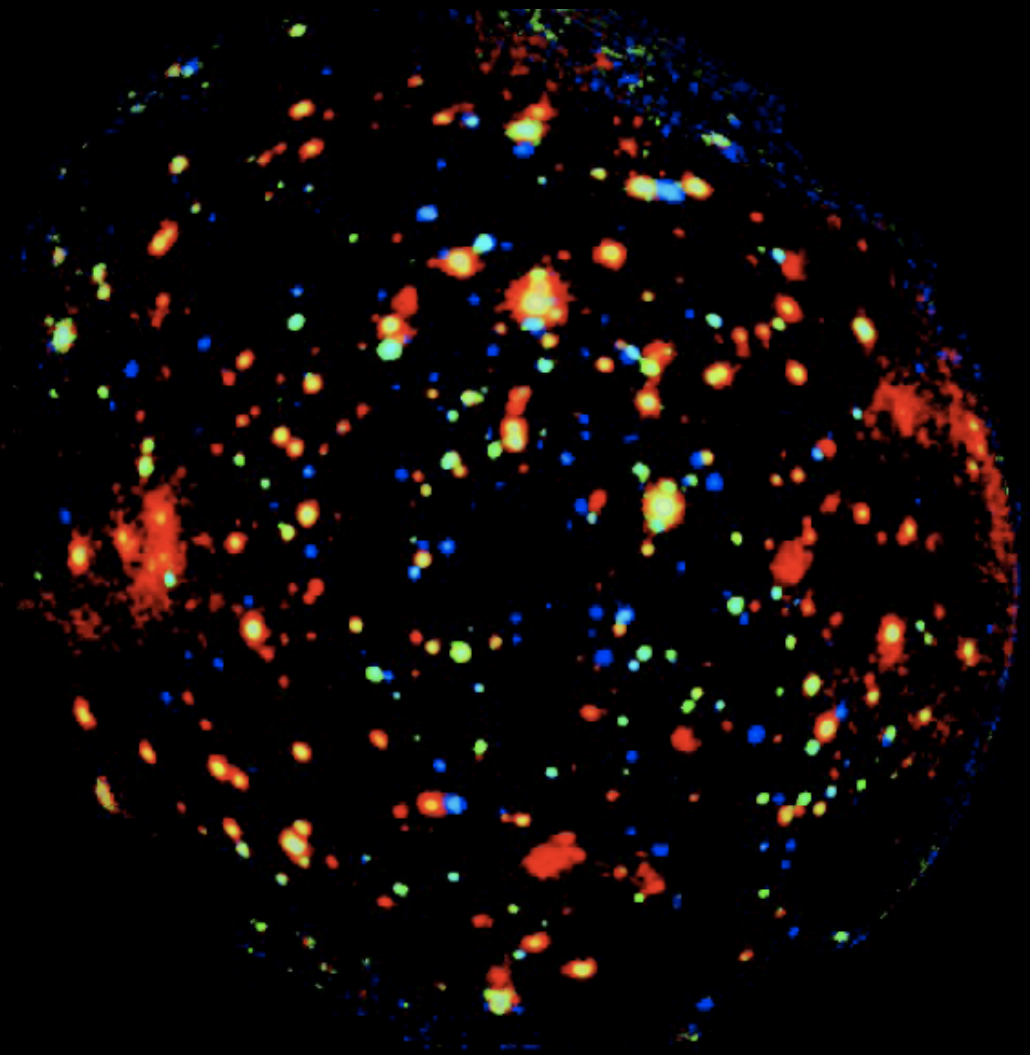
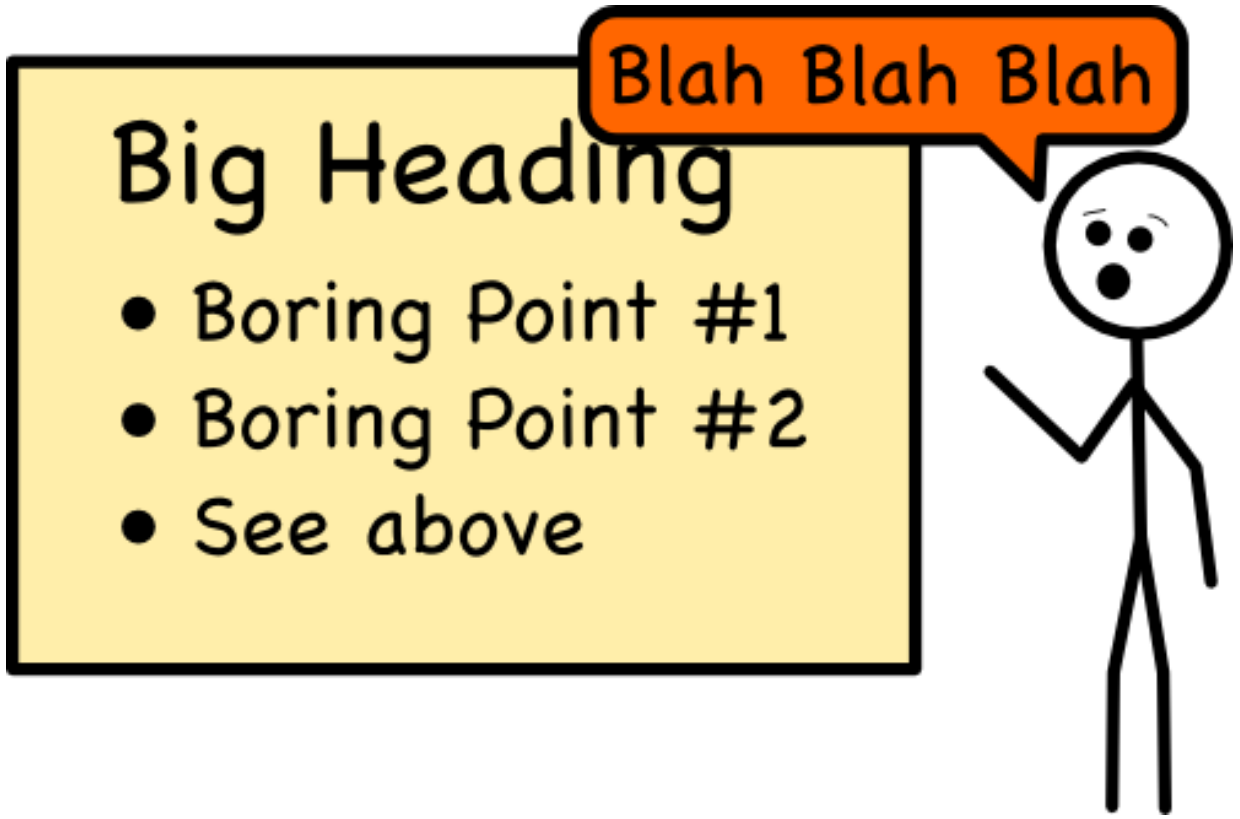
The XMM-CDFS in Cervia



Few good reasons to hold the meeting in Cervia

- To see the sunrise on the beach
- Close to some of the places narrated by Nico with unflagging gusto…
- To stay in the Grand Hotel at least once in your life…

Achtung!


