



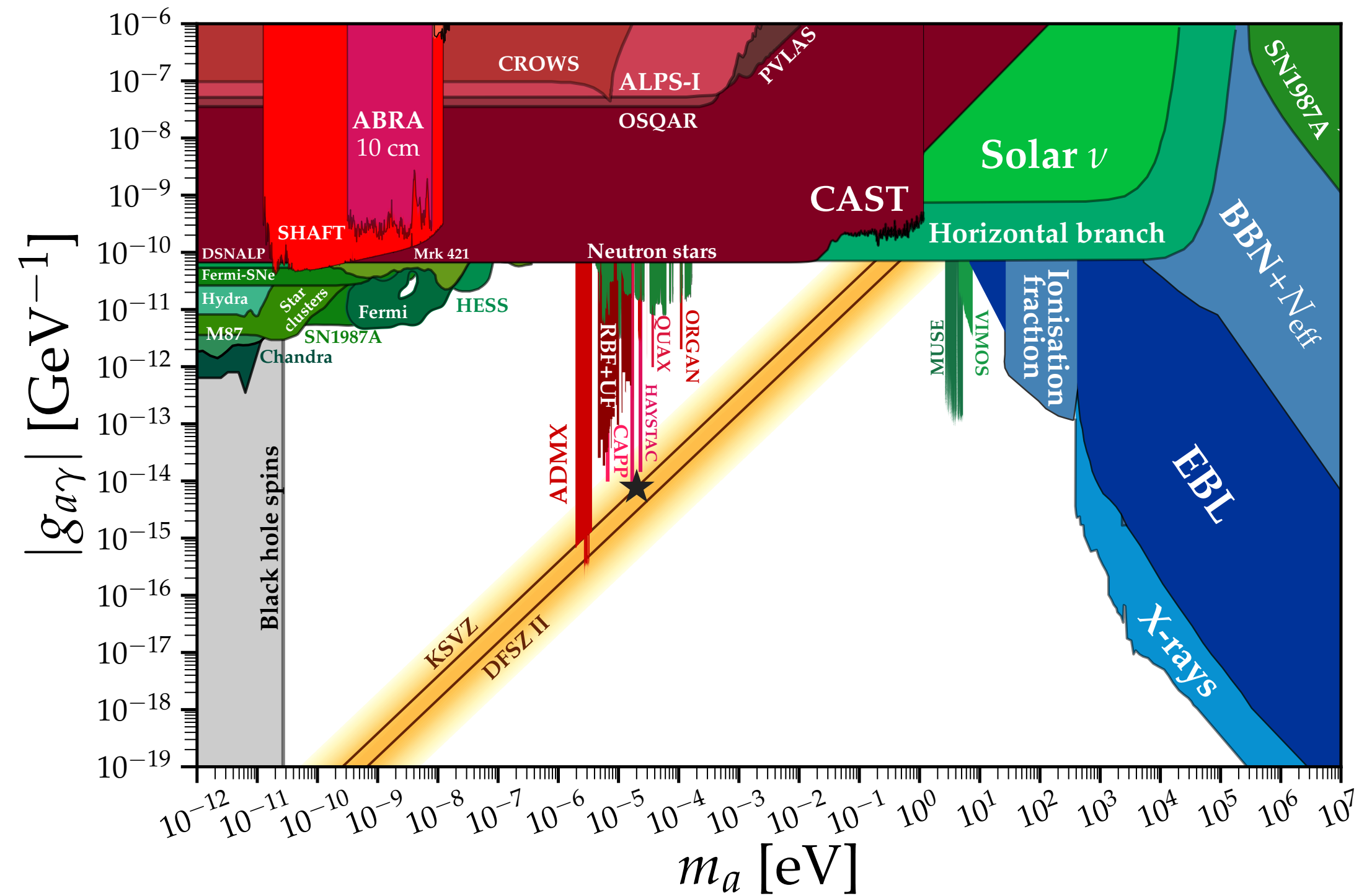
# Axion Dark Matter

Using Radio Observations of Neutron Stars to Probe the QCD Axion

**Thomas Edwards** with Bradley Kavanagh, Luca Visinelli,  
Samuel J. Witte, Dion Noordhuis, & Christoph Weniger

[2011.05377](#), [2011.05378](#), [2104.07670](#)  
[github.com/bradkav/axion-miniclusters](https://github.com/bradkav/axion-miniclusters)

