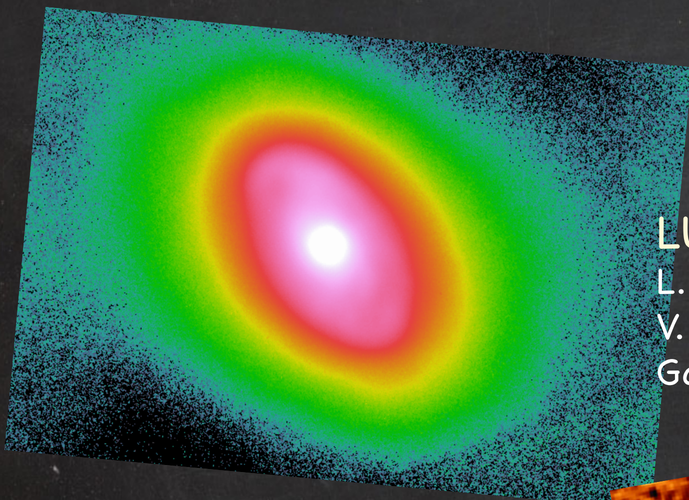
Galaxies and AGN observations with LBT: results, issues and perspectives

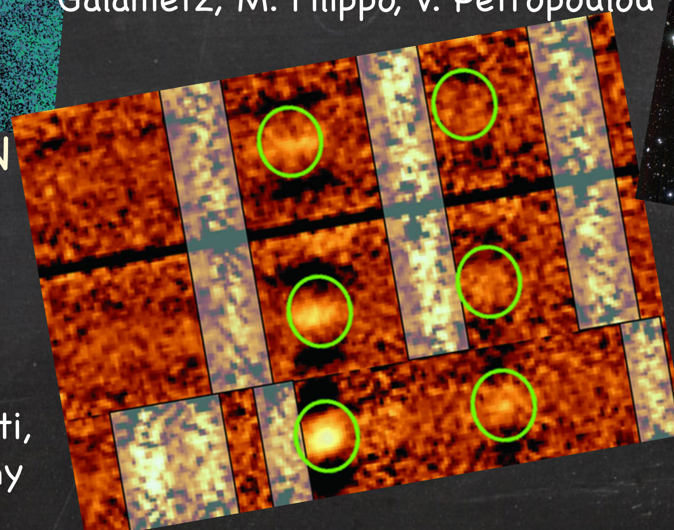


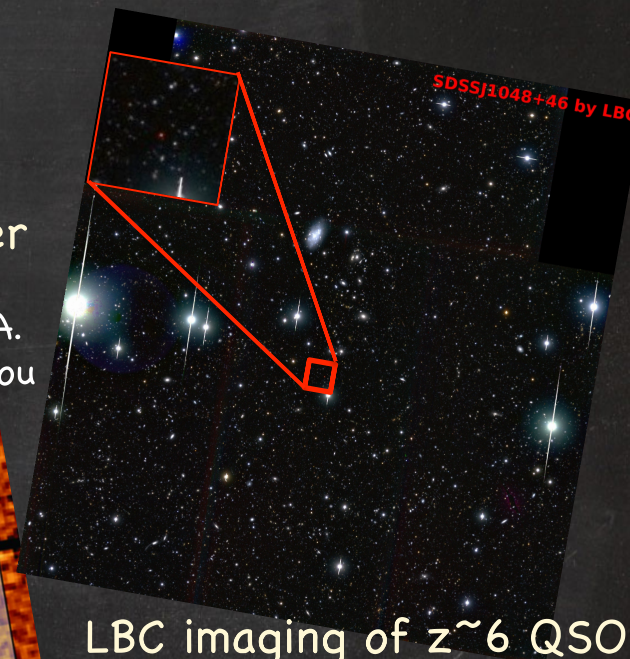
AO imaging of nearby AGN

E. Sani
C. Arcidiacono
R. Fanali
E. Pinna, K Boutsia, L. Busoni, F. Mannucci, F. Quiros-Pacheco, A. Puglisi, F. Quiros-Pacheco, G. Risaliti, A. Marconi, M. Salvati, D. McCarthy