Blah Blah Blah
Big Heading
• Boring Point #1
• Boring Point #2
• See above

Last-year motto, “work under last-minute pressure”, still true

Work in progress: the Bologna-Santander connection

XMM-*Newton* vs. *Chandra* source association (with all the relevant multi-wavelength information already associated)

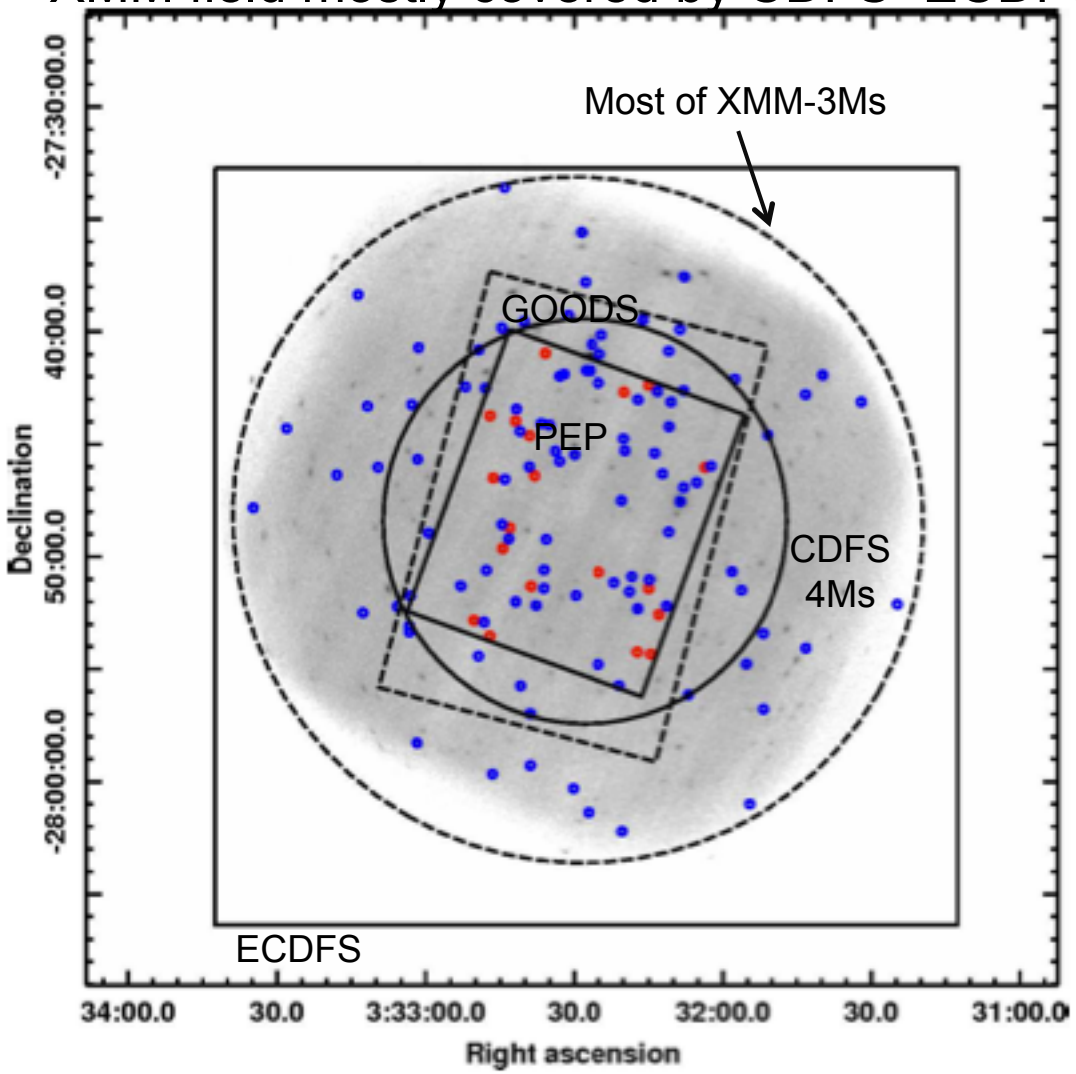
- **Possibly spurious sources** in the current **P34H 2-10 keV** XMM source catalog (411 entries, then some 'screening' applied by EMLDETECT): visual inspection + reliability parameter from cross-matching algorithm based on maximum-likelihood estimator (Francisco; Pineau et al. 2011) − comparison with simulations (Piero)

- Are there any **new XMM sources** out there?

- **Possibly 'blended' sources**: source confusion vs. simulations (Piero)

XMM spectroscopic sample (>8 σ): mining the redshift databases (Xue in primis, then Santini/Dahlen/Taylor for photo-z) – Need to cover at least the entire ECDFS region

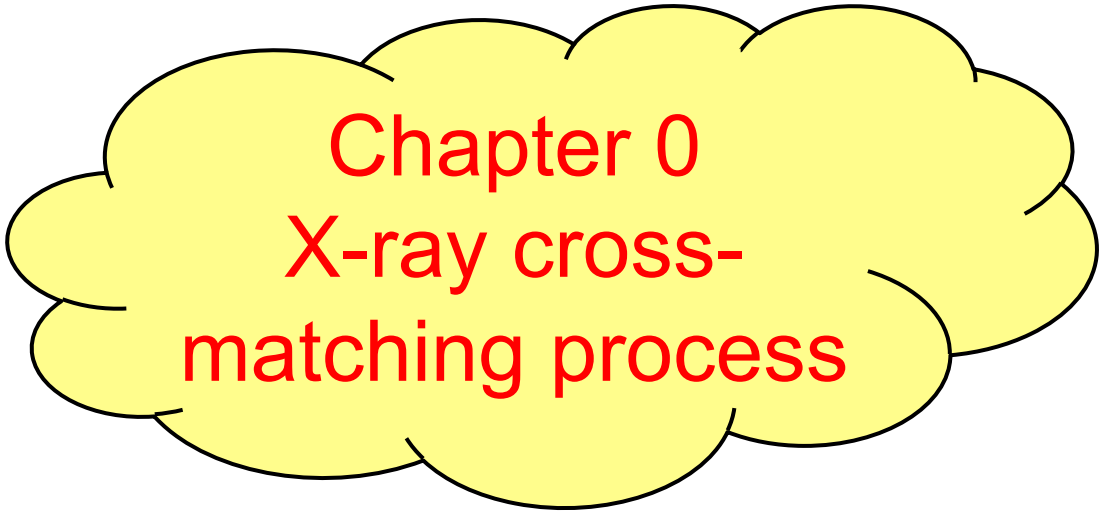
XMM field mostly covered by CDFS+ECDFS



First approach: to use the available *Chandra* source catalogs (740+762 + supplementary catalogs; ~1315 unique sources) for a preliminary and possibly quick source assessment [source ID, multi-lambda info (z in primis), estimates of source confusion and spurious sources]

adapted from Rovilos et al. (submitted)

