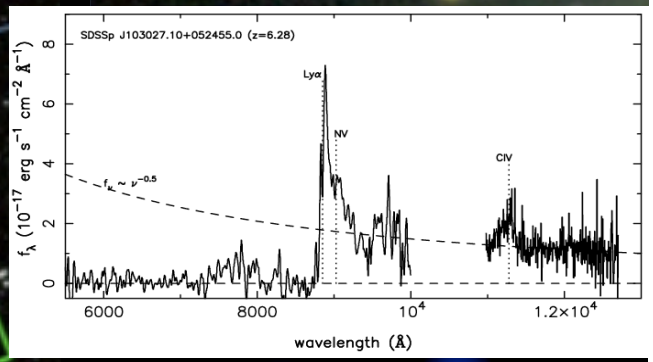
The J1030 deep field: an INAF legacy field for AGN

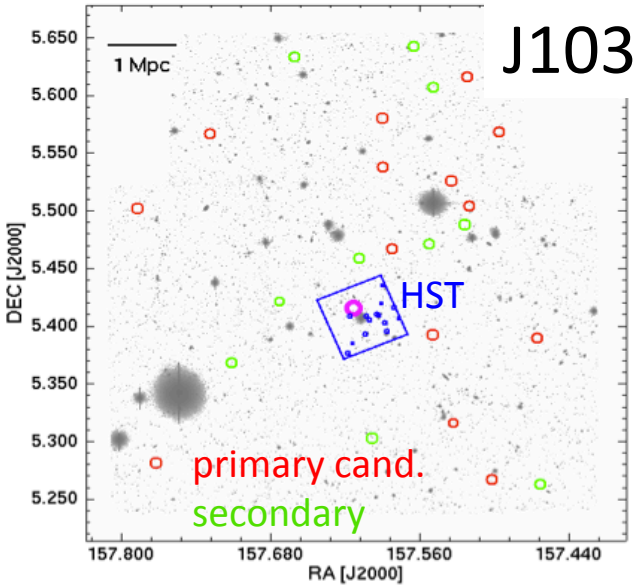
SDSSJ1030+0524 at z=6.31

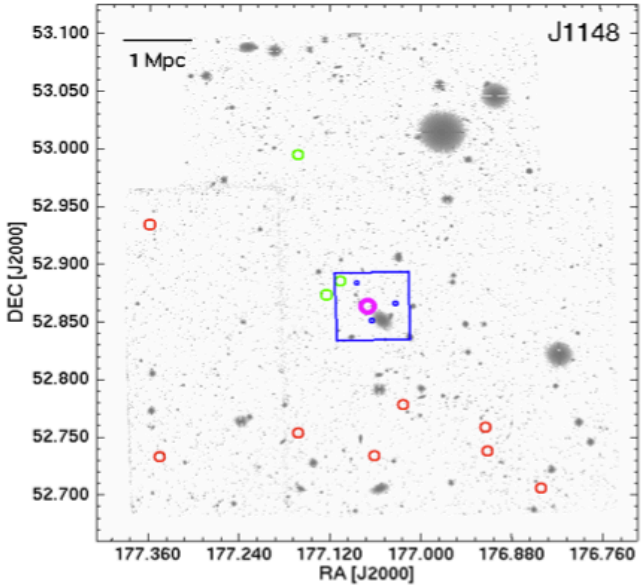


Roberto Gilli (INAF – OAS Bologna)

M. Mignoli, R. Nanni, B. Balmaverde, M. Brusa, F. Calura,
G.B. Caminha, N. Cappelluti, M. Cappi, M. Chiaberge,
A. Comastri, T. Costa, Q. D'Amato, R. Decarli, K. Iwasawa,
G. Lanzuisi, E. Liuzzo, C. Norman, M. Paolillo, A. Peca,
I. Prandoni, G. Risaliti, P. Rosati, E. Sani, P. Tozzi,
E. Vanzella, C. Vignali, F. Vito, G. Zamorani

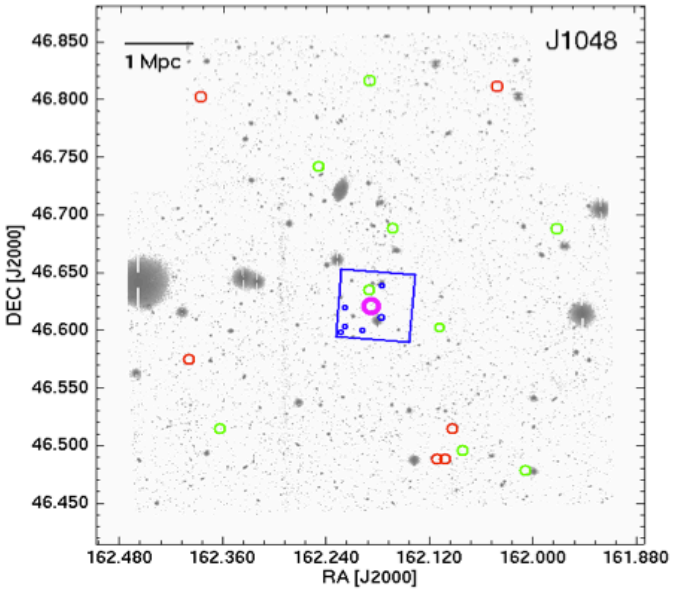
LBT/LBC *riz* imaging around four z~6 QSOs with $M_{BH}>10^9$ M_{sun}

