HI source finding using optical surveys

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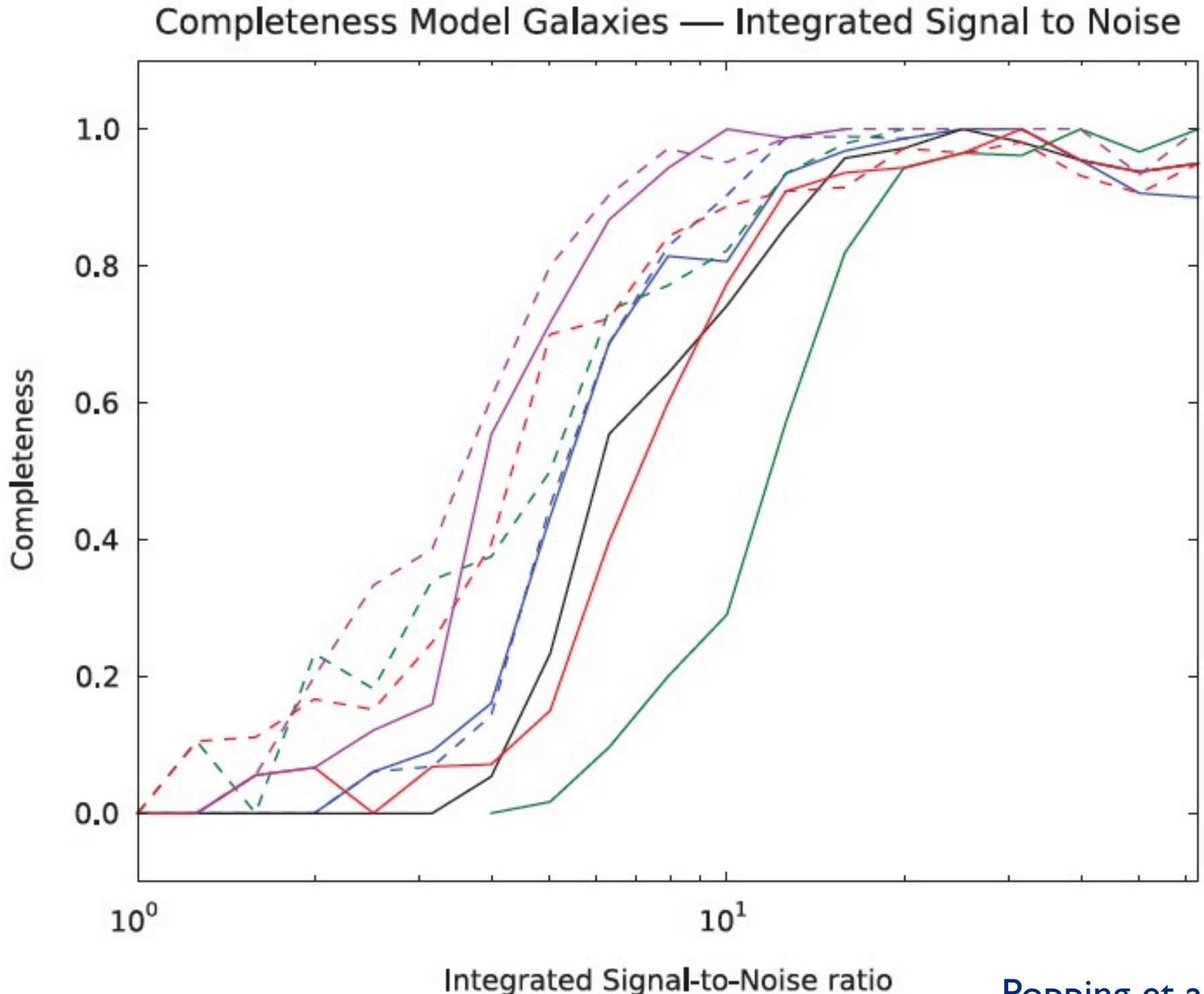
HI source finding

A lot of work has been done on source finding

- many source finding busy weeks
- many different algorithms
- number of papers
- SoFiA

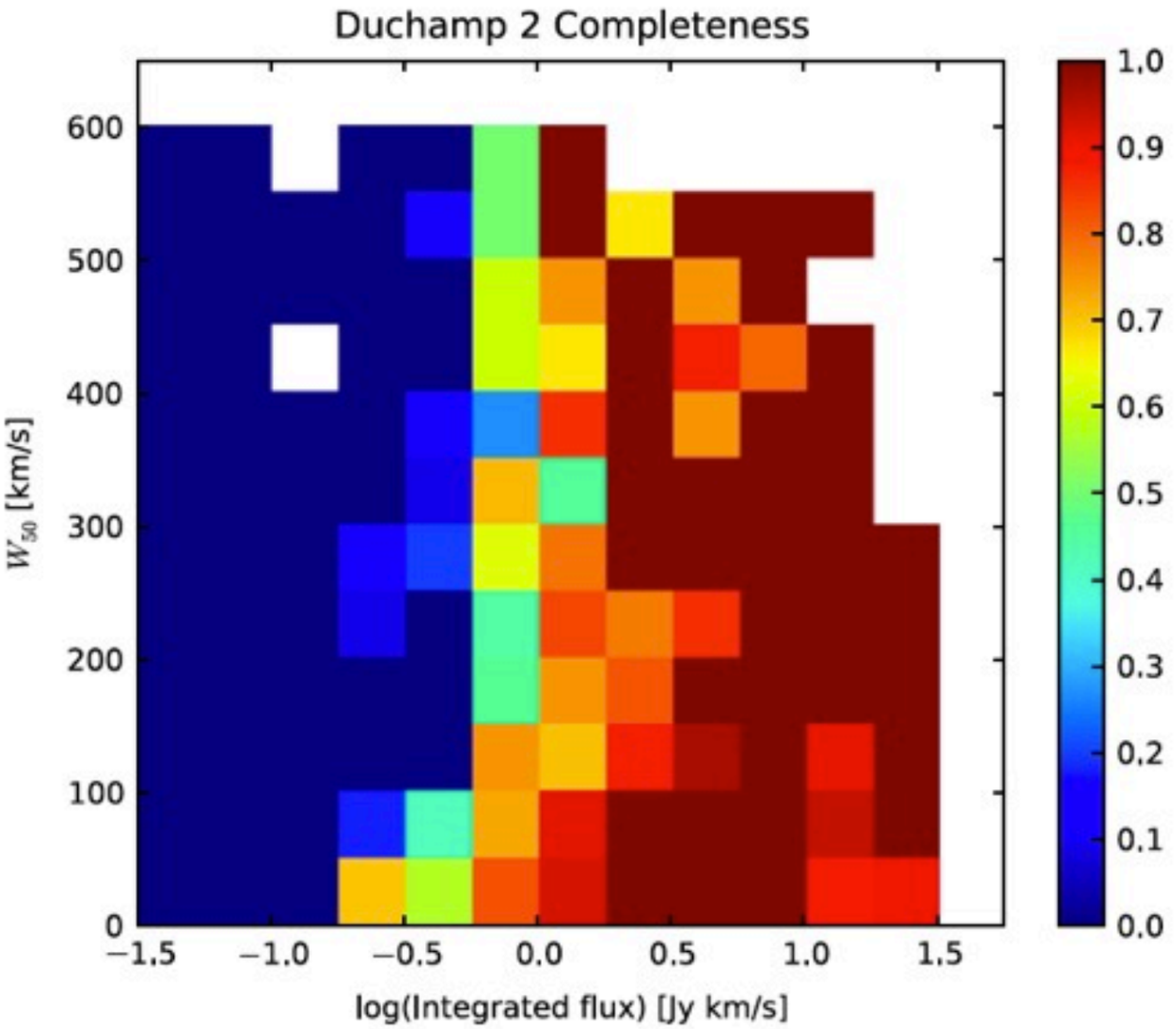
This is important and a great result, but are we there yet ...?