	XMM-CDFS	Chandra CDFS	Chandra CDFS+ECDFS
Area	0.22-0.25 deg2	0.13 deg2	0.25 deg2
N. Src.	411	740 (main) + 36 (suppl)	1315 unique sources


Chapter 0
X-ray cross-
matching process

X-ray cross-matching process (i)

SUMMARY

N=411 sources detected by XMM in the 2-10 keV band over the entire mosaic (all cameras)
➔**N=147** with signif≥10 (with XMM extracted spectra)

vs. N=740 X-ray sources in the CDF-S 4Ms main catalog

➔ N=207(159)/262 matches within 4(2) arcsec (~2−6 chance coincidences expected)
101/207 with PWXDetect signif≥10
Others from the ECDFS main source catalog

The matched fraction increases by ~9% if we focus on the inner CDFS region

Cross-matching process (ii)

STRATEGY

✓ Apparently, no systematic problem with XMM positions: an XMM vs. *Chandra* source match on the basis of the positions provides a first-order reliable source ID

✓ Maximum-likelihood approach (Francisco) is good but the number of good XMM sources lost using a rather conservative reliability solution is large ➔ some adjustments (let call it 'fine tuning') is needed!

WHY: (a) large XMM PSF (combined PSFs of three instruments, over 33×3 ObsIDs)

(b) source confusion (broad PSF wings) is sometimes an issue

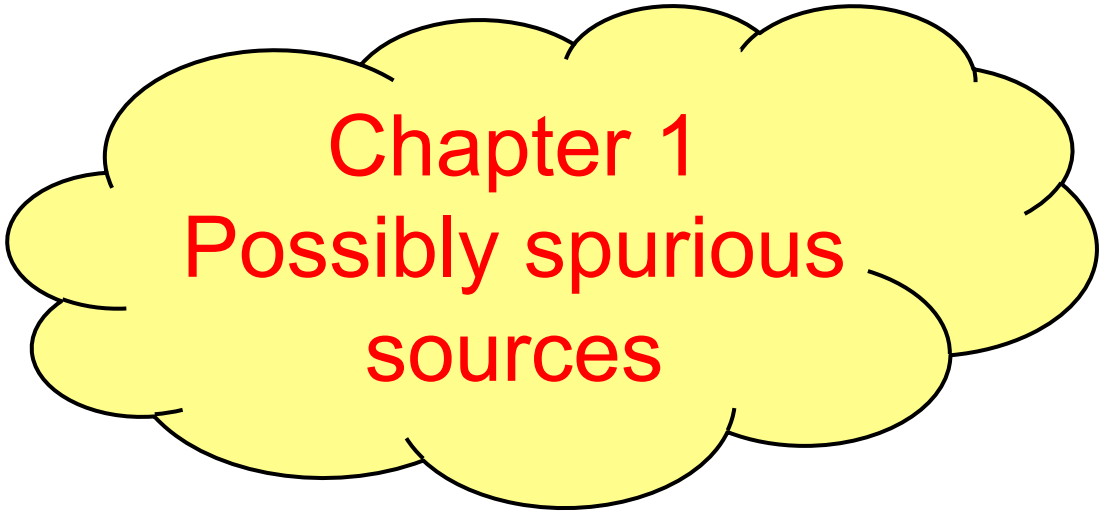
(c) high background level is not helping in finding the source centroid

(d) strong gradients in the exposures because of the 'observing pattern'

(e) usage of limited XMM information (2-10 keV, which means 2−7.8 keV counts), which may severely limit the quality of XMM source positions.

POSSIBLE SOLUTIONS: (a) visual inspection vs. maximum likilihood vs. simulations − needs to be done and optimized, but NOW everything is available

(b) XMM vs. *Chandra* hard-band flux comparison (BUT source variability might be an issue)


