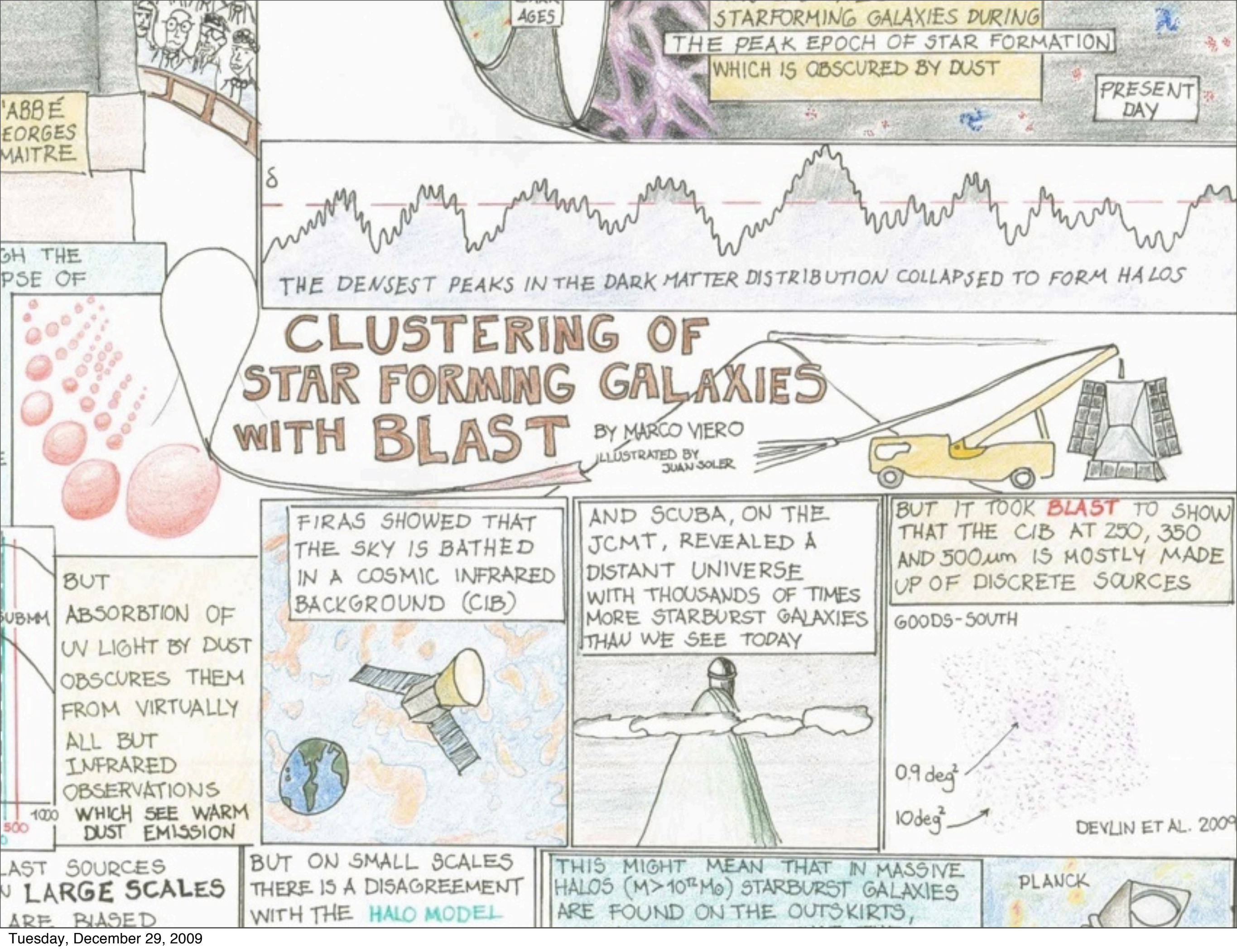




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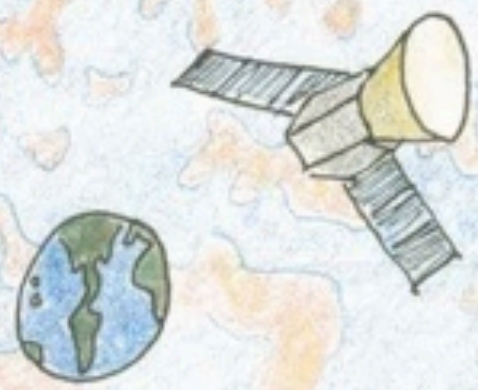
1000
500

LAST SOURCES
ON LARGE SCALES
ARE BIASED

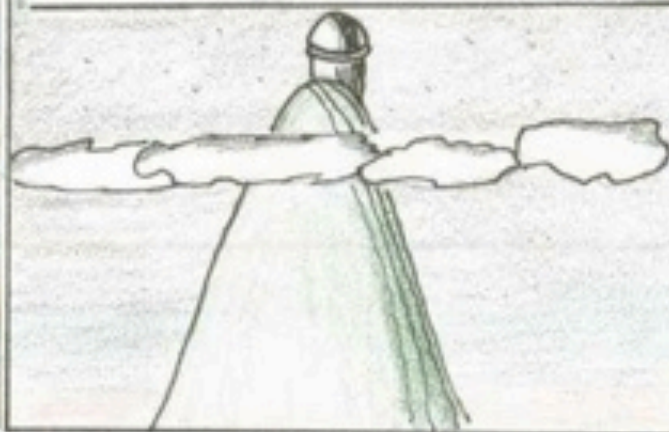
CLUSTERING OF STAR FORMING GALAXIES WITH BLAST

BY MARCO VIERO
ILLUSTRATED BY
JUAN SOLER

FIRAS SHOWED THAT
THE SKY IS BATHED
IN A COSMIC INFRARED
BACKGROUND (CIB)



AND SCUBA, ON THE
JCMT, REVEALED A
DISTANT UNIVERSE
WITH THOUSANDS OF TIMES
MORE STARBURST GALAXIES
THAN WE SEE TODAY



BUT IT TOOK **BLAST** TO SHOW
THAT THE CIB AT 250, 350
AND 500μm IS MOSTLY MADE
UP OF DISCRETE SOURCES

GOODS-SOUTH

0.9 deg²

10 deg²

DEVLIN ET AL. 2009

BUT ON SMALL SCALES
THERE IS A DISAGREEMENT
WITH THE **HALO MODEL**

THIS MIGHT MEAN THAT IN MASSIVE
HALOS ($M > 10^{12} M_{\odot}$) STARBURST GALAXIES
ARE FOUND ON THE OUTSKIRTS,

PLANCK



BLAST TEAM



UBC
Ed Chapin
Mark Halpern
Gaelen Marsden
Douglas Scott
Don Wiebe

CDF (France)
Guillaume Patanchon

U of T
Peter Martin
Barth
Netterfield
Marco Viero

JPL
Jamie Bock

UPenn
Simon Dicker
Jeff Klein
Marie Rex
Chris Semisch
Matt Truch

Brown University
Greg Tucker

U of Miami
Josh Gundersen
Nick Thomas

INAOE (Mexico)
David Hughes
Itziar Aretxaga

U Puerto Rico
Luca Olmi

Cardiff
University
Peter Ade
Matt Griffin
Peter Hargrave
Phil Mauskopf
Carole Tucker
Enzo Pascale
Lorenzo Moncelsi

Open
University
Mattia Negrello

‘people don’t understand us’

- Why Clustering?
 - ◉ On large scales:
 - relates galaxy formation to structure formation
 - find typical halo masses which host galaxy populations
 - ◉ On small scales:
 - distribution of galaxies within halos
 - ◉ Link populations

Outline

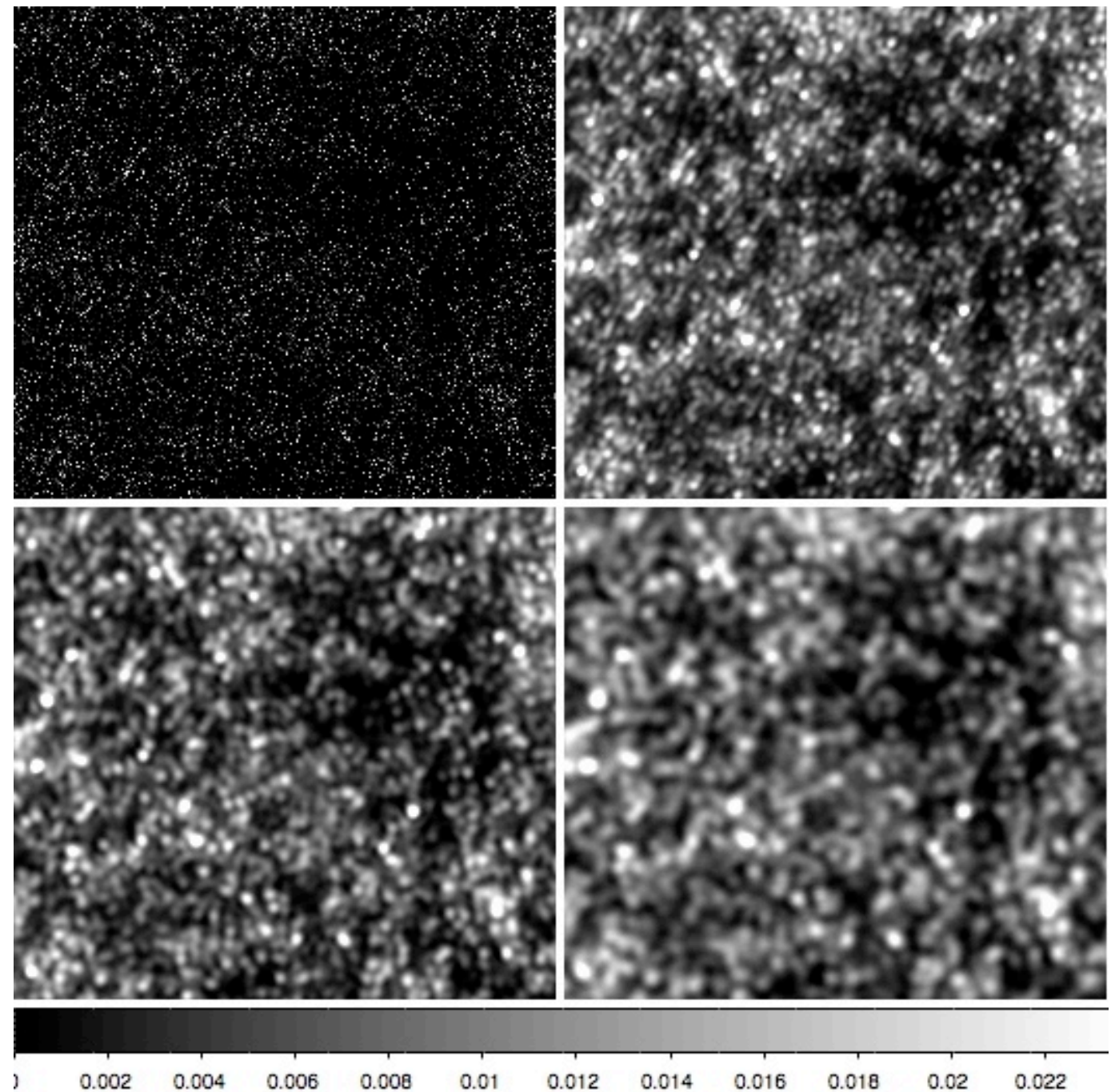
- Measurements - maps vs. catalogues
 - ◉ Complications
 - ◉ Maximizing information
- BLAST
 - ◉ Clustering from correlations of background fluctuations
 - ◉ Physical Interpretation
- Implications for Future Work