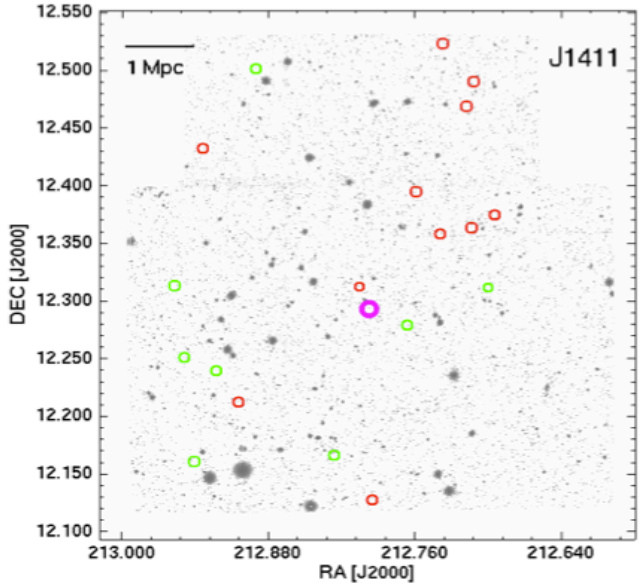




24 arcmin
8 pMpc

Morselli+14





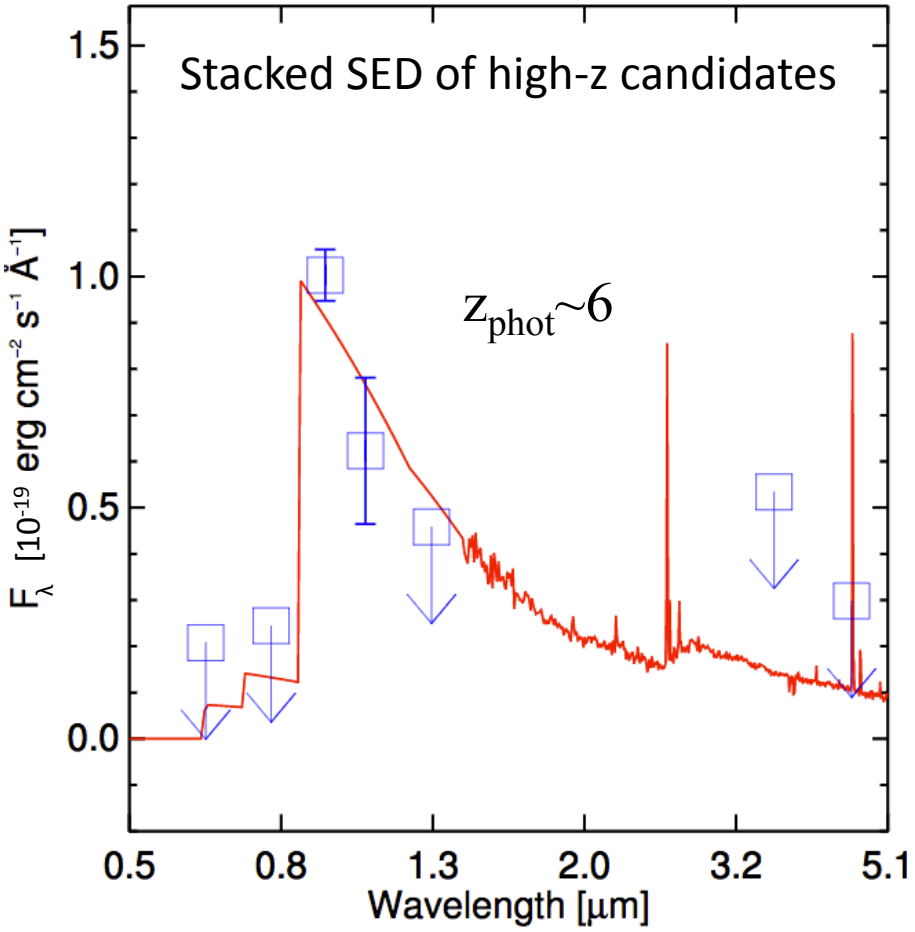
i-band dropouts
selected down to z_{AB}~25

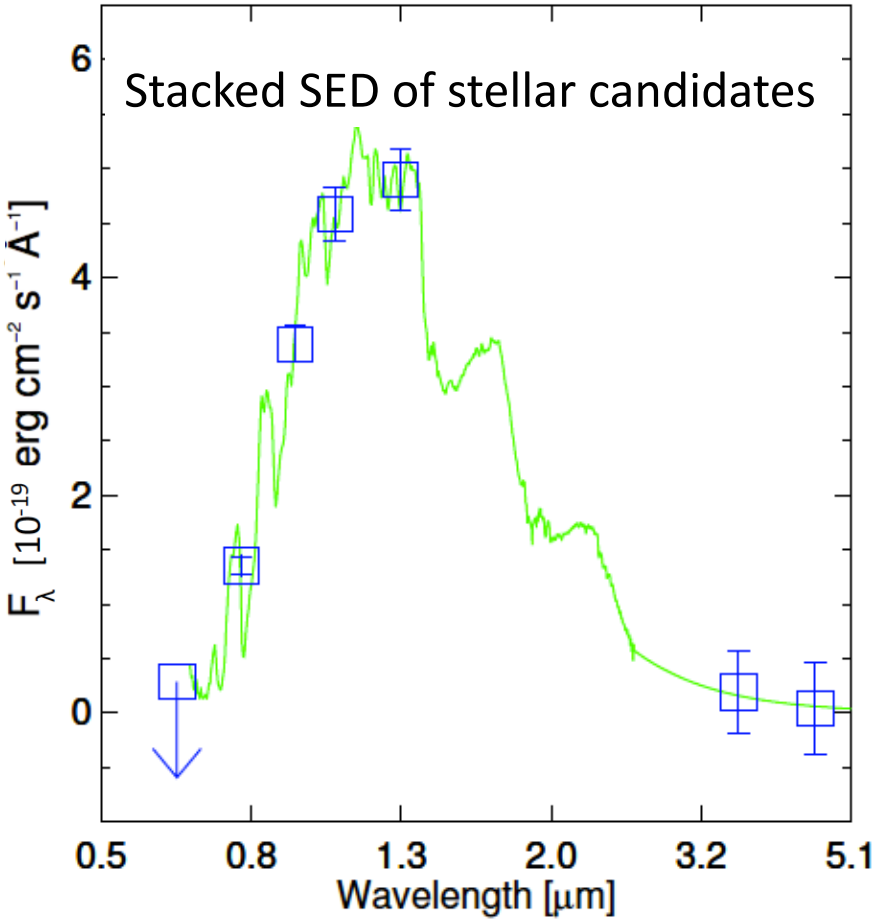
J1030 most overdense

Candidate z~6 LBGs around SDSS J1030+0524

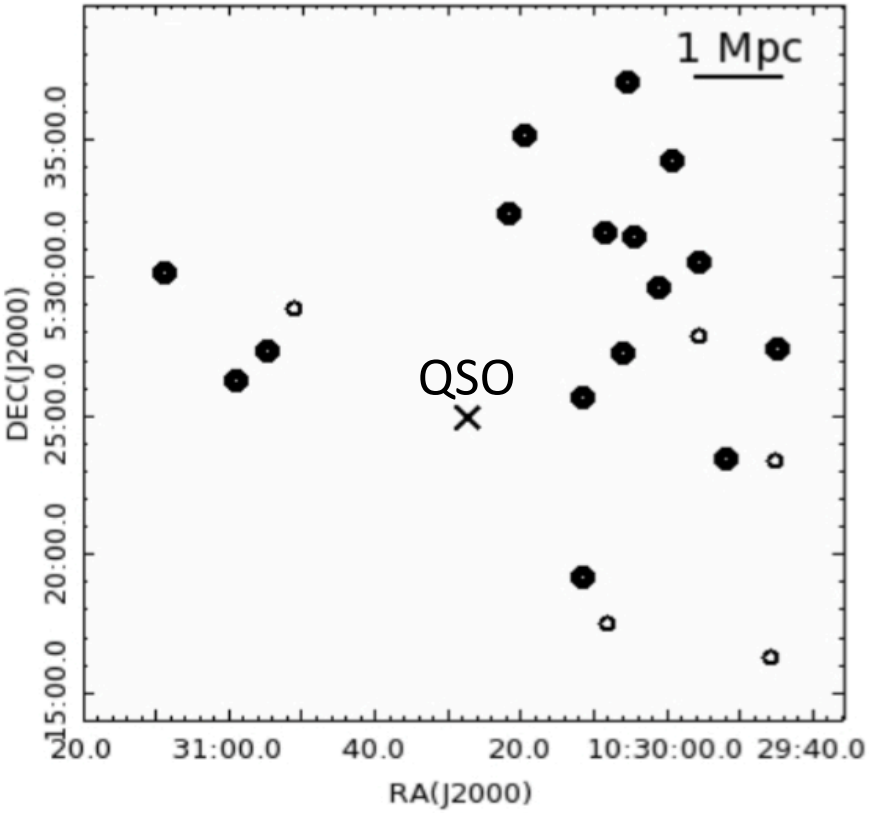
Y,J band imaging (WIRCAM 25'x25', ~24 AB mag)
20 z~6 LBG cand. selected down to z=25.5