Chapter 1
Possibly spurious
sources

I. Possibly spurious sources (i)

SELECTION and ESTIMATE

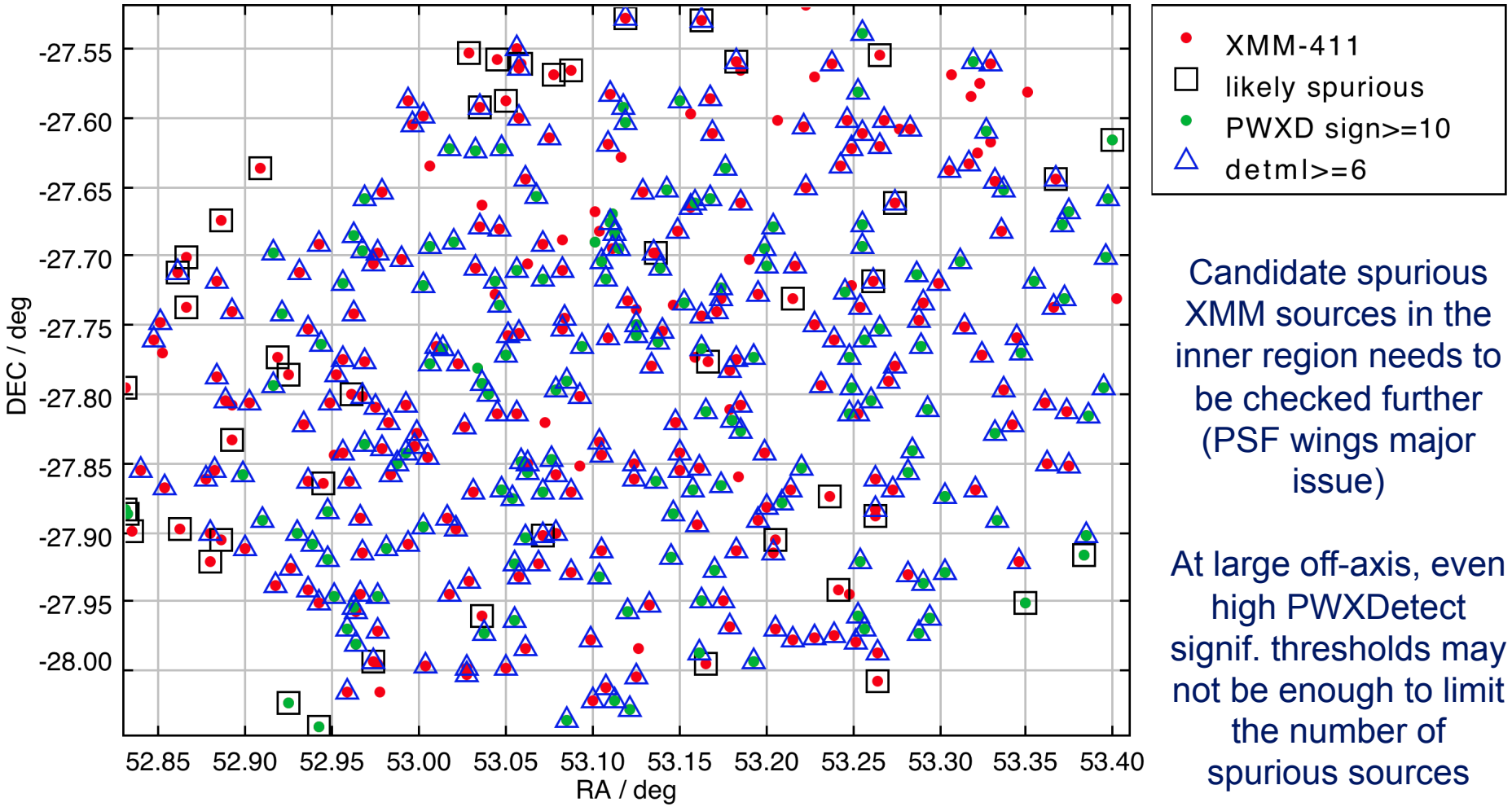
XMM sources with *Chandra* (relatively) good coverage and no *Chandra* counterpart are likely spurious sources (although very strong variability and different sensitivity in the 2−8 keV band may provide an alternative explanation) ➔ role of visual inspection of the images (different bands, smoothed, vs. Chandra, vs. IRAC, etc.)

- **$N_{spurious}$=54** (3 of which have a match with ECDFS/CDFS sources) − candidate spurious at present

- Very large off-axis angle is an issue

- Most of these sources excluded also by Francisco's ML approach

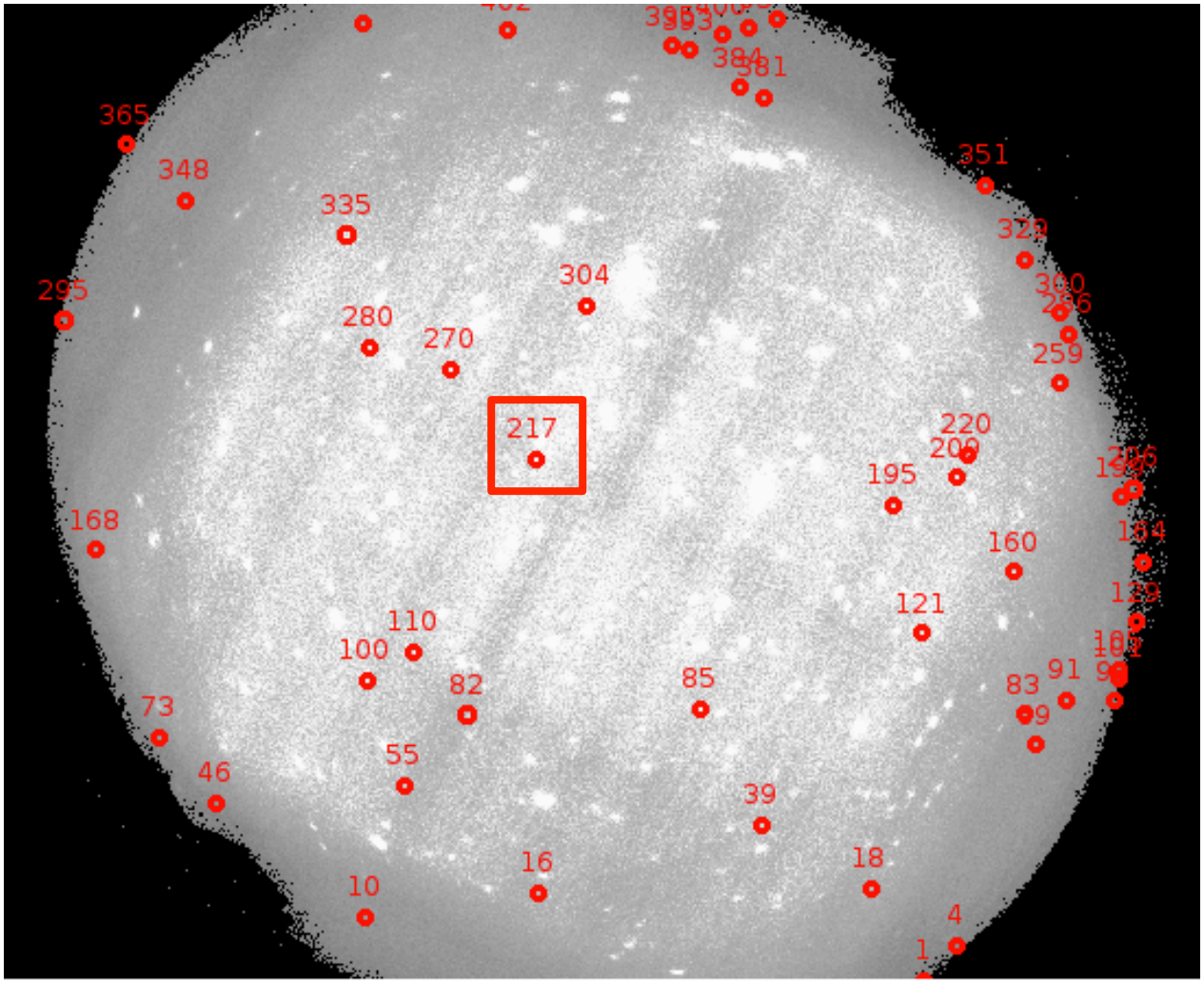
I. Possibly spurious sources (ii)