Measurements

Complications

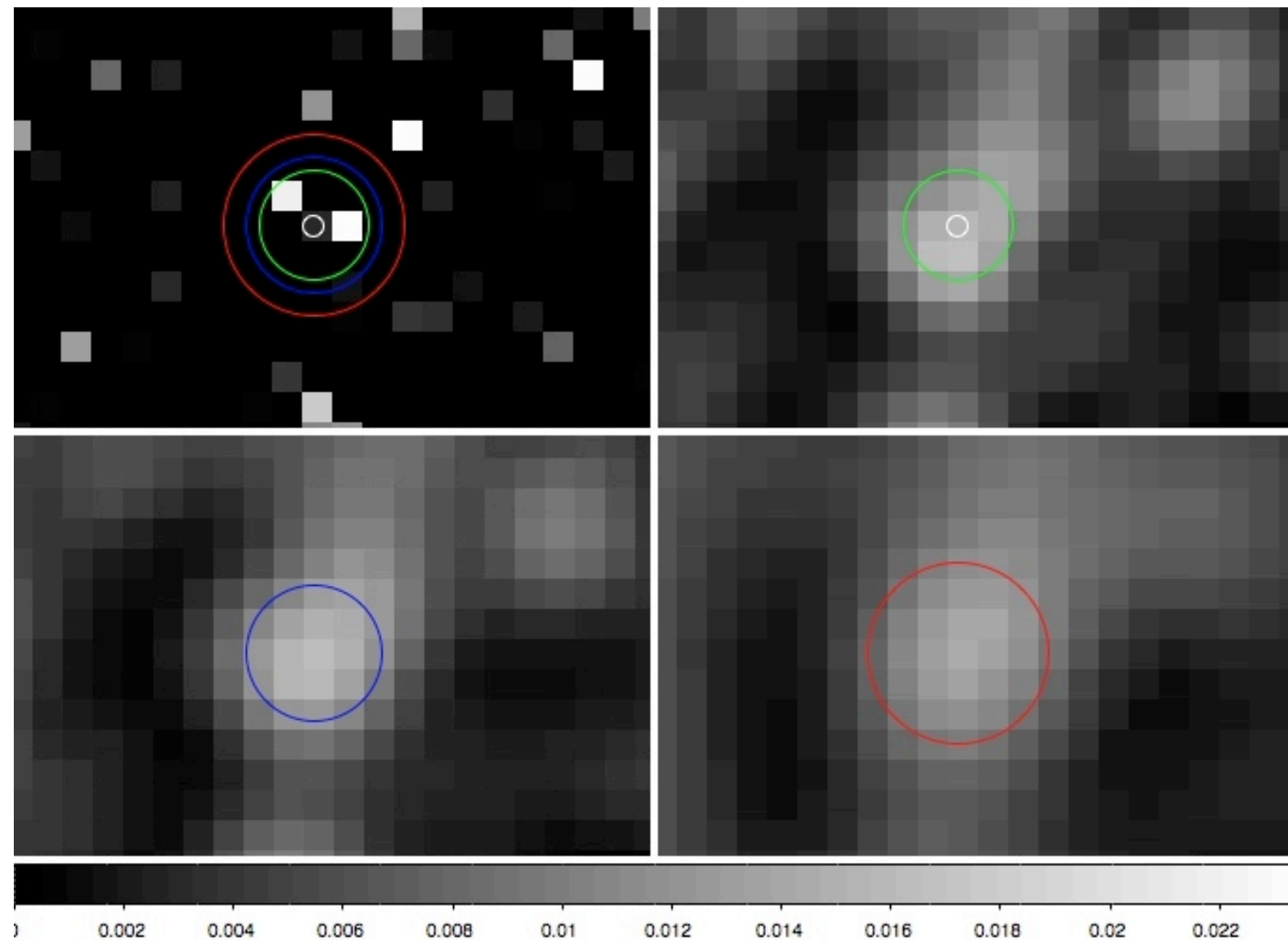
Complications

- While *large scales* well traced



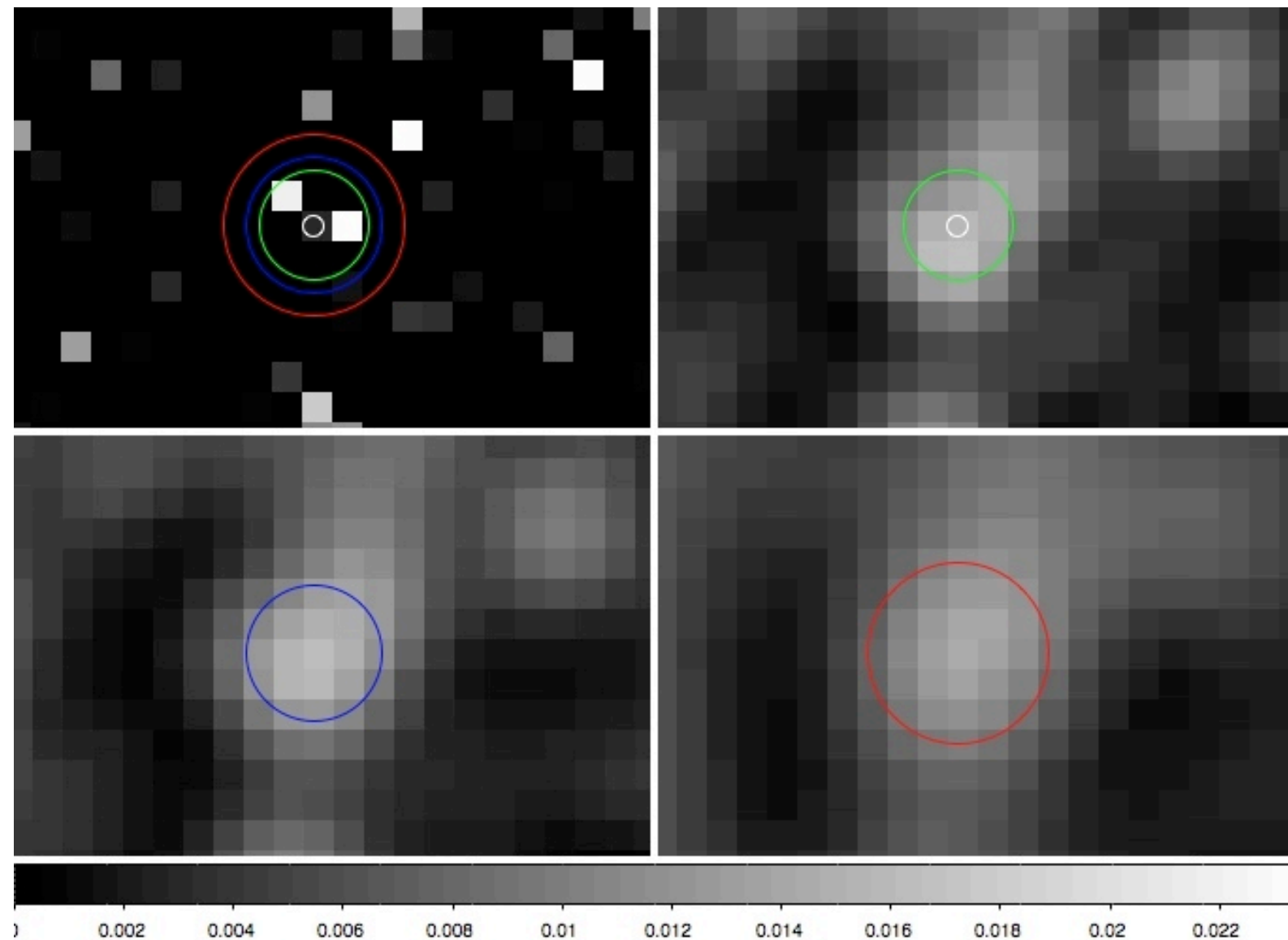
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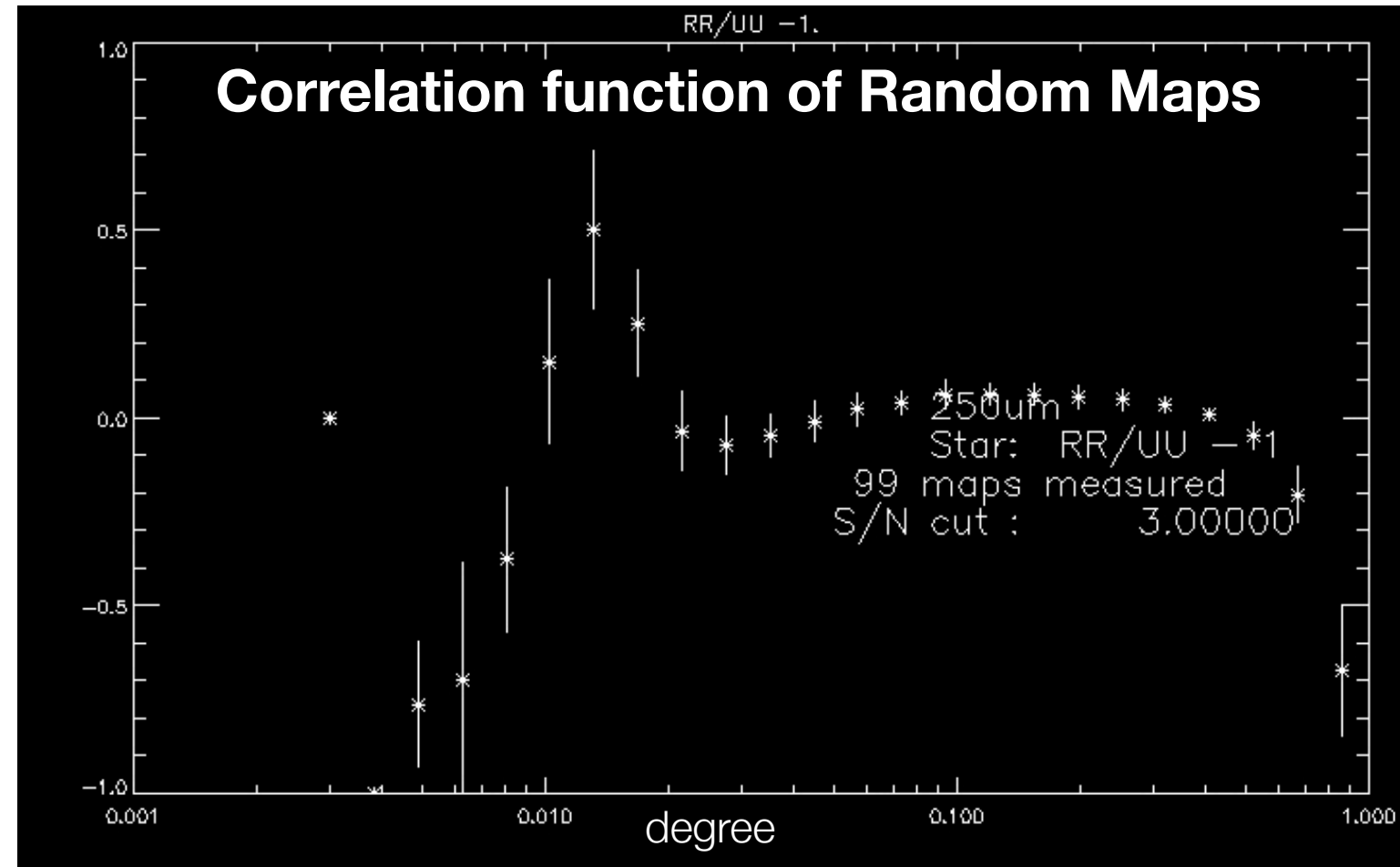
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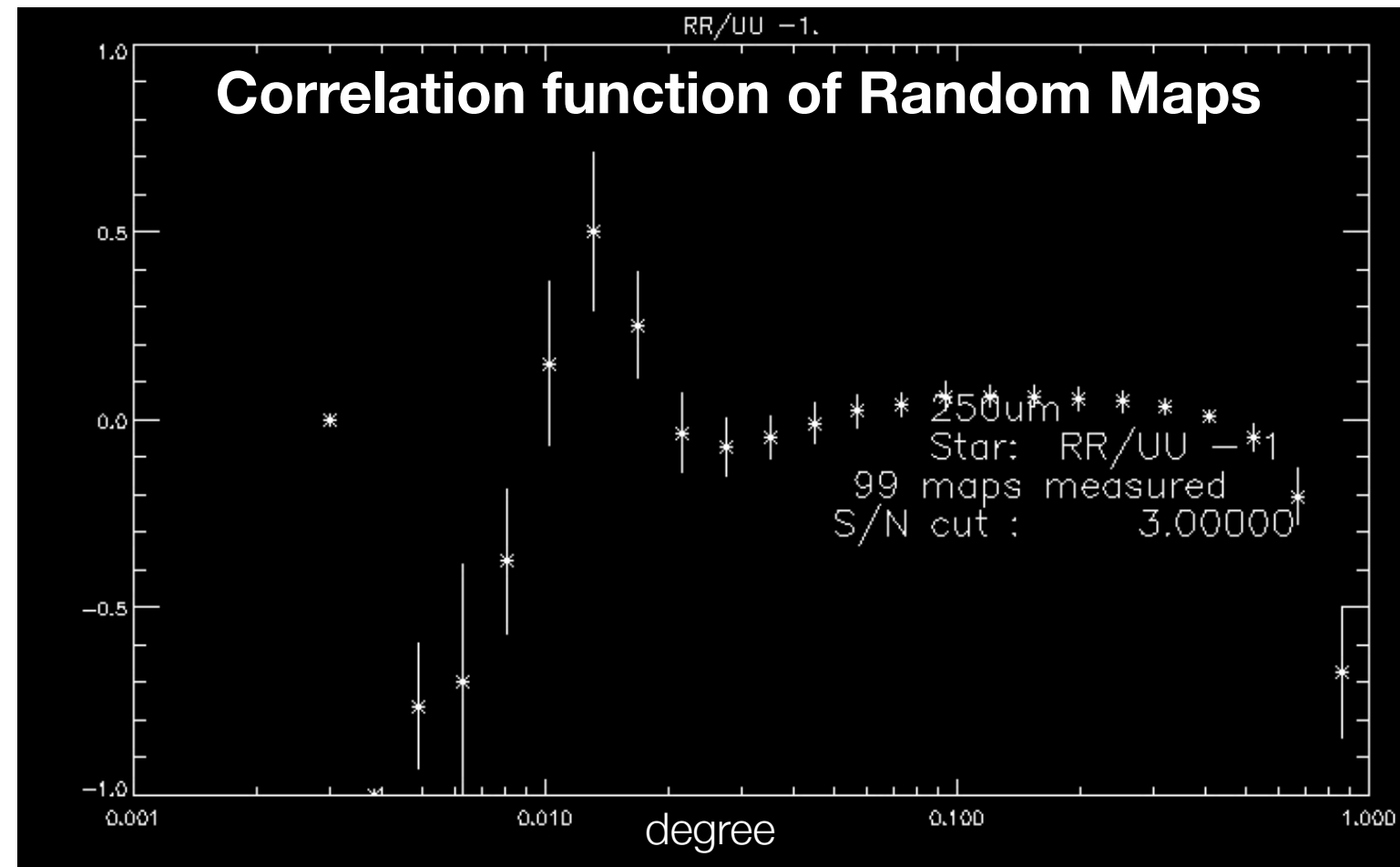
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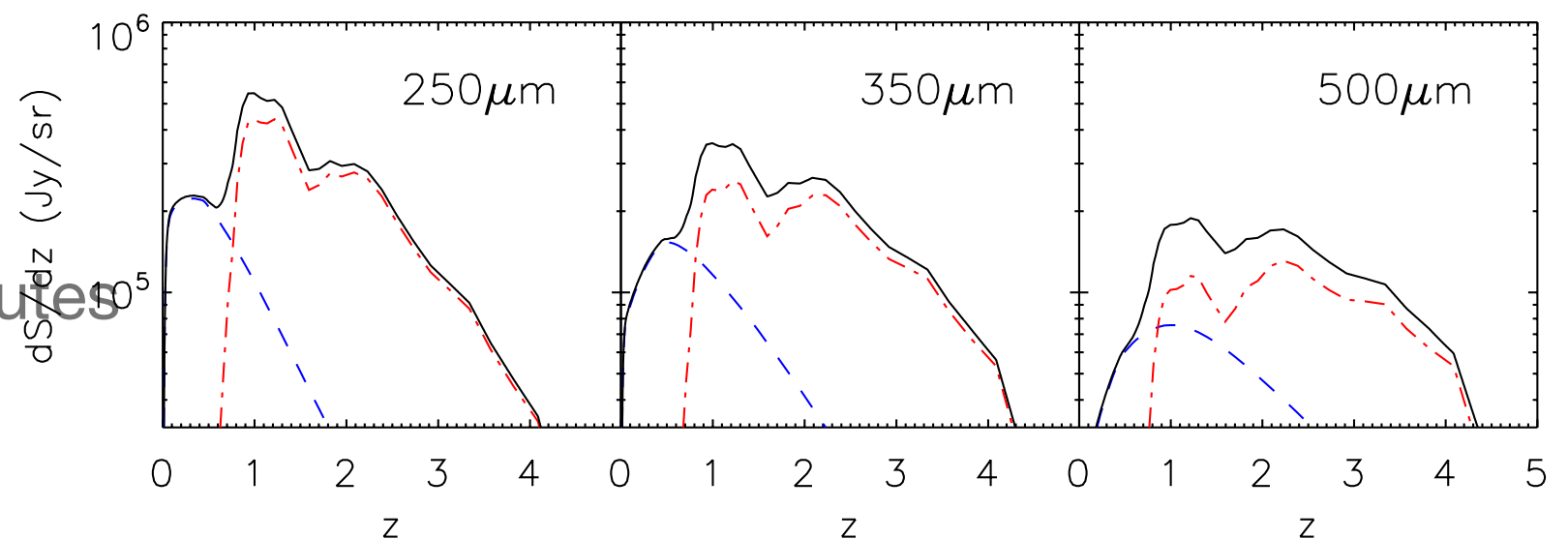
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 - ◉ confusion limits number of sources / area, need more area



Clustering from Power Spectrum

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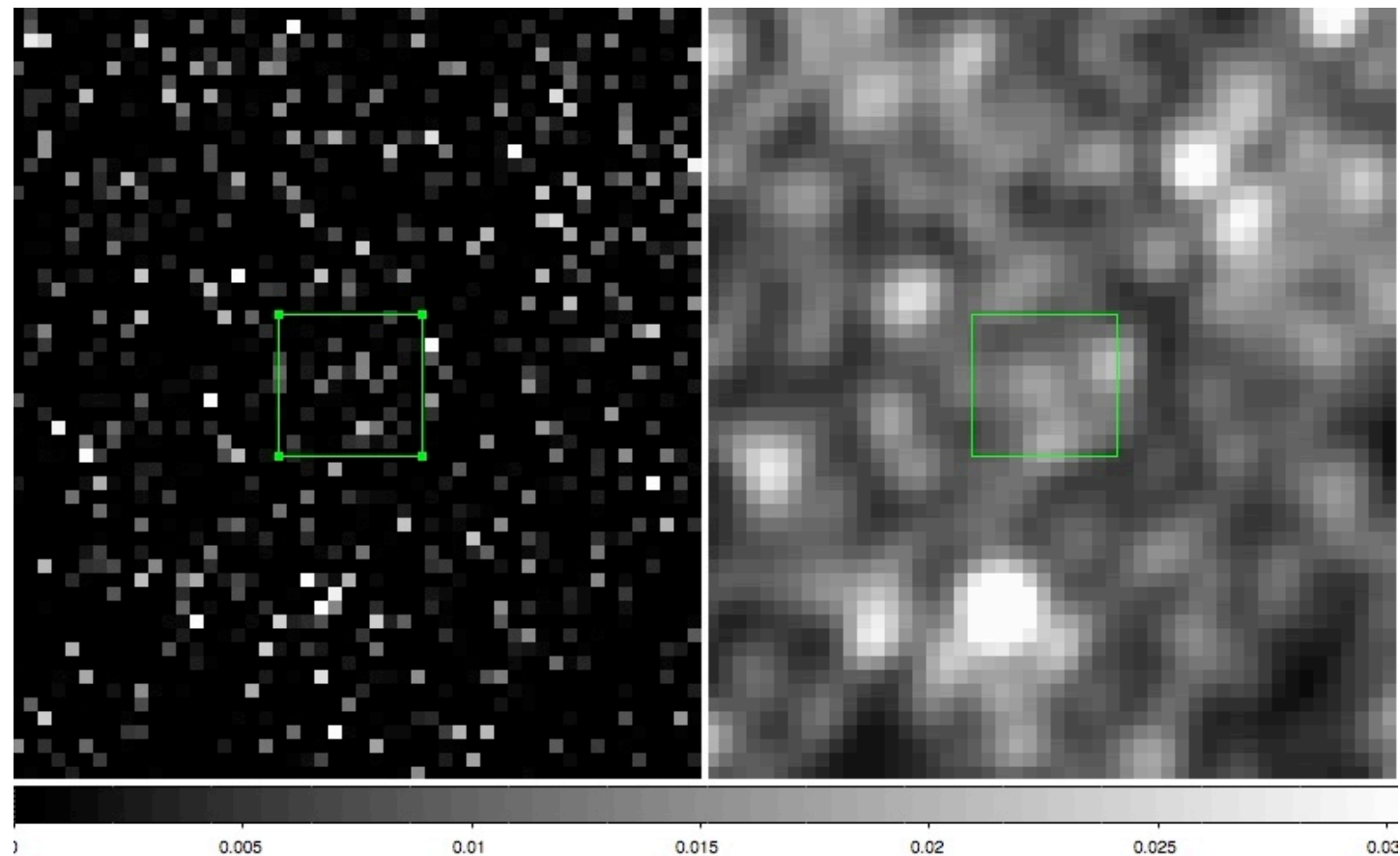
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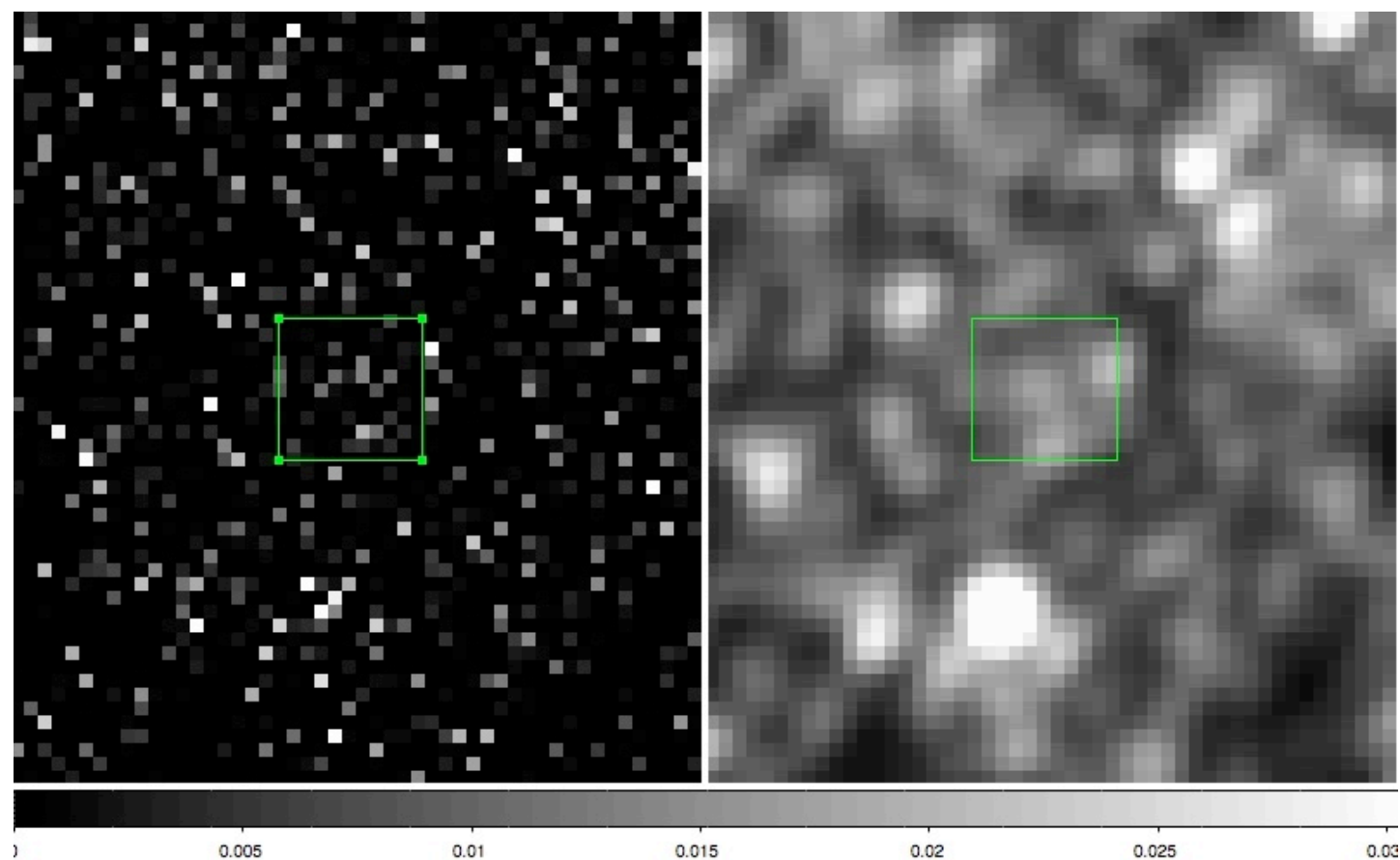
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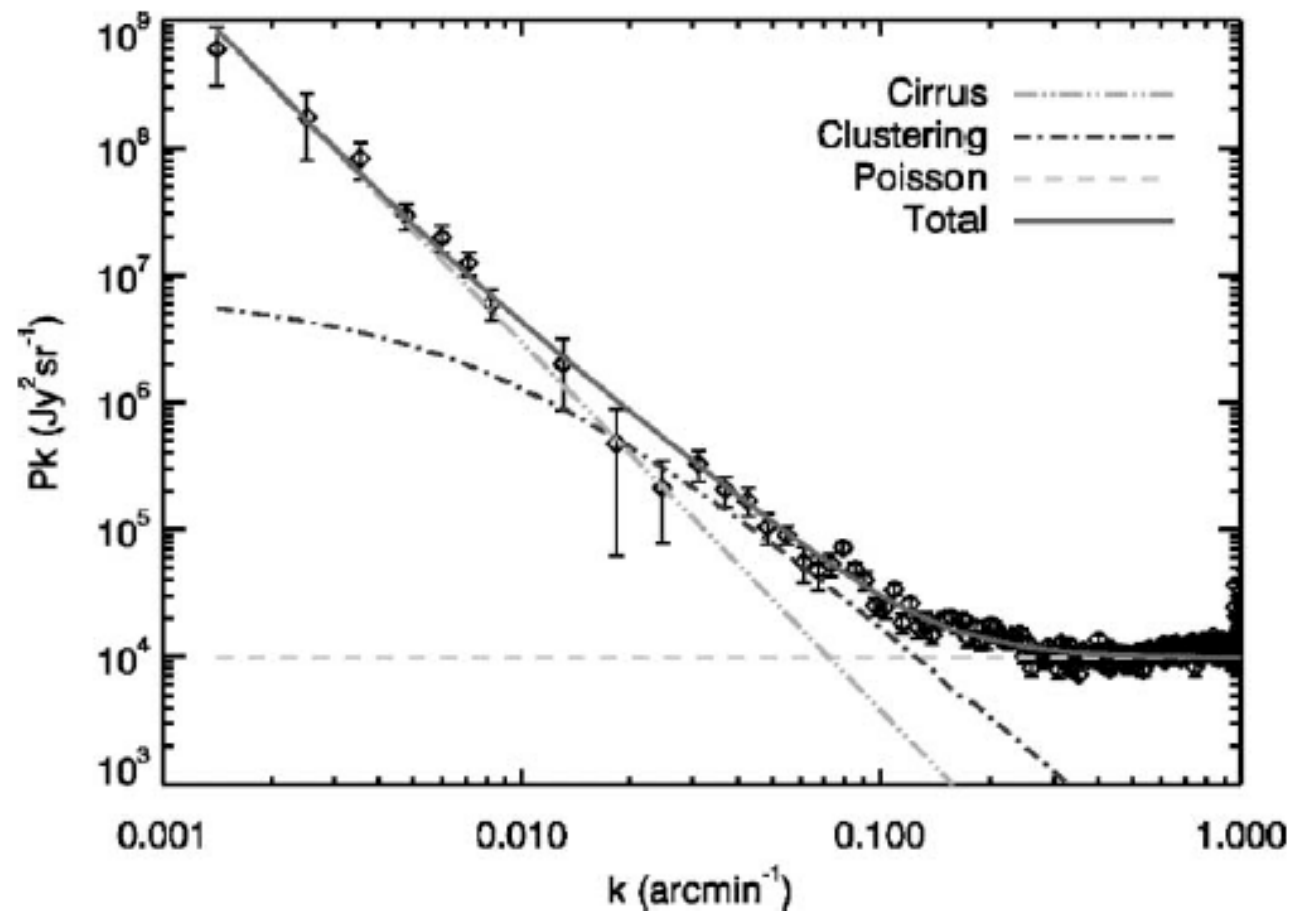
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Lagache+ 2007

