LOFAR view of SNRe identified with XMM-Newton in the Andromeda galaxy

LOFAR Family Meeting 2023

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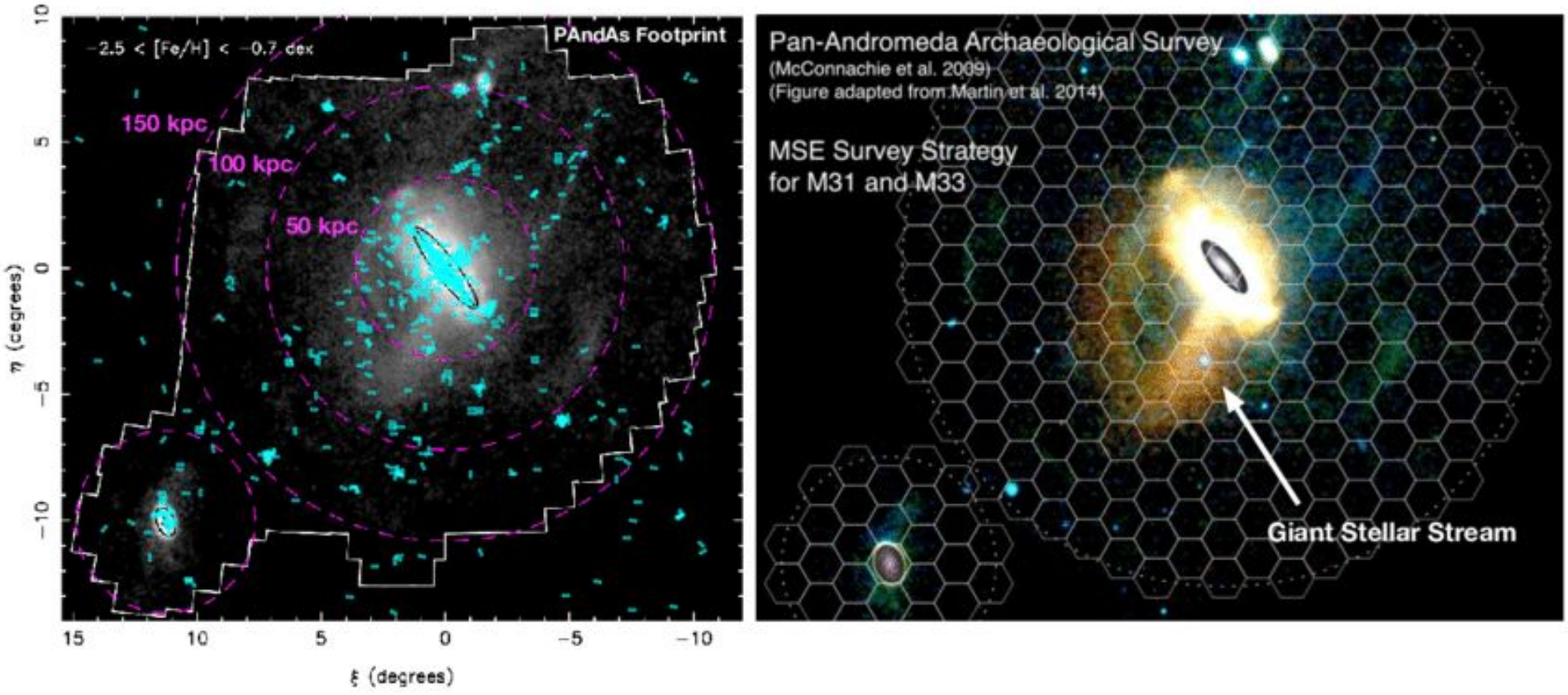
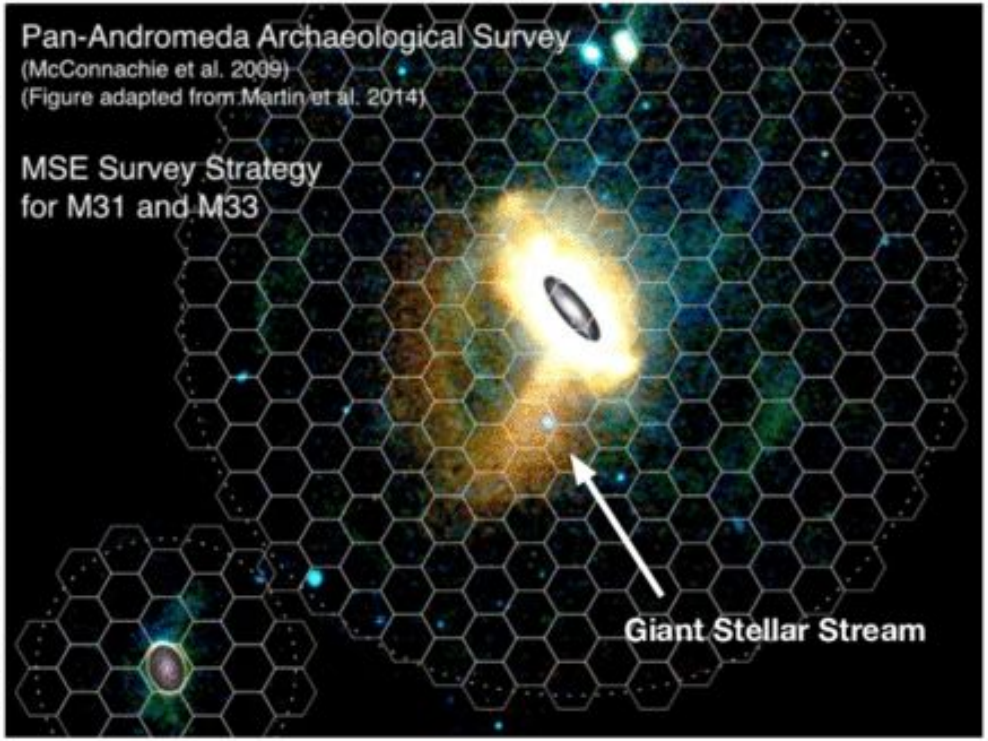
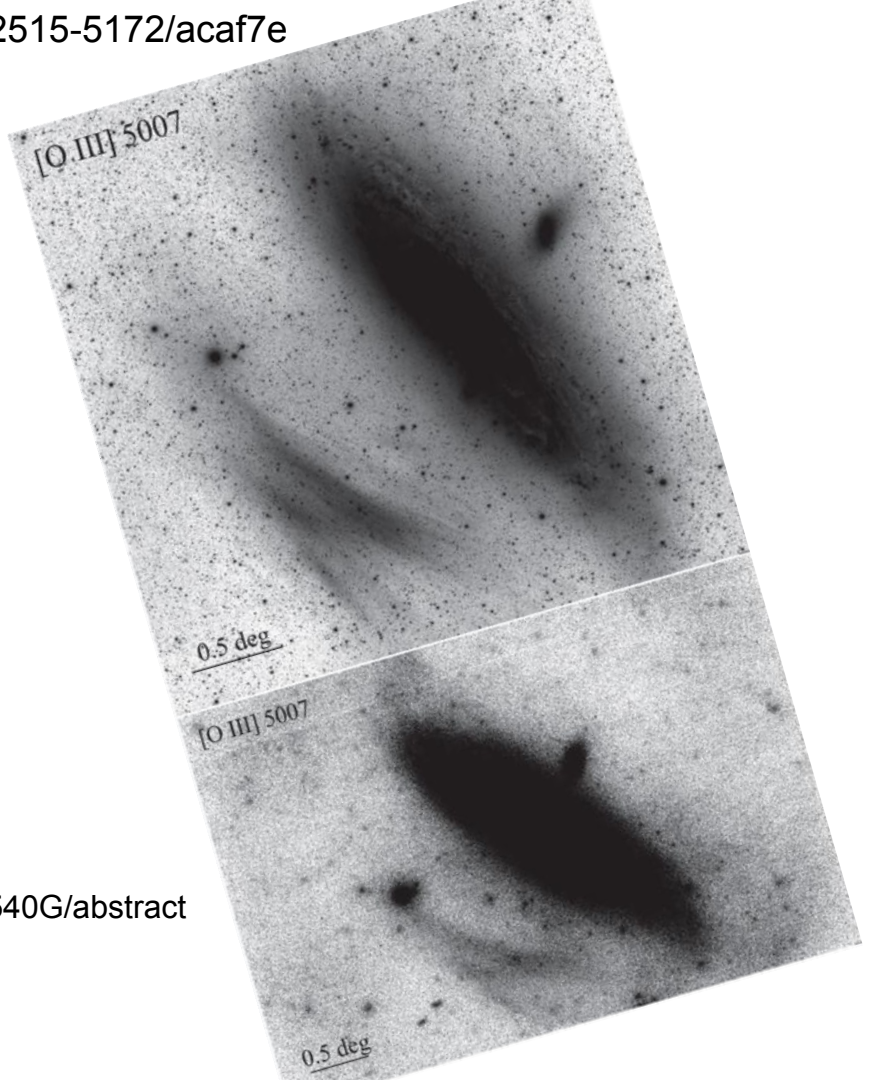
Close neighbour:
Andromeda/M31
~780 kpc / 2.5Mly
~ 45kpc / 2°
~ 6pc / arcsec