LUCI-MOS of z~1.4 cluster

L. Magrini,
V. Sommariva, G. Cresci, E. Sani, A. Galametz, M. Filippo, V. Petropoulou



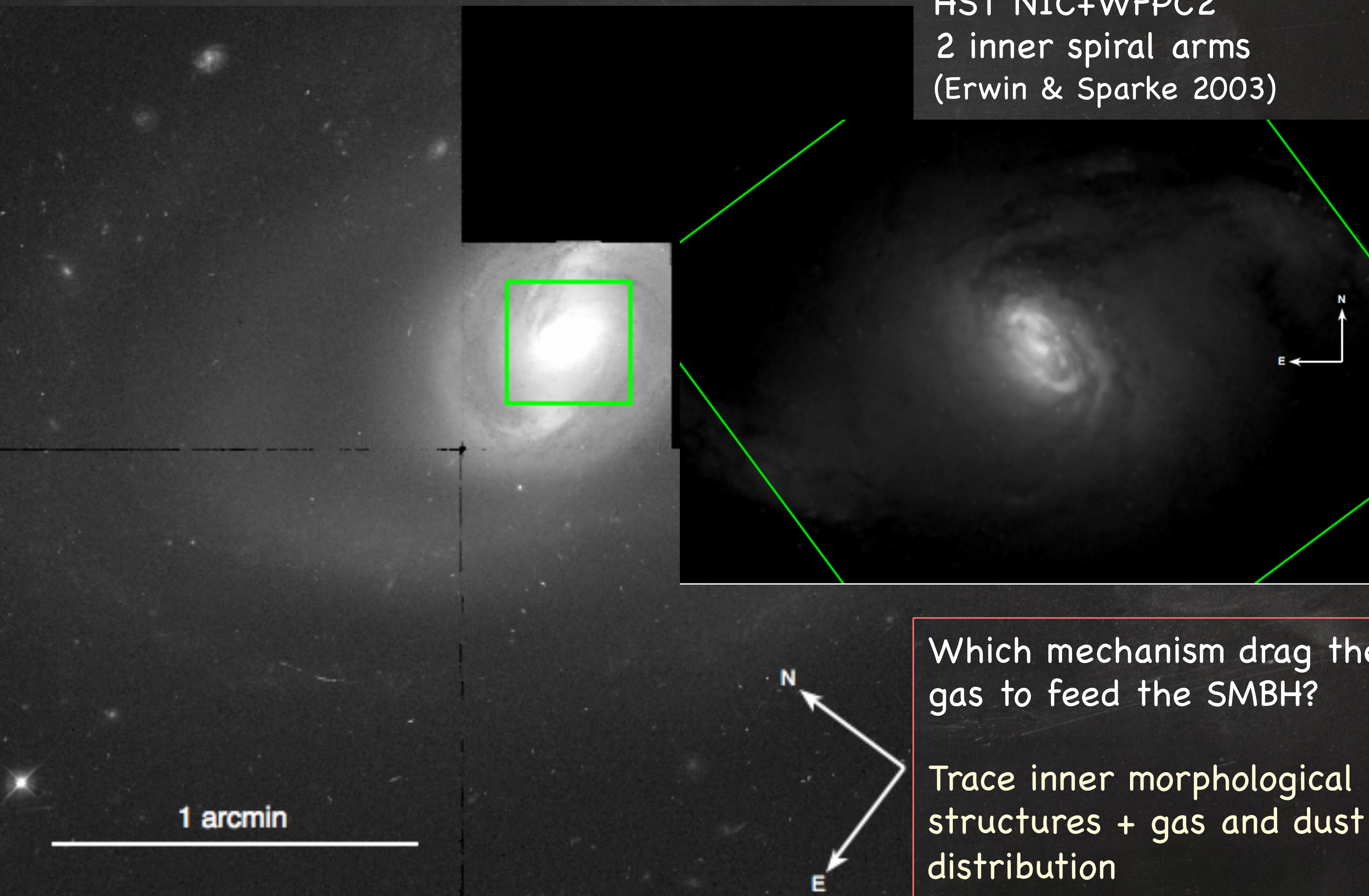


LBC imaging of z~6 QSO

R. Gilli
M. Mignoli,
L. Morselli