BLAST

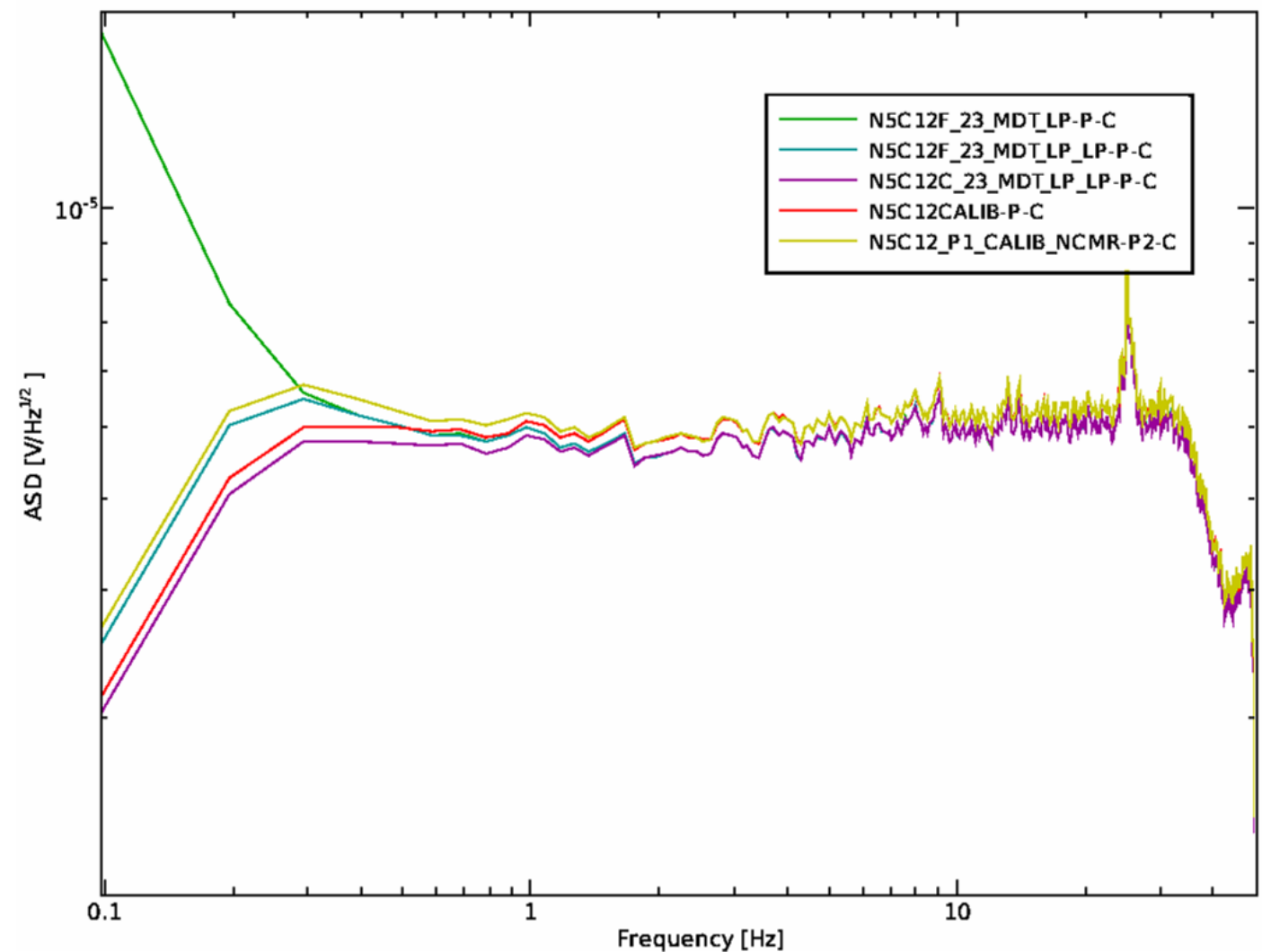
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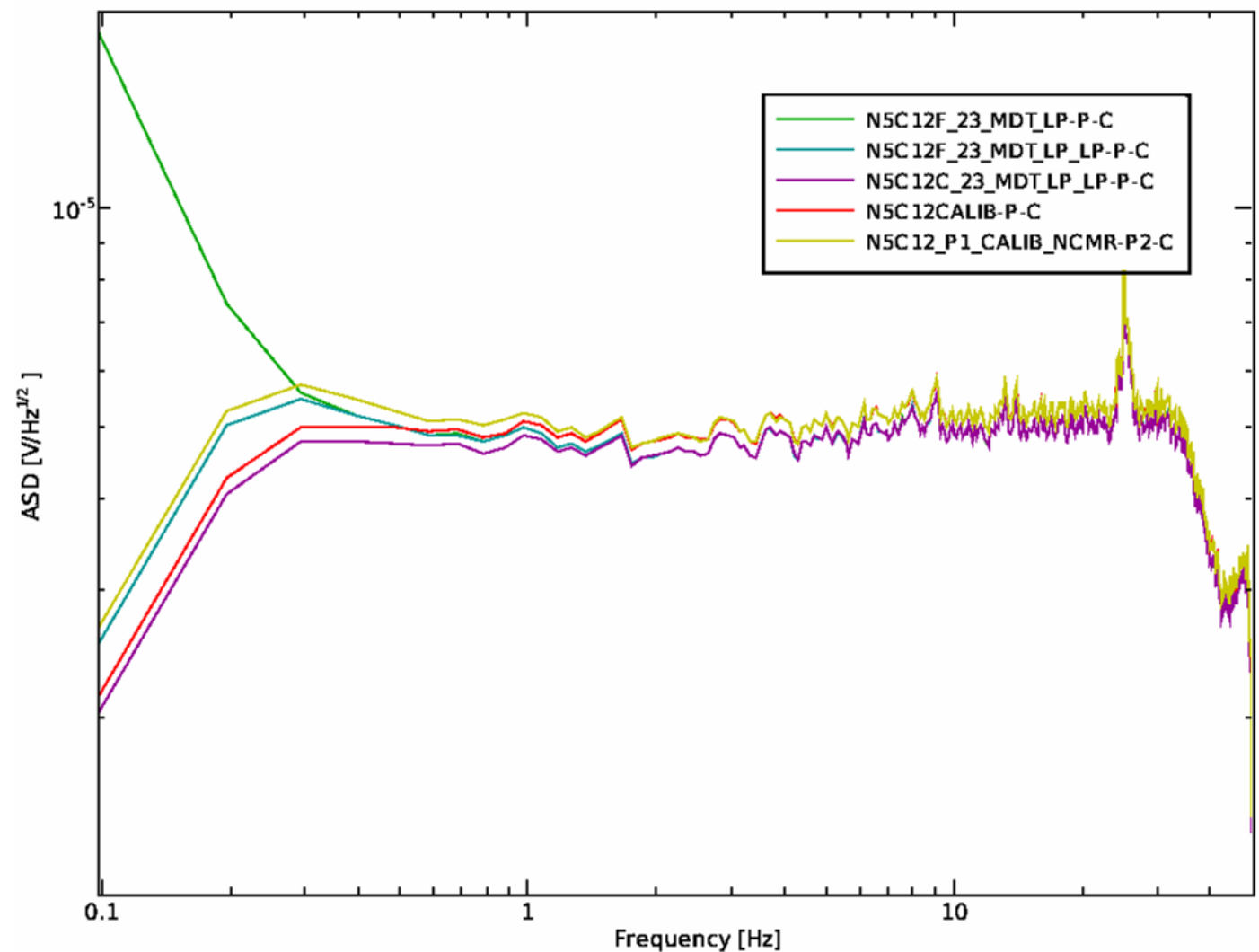
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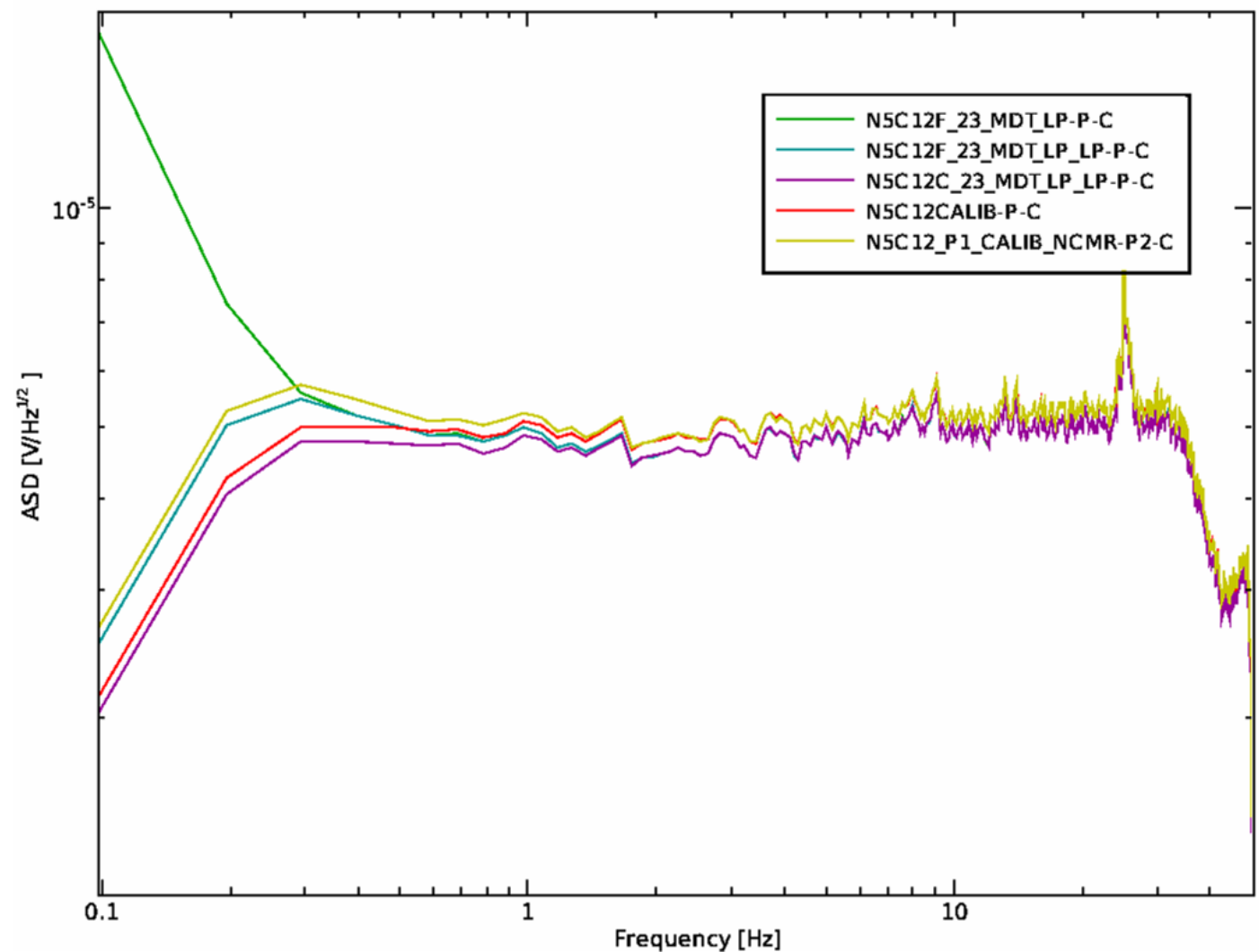
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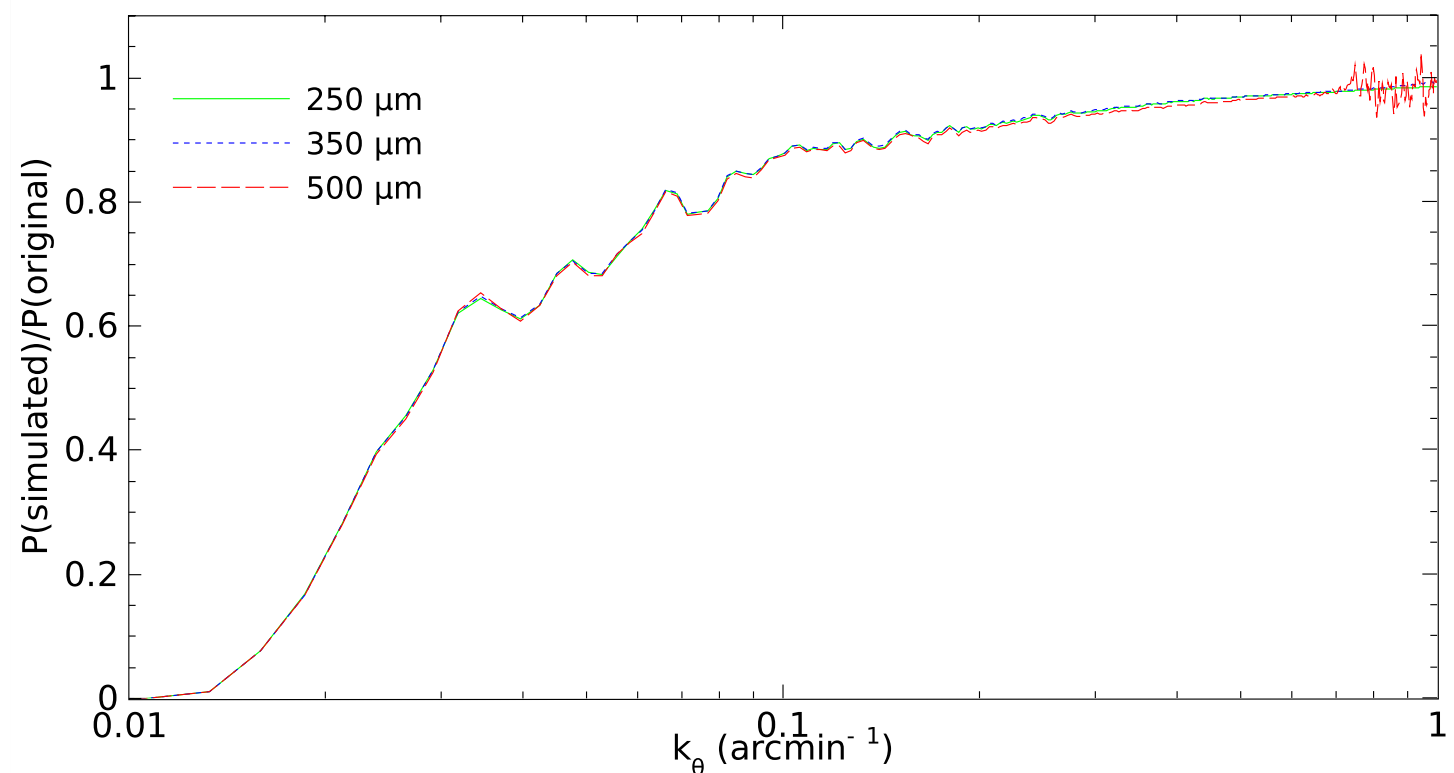
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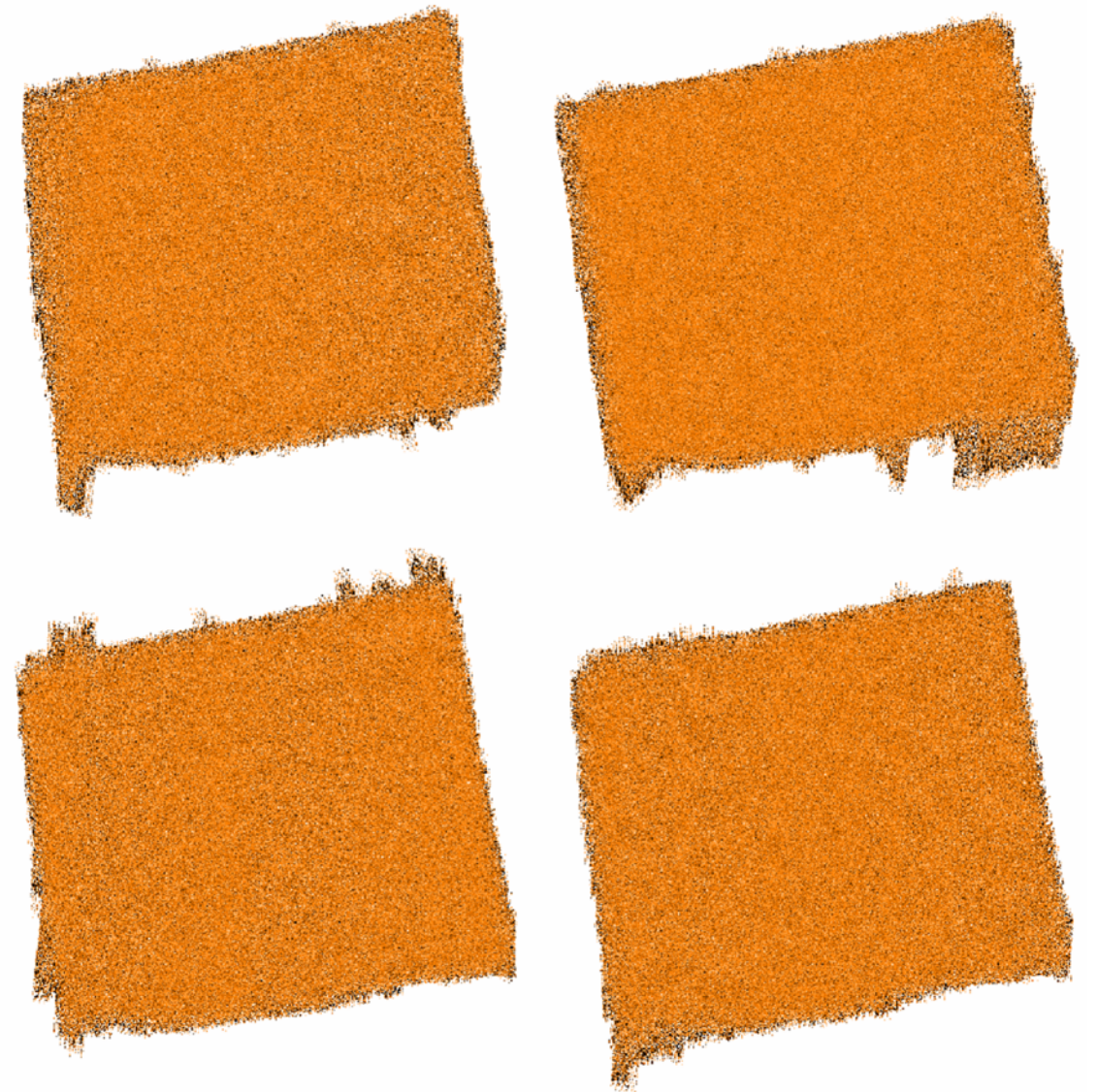
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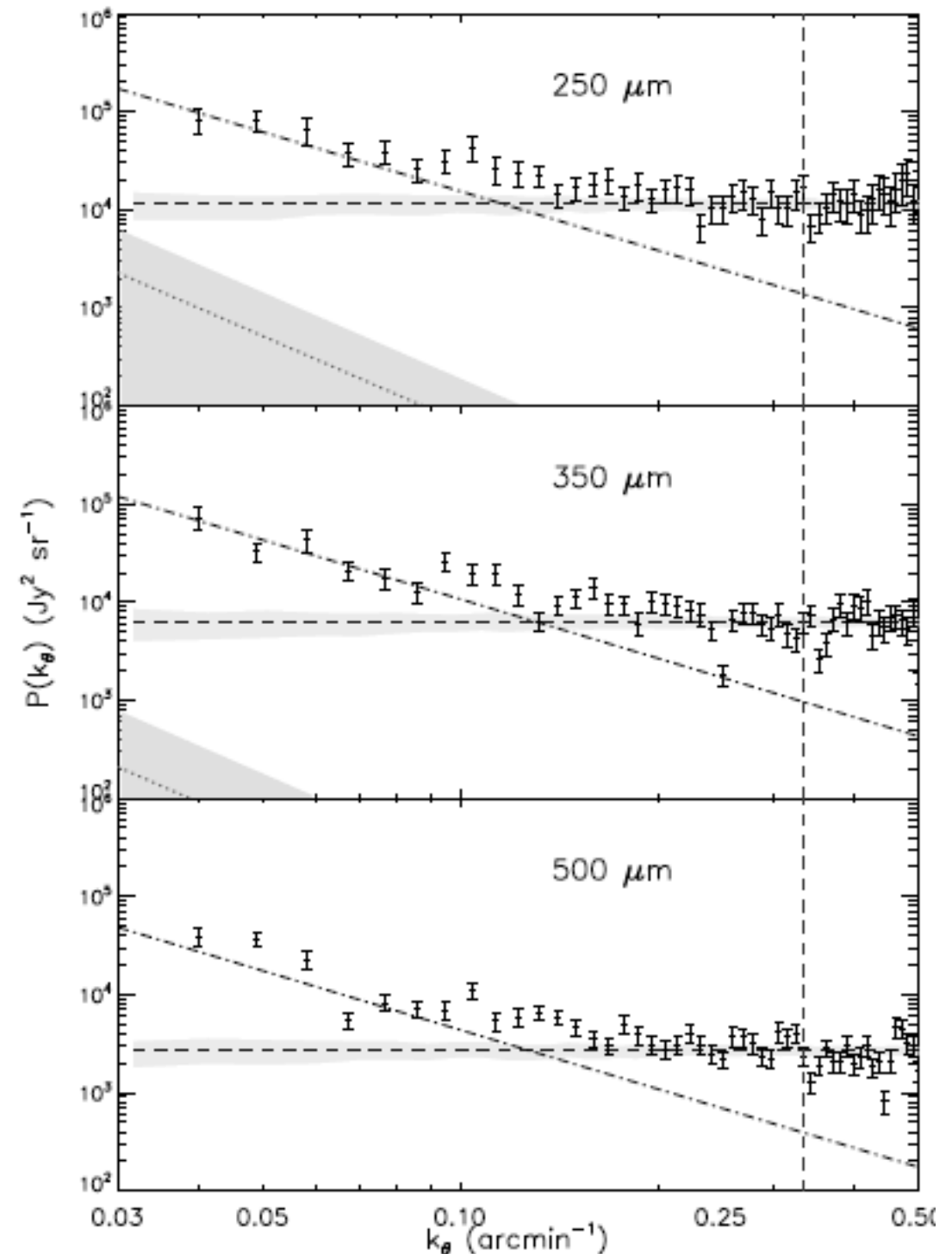
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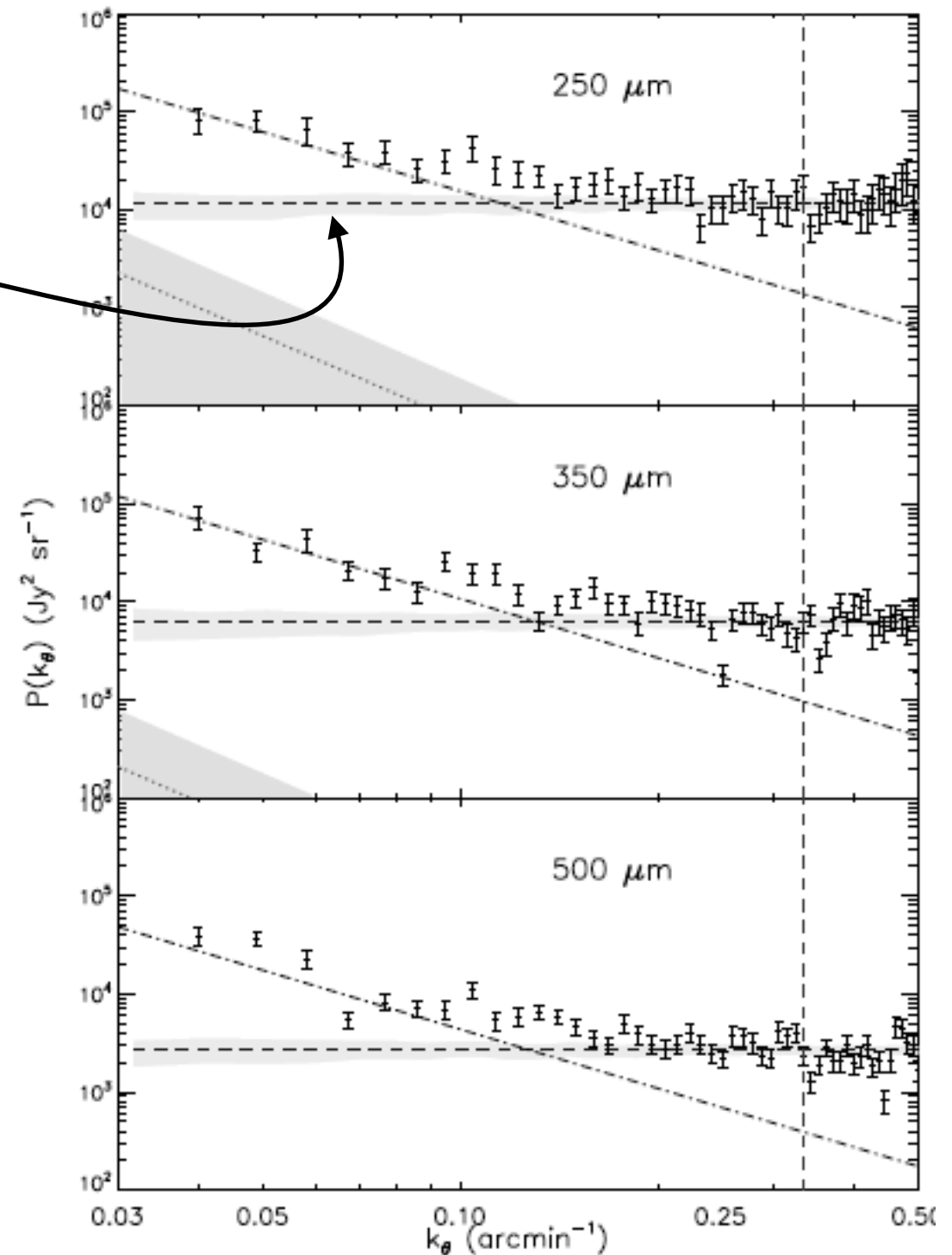
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 - ◉ power spectrum of cross-correlation of sub-maps