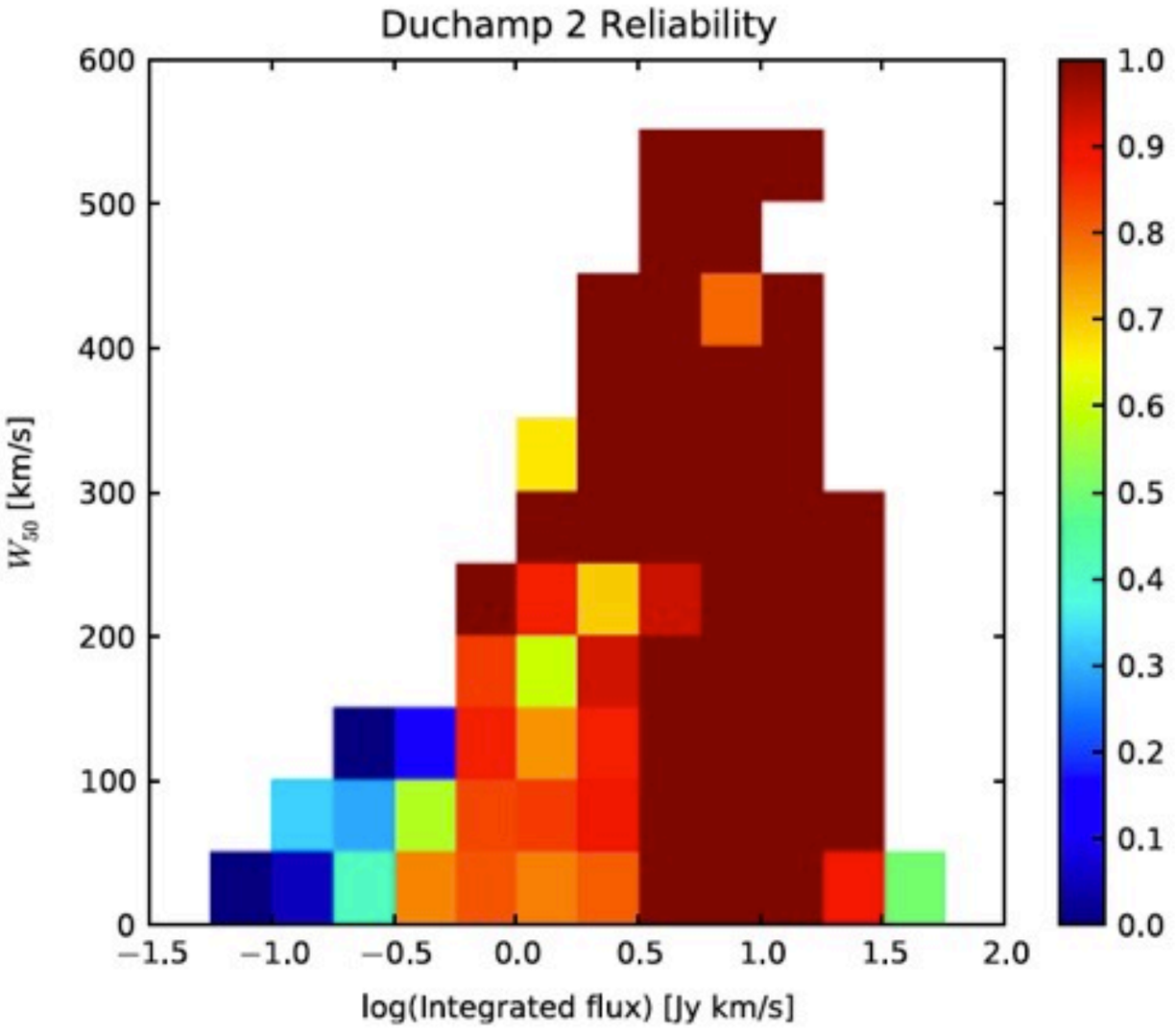
HI source finding



Popping et al., pasa 2012

HI source finding



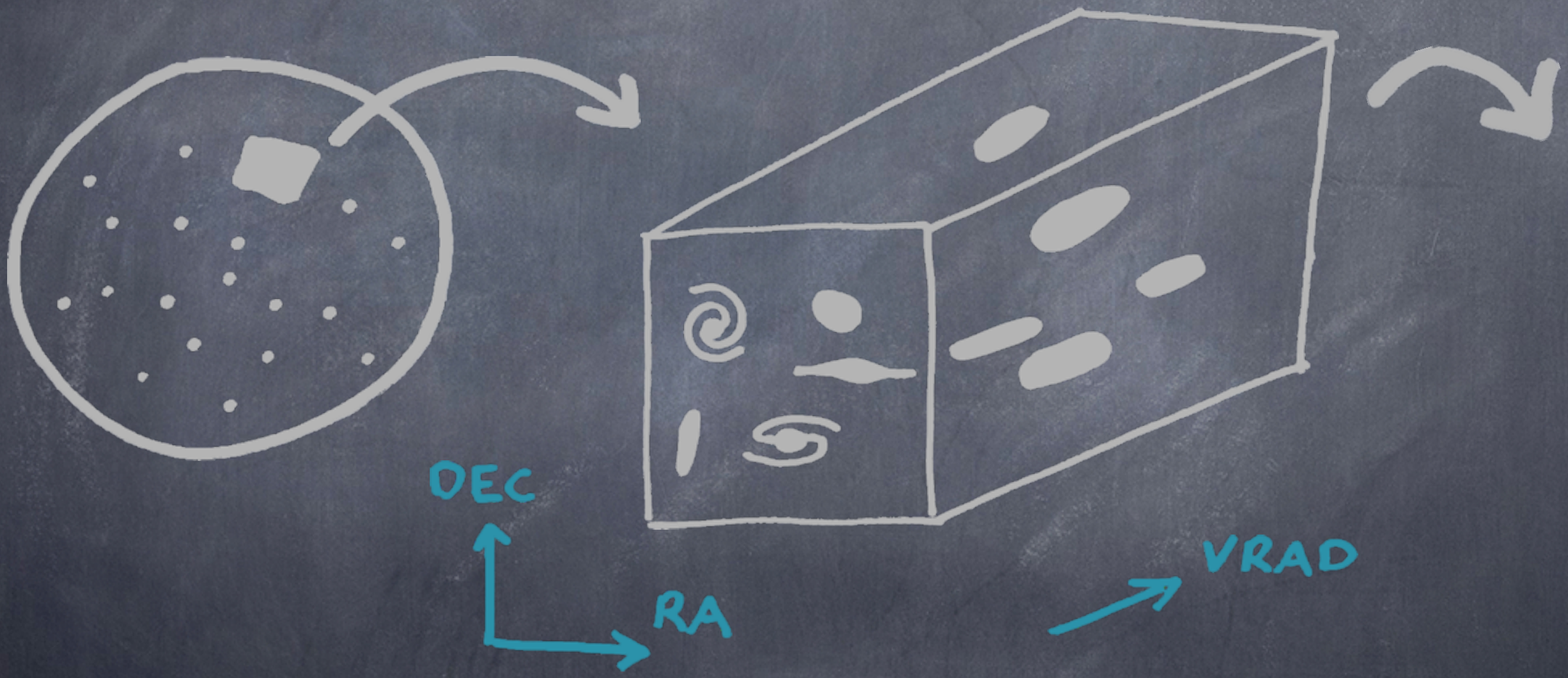


Popping et al., pasa 2012

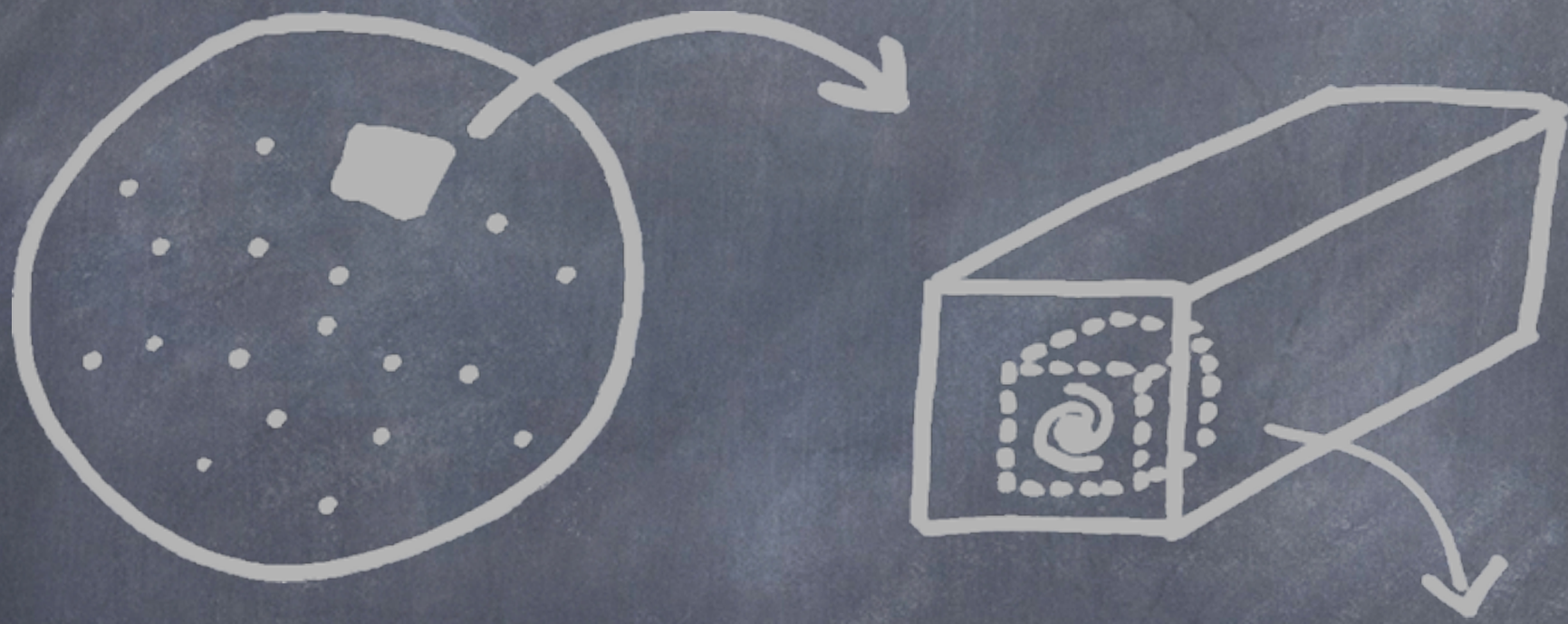
HI source finding

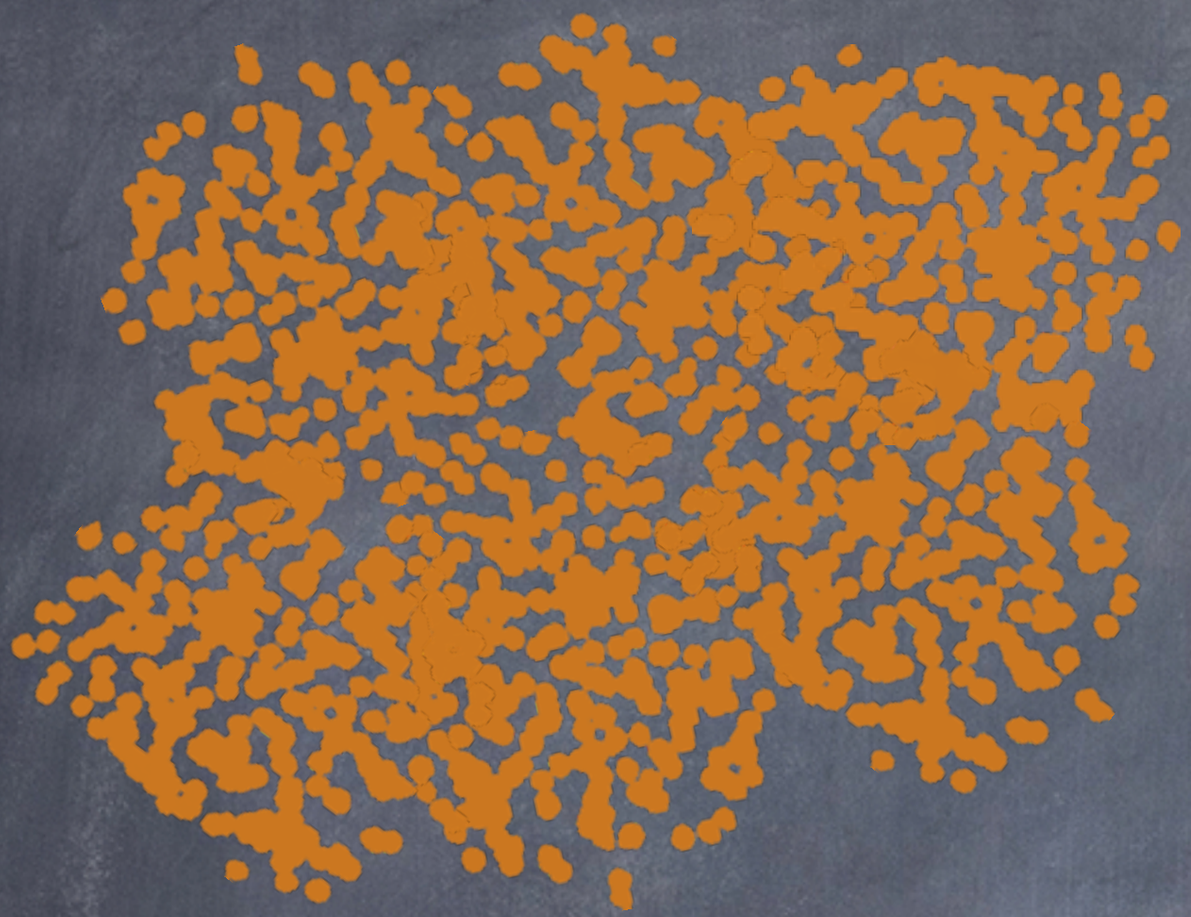
- Previous plots are in the “ideal world” with perfect noise
- Difficult to get a high completeness on sources with low flux levels
- Difficult to get a good reliability
- Both can be improved by using information (Ra, Dec, z) from optical catalogues
- People have known/assumed this, however the topic has largely been neglected.

Blind source finding



Targeted source finding



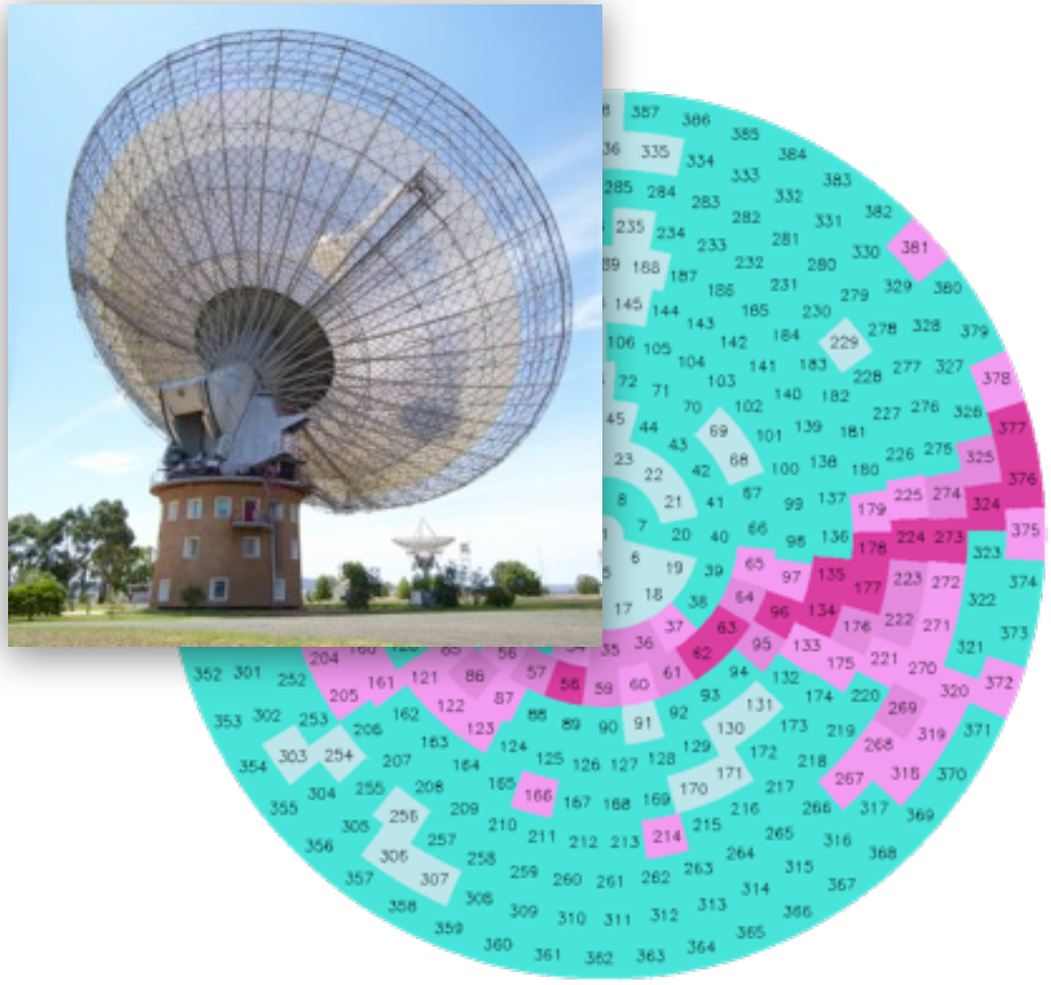


NOISE!

signal

noise

HIPASS II + GAMA



Good test case, where we have a lot of information

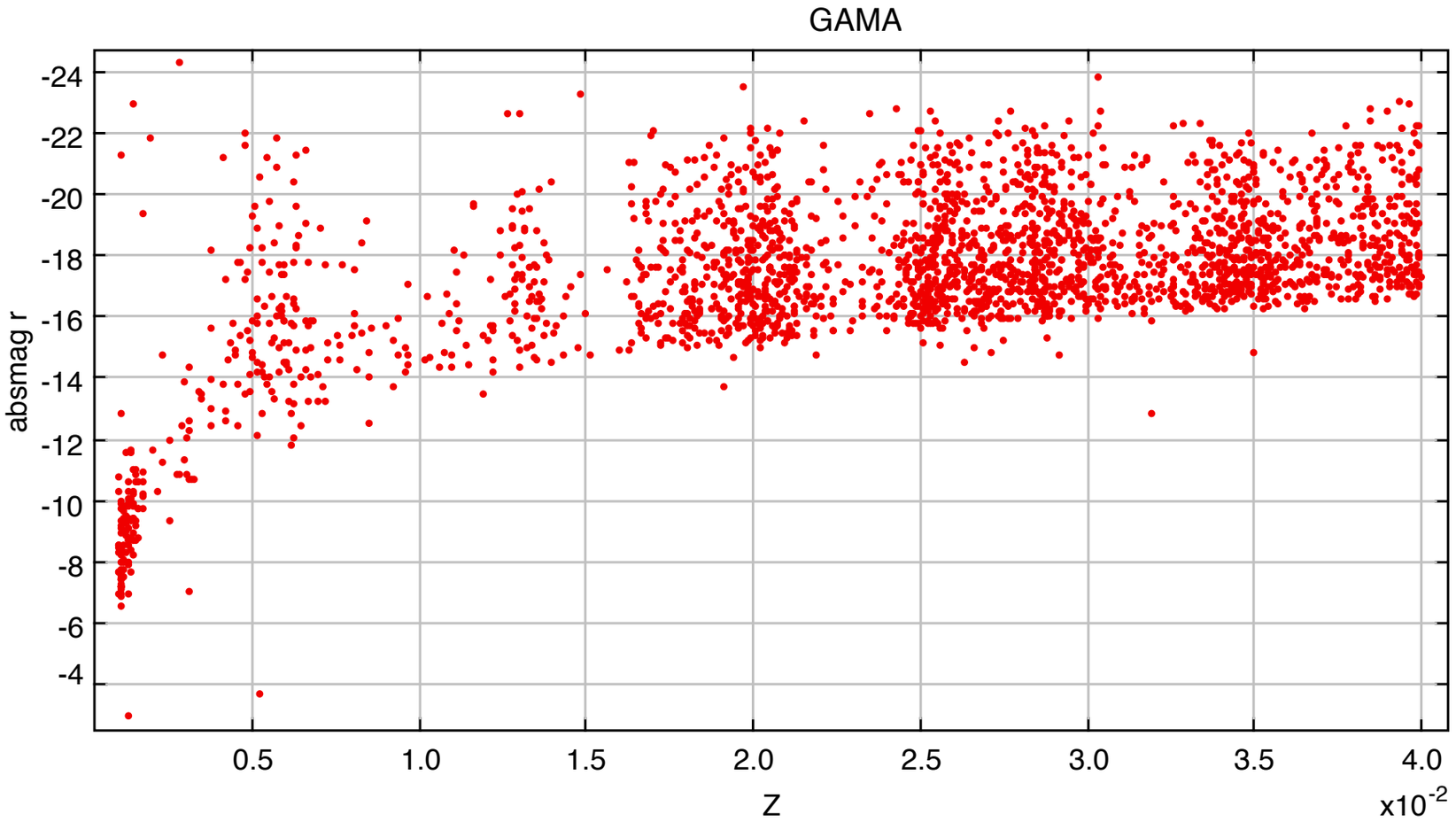
number of redshifts in GAMA: 2417
number of galaxies in hipass: 35
number of galaxies in hopcat: 30

