

X-ray Universe

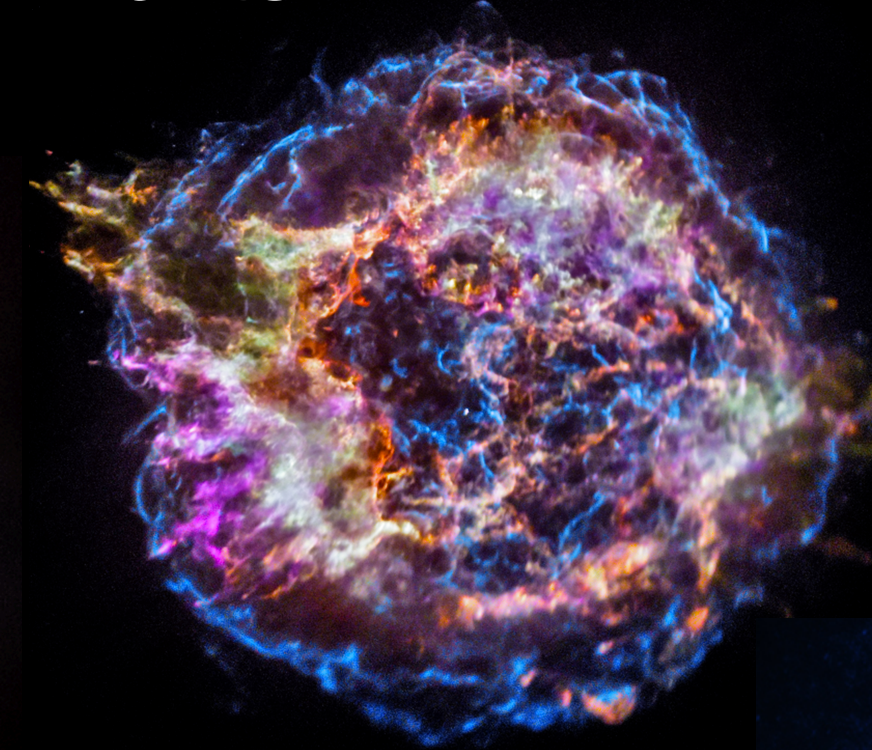
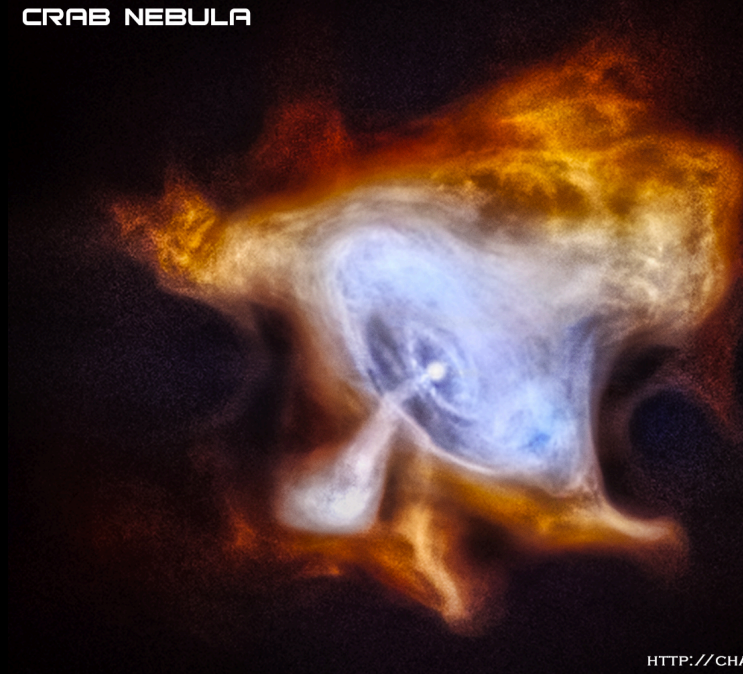
Solar System