C. Vignali, A. Comastri, E. Sani, G. Zamorani, N. Cappelluti,
E. Vanzella, M. Brusa

NGC 2273 AO imaging: PISCES@LBT

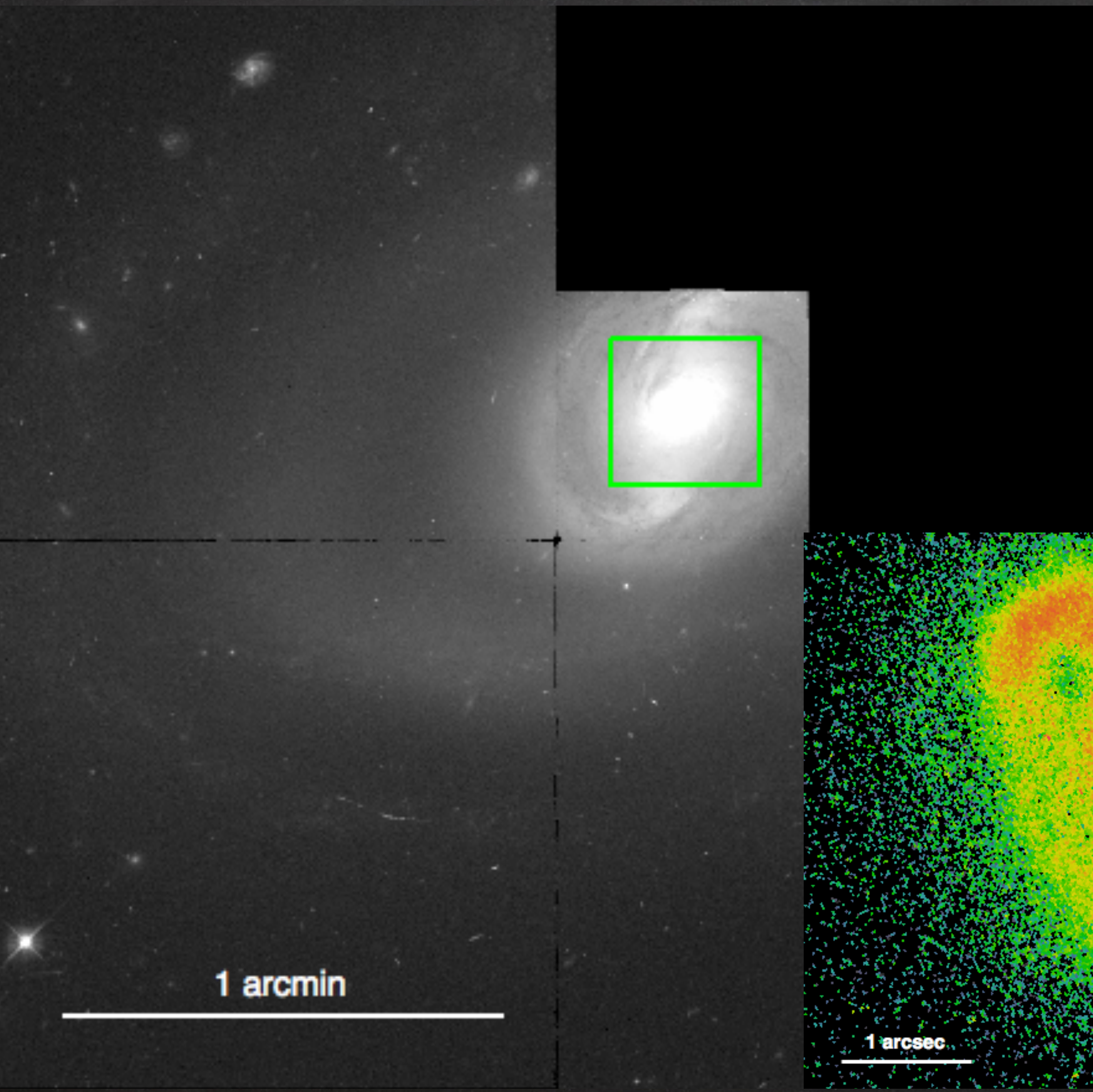
HST NIC+WFPC2
2 inner spiral arms
(Erwin & Sparke 2003)



Which mechanism drag the gas to feed the SMBH?

