Gravitational Wave Hotspots:
Determining Probable Locations For Single Source Gravitational Wave Emission

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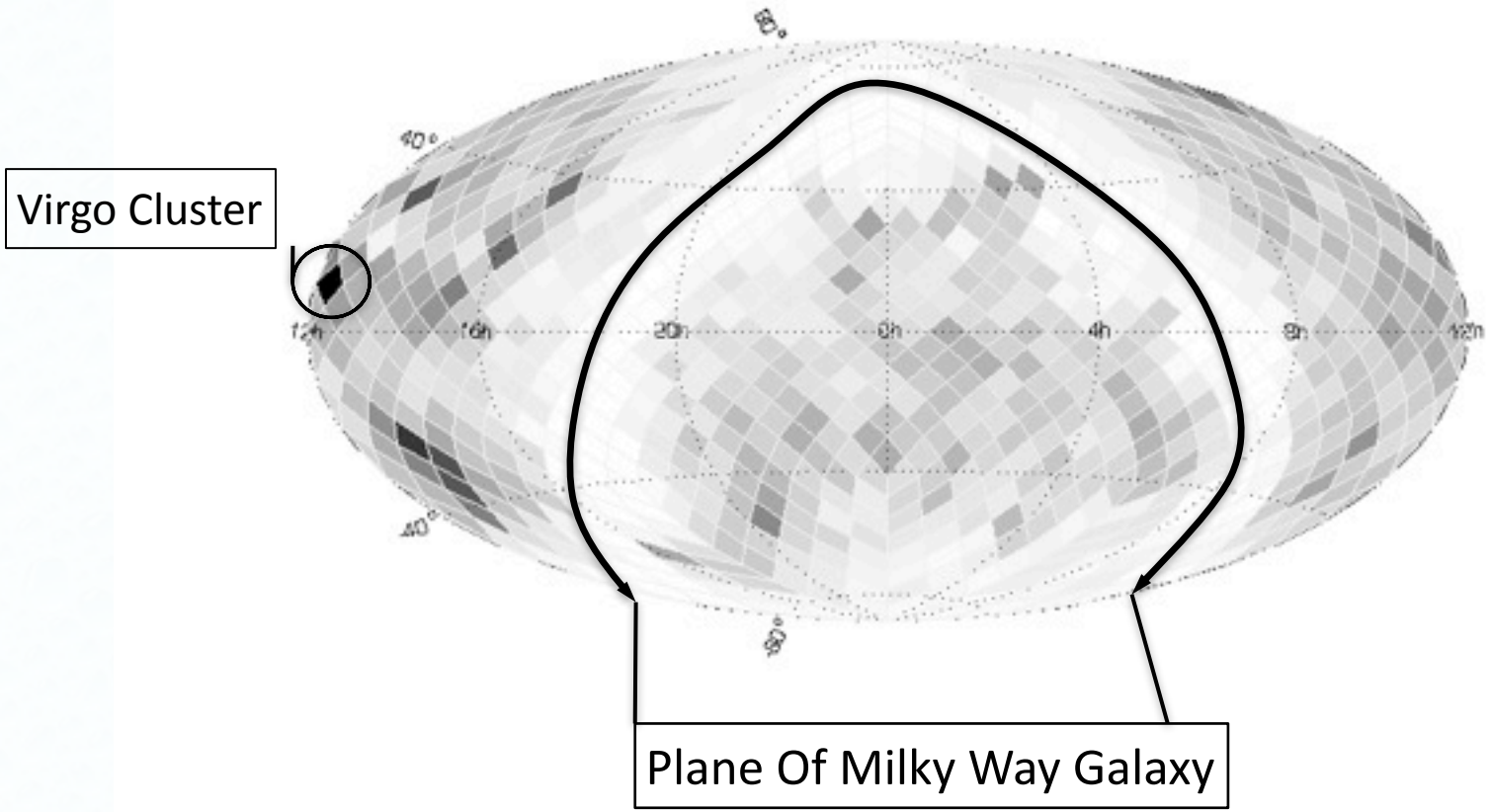
- Compiled ~70,000 extragalactic sources
  - From Tully Extragalactic Distance Database
  - All sources are within ~150 Mpc
  - Luminosity was used as a surrogate for central black hole mass