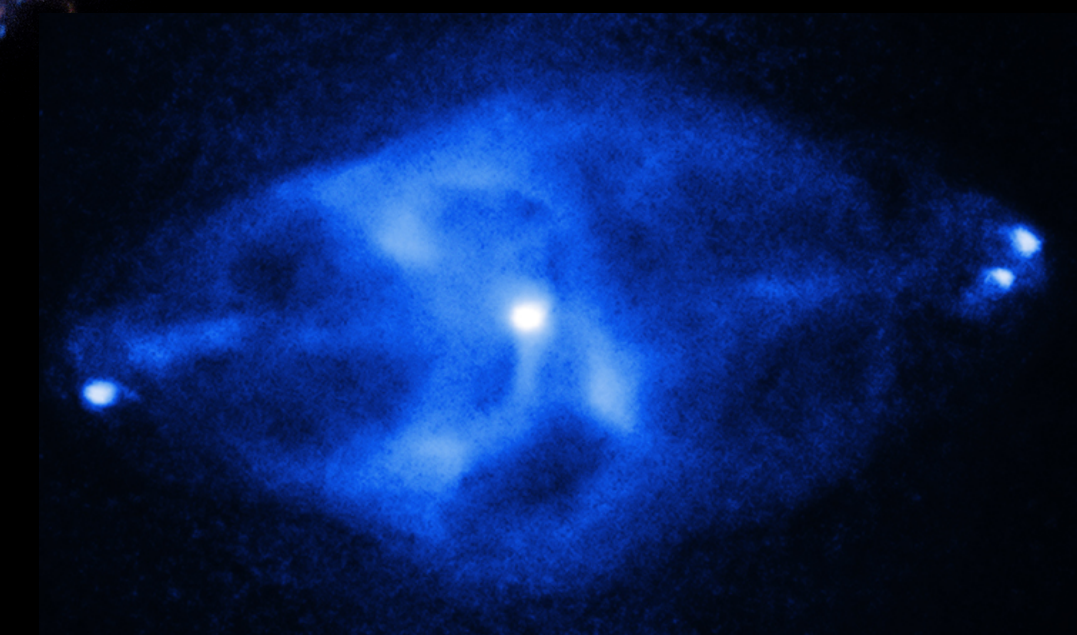
Hot gas $> 10^5$ K
Energetic particles

Supernova Remnants

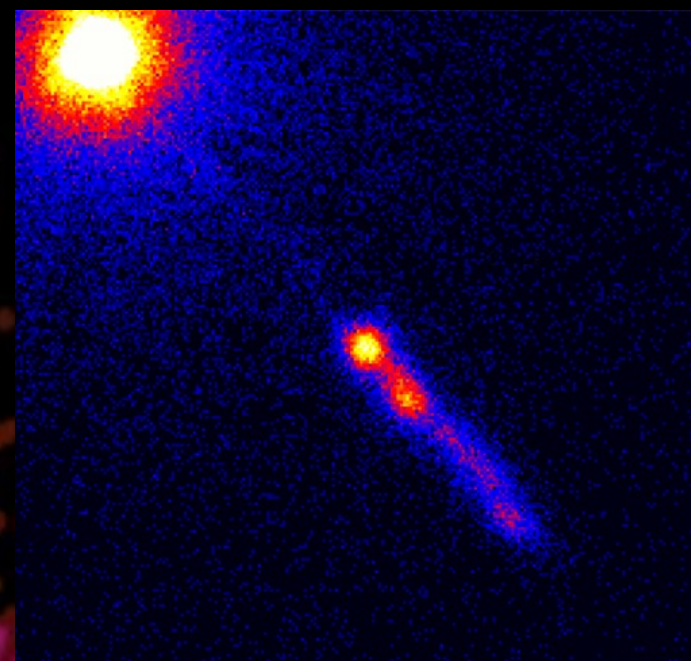
CRAB NEBULA



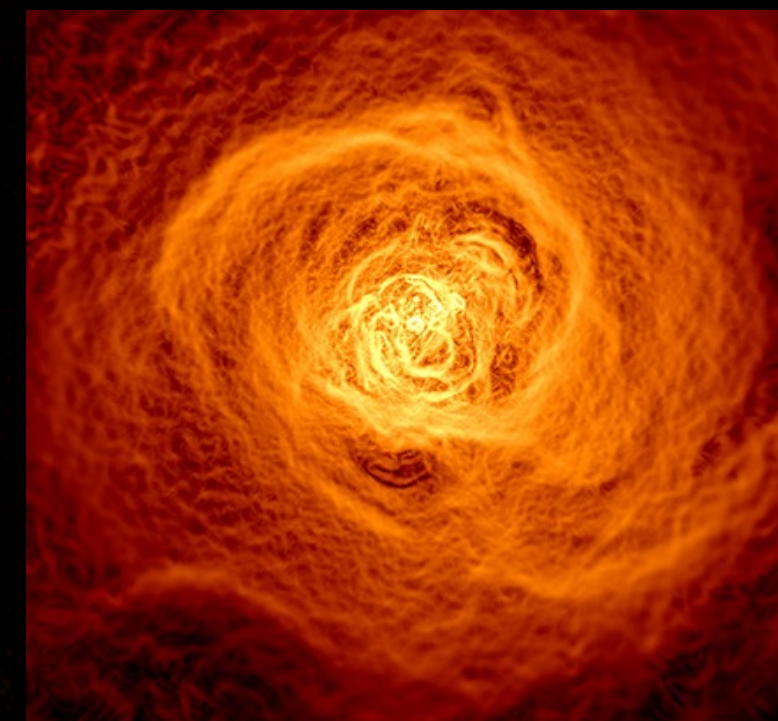
Radio Galaxies



