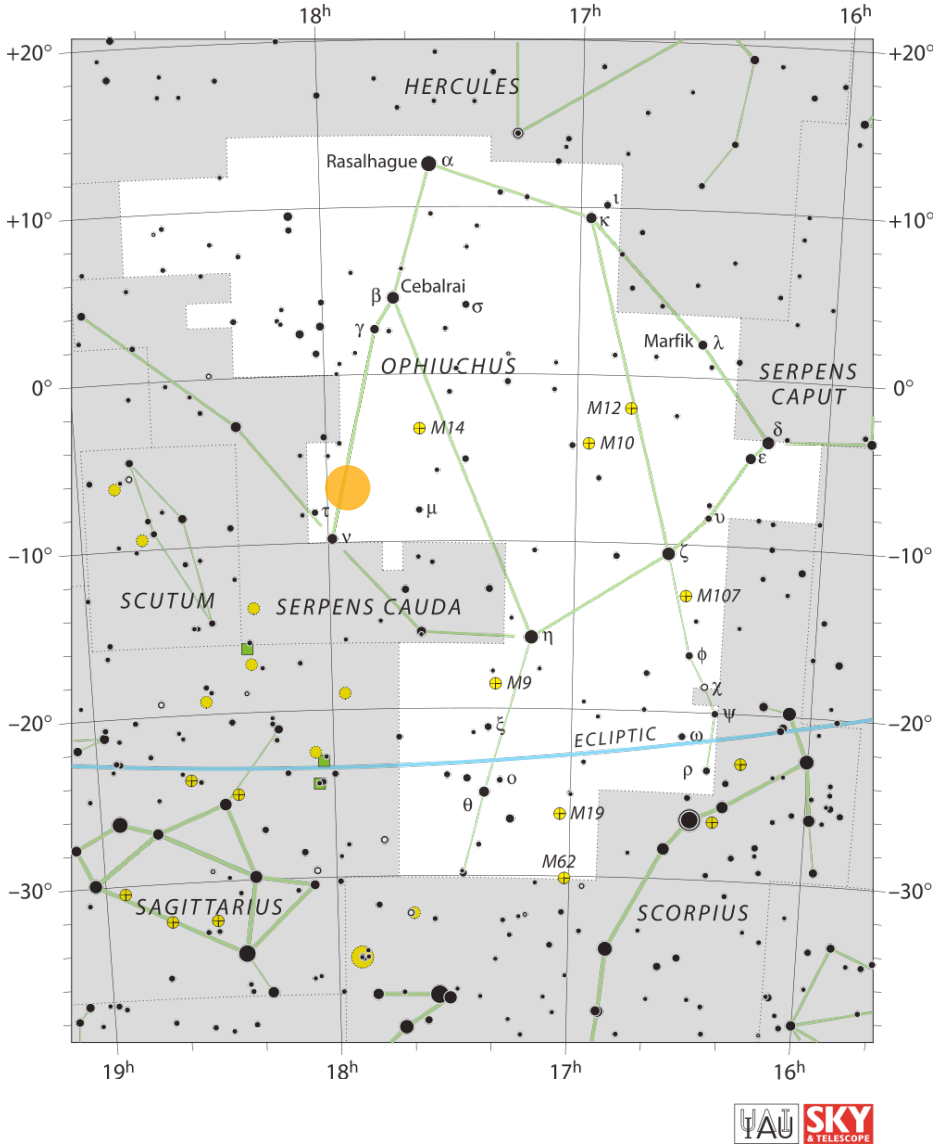
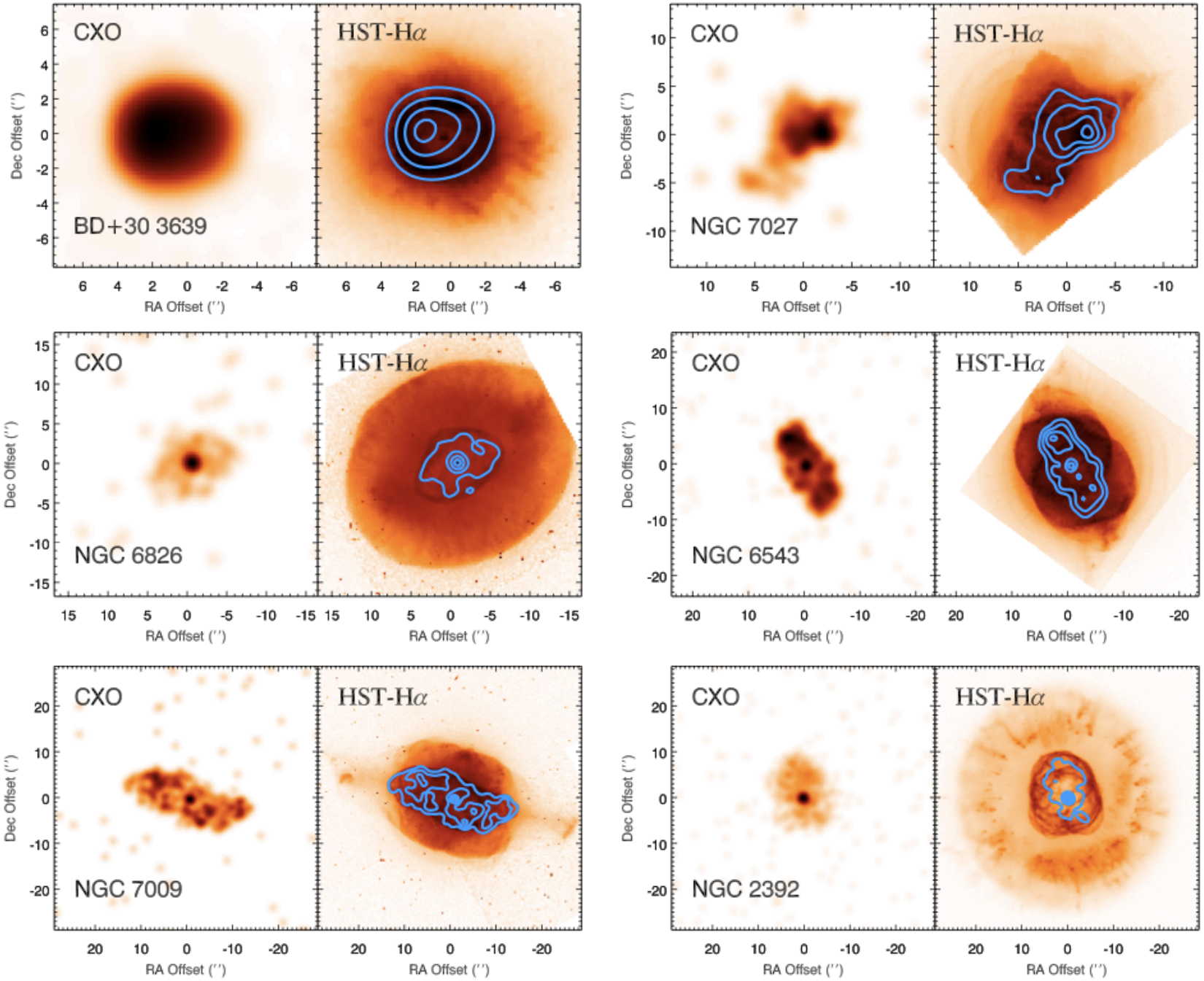
Discovery of expanding, X-ray emitting, bipolar structures around the recurrent nova RS Oph

Rodolfo Montez Jr.
Bridge Post-doctoral Fellow
Vanderbilt University



ChanPlaNS; Kastner et al. 2012



Data and Analysis

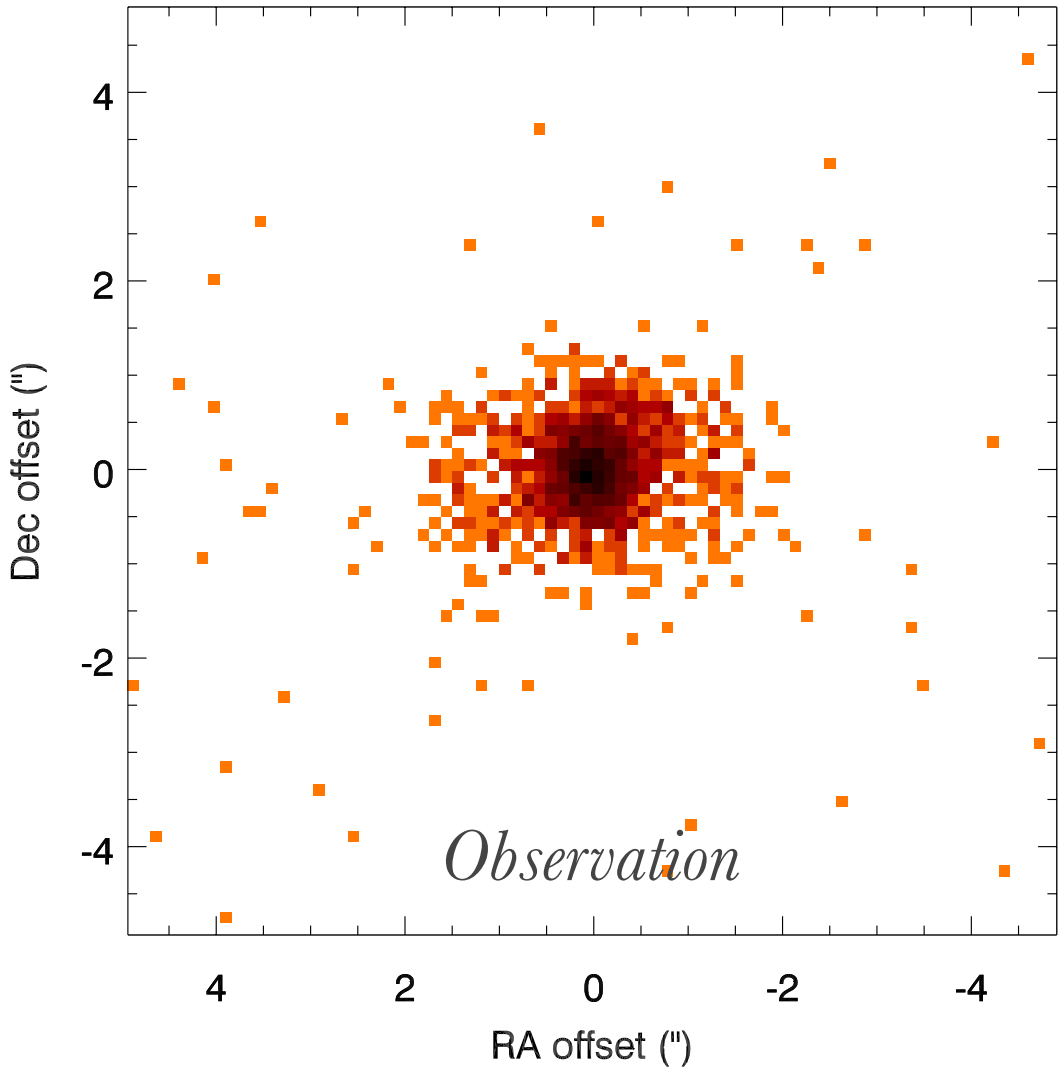
ObsID	Exposure (ks)	Observation Date	Since Eruption (day)
9952	130.35	20-Jul-09 16:12:39	1253d 20h 17m 27s
12404	87.71	23-May-11 22:20:48	1926d 2h 25m 36s
12403	157.78	25-May-11 10:14:38	1927d 14h 19m 26s

- Deep Chandra X-ray Observatory exposures (>100 ks)
- ACIS-S3 (BI chip) in sub-array mode (0.9s frame time)
- Sub-pixel Event Repositioning to improve spatial resolution of split events

Data and Analysis

2009 Observation

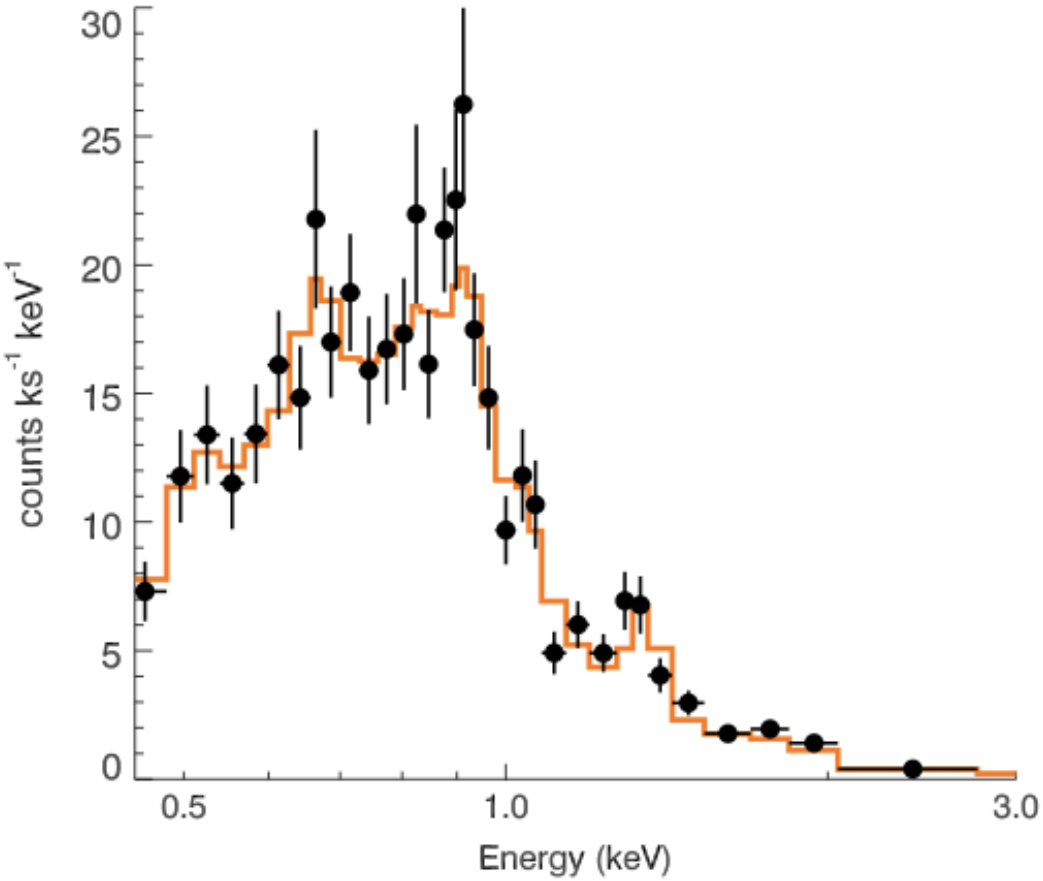
- Evidence for extended emission towards the east and west of the bright compact point source
- Ideal for image reconstruction



