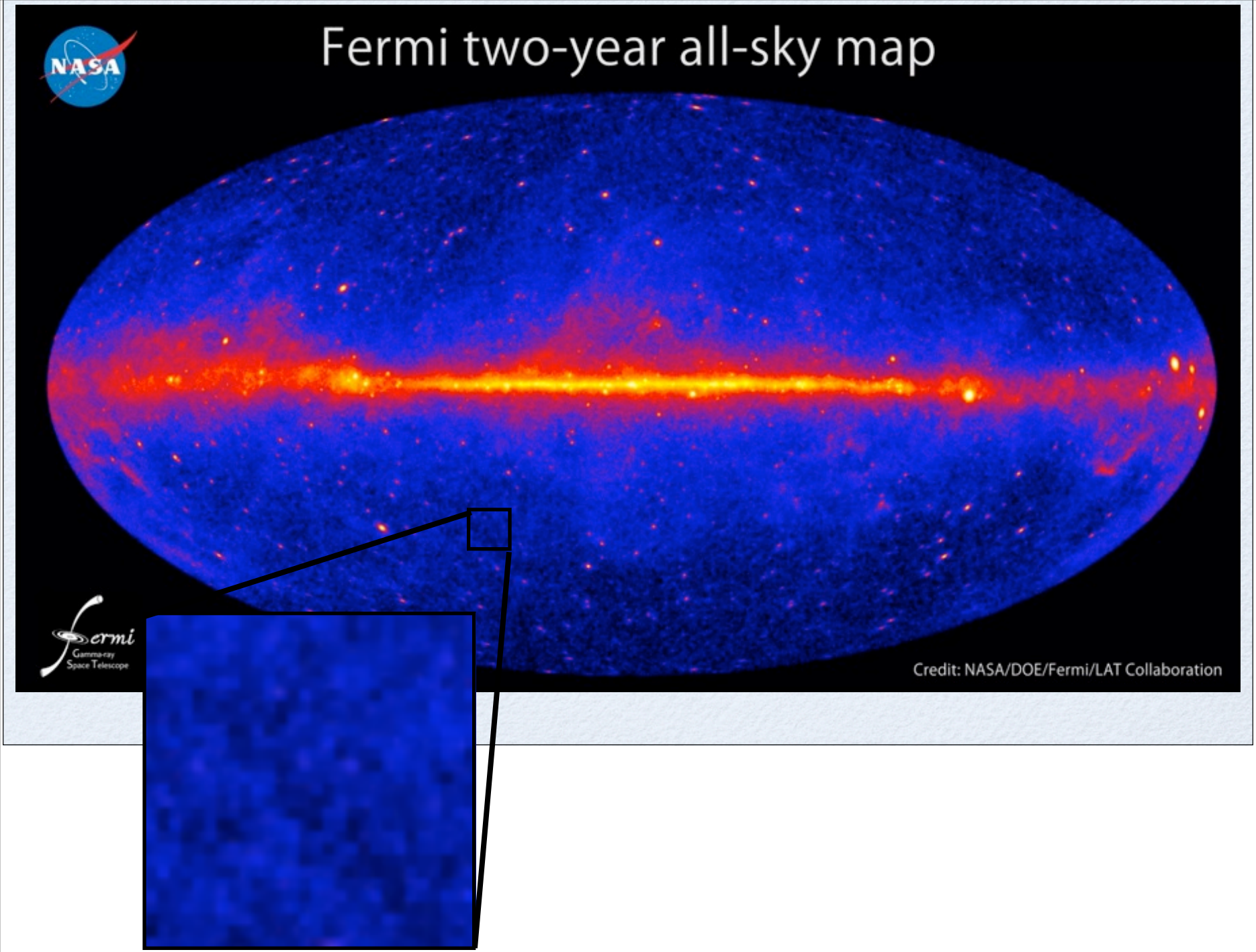
A new method to disentangle diffuse sources

Savvas M. Koushiappas


Fermi two-year all-sky map
NASA
Fermi
Gamma-ray
Space Telescope
Credit: NASA/DOE/Fermi/LAT Collaboration