Quasar Jets



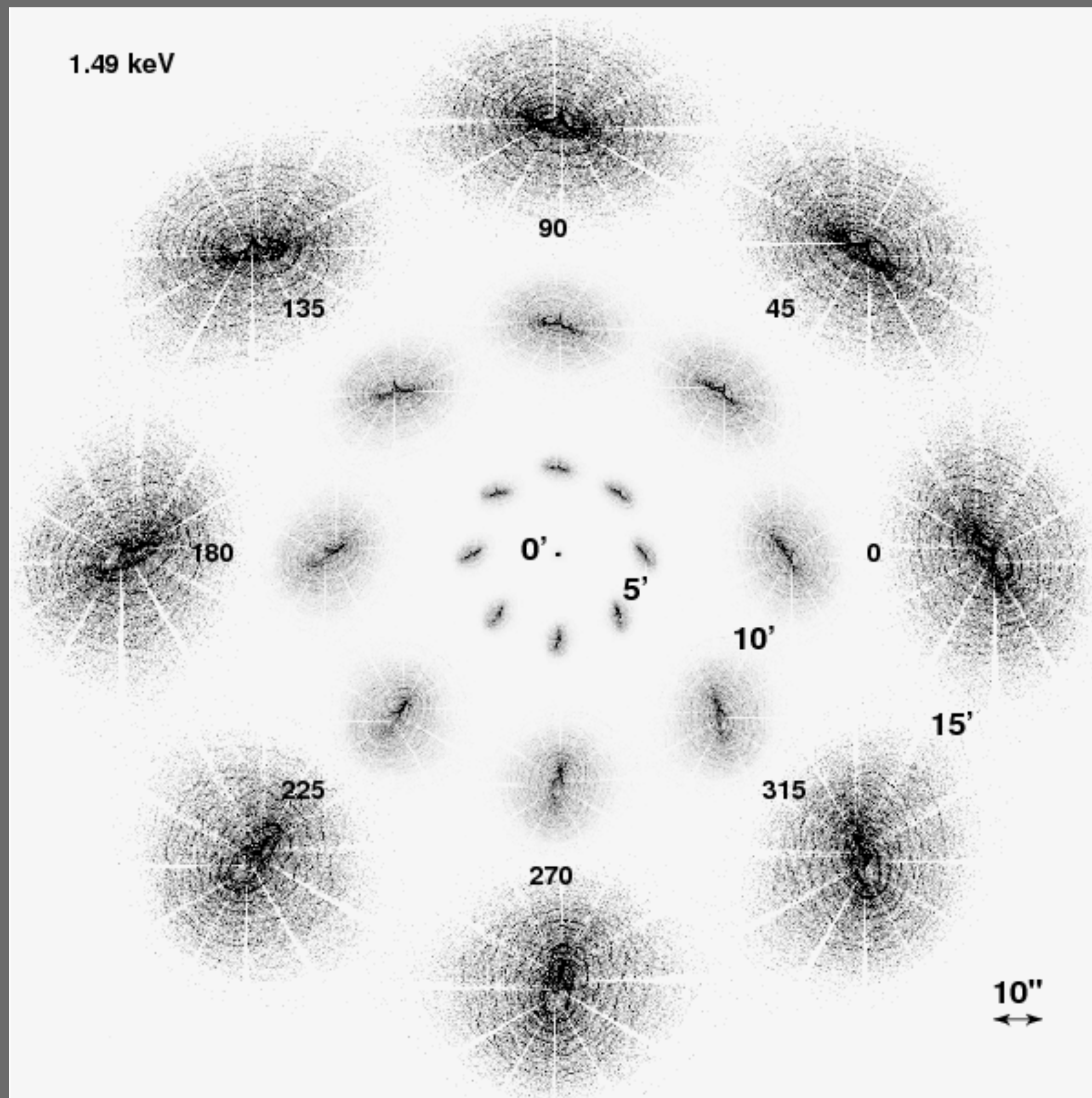
Clusters of Galaxies



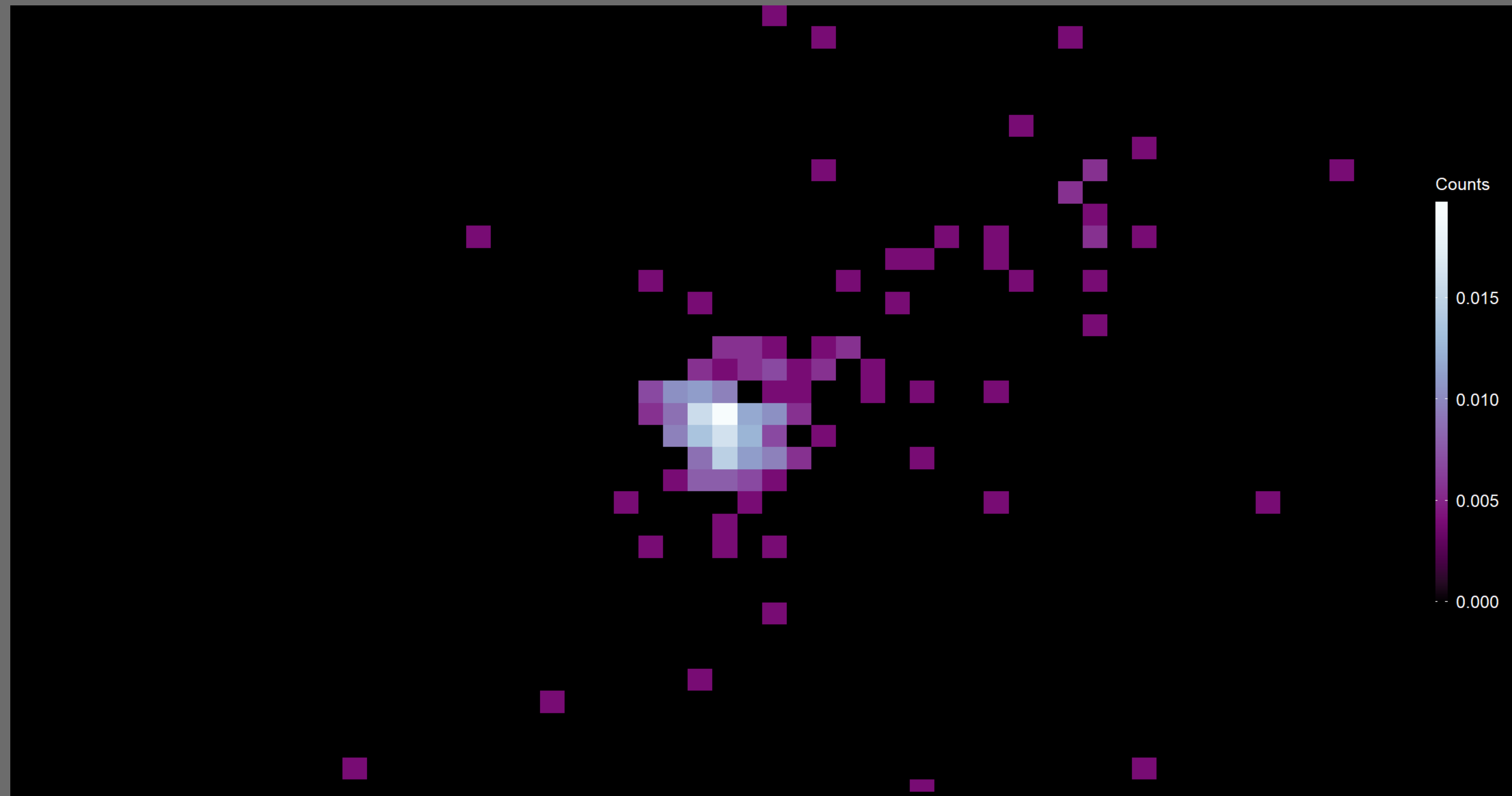
X-ray Images from Chandra X-ray Observatory

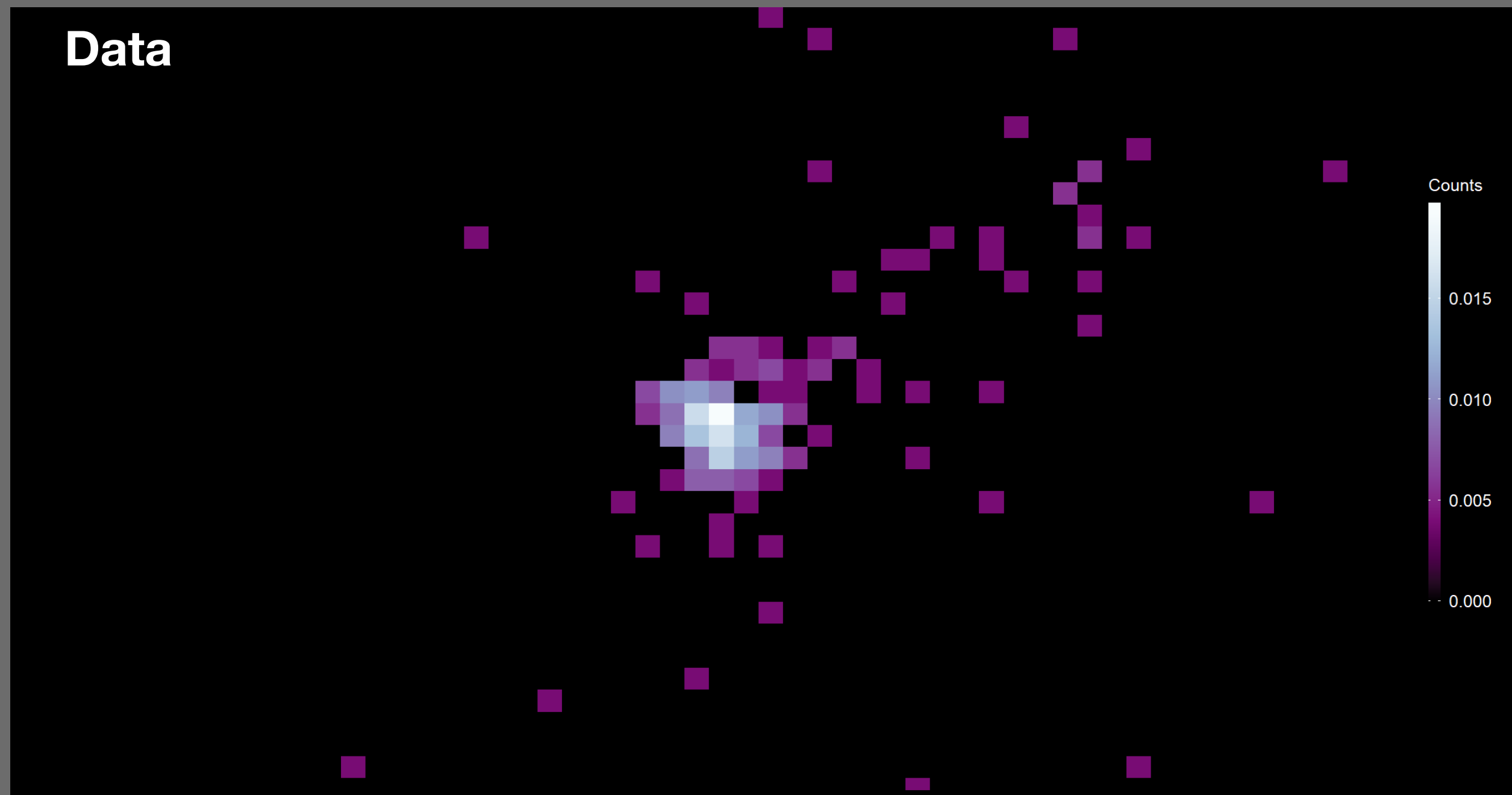
(False Color)