Data and Analysis

Image Reconstruction

- Extract source spectrum
- Fit the spectral shape
- Spectral shape is provided to the *Chandra Ray Tracer* (ChaRT)
- ChaRT bundle of rays is provided to the MARX detector simulator



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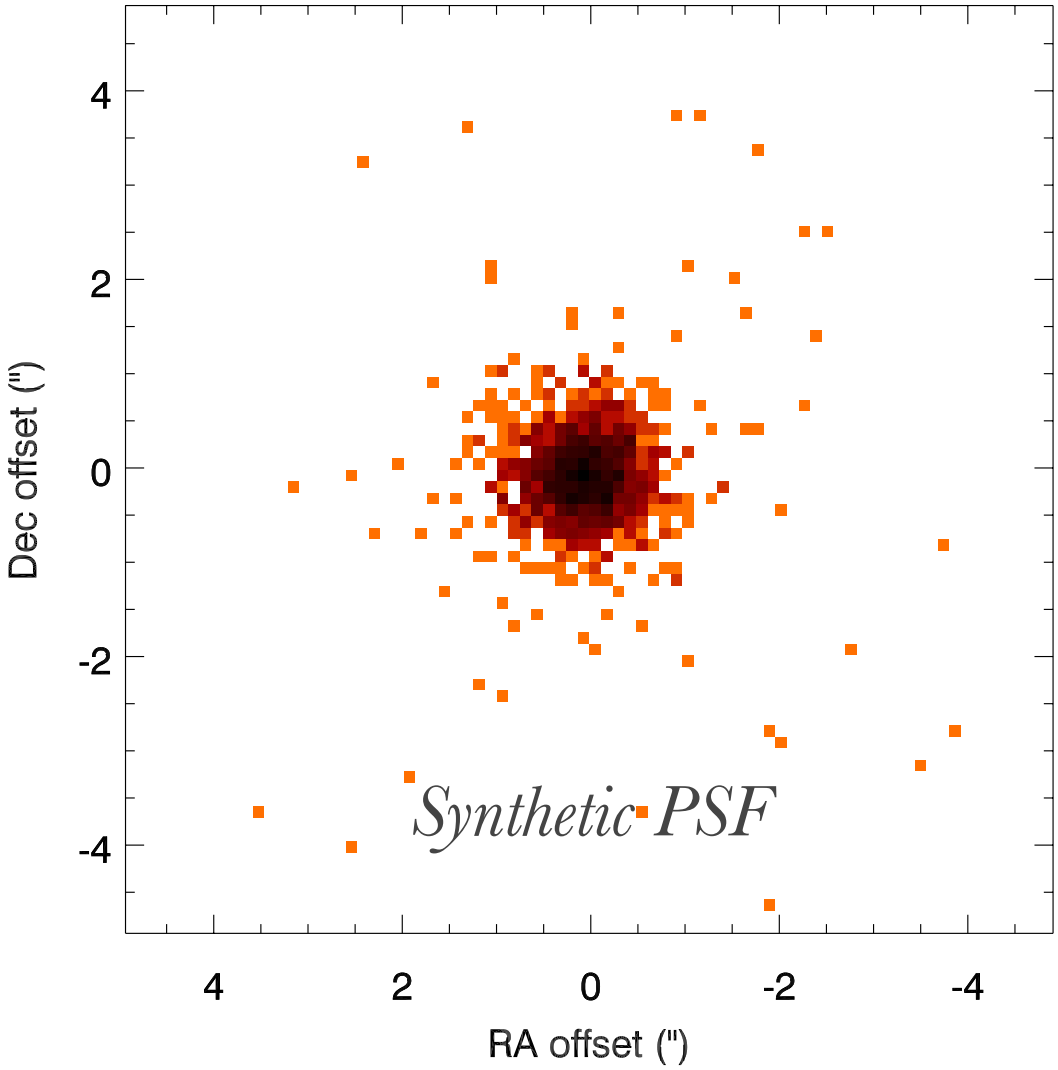
→ Synthetic PSF



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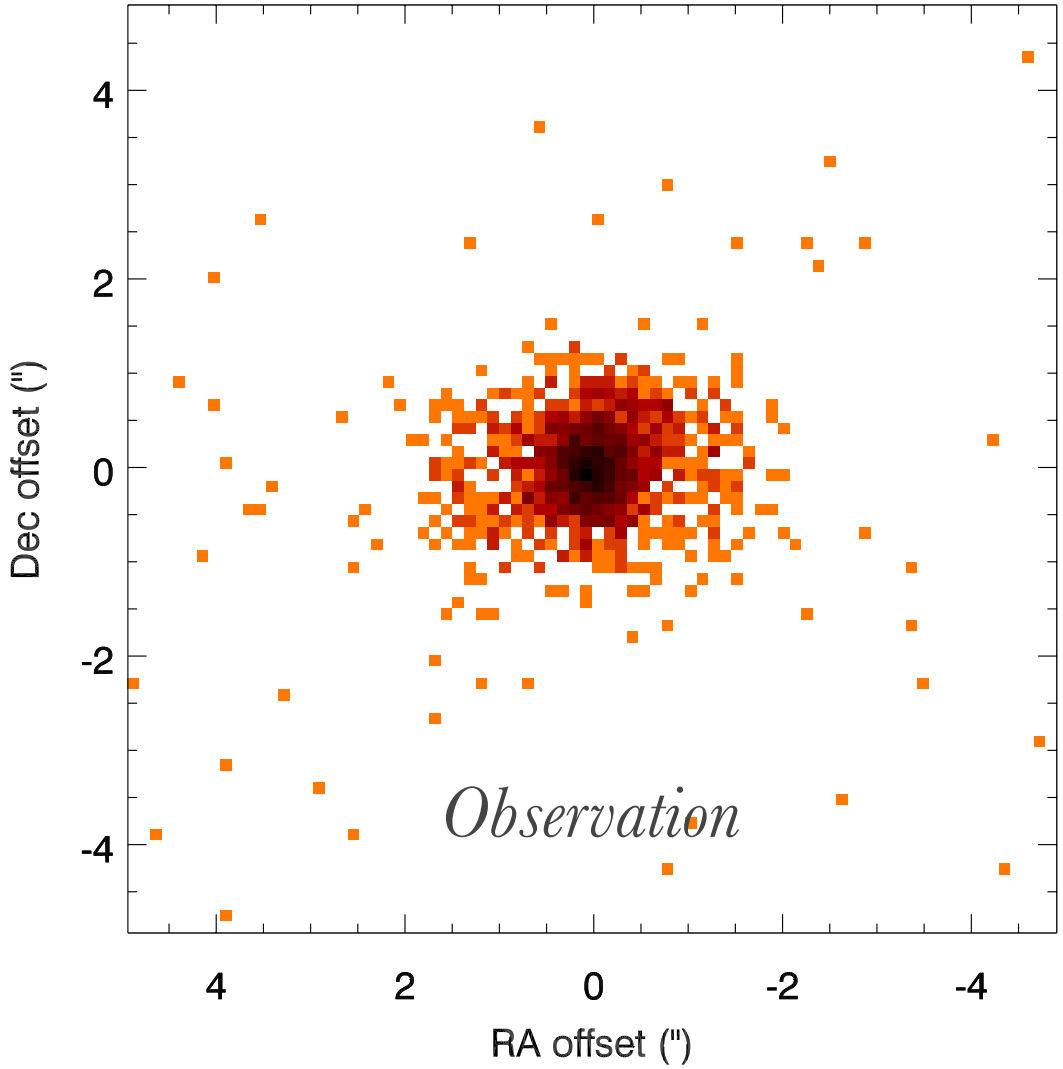


Data and Analysis

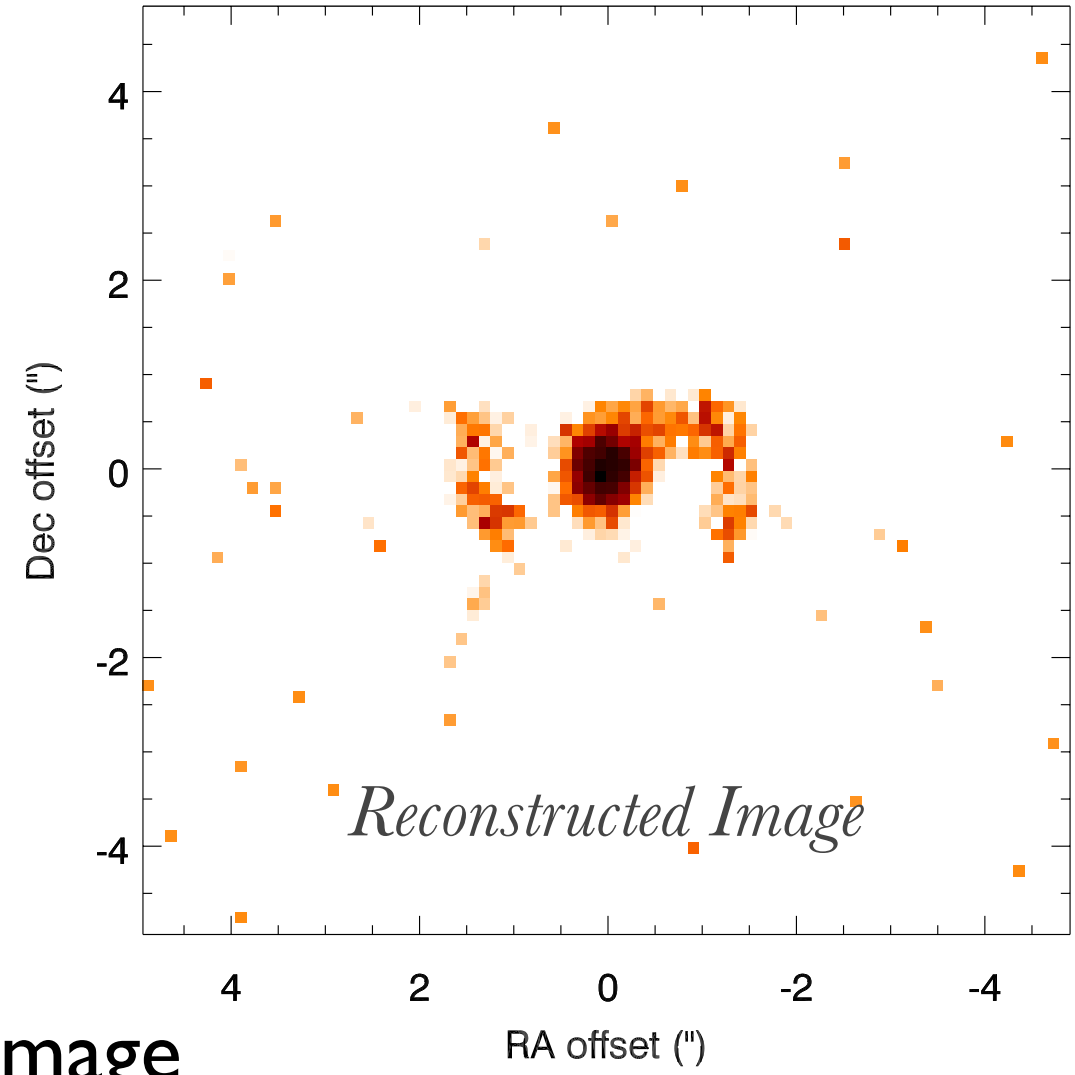
Image Reconstruction

- Extract source spectrum
- Fit the spectral shape
- Spectral shape is provided to the *Chandra Ray Tracer* (ChaRT)
- ChaRT bundle of rays is provided to the MARX detector simulator

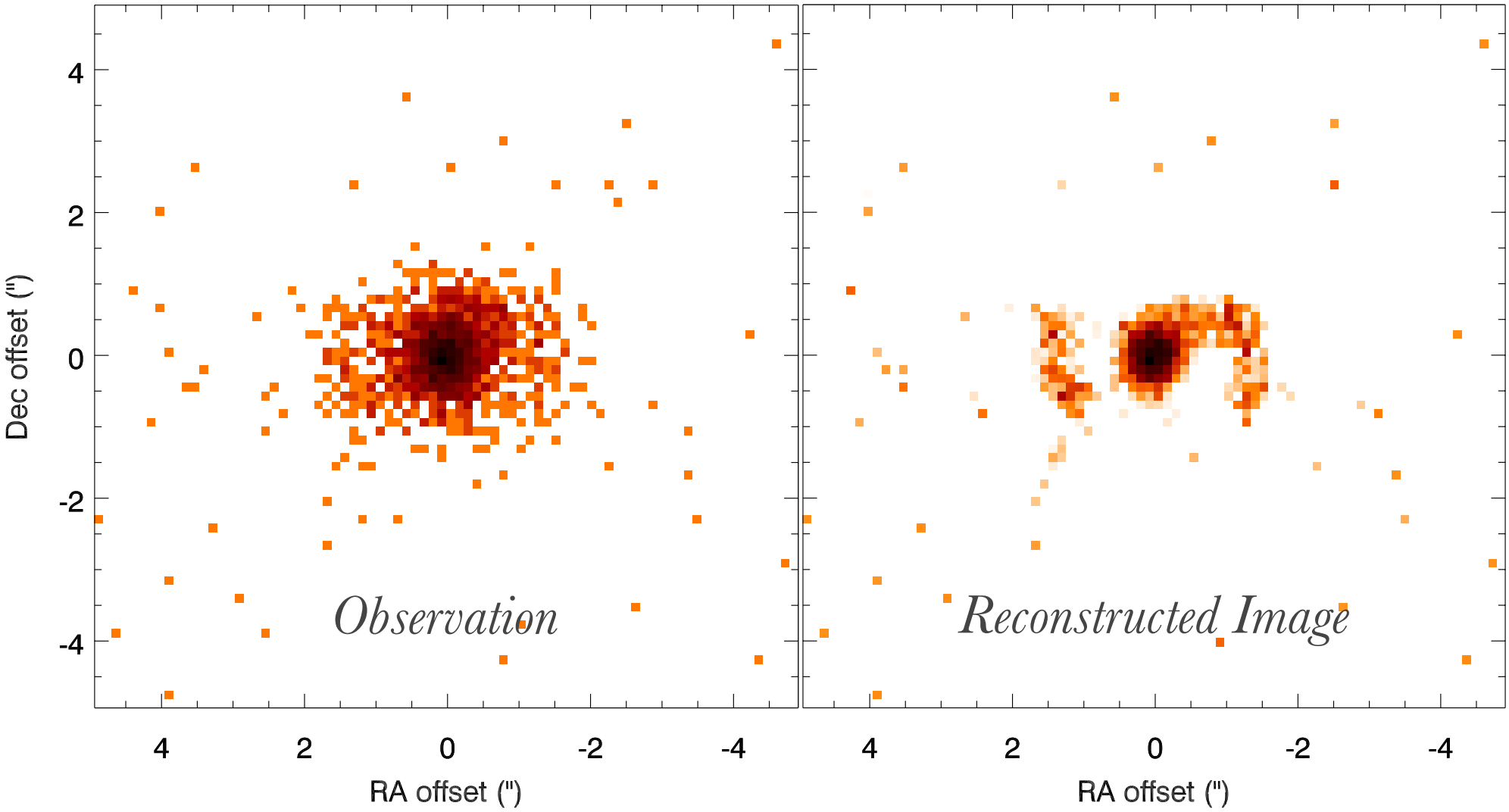
→ Synthetic PSF

- Perform a *Richardson-Lucy Maximum Likelihood Deconvolution* between the observed image with the PSF