Candidate spurious XMM sources in the inner region needs to be checked further (PSF wings major issue)

At large off-axis, even high PWXDetect signif. thresholds may not be enough to limit the number of spurious sources

I. Possibly spurious sources (iii)

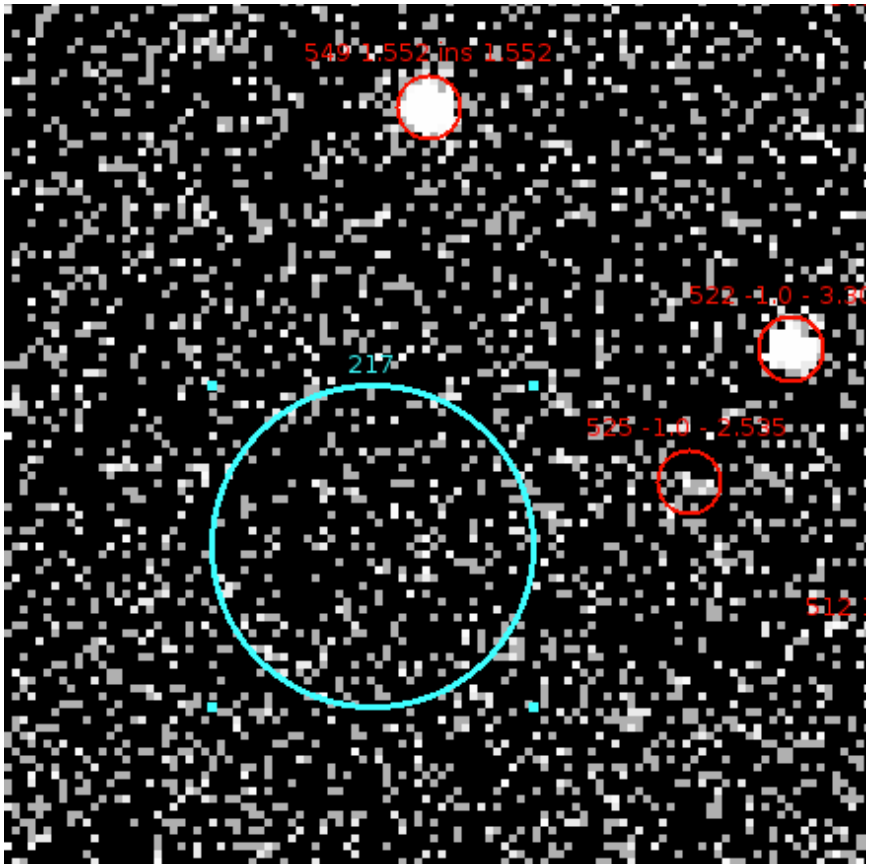


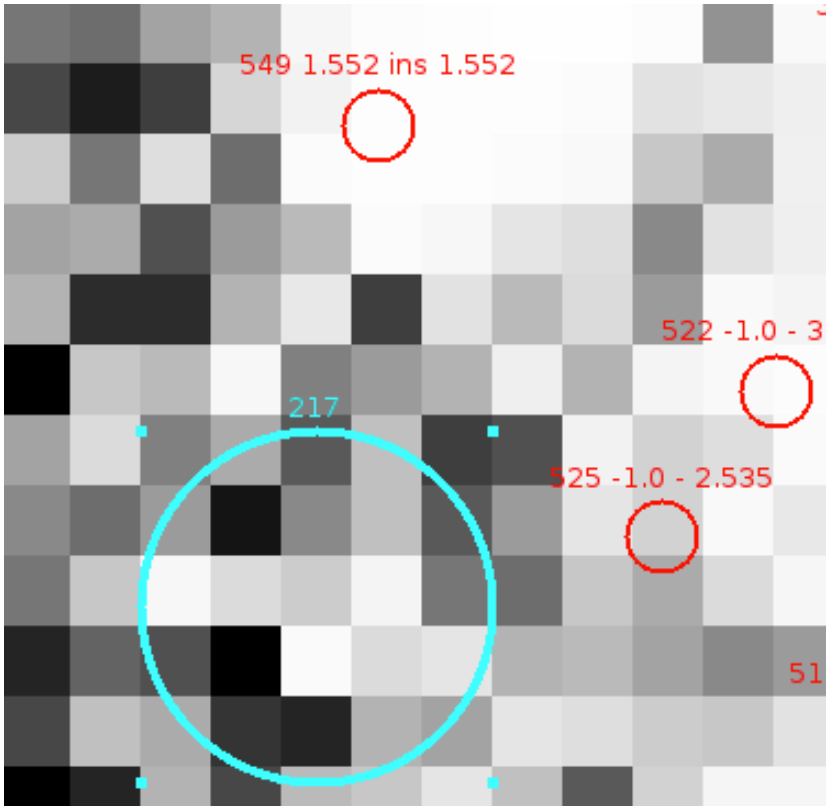
Outer-field XMM sources flagged as likely spurious might be actually spurious