Chandra Point Spread Function

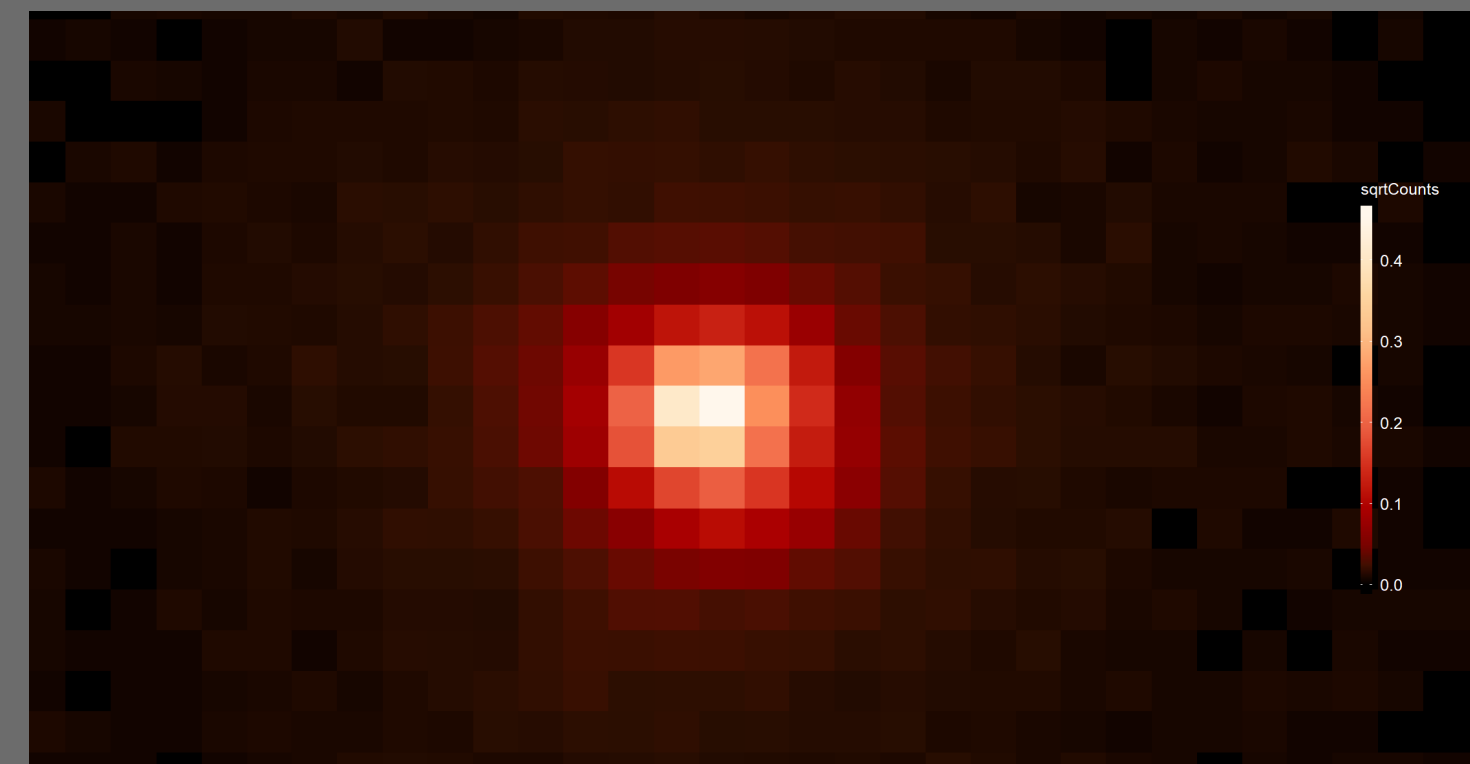


X-ray Image

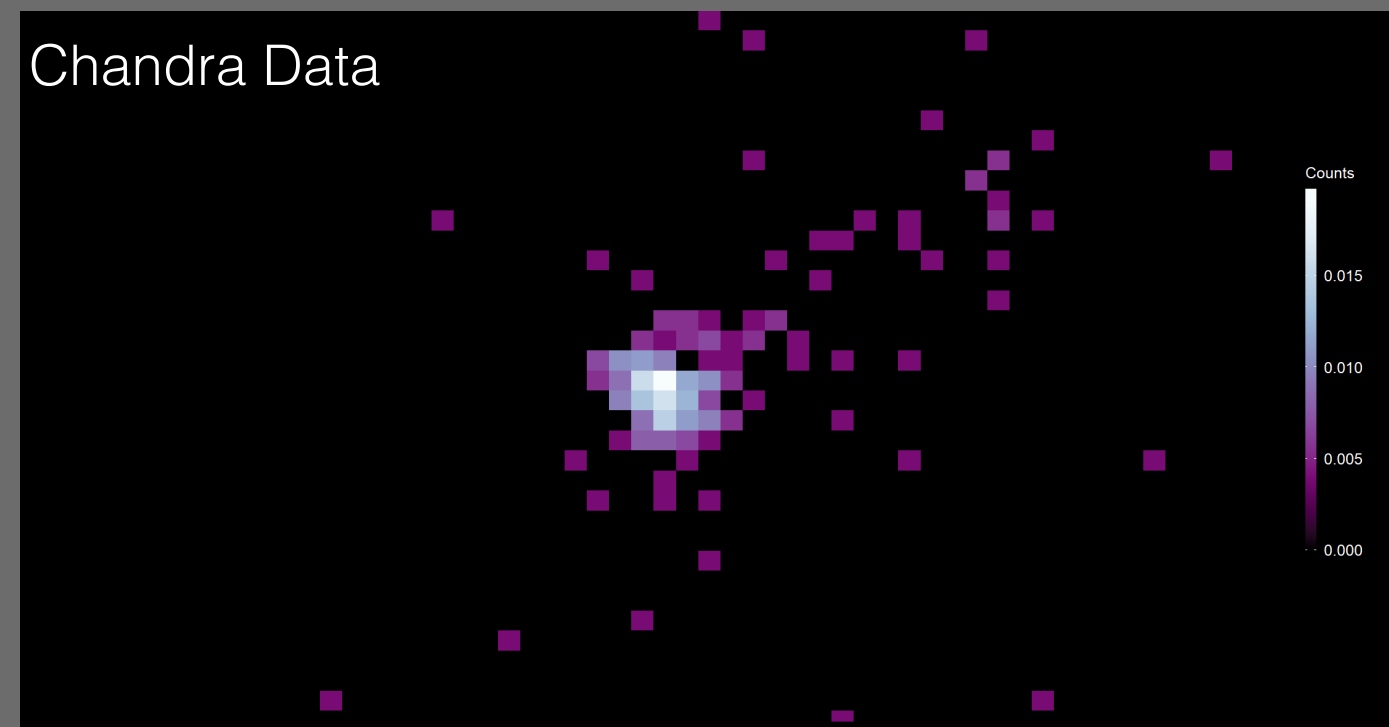




