



# *The Chandra* Source Catalog 2.0

F. Civano (CfA/CXC)

On behalf of the *Chandra* Source Catalog team

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<sup>1</sup>Smithsonian Astrophysical Observatory

<sup>3</sup>Northrop Grumman Mission Systems

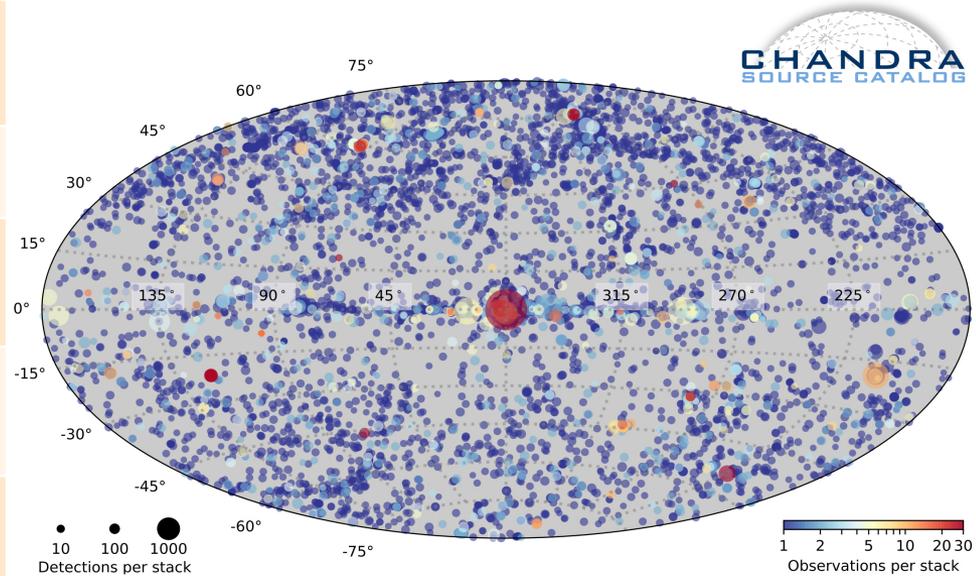
<sup>2</sup>Formerly Smithsonian Astrophysical Observatory

<sup>4</sup>MIT Kavli Institute for Astrophysics and Space Research



# CSC 2.0 in numbers

	CSC 1	CSC 2
<b>Individual obsids</b>	5110	10,382
<b>Obsid years</b>	1999-2009	1999-2014
<b>Total exposure</b>		245.8 Ms
<b>longest exposure</b>	190 ks	5.8 Ms
<b>Counts on-axis</b>	~10	~5
<b>Number of sources</b>	106,586	315,875
<b>Number of detections</b>	158,071	374,349



~550 deg<sup>2</sup>  
Area covered  
~1.3% of sky

# CSC 2.0 features

CHANDRA  
SOURCE CAT

- **Source detection on stacked observations**

- New source detection approach

- Wavelet detection with “permissive” parameters *plus* entirely new Voronoi tessellation algorithm for both background determination *and* source detection

- Maximum likelihood estimator grades candidate detection and improves on-axis detection limit to  $\sim 5$  net counts for exposures  $< 15$  ks

- MCMC draws provide relative astrometry position error *ellipses*

- Aperture photometry PDFs computed using Bayesian algorithms

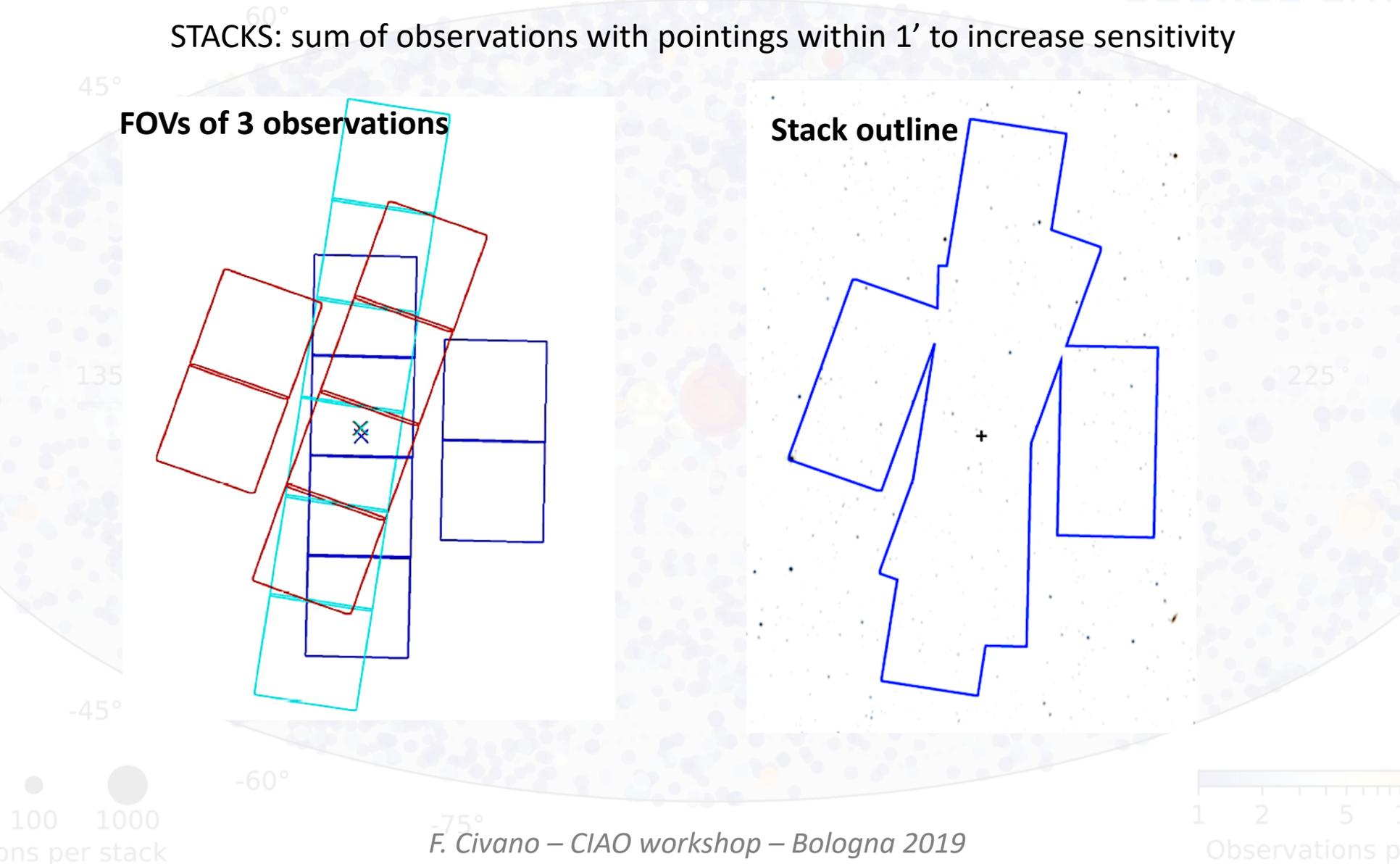
- Multiple observations grouped by multi-band Bayesian Blocks algorithm to improve S/N even for variable sources (properties archived for each block)

- Integrated multi-band limiting sensitivity computed on  $4'' \times 4''$  pixels

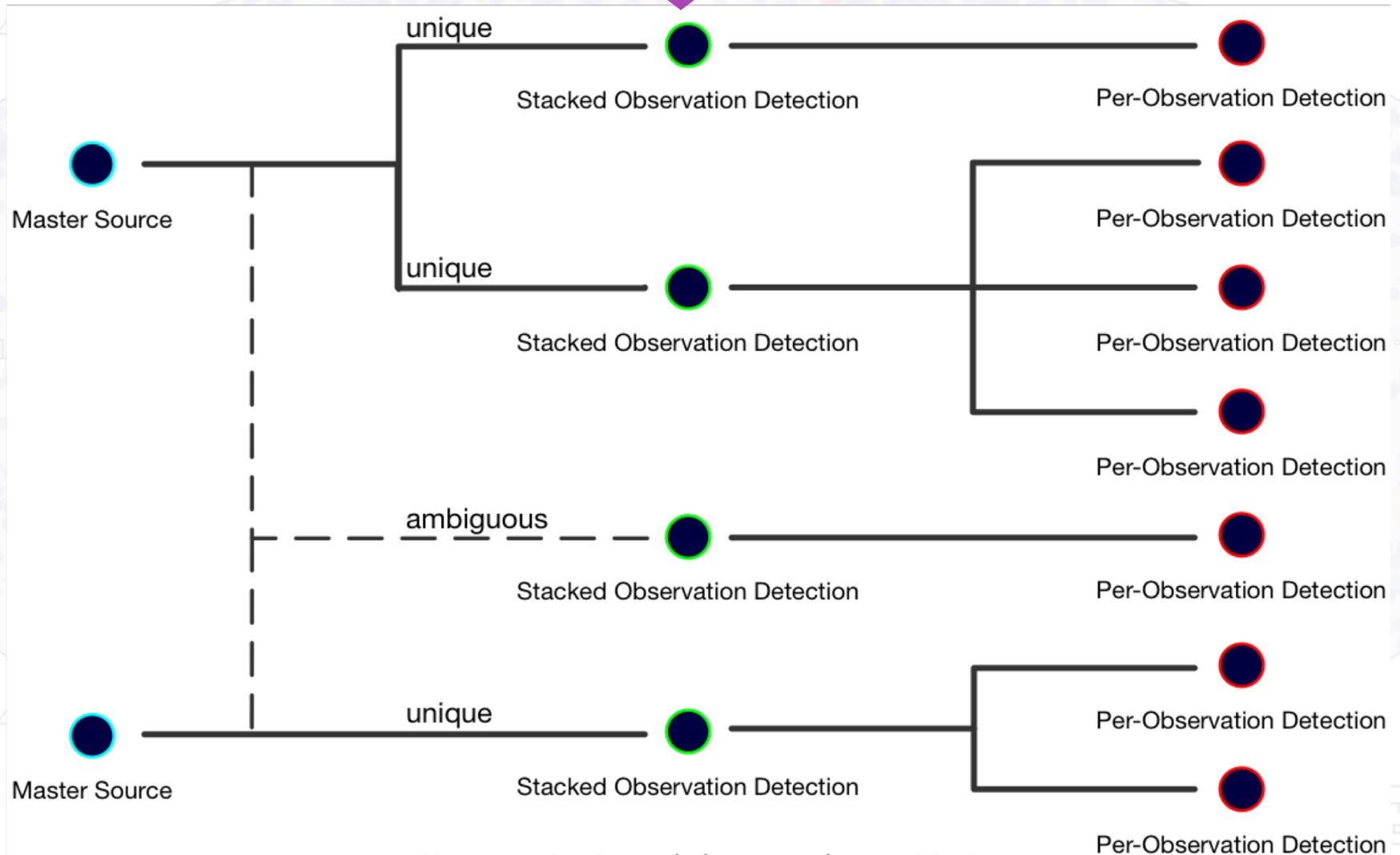


# Stacked observations

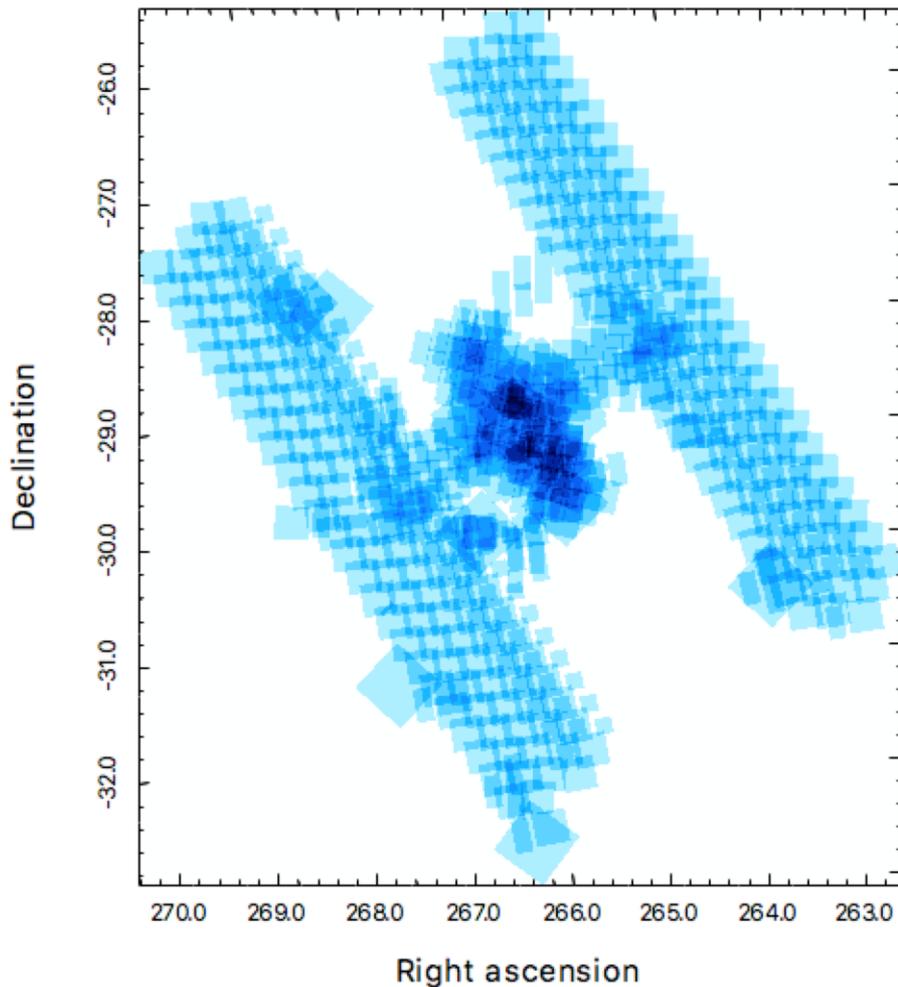
STACKS: sum of observations with pointings within 1' to increase sensitivity