Inner-field XMM sources need more careful checks

I. Possibly spurious sources (iv)

Verdict: dubious… ➔ some of these might be recovered by additional analysis





Chapter 2
Possibly new sources discovered by XMM

II. Possibly new XMM sources (i)

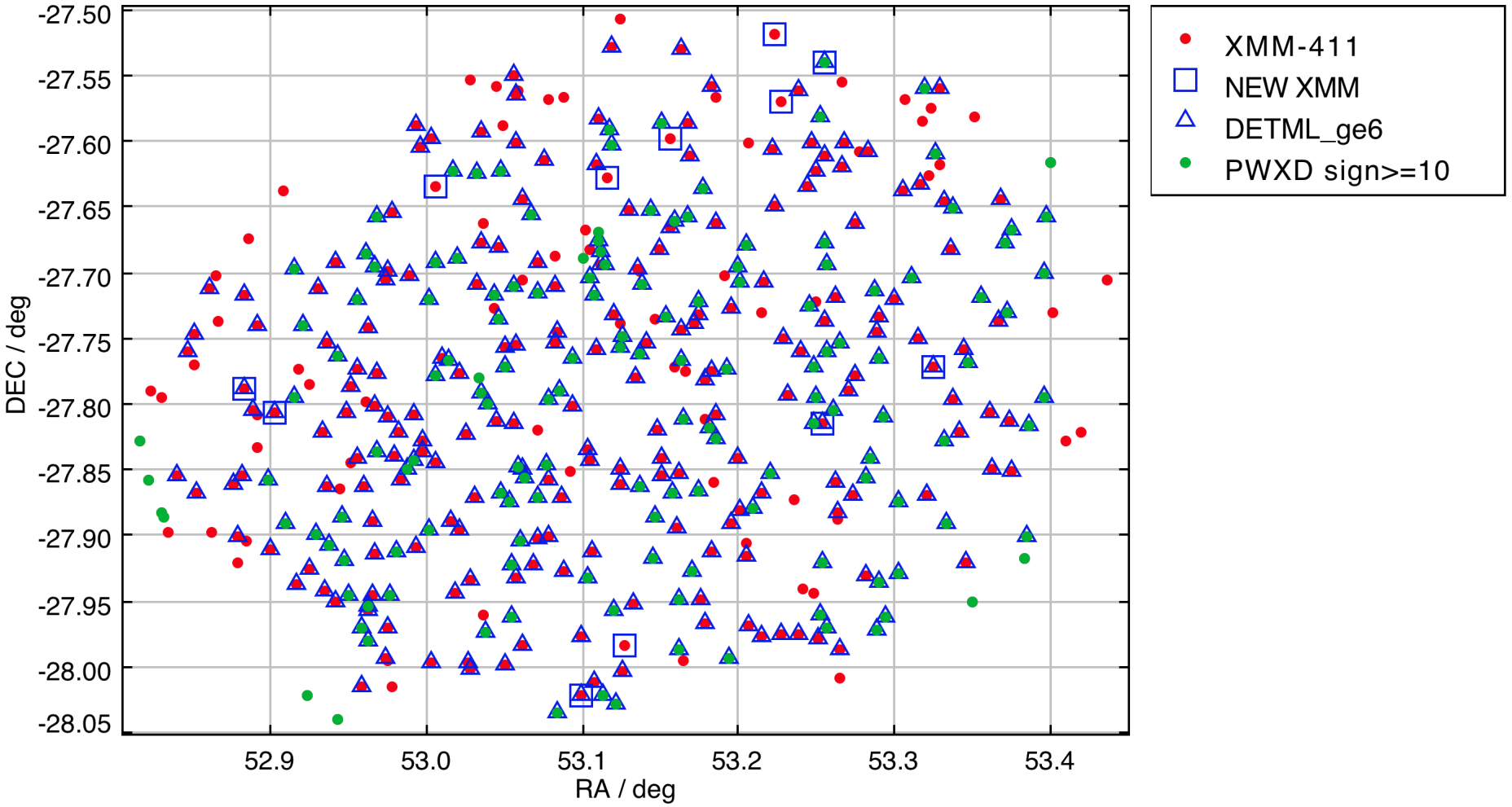
SUMMARY

12 possibly new XMM sources (some of which at high significance and with softer band counterparts), mostly in the outer regions.
7 are secure (2 without Chandra coverage), 5 are likely. Further 6 sources need to be checked (flagged as ‘dubious’ so far)

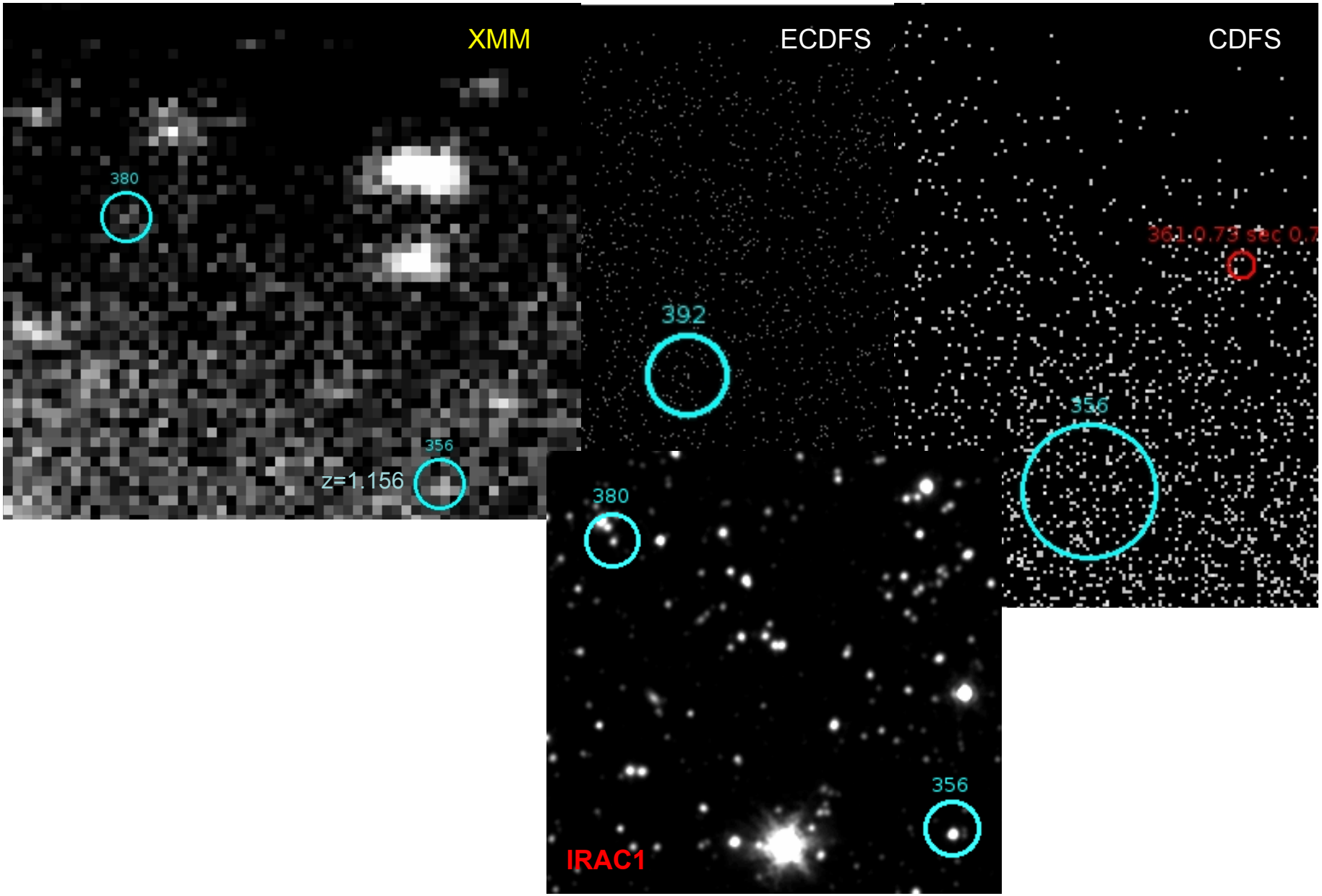
None is flagged as ‘good’ according to Francisco

Note that (a) outer regions have limited effective coverage in both CDFS-4Ms and ECDFS
&
(b) Xue et al. (2011) source catalog is conservative

II. Possibly new XMM sources (ii)



II. Possibly new XMM sources (iii)



Chapter 3

Blended or ‘single malt’?