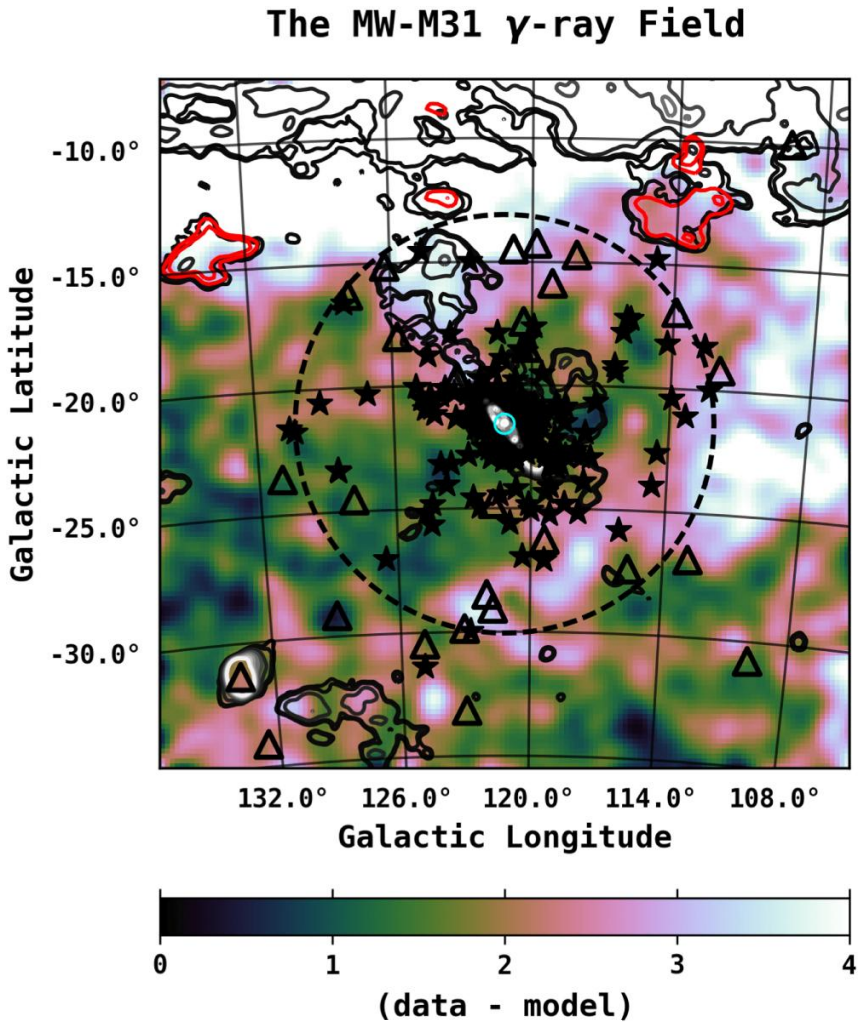
K.M. Gilbert+2019: https://ui.adsabs.harvard.edu/abs/2019BAAS...51c.540G/abstract arXiv:1904.01074