# Post Inflationary QCD Axions



[<https://cajohare.github.io/AxionLimits/>]

PQ field broken before or during inflation

↓  
Single mean background density of axions

PQ field broken after inflation

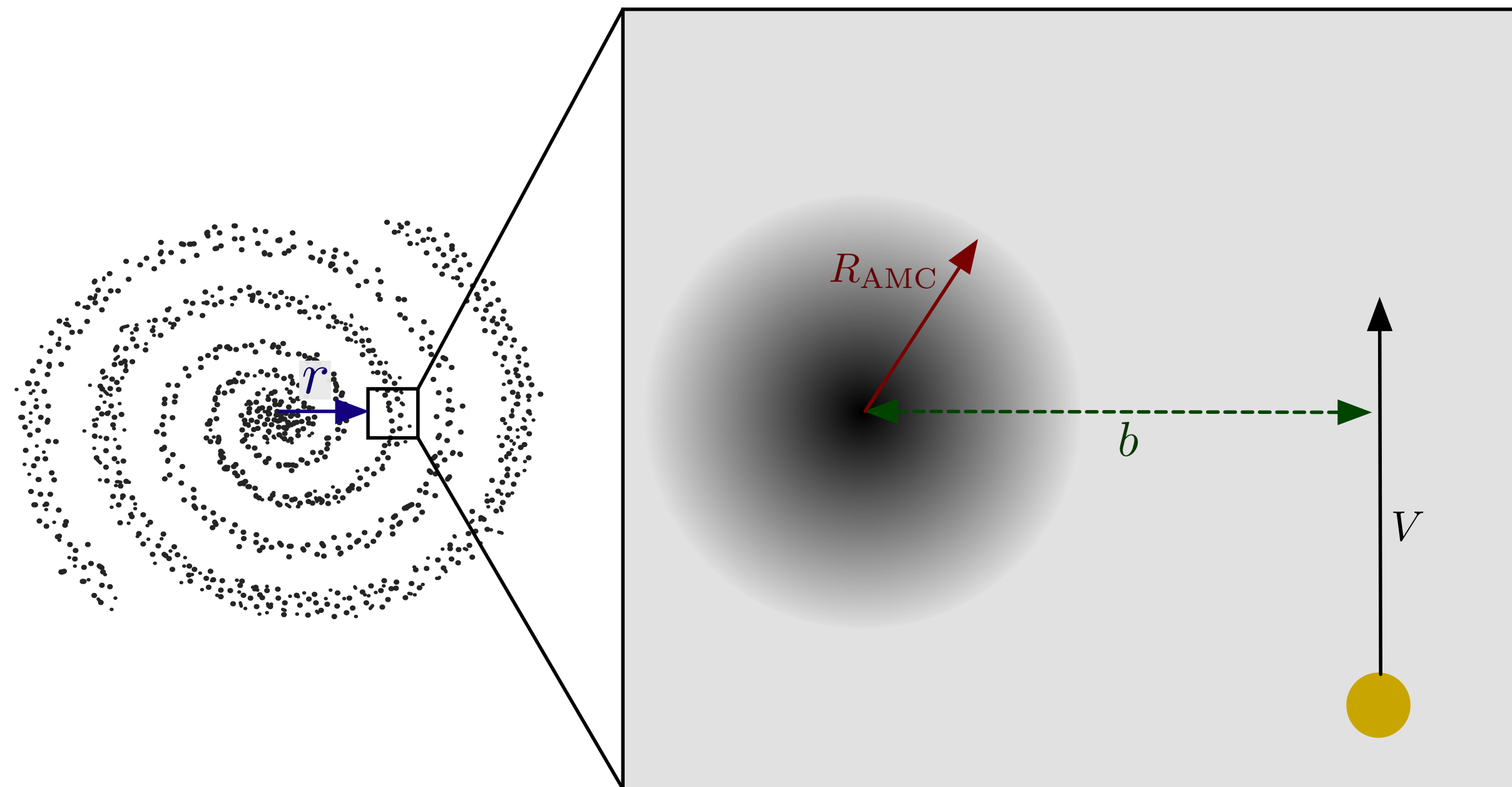
↓  
Topological defects that lead to axion **miniclusters**