Balmaverde+17

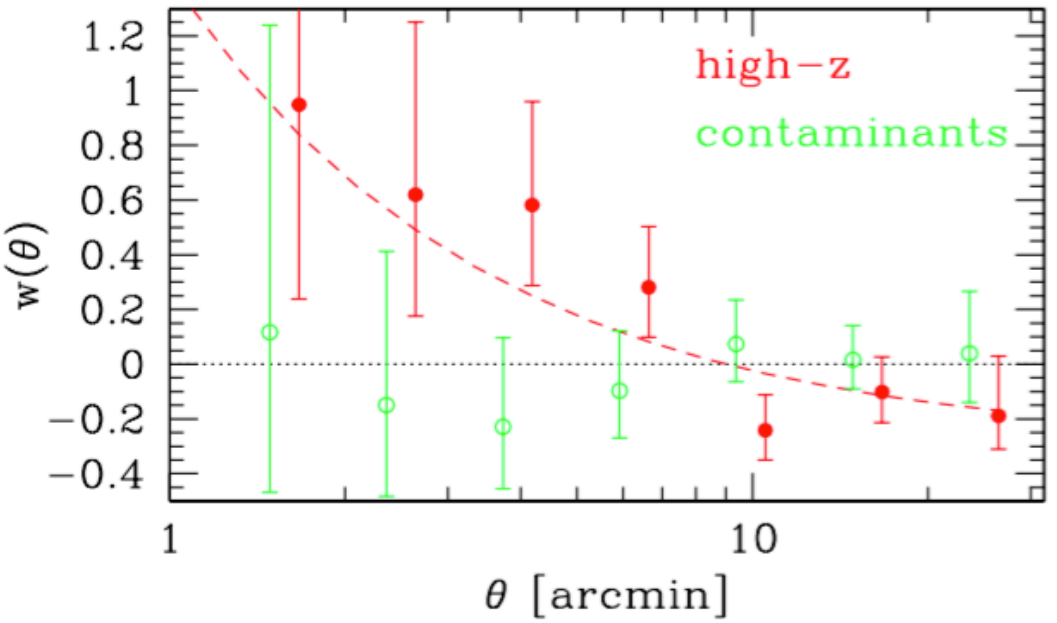




LBG candidates are clustered



Balmaverde+17

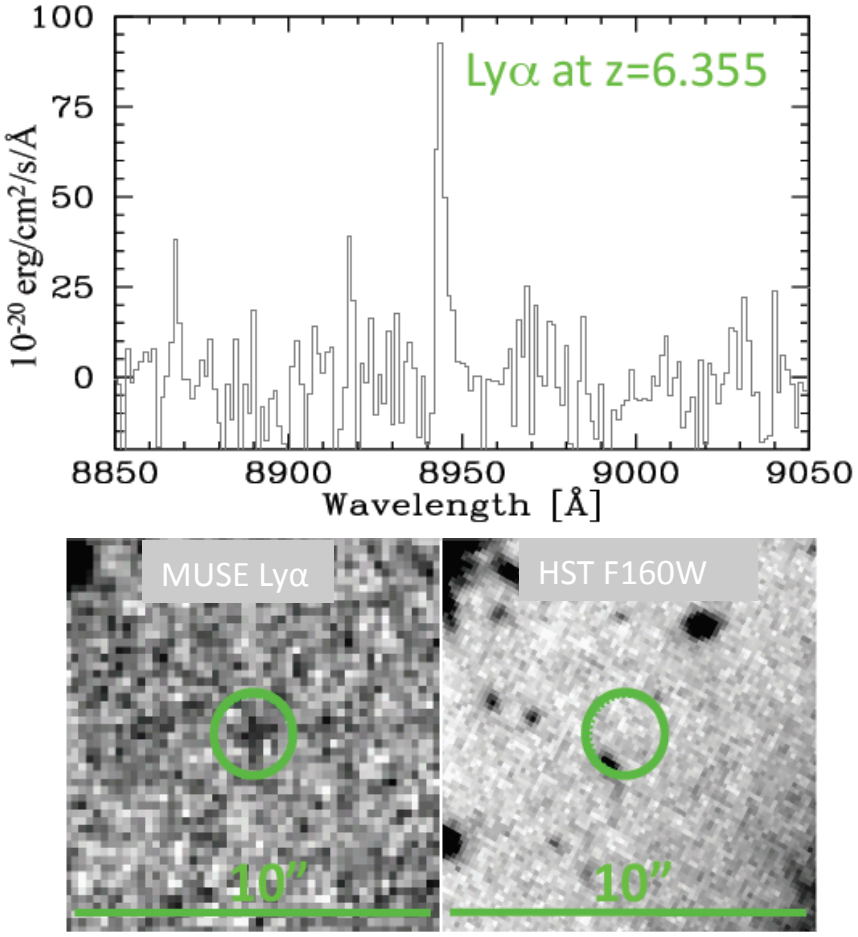


high-z candidates highly clustered as opposed to contaminants

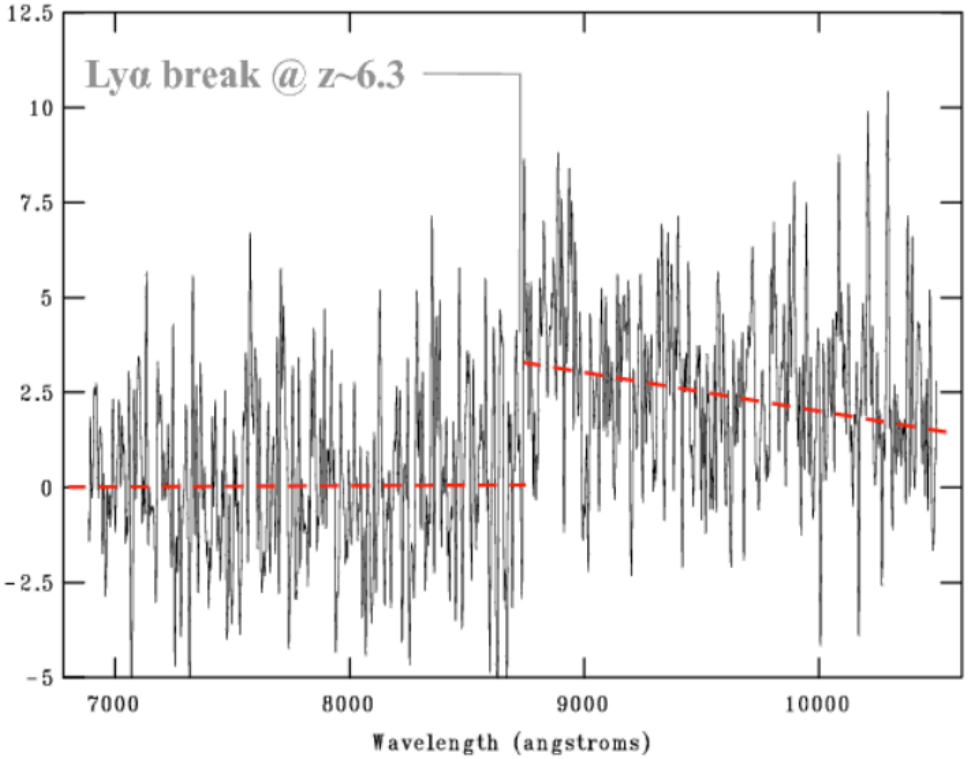
overdensity reinforced (>4σ, δ=2.4) – best evidence so far around a z~6 QSO