M. Drechler+2023: https://iopscience.iop.org/article/10.3847/2515-5172/acaf7e

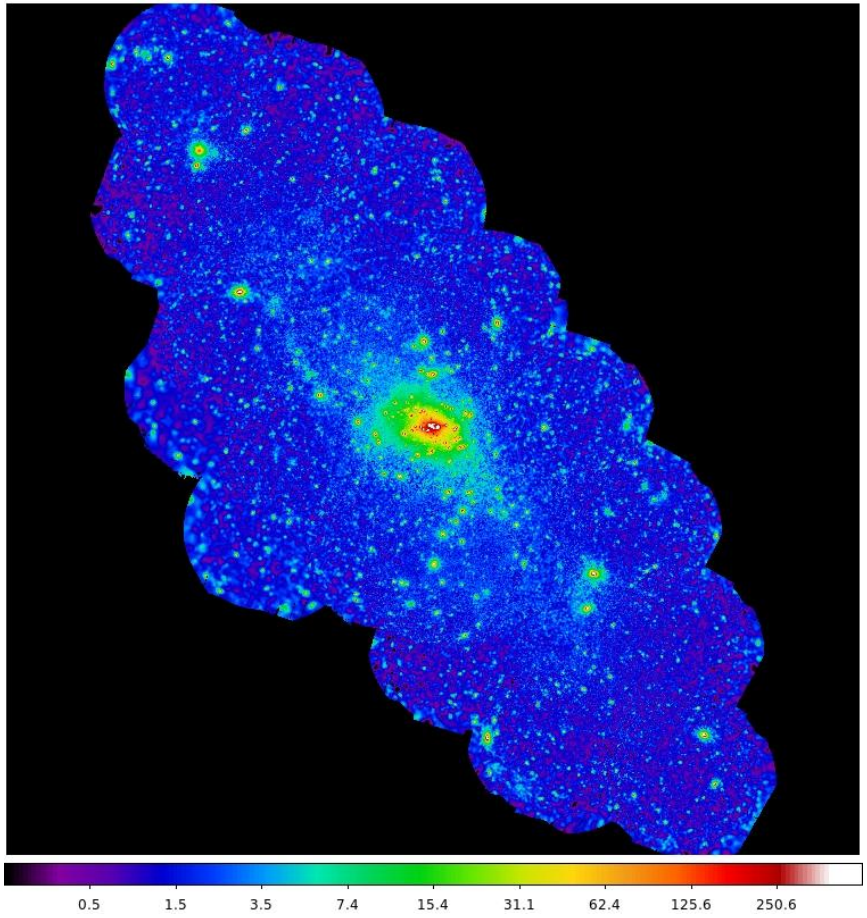




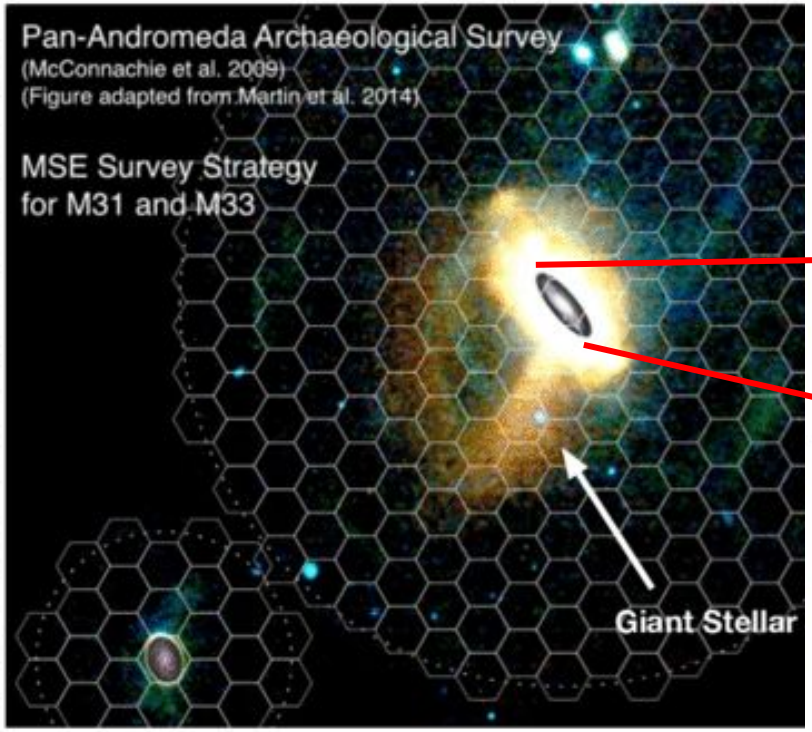
K.M. Gilbert+2019: https://ui.adsabs.harvard.edu/abs/2019BAAS...51c.540G/abstract
arXiv:1904.01074