Contributions to the gamma-ray background

Cosmic Rays

Blazars & AGN's

Starburst galaxies

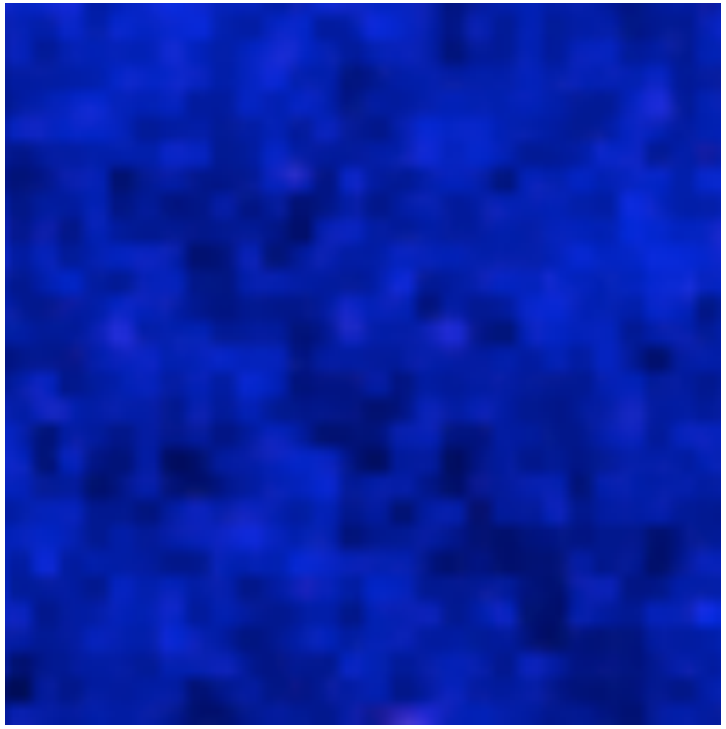
Pulsars

Dark Matter

Dark Matter Remnants

Unknown systematics

Solar System objects



Individual emission from any single object is NOT distinguishable

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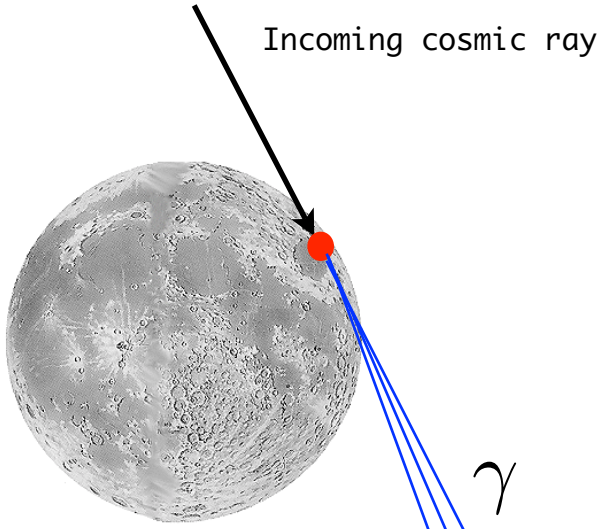
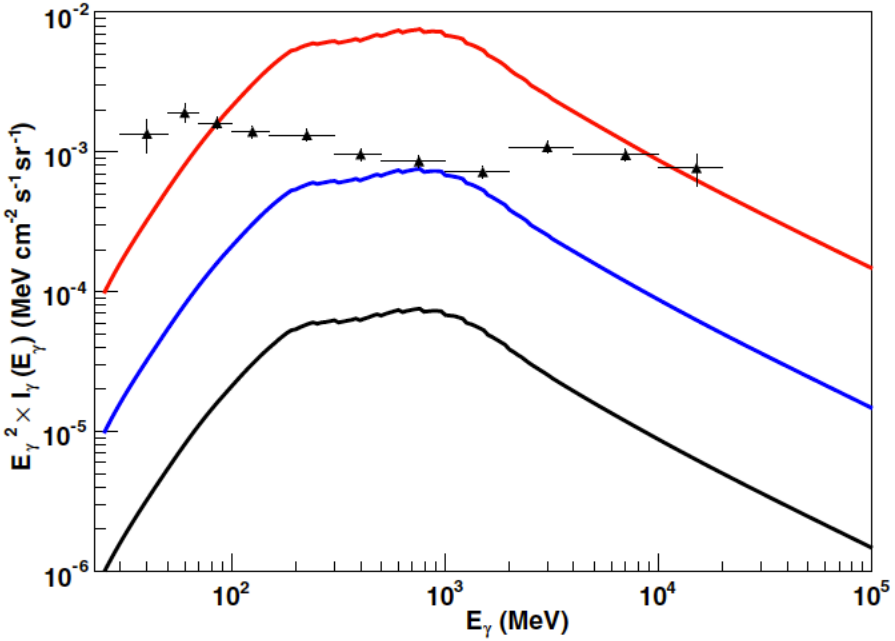


Solar System objects

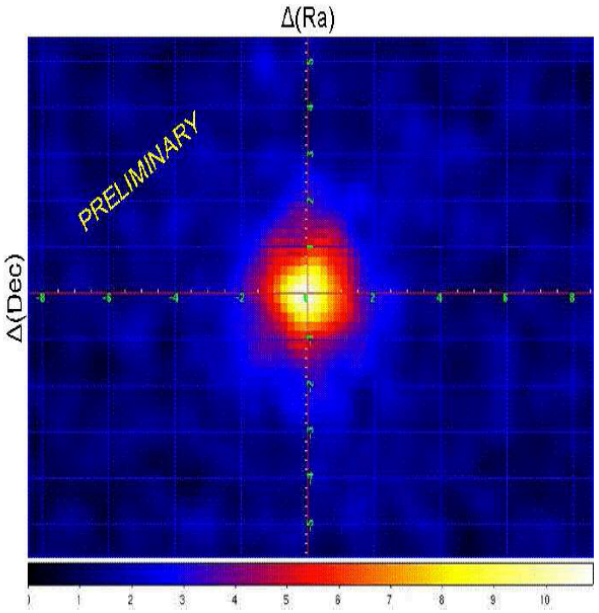
See Morris, Geophys. R. 89:10685 (1984), Moskalenko & Porter, ApJ 670:1467 (2007), ApJ 692:L54 (2009), Moskalenko et al., ApJ 681:1708 (2008)

Solar system contribution to the gamma-ray background

Moskalenko & Porter, 692:L54 (2009)



FERMI detection of the Moon



Giglietto et al., arXiv:0907.0543 (2009)

IMPORTANT

Contribution from the solar system is **unconstrained**

Question: Is it possible to “extract” the contribution of objects that may exhibit proper motion?

Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]

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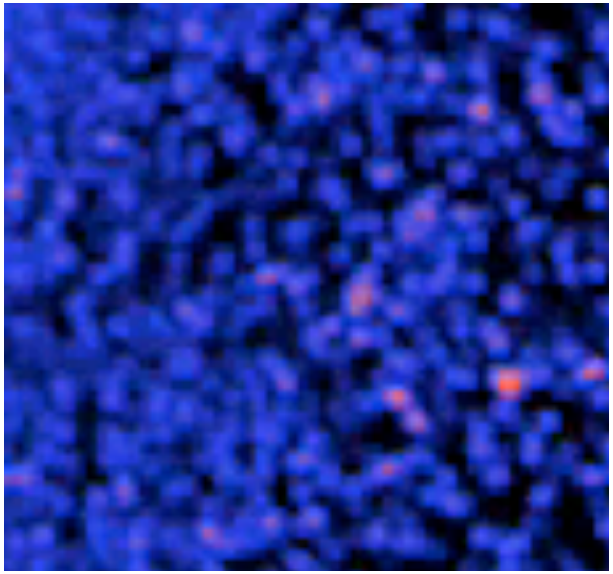
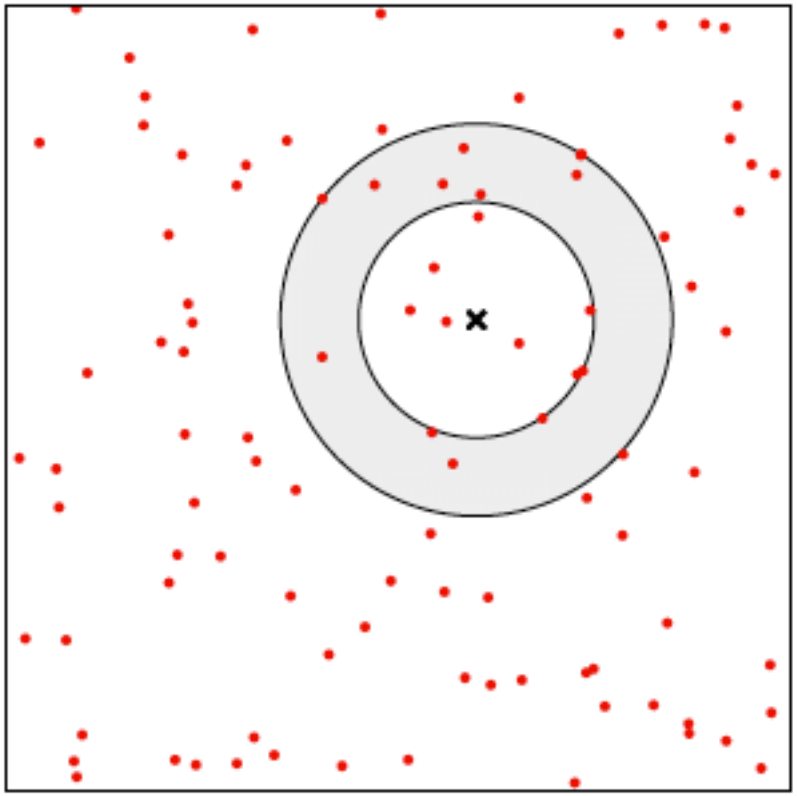


Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]

The two-point space-time correlation function



$$\xi_\theta(\Delta\theta) = \left\langle \frac{C(\Delta\theta) - \bar{\mathcal{N}}(\Delta\theta)}{\bar{\mathcal{N}}(\Delta\theta)} \right\rangle_p$$

Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]