BLAST Clustering Power Spectrum

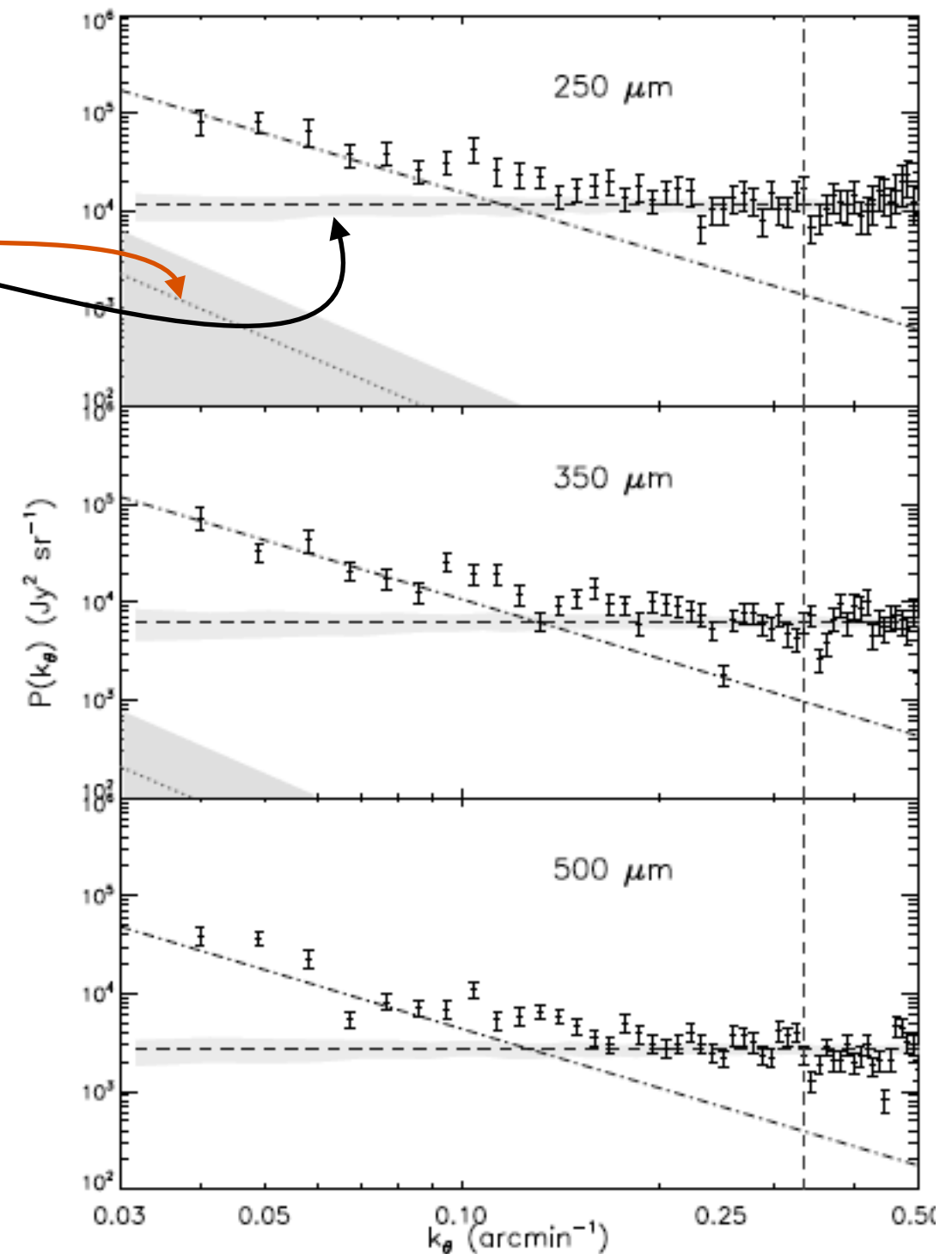
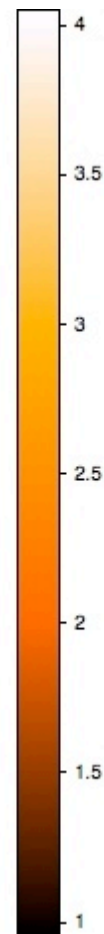
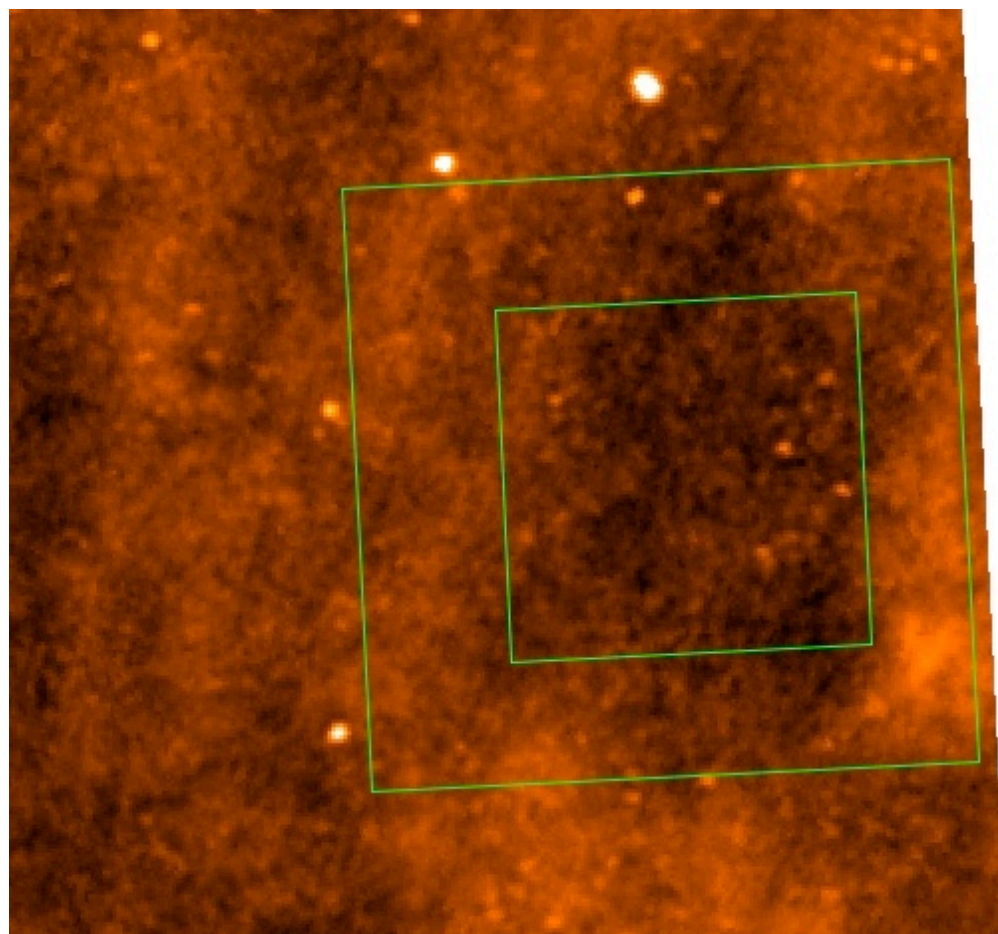
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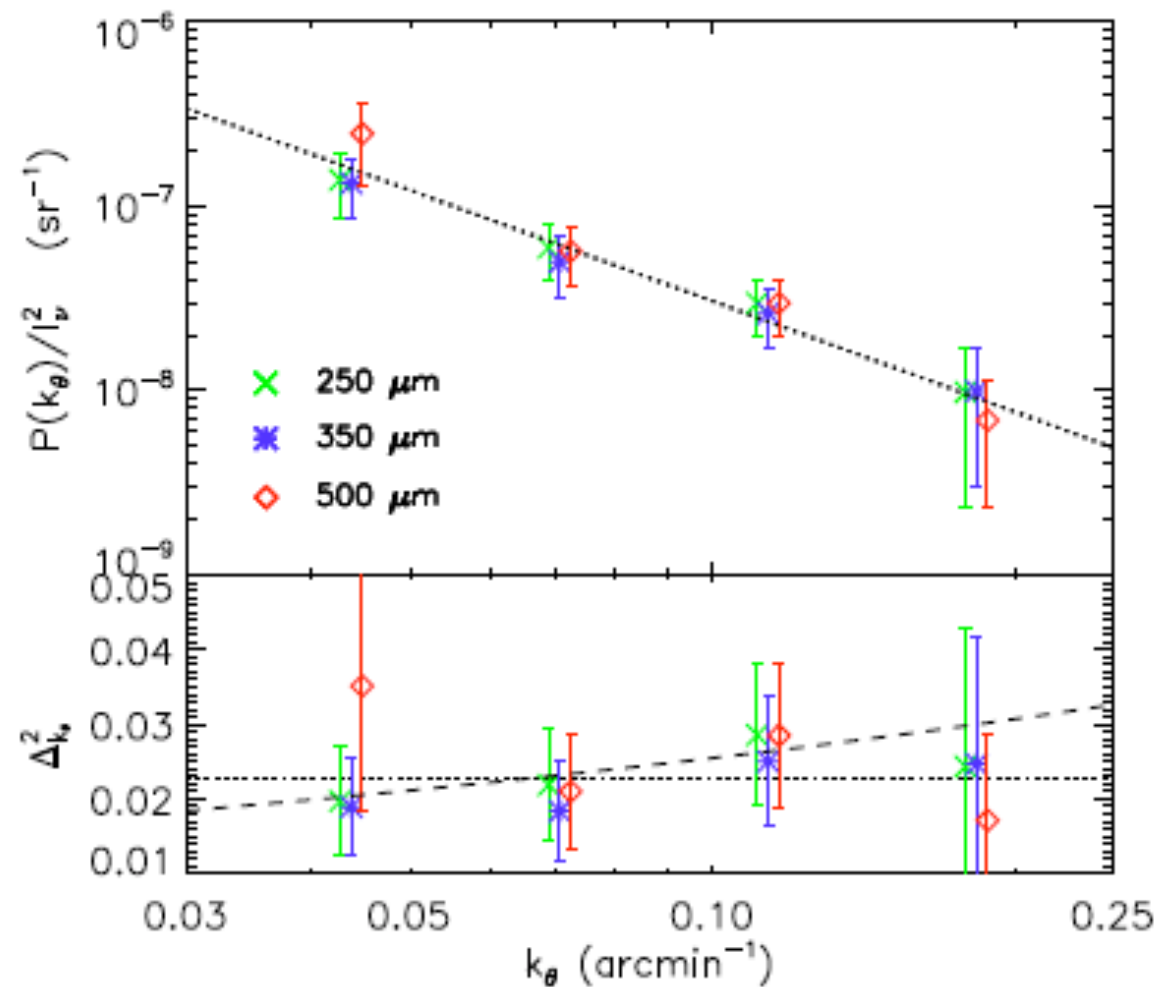
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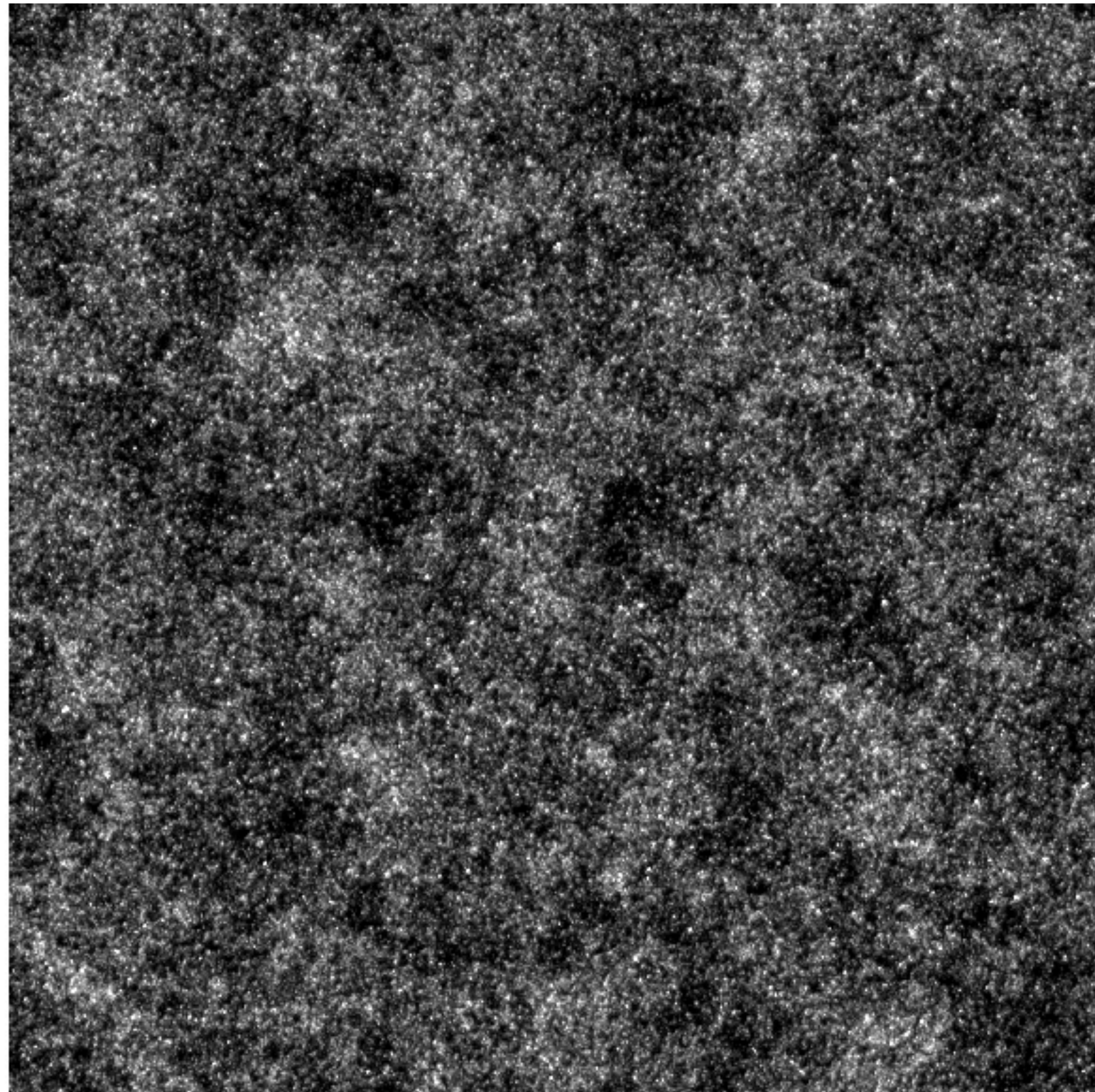
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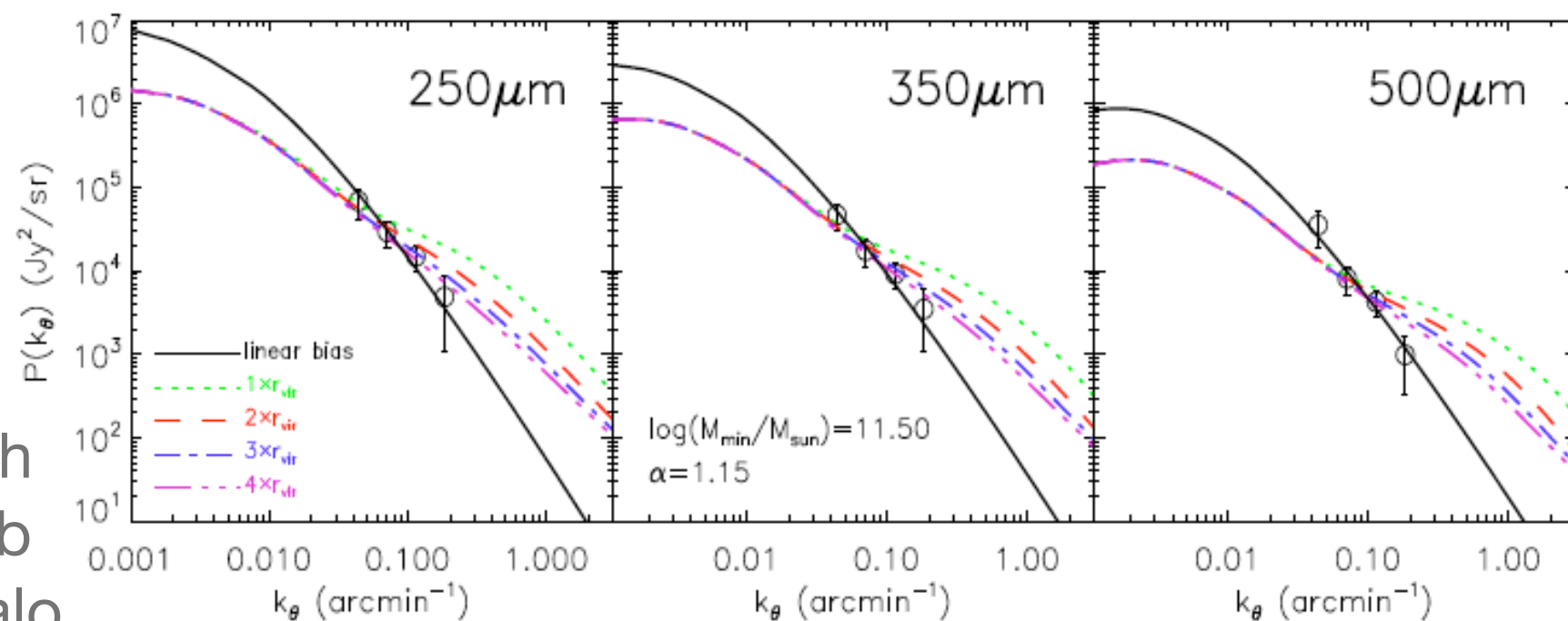
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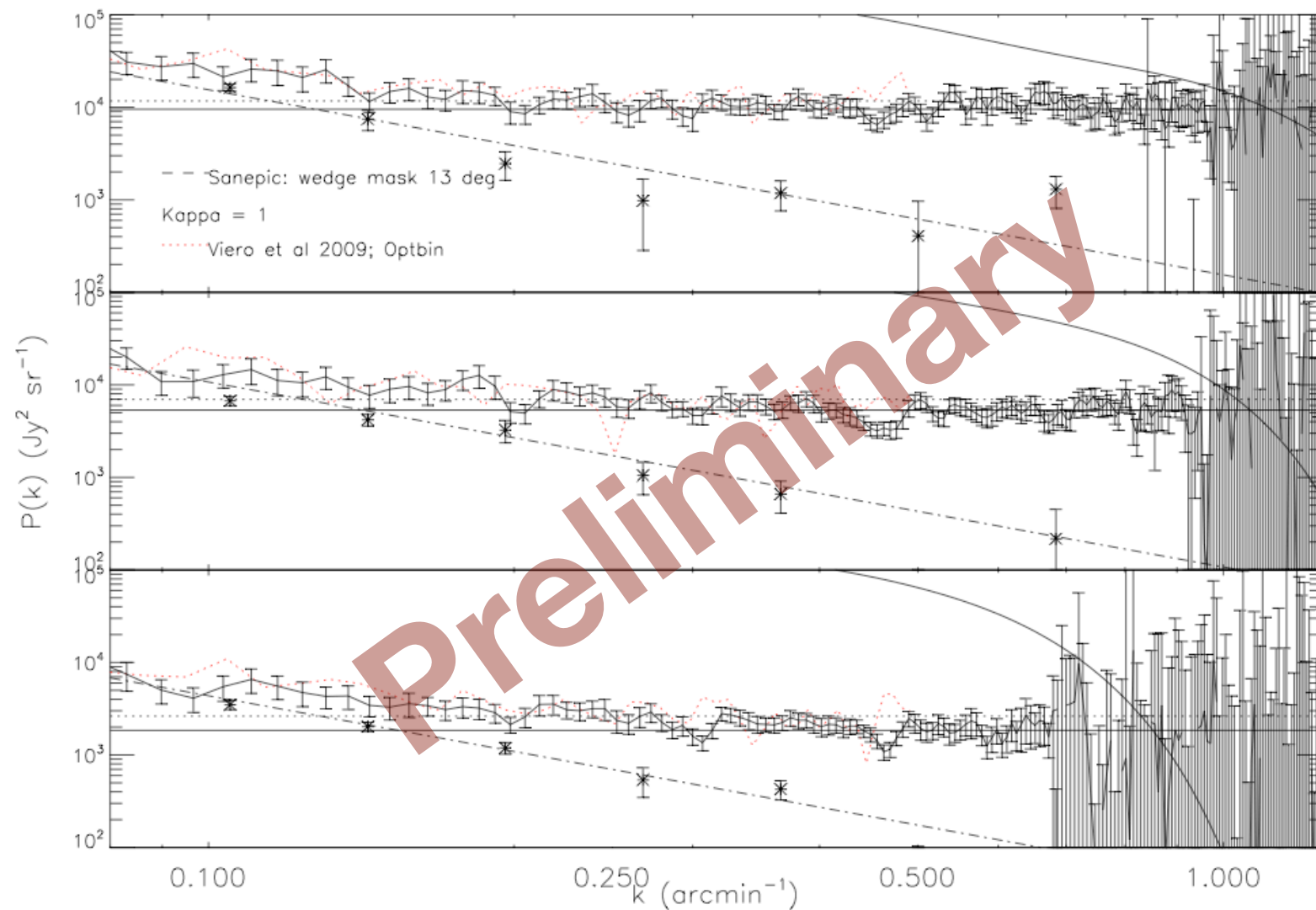
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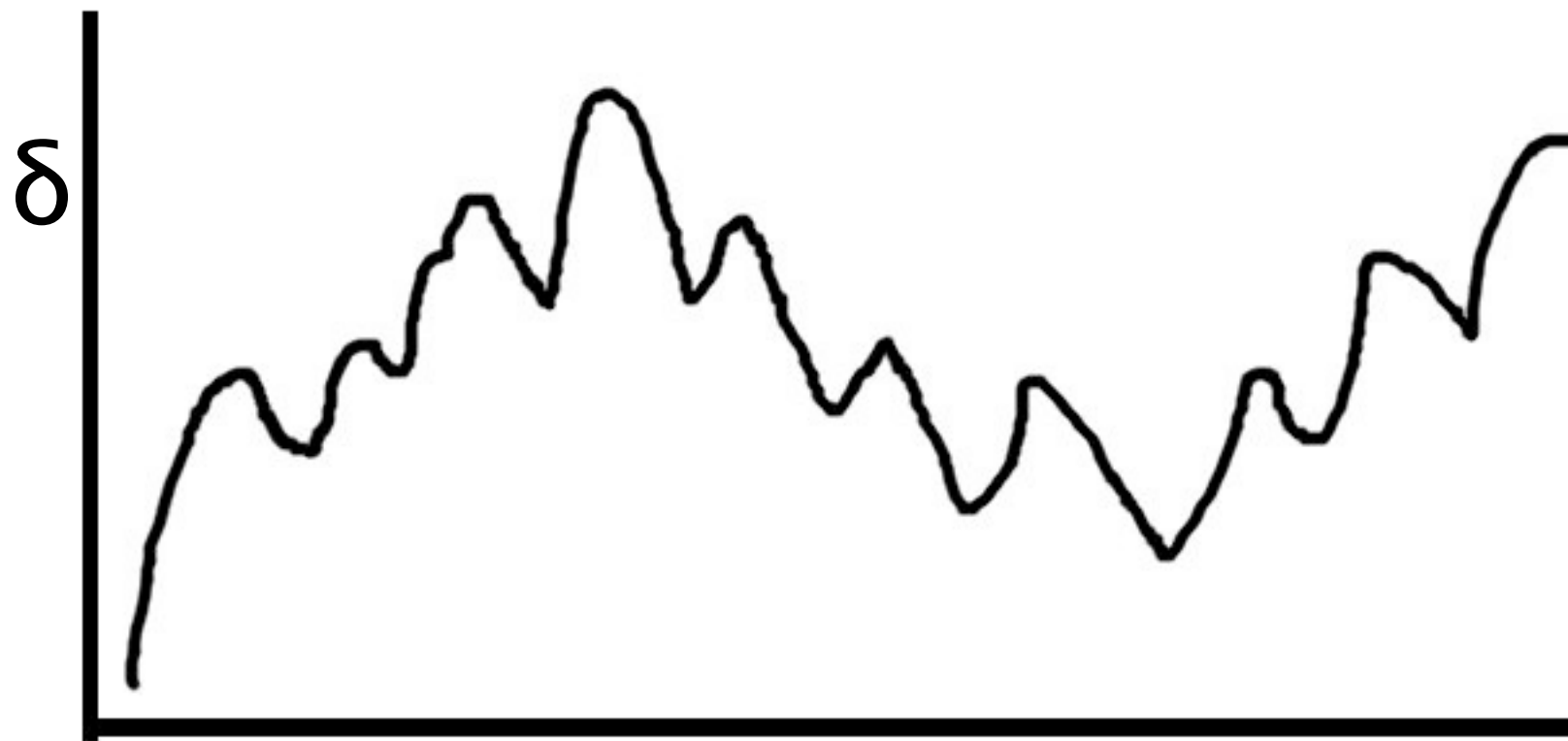
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- Further (ongoing) analysis with twice the data confirm this behaviour on small scales