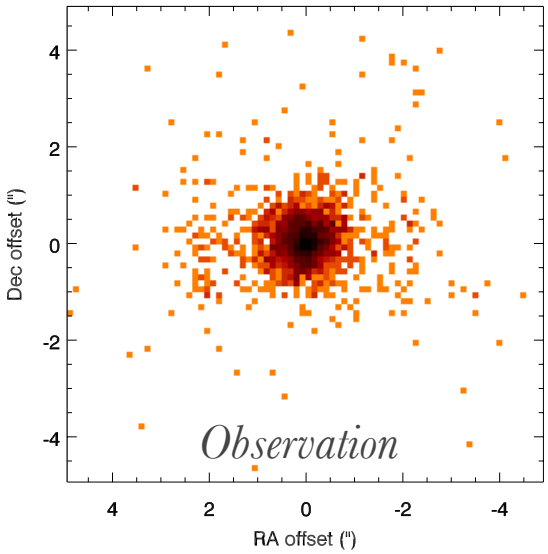
→ Reconstructed Image

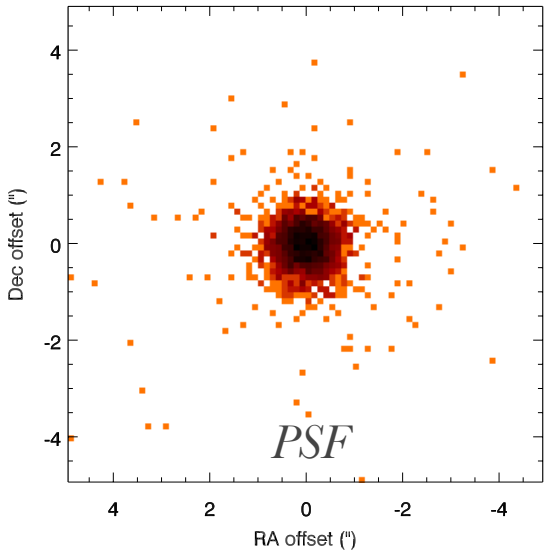


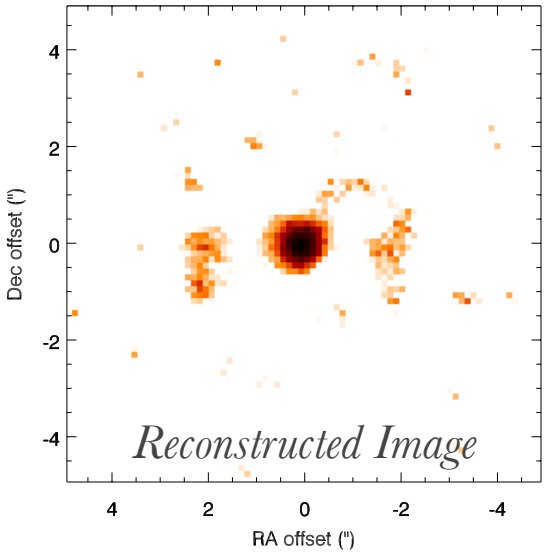
Extended X-ray Emission

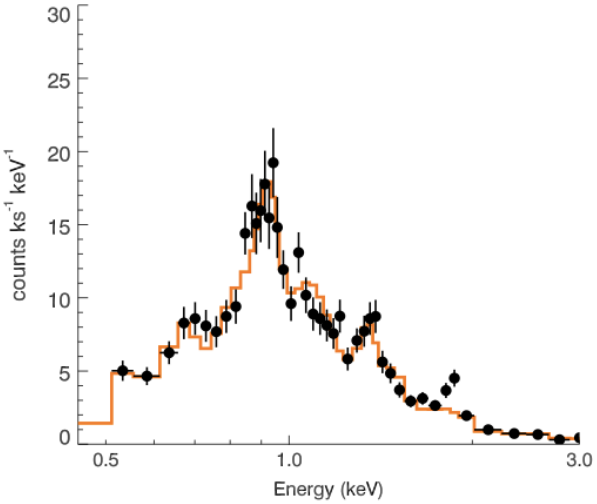


Data and Analysis





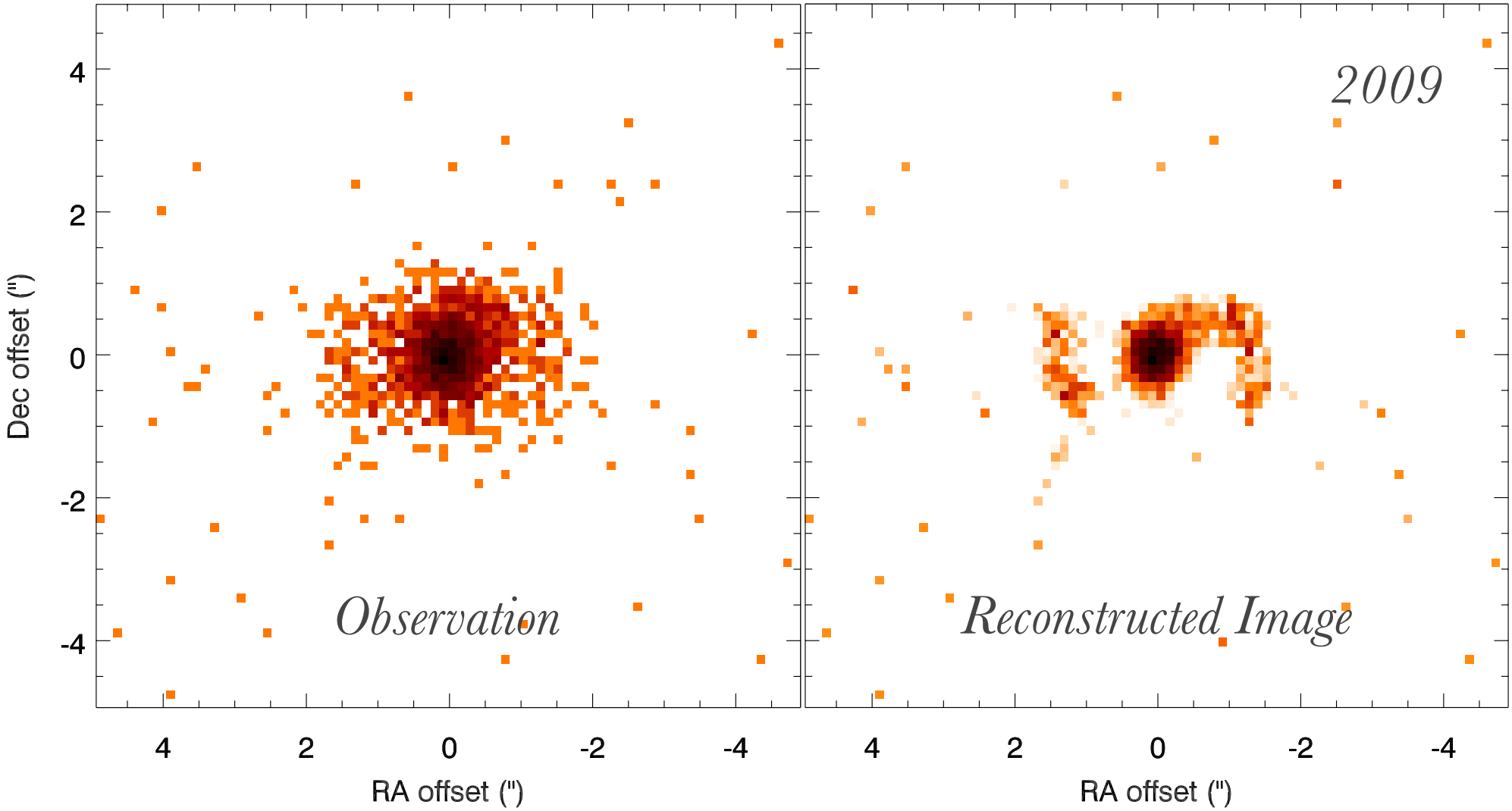




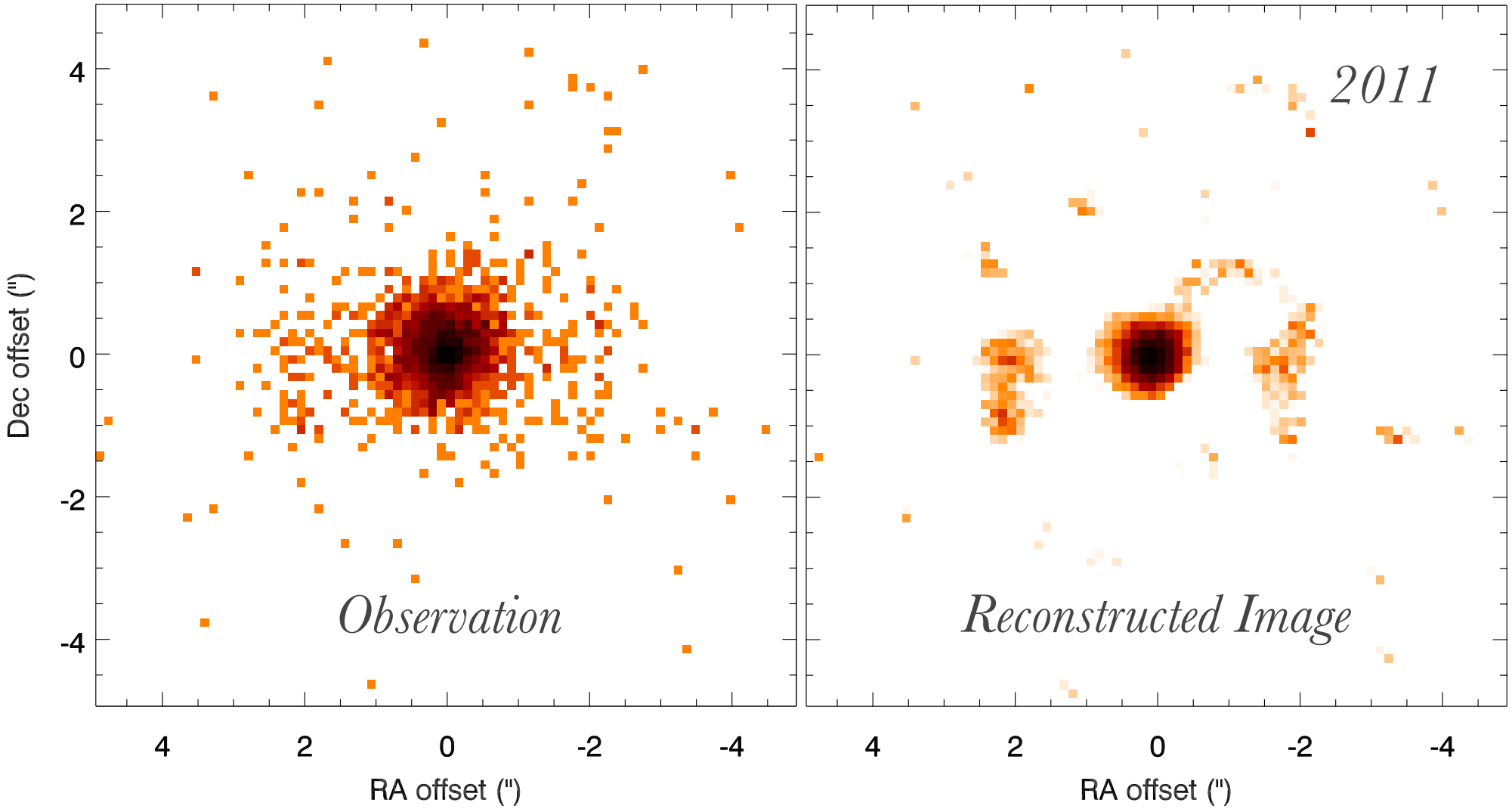
Spectra and Spectral Fit

2011 Observation

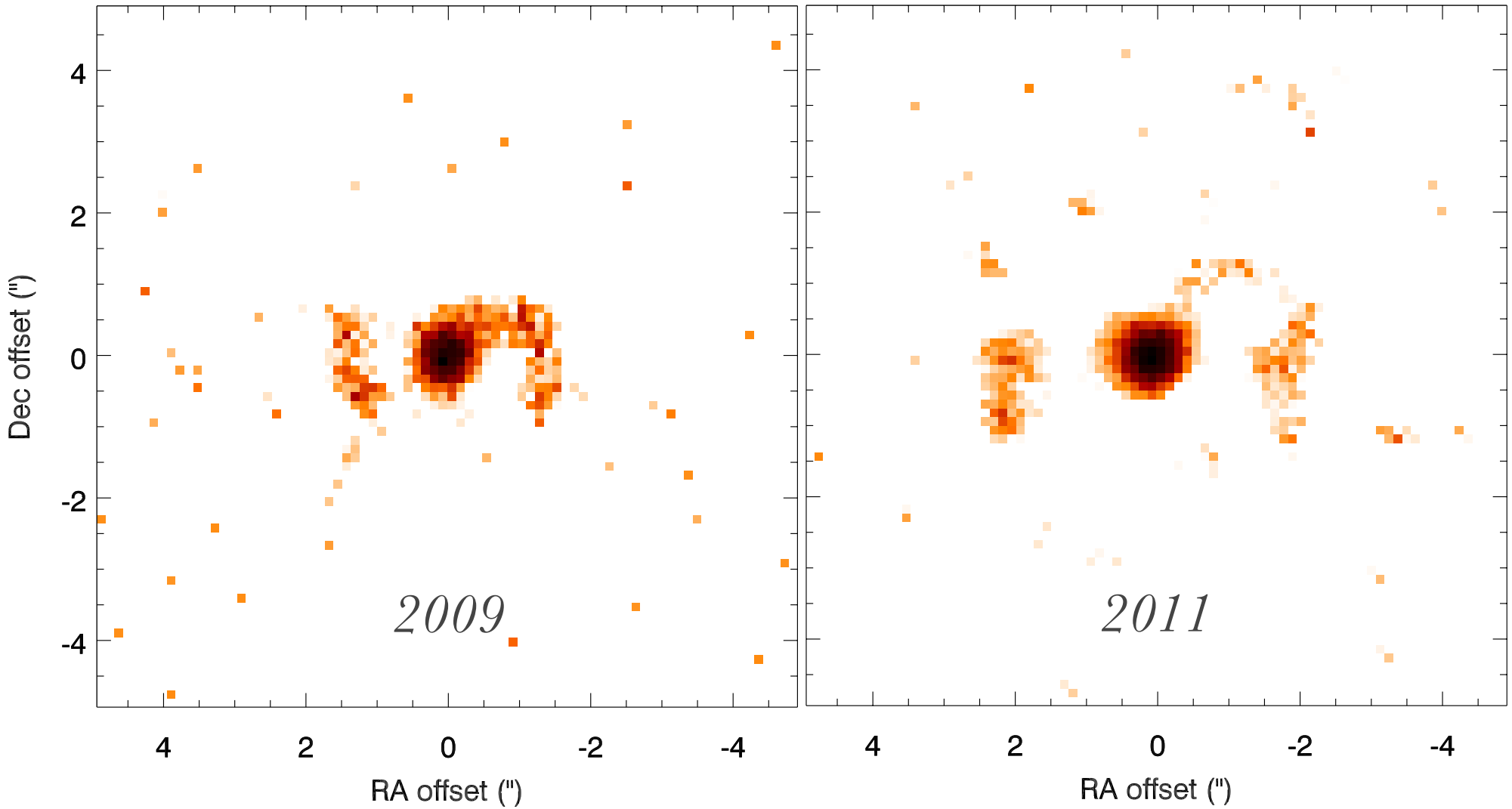