➔ intensive effort to get confirmation: spectroscopy + multi-band coverage

MUSE Lyman Alpha Emitter



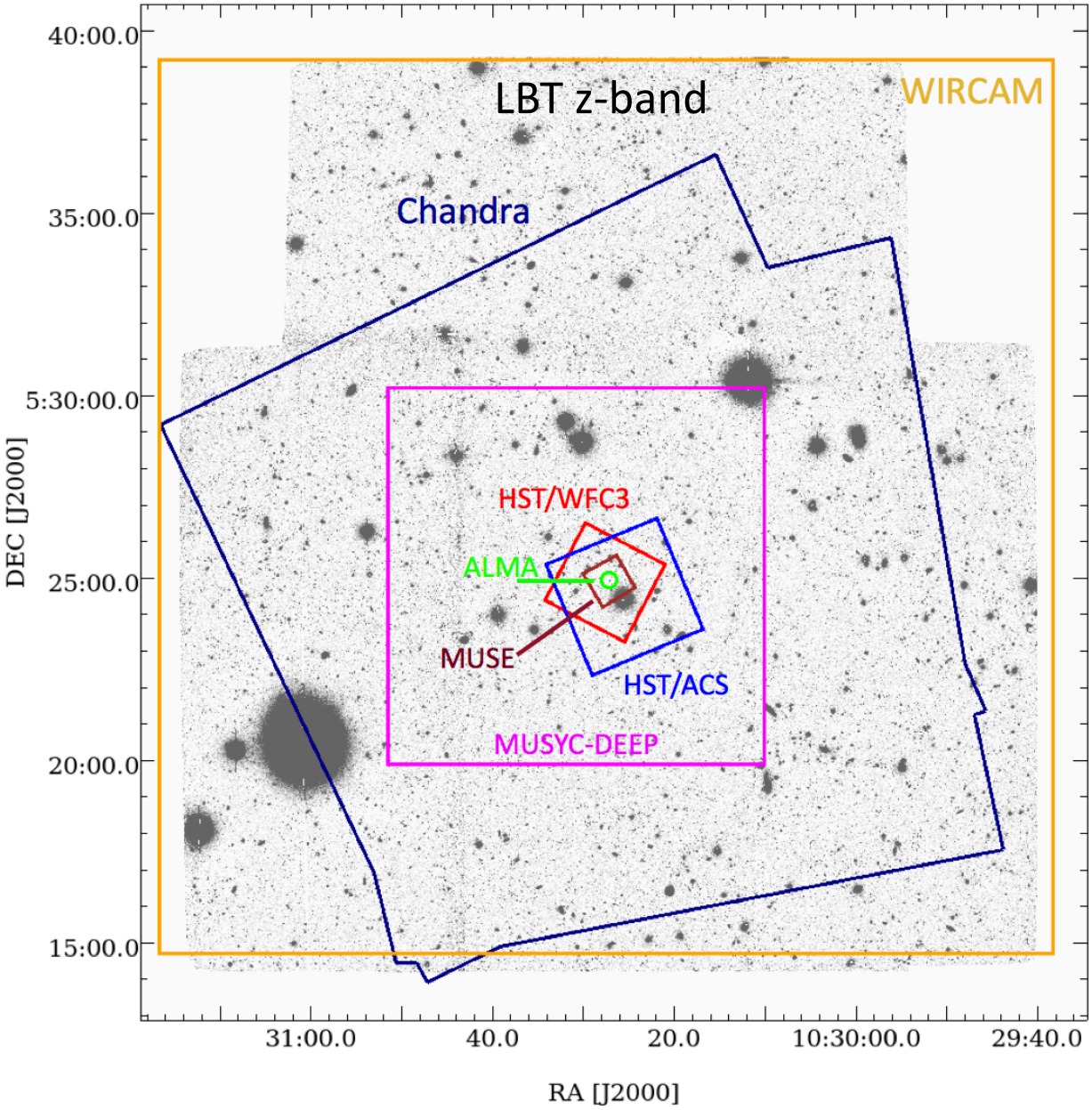
Keck Lyman Break Galaxy



separation from QSO ~ 3-4 pMpc …

ok, but need more spectra to confirm overdensity with high significance

The multi-λ deep survey in the SDSS J1030 field



24’ on a side

http://www.oabo.inaf.it/~LBTz6/1030/

Band	Survey/Instrument	Area	Depth(5σ)	INAF	Status/Refs/Notes
X-ray 0.5-7 keV	Chandra/ACIS-I	17' x 17'	1.7 x 10^{-16} erg/cm^2/s	✔	Nanni+18
X-ray 0.3-10 keV	XMM	30' diameter	1.0 x 10^{-15} erg/cm^2/s		Farrah+04 - reanalyzed data
Opt - U B V R i z	MUSYC Wide	30' x 30'	m_{AB} = 25-26		Blanc+08
Opt - r i z	LBT/LBC	23' x 25'	m_{AB} = 25, 26, 27.5	✔	Morselli+14
Opt - r i z	Subaru/Suprime-Cam	27' x 34'	m_{AB} = 26-28		Diaz+14
Opt - F775W F850LP	HST/ACS	3.3' x 3.3'	m_{AB} = 27.5		Stiavelli+05, Kim+09
NIR - Y J	WIRCAM/CFHT	24' x 24'	m_{AB} = 24	✔	Balmaverde+17
NIR - J H K	MUSYC Deep	10' x 10'	m_{AB} = 23		Quadri+07
NIR - K	MUSYC Wide	30' x 30'	m_{AB} = 21		Blanc+08
NIR - F160W	HST/WFC3	2' x 2'	m_{AB} = 27.5		HST archive
MIR 3.4-8.0 μm	Spitzer/IRAC	~35' x 35'	[3.4] = 22.7		IRSA archive
MIR 24 μm	Spitzer/MIPS	~10' x 16'	[24] = 19.5		IRSA archive
FIR - 1.2 mm	ALMA	0.4' FWHM	250 μJy		Decarli+17
FIR - 3.5 mm	ALMA	1.1' x 2.2'	33 μJy	✔	Priority B, Cycle6 - PI Gilli
Radio - 1.4 GHz	VLA	30' FWHM	75 μJy		Petric+03 - reanalyzed data
Radio - 1.4 GHz	JVLA	30' FWHM	7.5 μJy	✔	Observed June 2018, PI Prandoni

http://www.oabo.inaf.it/~LBTz6/1030/

images and catalogs publicly available

Spectroscopic data

Band	Telescope/Instrument/Mode	# slits/masks	Emission line sensitivity (5σ)		Status/Refs/Notes
Opt	LBT/MODS/MOS	9 masks	10^{-17} erg/cm^2/s	✔	LBT strategic program - in progress
Opt	Keck/DEIMOS/MOS	1 mask	10^{-17} erg/cm^2/s		Observed Dec. 2017, PI Cappelluti
Opt	VLT/MUSE/IFU	1 pointing	2×10^{-18} erg/cm^2/s		ESO archive - reanalyzed data
Opt	VLT/FORS2/MOS	3 masks	3×10^{-18} erg/cm^2/s	✔	To be observed, ESO P102A, PI Mignoli
NIR	LBT/LUCI/Long Slit	4 slits	2×10^{-17} erg/cm^2/s	✔	LBT strategic program - in progress

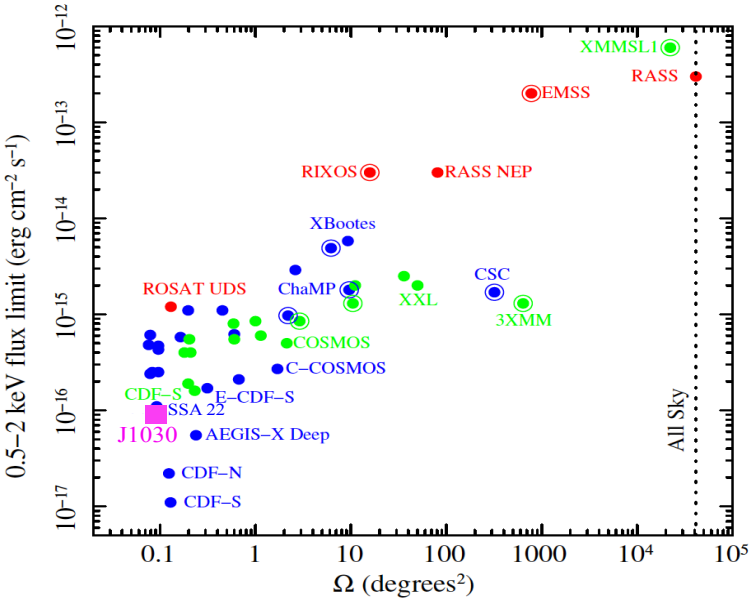
In the future.. GTO NIRCam/JWST, 3’x5’ mosaic