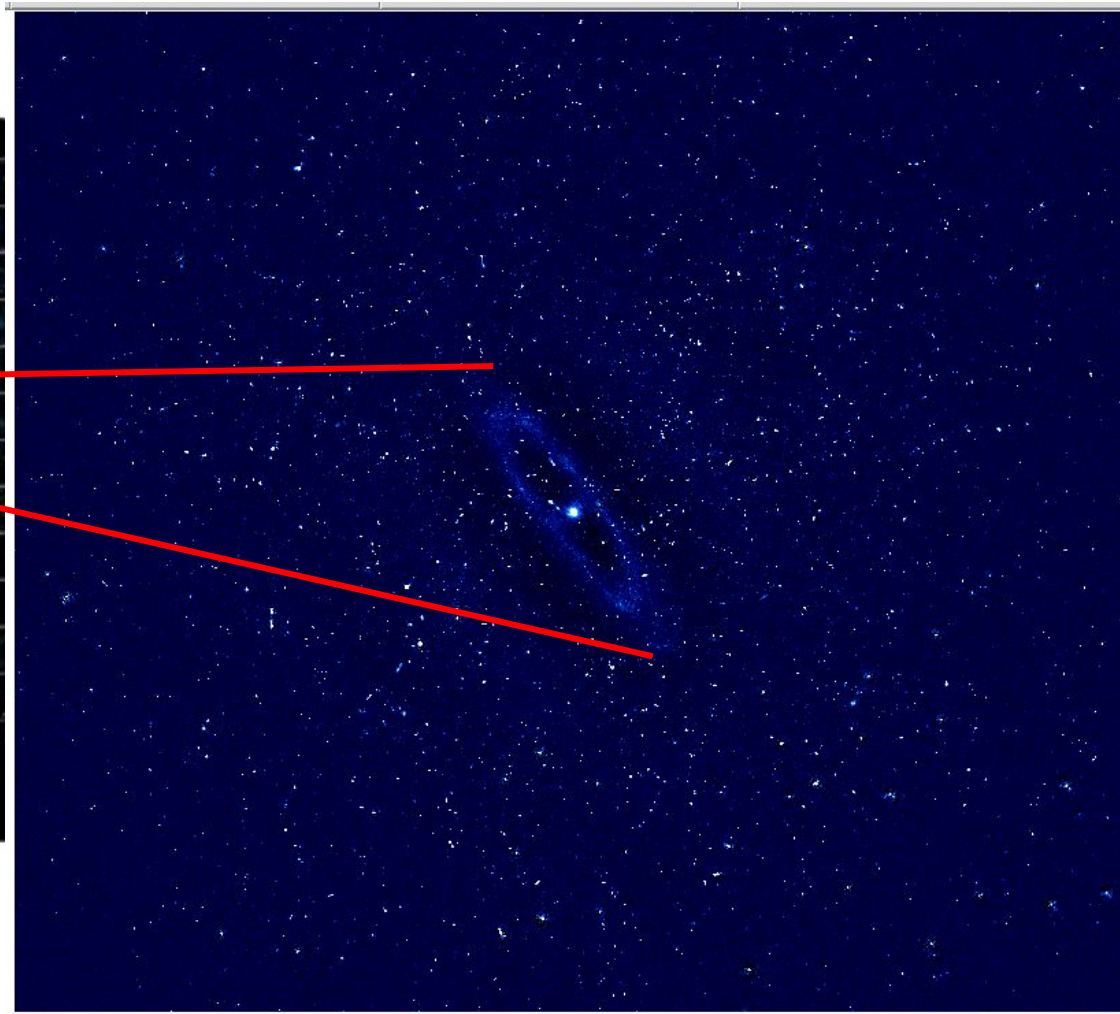


C. Karwin+2019 arXiv:1812.02958

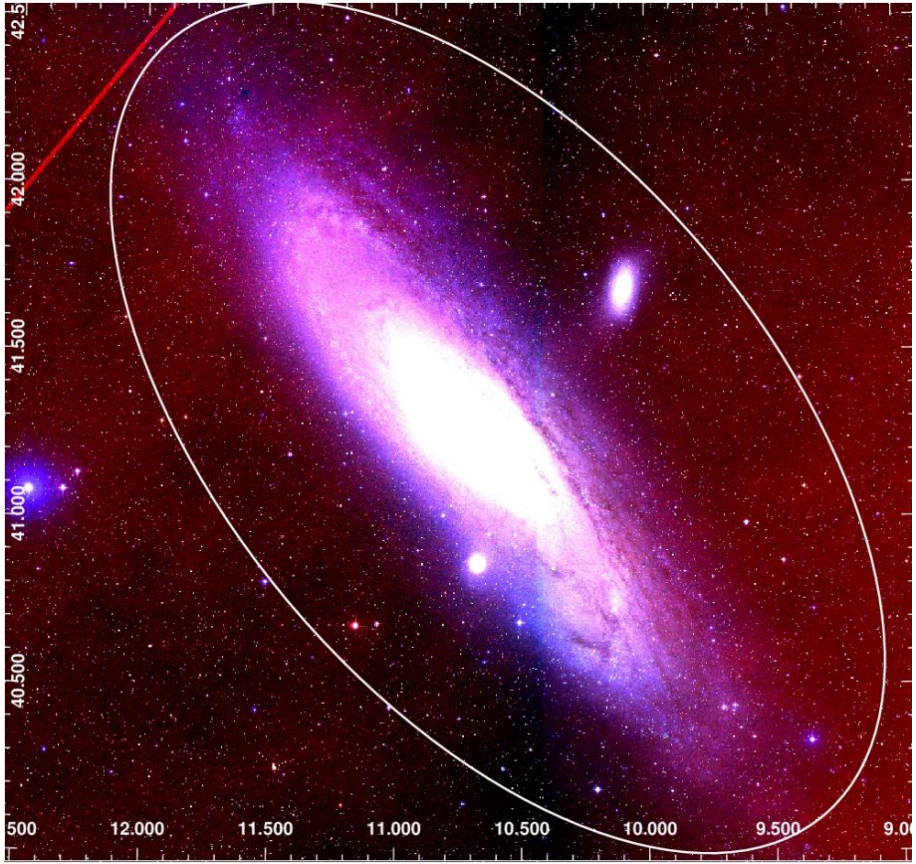


M. XMM-Newton 0.4-1.3 keV view from HEASARC archive

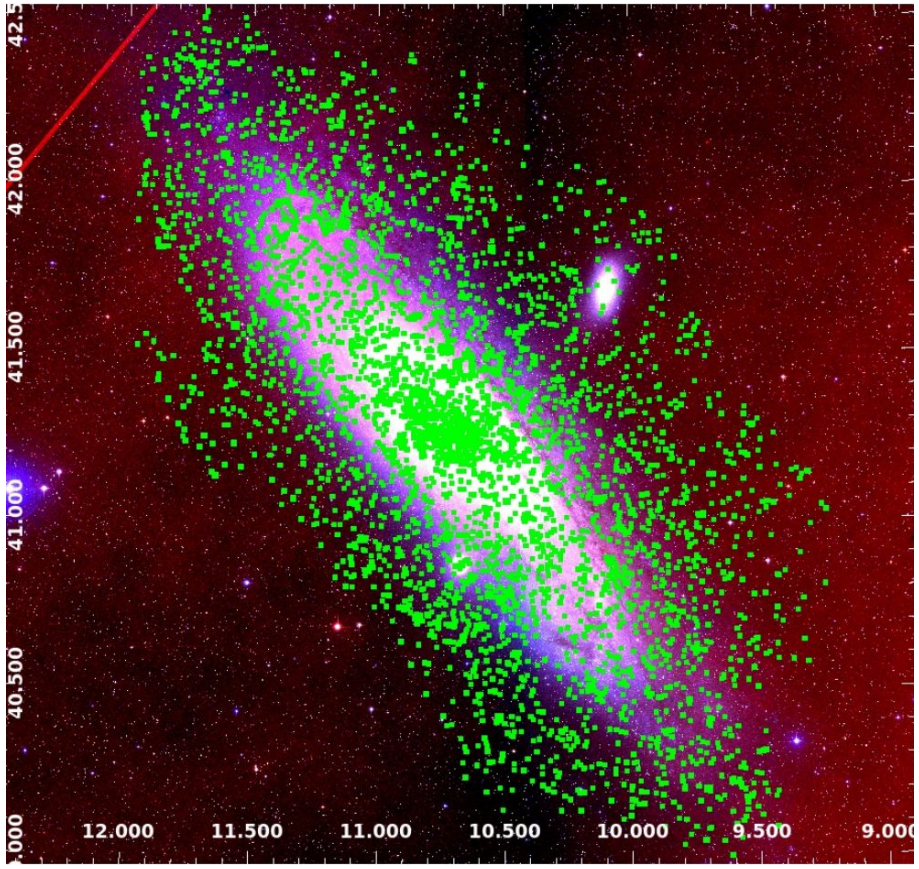

Pan-Andromeda Archaeological Survey
(McConnachie et al. 2009)
(Figure adapted from Martin et al. 2014)
MSE Survey Strategy
for M31 and M33
Giant Stellar



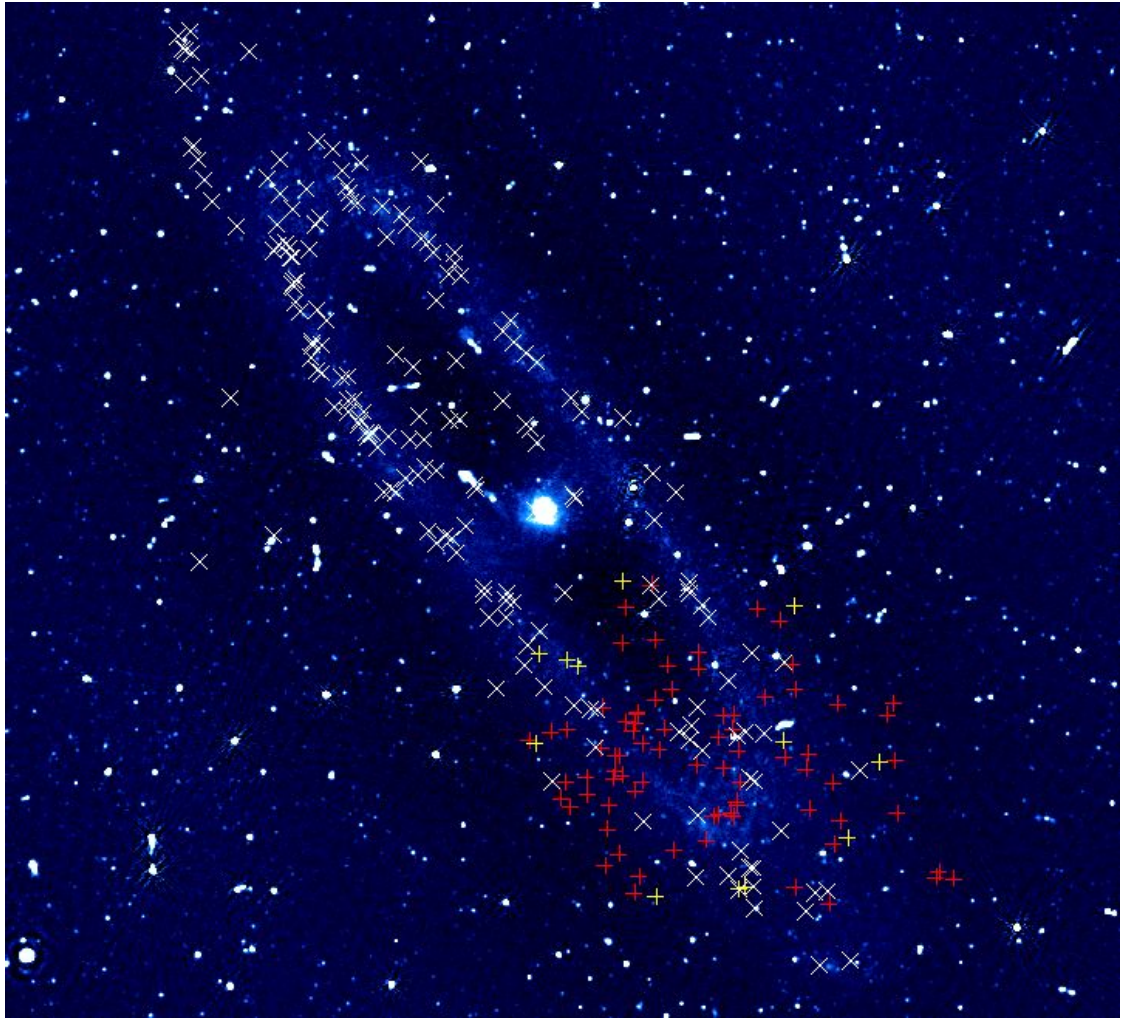

N
W



RGB image of M31 SDSS-2 survey (infrared,red, and blue filters). Ellipse: region for study of XMM-Newton archive data. *Credit: Sara Saeedi*