# Source detection hierarchy



# Example: Galactic Center Area



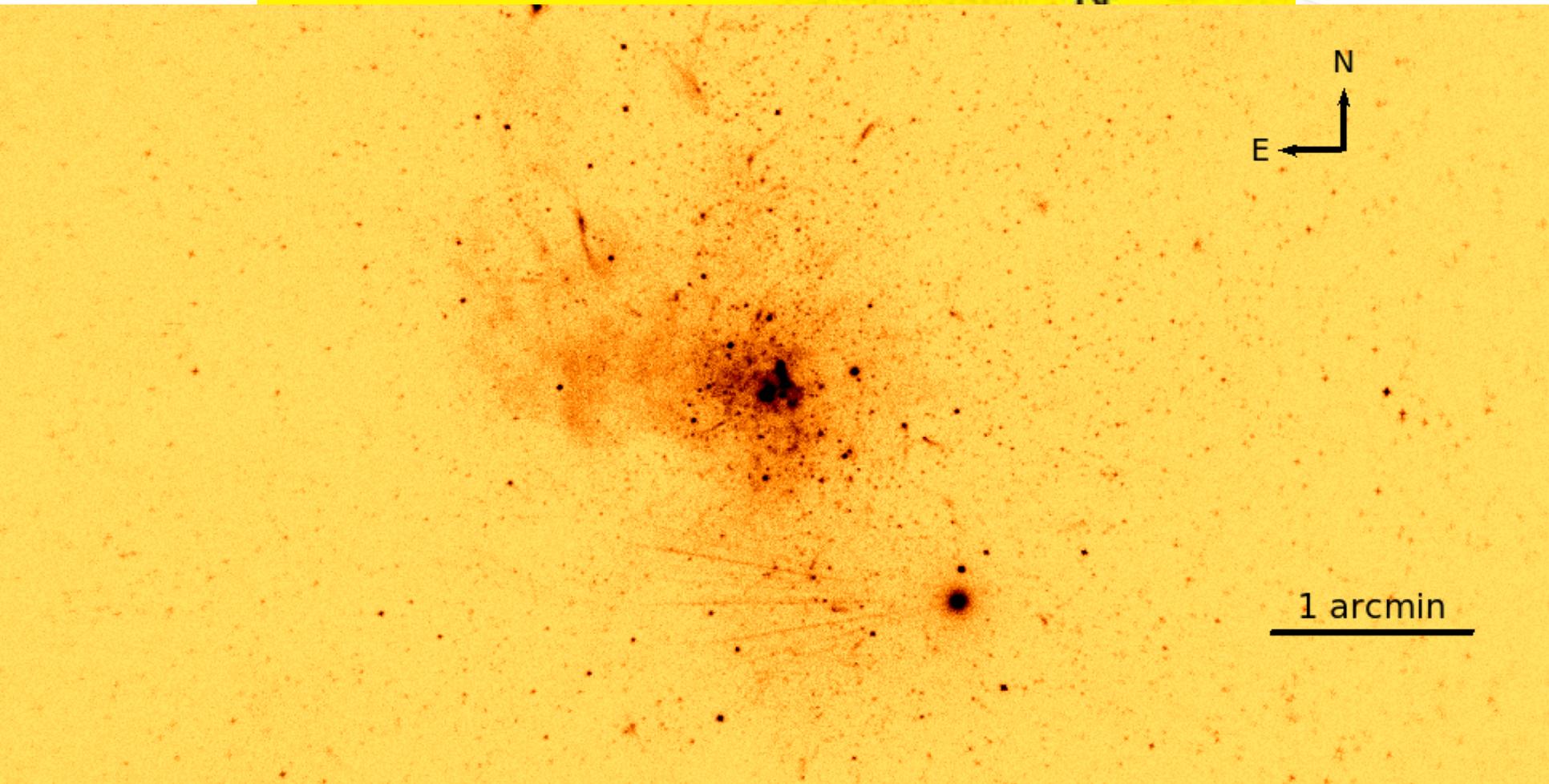
- 534 single *Chandra* observations
- 379 stacks (36 HRC and 343 ACIS)
- Total area covered  $\sim 19 \text{ deg}^2$
- Total exposure time  $\sim 9 \text{ Ms}$

100 1000  
ons per stack

1 2 5  
Observations p

# Example: Galactic Center Area

Sgr A\* - central stack of 71 observations



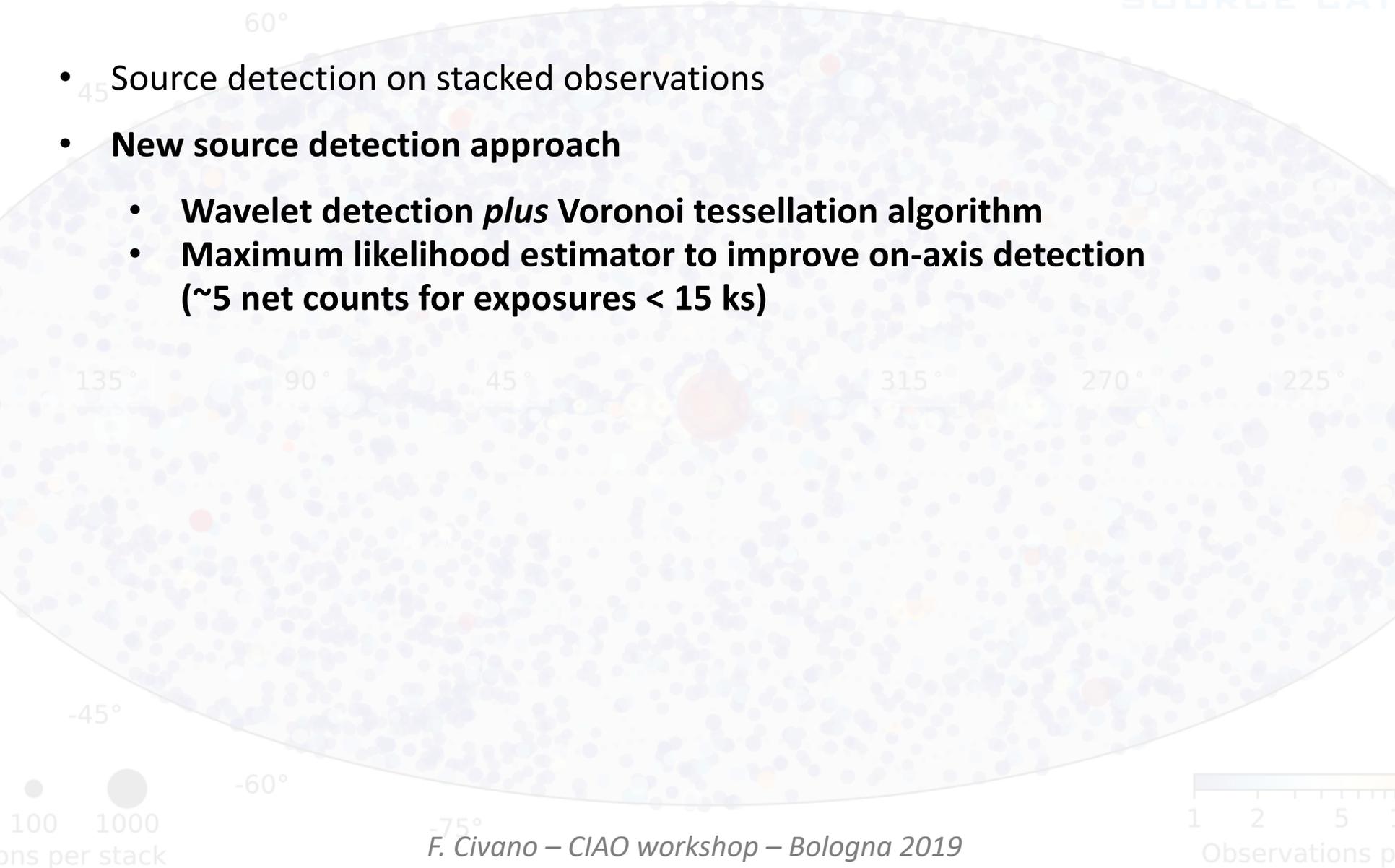
100 1000  
ons per stack

1 2 5  
Observations p

# CSC 2.0 features

CHAND  
SOURCE CAT

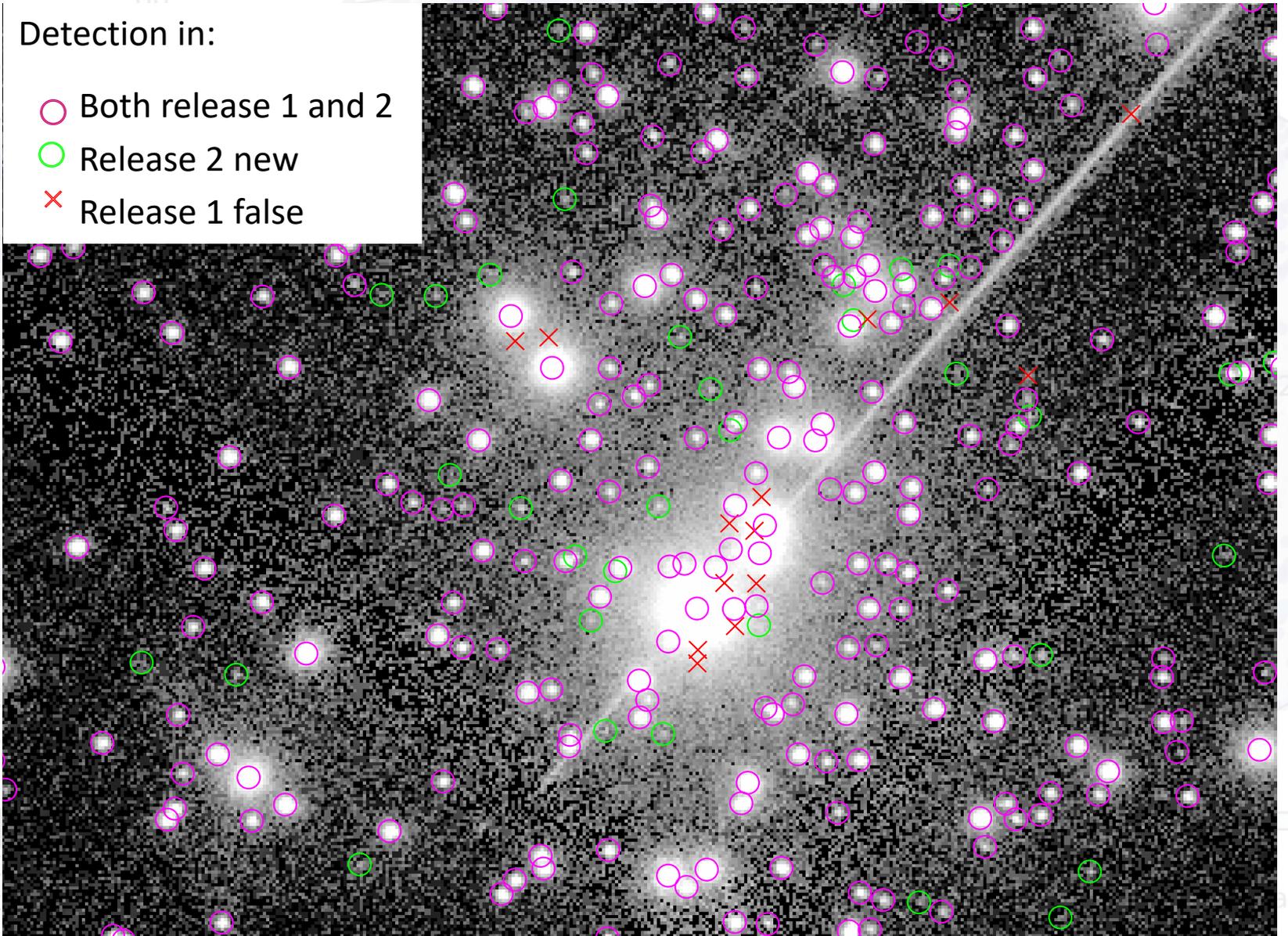
- Source detection on stacked observations
- **New source detection approach**
  - **Wavelet detection *plus* Voronoi tessellation algorithm**
  - **Maximum likelihood estimator to improve on-axis detection (~5 net counts for exposures < 15 ks)**