Procedure

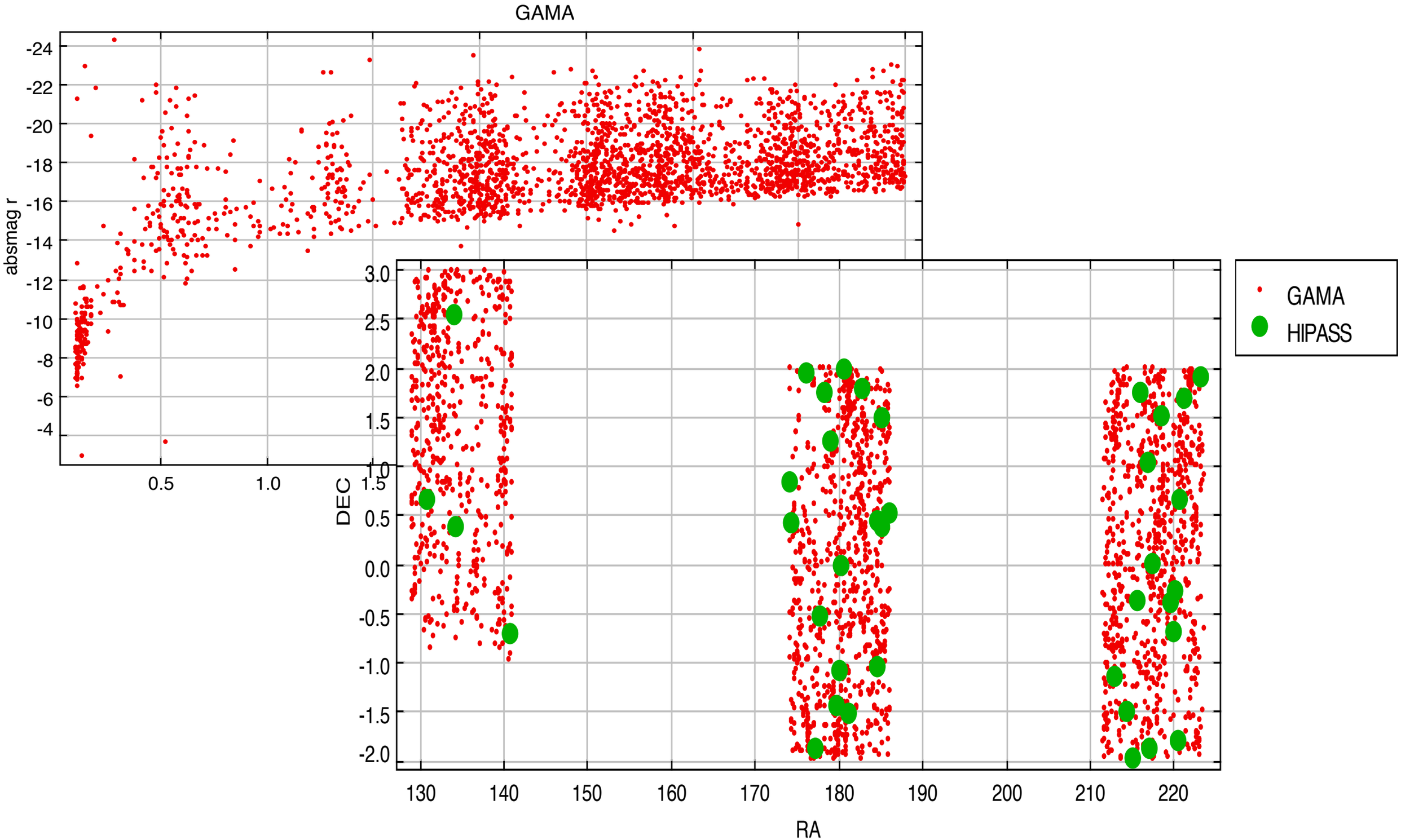
Python script:

- read optical catalogue (with, RA, DEC and z)
- convert position to x,y,z in HIPASS cubes
- extract a small cubelet around the given position
- look for HI detection using DUCHAMP
- extract spectrum, moment map etc ..

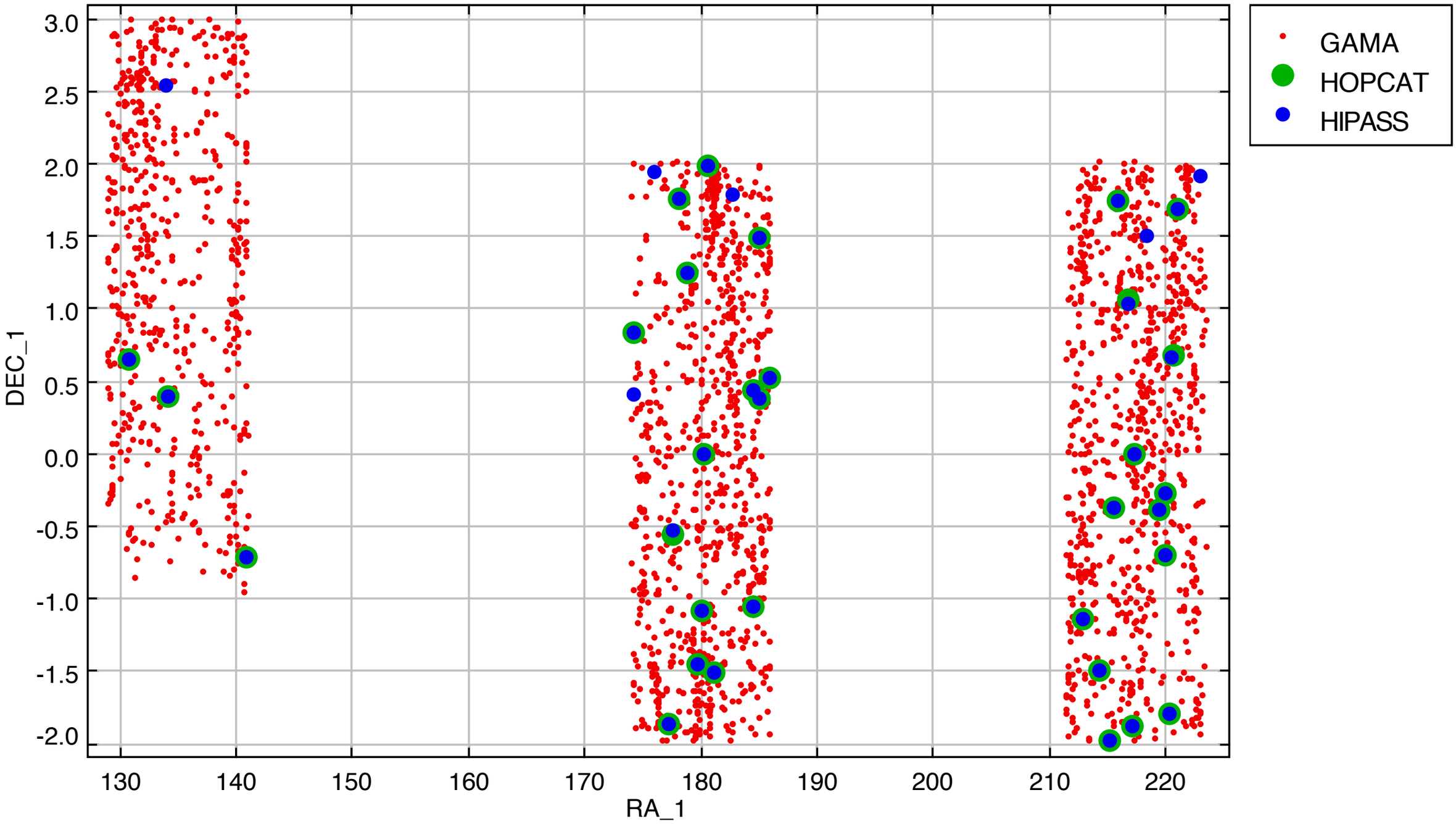
HIPASS + GAMA


GAMA
absmag r
-24
-22
-20
-18
-16
-14
-12
-10
-8
-6
-4
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Z
x10^-2

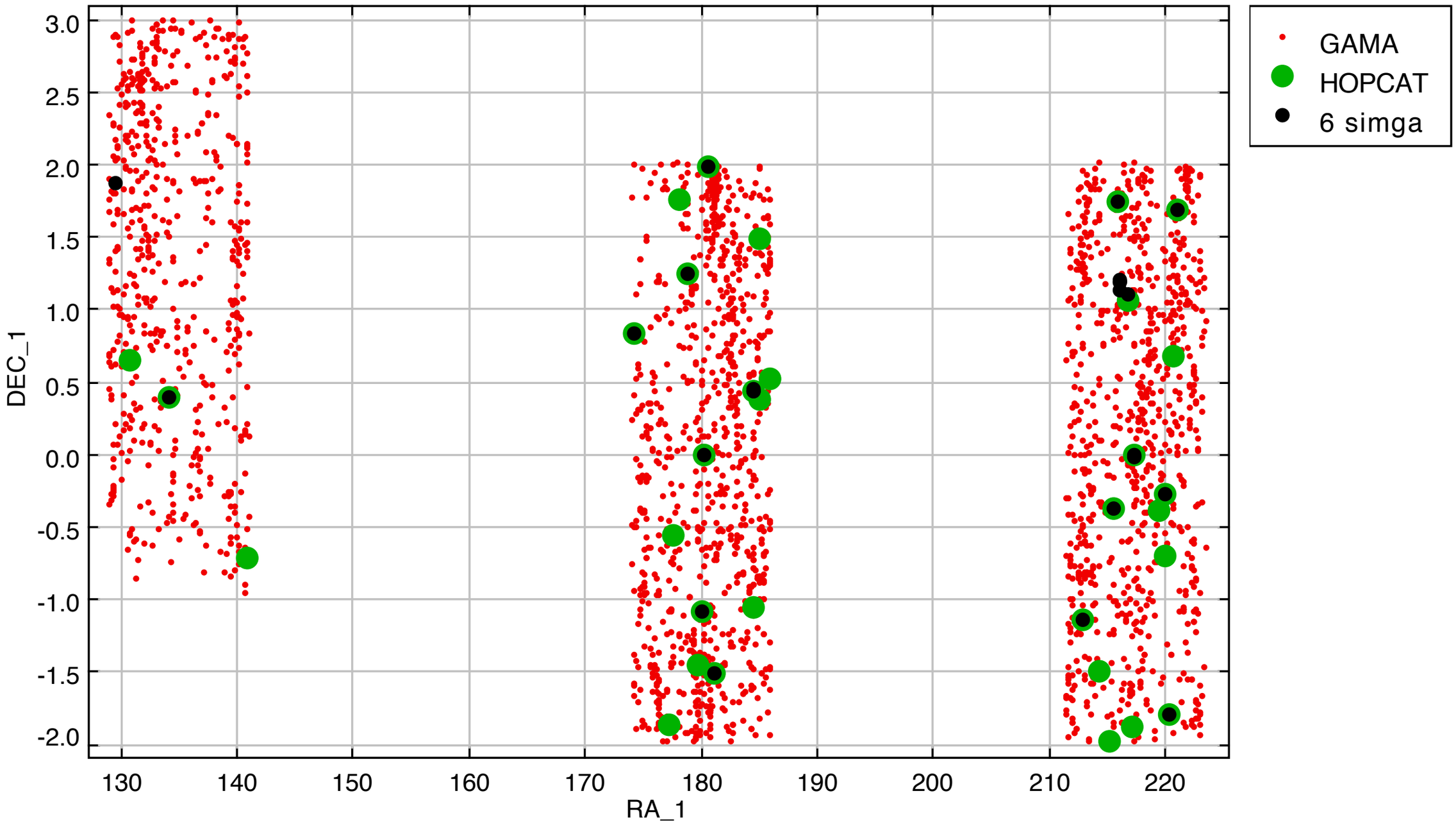
HIPASS + GAMA


GAMA
absmag r
-24
-22
-20
-18
-16
-14
-12
-10
-8
-6
-4
0.5
1.0
DEC
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
130
140
150
160
170
180
190
200
210
220
RA
GAMA
HIPASS

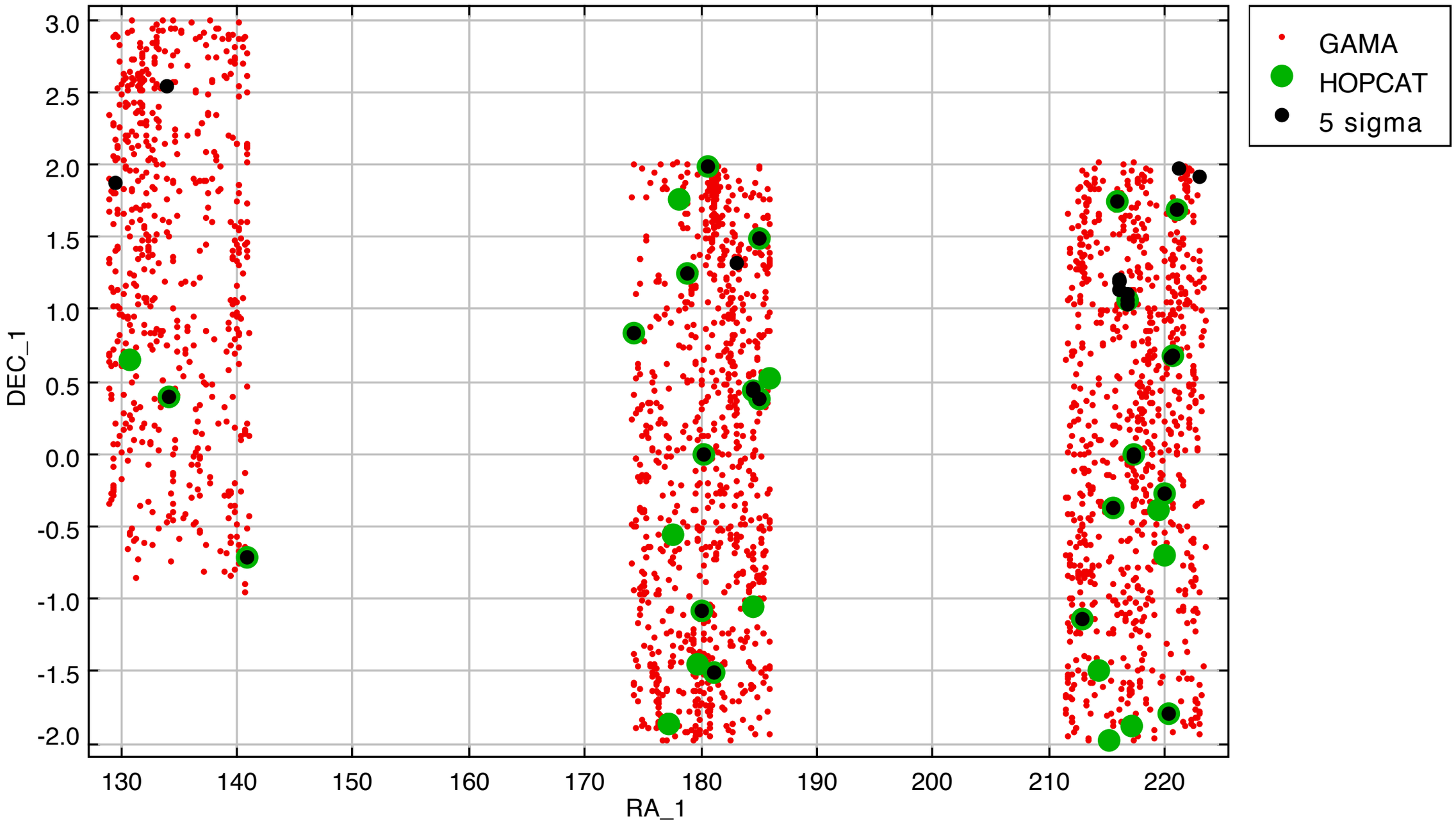
HOPCAT


GAMA
HOPCAT
HIPASS
DEC_1
RA_1
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
130
140
150
160
170
180
190
200
210
220