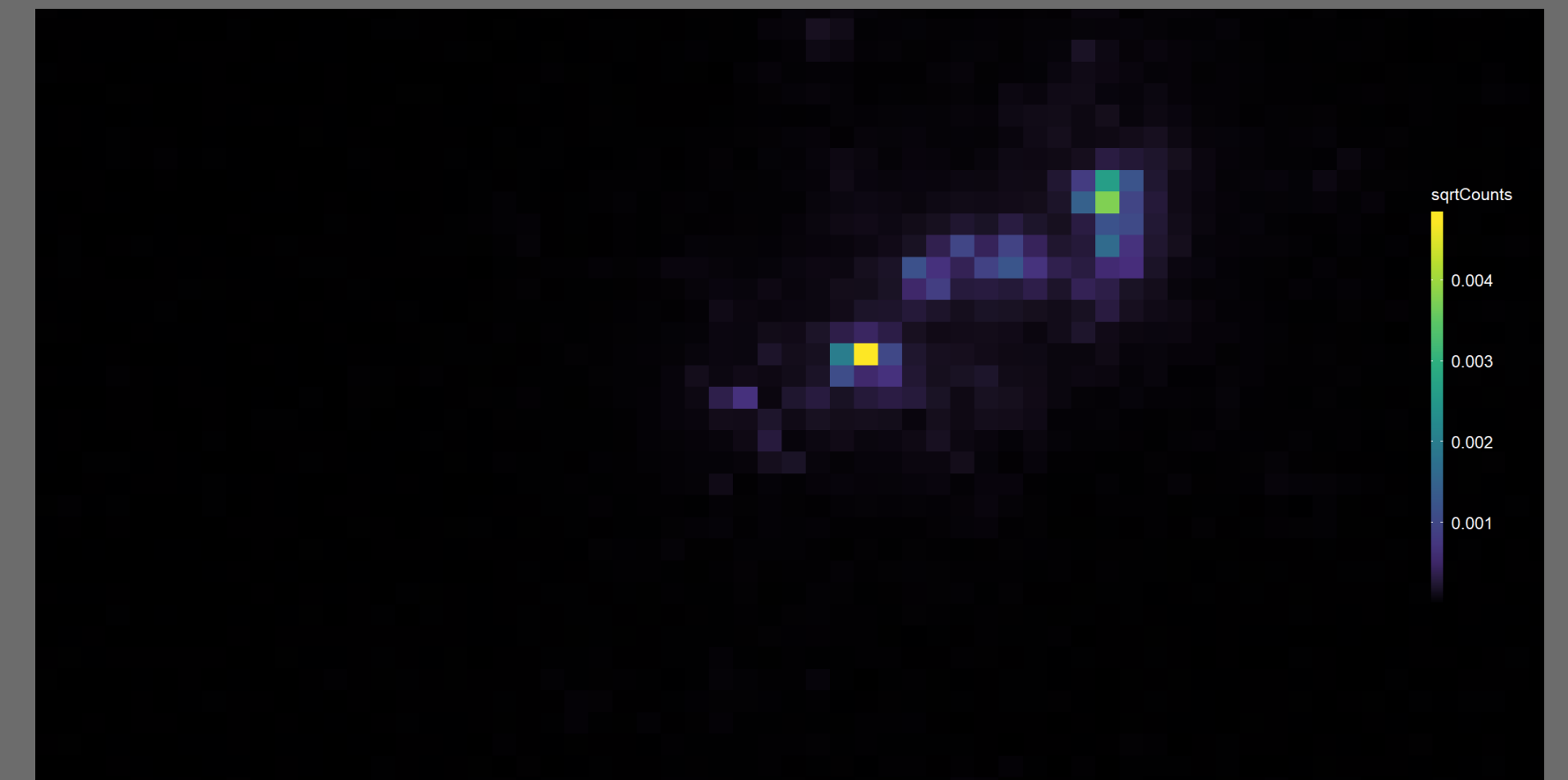
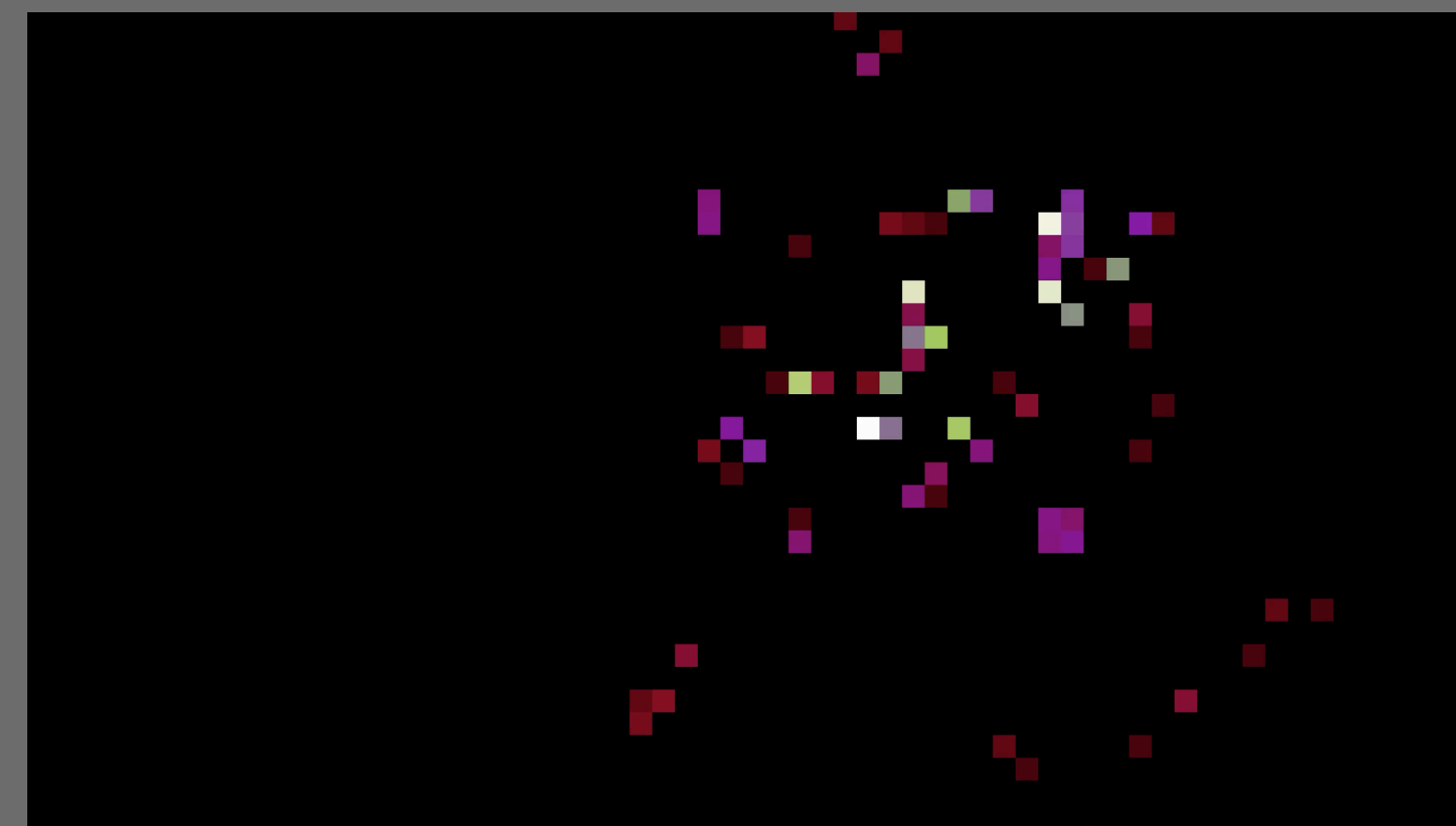
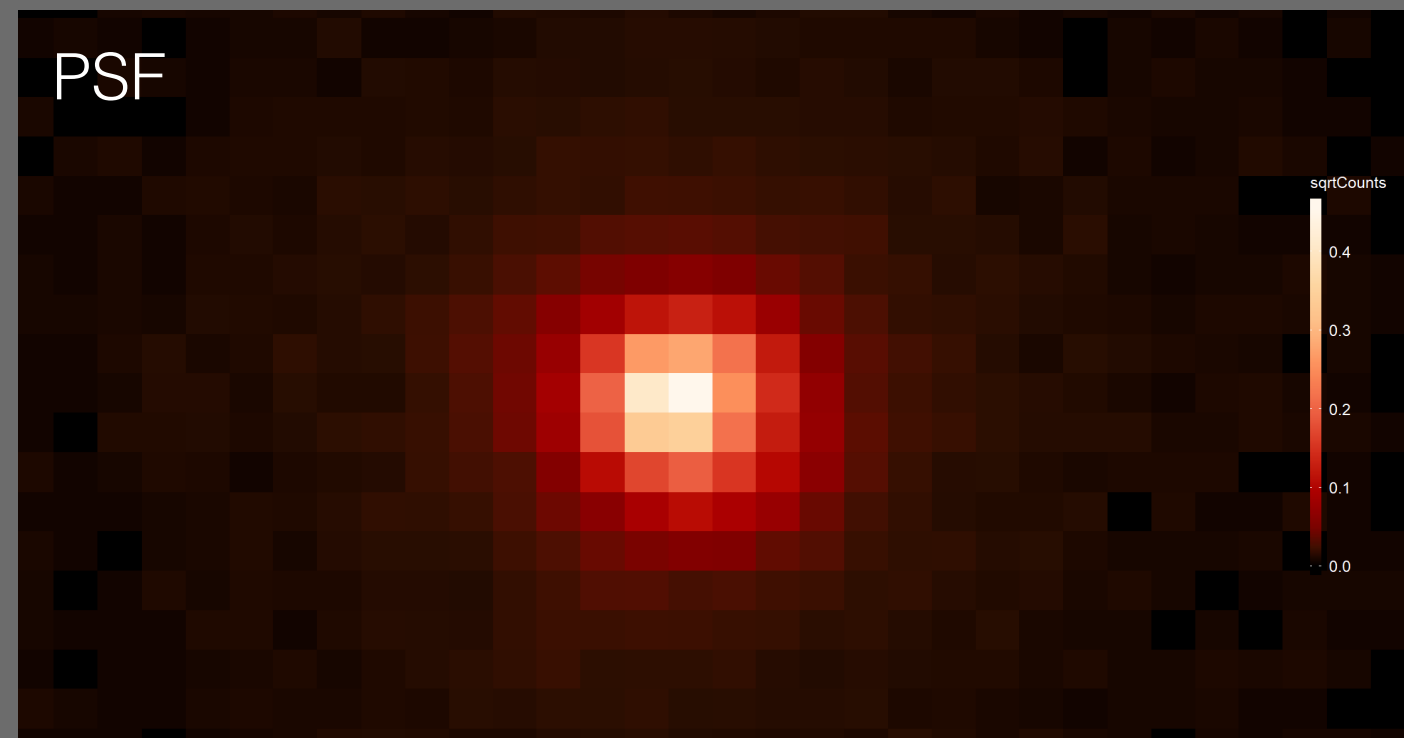
PSF