Extended X-ray Emission



Extended X-ray Emission



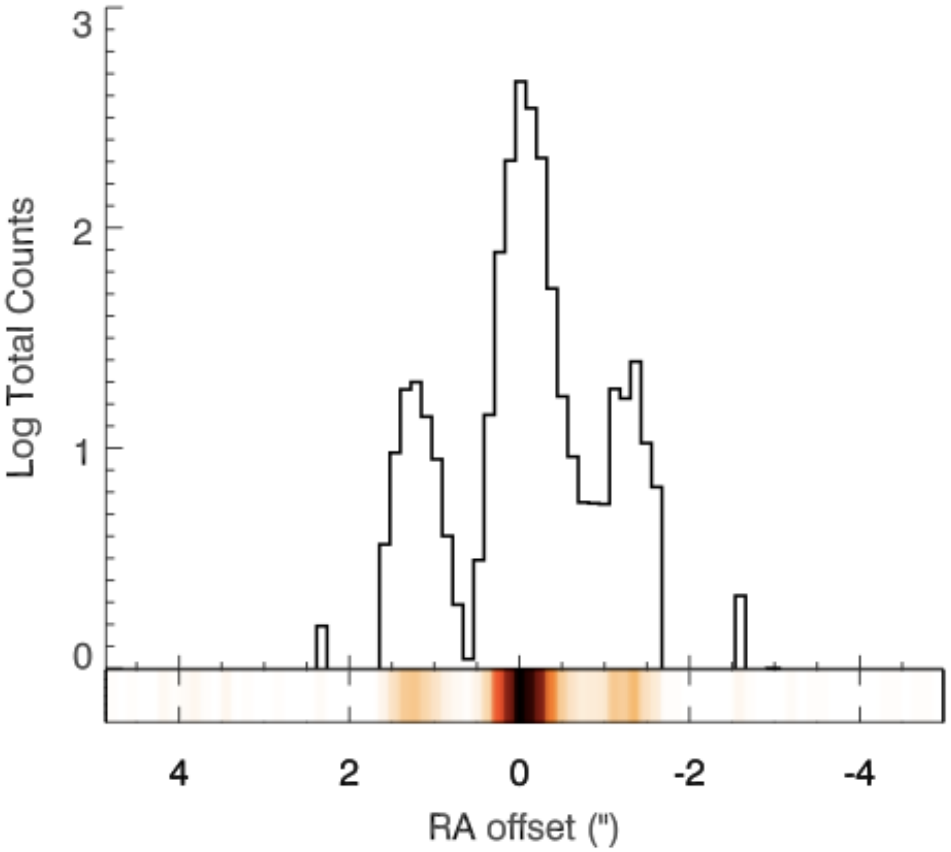
Extended X-ray Emission



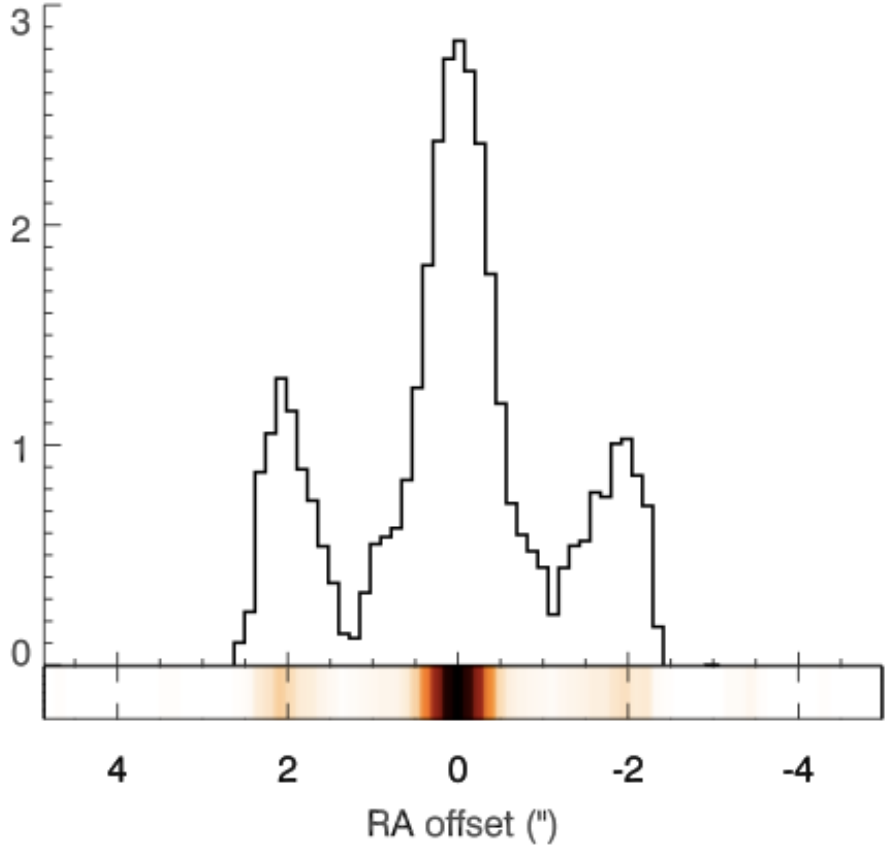
Extended X-ray Emission

E-W Profiles

2009



2011



Extended X-ray Emission

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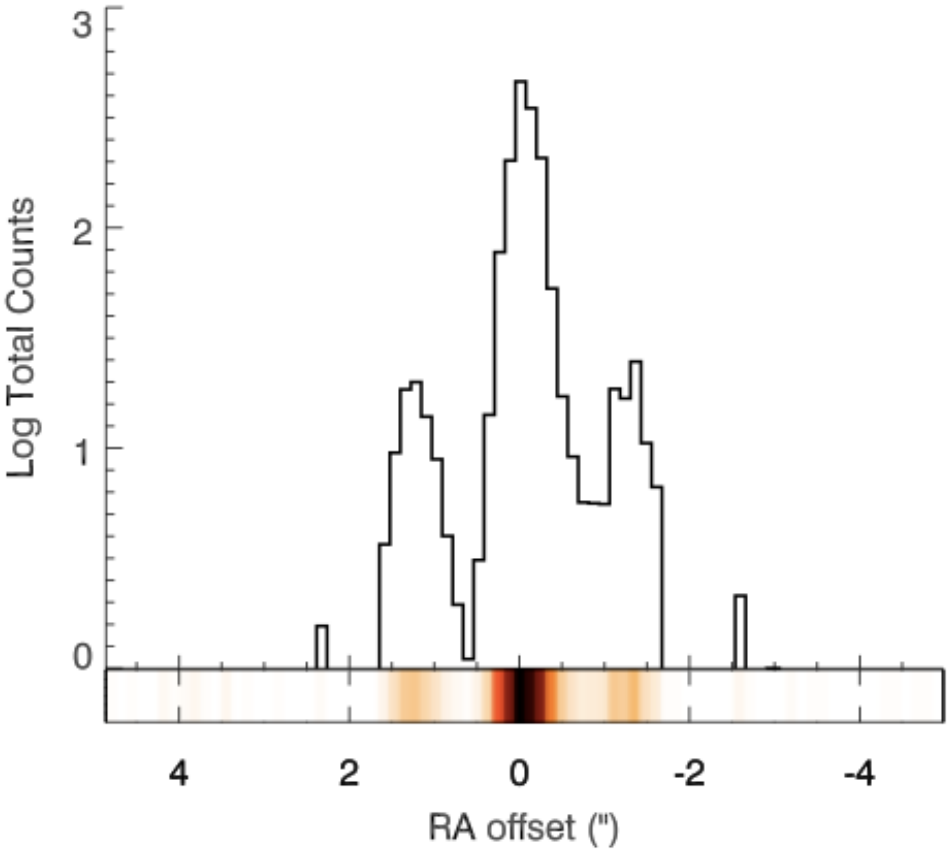

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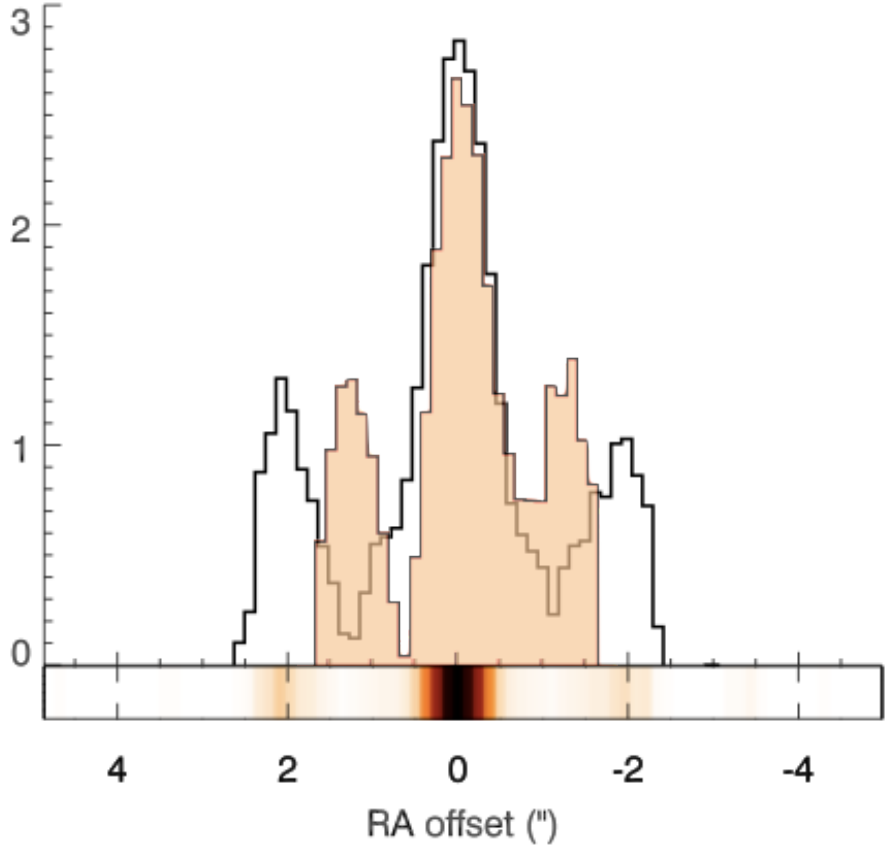