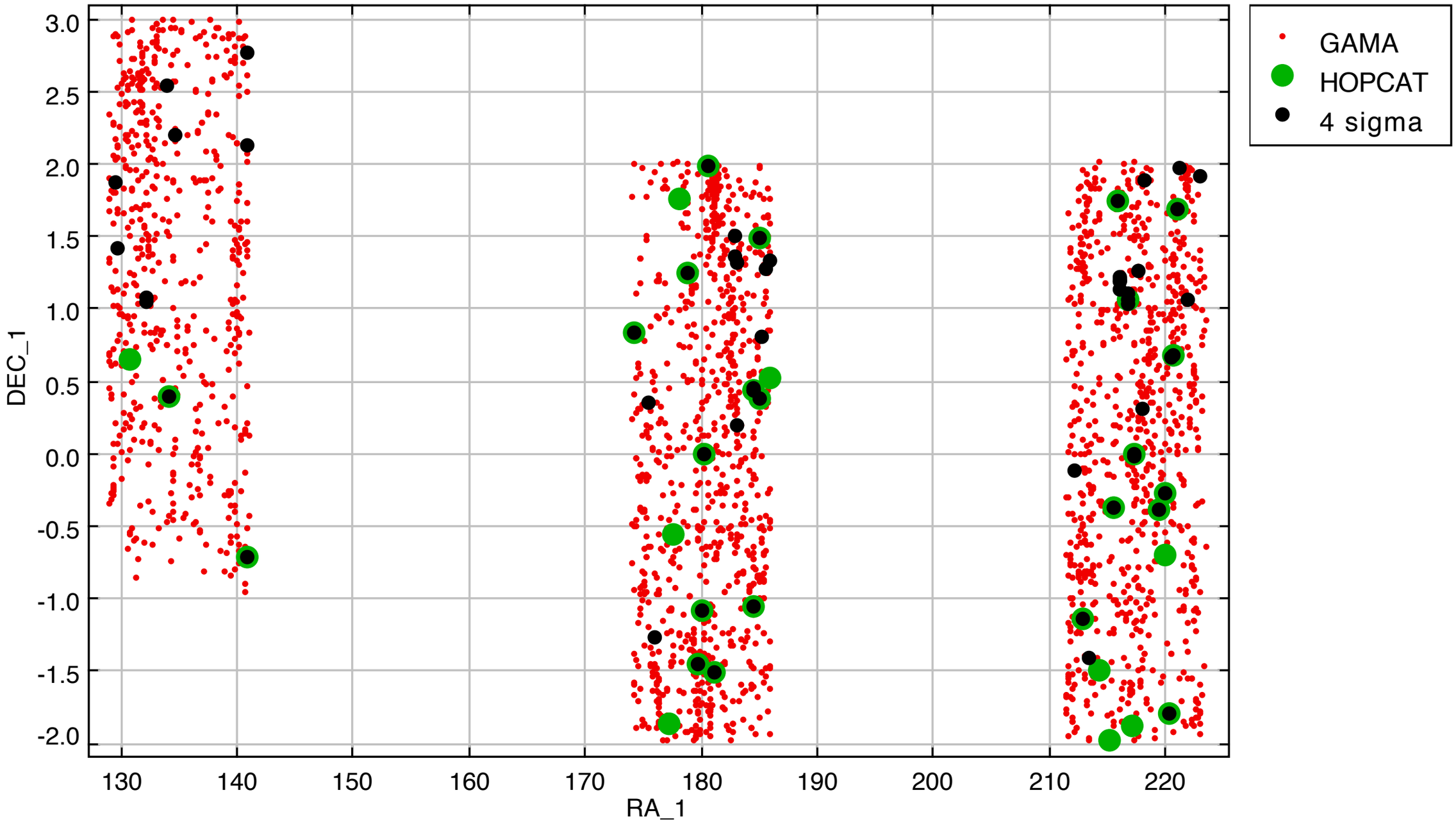
6σ threshold



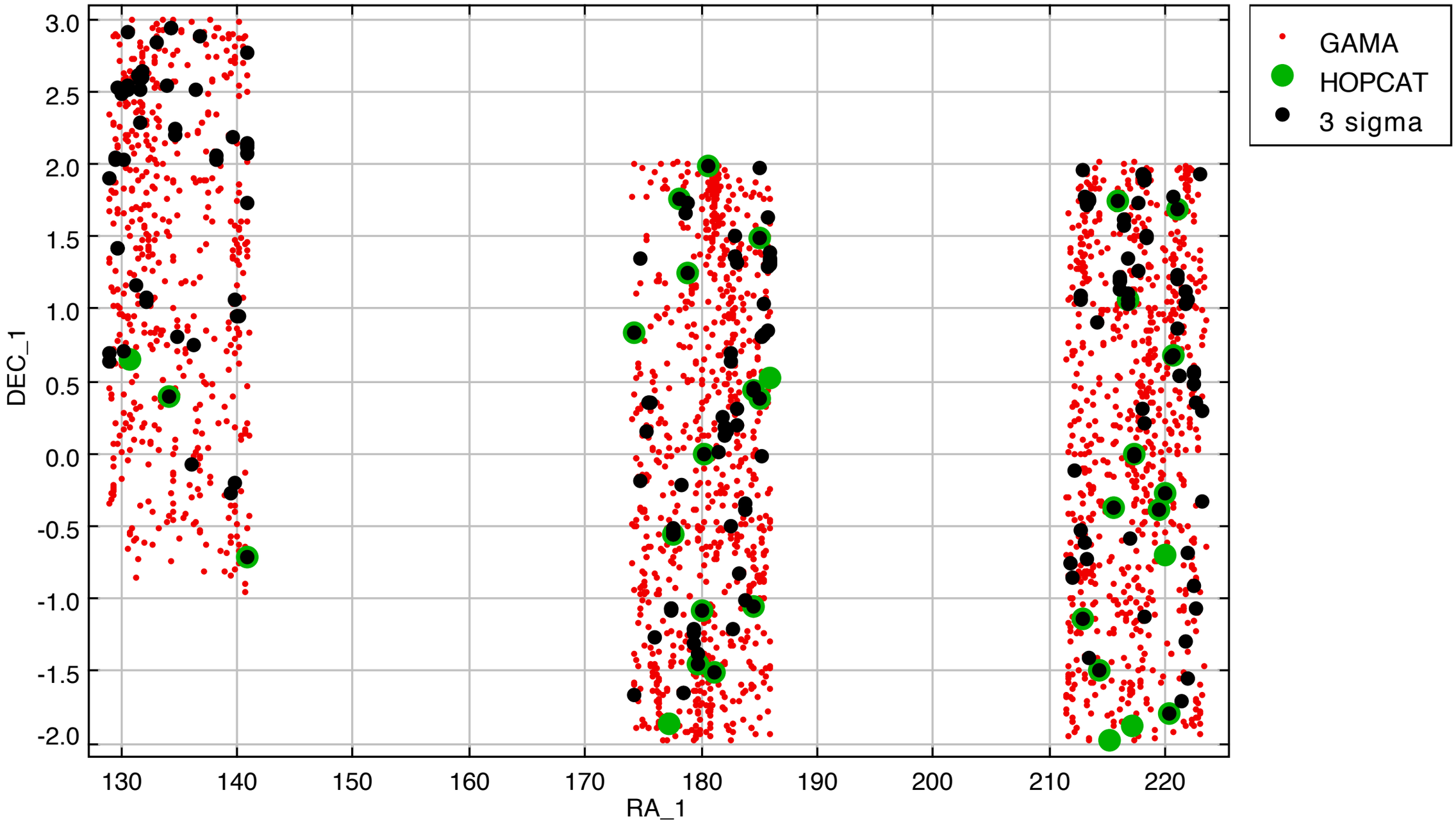
5σ threshold



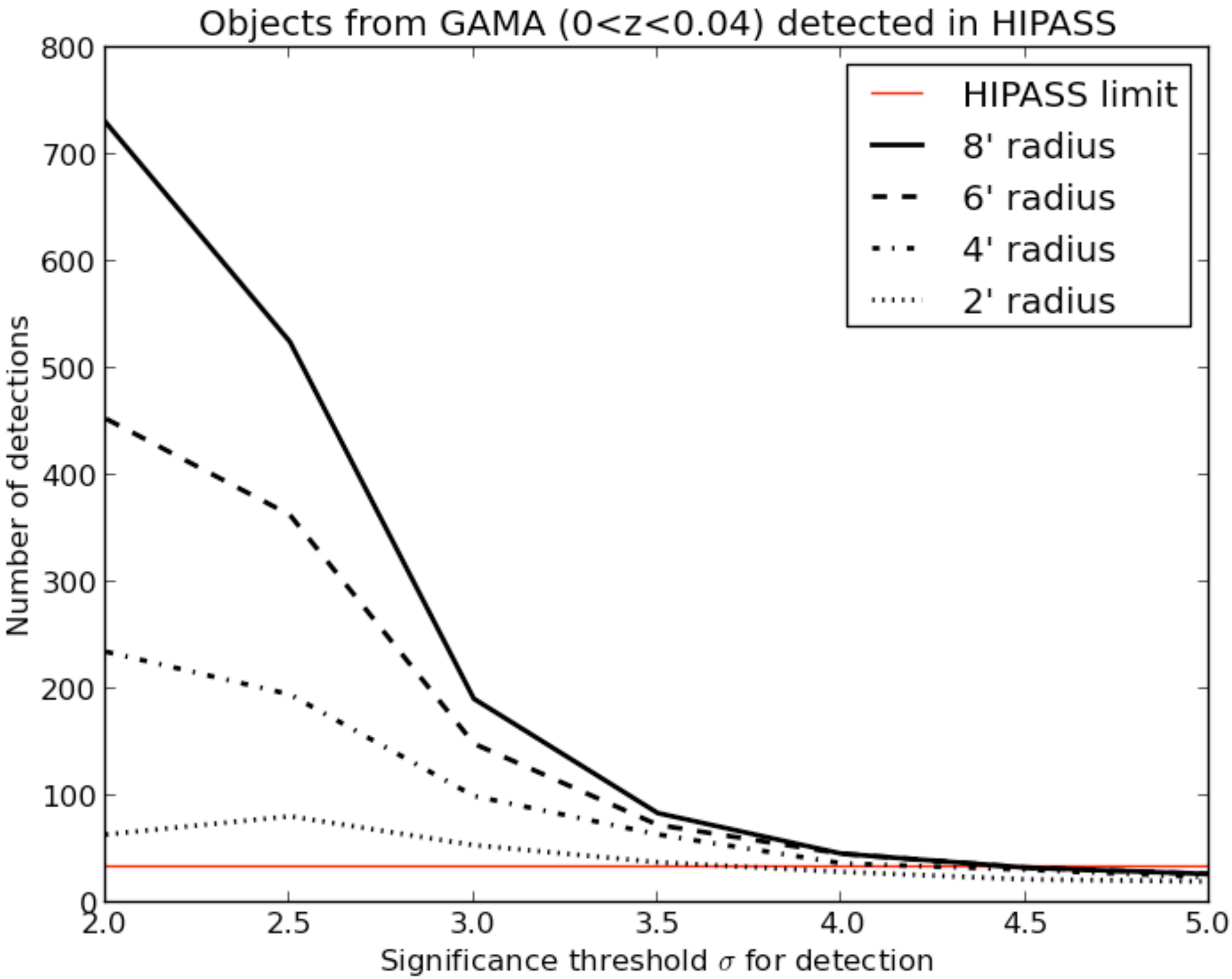
4σ threshold



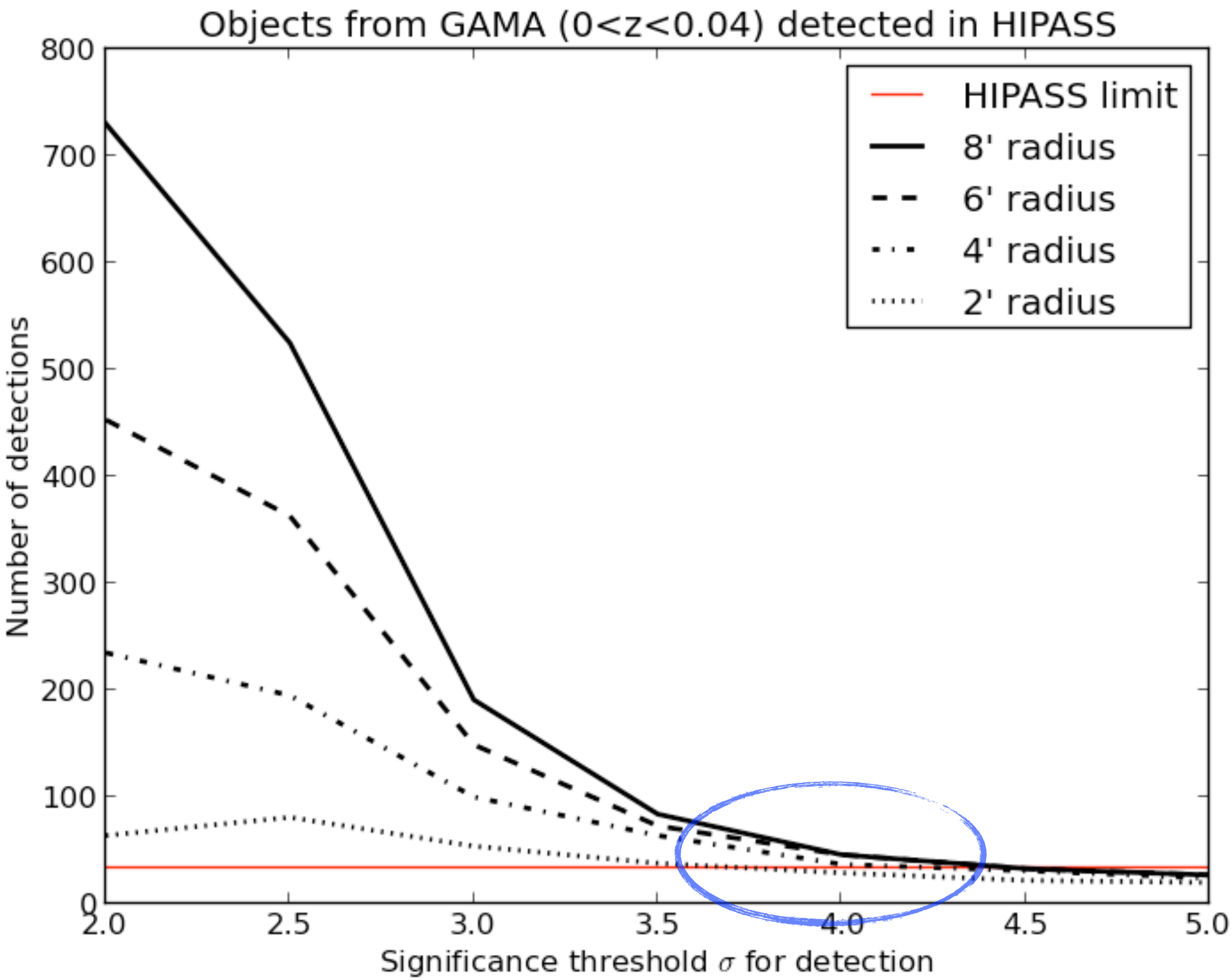
3σ threshold



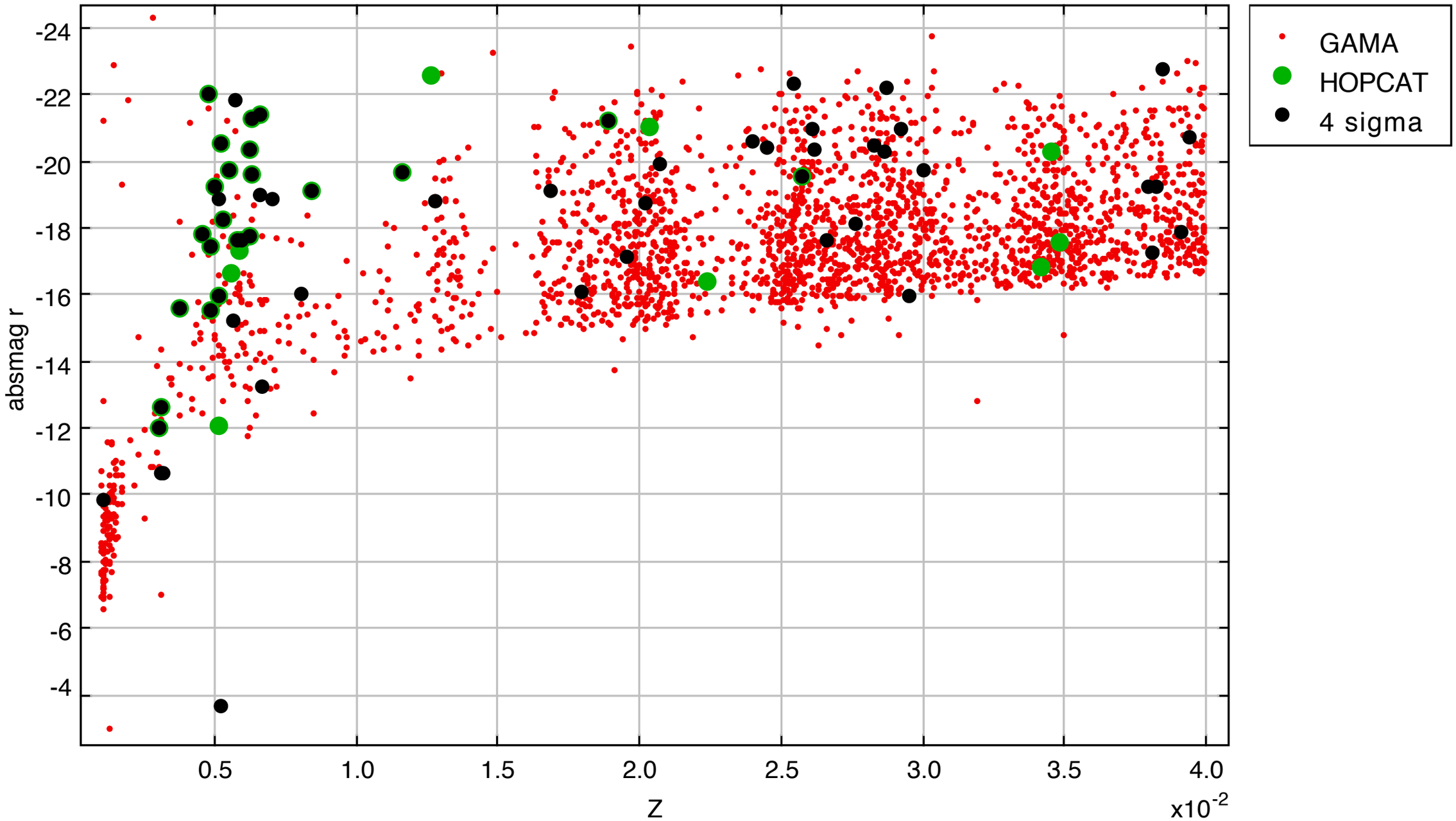
Search results



Search results



4σ threshold



Findings

- Most HOPCAT/HIPASS sources recovered, however not all
  - When inspecting data, these did not look like proper detections (HIPASS II ?)

- Confusion is a problem, especially at high redshift