$$\mathcal{L} \propto g_{a\gamma\gamma} a \mathbf{E} \cdot \mathbf{B}$$

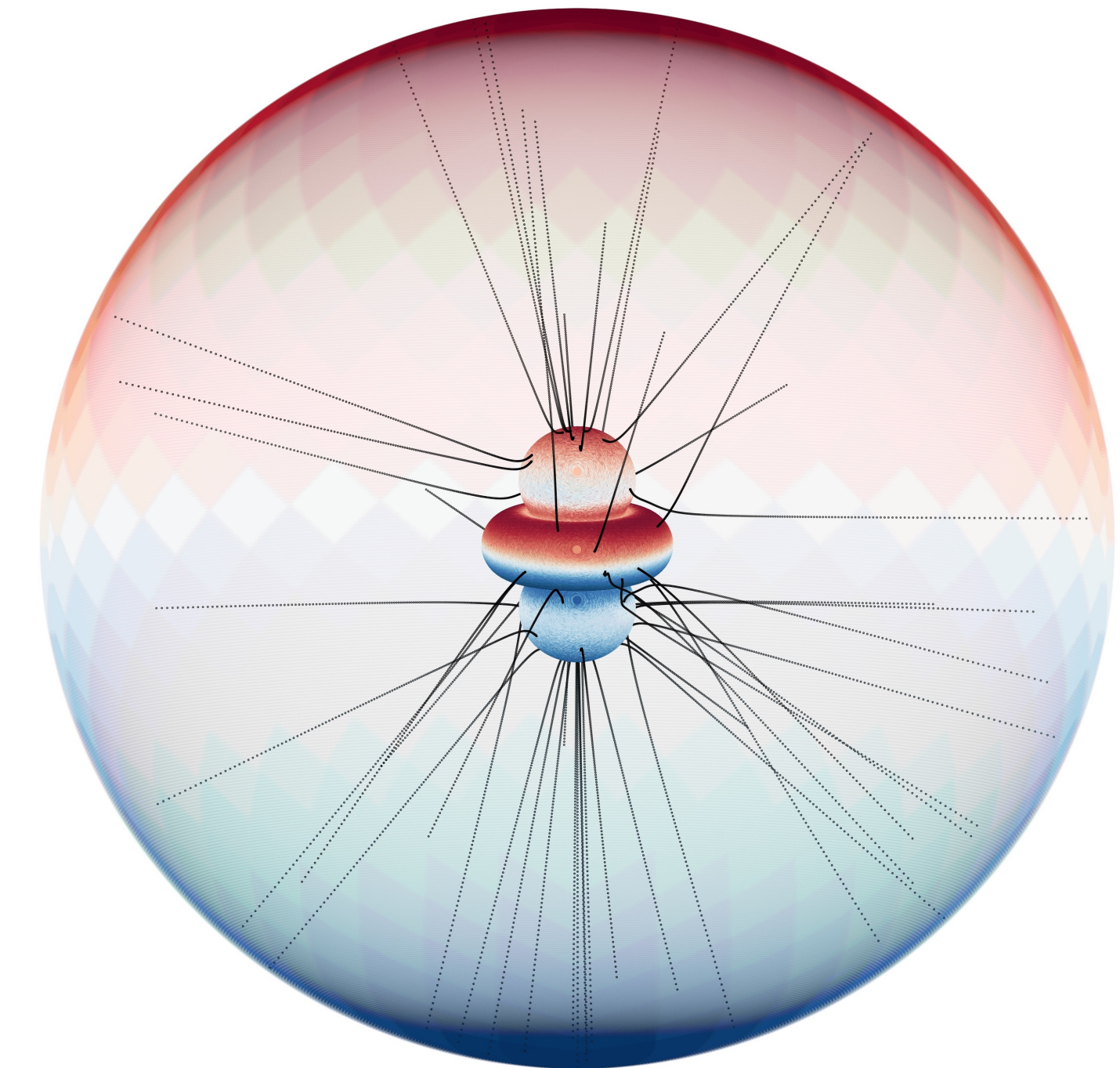
# Getting to the Signal

[Safdi et al., [1811.01020](#)]