RGB image of M31 SDSS-2 survey (infrared,red, and blue filters). In green are positions of all sources detected in the field of study. *Credit: Sara Saeedi*

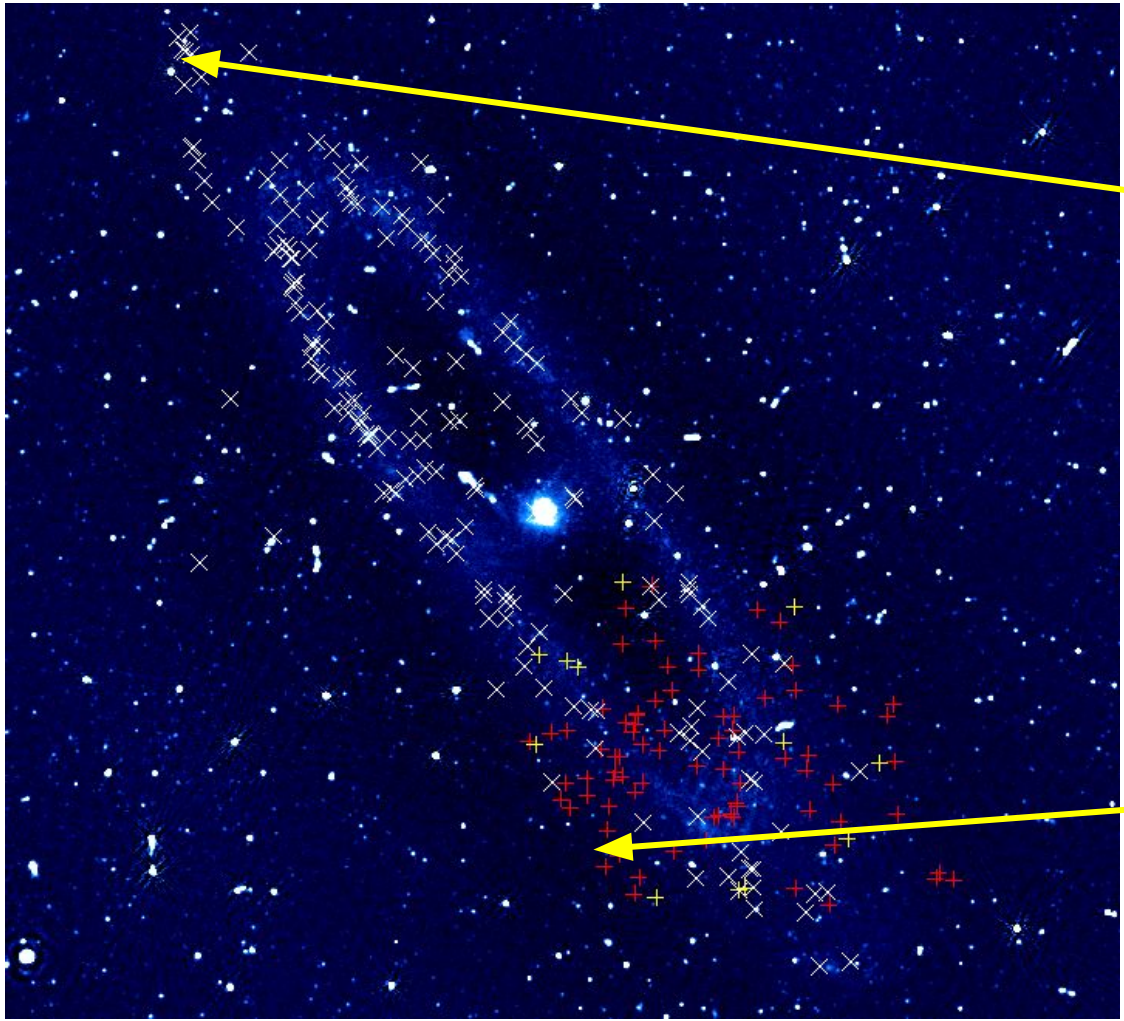


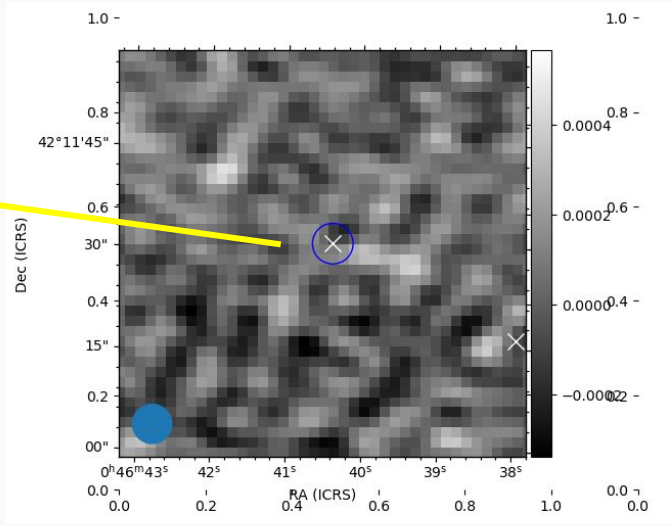
XMM Source identification:
Sara Saeedi & Manami Sasaki,
FAU Bamberg

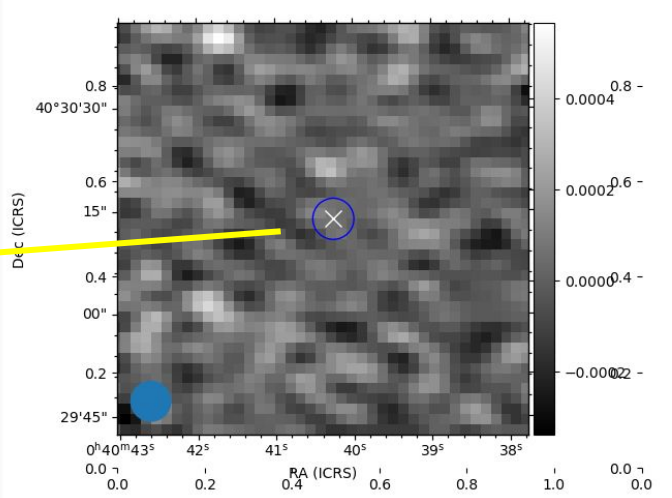
Here we show only initial test subset (~180 / ~3800 total)