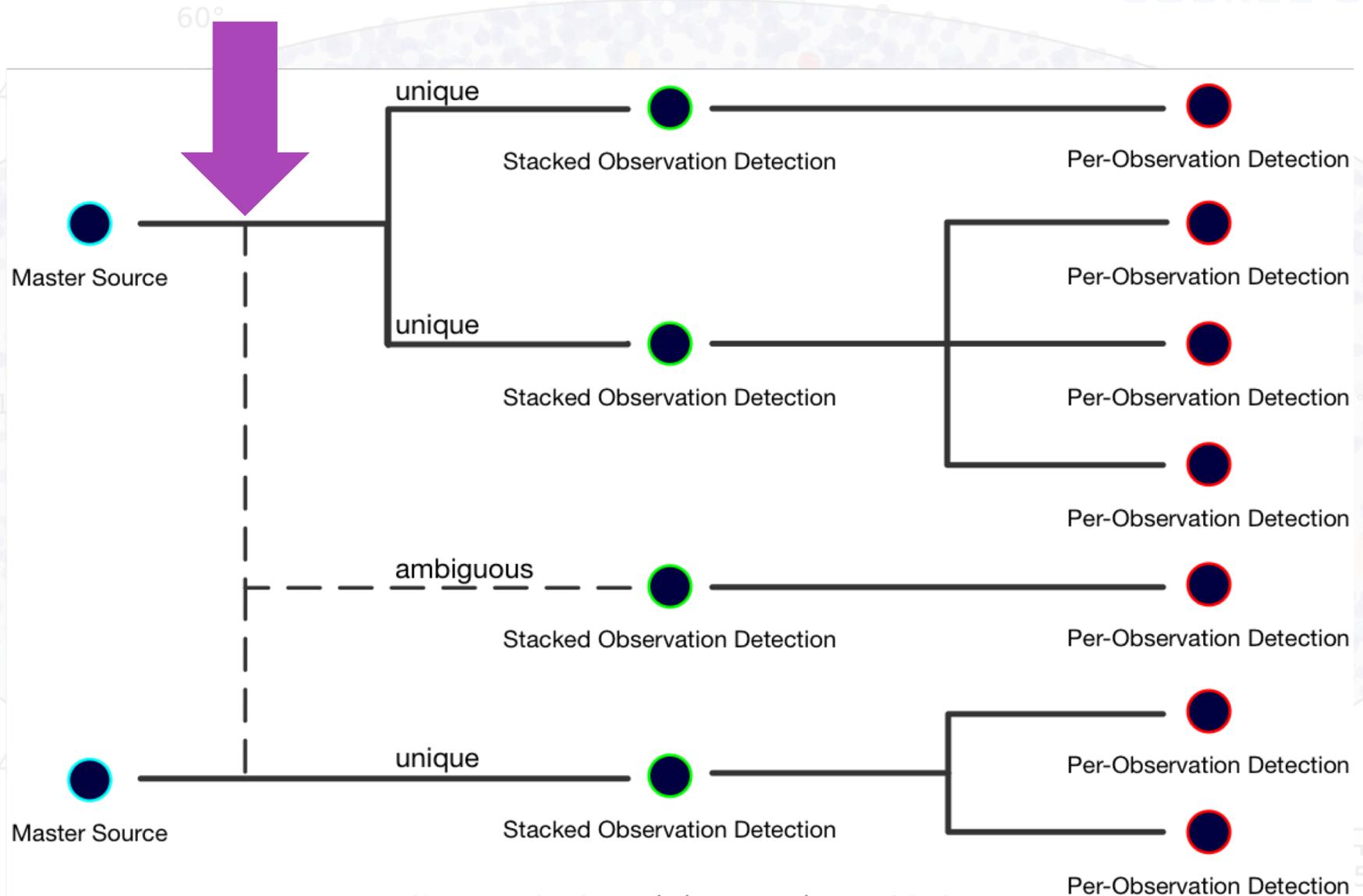
# Detection: reaching the faintest sources

Detection in:

- Both release 1 and 2
- Release 2 new
- × Release 1 false



# Master matching process



# Detections and sources

On-axis: *Chandra* PSF is small ( $\sim 1''$ )

detect\_id  
acisfj1626350m242314\_001.0013

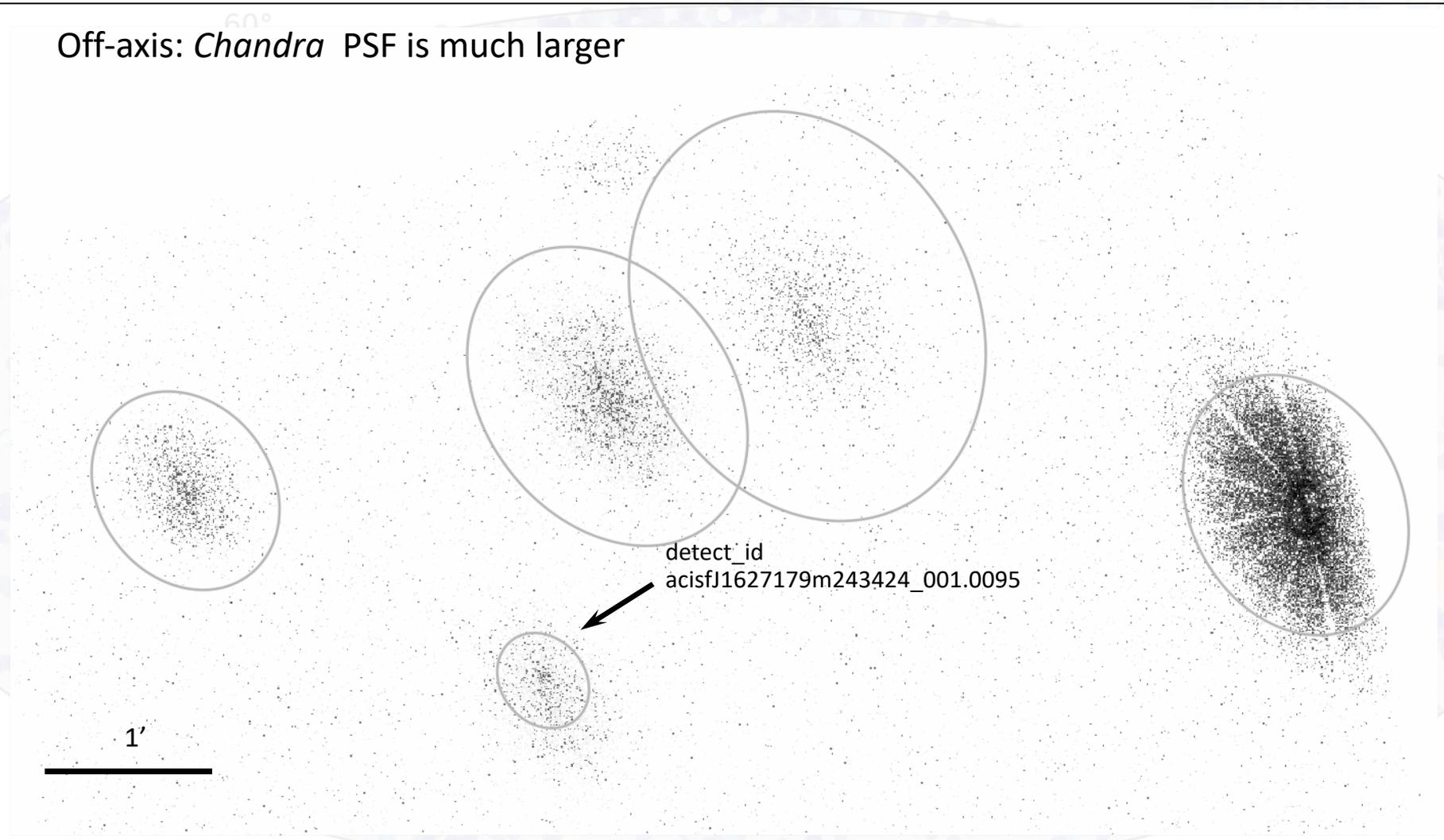
detect\_id  
acisfj1626350m242314\_001.0078

detect\_id  
acisfj1626350m242314\_001.0012

1'

# Detections and sources

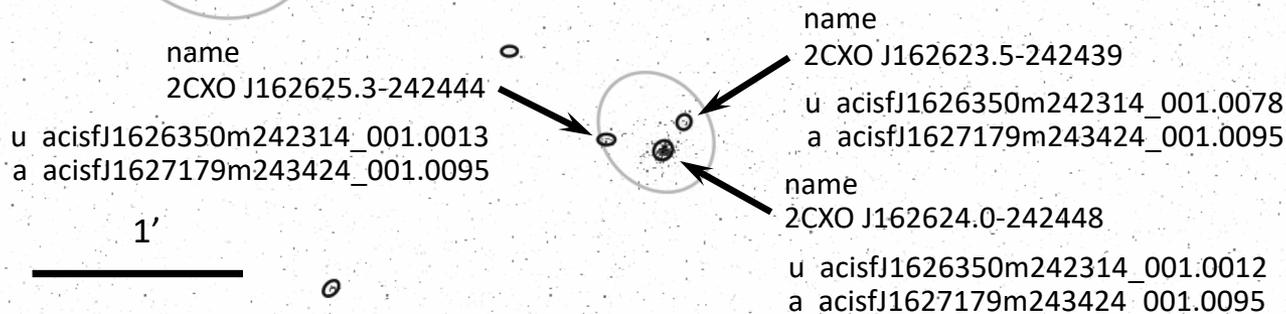
Off-axis: *Chandra* PSF is much larger



# Detections and sources

Multiple sources on-axis may be **CONFUSED** in off-axis observations of the same field

*The catalog reconciles detections at different off-axis angles*



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  - Maximum likelihood estimator to improve on-axis detection (~5 net counts for exposures < 15 ks)
- **MCMC draws provide relative astrometry position error *ellipses***

- Aperture photometry PDFs computed using Bayesian algorithms
- Multiple observations grouped by multi-band Bayesian Blocks algorithm to improve S/N even for variable sources (properties archived for each block)
- Integrated multi-band limiting sensitivity computed on 4" x 4" pixels