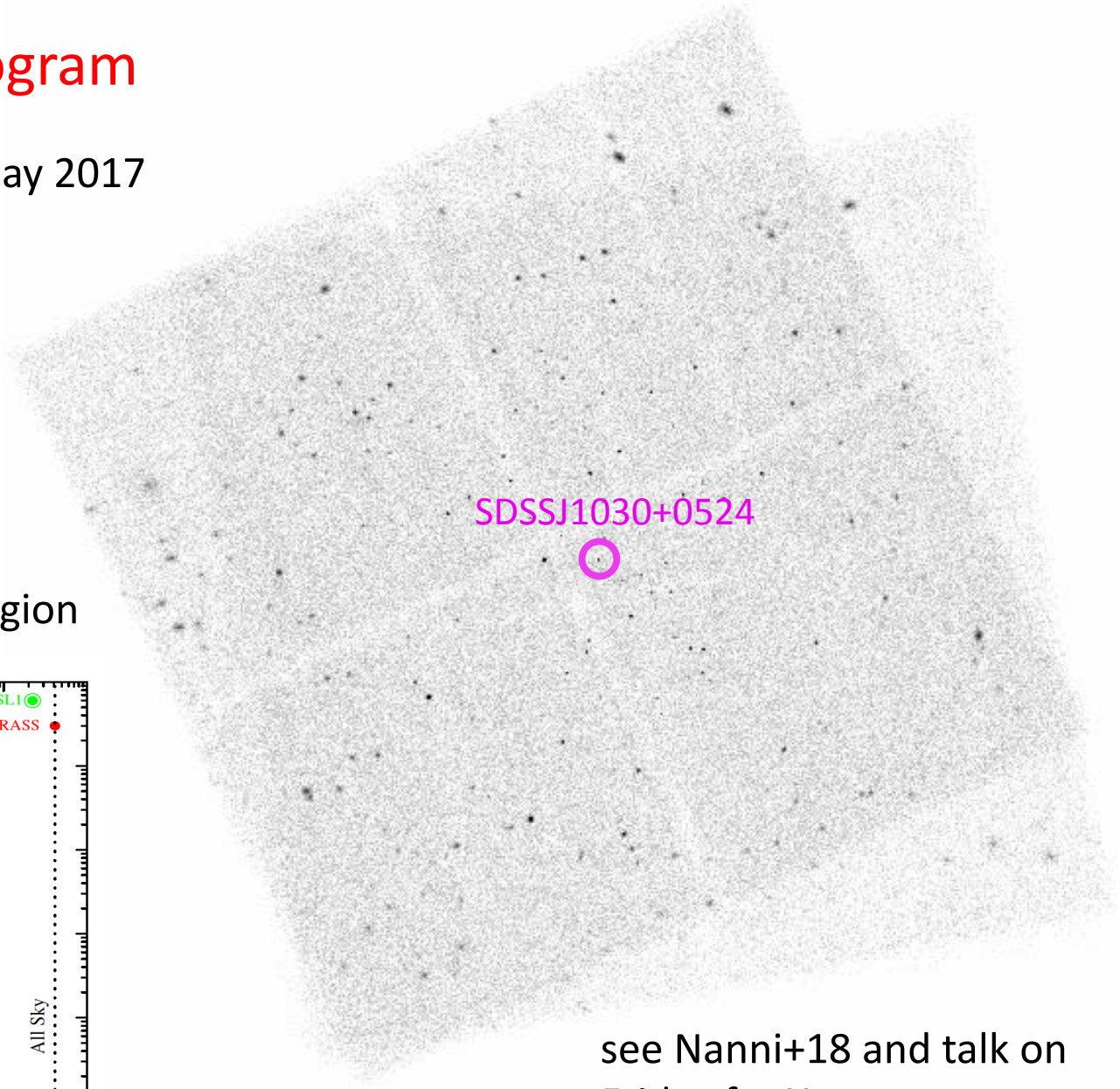
Chandra large program

500ks with ACIS-I, obs. Jan-May 2017

FoV~17'x17'
>250 X-ray sources
$F_{soft} > 9x10^{-17}$ erg/cm^2/s
Nanni+ in prep.

4th deepest X-ray survey
only one in a high-z biased region





see Nanni+18 and talk on Friday for X-ray spectrum and variability of the QSO

LBT strategic program, follow-up opt/NIR spectroscopy

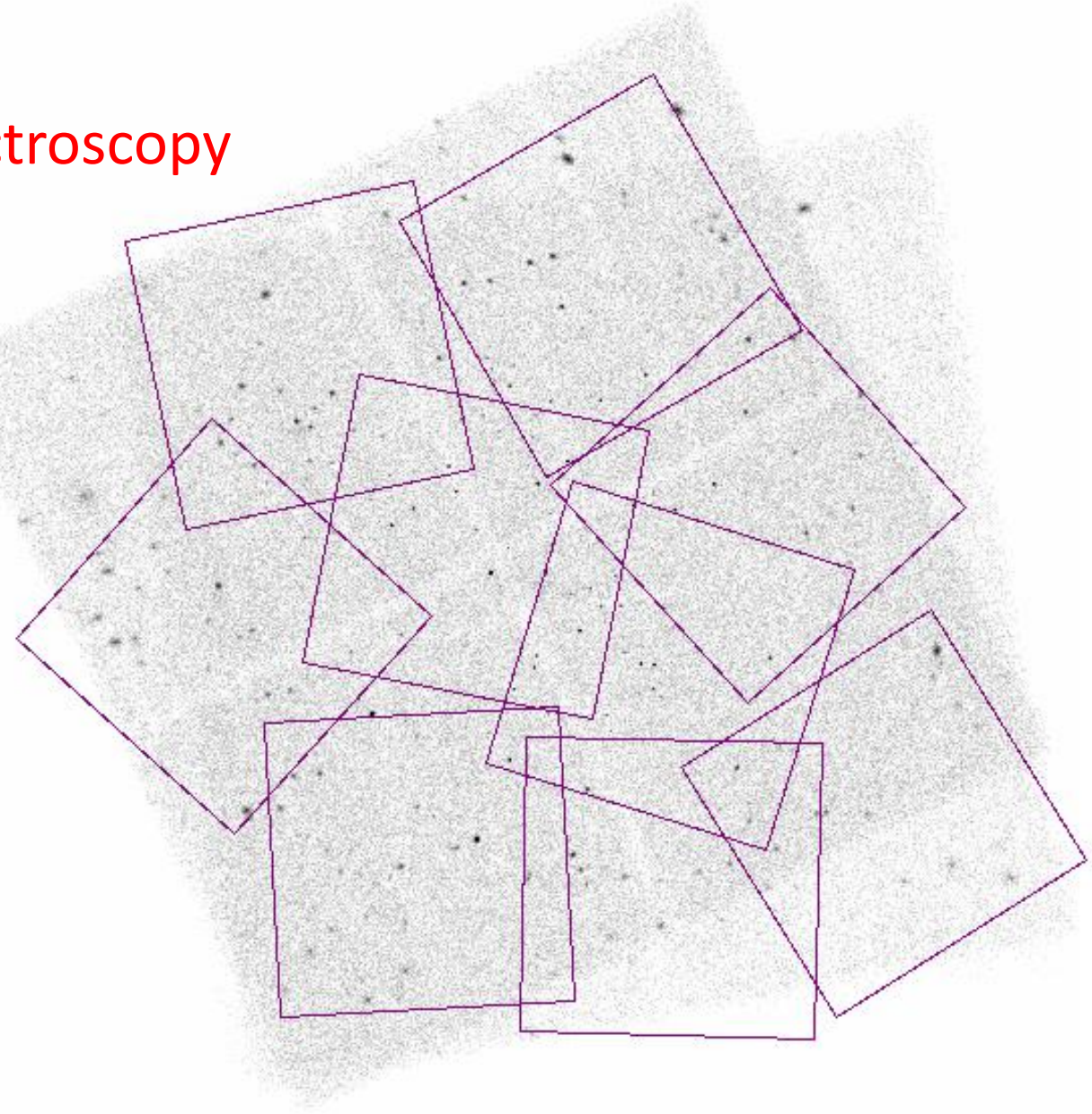
52hrs approved in 2017:

9 MODS masks, 4hr each
4 long slit LUCI, 4hr each

targets: ~200 X-ray sources
+ high-z and radio fillers

As of Oct 2018:
1/9 MODS masks observed
2/4 LUCI slits

program has been carried over,
new obs. from Nov 2018



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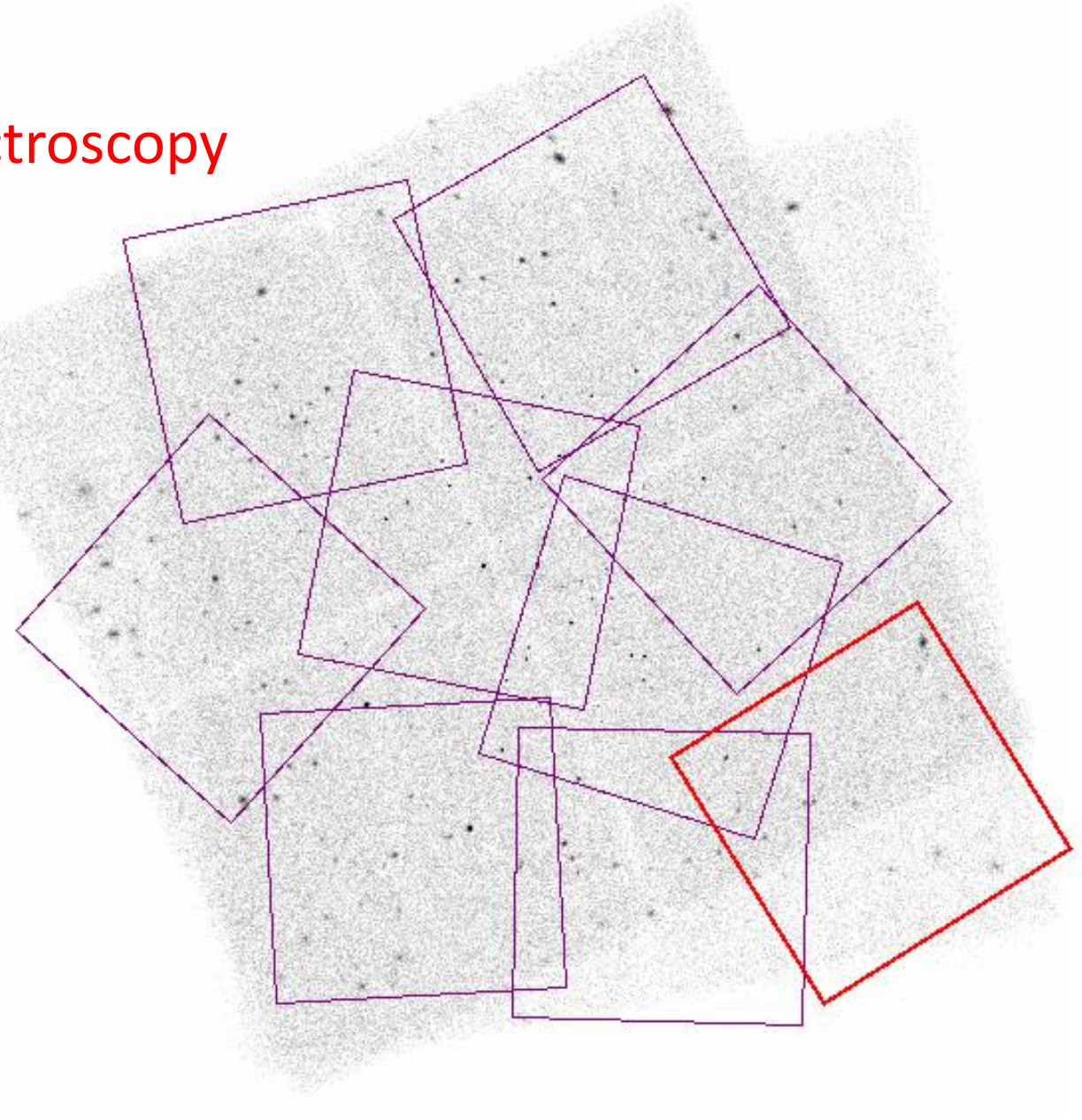


JVLA deep µJy field

PI I. Prandoni
Obs. June 2018, 36hr, A-array
1.4GHz, 1.5" res., 30' FWHM FoV

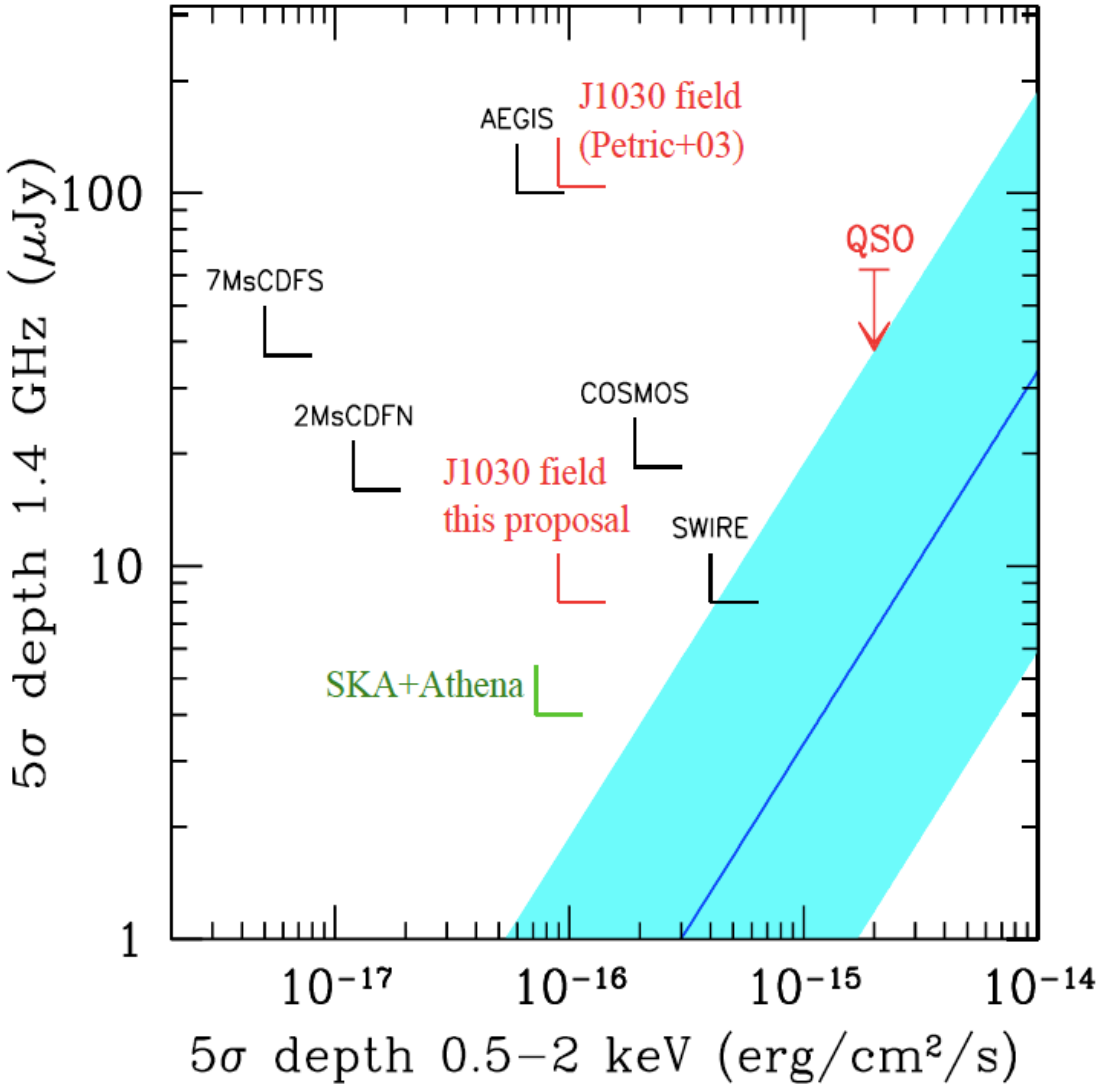
expected rms 1.7-1.8 uJy
x10 better rms than existing data