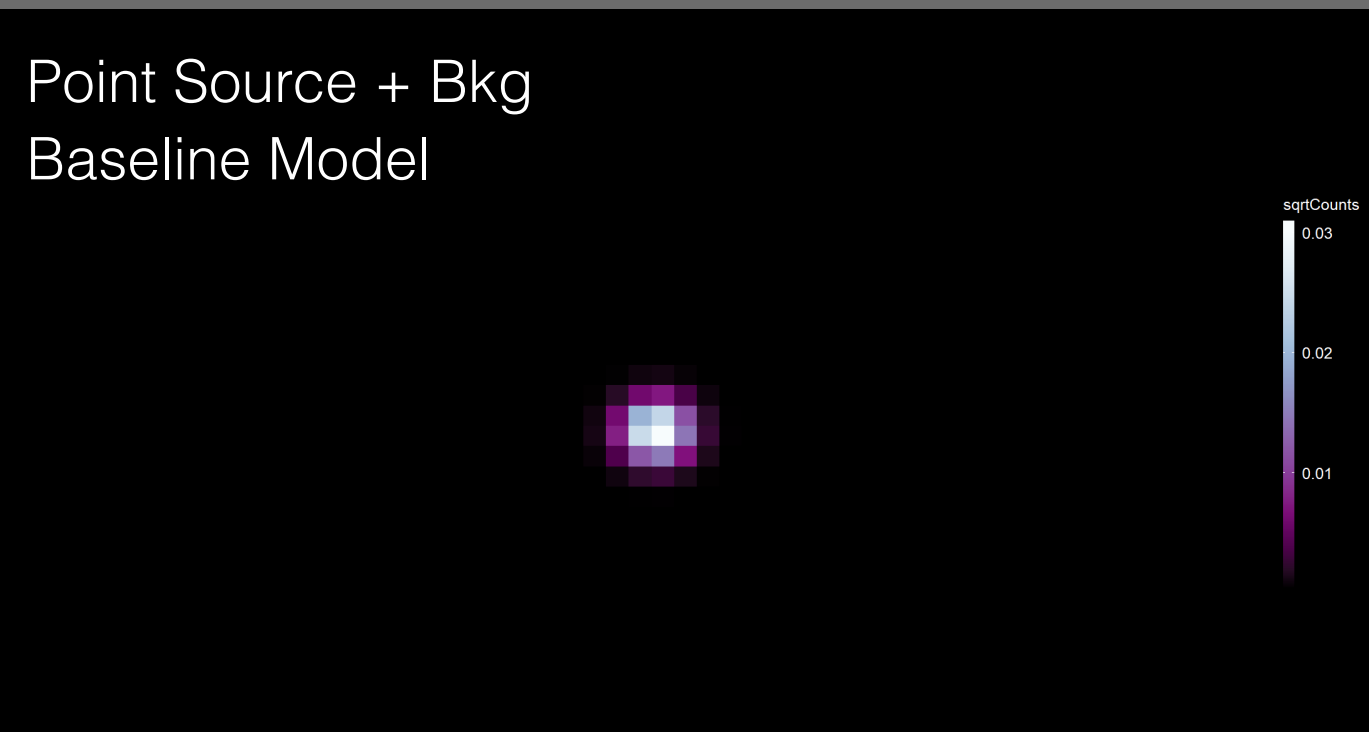
X-ray Images



LIRA - Low-Counts Image Reconstruction and Analysis
Bayesian Hierarchical Model



McKeough et al 2016



Posterior Draws with MCMC
Expected photon counts in each pixel
given the observed counts