  - Parkes beam is huge

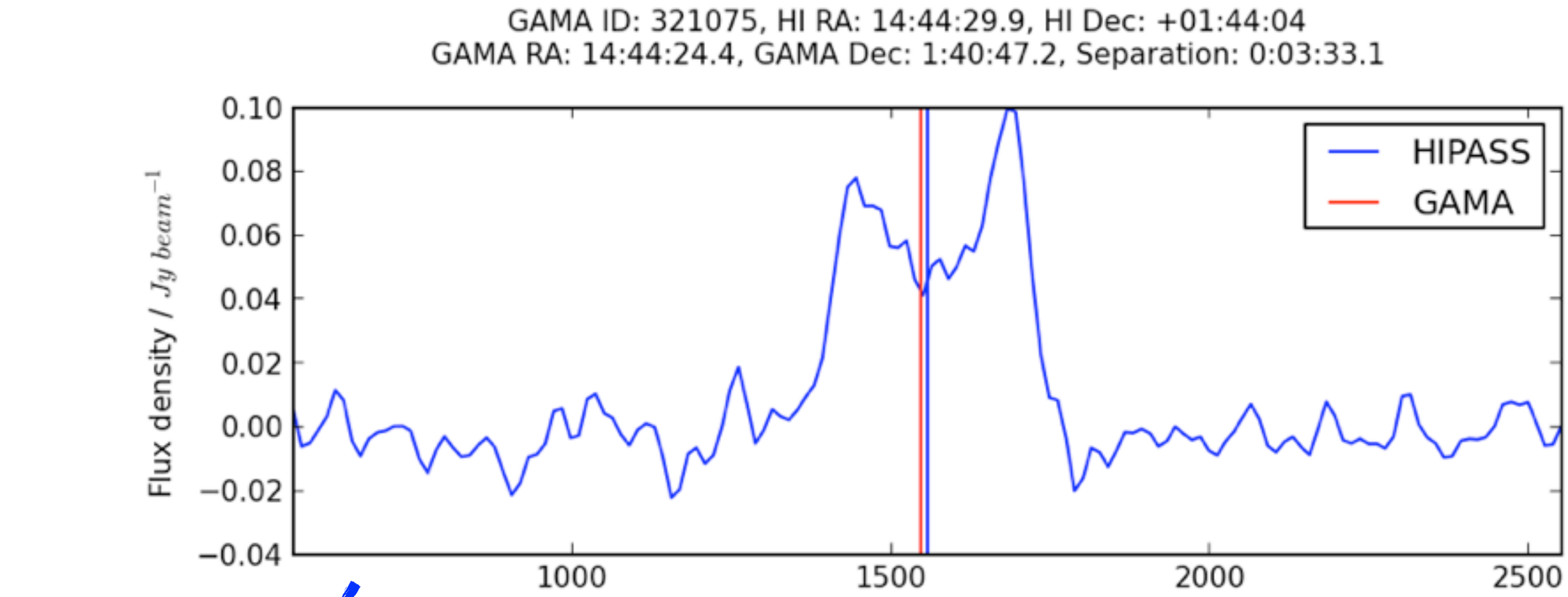
- Many new detections
  - Not all reliable, at low threshold levels more artifacts and random noise peaks

number of galaxies in hipass: 35
number of galaxies in hopcat: 30

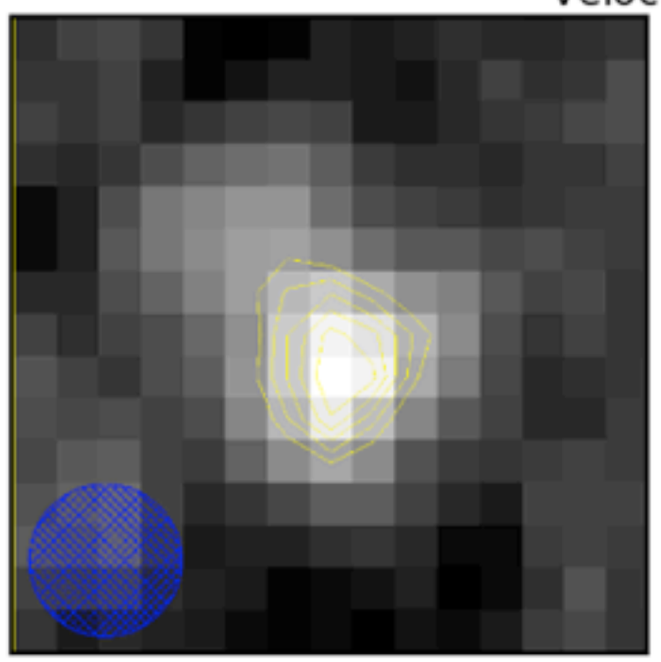
search results:

6σ: 24 matches
5σ: 35 matches
4σ: 59 matches
3σ: 198 matches

examples ...



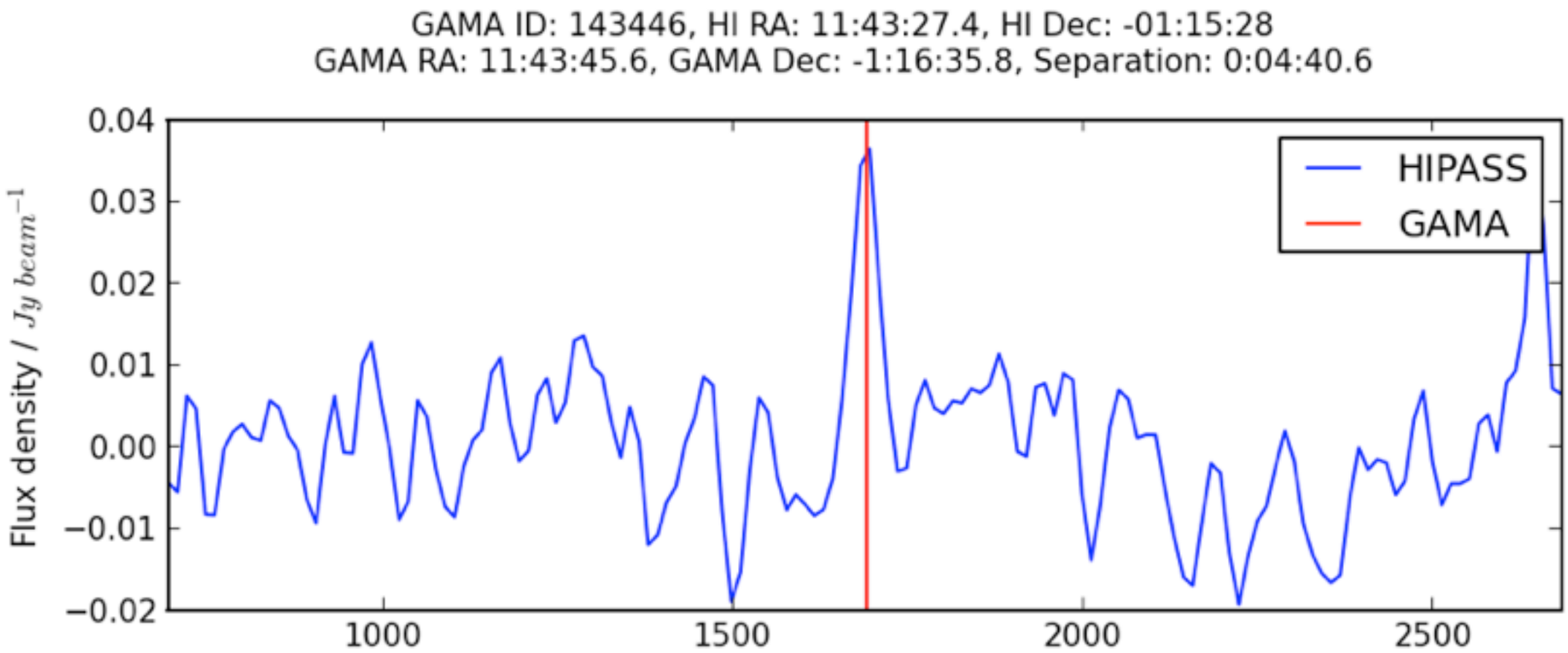
known

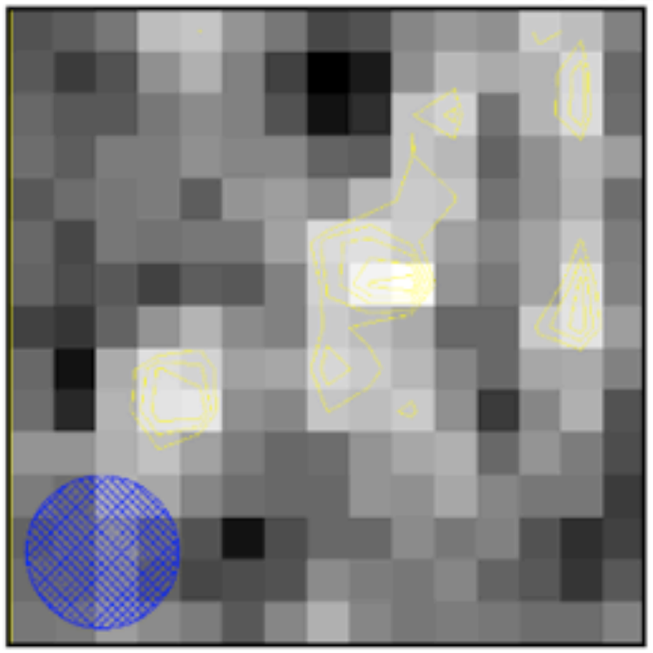


HIPASS zero-moment map

GAMA image

examples ...