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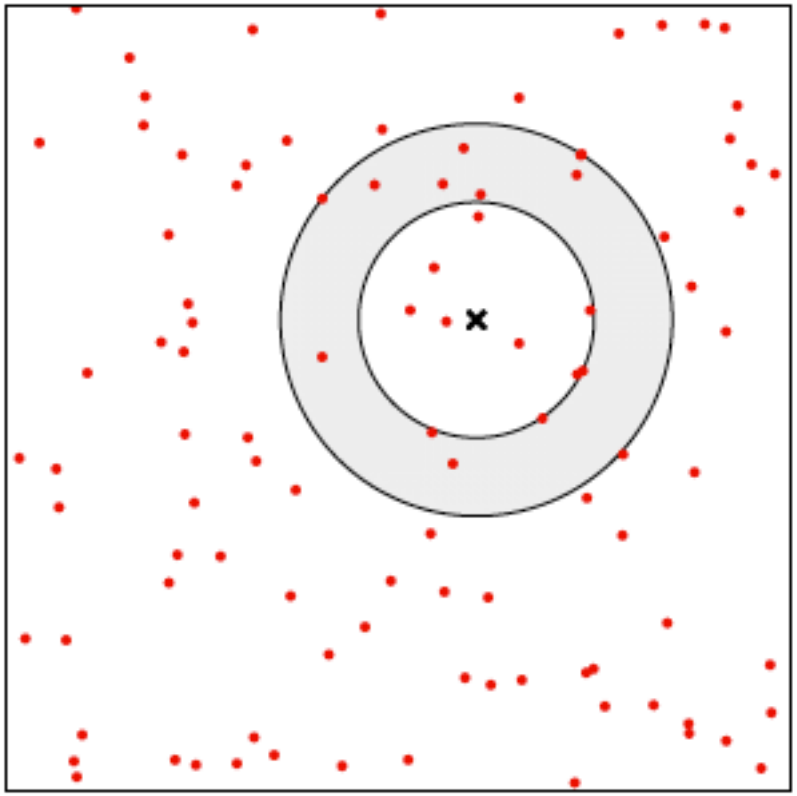
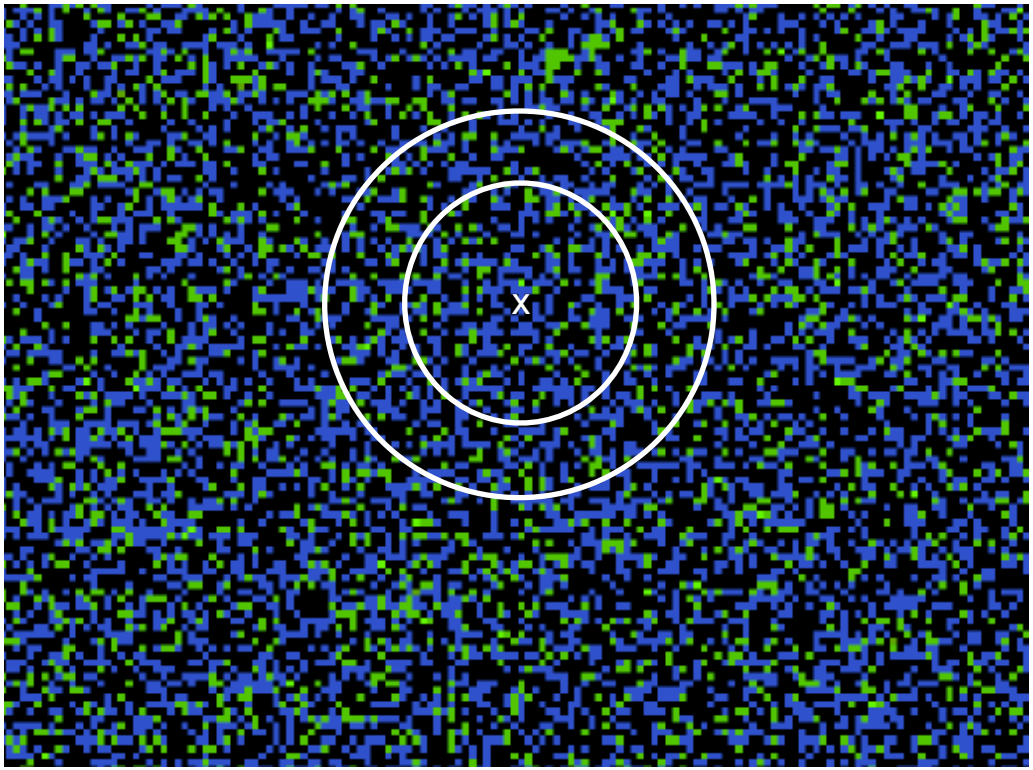