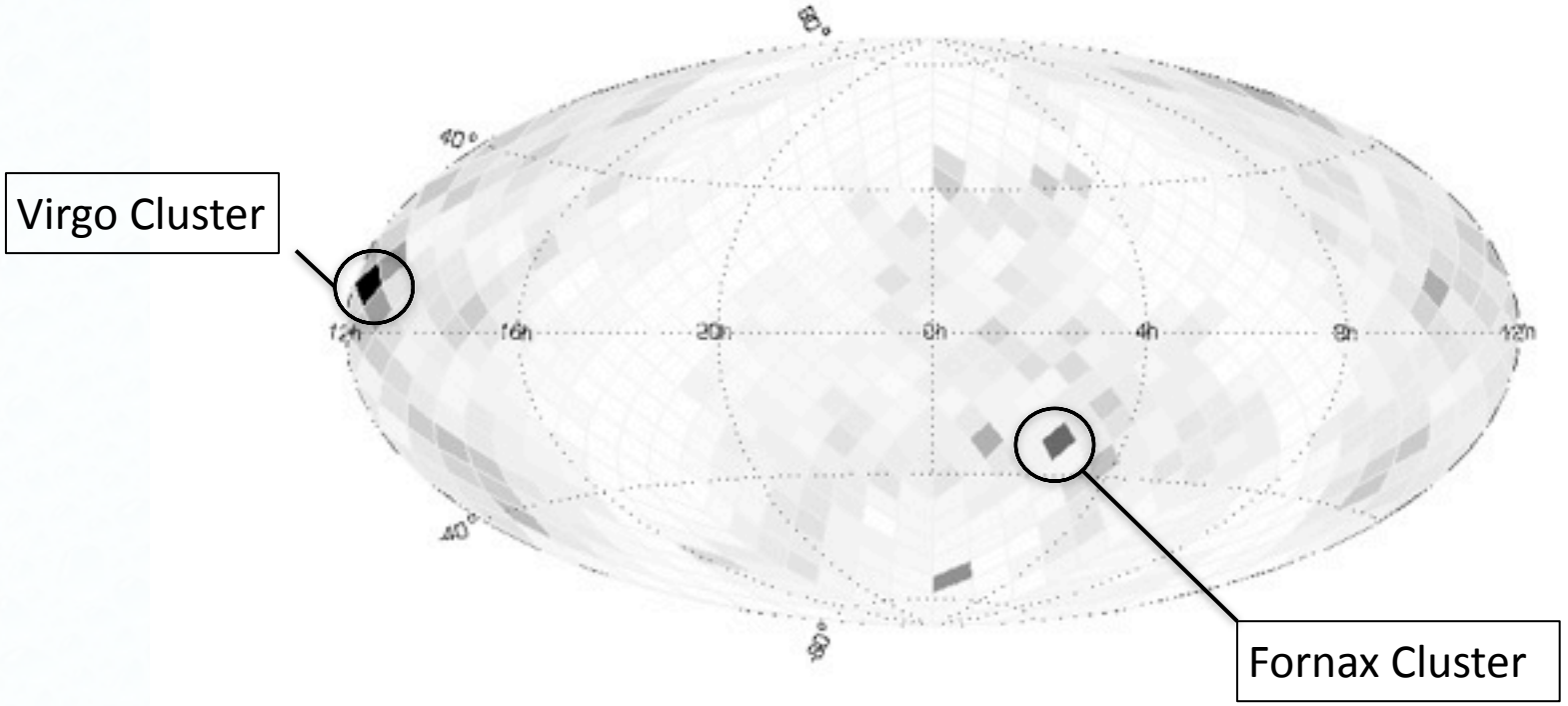
- Basic Assumptions
  - Every galaxy has an equal chance of containing a SMBH binary
  - Binaries are approximately equal-mass
  - Every binary orbit has the same period