III. XMM emission from multiple sources (i)

SUMMARY

At least 27 XMM sources whose X-ray emission is possibly the sum of 2−3 *Chandra* sources. In about 50% of the cases, the second source provides a minor contribution. Accurate XMM PSF analysis, comparison with *Chandra* spectral properties, 'treatment' within XSPEC may be needed

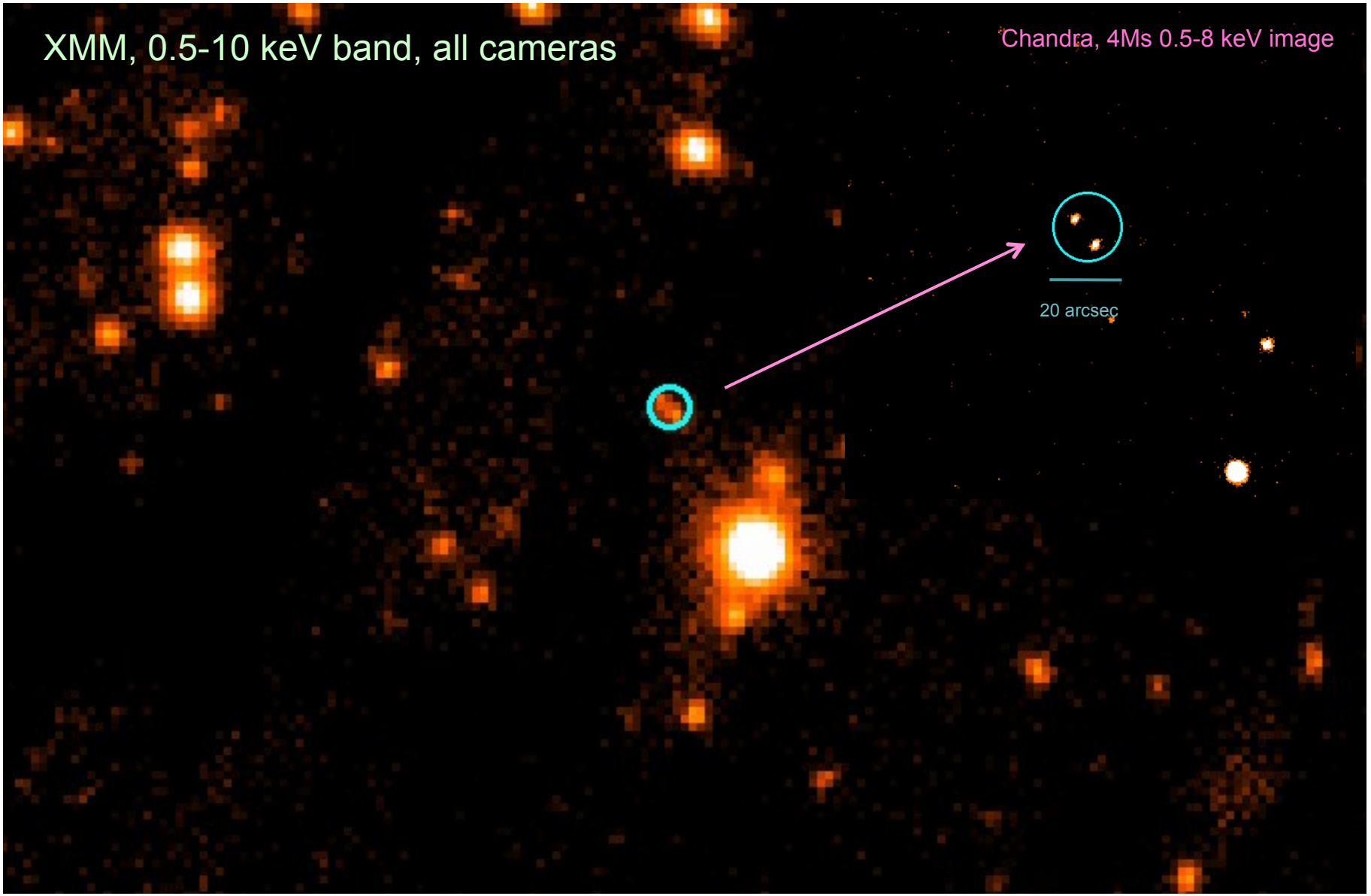
Francisco's analysis useful to quantify and qualify what is suggested by visual inspection

Chandra/multi-wavelength mandatory for better source centroid and more accurate flux estimate

Far off-axis angles: cases of 3 *Chandra* sources likely contributing to the XMM flux