[Hook et al., [1804.03145](#)]



[TE, Kavanagh, Visinelli, Weniger, [2011.05377](#)]



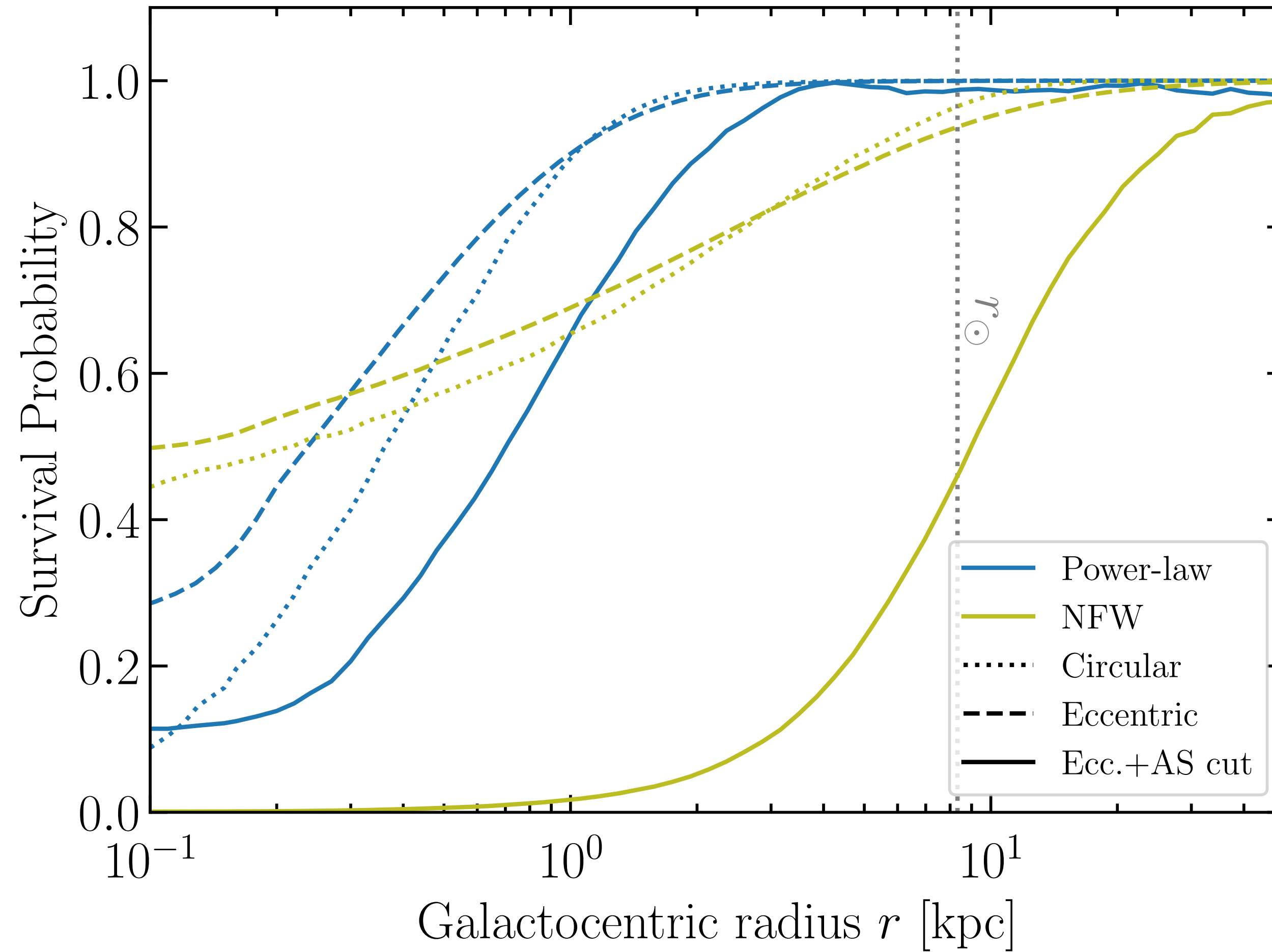
[TE, Kavanagh, Visinelli, Weniger, [2011.05378](#)]