# CSC 2.0 features

CHAND  
SOURCE CAT

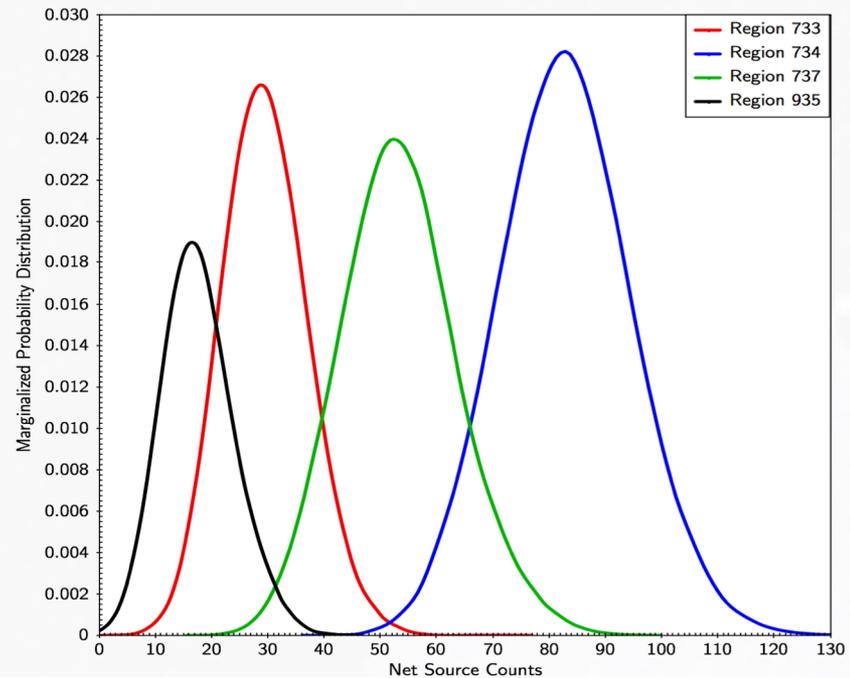
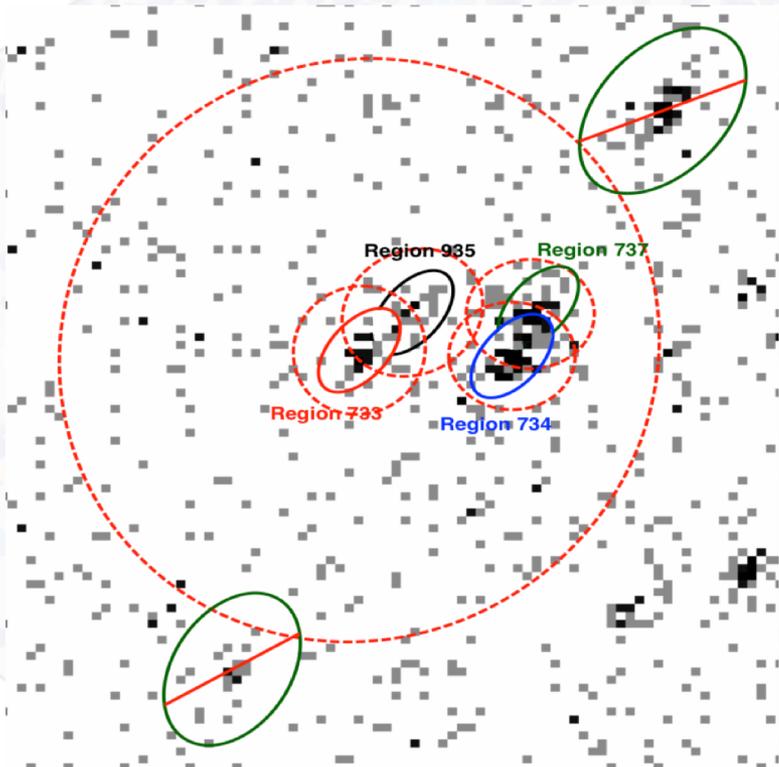
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- MCMC draws provide relative astrometry position error *ellipses*
- **Aperture photometry; multi-band Bayesian Blocks algorithm**

● ●  
100 1000  
ons per stack

1 2 5  
Observations p

# Source Properties: Aperture Photometry

Fluxes are measured in each observation: Bayesian approach for simultaneous aperture photometry estimation in crowded fields (*Primini, F. A. & Kashyap, V. L. 2014*)



Photometric PDFs are estimated simultaneously for the overlapping detections

# Source Properties: Aperture Photometry

## Bayesian Model

Analyze sources with overlapping apertures, near-by sources, and background simultaneously.

Joint posterior for source fluxes and background flux (for single observation):

$$P(s_1 \dots s_n, b | C_1 \dots C_n, B) = K \times P(b) P_{Pois}(B | \phi) \prod P(s_i) P_{Pois}(C_i | \theta_i)$$
$$\theta_i = E_i \times \left[ \sum_{j=1}^n f_{ij} s_j + \Omega_i b \right]; \quad \phi = E_b \times \left[ \sum_{i=1}^n g_i s_i + \Omega_b b \right]$$

Counts in overlapping regions assigned to brightest source

Master source flux for source  $s_k$  in an  $n$ -source bundle is determined from the Bayesian block for that source with the largest exposure. In this case:

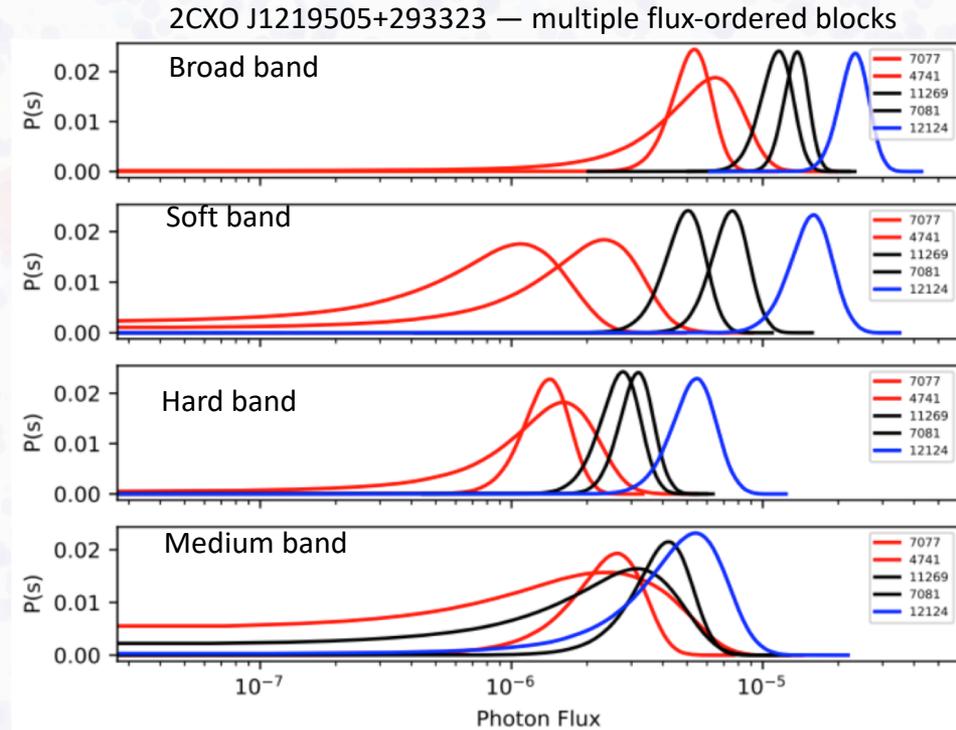
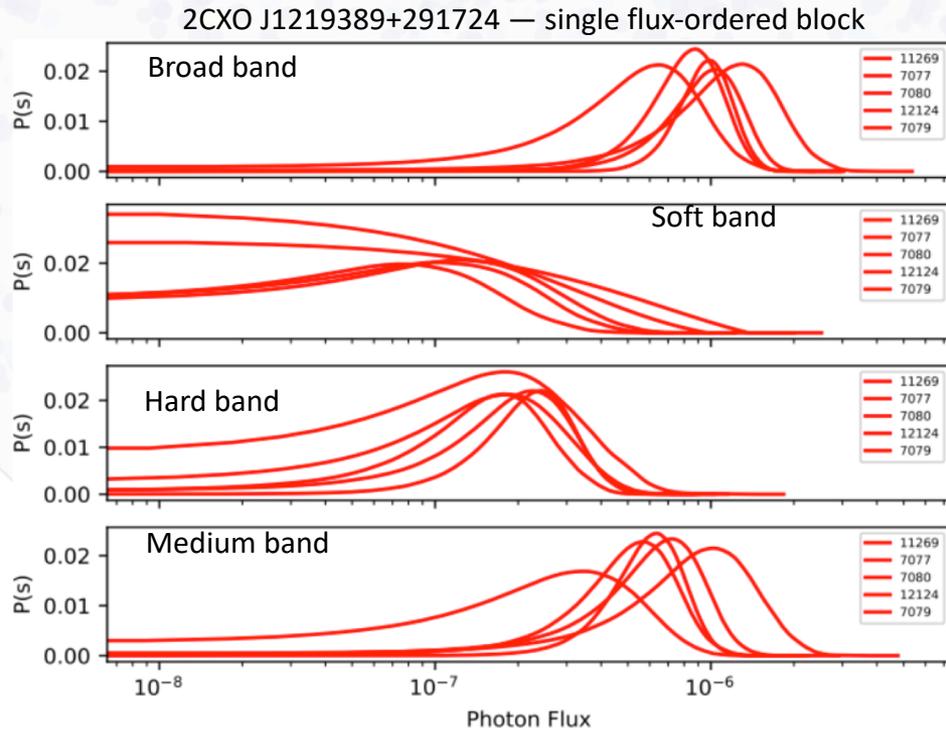
$$P(s_k | \{C_i^j\}, \{B^j\}) \cong P(s_k) \prod_{j=1}^m \left[ P_{Pois}(B^j | \hat{\phi}^j) \times P_{Pois}(C_k^j | \hat{\theta}_k^j) \prod_{i=1, i \neq k}^n P_{Pois}(C_i^j | \hat{\theta}_i^j) \right]$$

In all cases, a marginalized posterior is obtained for each source are obtained by integration over all other sources and background.

Posteriors optimized and sampled using MCMC in Sherpa.

# Grouping Observations to Improve S/N

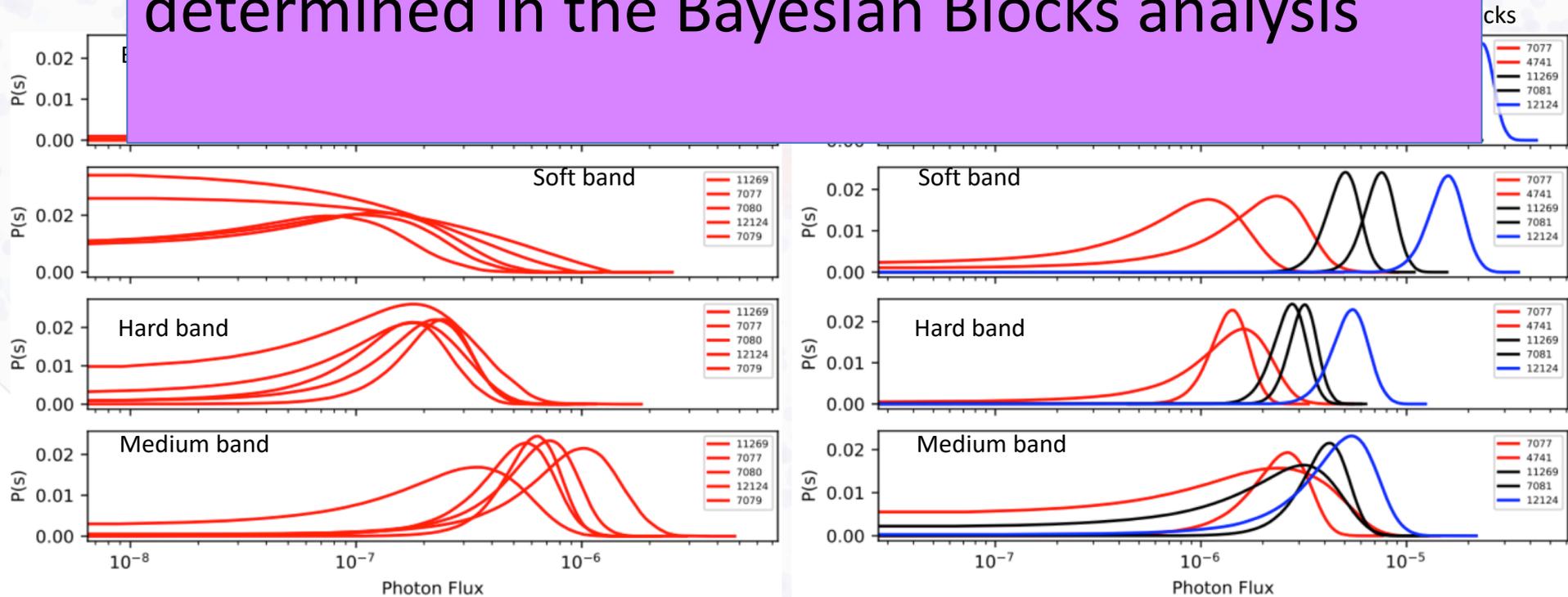
- Multi-band Bayesian Blocks analysis (*Scargle+2013*) on detection fluxes to identify observations that can be analyzed/grouped together
- The combined properties for the longest exposure Bayesian Block are databased, but the properties for *all* blocks are recorded in a FITS data product