Extended X-ray Emission

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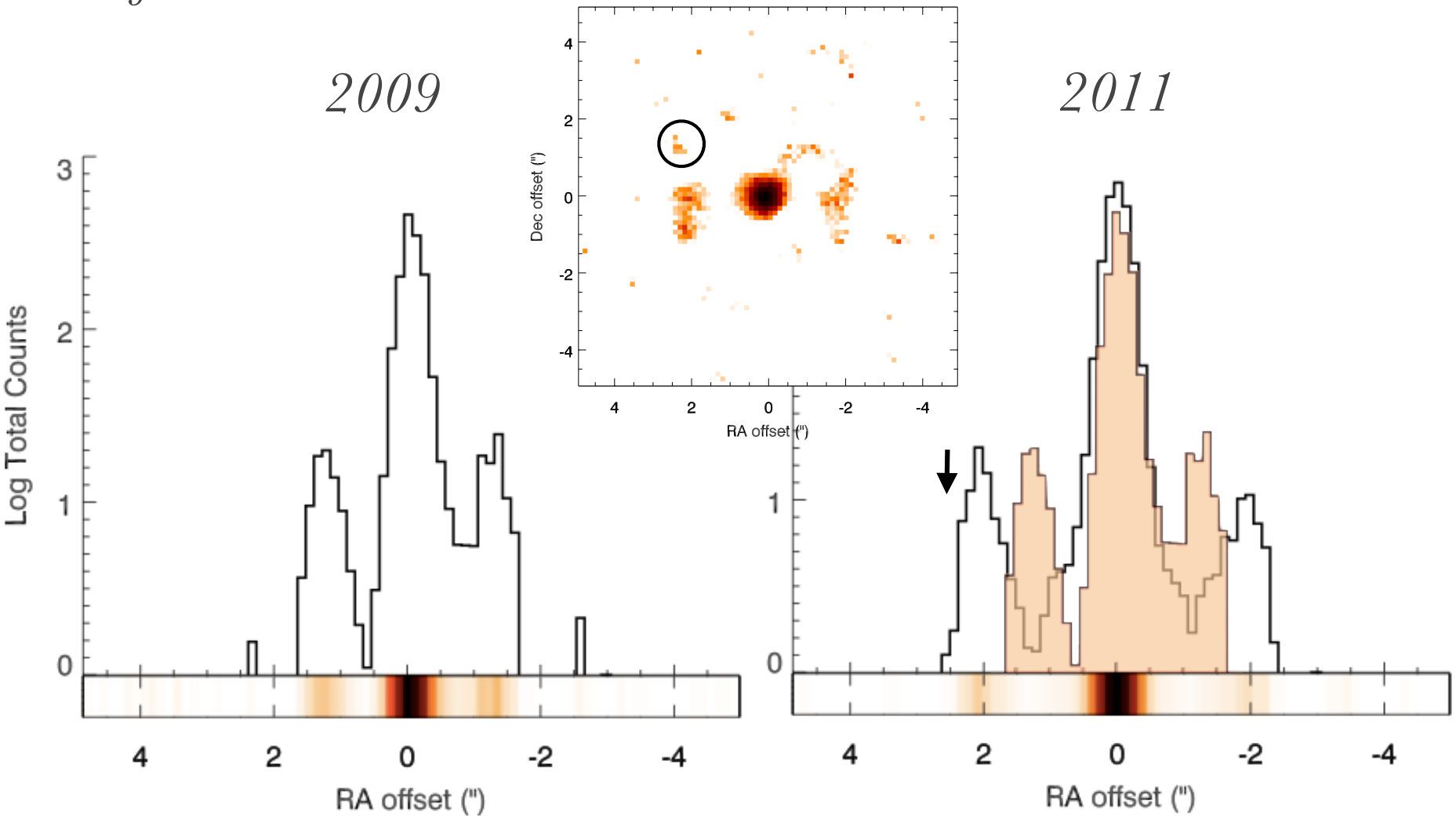
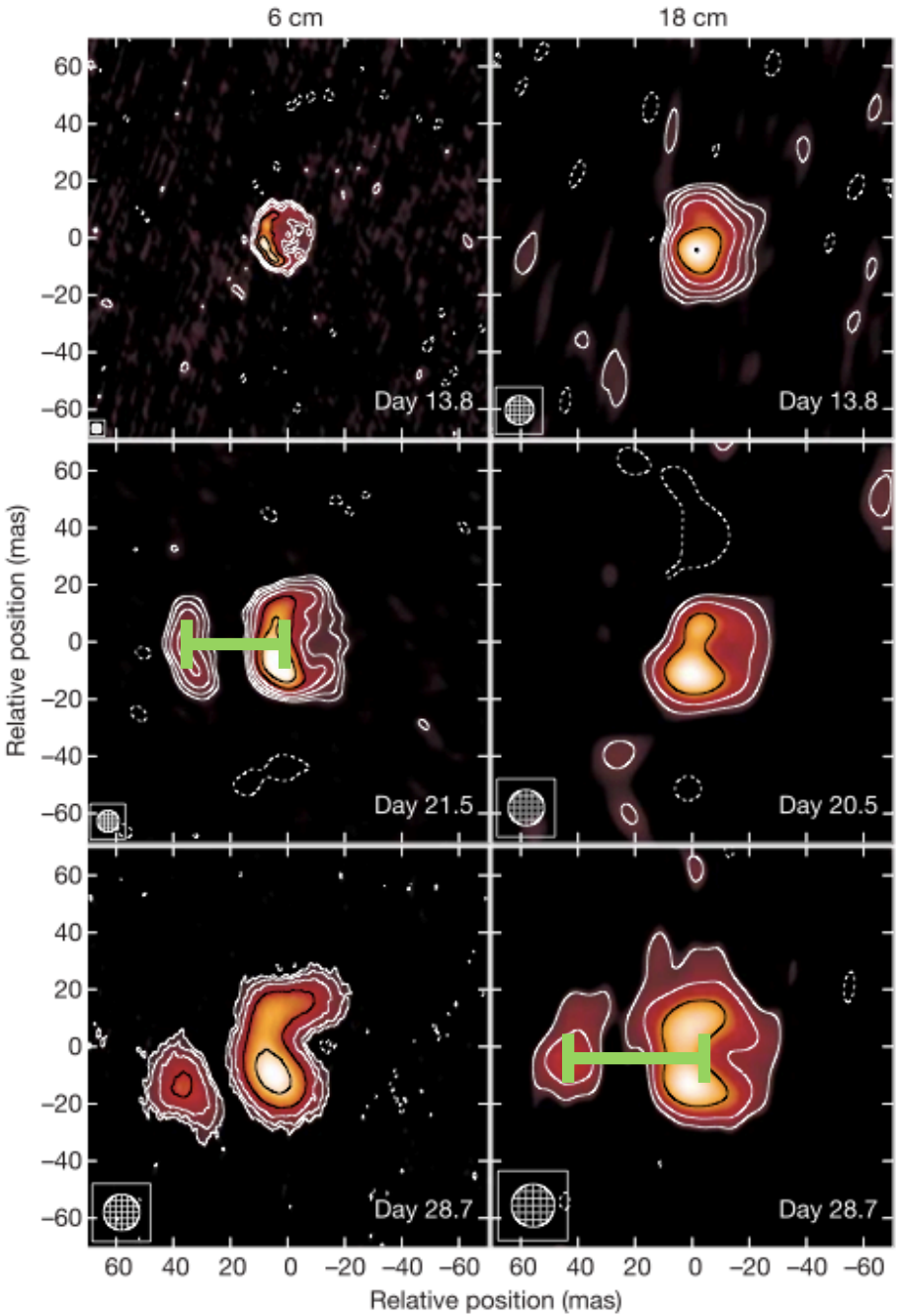


Multiwavelength Imaging

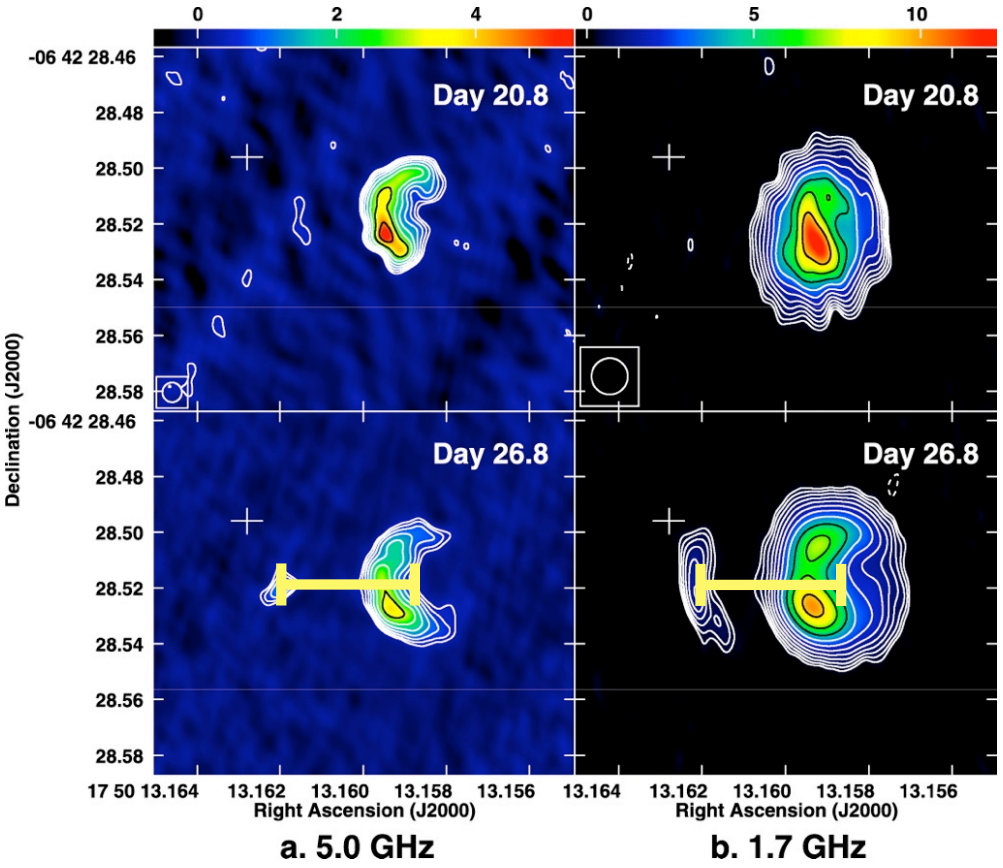
O'Brien et al. 2006



Observation Info	Observation Date	Day	Size (mas)
EVN (6 cm)	6-Mar-2006	21.5	38.6
VLBA (5 GHz)	11-Mar-2006	26.8	34.0
VLBA (18 cm)	13-Mar-2006	28.7	44.9
VLBA (6 cm)	13-Mar-2006	28.7	39.2
VLBA1	18-Mar-2006	34	56.8
VLBA2	23-Mar-2006	39	63.2
VLBA3	29-Mar-2006	45	70.9
VLBA4	4-Apr-2006	51	81.8
HST1	17-Jul-2006	155	180
HST2	7-May-2007	449	550
CXO (7457)	4-Aug-2007	537	<1000
CXO (9952)	20-Jul-2009	1254	1300
CXO (12403/4)	25-May-2011	1928	2000

Multiwavelength Imaging

Rupen et al. 2008



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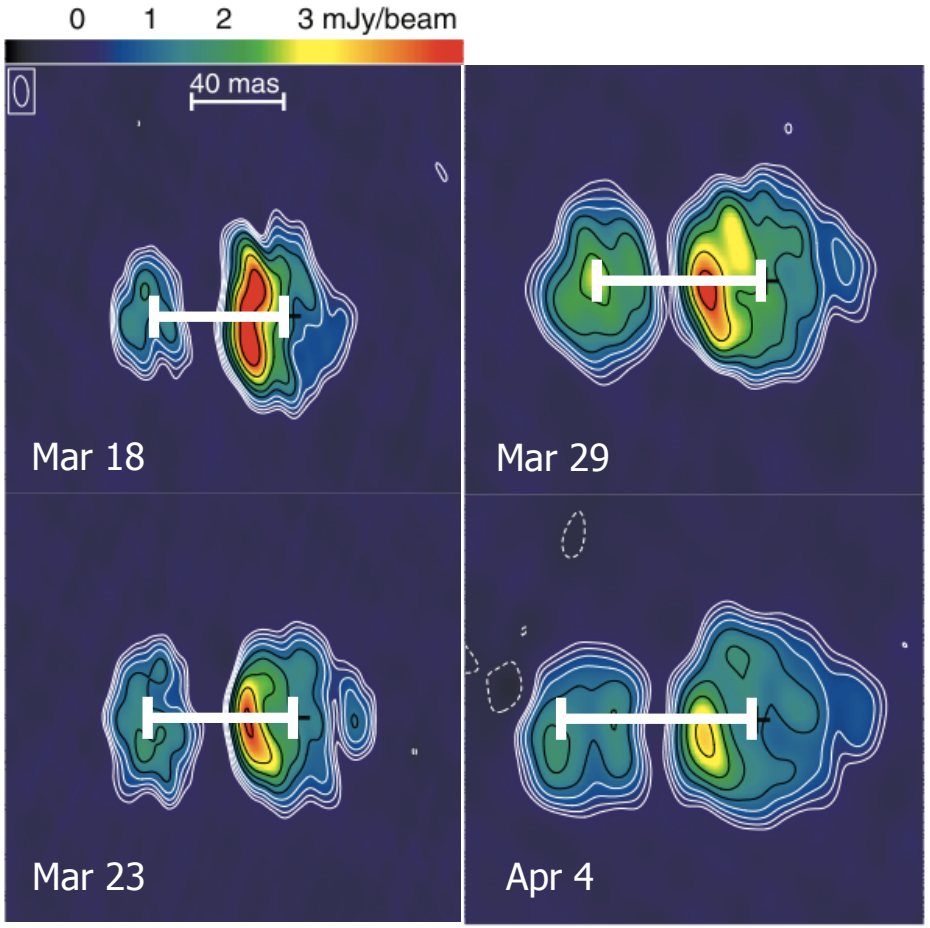
Multiwavelength Imaging