[Witte, TE, Noordhuis, Weniger, [2104.07670](#)]

[Leroy, Chianese, TE, Weniger, [1912.08815](#)]



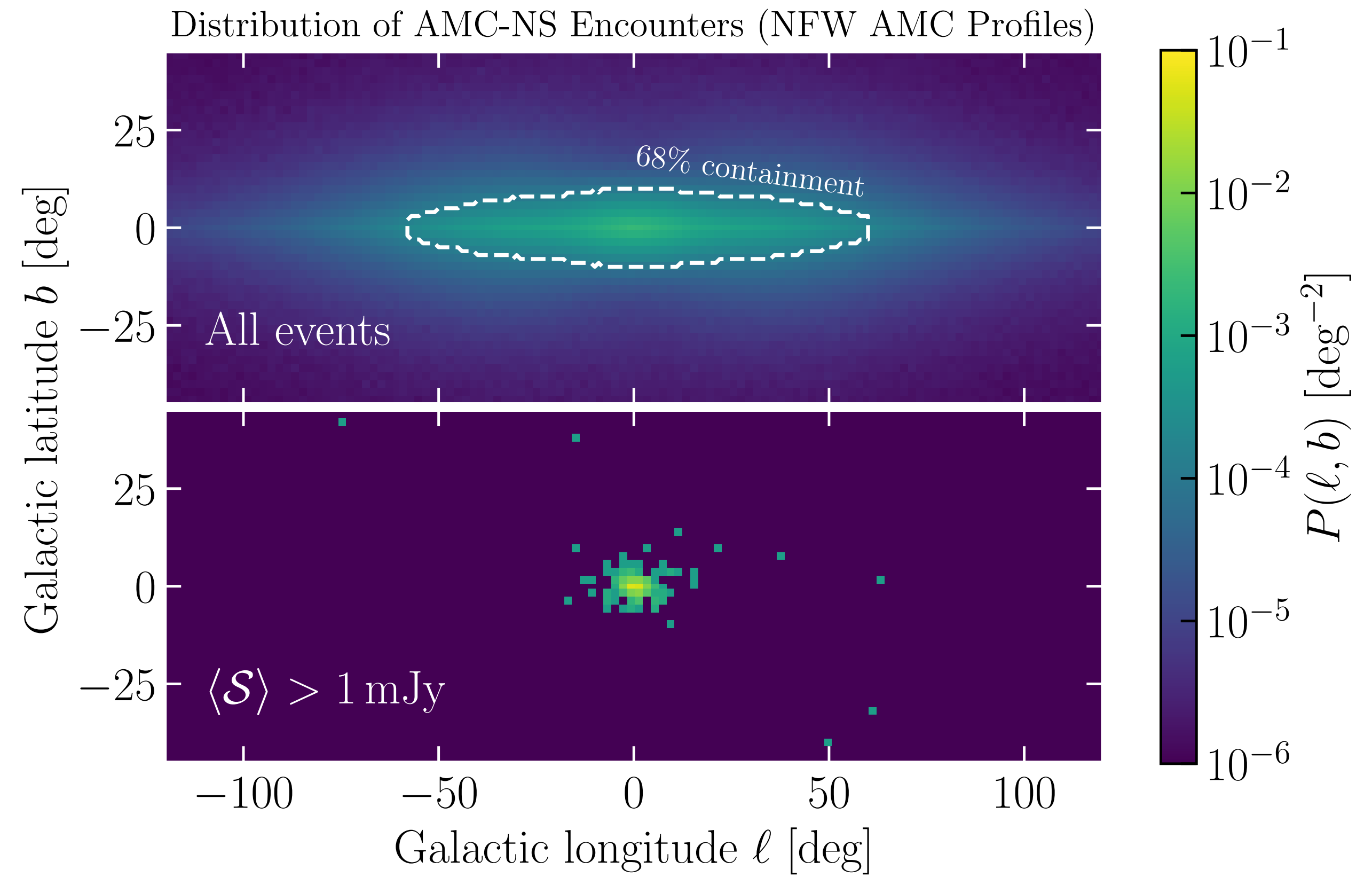
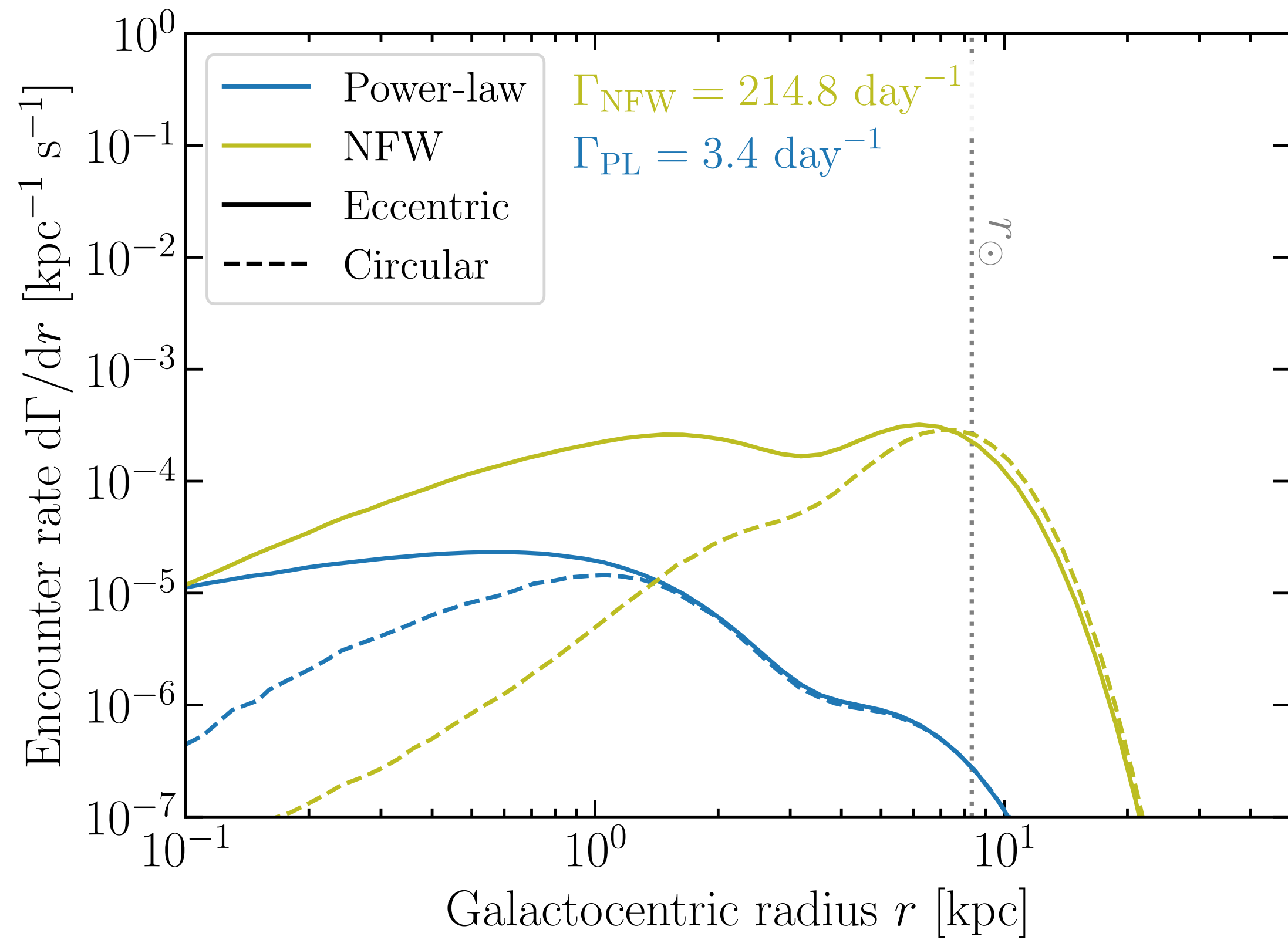
# Survival Probability