Galaxy Distribution
(Number Density)



Galaxy Distribution

[Each Pixel = Σ (distance to source)$^{-1}$]



Integrated GW Power Statistic

$$h \propto \frac{M_C^{5/3}}{d}$$

GW Strain

$$\tau \propto \frac{1}{M_C^{5/3}}$$

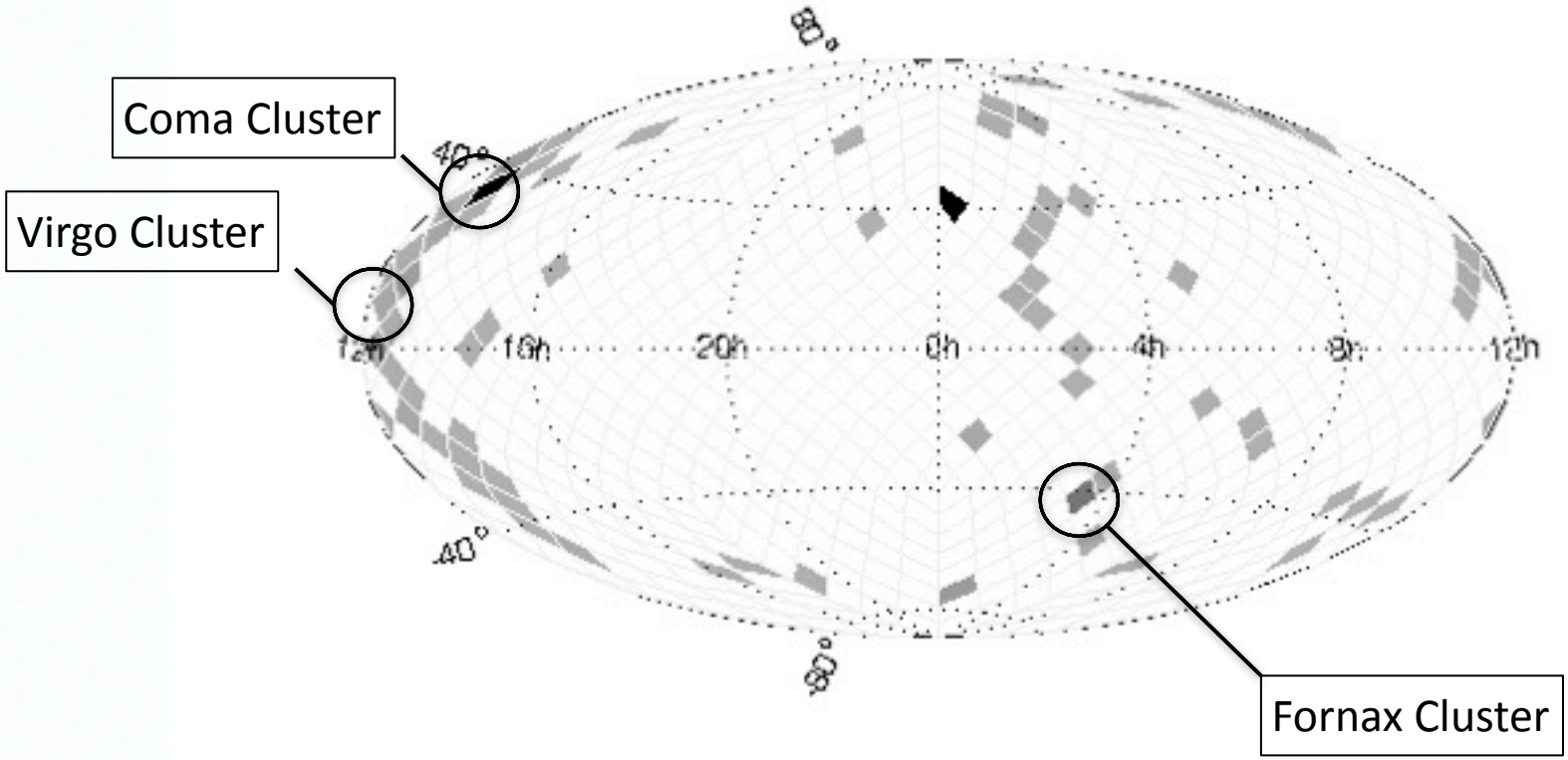
Lifetime Of Source

$$p \propto h^2 \tau \propto \frac{M_C^{5/3}}{d^2}$$

Integrated GW Power

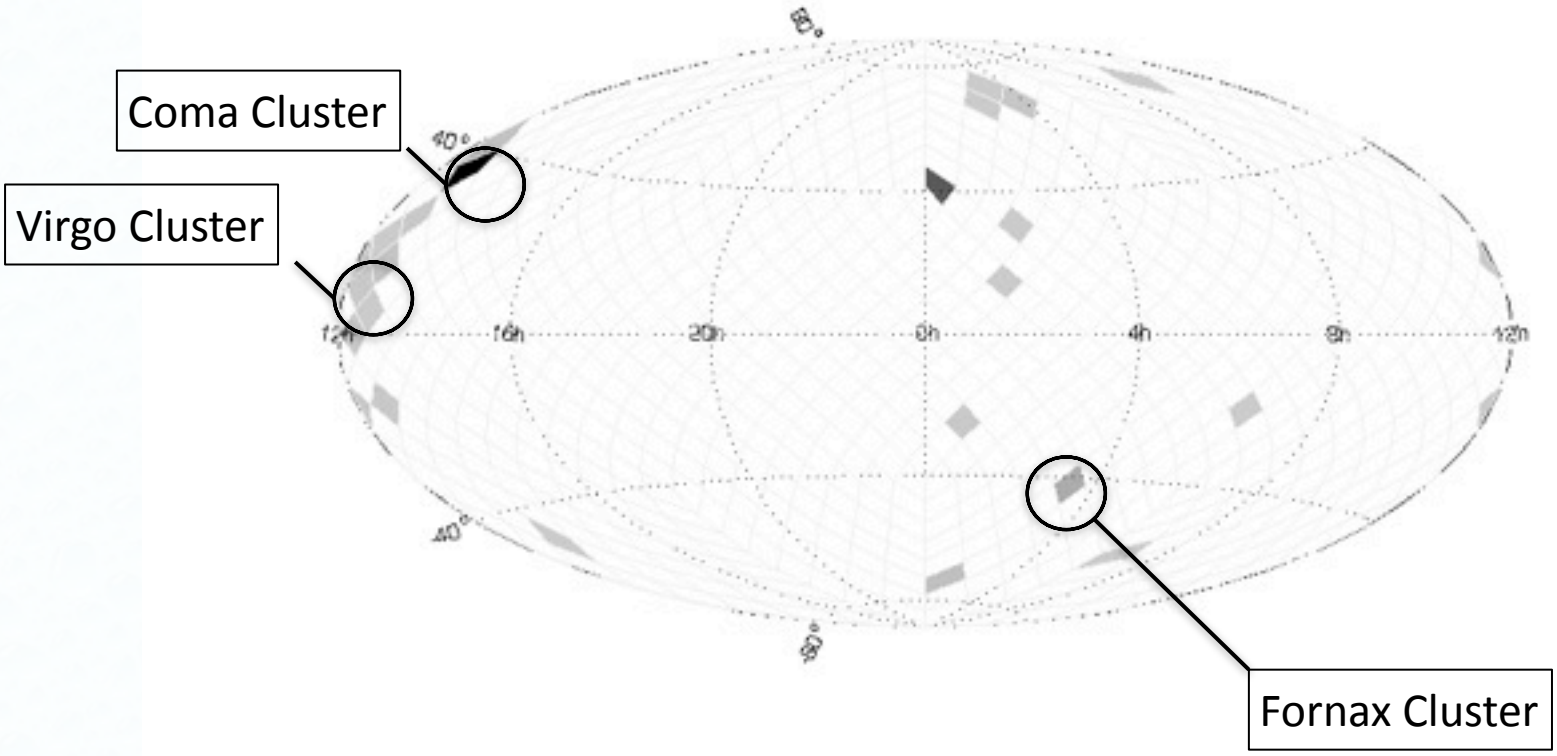
Galaxy Distribution

[Each Pixel = Σ ($\tau_1 + \tau_2 + \ldots$)]