# Grouping Observations to Improve S/N

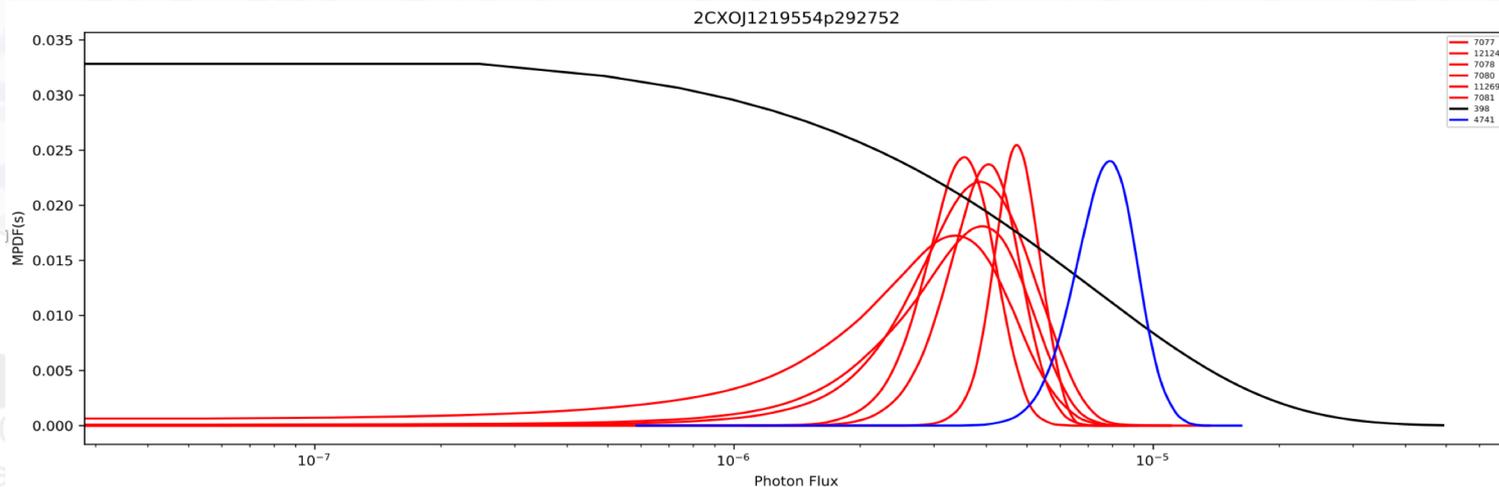
- Multi-band Bayesian Blocks analysis (*Scargle+2013*) on detection fluxes to identify observations that can be analyzed/grouped together
- The combined properties for the longest exposure Bayesian Block are databased, but

master level fluxes --> the best flux block determined in the Bayesian Blocks analysis



# Temporal Variability

- **Single observation:** Gregory-Loredo Test: Hypothesis rejection test (i.e., odds ratio of assuming variability vs not assuming it). The probability that events detected are not arriving at a uniform rate. Used to estimate intra-obs variability (pick max prob among stack obsids).
- **Multiple observations:** Inter-observation variability. Variability test is based on a likelihood ratio between the null hypothesis of no variability, and the assumption of variability, when several observations are considered.



# CSC 2.0 features

CHAND  
SOURCE CAT

- Source detection on stacked observations
- New source detection approach
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  - Maximum likelihood estimator to improve on-axis detection (~5 net counts for exposures < 15 ks)
- MCMC draws provide relative astrometry position error *ellipses*
- Aperture photometry; multi-band Bayesian Blocks algorithm
- **Multi-band limiting sensitivity computed on 4" x 4" pixels**

100 1000  
ons per stack

-75°  
F. Civano – CIAO workshop – Bologna 2019

1 2 5 10  
Observations p

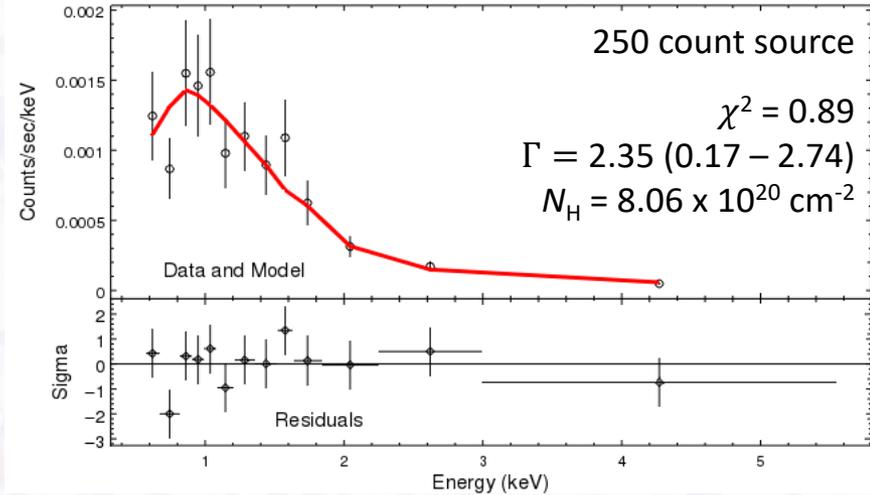
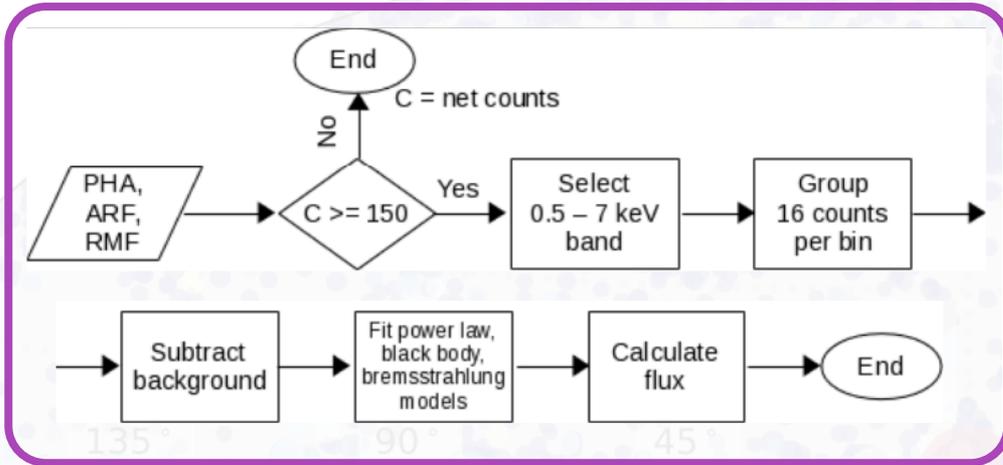
# CSC 2.0 new features

- Source detection on stacked observations
- New source detection approach
  - Wavelet detection *plus* Voronoi tessellation algorithm
  - Maximum likelihood estimator to improve on-axis detection (~5 net counts for exposures < 15 ks)
- MCMC draws provide relative astrometry position error *ellipses*
- Aperture photometry; multi-band Bayesian Blocks algorithm
- Multi-band limiting sensitivity computed on 4" x 4" pixels
- **Spectra extraction of ALL DETECTIONS and spectral analysis**

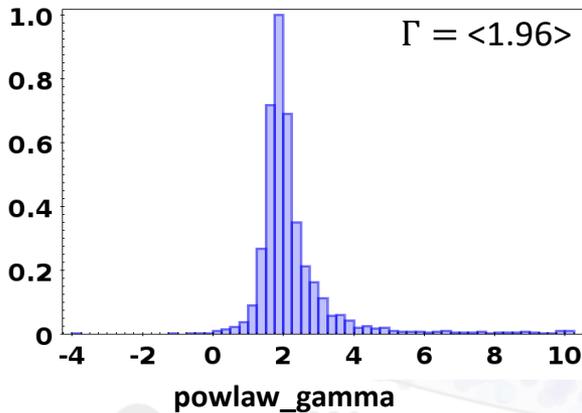
100 1000  
ons per stack



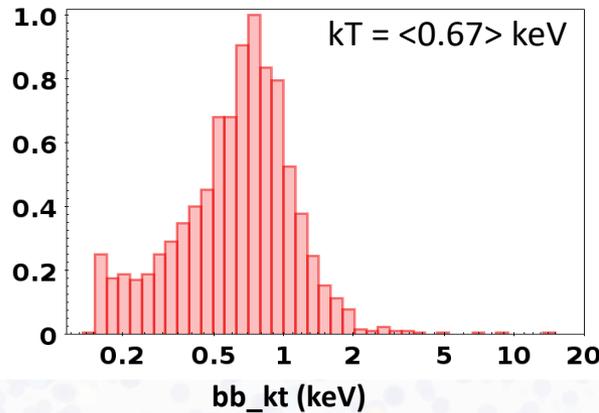
# Spectral Analysis



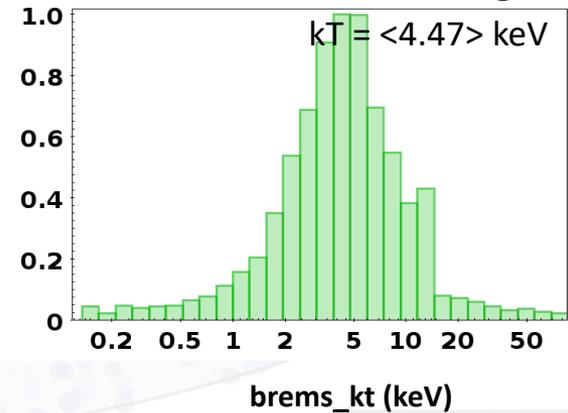
Abs. power law



Abs. black body

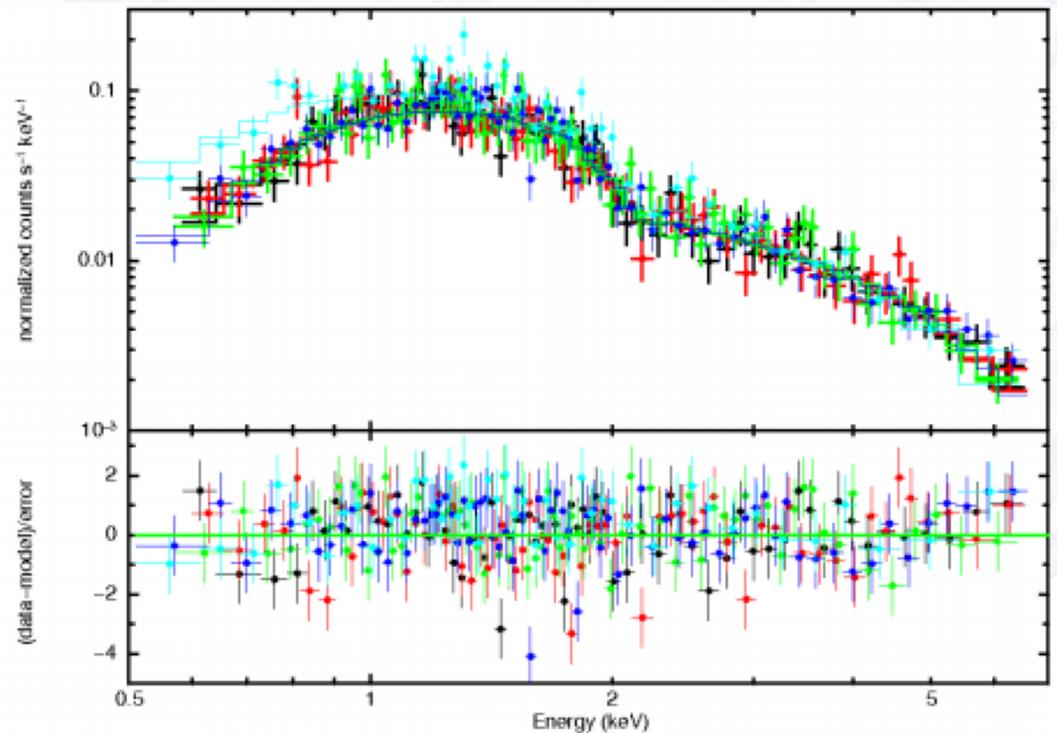
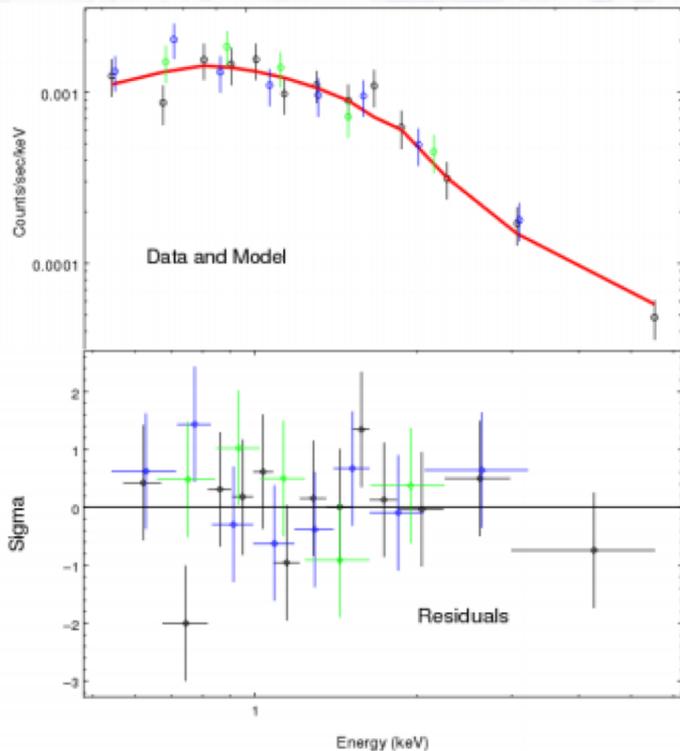