Survival probability at Solar circle:  
 $\mathcal{O}(40\%)$  for NFW profiles  
 $\mathcal{O}(99\%)$  for PL profiles

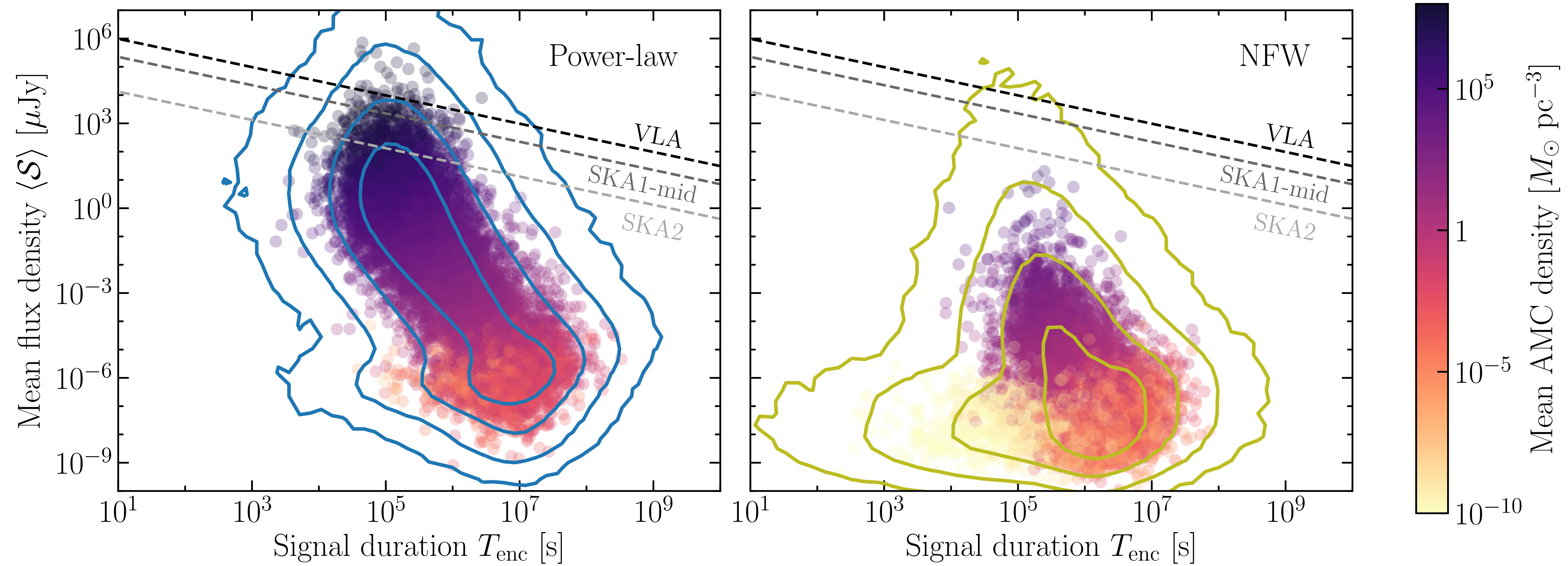
[Distributions and tools for re-casting available online: [github.com/bradkav/axion-miniclusters](https://github.com/bradkav/axion-miniclusters)]

# Sky Position



[TE, Kavanagh, Visinelli, Weniger, 2011.05378]