one of few µJy radio surveys

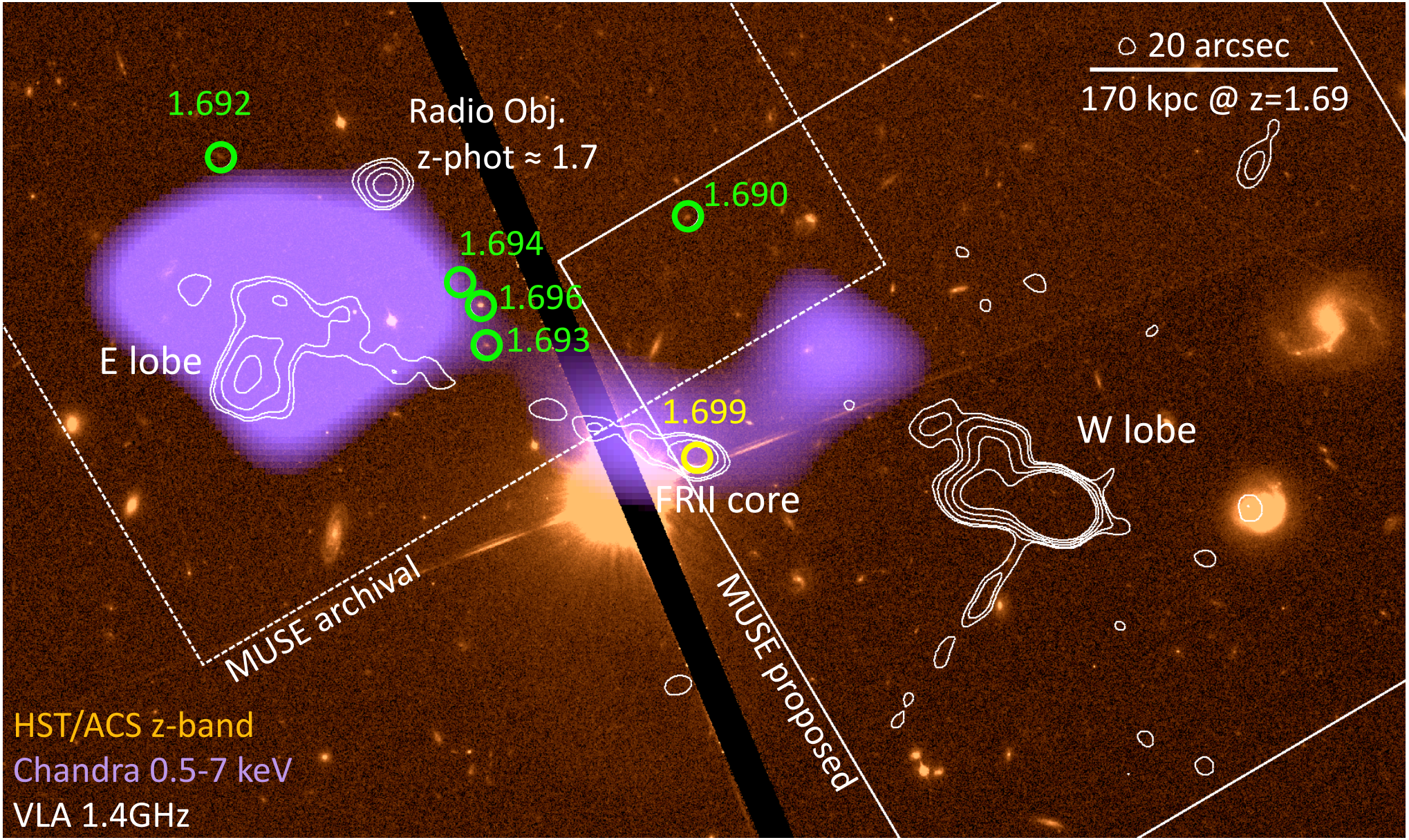
test field for SKA/Athena synergies

~4700 SFG expected
~1500 AGN

PhD project of Q. D'Amato

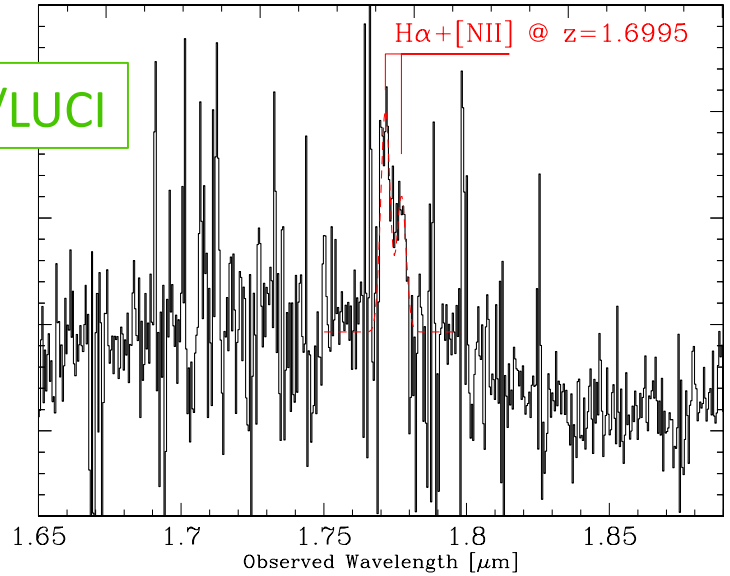


Proto-cluster around a Compton-thick FRII at z=1.7

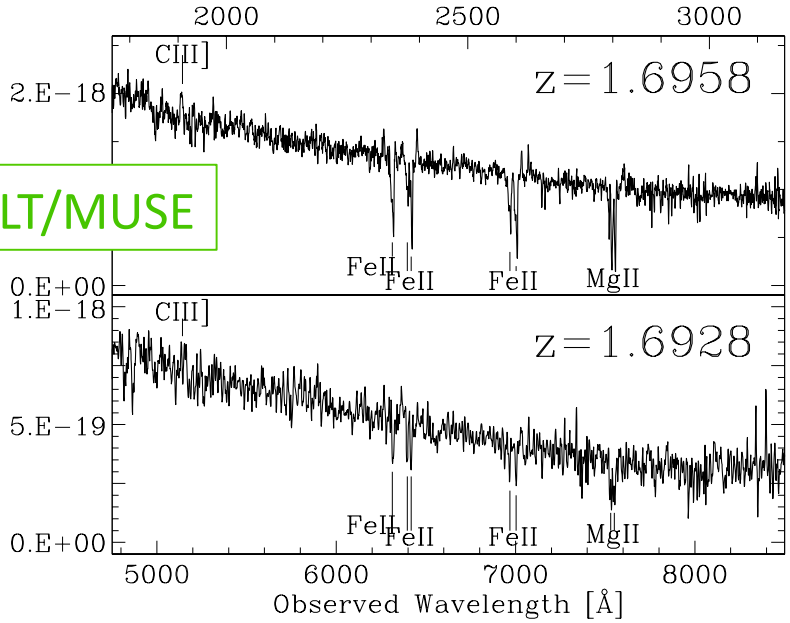


XID189 (FRII - HEG)