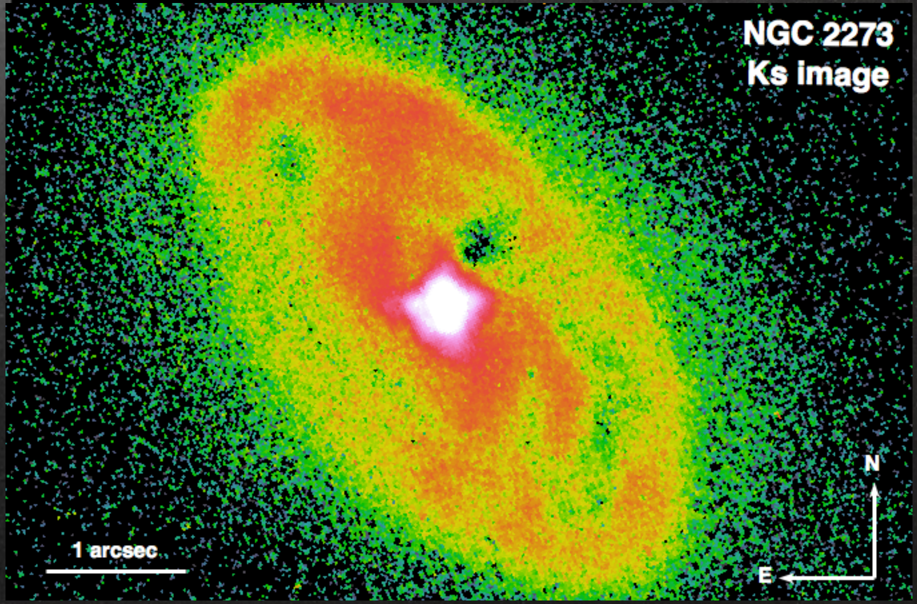
Trace inner morphological structures + gas and dust distribution