Posterior Mean

Esch et al 2004, Connors & Van Dyk 2007, Stein et al. 2015

X-ray Images

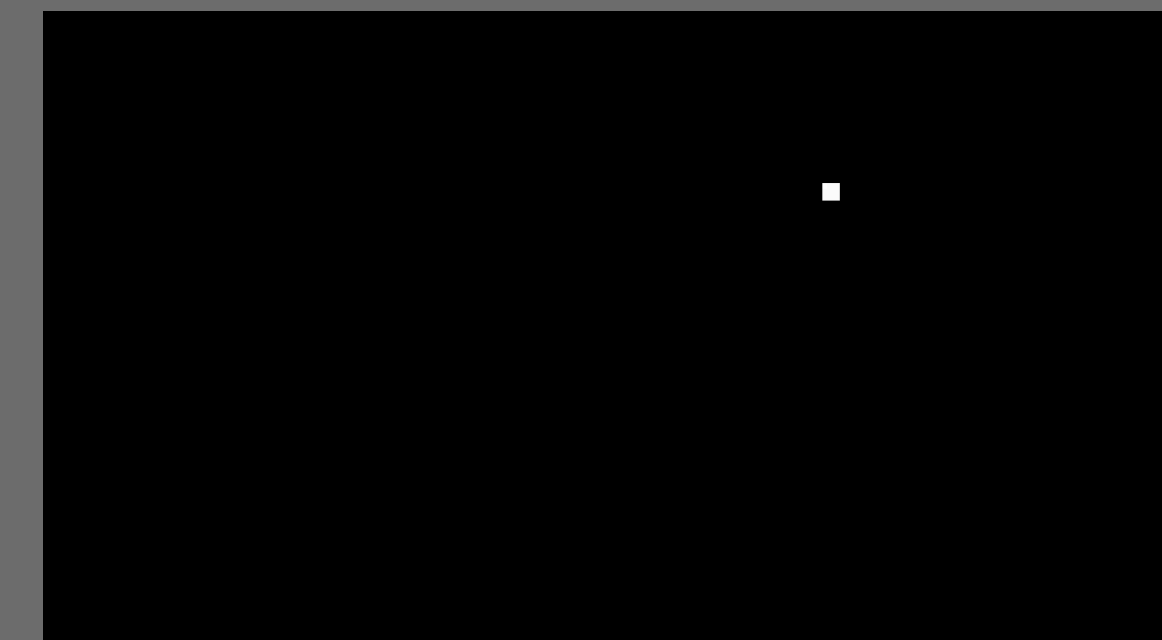
Finding the source boundary

Posterior Draws with MCMC
probability distribution of pixel assignments



ISING Prior
Correlation between neighboring pixels

Optimal Boundary



Boundary with maximum probability
given LIRA-Ising posterior

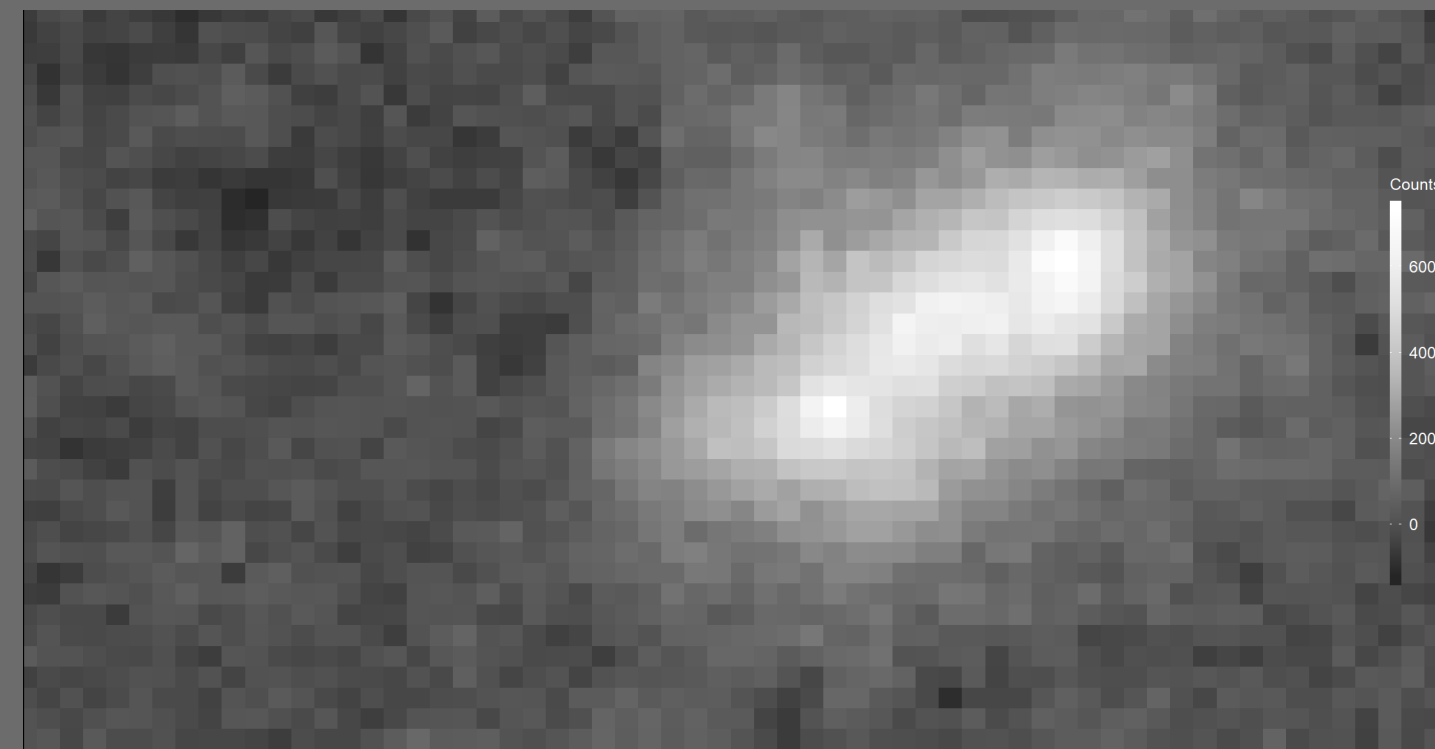
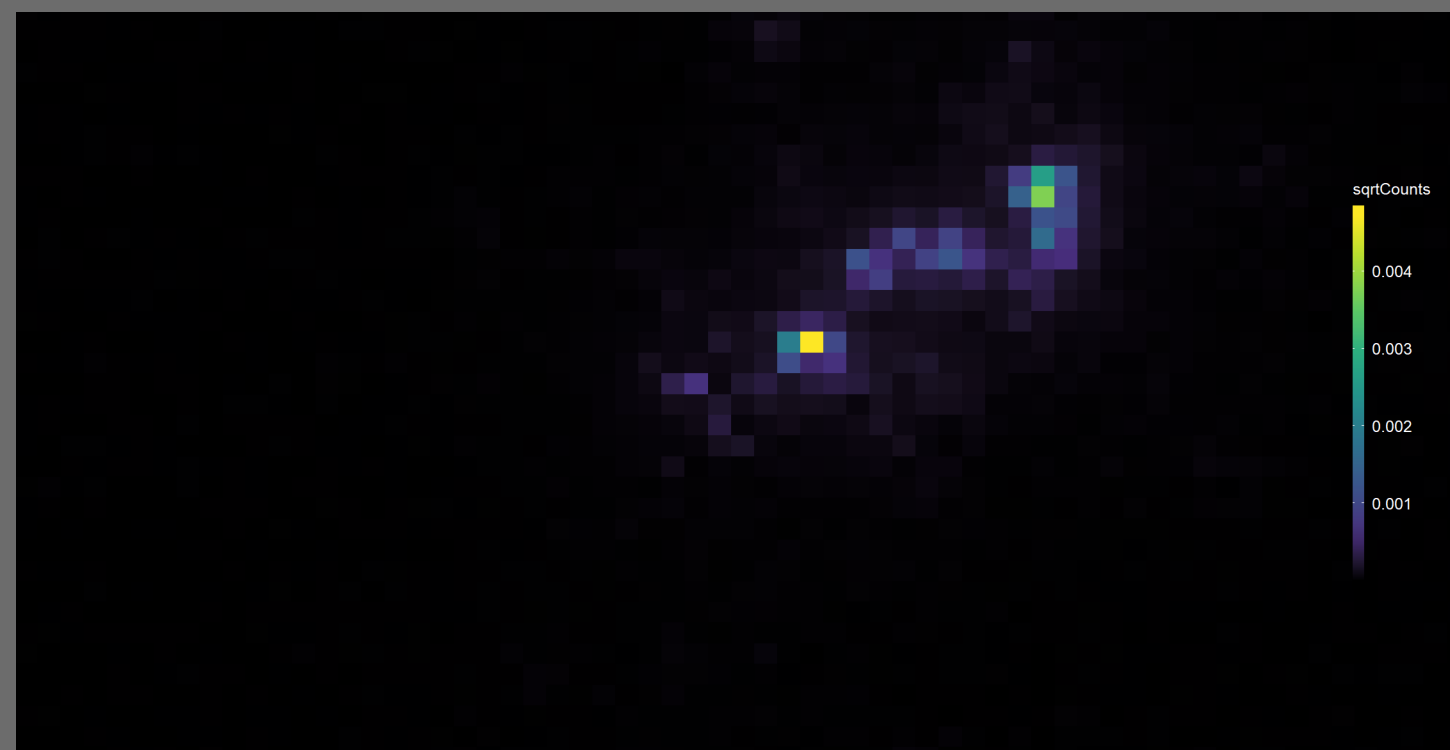
McKeough et al (in prep)