# Radio Transients

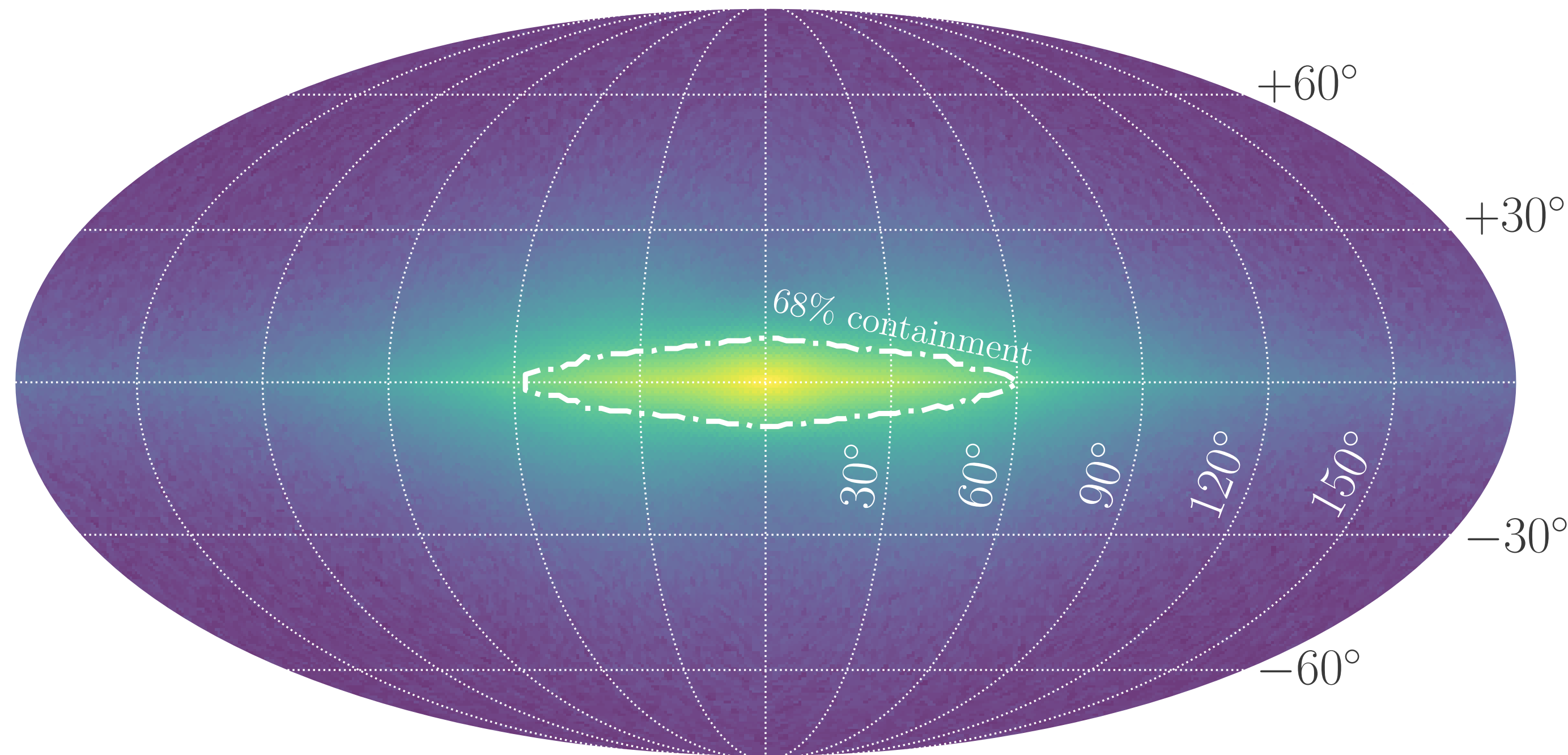


[TE, Kavanagh, Visinelli, Weniger, [2011.05378](#)]

$$g_{a\gamma\gamma} = 8 \times 10^{-15} \text{ GeV}^{-1}$$

$$m_a = 20 \mu\text{eV}$$

# Conclusions



1. Axion miniclusters are **heavily disrupted** by interactions with stars in the Milky Way
2. Minicluster – neutron star interactions can lead to bright radio transients that are potentially **detectable with current radio telescopes**

[Distributions and tools for re-casting available online: [github.com/bradkav/axion-miniclusters](https://github.com/bradkav/axion-miniclusters)]