Briefly: Halo-Model

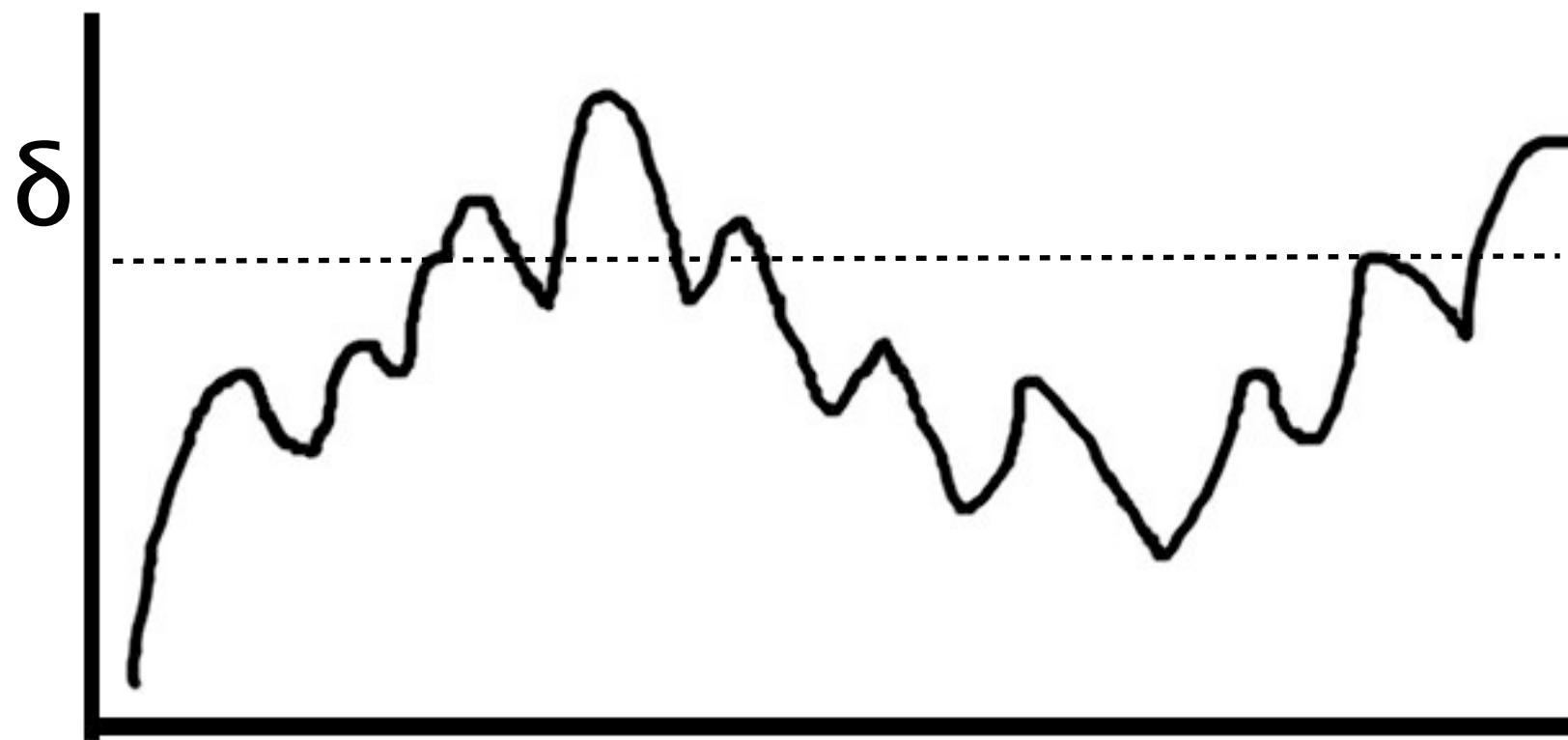
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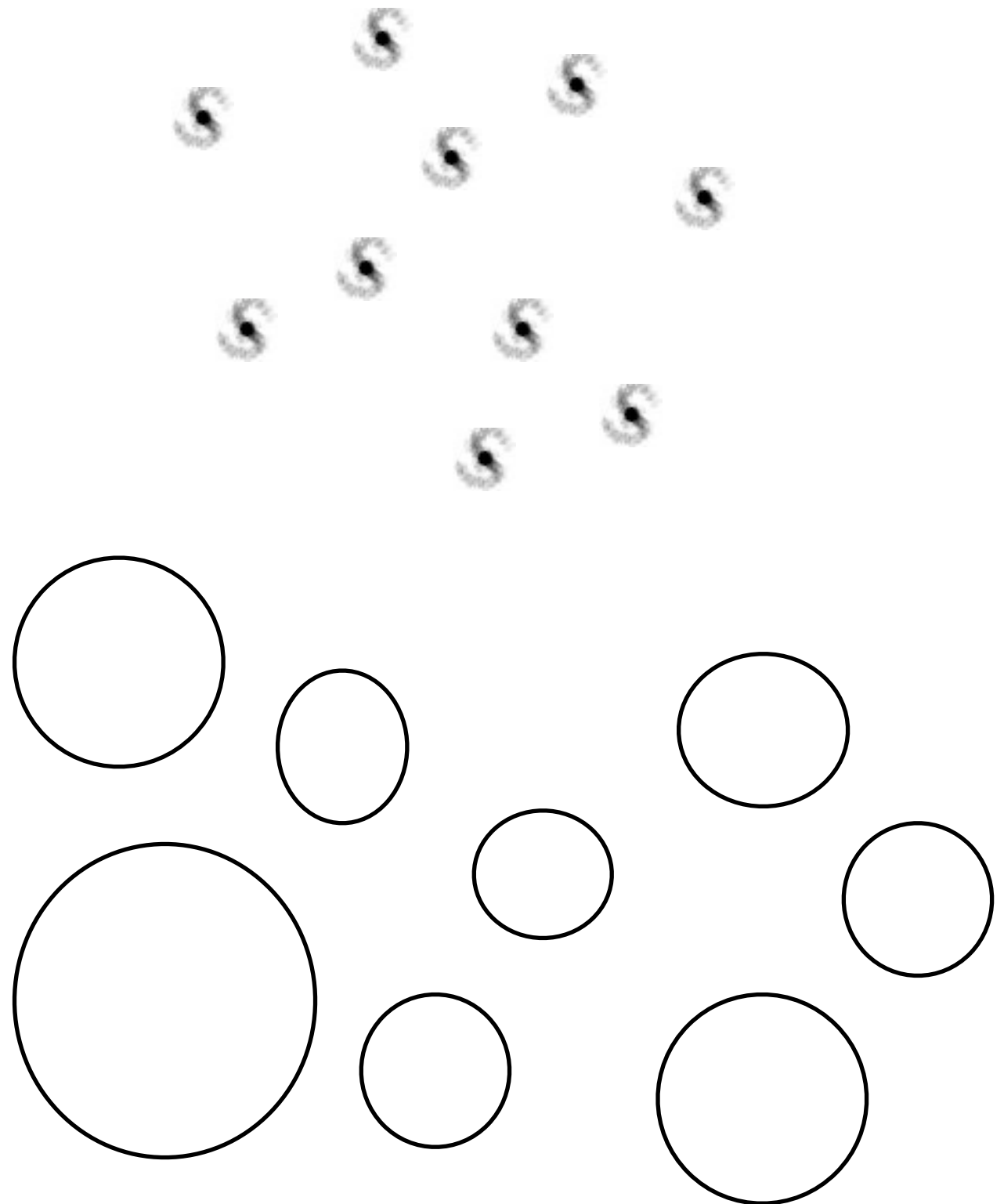
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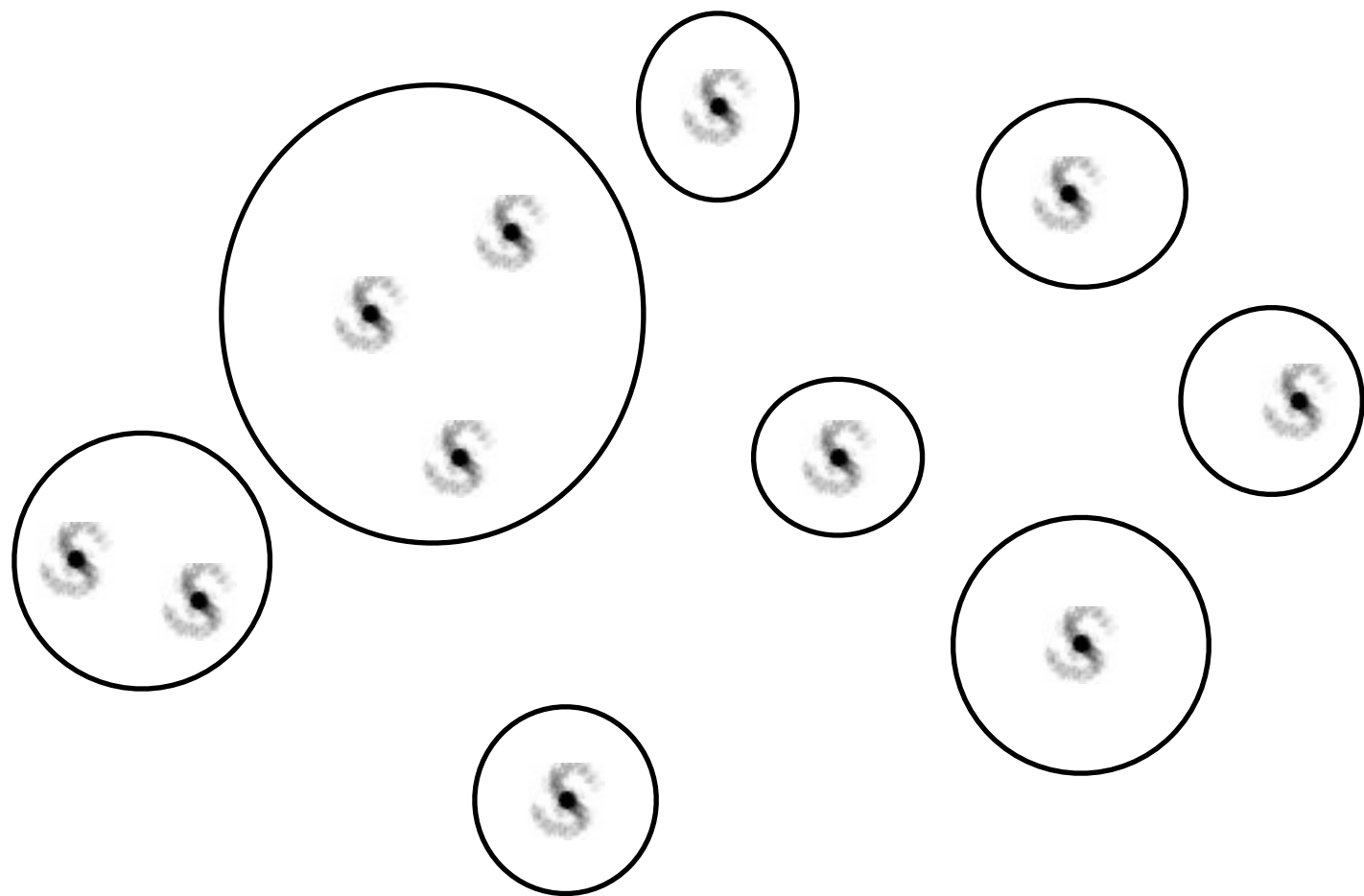
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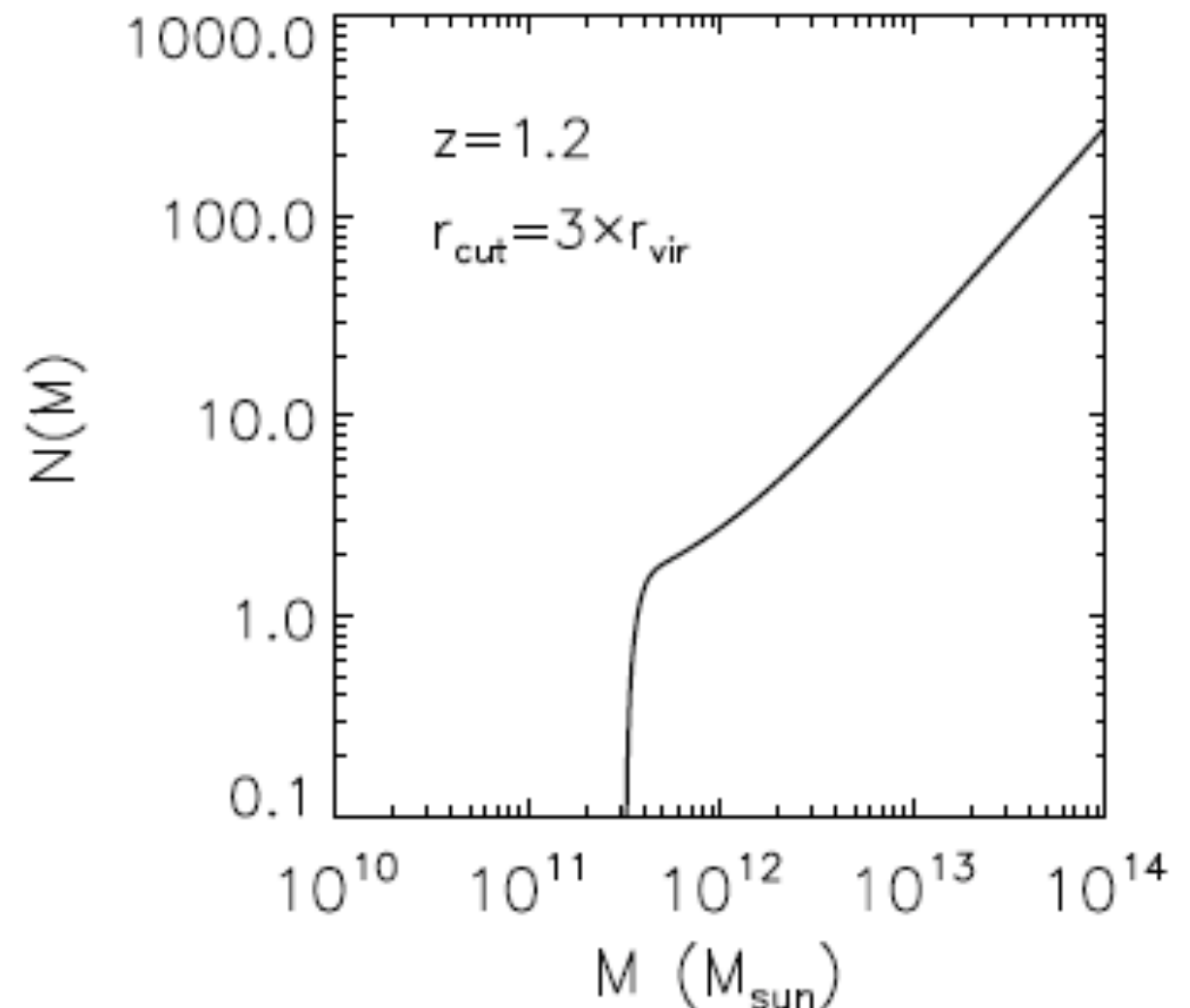
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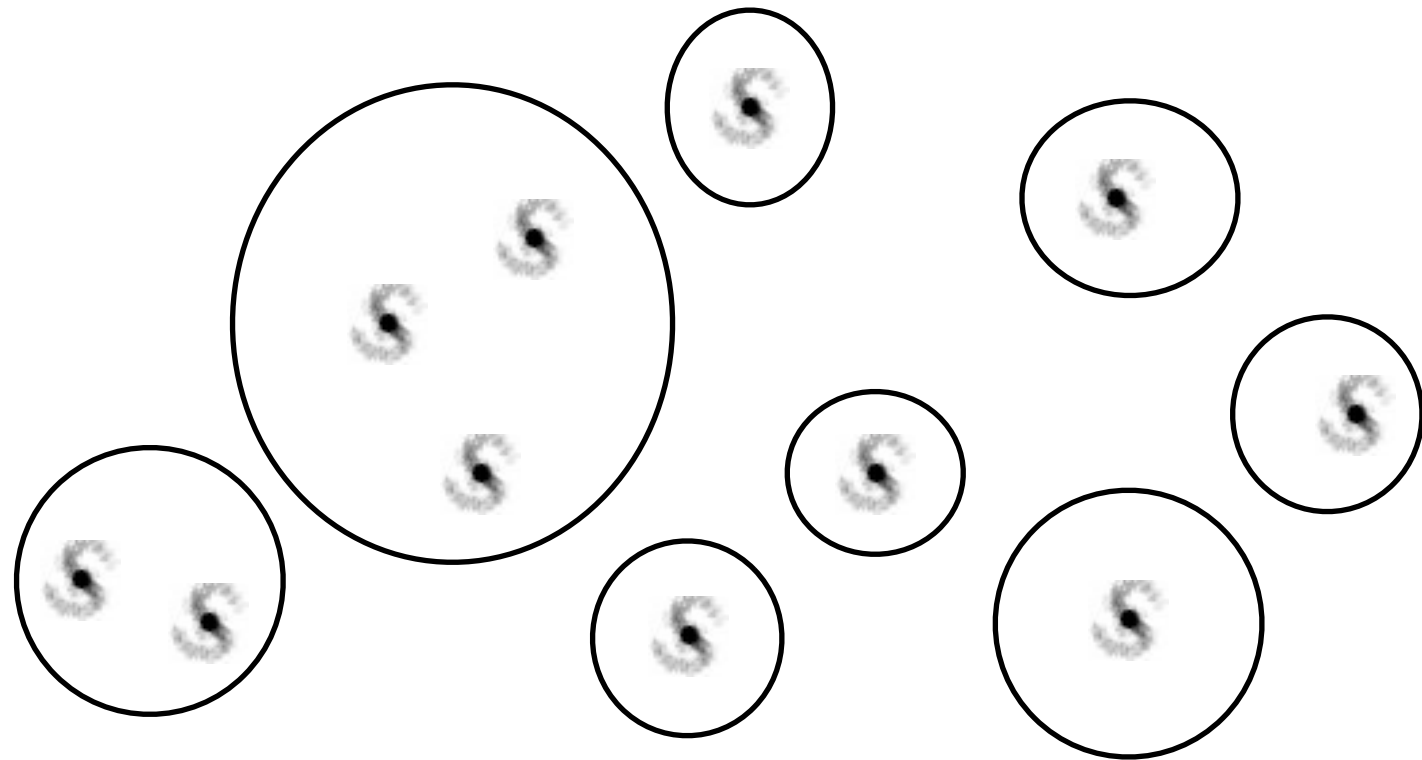
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- Prescription for assigning Galaxies to Halos as Function of Mass (aka HON):
 - ◉ $N = (M/M_1)^\alpha$