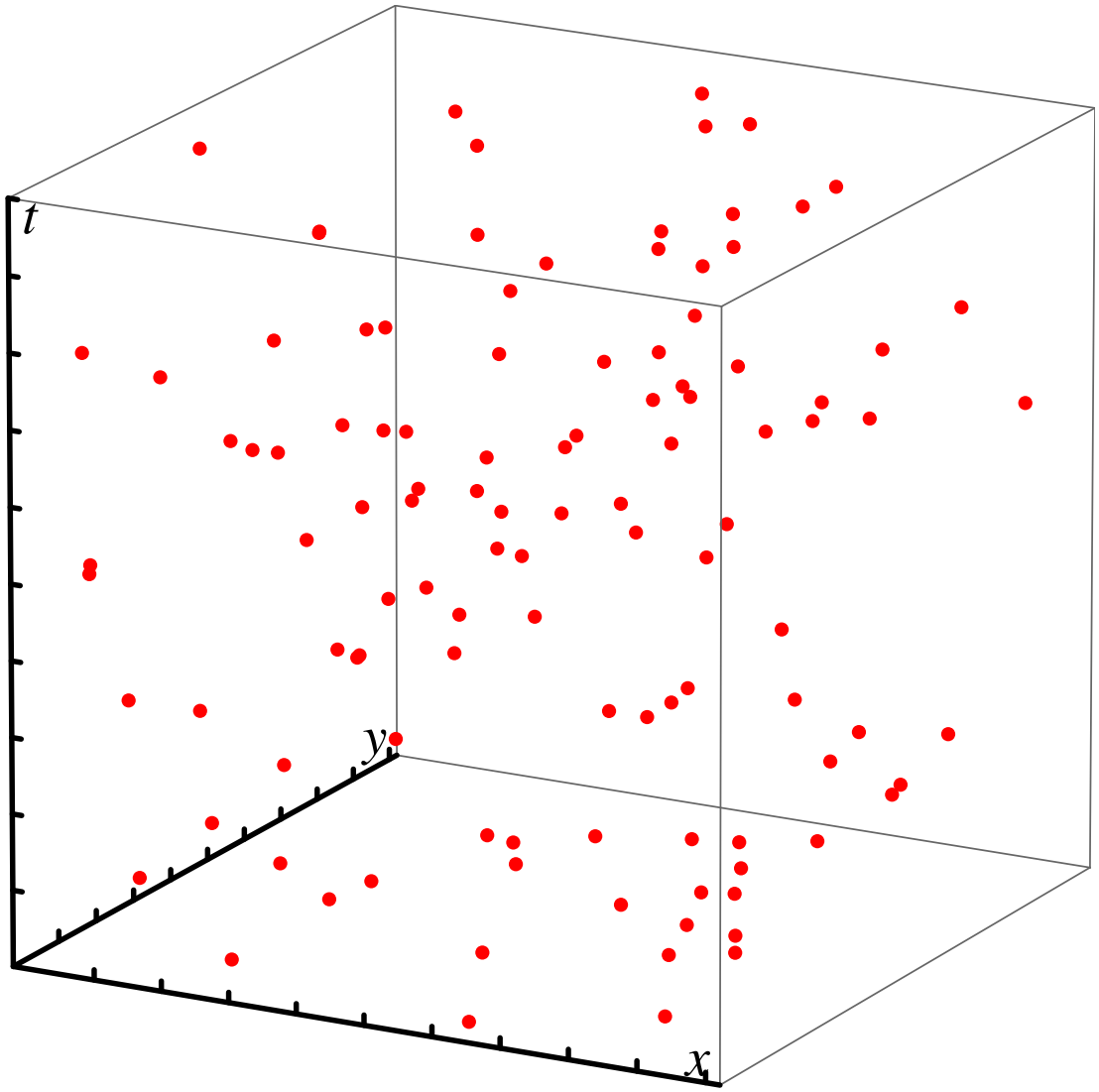


$$\xi_\theta(\Delta\theta) = \left\langle \frac{C(\Delta\theta) - \bar{\mathcal{N}}(\Delta\theta)}{\bar{\mathcal{N}}(\Delta\theta)} \right\rangle_p$$

$$\xi_{\theta,t}(\Delta\theta, \Delta t) = \left\langle \frac{C(\Delta\theta, \Delta t) - \bar{\mathcal{N}}(\Delta\theta, \Delta t)}{\bar{\mathcal{N}}(\Delta\theta, \Delta t)} \right\rangle_{\text{events}}$$

Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]