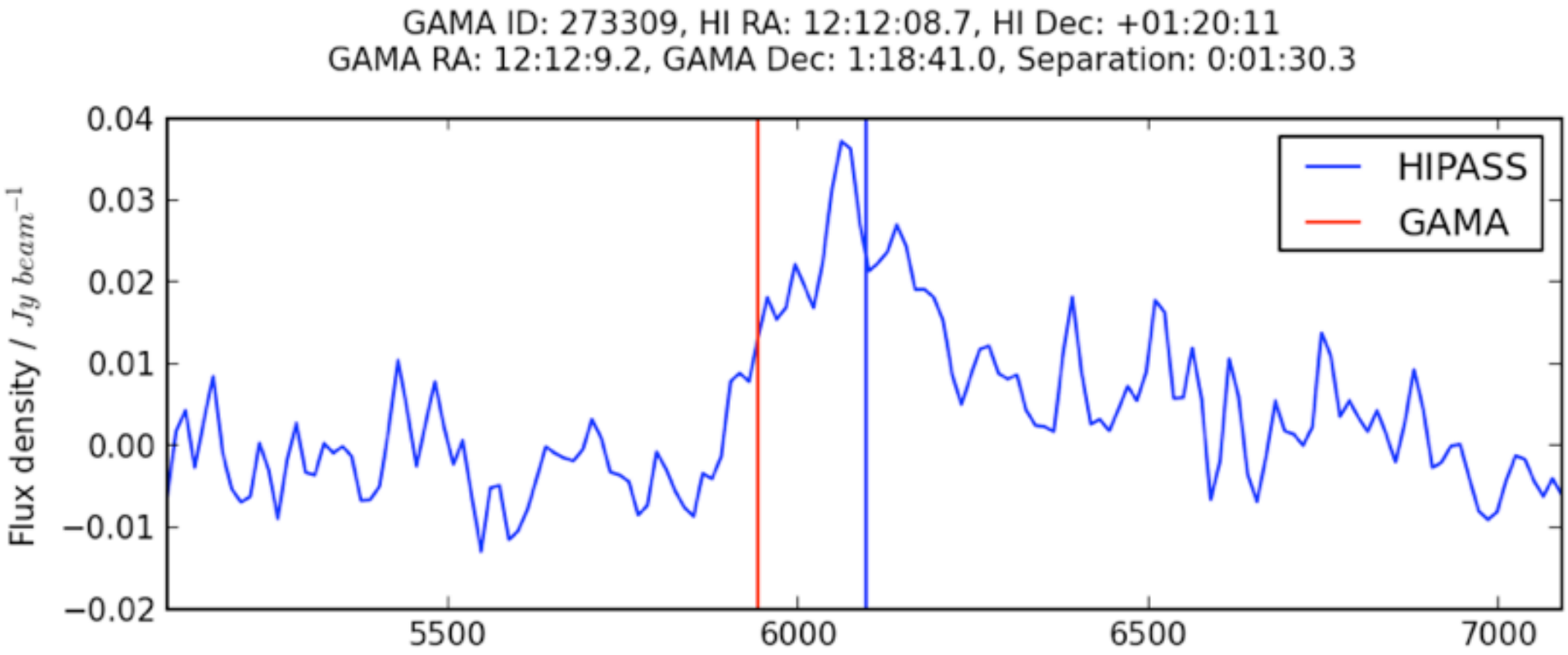




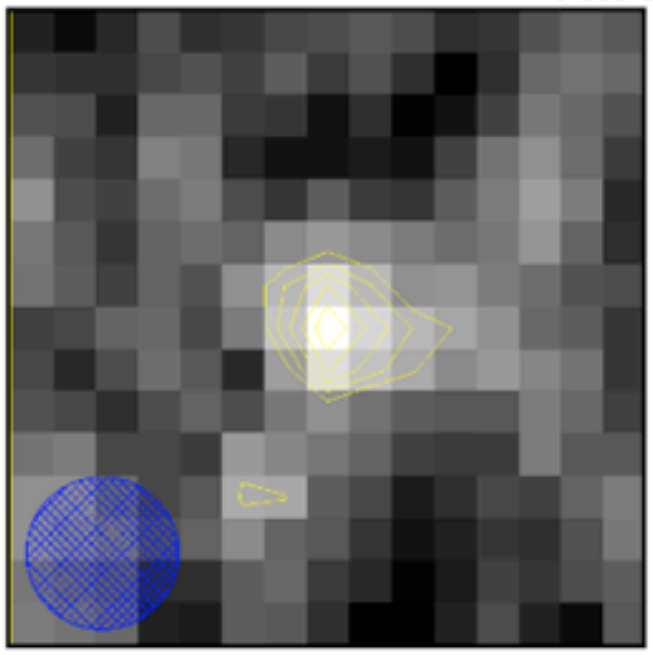
HIPASS zero-moment map

GAMA image

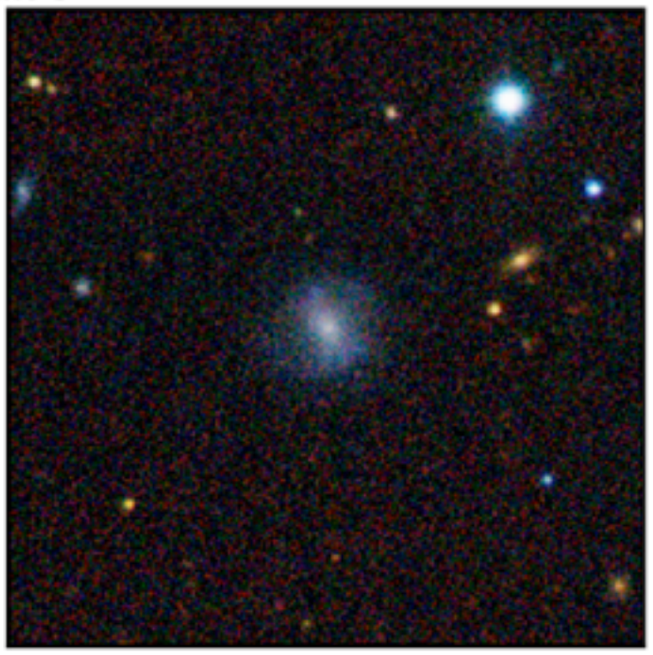
examples ...



new !!

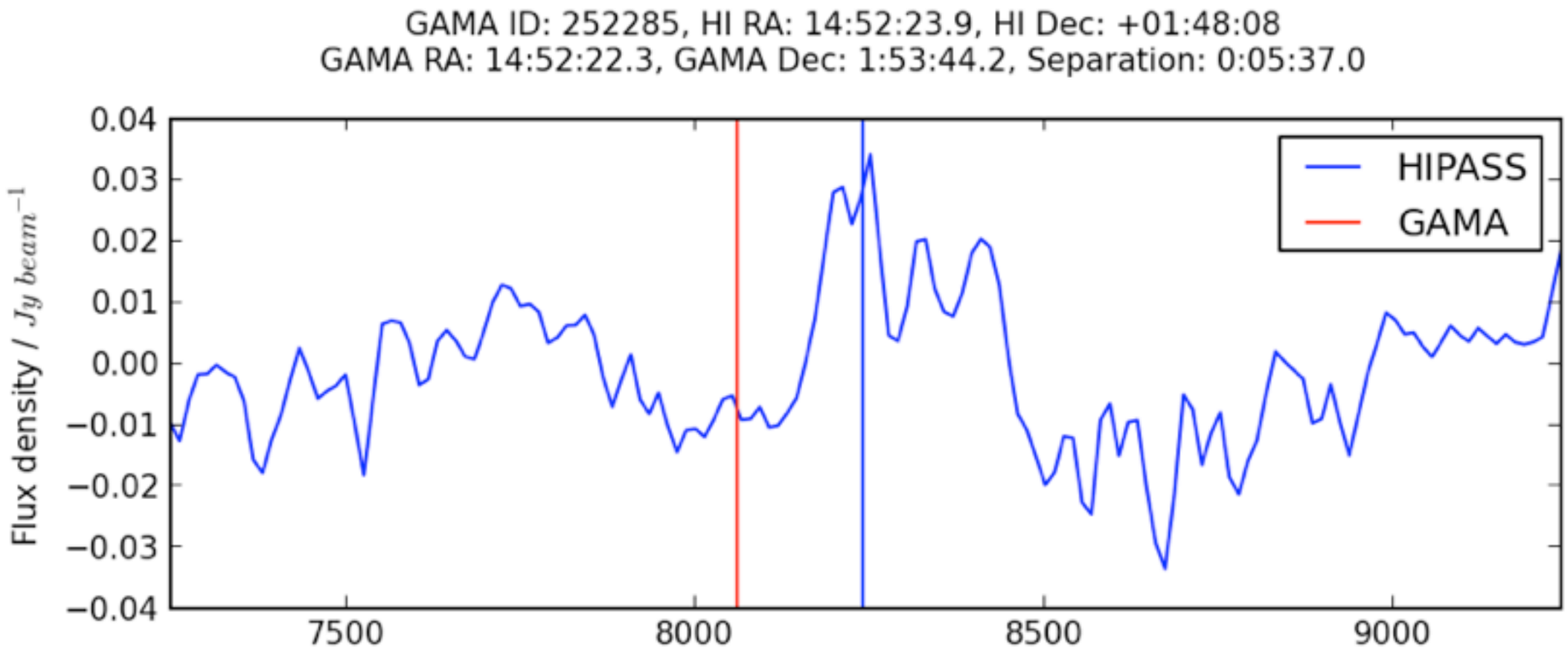


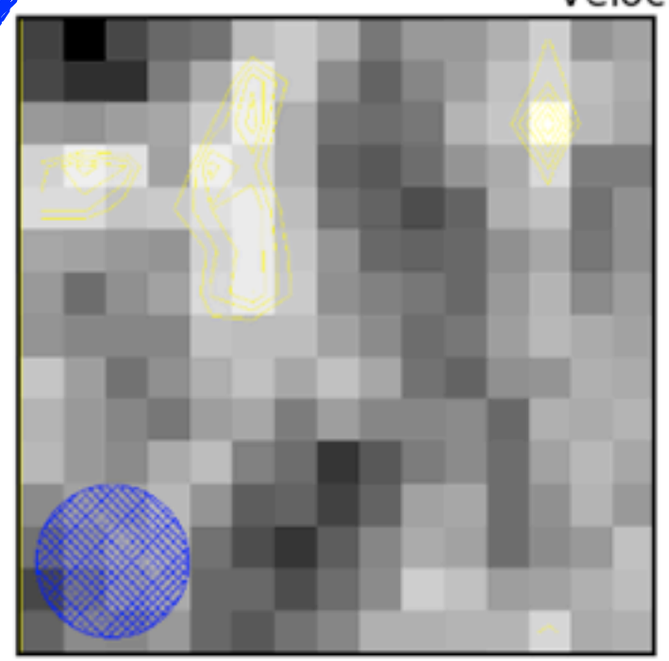
HIPASS zero-moment map



GAMA image

examples ...