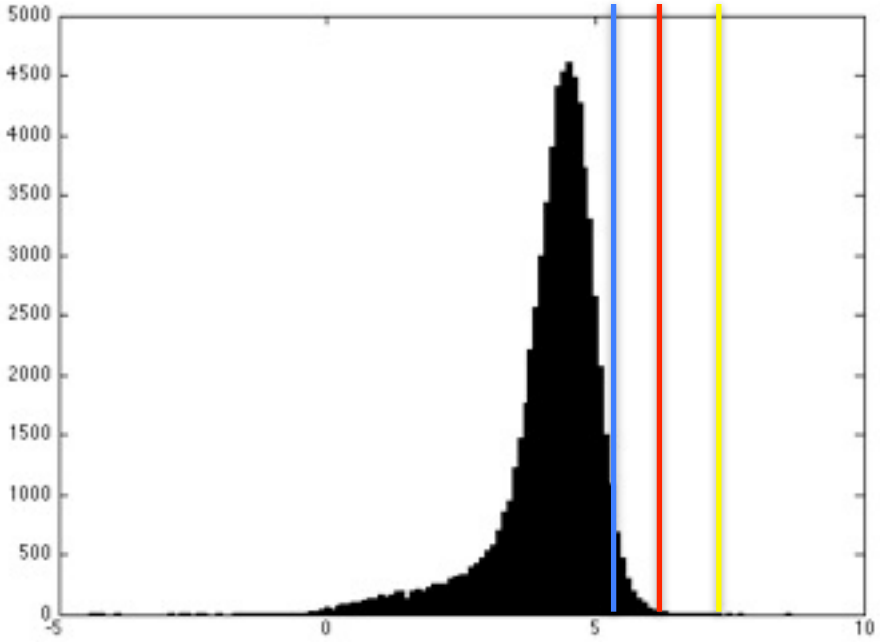
Integrated GW Power

$$\int_{Observation} P_{pixel} = \sum (p_1 + p_2 + \ldots)$$

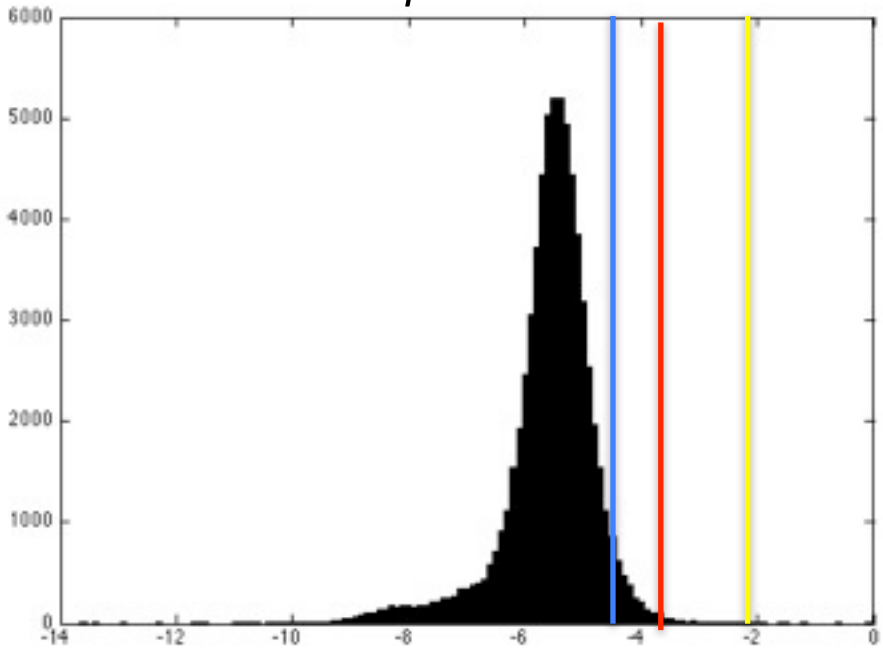


Histograms Of Galactic Statistics

h Statistic



p Statistic



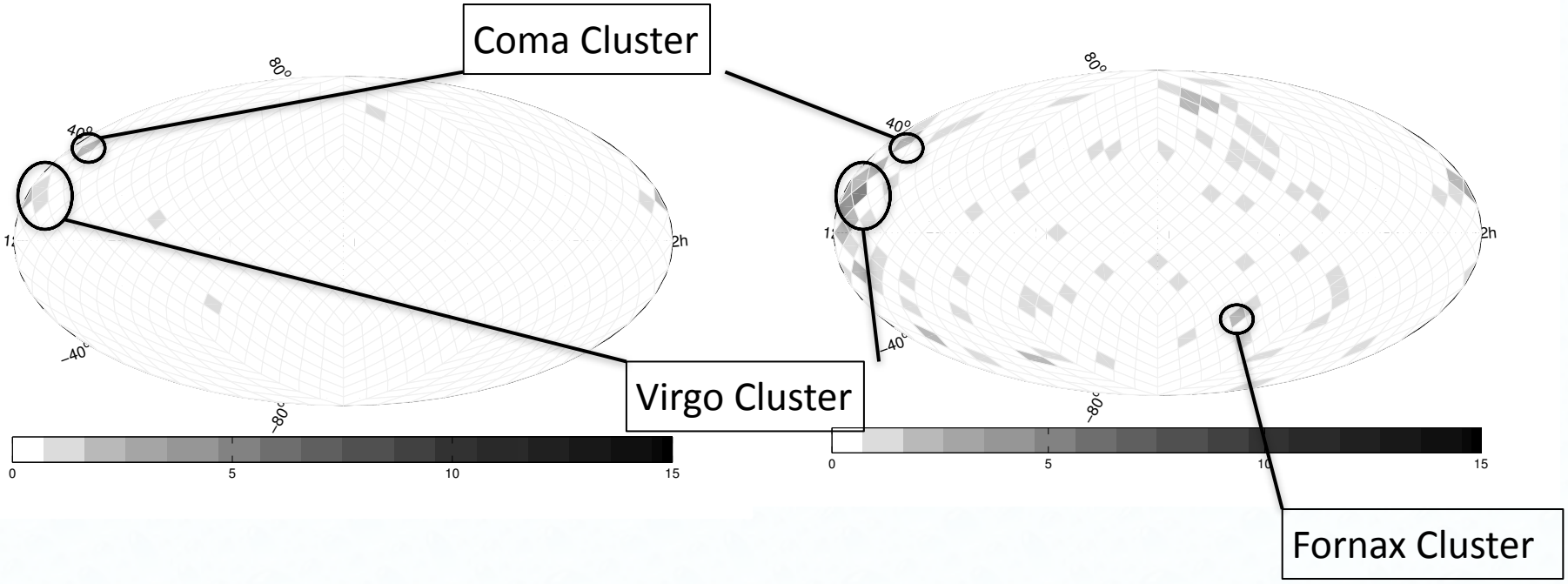
Case A
10 sources

Case B
100 sources

Case C
1000 sources

Location Of Probable Sources

Based On PTA Sensitivity To *h*