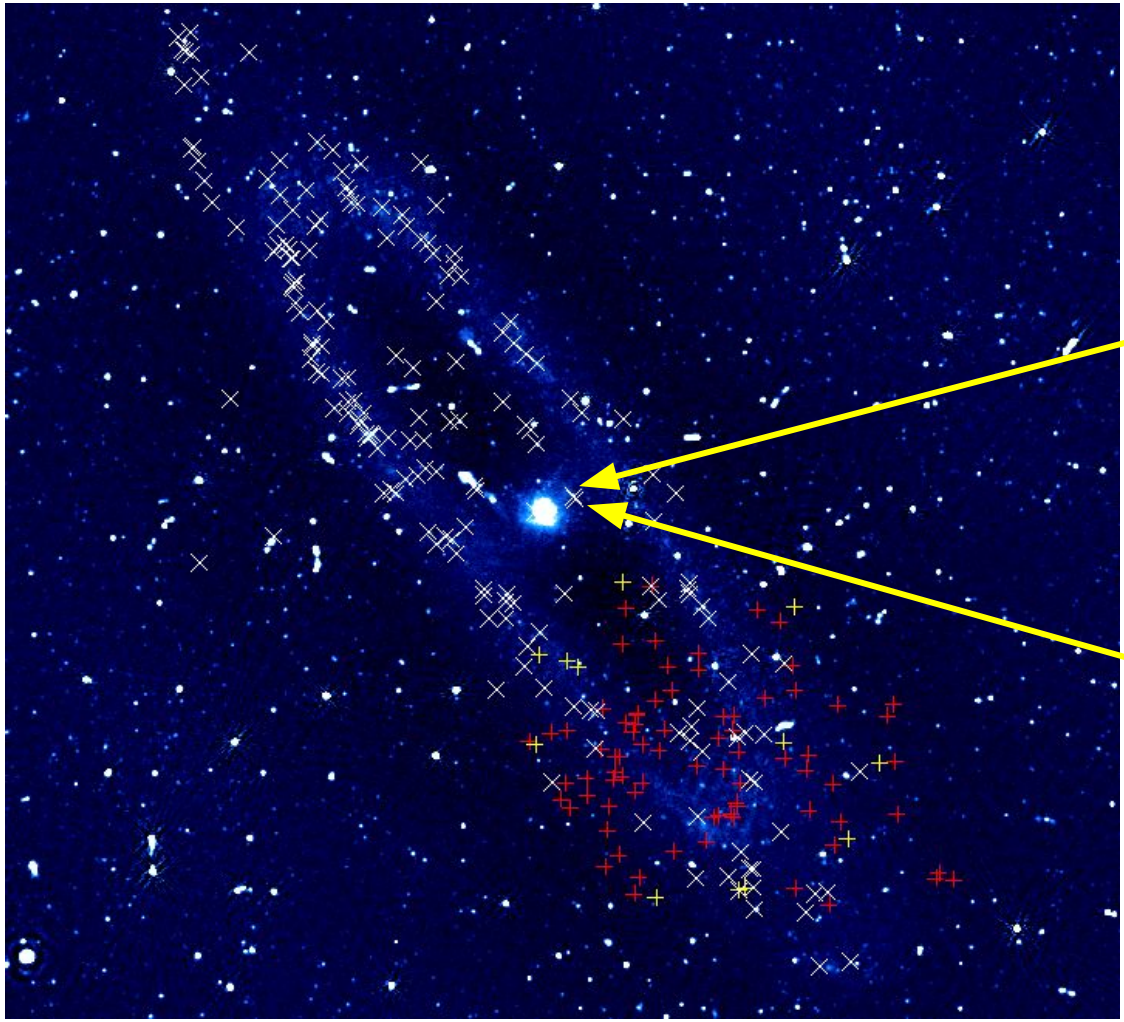
Full catalogue cross-matches:

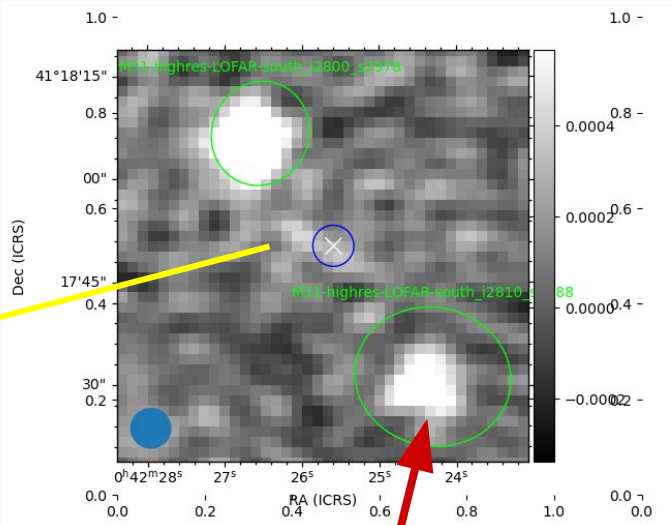
1. XMM-Newton Serendipitous Source Catalogue (DR12): data covers the whole filed of M31 without any classification (2020A&A...641A.136W).
2. Stiele et al, 2021: Old data and not very deep, which is the first classification of X-ray sources in the field of M31 (2011yCat..35340055S).
3. Sasaki et al, 2018: deep study of the north of M31 with classification. (2018A&A...620A..28S)
4. Saeedi et al, in prep.: deep study of the south of M31 with classification.

