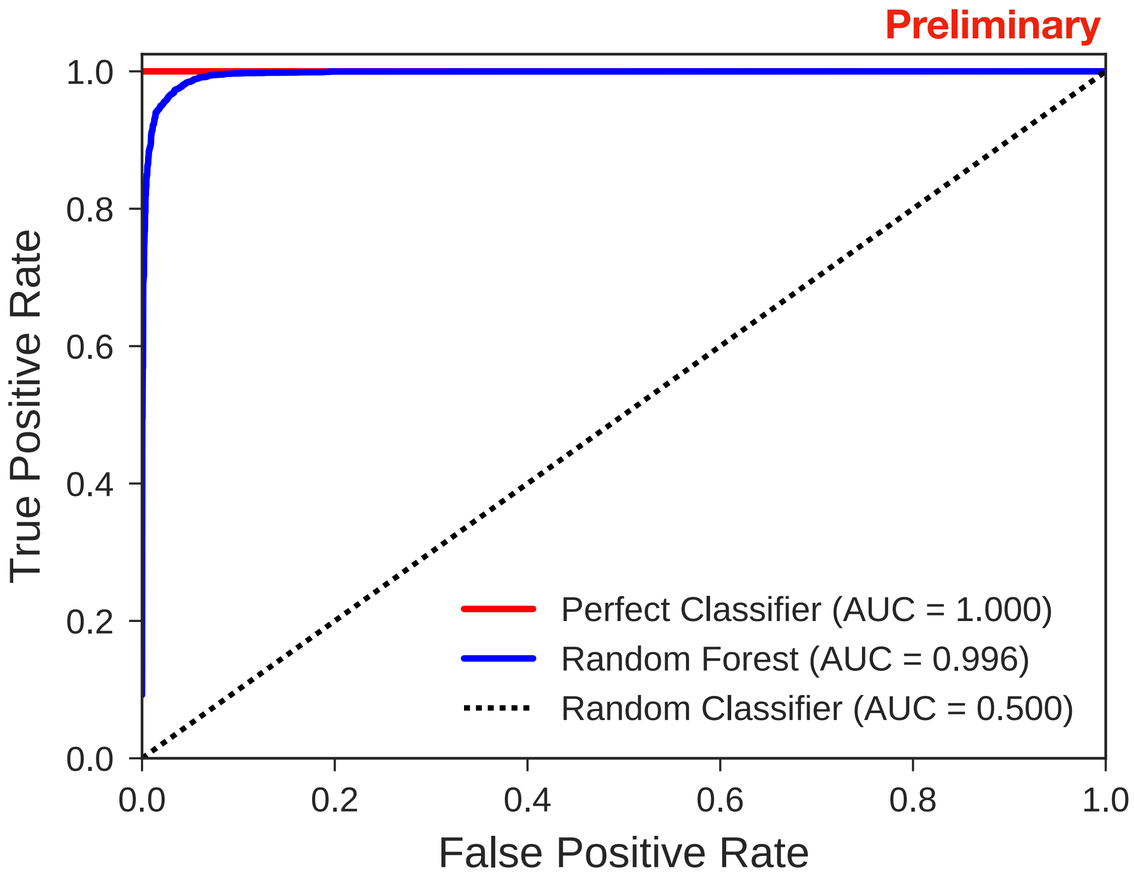
Classifier





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