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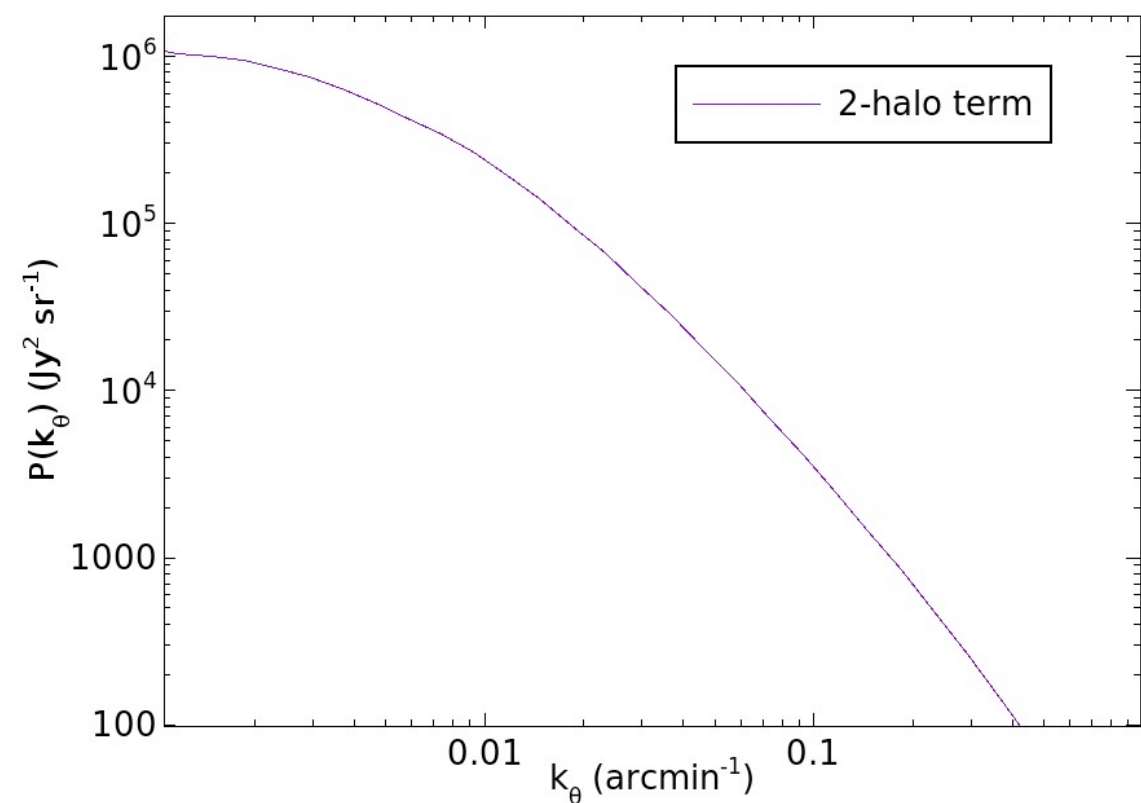
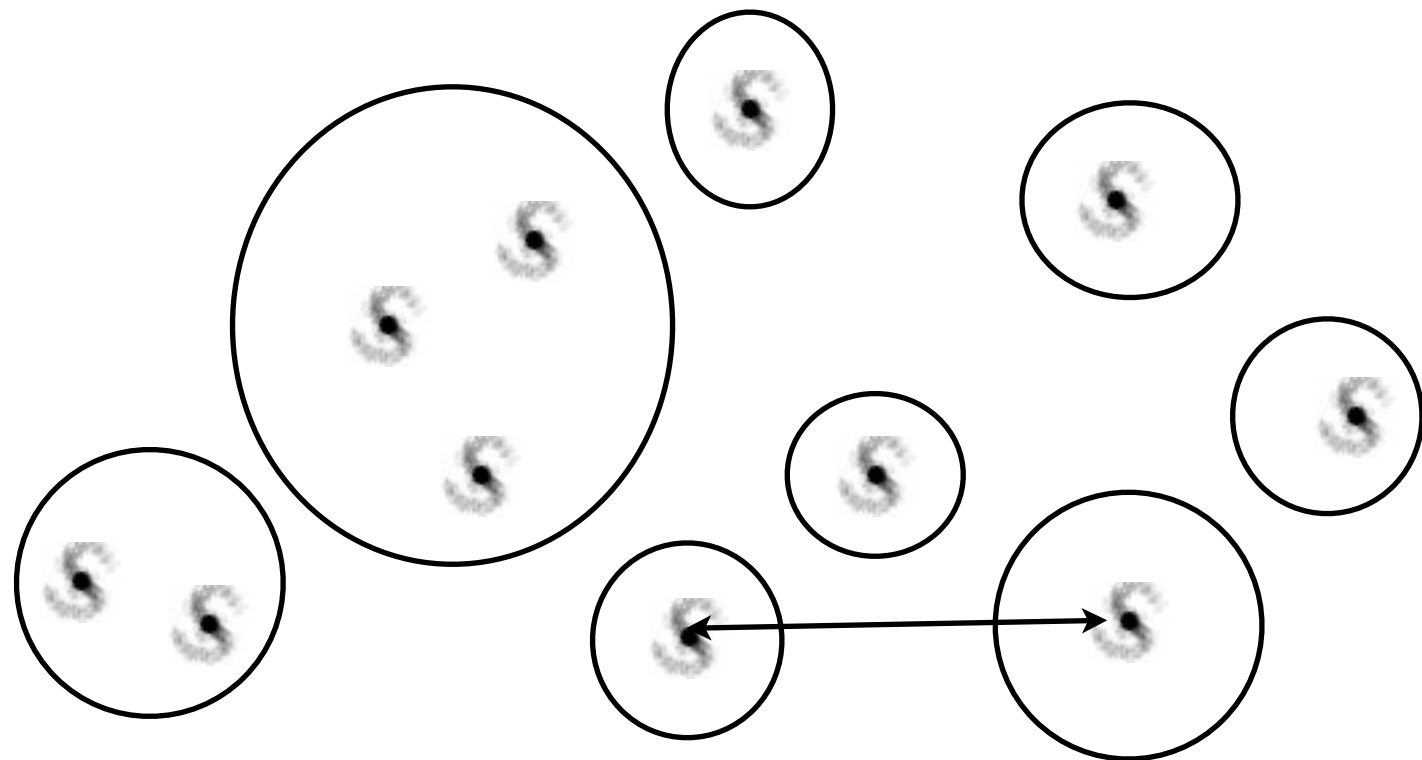
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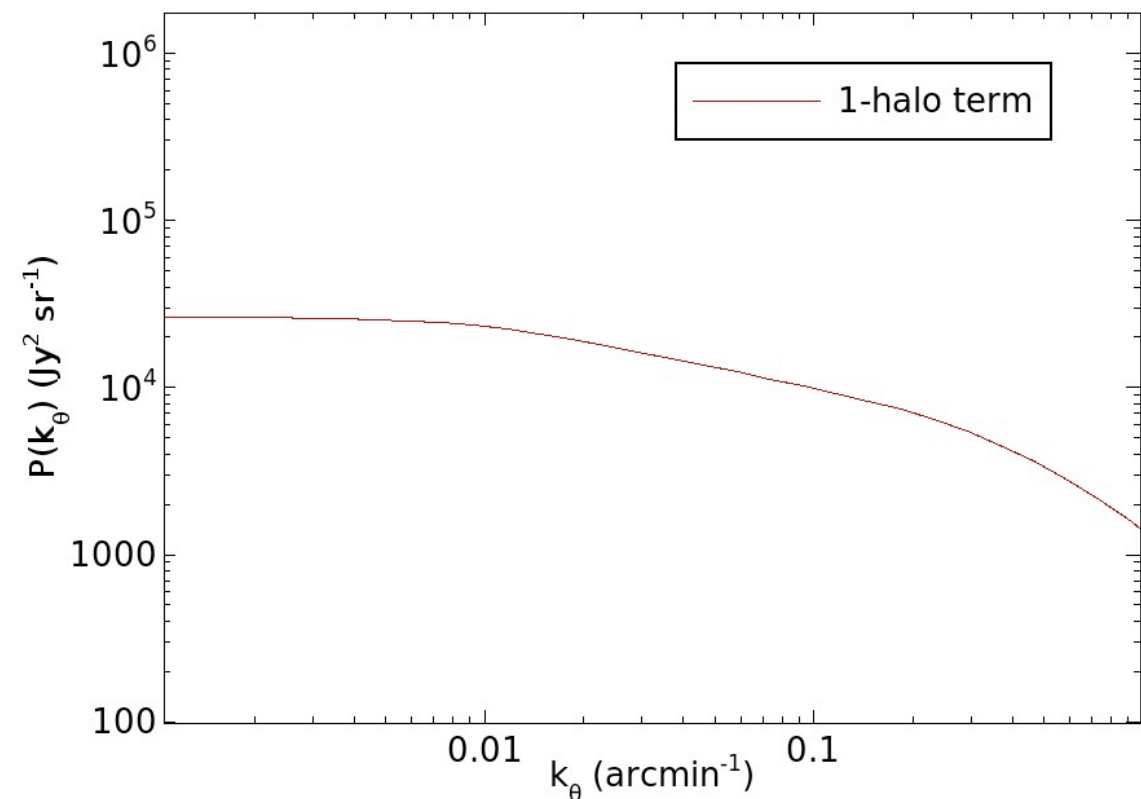
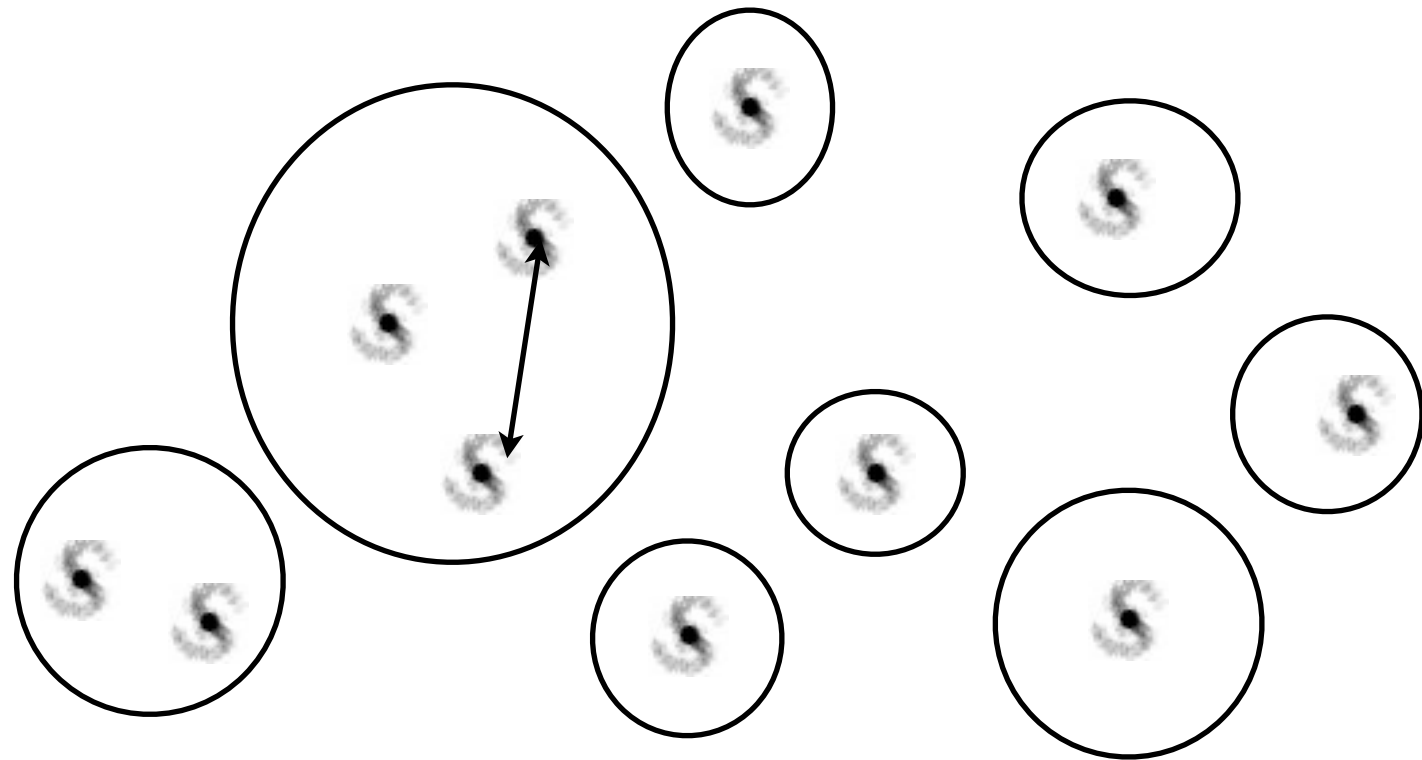
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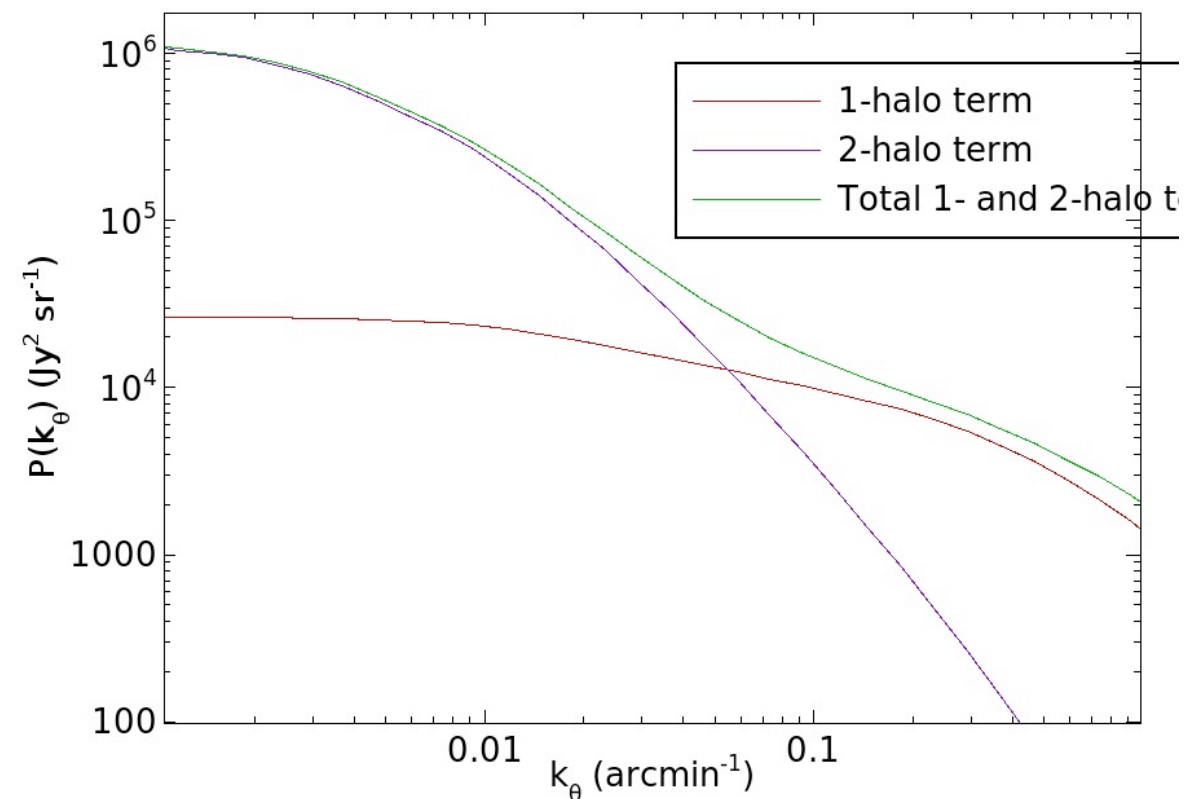
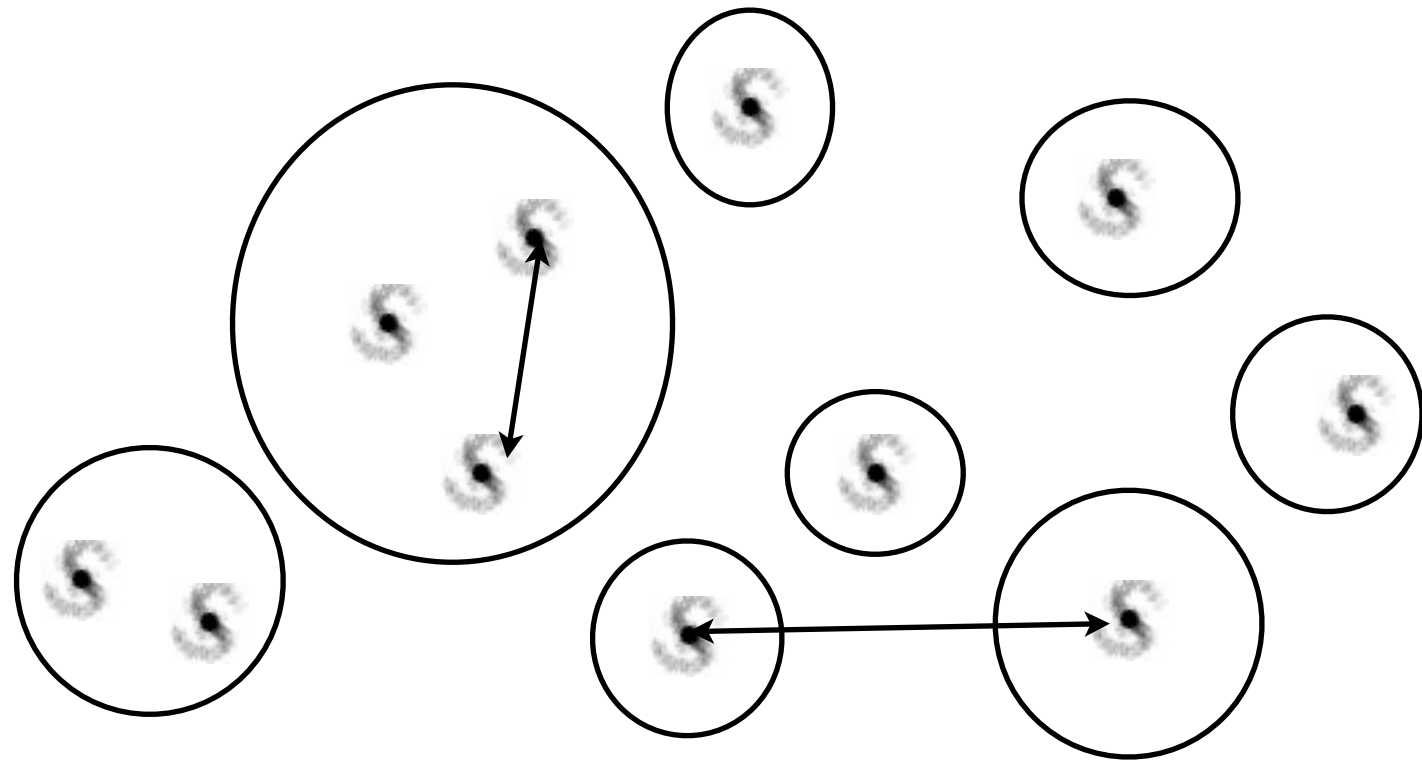