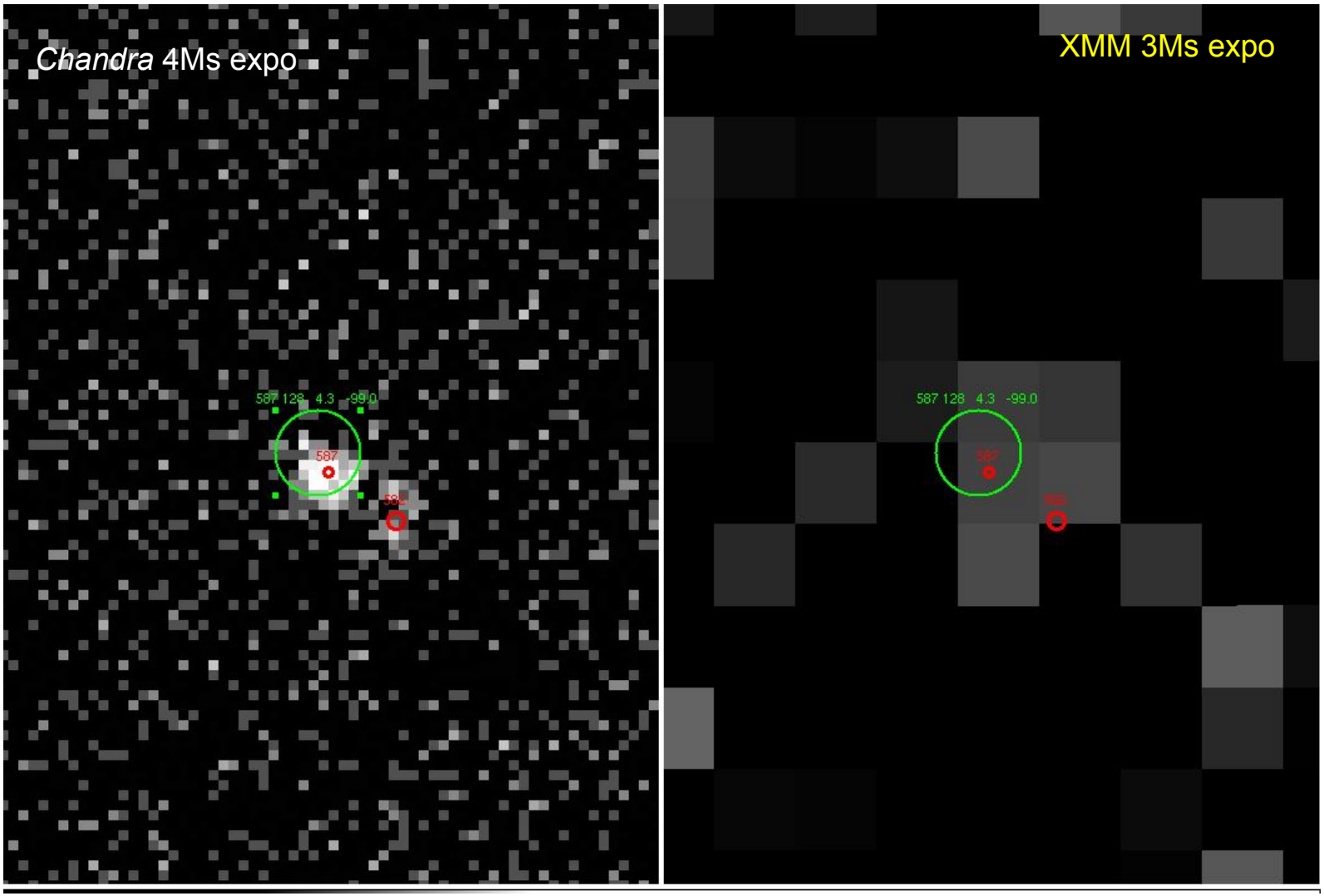
POSSIBLE PROBLEM: the significance of the XMM source detection may be influenced by the presence of more *Chandra* sources

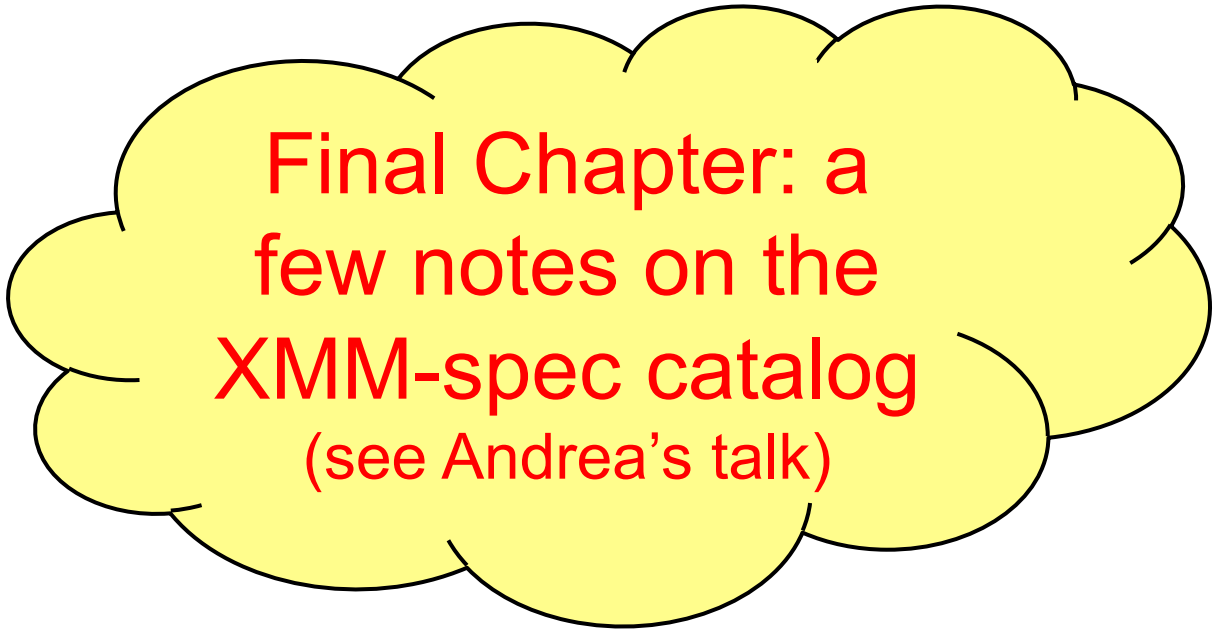
III. XMM emission from multiple sources (ii)



III. XMM emission from multiple sources (iii)

Two sources at z=0.28




Final Chapter: a
few notes on the
XMM-spec catalog
(see Andrea's talk)

XMM-spectroscopic catalog

- PWXDetect signif ≥10 + EMLDETECTION: N=142 sources (130 with T>1Ms)
- Spectral extraction for 133 sources:

  ➔ N=86 secure spec. redshifts
  N=22 likely/tent./ins.
  N=23 photo-z
  N=1 no info
  N=1 no X-ray match but likely src.

- 142-133=9 ➔ N=4 secure sp./N=1 tent./N=4 spurious sources

- PWXDetect signif =8−10 + EMLDETECTION: N=44 sources (41 with T>1Ms)
- Spectral extraction for 38 sources:

  ➔ N=16 secure spec. redshifts
  N=8 likely/tent./ins.
  N=13 photo-z
  N=1 no info

- 44-38=6 ➔ N=4 secure sp./N=1 tent./N=1 photo-z

What's next (in my to-do list)

What's next

To-do list (random order, not complete)

1. Re-check on the available spec-z/photo-z catalogs + updates on recent follow-up optical/near-IR spectroscopic runs (John?);
2. Verify which photo-z solution is likely more appropriate for the XMM-spec catalog;
3. Optical source classification ➔ create an internal spectroscopic database (with at least mono-dim. spectra), starting with the sources of the XMM-spec catalog;
4. Improve XMM positions using either (a) a partially different energy band [1-5 keV?] or (b) the PSF information [time consuming; 33x3 images] or (c) fitting the positions within EMLDETECT (but this solution was discarded at the beginning);
5. Produce a **validated XMM source catalog** with the main and verified information (X-ray and other wavelengths) to distribute to the CDFS 'aficionados'.


THE END