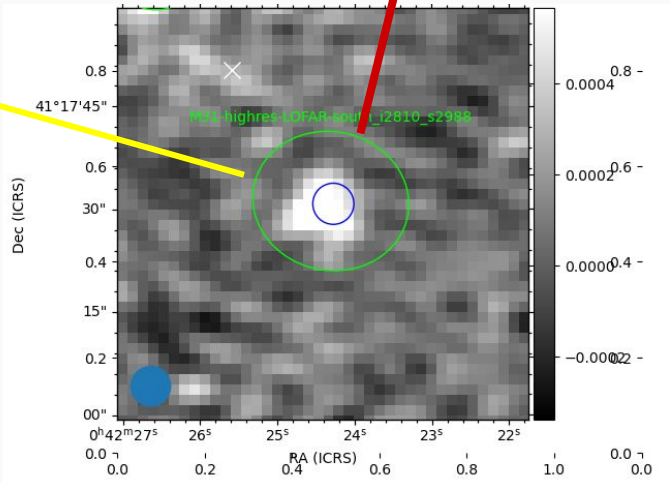


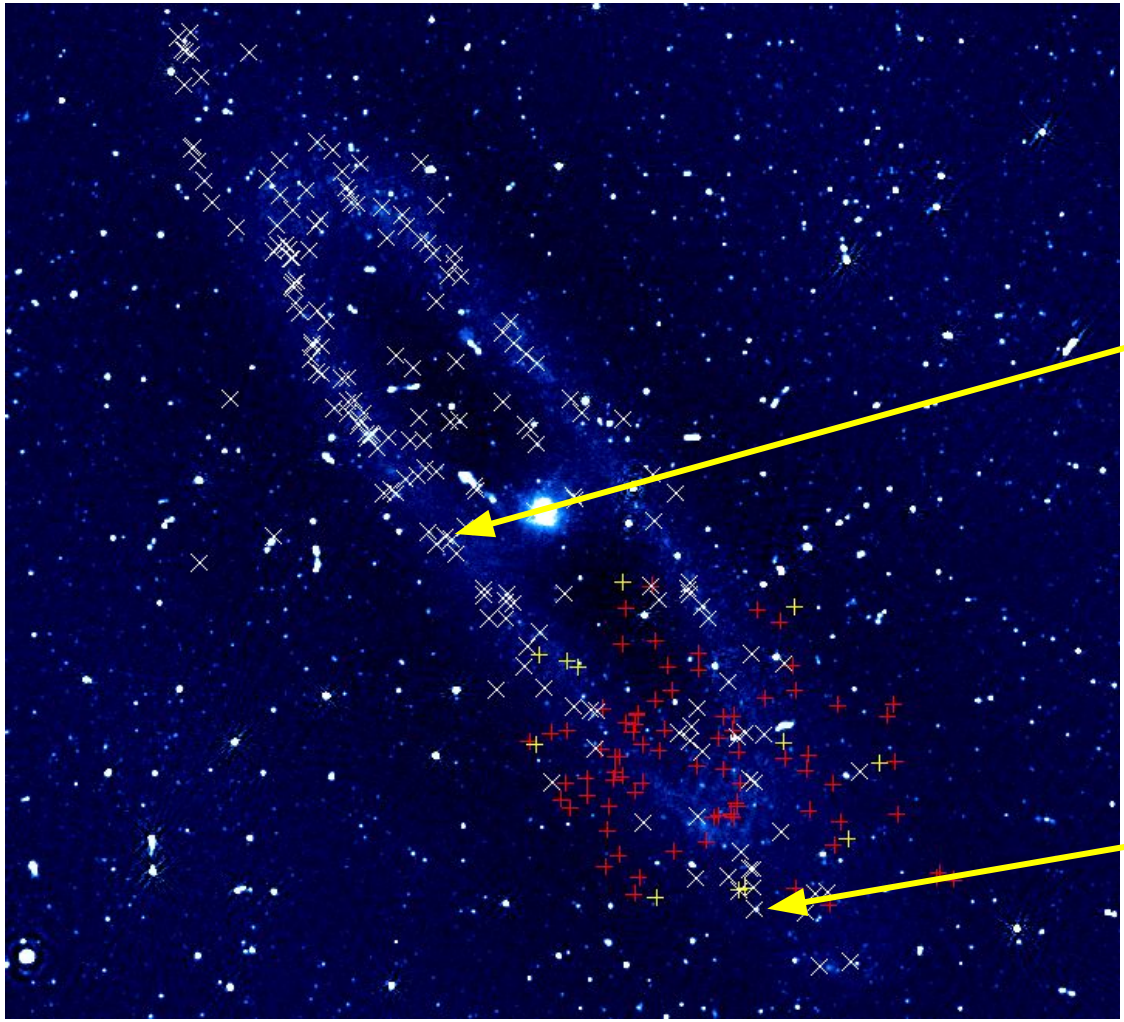

1.0
0.8
42°11'45"
0.6
30"
0.4
15"
0.2
00"
0.0
Dec (ICRS)
0h46m43s
42s
41s
40s
39s
38s
RA (ICRS)
0.0
0.2
0.4
0.6
0.8
1.0
0.0004
0.0002
0.0000
−0.0002

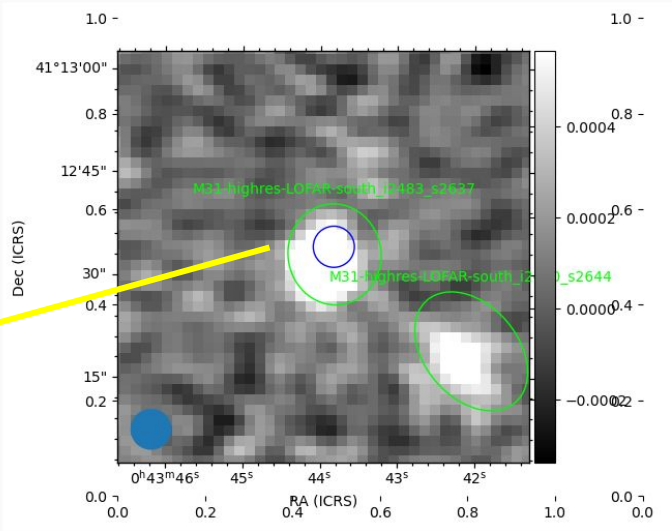

0.8
40°30'30"
0.6
15"
0.4
00"
0.2
29'45"
0.0
Dec (ICRS)
0h40m43s
42s
41s
40s
39s
38s
RA (ICRS)
0.0
0.2
0.4
0.6
0.8
1.0
0.0004
0.0002
0.0000
−0.0002




M31-highres-LOFAR-south_i2800_s2978
M31-highres-LOFAR-south_i2810_s2988
Dec (ICRS)
RA (ICRS)
41°18'15"
17'45"
0h42m28s
27s
26s
25s
24s


M31-highres-LOFAR-south_i2810_s2988
Dec (ICRS)
RA (ICRS)
41°17'45"
0h42m27s
26s
25s
24s
23s
22s

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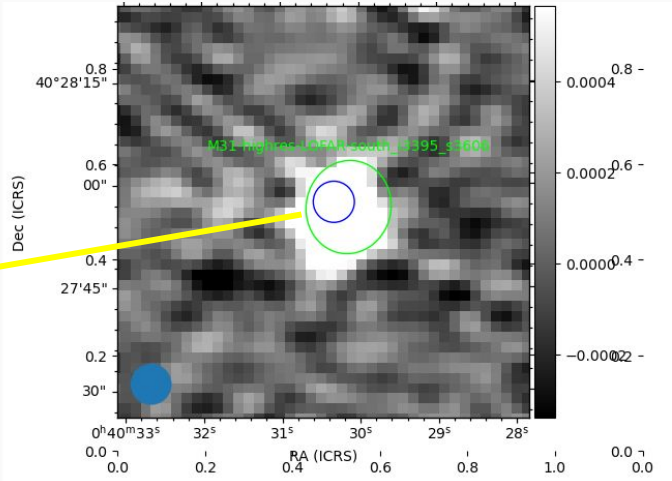
M31-highres-LOFAR-south_s2644
Dec (ICRS)
RA (ICRS)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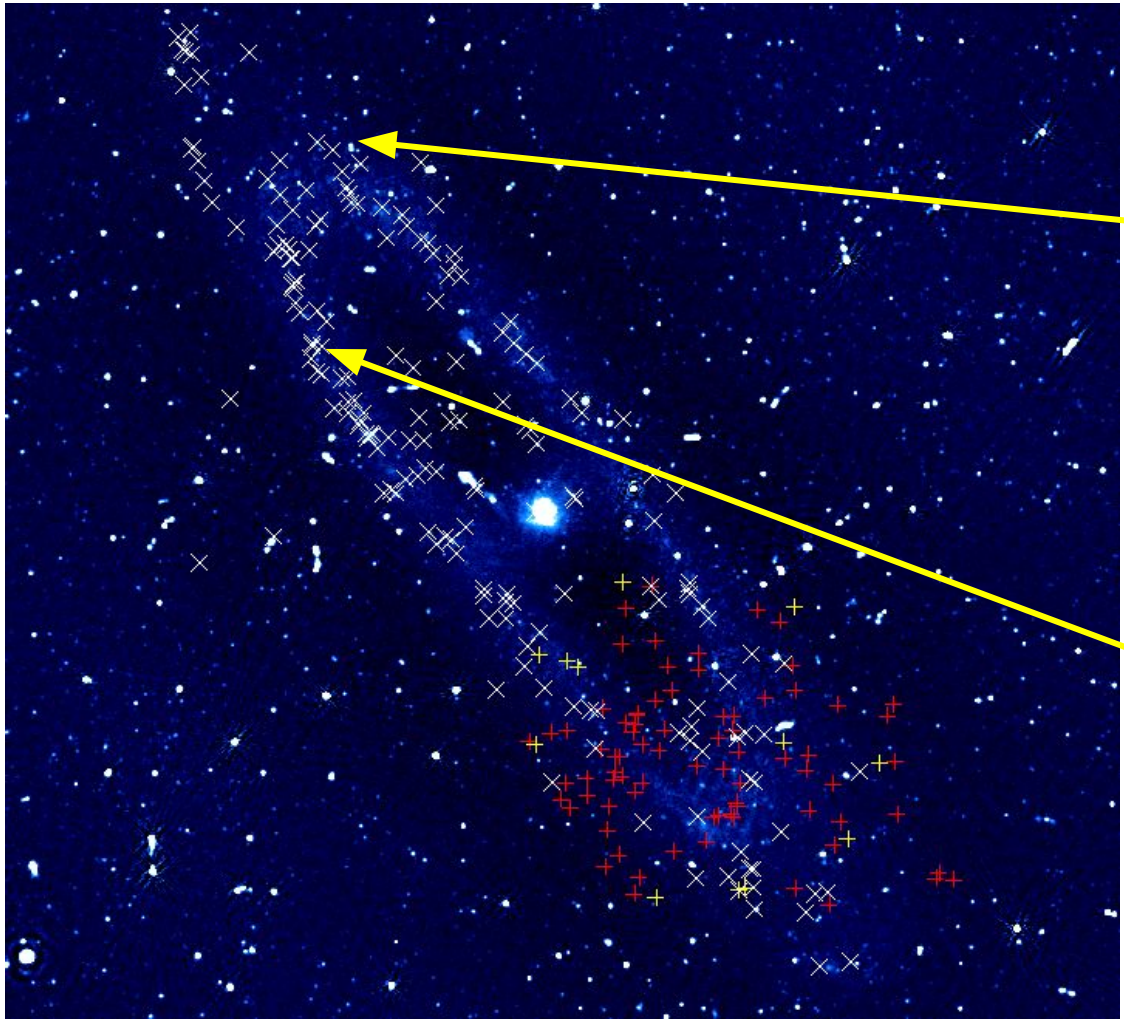
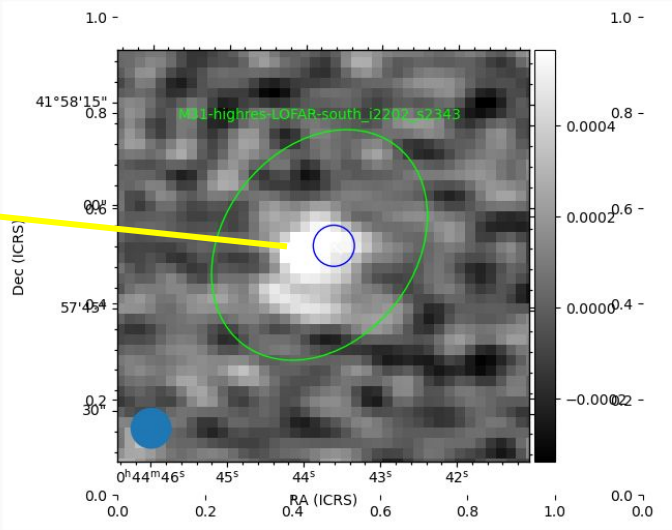
Dec (ICRS)
RA (ICRS)