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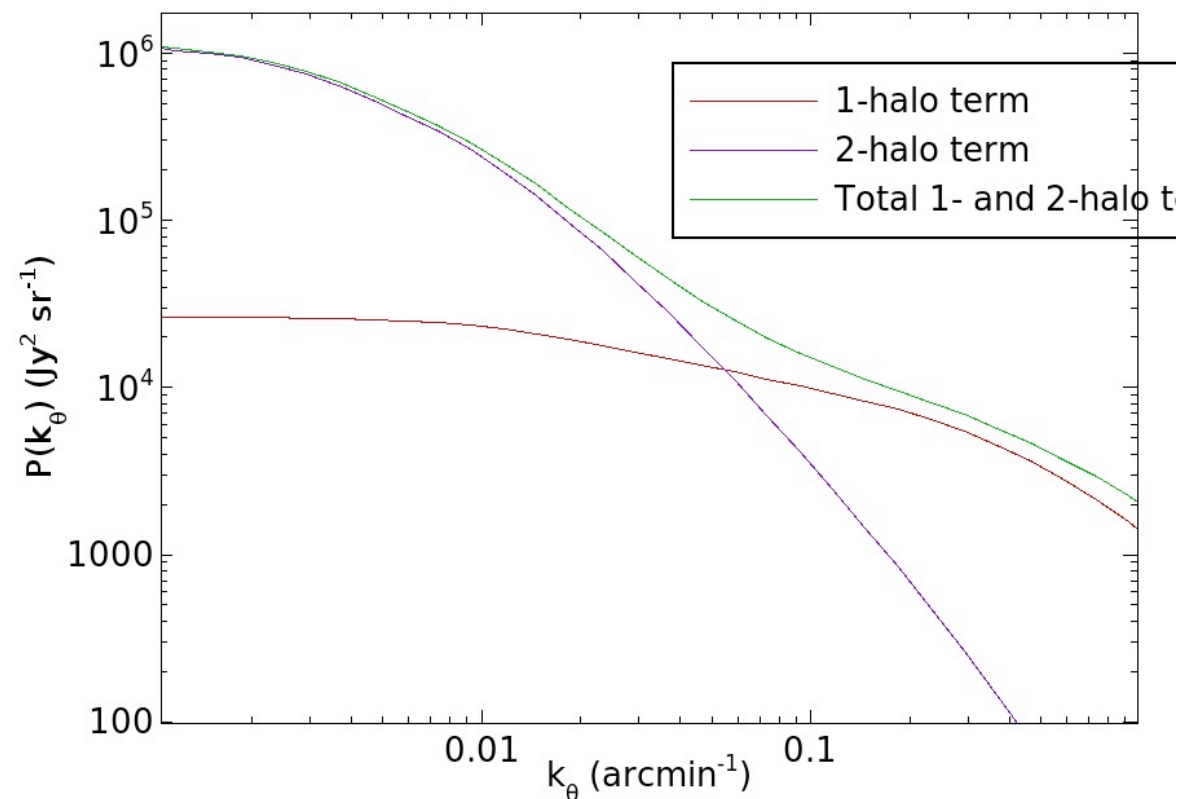
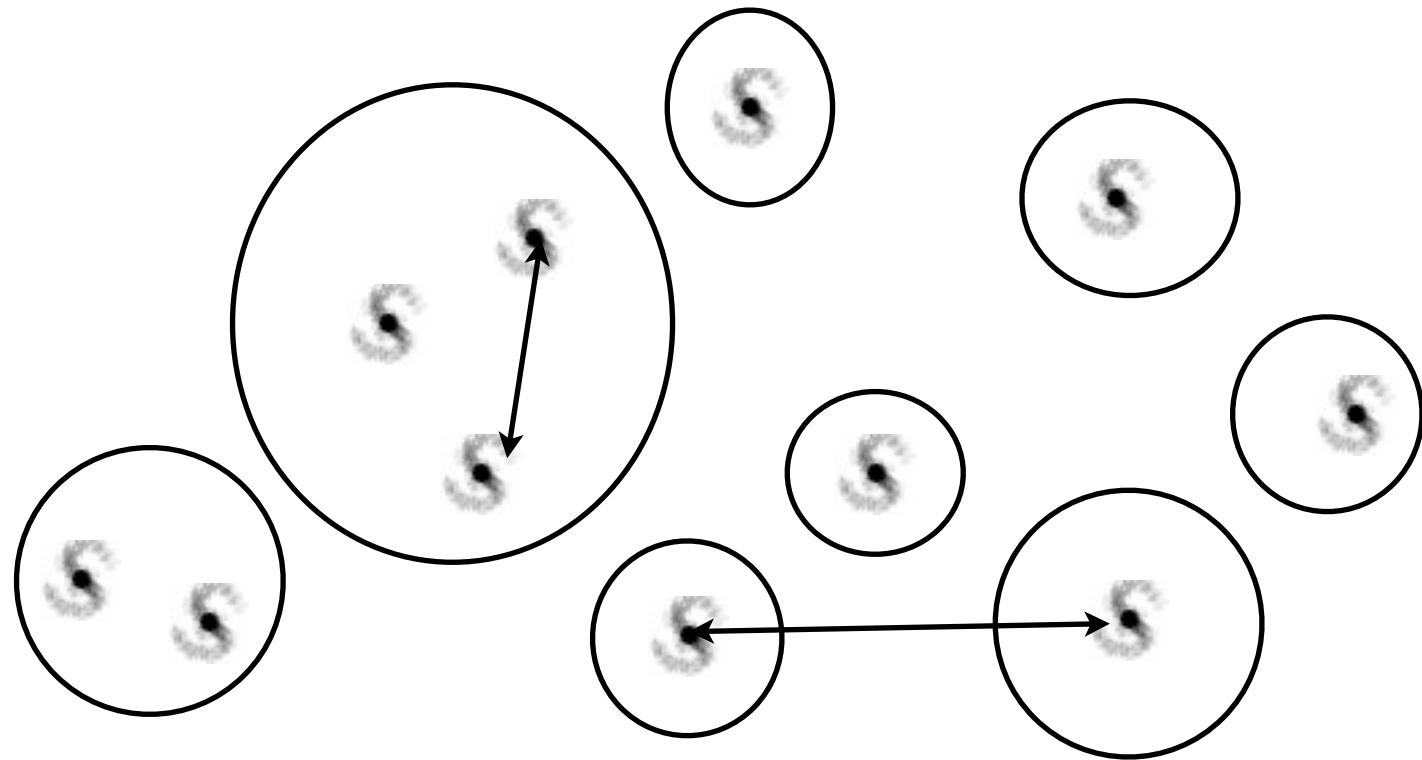
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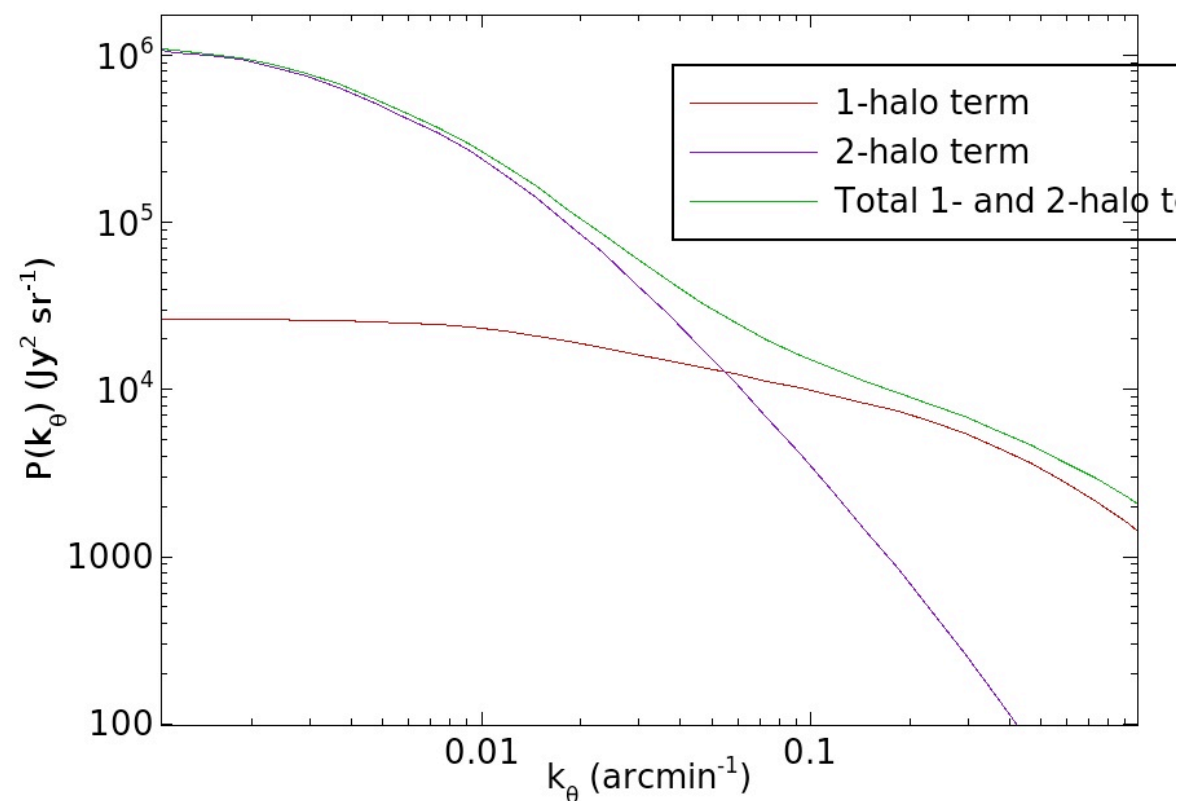
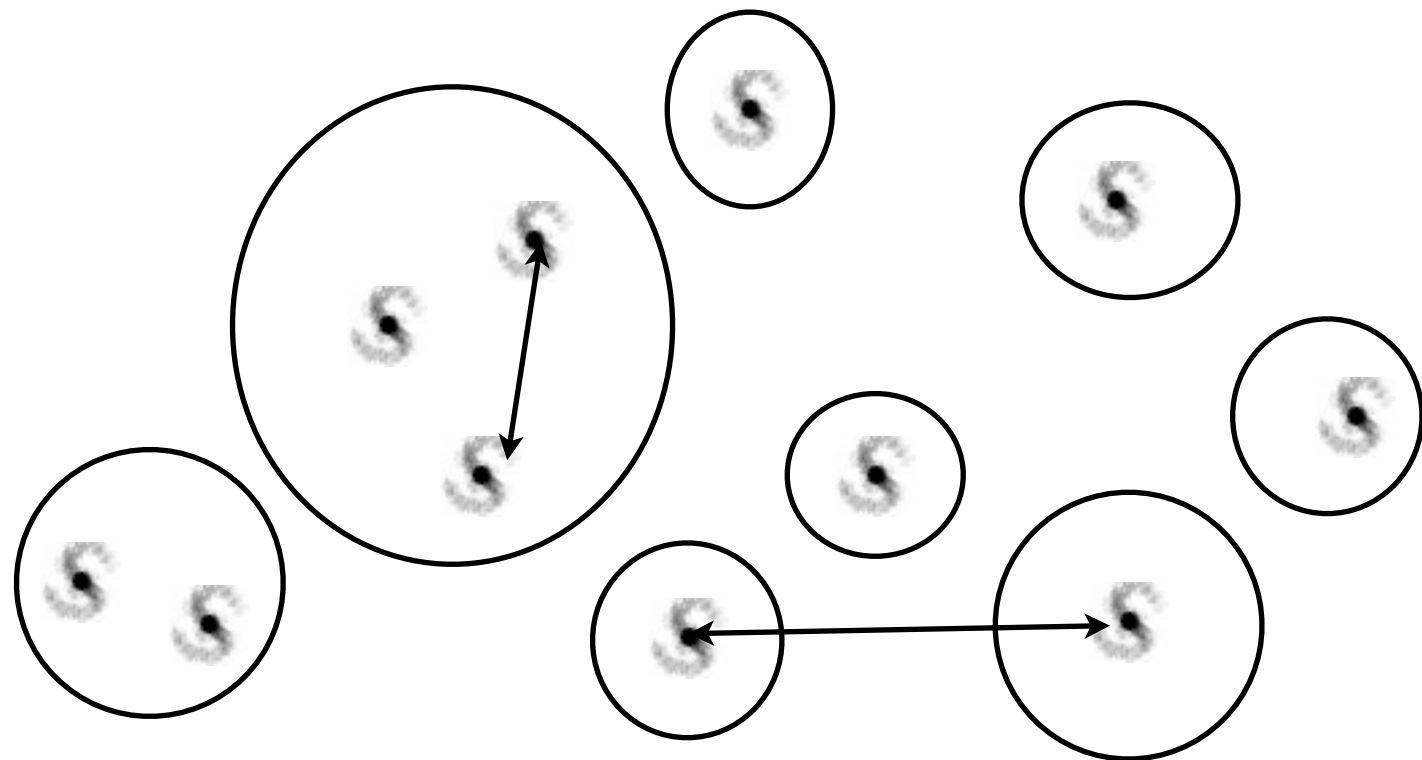
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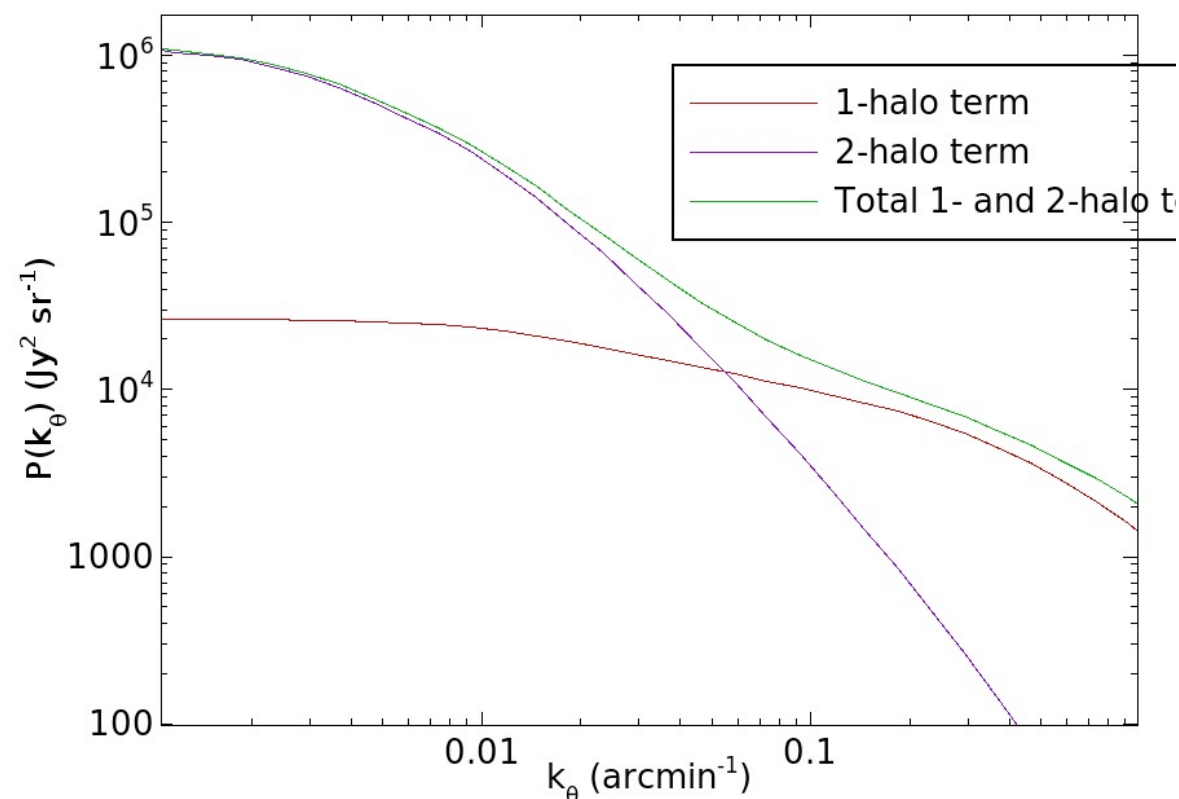
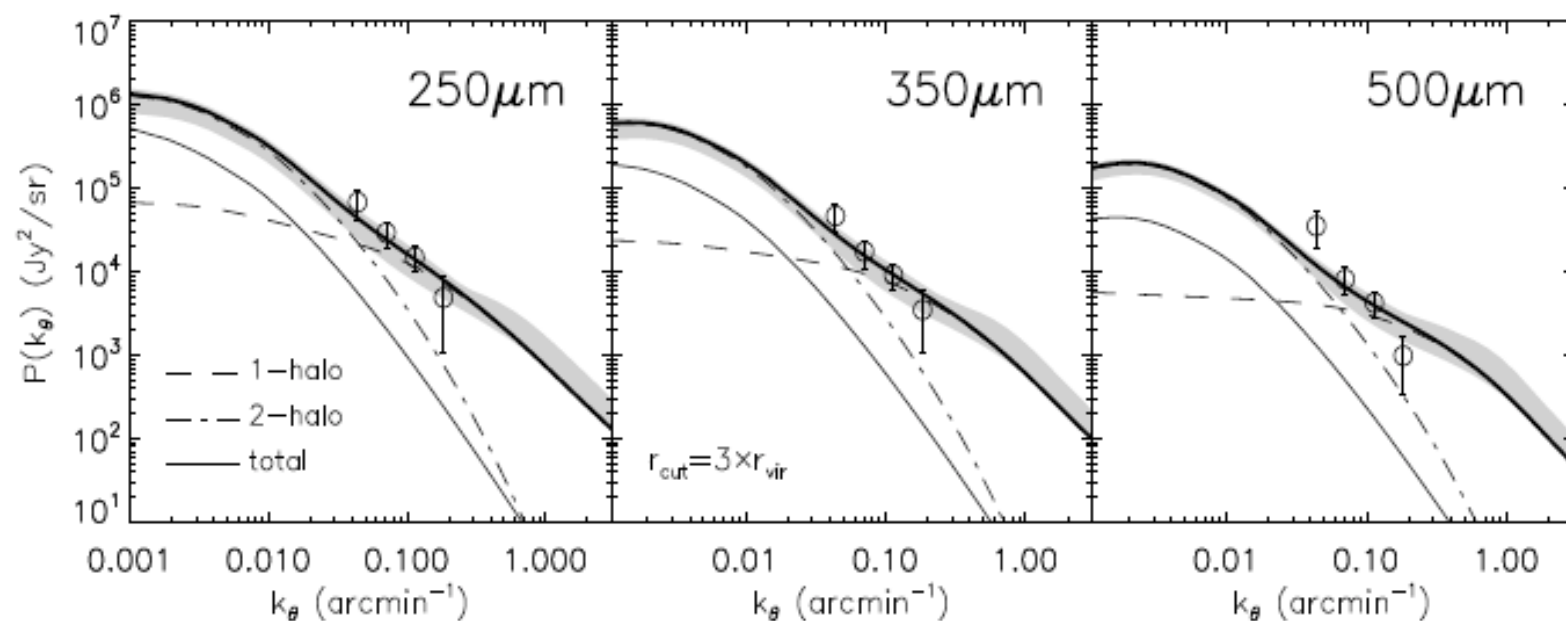
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- Model *Must* have a Bump!