Abs. bremsstrahlung



# Joint Spectral Fits

- Sources that are observed multiple times are grouped by the Bayesian blocks analysis
- All spectra in the block are simultaneously fit



# CSC 2.0 features

CHAND  
SOURCE CAT

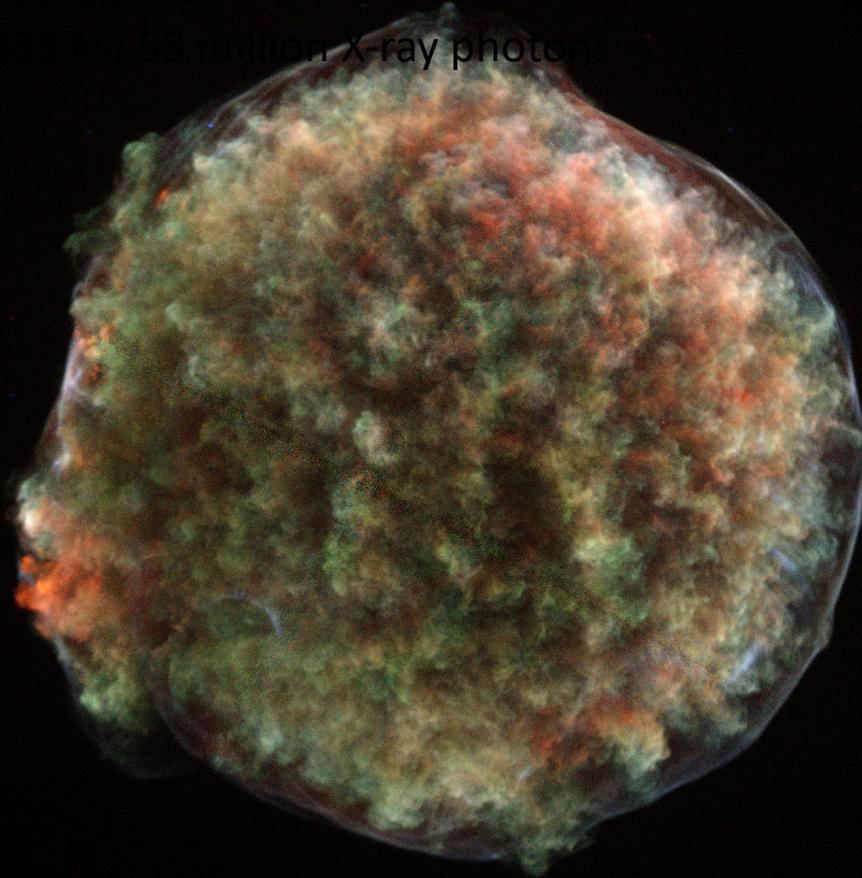
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- MCMC draws provide relative astrometry position error *ellipses*
- Aperture photometry; multi-band Bayesian Blocks algorithm
- Multi-band limiting sensitivity computed on 4" x 4" pixels
- Spectra extraction and spectral analysis
- **Extended emission properties**

100 1000  
ons per stack

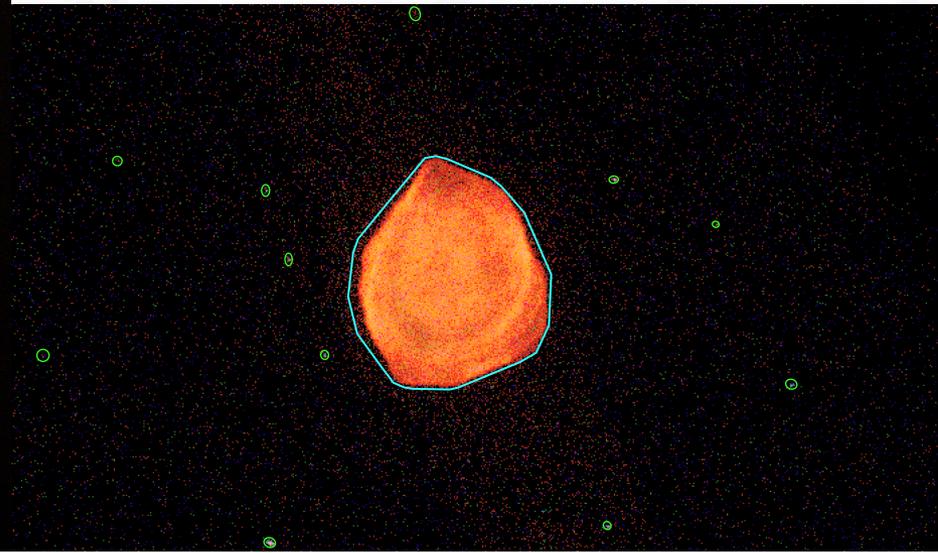
-75°  
F. Civano – CIAO workshop – Bologna 2019

1 2 5 10  
Observations p

# Extended emissions



- SNRs, cluster of galaxies, extended galaxies, jets, etc.
- Photometric properties are integrated over a convex hull bounding region aperture (cyan below).
- Fluxes and regions are going to be provided.



# Databased properties

CHAND  
SOURCE CAT

## Master Source Properties

- Source name, position and position errors, significance, source flags, multi-band deconvolved extent, multi-band aperture photometry (photon and energy fluxes, spectral model fluxes [multiple spectral models]), hardness ratios, spectral model fits [multiple spectral models], multi-band intra- and inter-observation temporal variability

## Stacked-Observation Detection Properties

- Position and position errors, multi-band significance, detection flags and codes, multi-band deconvolved extent, multi-band aperture photometry (net counts and count rates, photon and energy fluxes), aperture parameters, hardness ratios, multi-band intra- and inter-observation temporal variability

## Per-Observation Detection Properties

- Detector position, multi-band significance, detection flags and codes, multi-band raw, PSF, and deconvolved extent, multi-band aperture photometry (total counts, net counts and count rates, photon and energy fluxes, spectral model fluxes [multiple spectral models]), masked aperture parameters, spectral model fits [multiple spectral models], multi-band intra-observation temporal variability

100 1000  
ons per stack



# Science-Ready FITS Data Products

~25 million files, ~32 TB

## Observation Data Products

- Observation event list, aspect solution and histogram, bad pixel map, FoV, pixel mask
- Multi-band images, background images, exposure maps

## Stacked-Observation Data Products

- Stack event list, FoV, merged detection list
- Multi-band images, background images, exposure maps, limiting sensitivity

## Detection Region Data Products

- Detection region stack and observation region definitions, event lists
- Multi-band per-stack and per-observation images, exposure maps, position error MCMC draws, aperture photometry PDFs
- Multi-band per-observation PSFs, light curves
- Per-observation PHA spectrum, RMF, ARF

## Source Level Data Products

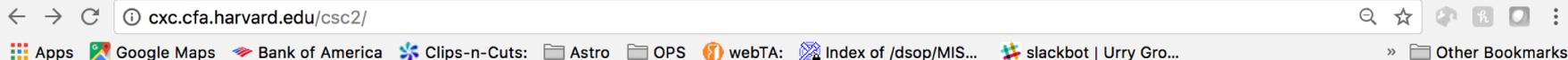
- Aperture photometry PDFs, per-Bayesian block properties (aperture photometry fluxes, model energy fluxes, spectral fits, hardness ratios)

100 1000  
ons per stack

1 2 5  
Observations p

# Data Access

<http://cxc.cfa.harvard.edu/csc2/>



[CSC 2](#) [CSC 1](#)

## Chandra Source Catalog Release 2.0 (CSC 2.0) Current Database

[What's New?](#) | [Watch Out](#)

The Chandra Source Catalog (CSC) is ultimately intended to be the definitive catalog of X-ray sources detected by the [Chandra X-ray Observatory](#). To achieve that goal, the catalog will be released to the user community in a series of increments with increasing capability. The second major release of the CSC (release 2.0) includes data for roughly 315,000 X-ray sources on the sky extracted from 10,382 Chandra ACIS and HRC-I imaging observations released publicly through the end of 2014.

### CSC Data Access:

[CSCview](#)

[CSCview Help](#)

[Command-line Interface](#)

### CSC Homepage

#### About the Catalog>

- [Catalog Organization](#)
- [Catalog Release Views and Database Access Views](#)
- [Catalog Statistical Characterization](#)
- [Caveats and Limitations](#)
- [Version History](#)

#### Creating the Catalog>

- [Observation Selection](#)
- [Catalog Processing](#)
- [Data Products](#)
- [Chandra Data Archive](#)

#### Using the Catalog>

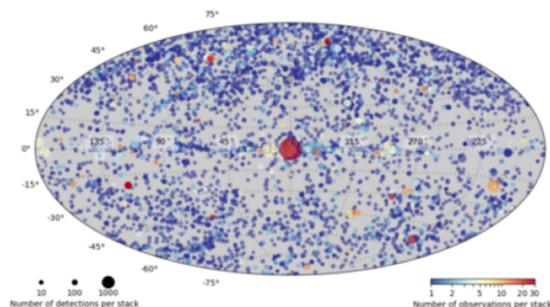
- [Threads](#)
- [Level-3 Files](#)
- [CSCview GUI](#)

#### Catalog Columns>

- Master Sources Table:  
[alphabetical](#) | [by context](#)
- Stacked Observation  
Detections Table:  
[alphabetical](#) | [by context](#)
- Per-Observation Detections  
Table:  
[alphabetical](#) | [by context](#)

#### Column Descriptions>

- [Position and Position Errors](#)



[Version: [full-size](#)]

The locations, in Galactic coordinates, of the 362,182 detections in the CSC 2.0 pre1 release. The size of each symbol is proportional to the logarithm of the number of sources detected in the field, while the color encodes the number of closely-located observations.

What is CSC 2.0?

How do I access or download CSC 2.0?

Is my favorite source in CSC 2.0?