If $\xi \neq 0$ → signal



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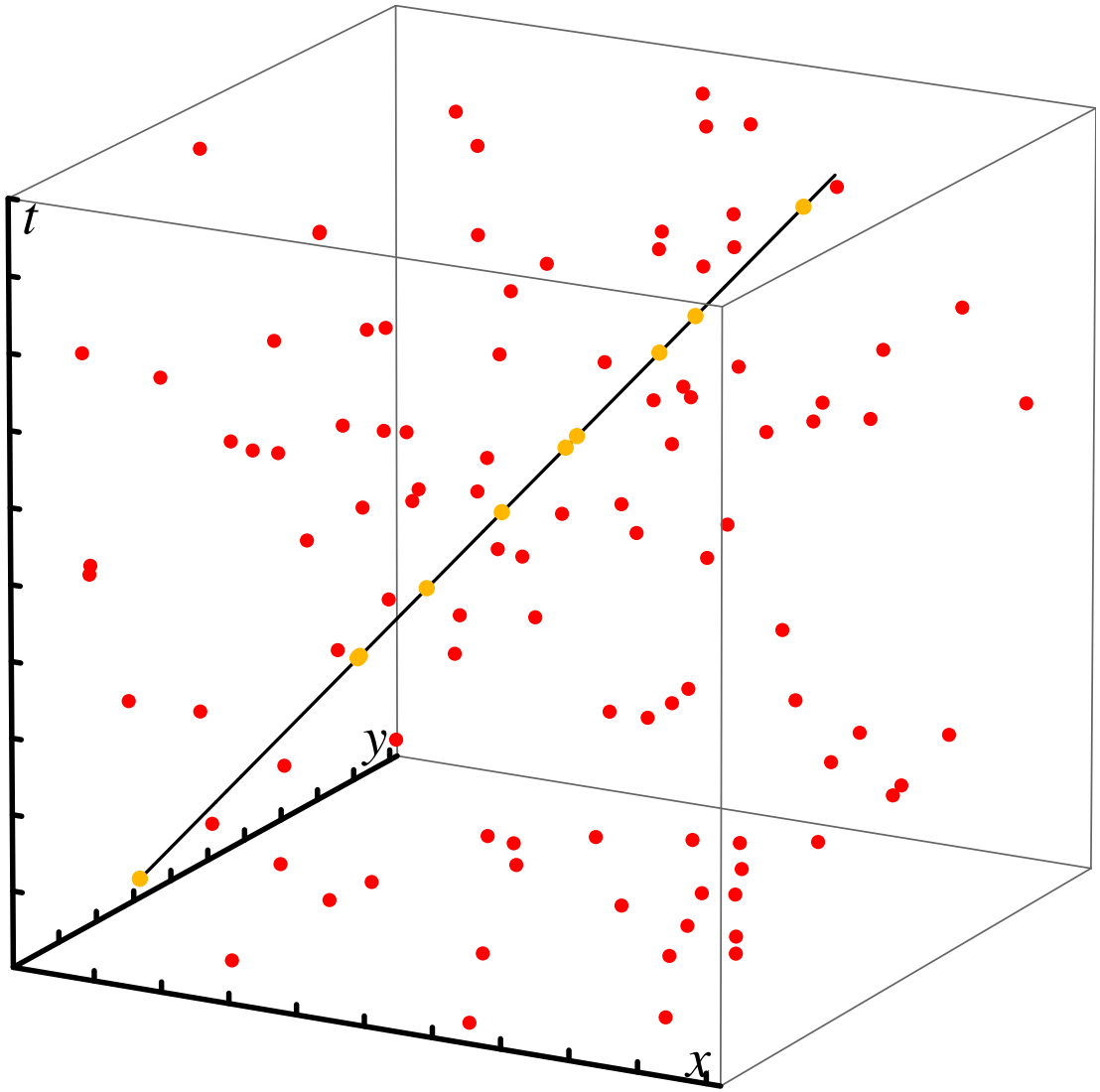
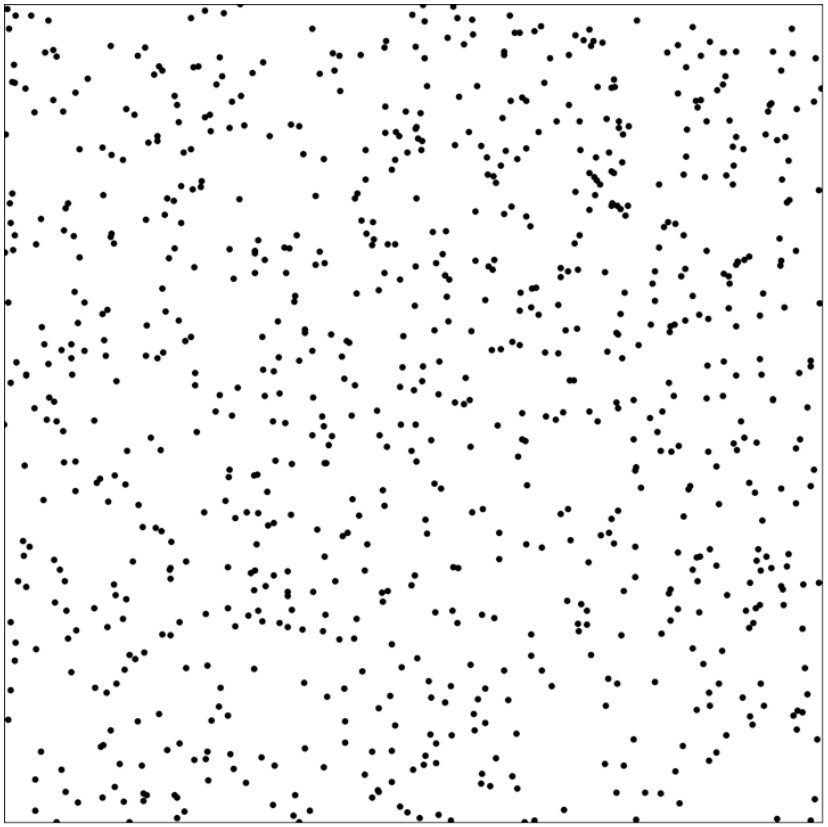
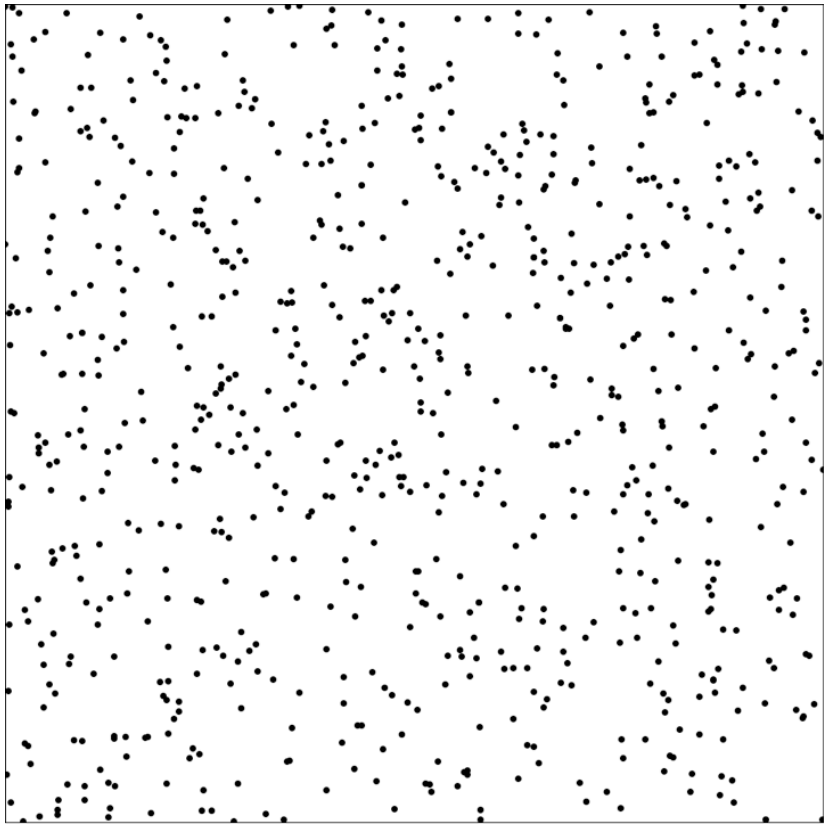


Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]

Testing the formalism





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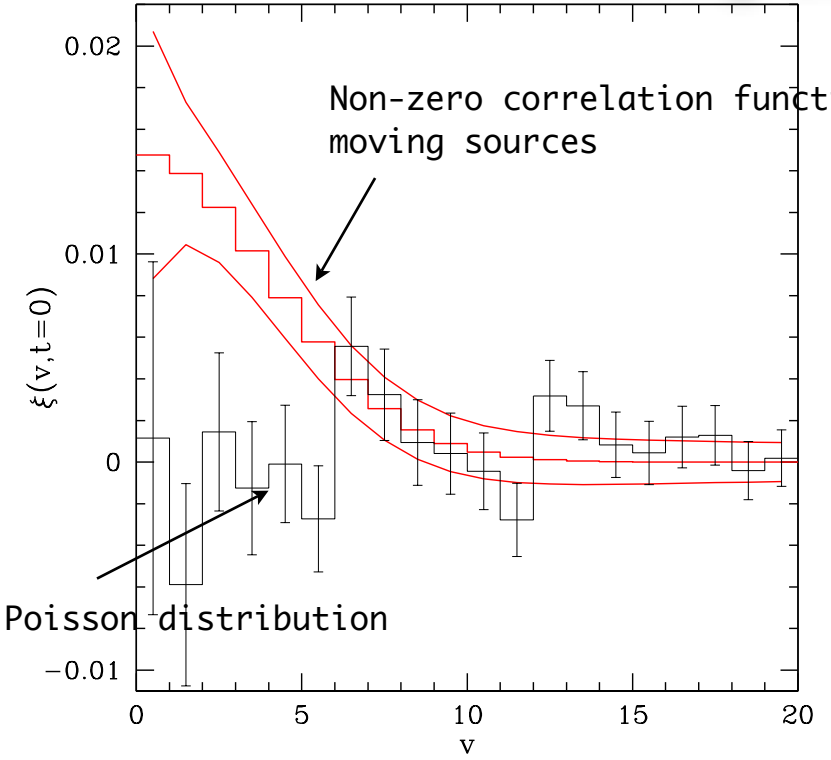
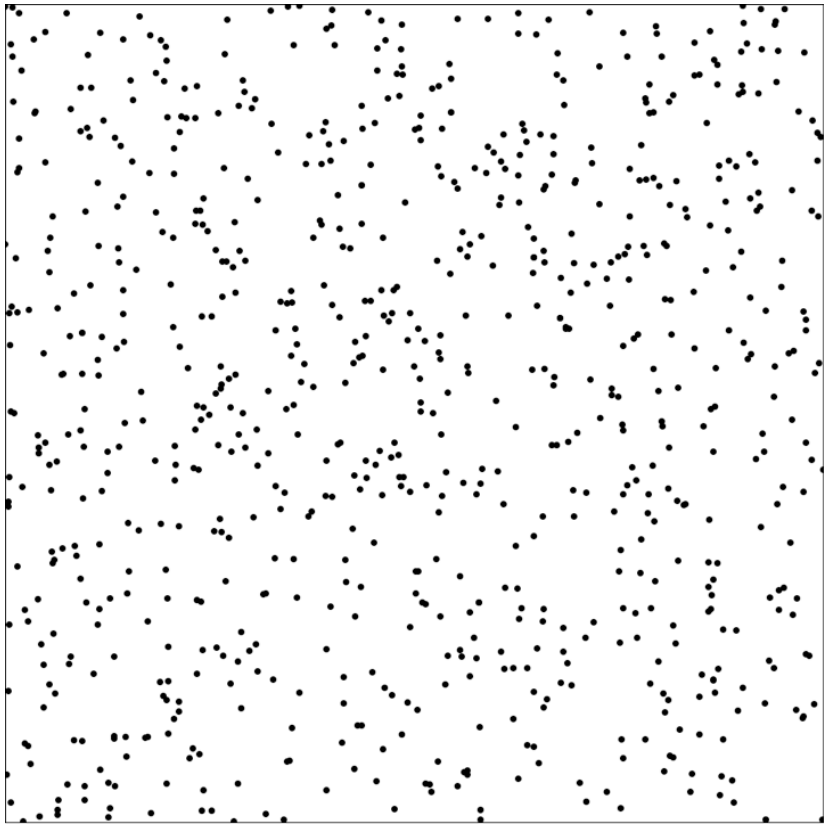