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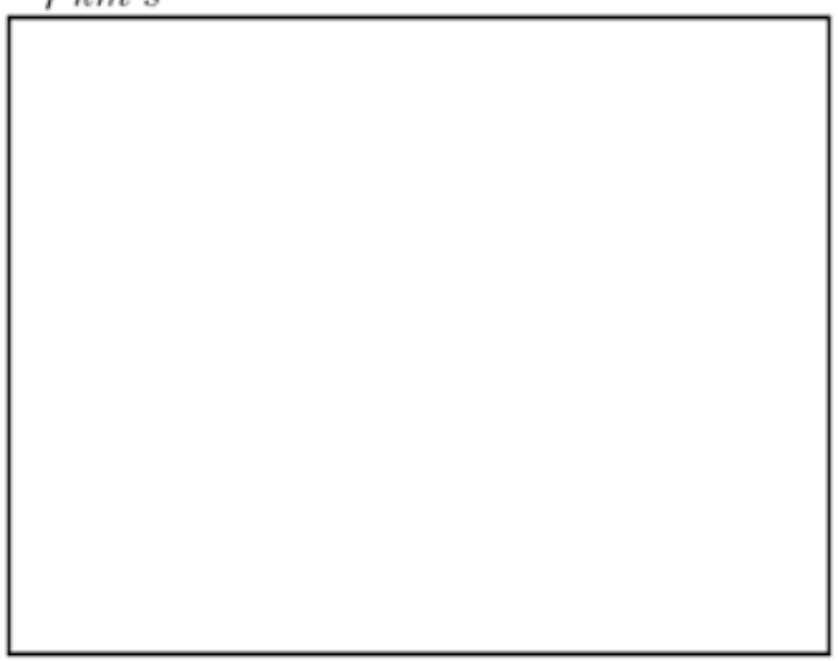
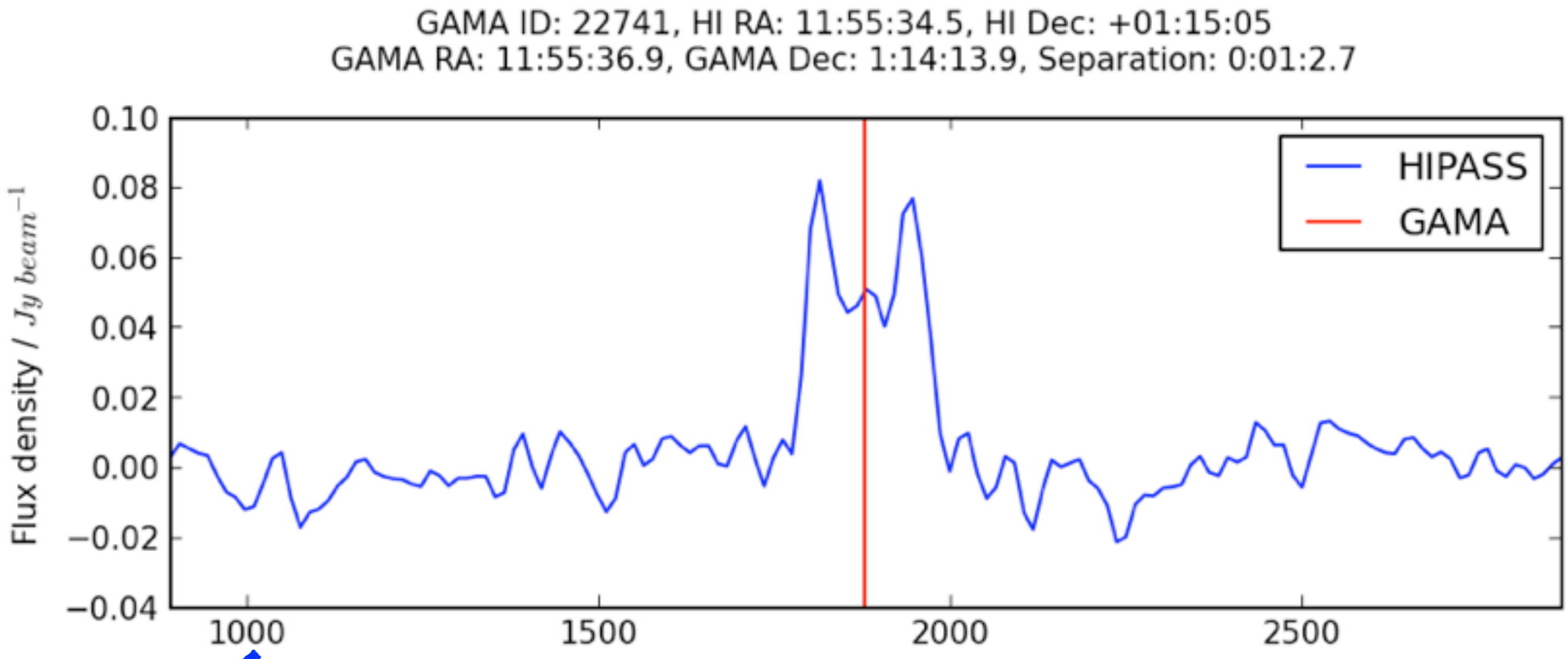
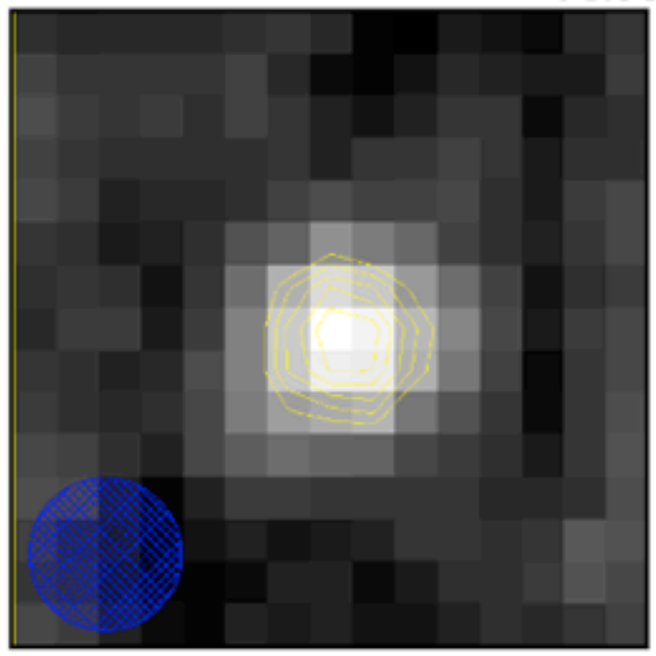


No GAMA image available

examples ...



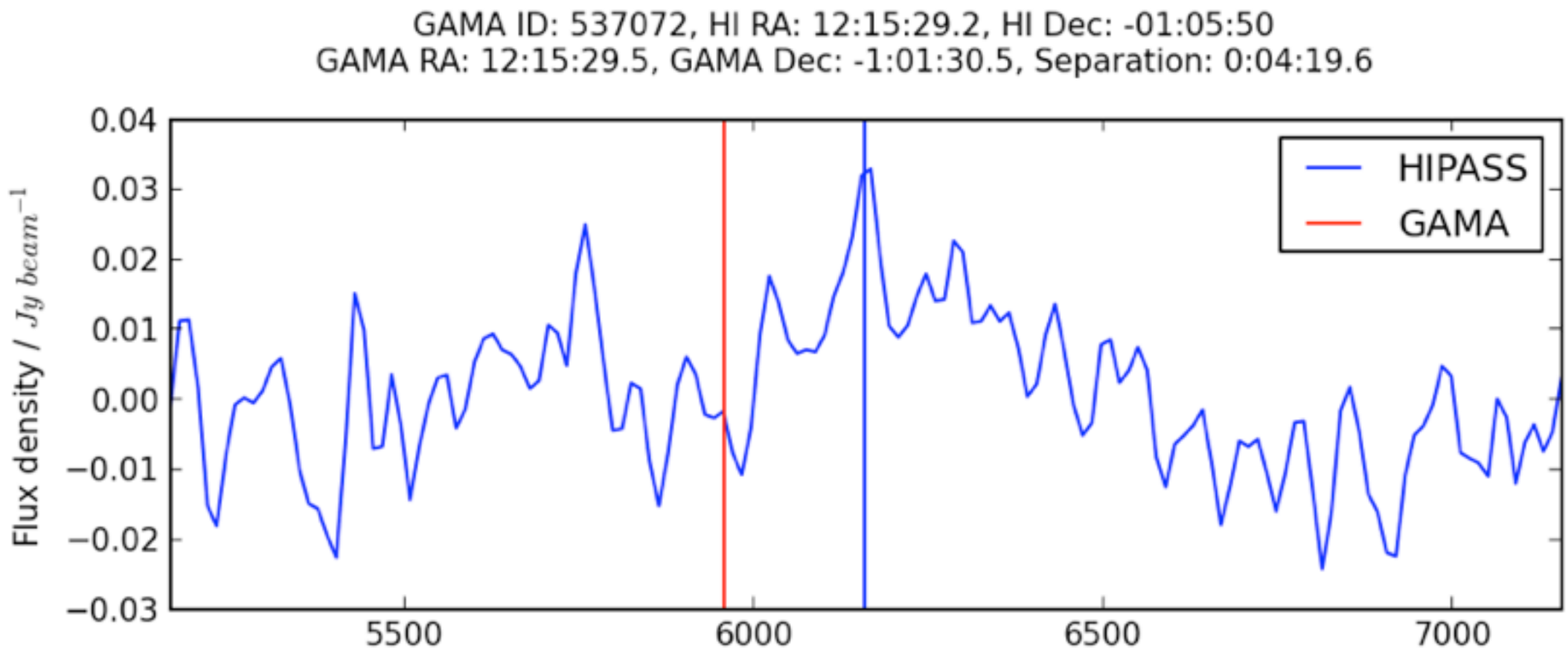
known



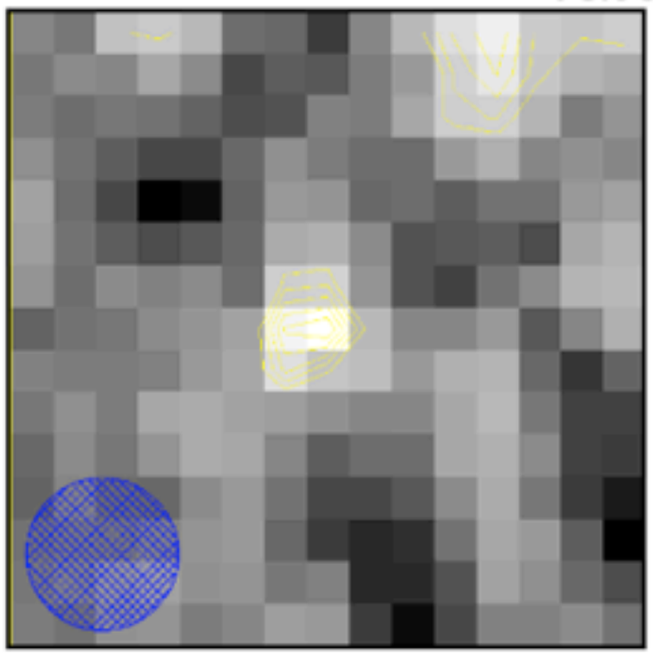
HIPASS zero-moment map

GAMA image

examples ...



naah..



HIPASS zero-moment map

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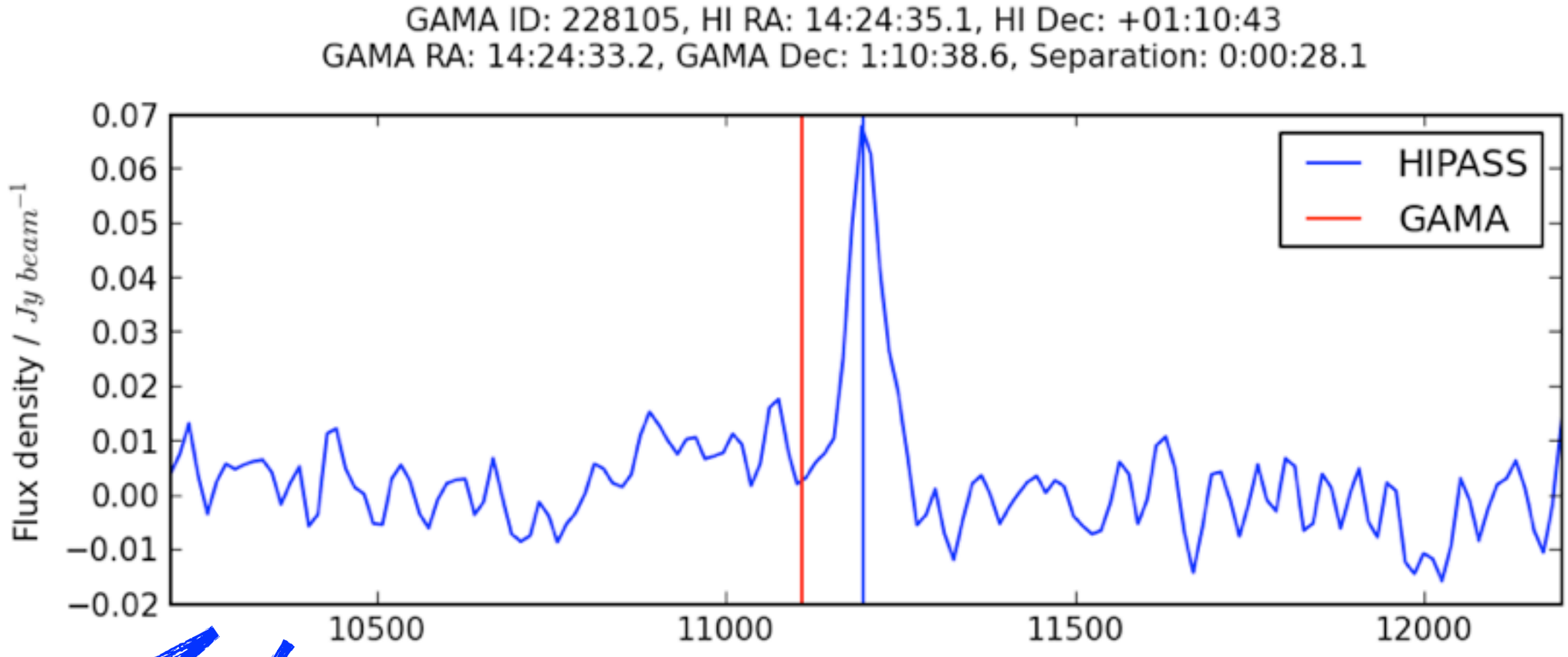
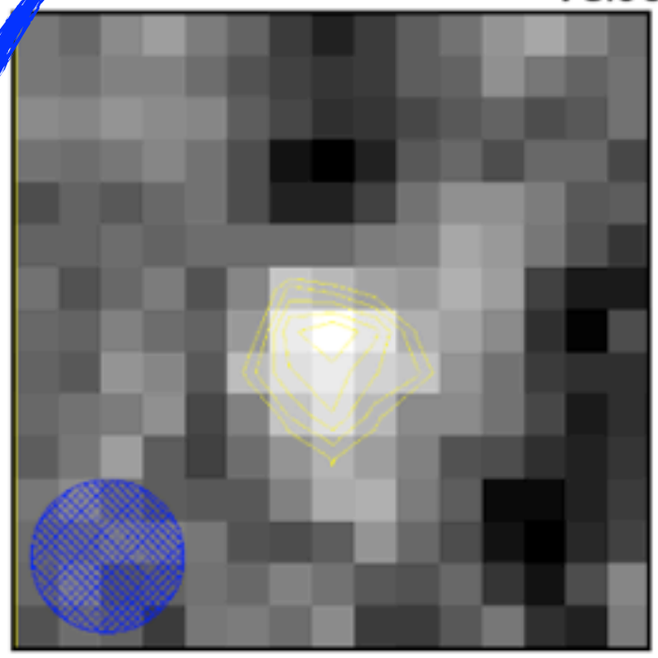
examples ...