M31-highres-LOFAR-south_i2287_s2343
Dec (ICRS)
RA (ICRS)
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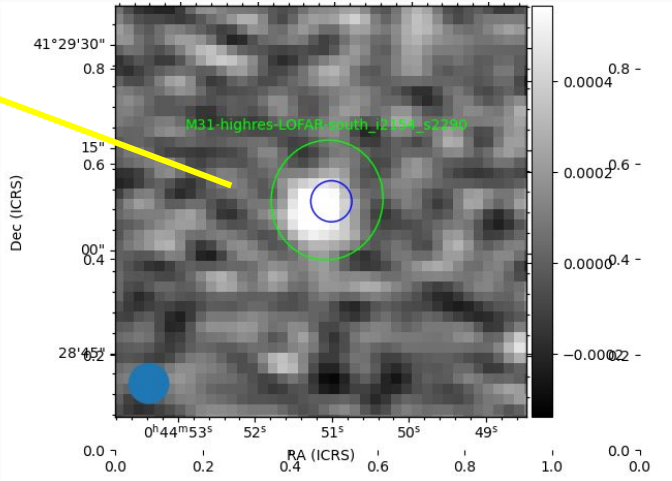
57'45"
30"
0h44m46s
45s
44s
43s
42s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Dec (ICRS)
RA (ICRS)
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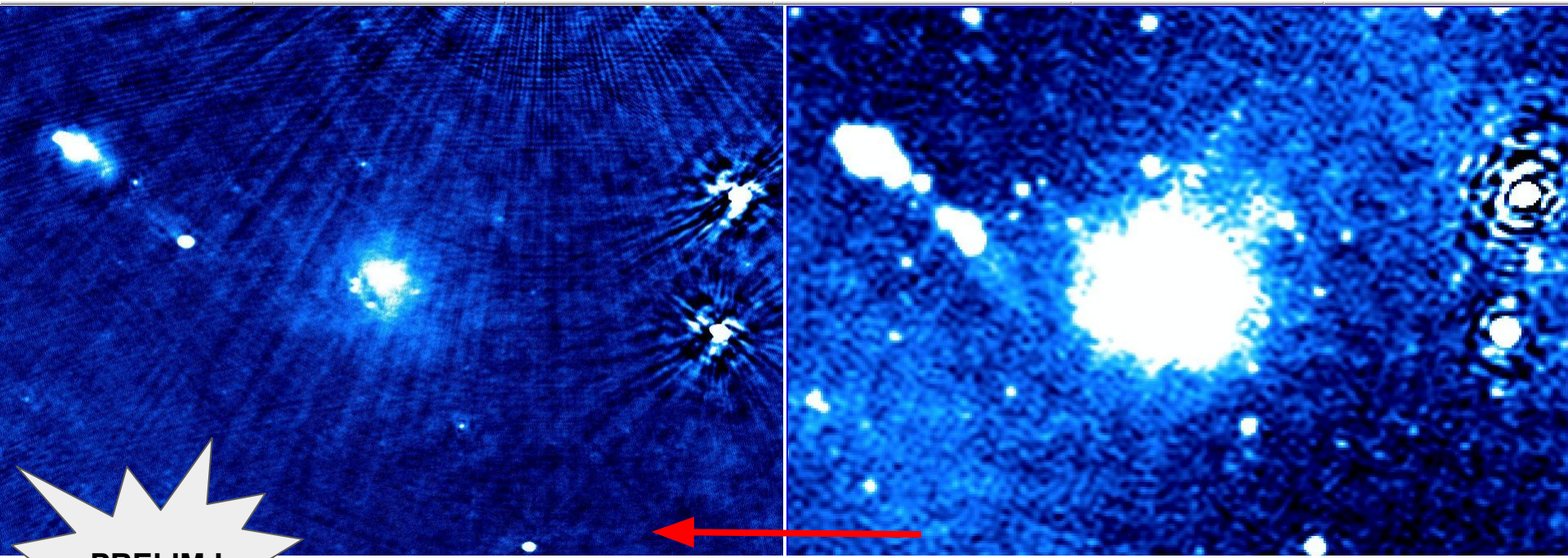
15"
00"
28'45"
0h44m53s
52s
51s
50s
49s

First step forward: LOFAR-VLBI



PRELIM.!

Reminder: ILT has angular resolution (sub-pc) comparable to HST and Chandra!

Second step forward: spectral analysis

+ uGMRT?....

Conclusions

- Dutch LOFAR HBA data imaged, analysis ongoing for low-hanging fruit
- ILT data reduction ongoing, but results promising - widefield VLBI of this field would be amazing result for LOFAR!
- Dutch LBA and NenuFAR observing time granted next cycle.
- Open questions which LOFAR1 can still answer in 2023: SNR ring imaging? Evidence of Fermi bubbles? Fossil jet emission?