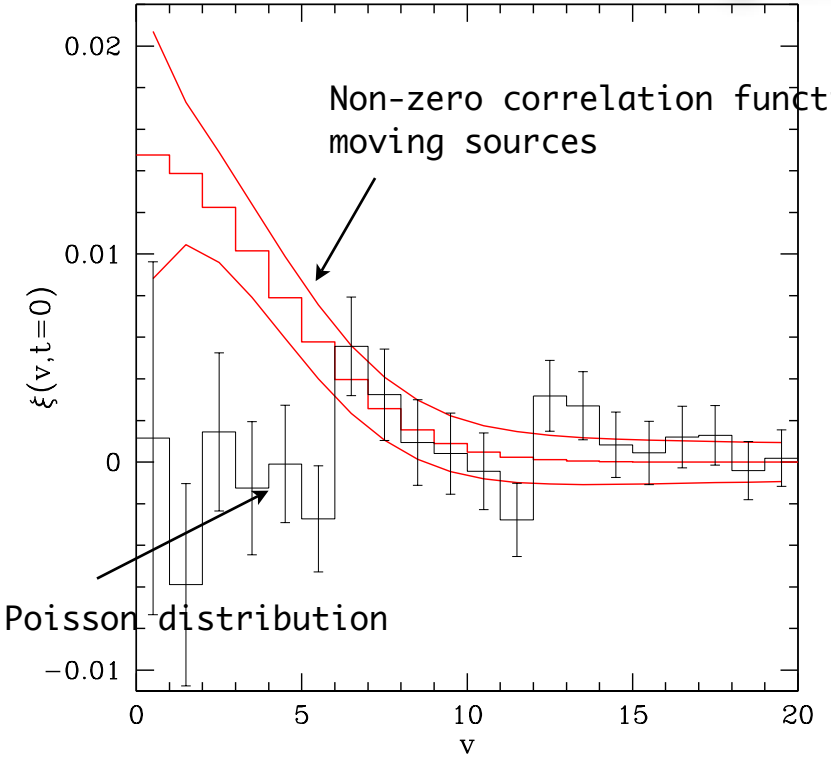


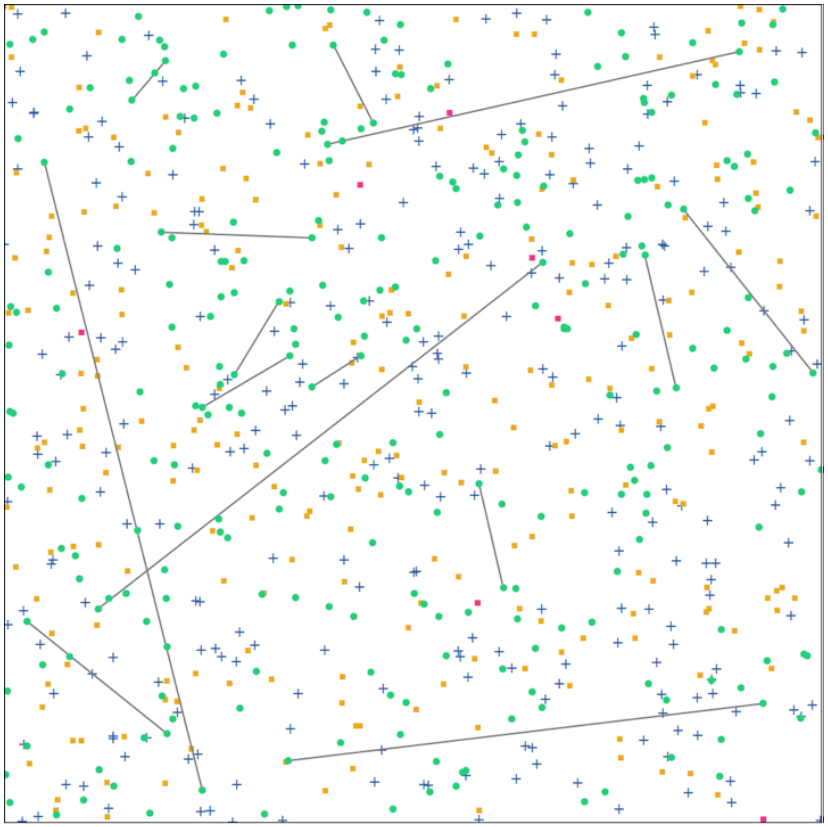
Less than 5% of events comes from sources which generated more than 1 events

95% of these generate exactly 2 events

Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]

Testing the formalism





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Shape: Velocity distribution
Amplitude: Flux

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In progress:
Application to FERMI-LAT data

Conclusion

No individual source detection $\neq$ No information

New tools $\longrightarrow$ Potential discoveries

See: Alex Geringer-Sameth & Koushiappas [arXiv:1012.1873]