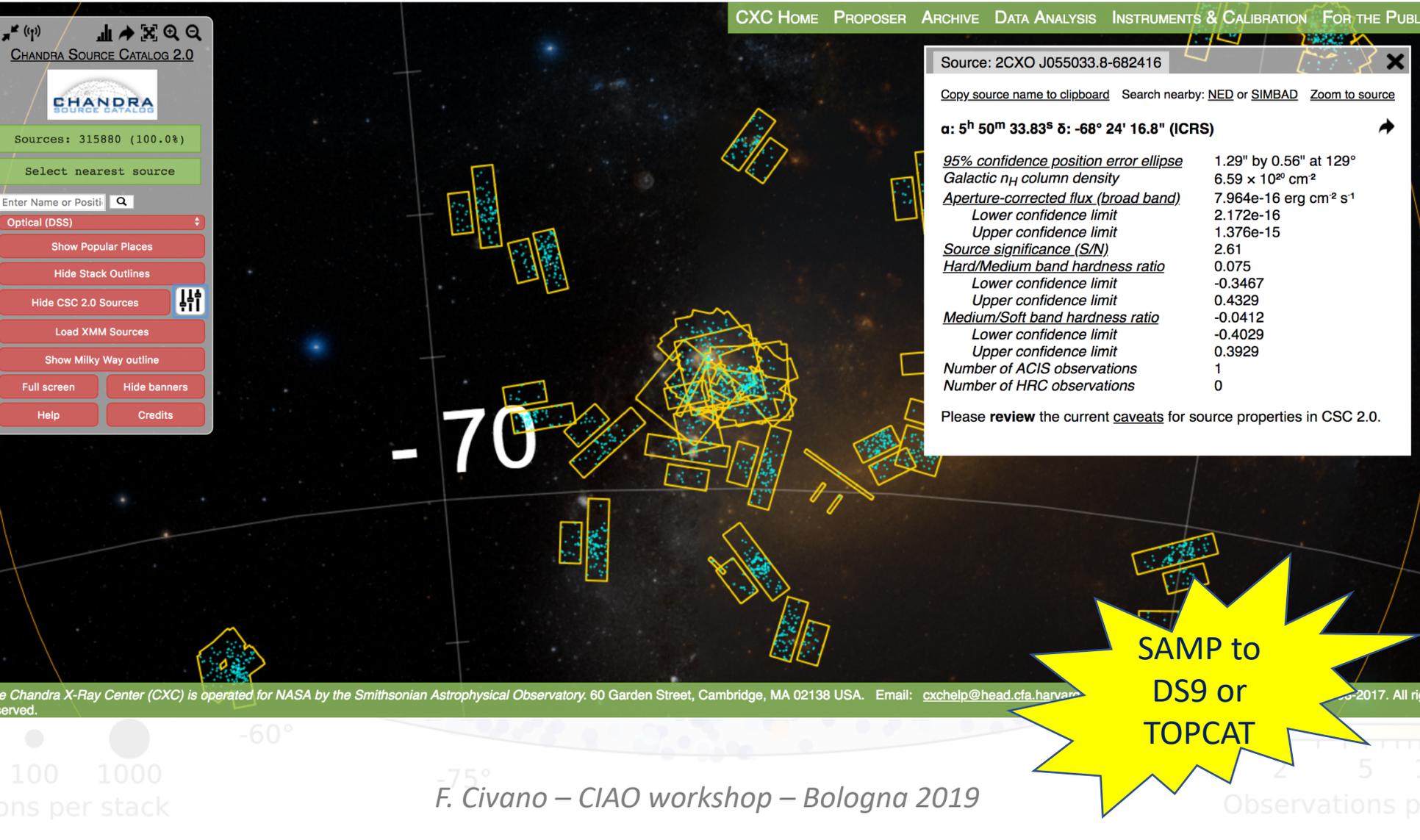
How do I find the flux of a source?

What is the processing status of CSC 2.0?

Use the WWT to view the processing status of CSC 2.0

How do I cite CSC 2.0?

# For a quick view: WWT



SAMP to  
DS9 or  
TOPCAT

# Data Access

<http://cxc.cfa.harvard.edu/csc2/>



[CSC 2](#) [CSC 1](#)

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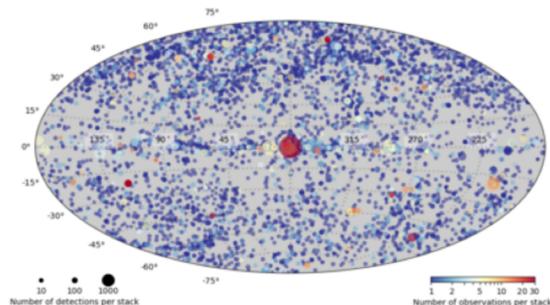
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How do I find the flux of a source?

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Use the WWT to view the processing status of CSC 2.0

How do I cite CSC 2.0?

# Data Retrieval: CSCView

The screenshot shows the CSCView software interface with several red boxes and arrows pointing to specific features:

- Standard queries:** A box highlights the 'Standard Queries' list on the left sidebar.
- Properties to be retrieved:** A box highlights the 'Result Set' table in the center, which lists various properties like 'name', 'ra', 'dec', and 'err\_ellipse\_r0'.
- Criteria to search on: ADQL queries:** A box highlights the 'Search Criteria' input field, which contains the query: `( significance >= 5.0 )`.
- List of properties that can be selected:** A box highlights the 'Source Properties' tree on the left, showing a hierarchy of properties such as 'Position Error: Ellipse'.
- Cone search and cross-match:** A box highlights the 'Position Search' section at the bottom, which includes radio buttons for 'None', 'Cone', and 'Crossmatch', and input fields for 'Name', 'Resolver', 'Radius', and 'Units'.

At the bottom of the interface, a table displays the search results:

Table	Name	Datatype	Units	Description
Master Sources	err_ellipse_r0	double	arcsec	Major radius of the 95% confidence level position error ellipse
Master Sources	err_ellipse_r1	double	arcsec	Minor radius of the 95% confidence level position error ellipse
Master Sources	err_ellipse_ang	double	deg	Position angle (ref. local true north) of the major axis of the 95% confidence level error ellipse

100 1000  
ons per stack

-60°

-75°

1 2 5  
Observations p

# Data Retrieval: CSCView

Chandra Source Catalog: Current Database

Retrieved tabular properties

Select all

105 of 1 row matched, 52 rows returned

Select	name	ra	dec	err_ellipse_r0 (arcsec)	err_ellipse_r1 (arcsec)	err_ellipse_ang (deg)	conf_flag	sat_src_flg	significance	flux_aper_b (erg/s/cm <sup>2</sup> )	flux_aper_lolim_b (erg/s/cm <sup>2</sup> )	flux_aper_hilim_b (erg/s/cm <sup>2</sup> )	flux_ (erg/s)
<input type="checkbox"/>	2CXO J210635.1+233051	21 06 35.16	+23 30 51.47	2.15	1.59	105.3	TRUE	FALSE	6.32	4.014e-15	1.302e-15	6.727e-15	0.00
<input type="checkbox"/>	2CXO J210643.6+232757	21 06 43.66	+23 27 57.10	1.68	0.98	90.1	TRUE	FALSE	7.03	1.467e-14	1.199e-14	1.735e-14	2.3
<input type="checkbox"/>	2CXO J210644.4+233859	21 06 44.43	+23 38 59.96	1.09	0.64	101.1	TRUE	FALSE	13.87	4.081e-14	3.711e-14	4.450e-14	9.5
<input type="checkbox"/>	2CXO J210646.2+232749	21 06 46.26	+23 27 49.41	2.54	1.68	102.3	TRUE	FALSE	6.63	1.123e-14	8.880e-15	1.345e-14	7.1
<input type="checkbox"/>	2CXO J210646.3+233207	21 06 46.31	+23 32 07.25	1.11	0.84	121.4	FALSE	FALSE	7.33	1.016e-14	8.194e-15	1.212e-14	6.8
<input type="checkbox"/>	2CXO J210647.6+232651	21 06 47.64	+23 26 51.01	2.04	1.37	89.2	TRUE	FALSE	5.93	1.564e-14	1.141e-14	1.965e-14	1.4
<input type="checkbox"/>	2CXO J210649.1+233336	21 06 49.15	+23 33 36.02	0.76	0.41	103.1	TRUE	FALSE	16.07	4.965e-14	4.636e-14	5.295e-14	3.2
<input checked="" type="checkbox"/>	2CXO J210651.7+234321	21 06 51.71	+23 43 21.07	1.59	1.15	156.4	FALSE	FALSE	11.72	6.632e-14	5.926e-14	7.337e-14	4.7
<input type="checkbox"/>	2CXO J210652.8+232718	21 06 52.81	+23 27 18.55	1.09	0.88	105.4	TRUE	FALSE	8.31	1.442e-14	1.195e-14	1.675e-14	8.7
<input type="checkbox"/>	2CXO J210653.3+233327	21 06 53.38	+23 33 27.73	0.77	0.46	106.6	TRUE	FALSE	10.25	2.419e-14	2.174e-14	2.665e-14	2.1
<input type="checkbox"/>	2CXO J210654.4+232657	21 06 54.49	+23 26 57.30	1.51	0.87	92.5	TRUE	FALSE	6.81	1.443e-14	1.209e-14	1.663e-14	1.2
<input type="checkbox"/>	2CXO J210654.5+233242	21 06 54.53	+23 32 42.85	0.62	0.51	140.9	TRUE	FALSE	9.34	2.678e-14	2.373e-14	2.965e-14	2.5
<input type="checkbox"/>	2CXO J210656.1+233221	21 06 56.12	+23 32 21.13	0.50	0.50	0.0	TRUE	FALSE	7.67	1.036e-14	8.883e-15	1.175e-14	7.3
<input checked="" type="checkbox"/>	2CXO J210657.0+233407	21 06 57.05	+23 34 07.20	0.44	0.34	131.5	FALSE	FALSE	16.46	4.774e-14	4.469e-14	5.061e-14	3.3
<input type="checkbox"/>	2CXO J210658.0+233110	21 06 58.09	+23 31 10.56	0.82	0.64	125.1	FALSE	FALSE	5.50	6.315e-15	5.038e-15	7.522e-15	4.7
<input type="checkbox"/>	2CXO J210659.5+232907	21 06 59.56	+23 29 07.87	0.86	0.52	95.8	FALSE	FALSE	5.20	7.514e-15	5.994e-15	8.949e-15	7.0
<input type="checkbox"/>	2CXO J210700.3+233152	21 07 00.39	+23 31 52.25	0.42	0.35	121.2	TRUE	FALSE	8.84	7.032e-15	6.124e-15	7.940e-15	0.00
<input type="checkbox"/>	2CXO J210701.2+233153	21 07 01.21	+23 31 53.00	0.47	0.41	104.0	TRUE	FALSE	6.87	6.232e-15	5.290e-15	7.175e-15	5.6
<input type="checkbox"/>	2CXO J210703.1+233022	21 07 03.13	+23 30 22.21	0.32	0.29	94.9	TRUE	FALSE	19.77	6.002e-14	5.705e-14	6.299e-14	3.6
<input type="checkbox"/>	2CXO J210703.7+233234	21 07 03.80	+23 32 34.14	0.47	0.38	107.9	TRUE	FALSE	5.79	6.494e-15	5.355e-15	7.634e-15	4.1
<input type="checkbox"/>	2CXO J210703.9+233113	21 07 03.97	+23 31 13.24	0.58	0.42	115.2	TRUE	FALSE	5.53	5.989e-15	4.882e-15	7.096e-15	4.9
<input type="checkbox"/>	2CXO J210705.9+232844	21 07 05.96	+23 28 44.18	0.61	0.54	95.1	FALSE	FALSE	6.84	7.911e-15	6.675e-15	9.147e-15	5.9
<input type="checkbox"/>	2CXO J210707.2+234358	21 07 07.25	+23 43 58.39	3.73	3.11	151.6	TRUE	FALSE	6.05	1.038e-14	5.588e-15	1.517e-14	4.5
<input type="checkbox"/>	2CXO J210709.6+233536	21 07 09.65	+23 35 36.26	0.80	0.61	152.5	TRUE	FALSE	5.14	4.771e-15	3.737e-15	5.806e-15	4.0
<input type="checkbox"/>	2CXO J210710.3+234100	21 07 10.39	+23 41 00.58	1.83	1.27	151.5	TRUE	FALSE	5.24	1.641e-14	1.142e-14	2.117e-14	1.2
<input type="checkbox"/>	2CXO J210713.4+233351	21 07 13.43	+23 33 51.83	0.35	0.32	144.2	TRUE	FALSE	5.82	4.859e-15	3.963e-15	5.754e-15	3.8
<input type="checkbox"/>	2CXO J210714.8+233145	21 07 14.82	+23 31 45.15	0.30	0.30	0.0	TRUE	FALSE	13.48	3.540e-14	3.277e-14	3.803e-14	3.1
<input checked="" type="checkbox"/>	2CXO J210715.1+233315	21 07 15.14	+23 33 15.30	0.31	0.30	113.4	FALSE	FALSE	12.87	1.903e-14	1.751e-14	2.054e-14	1.2
<input type="checkbox"/>	2CXO J210715.8+233355	21 07 15.85	+23 33 55.56	0.35	0.32	166.6	TRUE	FALSE	5.97	7.011e-15	5.798e-15	8.157e-15	6.4
<input type="checkbox"/>	2CXO J210715.9+233058	21 07 15.96	+23 30 58.17	0.31	0.30	60.9	FALSE	FALSE	8.95	8.337e-15	7.352e-15	9.264e-15	4.5
<input type="checkbox"/>	2CXO J210717.1+232803	21 07 17.19	+23 28 03.28	0.50	0.43	36.7	FALSE	FALSE	8.60	1.025e-14	8.925e-15	1.149e-14	7.8
<input type="checkbox"/>	2CXO J210720.5+233047	21 07 20.58	+23 30 47.69	0.32	0.31	57.1	FALSE	FALSE	8.67	1.061e-14	9.416e-15	1.181e-14	7.8
<input type="checkbox"/>	2CXO J210722.1+233131	21 07 22.14	+23 31 31.43	0.34	0.34	161.5	TRUE	FALSE	5.14	5.146e-15	4.105e-15	6.128e-15	4.6
<input type="checkbox"/>	2CXO J210723.7+233216	21 07 23.76	+23 32 16.15	0.32	0.31	20.1	FALSE	FALSE	6.14	2.872e-15	2.342e-15	3.403e-15	1.0
<input type="checkbox"/>	2CXO J210724.5+233301	21 07 24.56	+23 33 01.01	0.34	0.32	34.1	FALSE	FALSE	5.63	6.440e-15	5.265e-15	7.614e-15	5.4
<input type="checkbox"/>	2CXO J210731.3+233529	21 07 31.34	+23 35 29.92	0.76	0.54	9.8	TRUE	FALSE	6.92	8.721e-15	7.210e-15	1.014e-14	7.0
<input type="checkbox"/>	2CXO J210735.0+234217	21 07 35.09	+23 42 17.82	2.35	1.87	167.4	TRUE	FALSE	5.03	1.322e-14	8.528e-15	1.770e-14	1.1
<input type="checkbox"/>	2CXO J210735.6+233502	21 07 35.62	+23 35 02.11	0.70	0.45	10.6	TRUE	FALSE	6.76	5.990e-15	4.721e-15	7.188e-15	3.7
<input type="checkbox"/>	2CXO J210741.5+232924	21 07 41.53	+23 29 24.92	0.84	0.48	43.1	TRUE	FALSE	12.39	2.104e-14	1.902e-14	2.305e-14	1.3
<input type="checkbox"/>	2CXO J210742.0+233238	21 07 42.07	+23 32 38.38	0.63	0.49	31.7	FALSE	FALSE	8.09	1.332e-14	1.096e-14	1.553e-14	9.8
<input type="checkbox"/>	2CXO J210746.7+233128	21 07 46.75	+23 31 28.44	1.20	0.75	41.9	FALSE	FALSE	8.99	1.069e-14	8.859e-15	1.241e-14	6.3