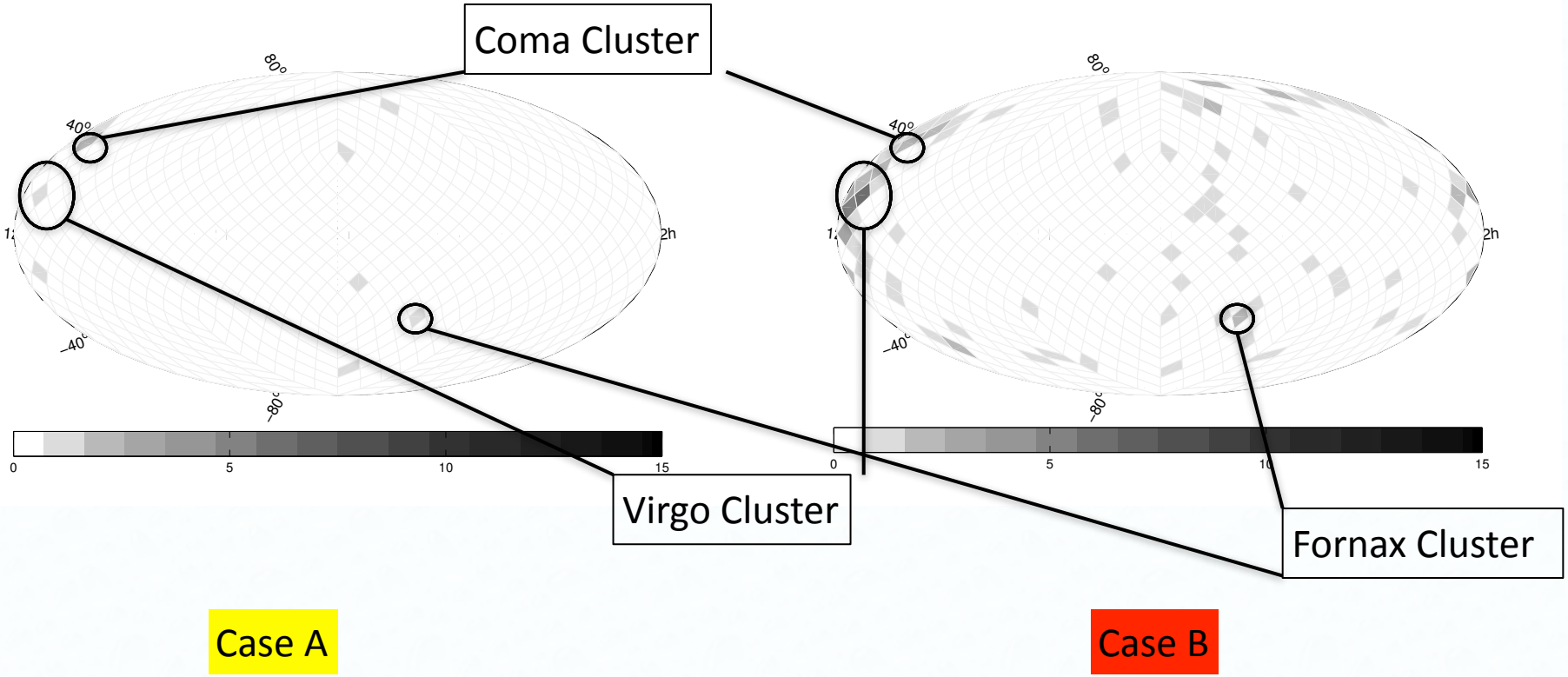


Case A

Case B

Location Of Probable Sources

Based On PTA Sensitivity To *p*



Probability Conclusions

	Virgo	Coma	Fornax	Average
Case A - *h*	0.02%	95.5%	0%	0.1%
Case A - *p*	0.2%	0.06%	0.08%	0.18%
Case B - *h*	0.21%	1.5%	20.5%	0.24%
Case B - *p*	0.3%	0.03%	0.42%	0.06%
Case C - *h*	1%	0.22%	1.56%	0.05%
Case C - *p*	0.65%	0.01%	0.33%	0.01%

Overall Conclusions

- Local Universe Is NON-ISOTROPIC
- “Hotspots” Occur In Close Galaxy Clusters
  - Virgo Cluster
    - Consistently significant zone of the sky
  - Coma Cluster
    - High potential to catch bright and long sources
  - Fornax Cluster
    - Probability dramatically improves with sensitivity
- Implications For Optimizing PTAs
  - Increase Sensitivity In Directions Of Clusters