Sokoloski et al. 2008



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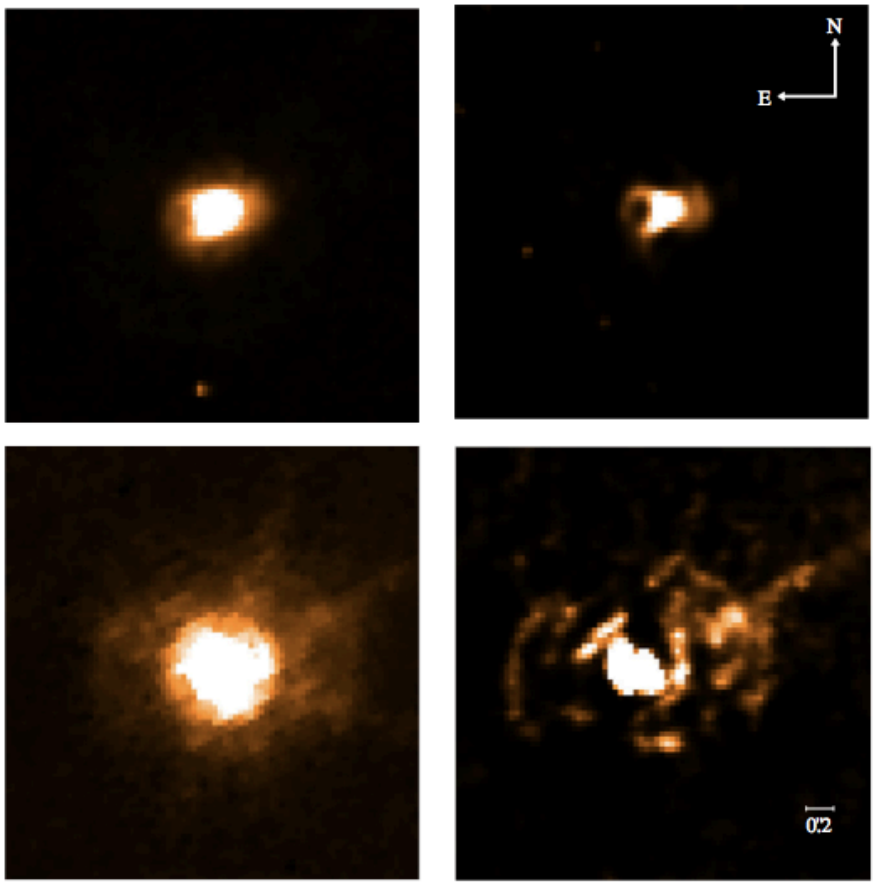
Multiwavelength Imaging

Ribeiro et al. 2009



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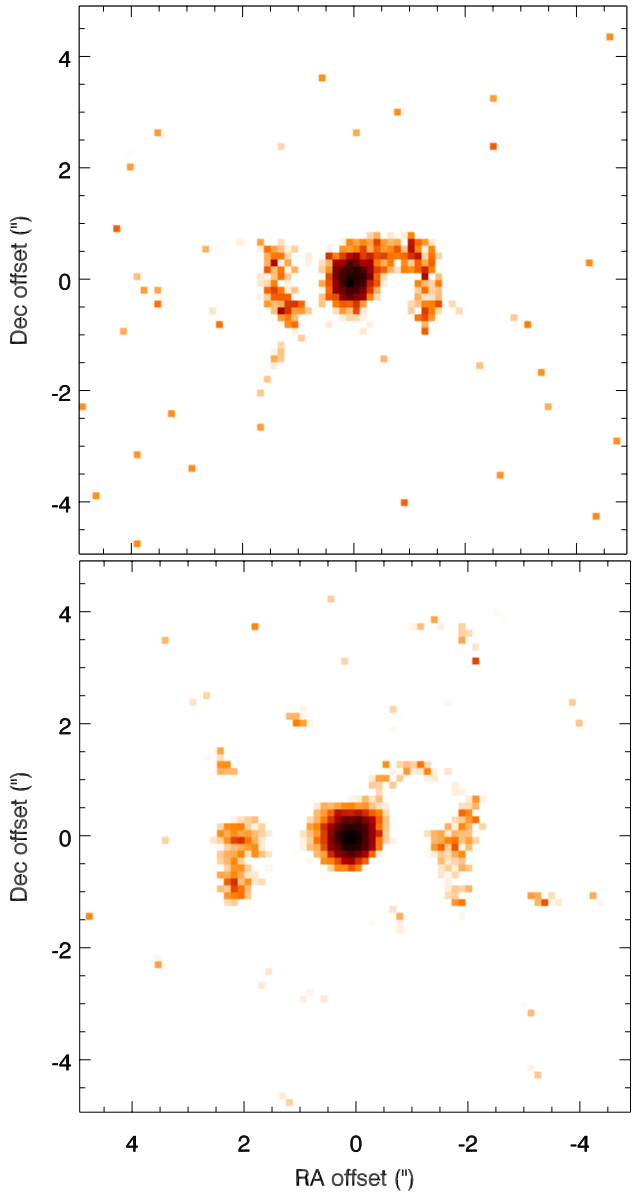
Multiwavelength Imaging

Montez et al. 2013 (in prep)



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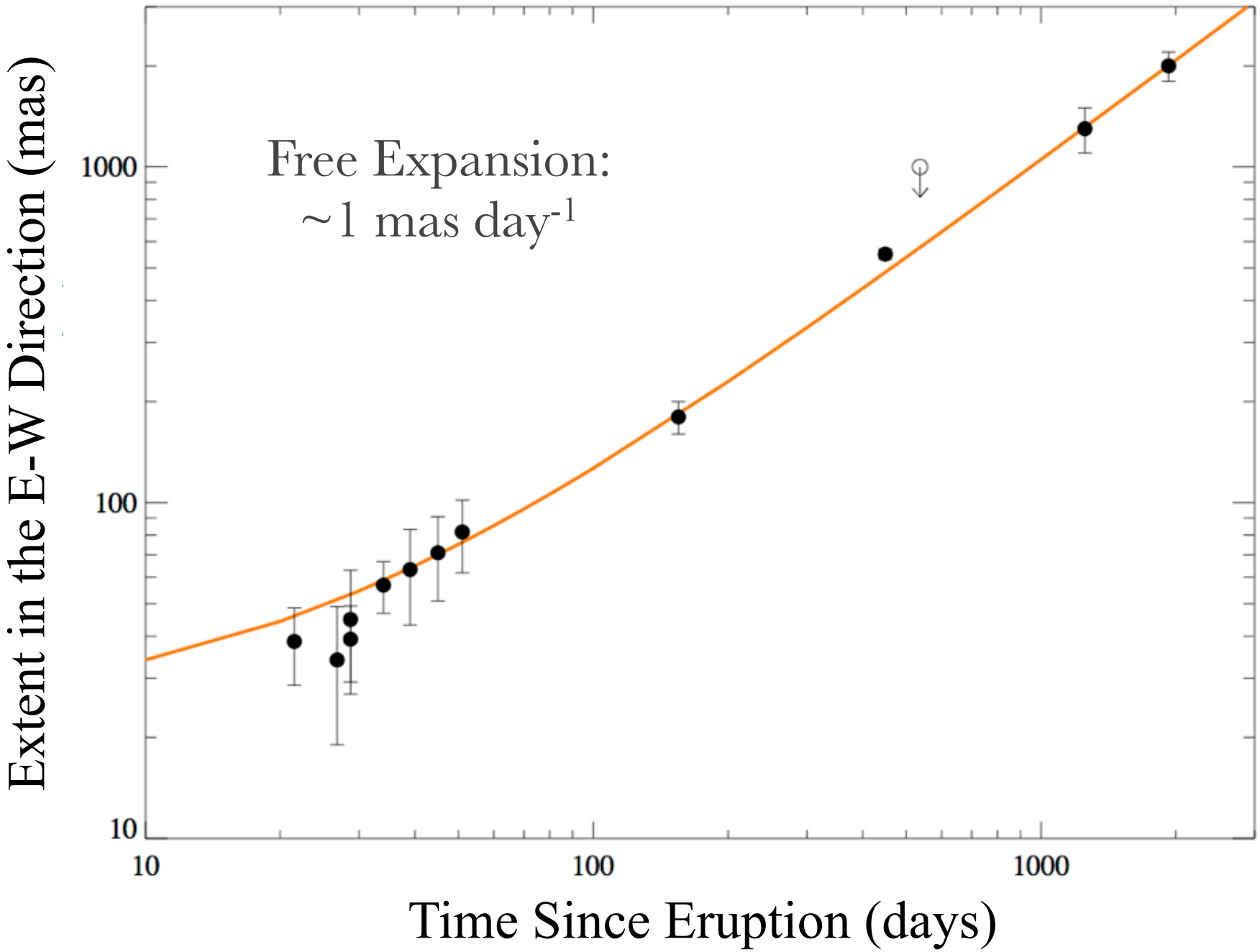
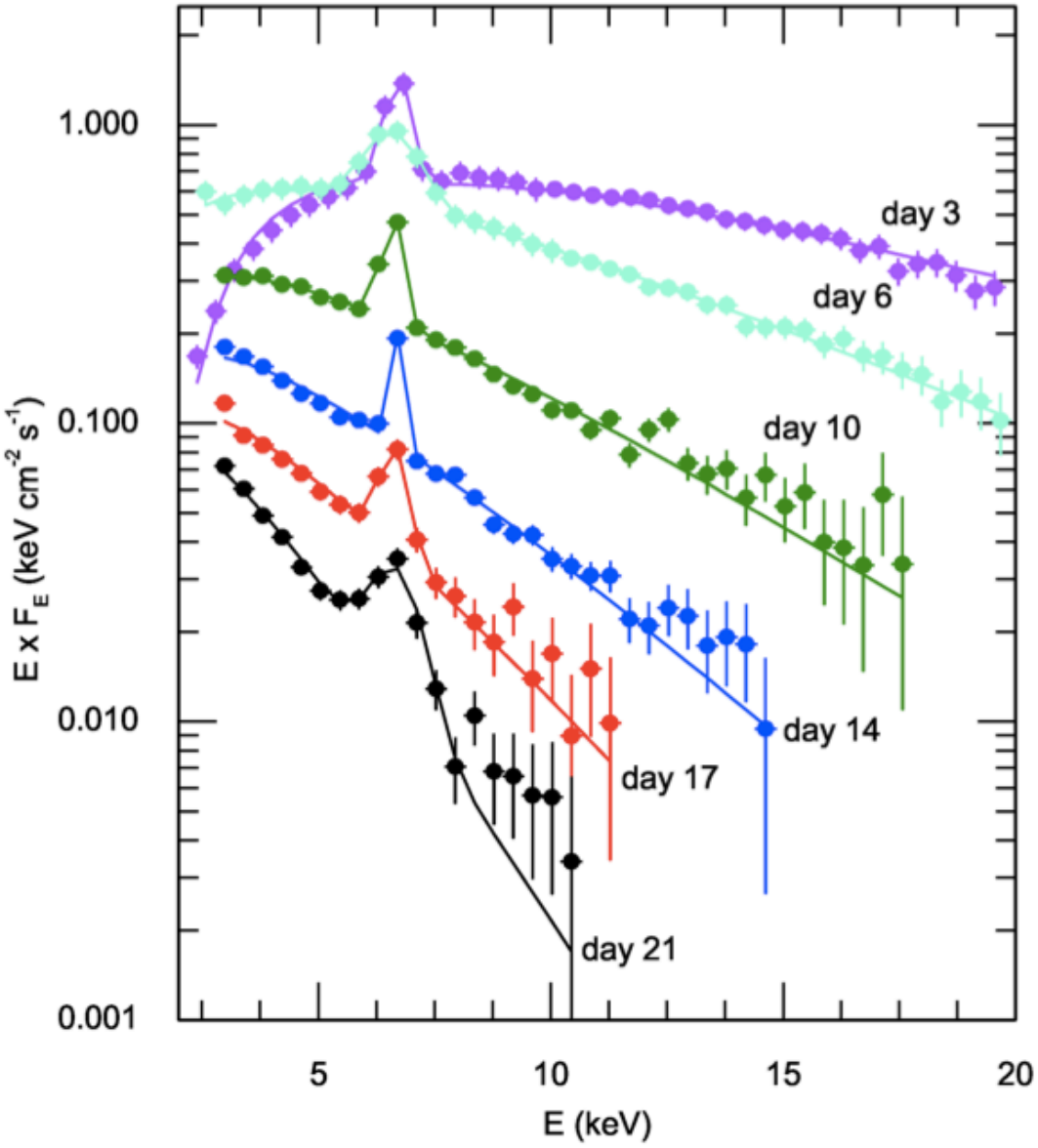
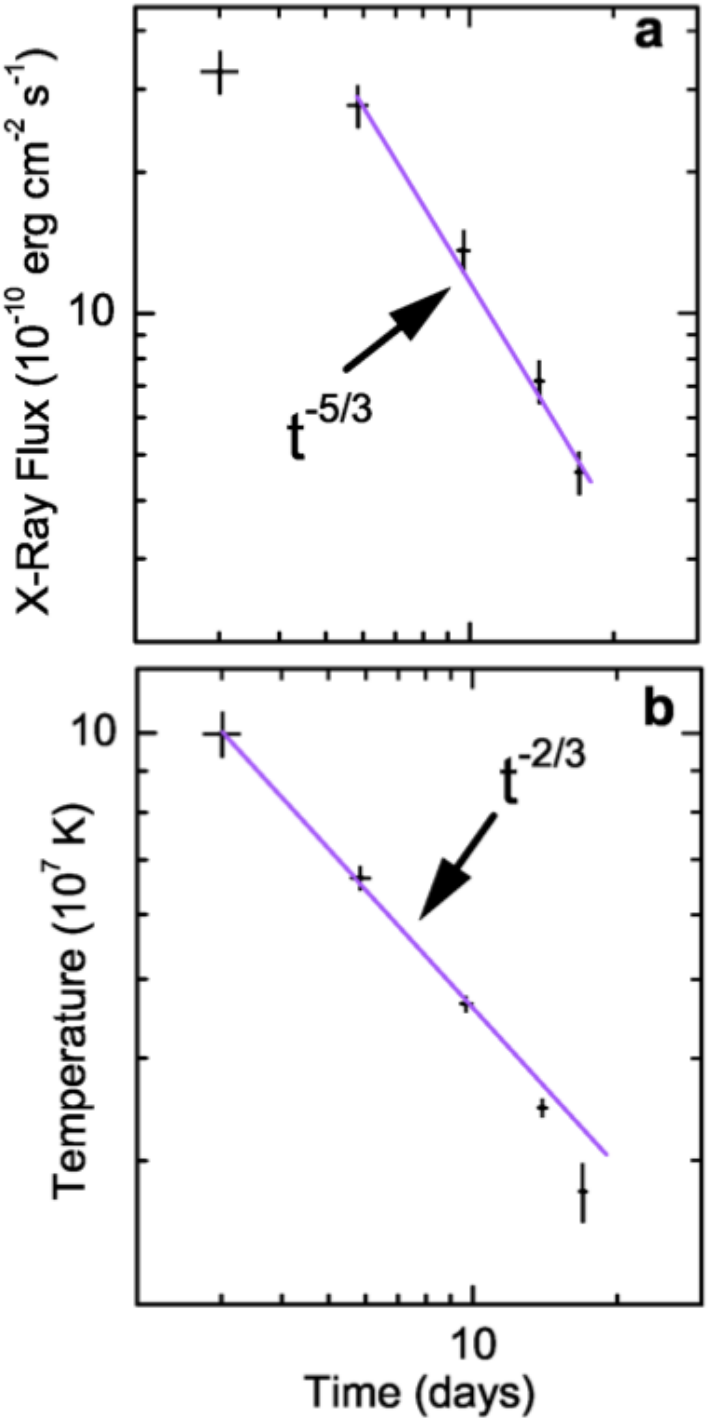
Freely Expanding Blastwave