new

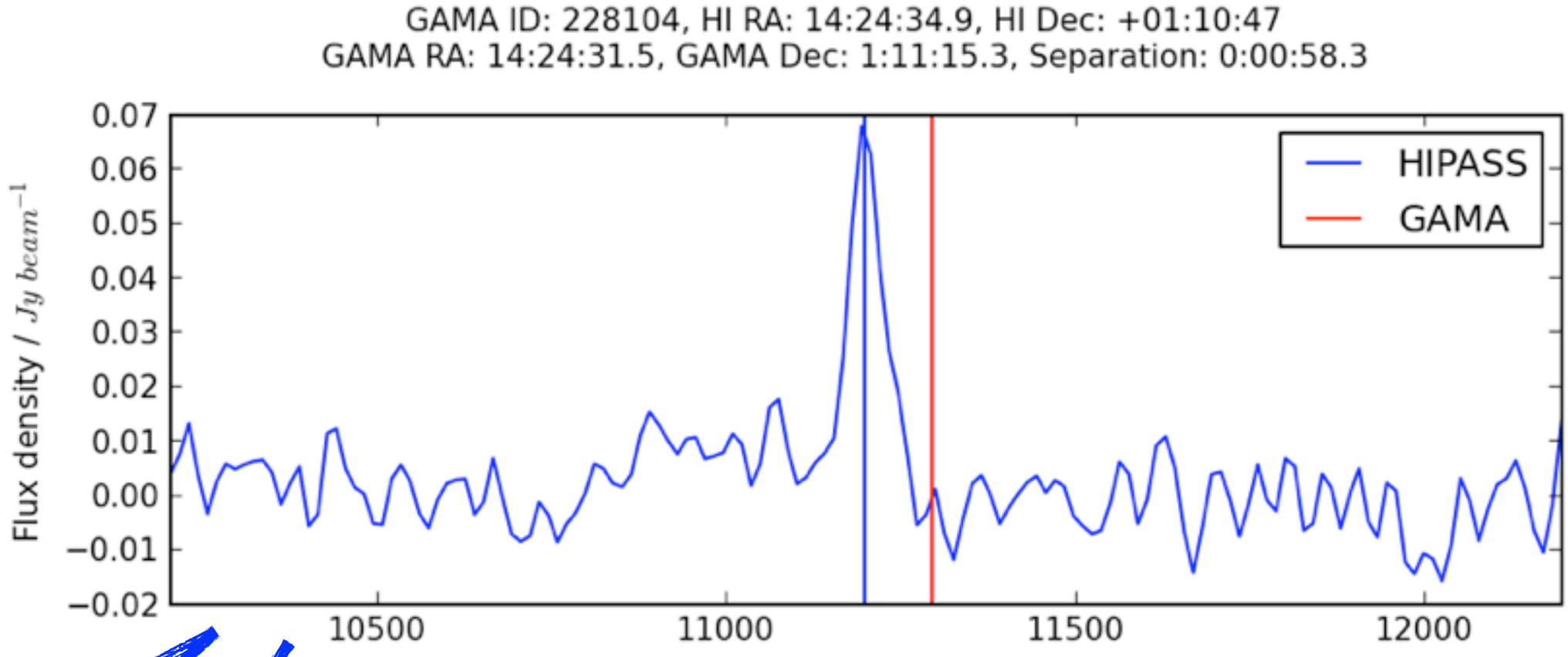
confused



HIPASS zero-moment map

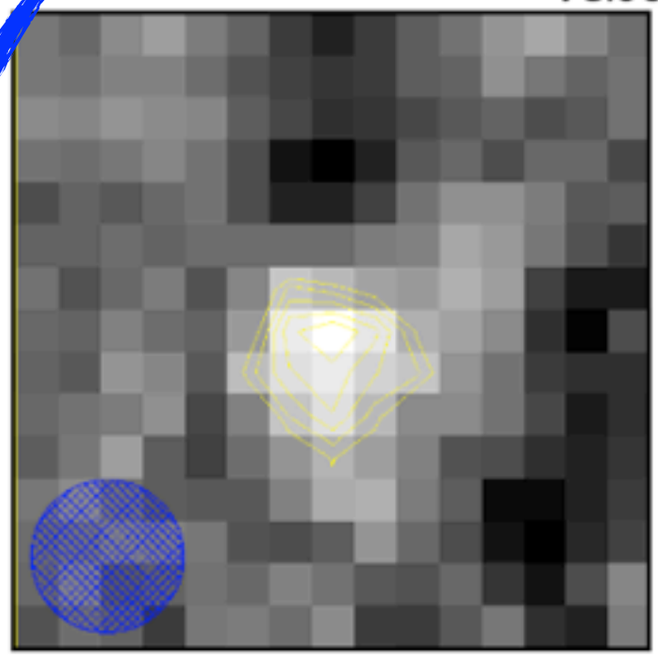
No GAMA image available

examples ...



new

confused

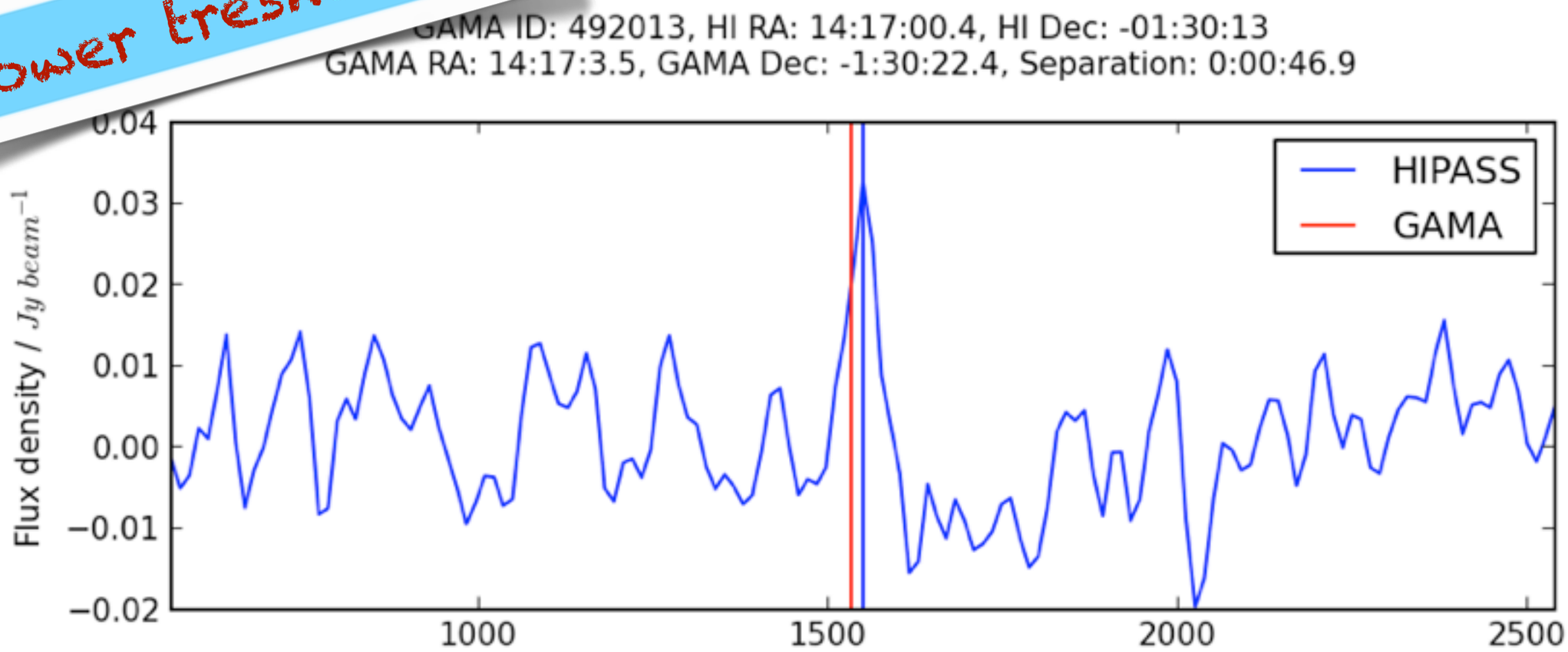


HIPASS zero-moment map

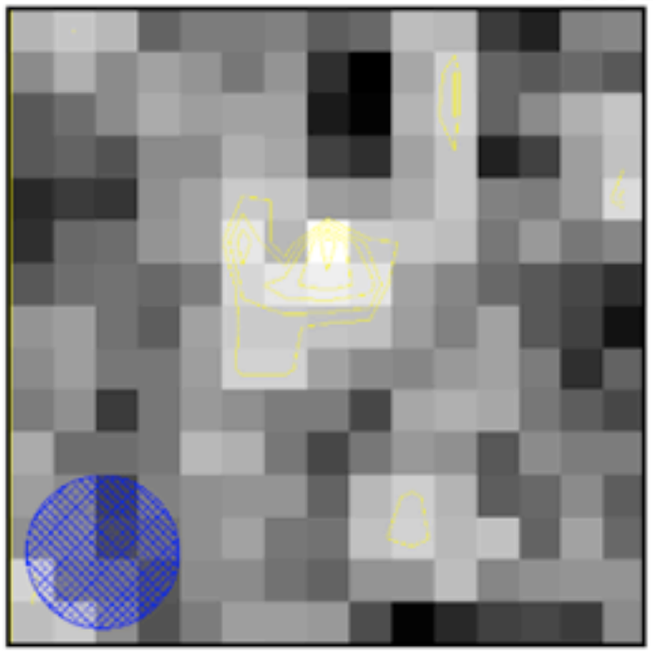
No GAMA image available

examples ...

Lower treshold ..



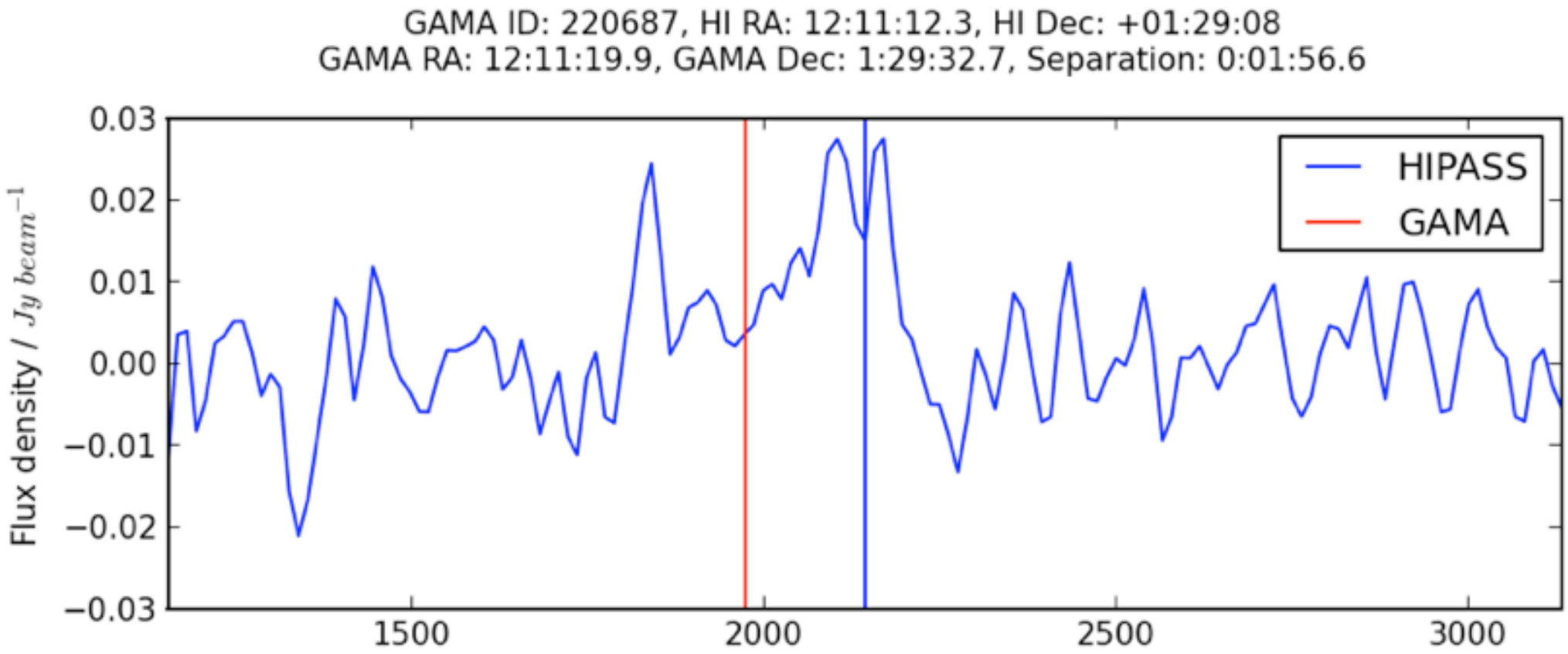
new !!



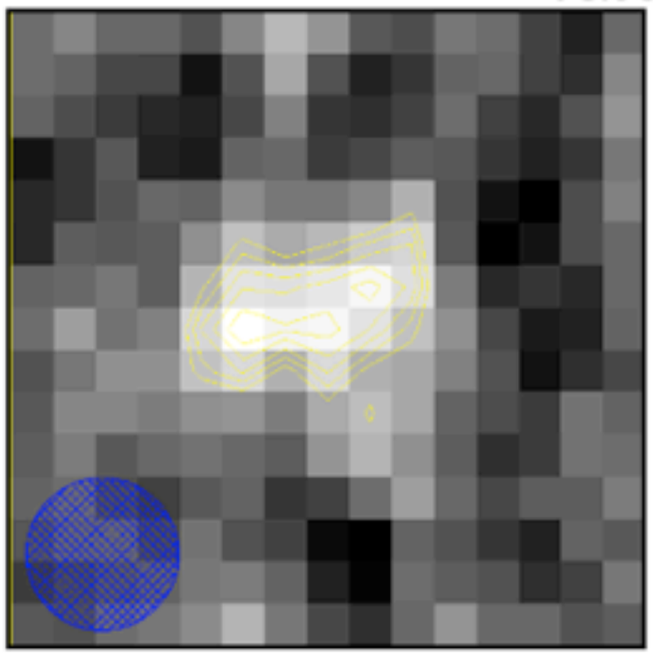
HIPASS zero-moment map

GAMA image

examples ...



new !!



HIPASS zero-moment map

GAMA image

4σ search

number of galaxies in hipass: 35
number of galaxies in hopcat: 30

58 cross matches between GAMA and HIPASS II
50 individual detections when taking out confusion
45 true detections after inspecting cubes by eye
5 questionable or false detections

~30% more detections than HICAT
~90% reliable detections

even higher detection rates can be achieved at lower clipping levels, however at the cost of reliability

Blind search on full HIPASS II cubes using the same DUCHAMP parameters gives >500 detections (reliability < 10%)

Conclusion

Source finding using optical catalogues is a very useful addition to blind HI searches !!

- Using optical catalogues can significantly increase the number of detections
- Cross matching has a very high reliability
- Using prior information makes source finding much faster
- Optical information can be used as check/filter for blind searches
- Method can be applied to much data discussed this week

Great scientific potential !

- Tully-Fisher Relation
- HI properties of optical galaxies (type, color etc ...)