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Change the Halos



How to Change Model to Fit Data?

Change the Halos

Change How Galaxies Trace Halos

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- Model Halos are Spherical, whereas simulations show they are fact tri-axial

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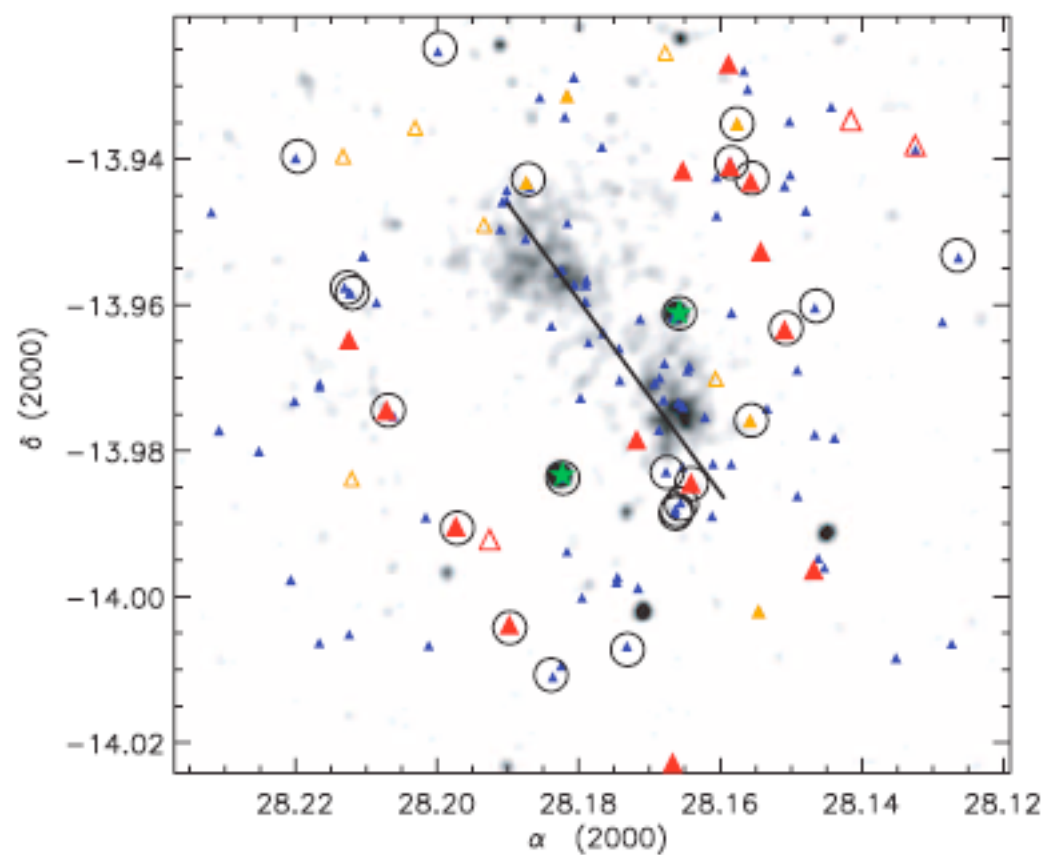
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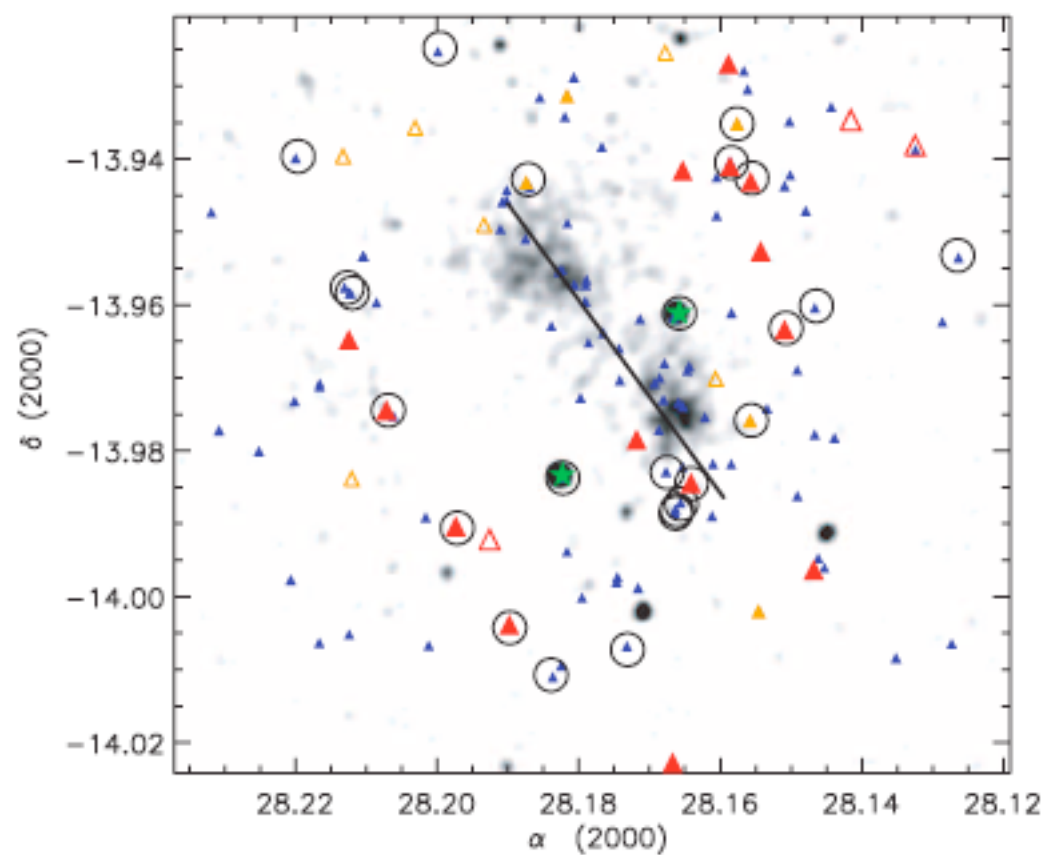


Marcillac et al. 2007

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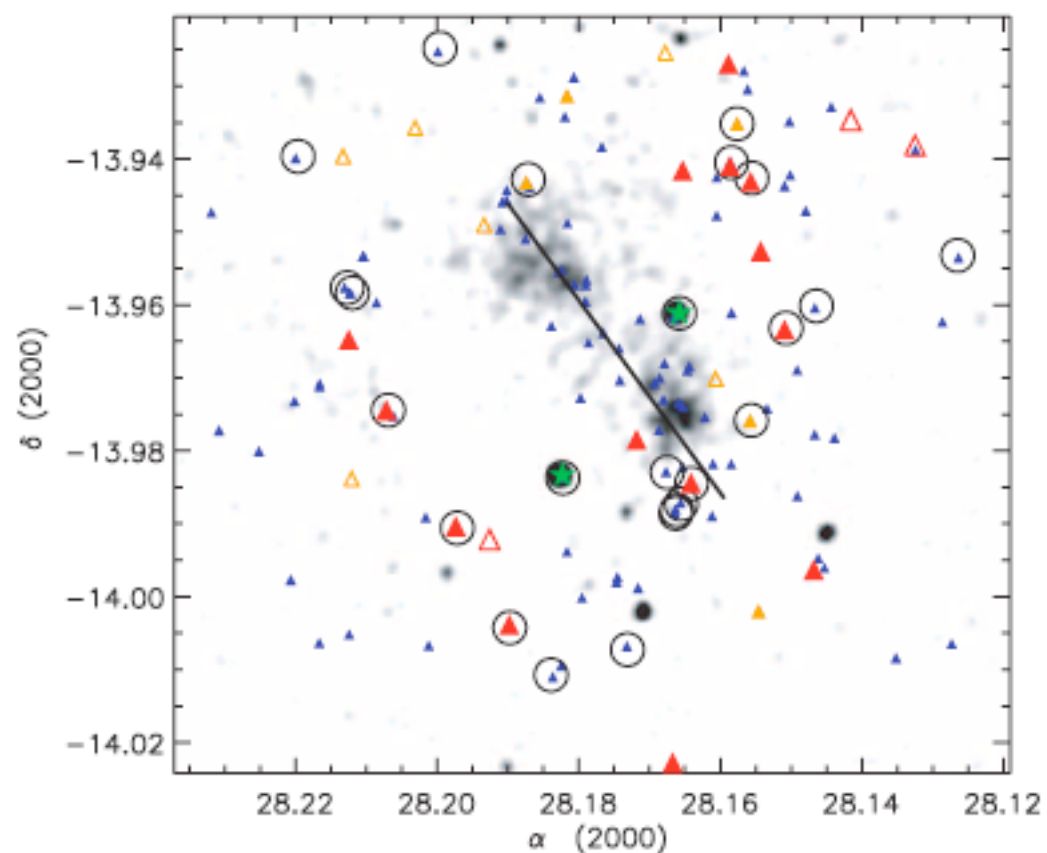


Marcillac et al. 2007

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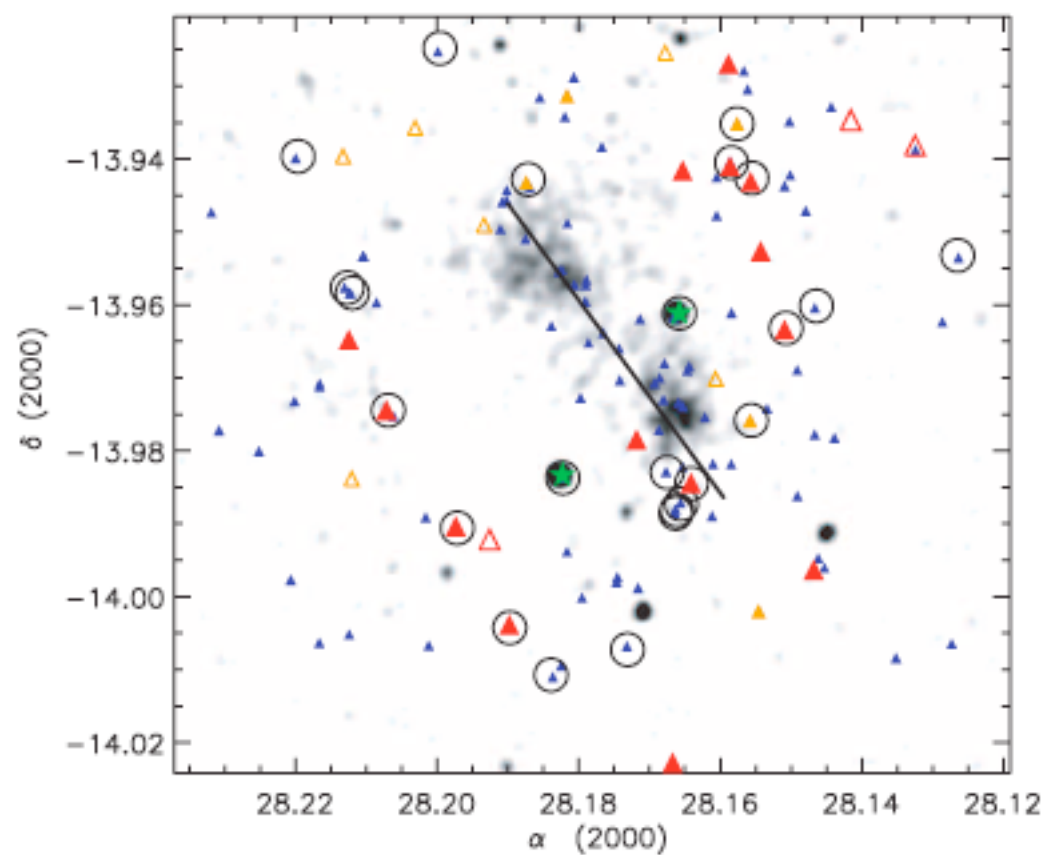


Marcillac et al. 2007

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 - It may be that the *environment* influences **where** Star Formation takes place!



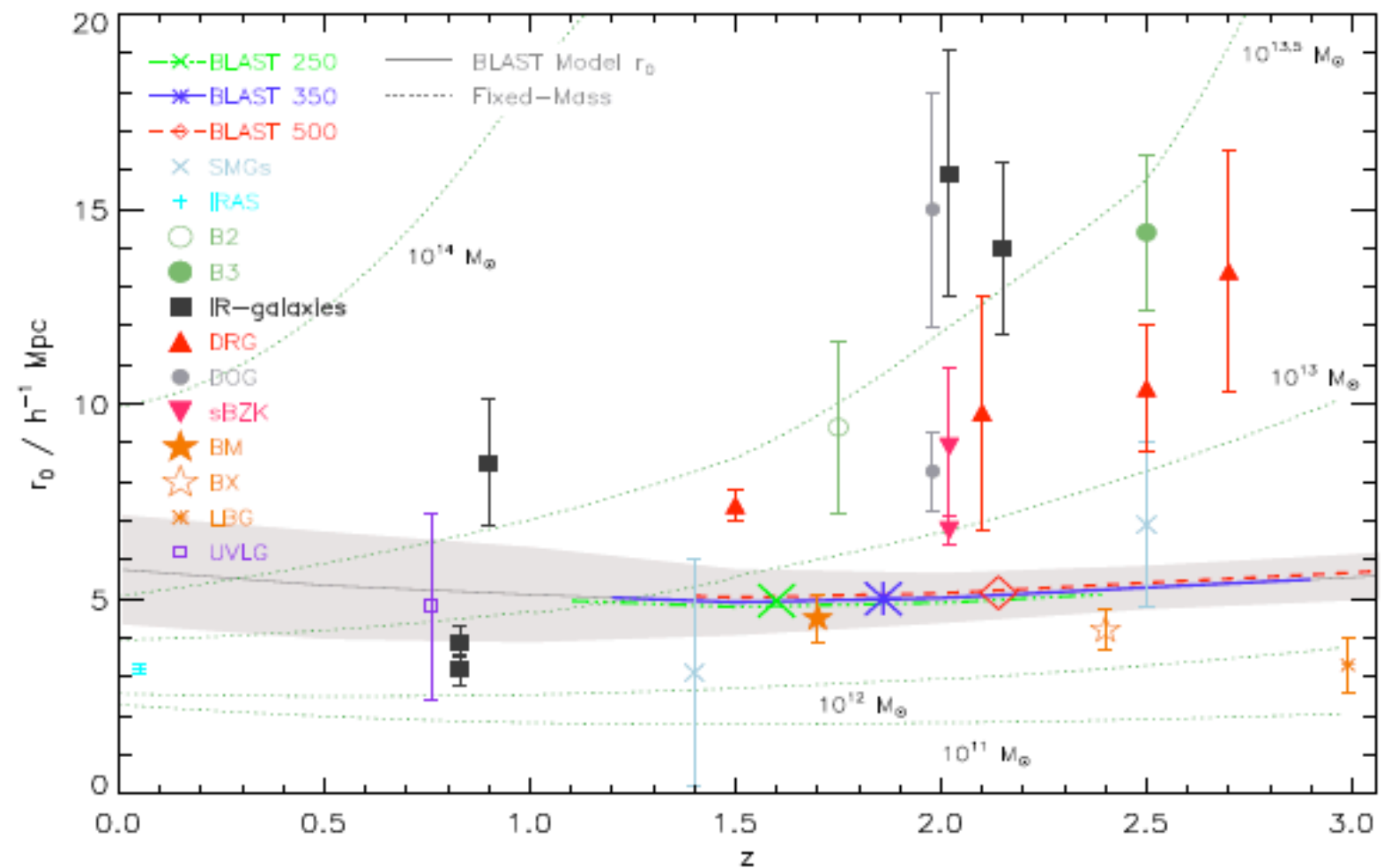
Marcillac et al. 2007

Implications

Clustering in Context

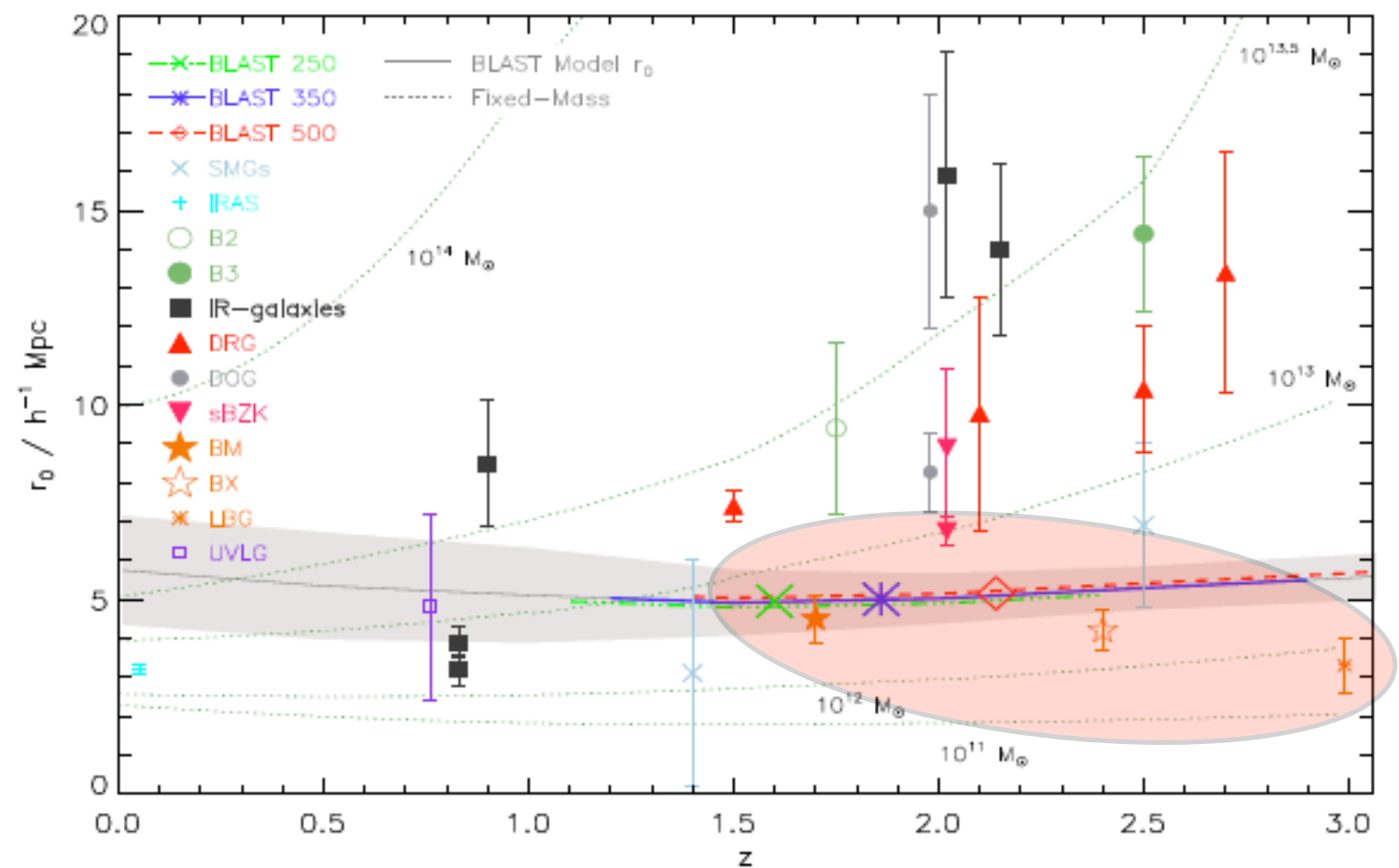
Clustering in Context

• Clustering Properties



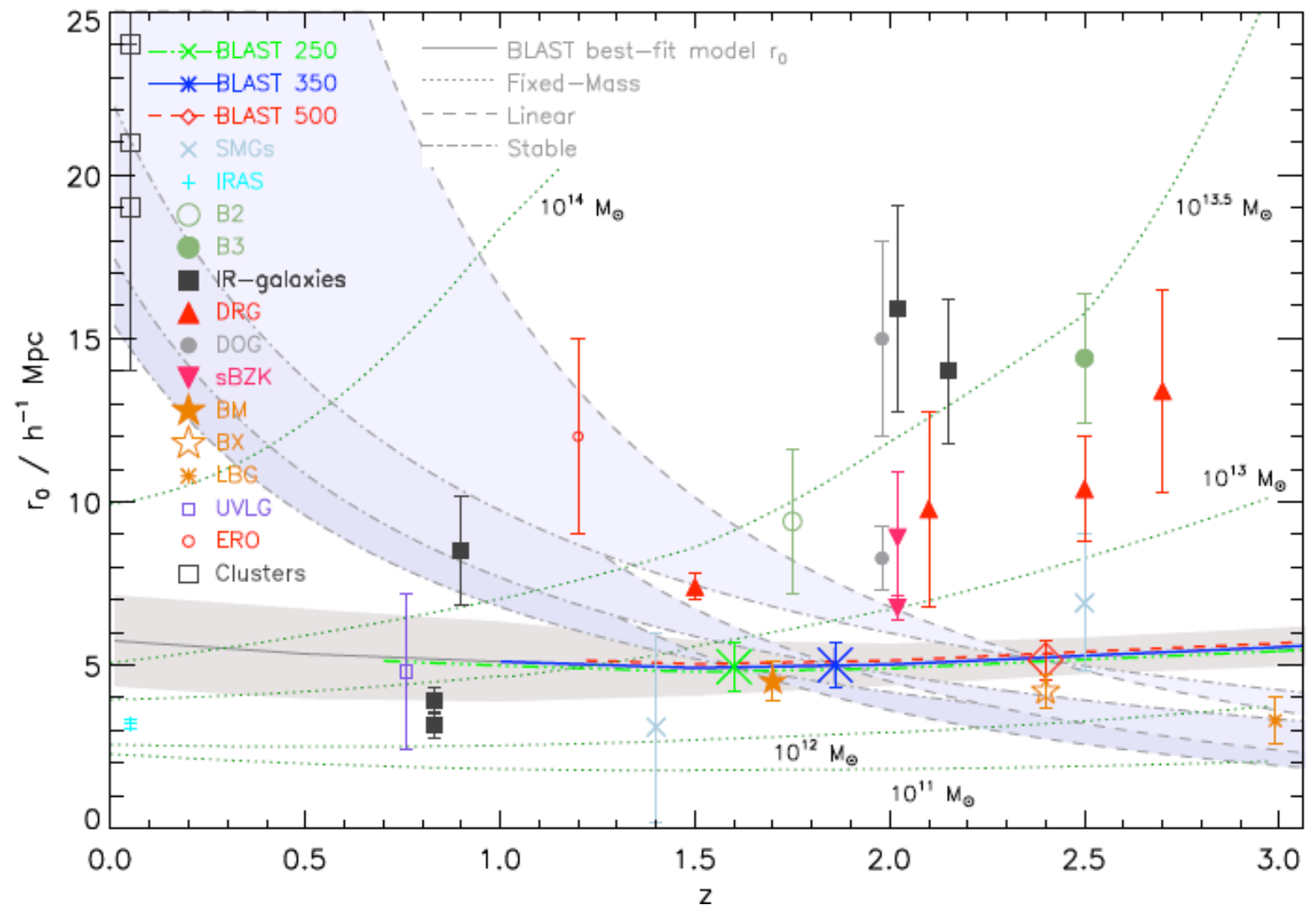
Clustering in Context

- Clustering Properties
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Clustering in Context

- Clustering Properties
 - BLAST, BX/BM and LBGs all seem to have similar clustering properties
- Clustering Evolution
 - $\xi(r,z) = (r/r_0)^{-\gamma}(1+z)^{\gamma-(3+\epsilon)}$
 - Stable Clustering $\epsilon = 0$,
 - Linear Clustering $\epsilon = 1$



Implications



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- Power spectrum a natural way to approach clustering measurements with all these large-beam experiments



TAKE HOME

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- Power Spectrum a natural way to measure galaxy clustering in confused maps

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- Power Spectrum a natural way to measure galaxy clustering in confused maps
- BLAST clustering on small scales may indicate dusty star-forming galaxies do not trace halos in a simple way
 - ◉ Possibly due to environmental effects in large halos, (much like Filiberto sees)

to be continued . . .



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BLAST

Balloon-borne Large-Aperture Sub-millimeter Telescope



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