Post-Sedov-Taylor Phase

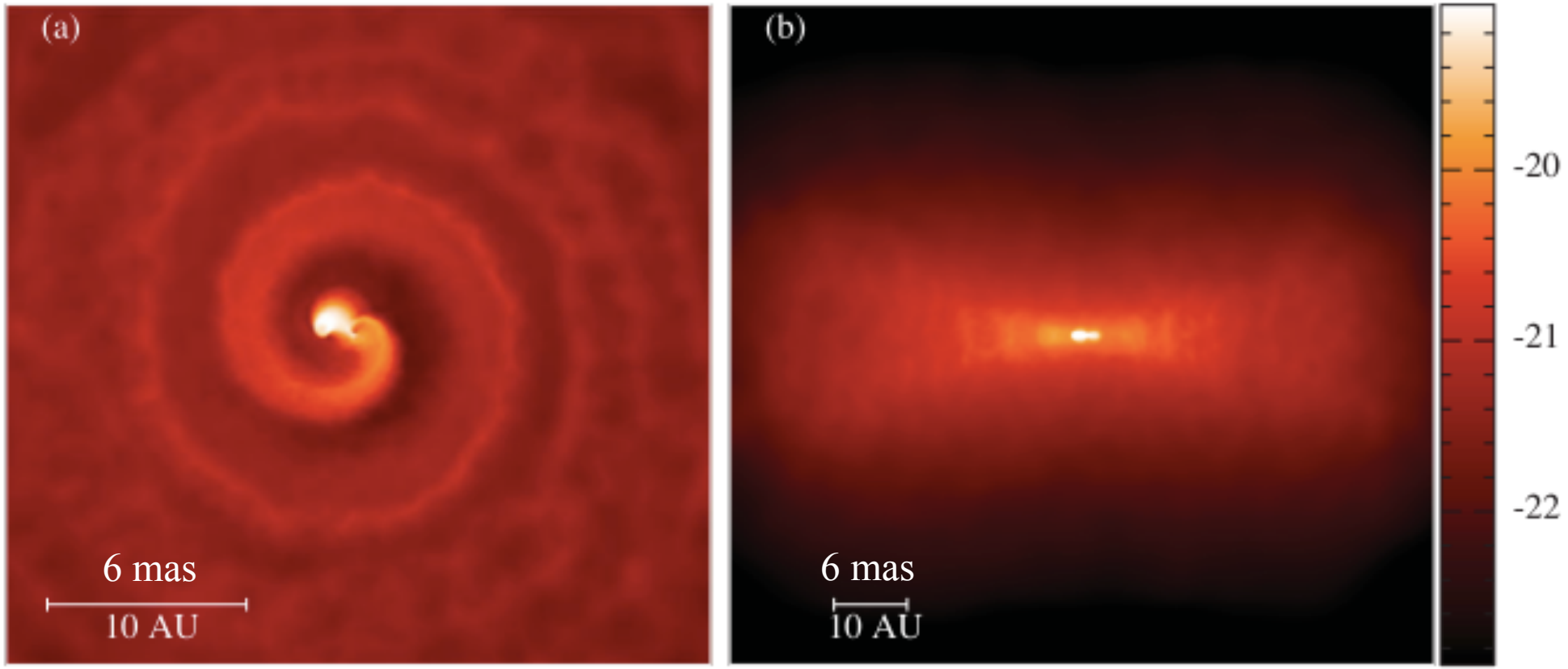
Sokoloski et al. 2006





Asymmetric Outflow of RS Oph

Mohamed et al. 2011



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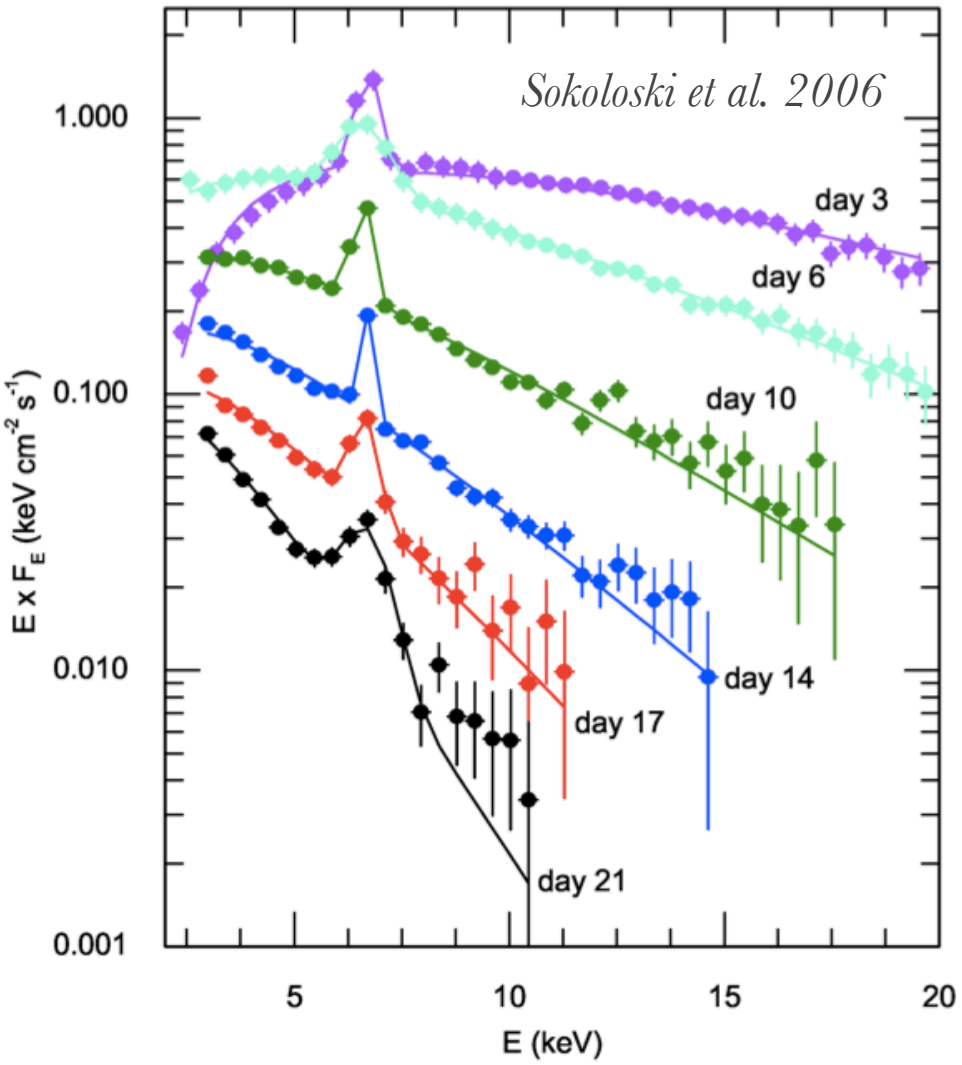