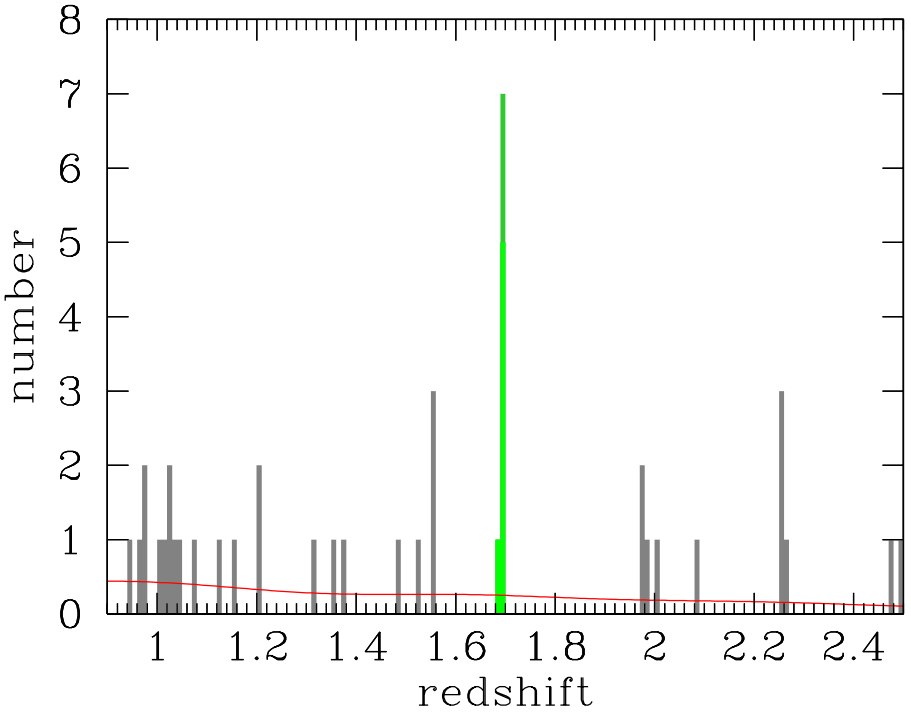
LBT/LUCI



VLT/MUSE



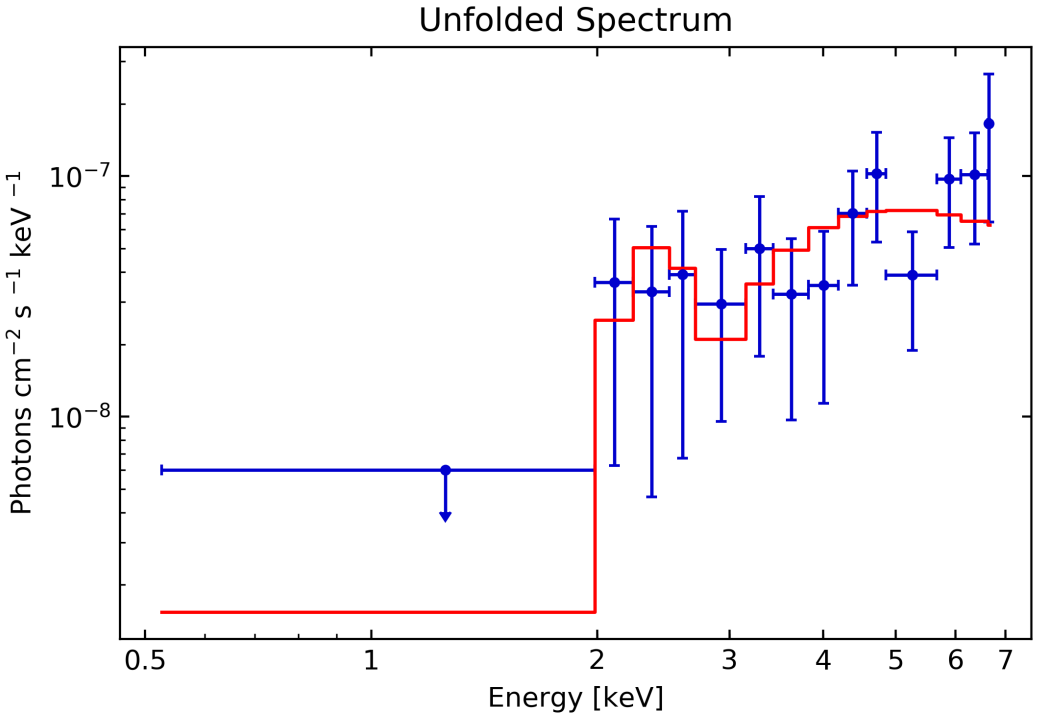
blue galaxies, SFR~8-70 M_{sun}/yr



σ_v ~ 500 km/s
likely progenitor of a >10^{14} M_{sun}
local galaxy cluster

WORK IN PROGRESS

XID189: a Compton-thick FRII at z=1.699



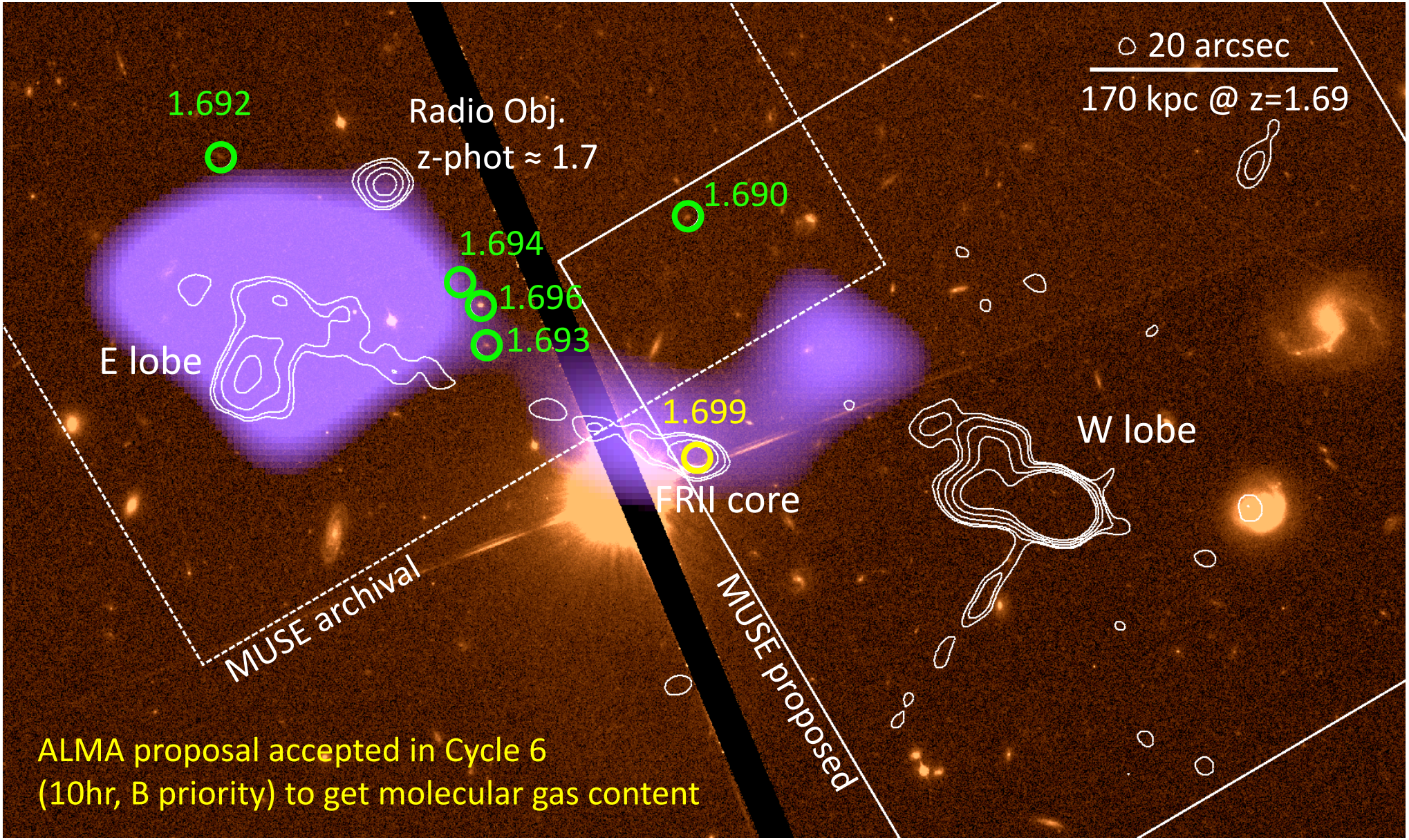
30 counts , hard band only

N_H= 1.5 (± 0.5) x 10^{24} cm^{-2}
L_x=1.8 x 10^{44} erg/s

→ Compton-thick QSO

See Poster #24 by A. Peca for X-ray spectral analysis and X-ray based redshifts in the J1030 field

Proto-cluster around a Compton-thick FRII at z=1.7



Conclusions

The J1030 field is competitive with other major multi-band deep surveys
(4th deepest in the X-rays, ~2nd in the radio)

Only deep survey in a highly biased field in the early Universe

Data routinely released. See the project website: http://www.oabo.inaf.it/~LBTz6/1030/

Collaboration and data completely open.

Everyone welcome to join and exploit these datasets

Major role of INAF in this excellent field for AGN studies: INAF AGN legacy field?