X-ray Images

Finding the source boundary

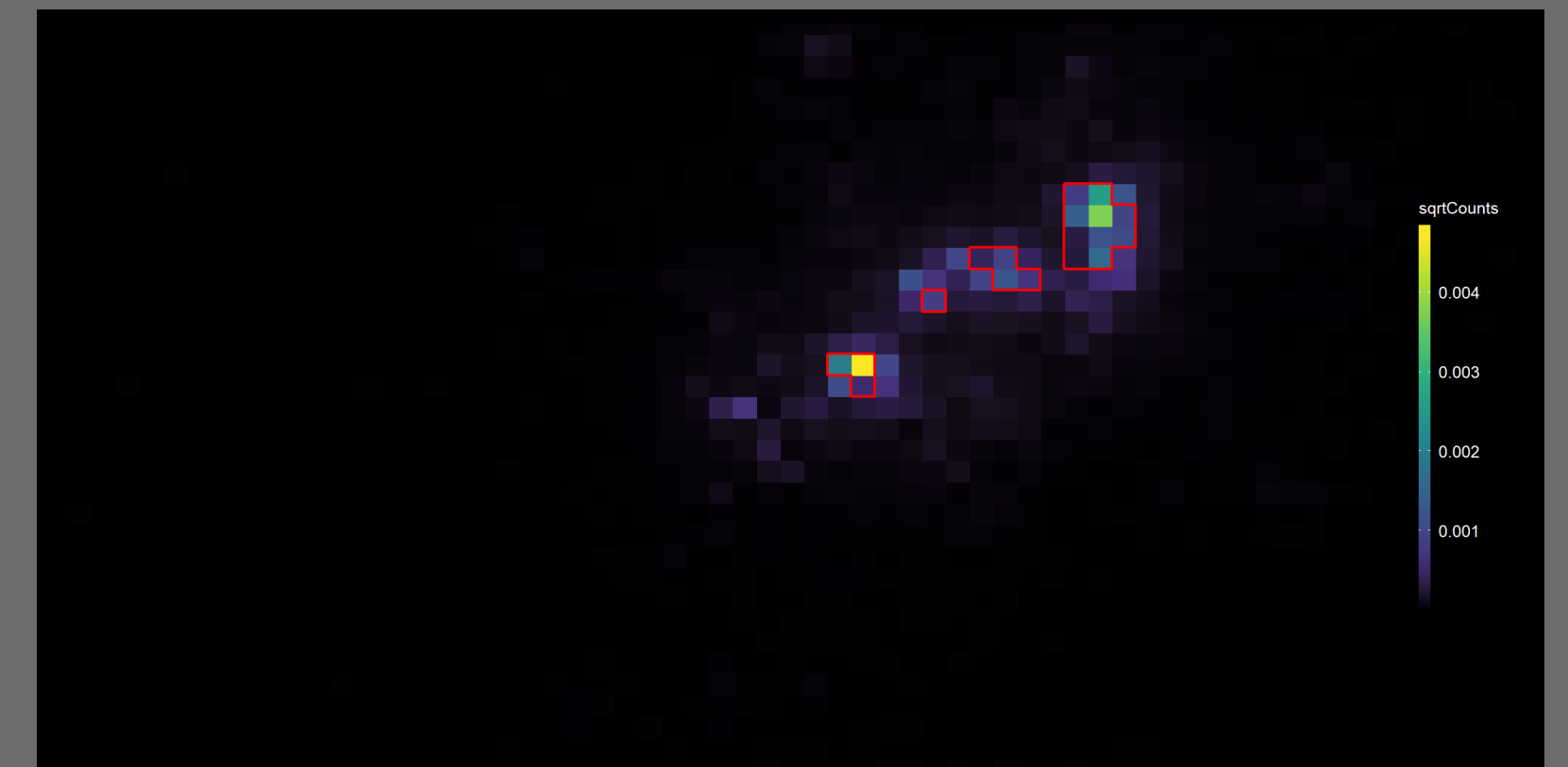
Posterior Draws with MCMC
probability distribution of pixel assignments

Posterior Mean



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