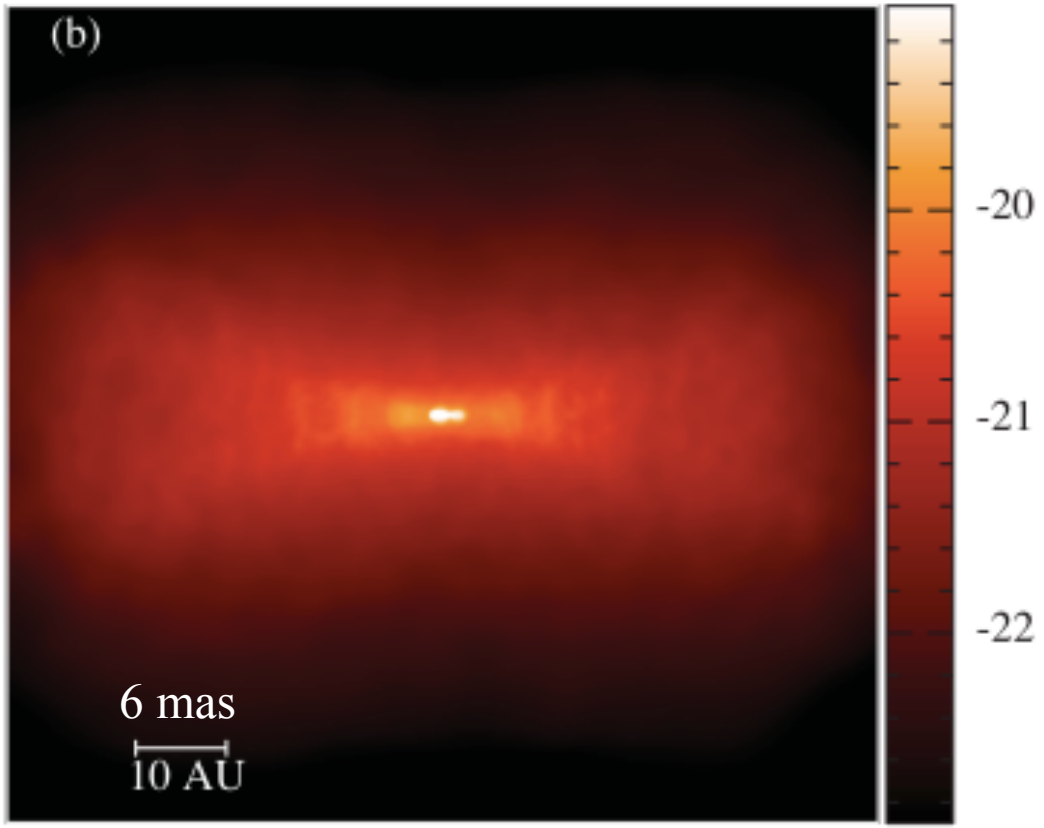

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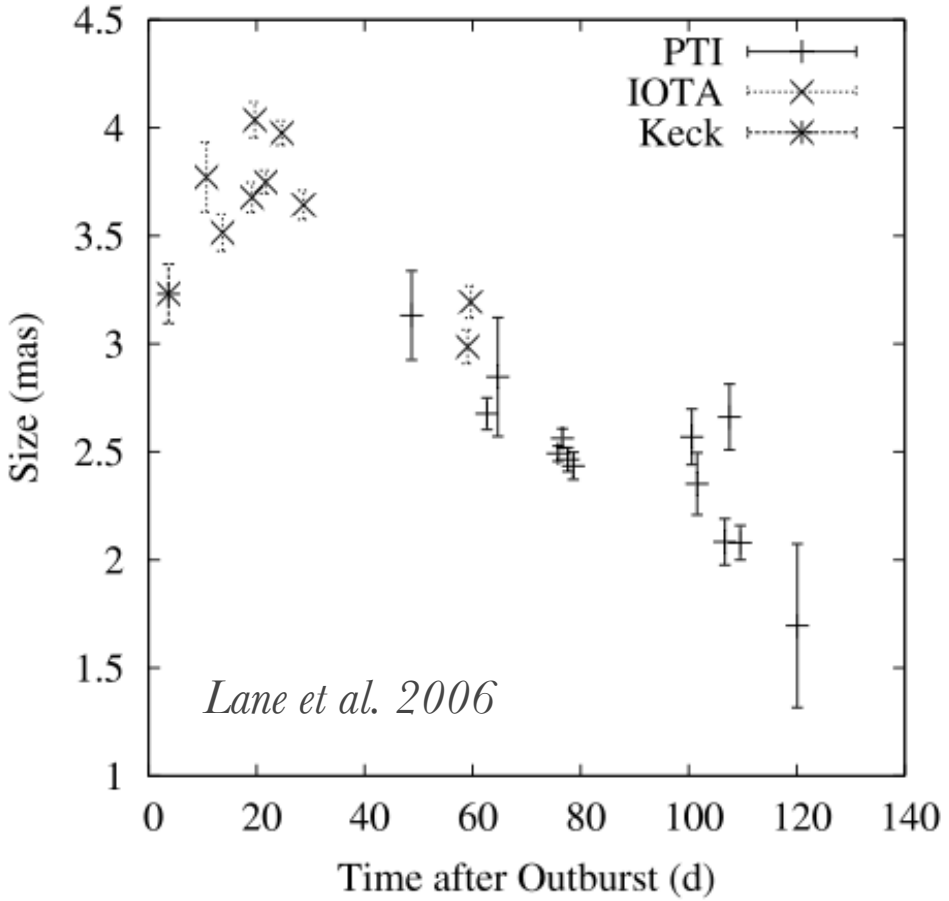
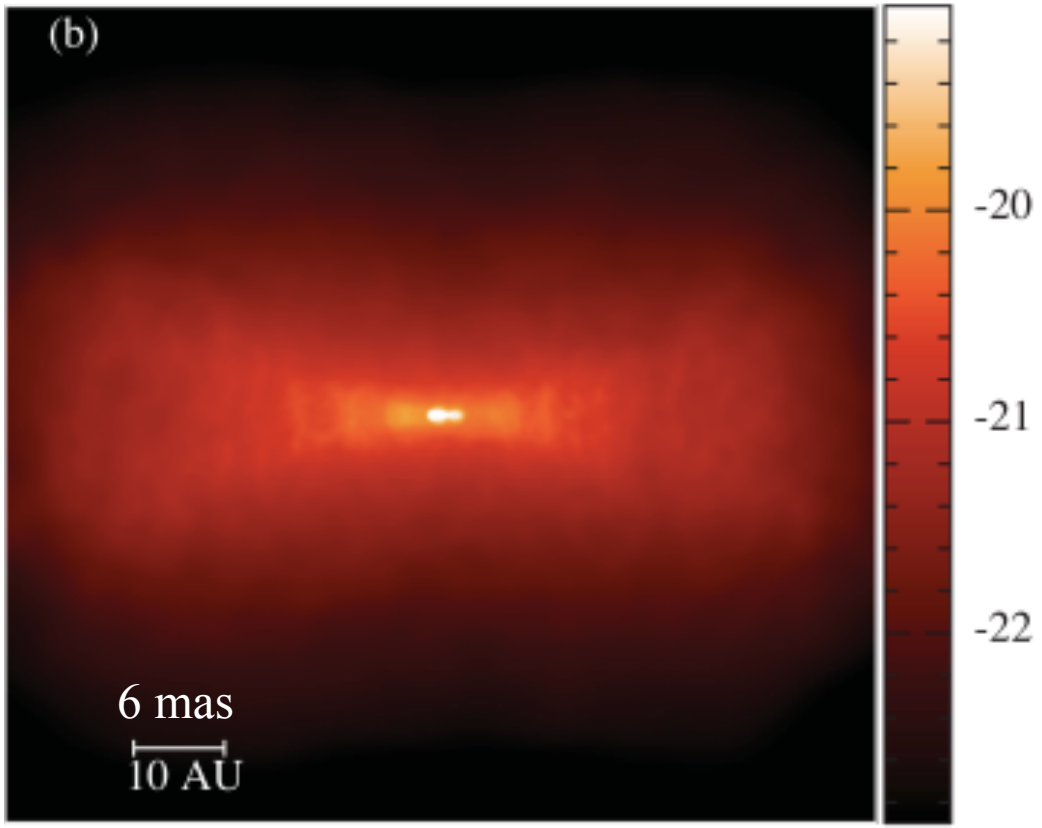
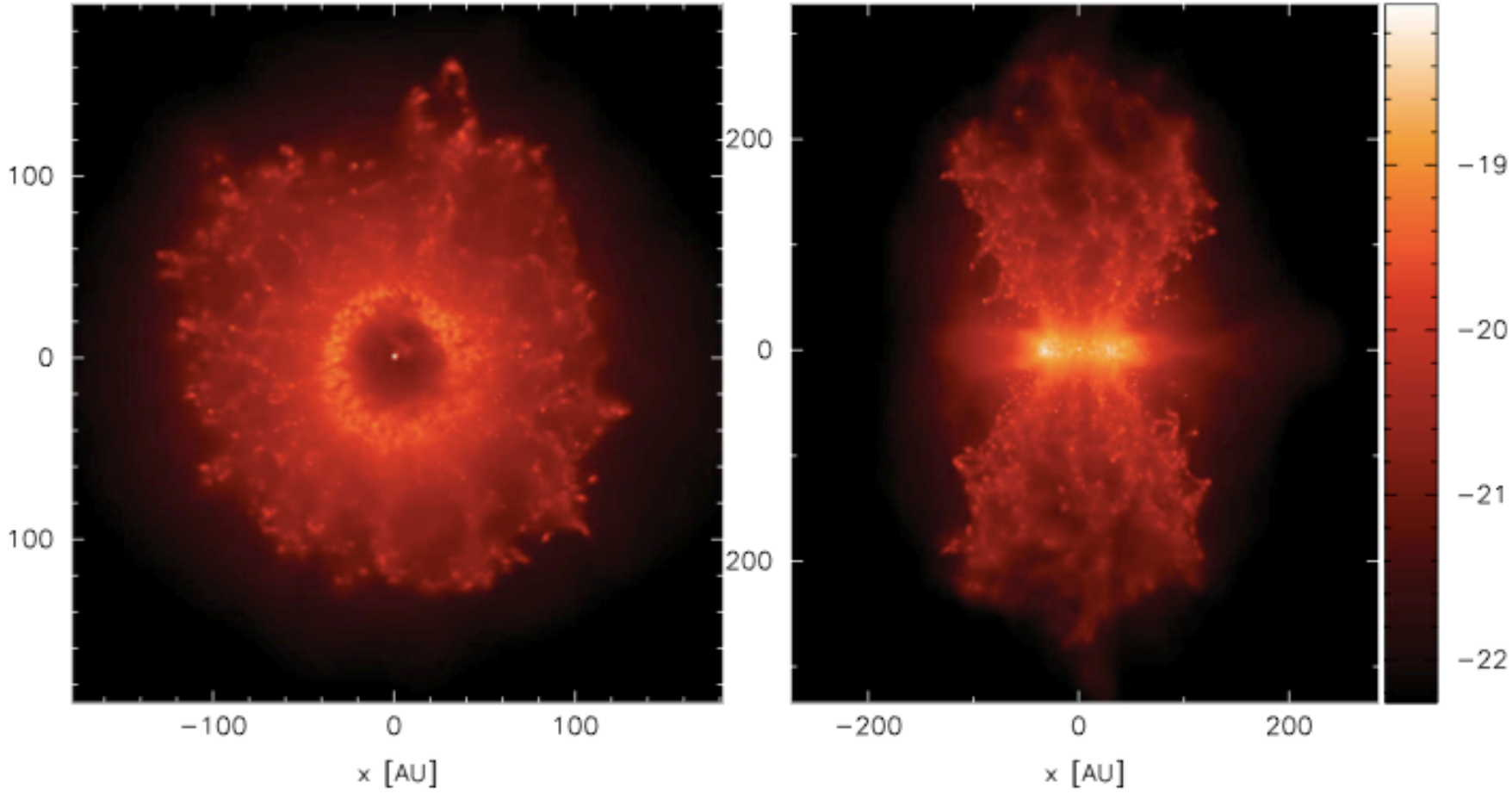


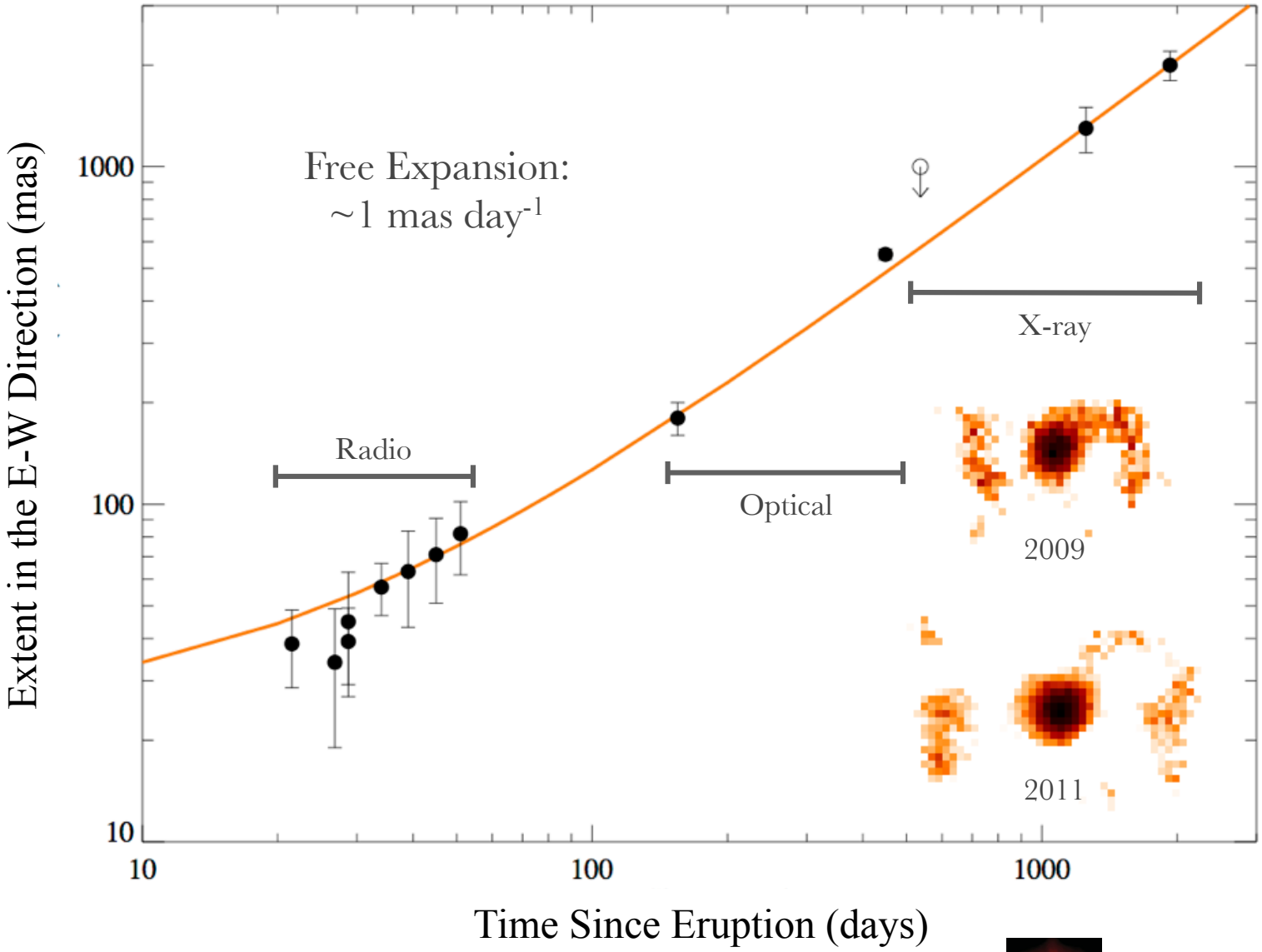


Asymmetric Outflow of RS Oph

Mohamed et al. 2011

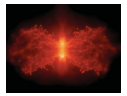


Conclusions



NIR

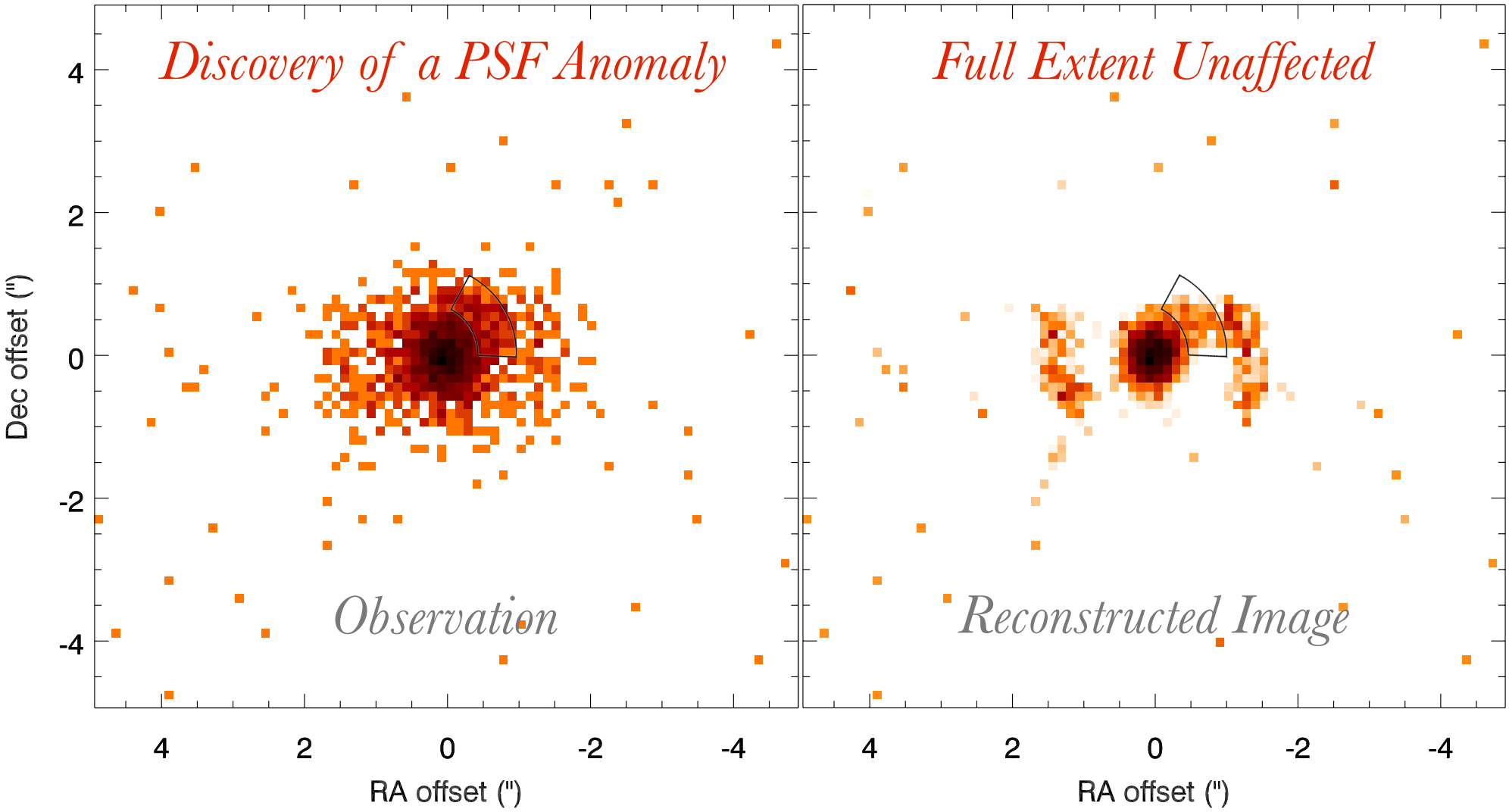
X-ray



Modeling

Thank you!

Extended X-ray Emission *(Caveat)*



Extended X-ray Emission *(Caveat)*