Select FITS data products here

Energy Bands:  broad [ACIS]  hard [ACIS]  medium [ACIS]  soft [ACIS]  ultrasoft [ACIS]  wide [HRC]

Product Type	Product Specifier	Format	Description
Bayesian Blocks source properties	bayesblks	FITS table	Bayesian Blocks source properties
Per-Master source region aperture photometry PDF	srcaperphot_b	FITS table	Per-Master source region aperture photometry PDF; ACIS broad energy band
Per-Master source region aperture photometry PDF	srcaperphot_w	FITS table	Per-Master source region aperture photometry PDF; HRC wide energy band
Event List	regev3	FITS table	The source region event file consists of a single FITS format event file for each observation
Point Spread Function	psf_b	FITS image	Per-energy-band local model point spread function images (s/cm <sup>2</sup> ) for the broad energy band
Point Spread Function	psf_w	FITS image	Per-energy-band local model point spread function images (s/cm <sup>2</sup> ) for the wide energy band
Exposure Map	repxnman_b	FITS image	Per-energy-band exposure map images (s/cm <sup>2</sup> ) for the broad energy band

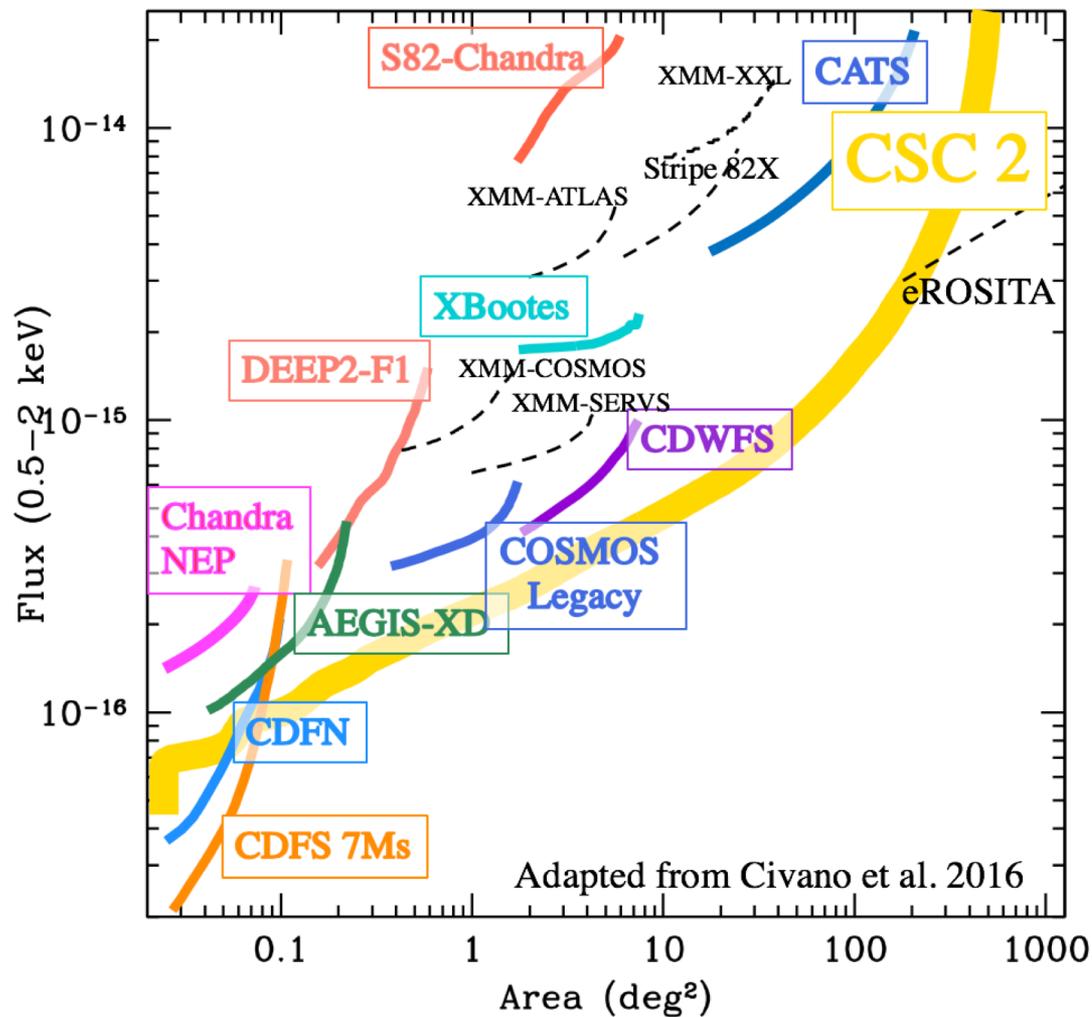
SAMP to DS9 or TOPCAT



● 100 ● 1000  
ons per stack

1 2 5  
Observations p

# CSC 2.0 as a survey



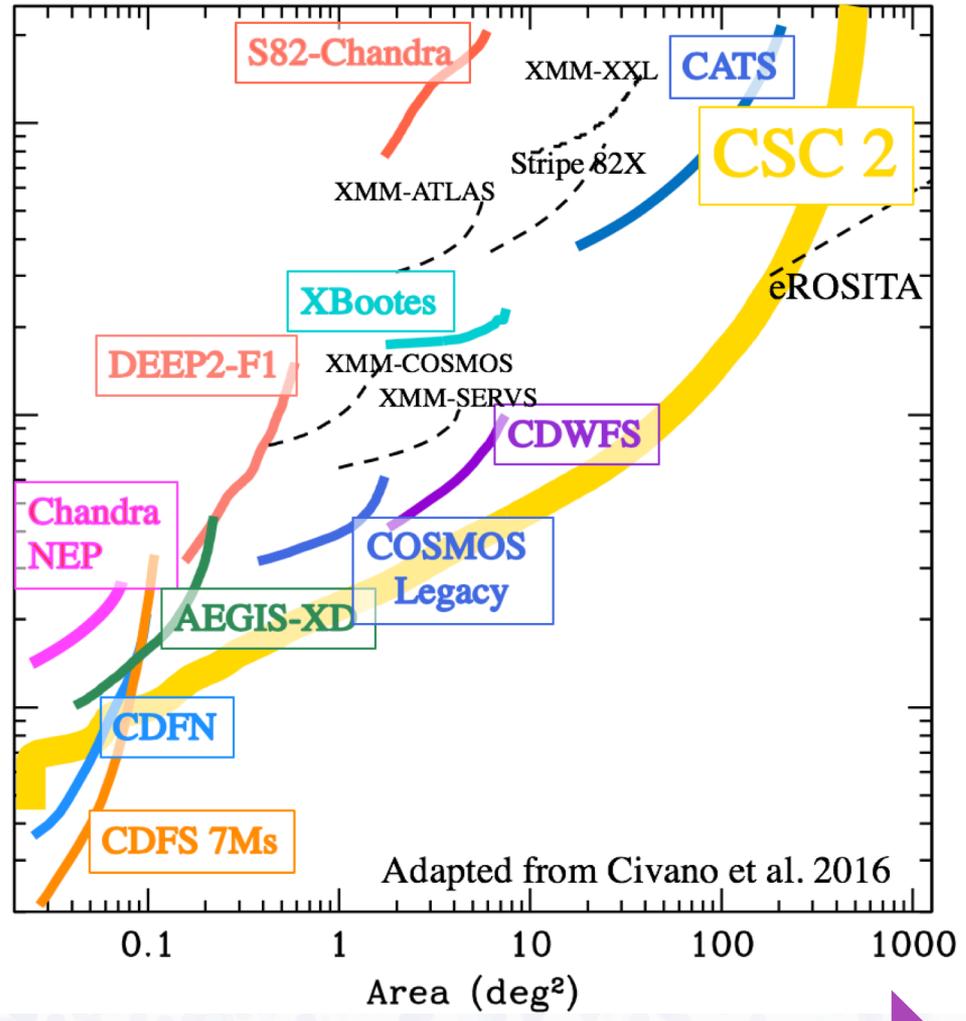
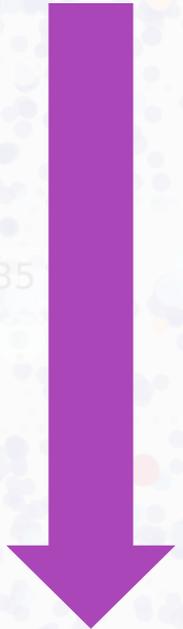
~550 deg<sup>2</sup>  
Area covered

100 1000  
ons per stack

1 2 5  
Observations p

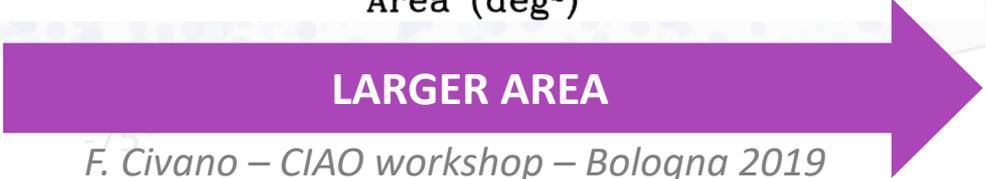
# CSC 2.0 as a survey

More sensitive



~550 deg<sup>2</sup>  
Area covered

LARGER AREA



100 1000  
ons per stack

1 2 5  
Observations p