NGC 2273 AO imaging: PISCES@LBT



Lack of multi-band imaging
→ No dusty structures morphology

R+I = 15.5+15.0
+ → poor SR
seeing > 1″
Still enough to detect 3m-spirals



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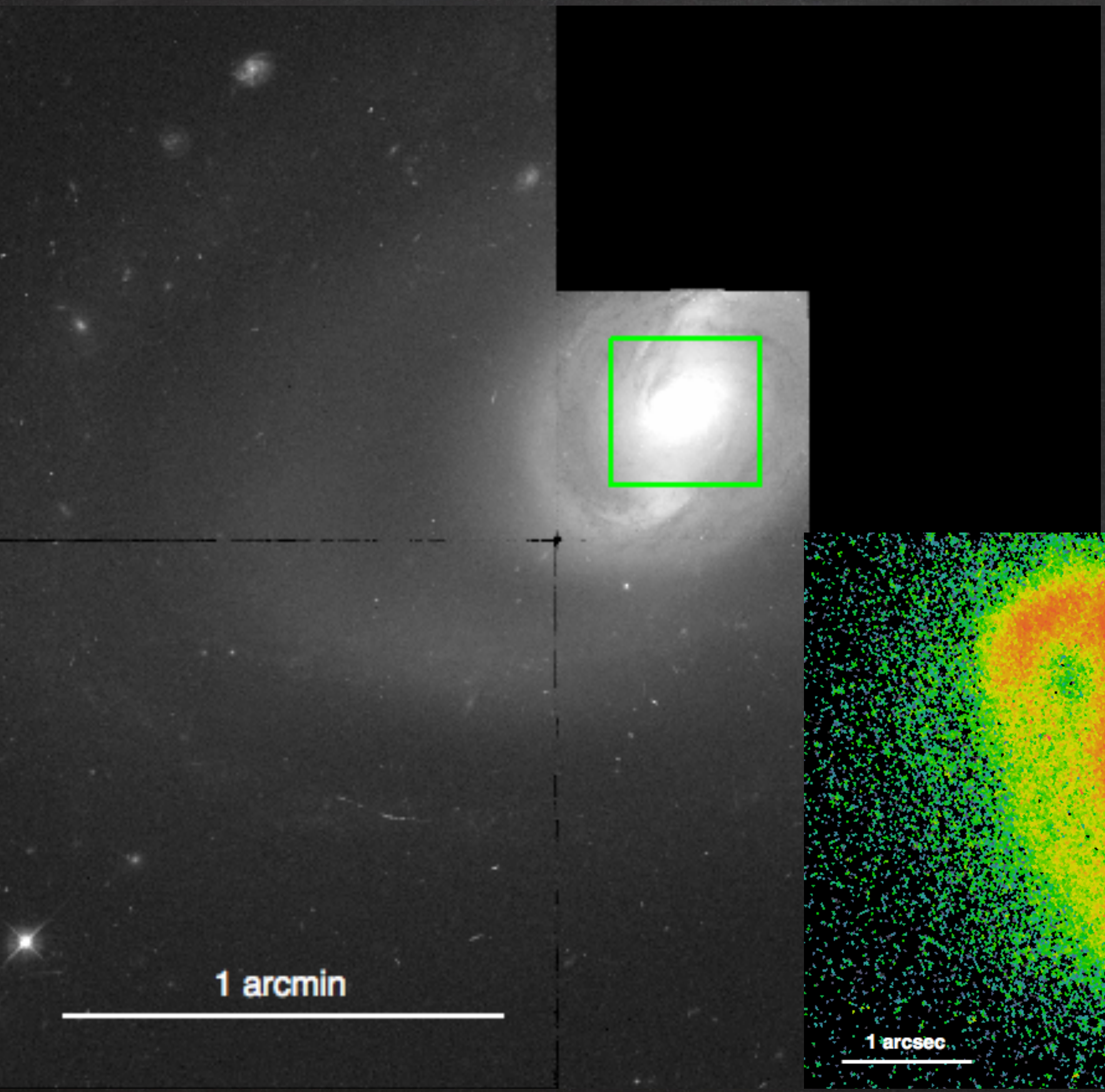

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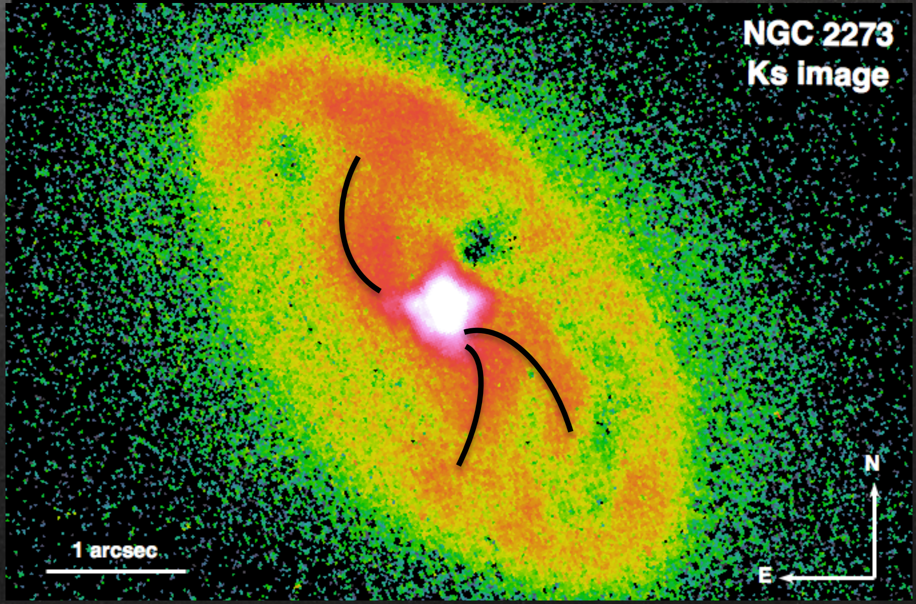


NGC 2273: simulations

Gaseous disk
Exponential density profile

- M_{disk} = 23*10^7 M_{sun}
- R = 100 pc
- z = 30 pc

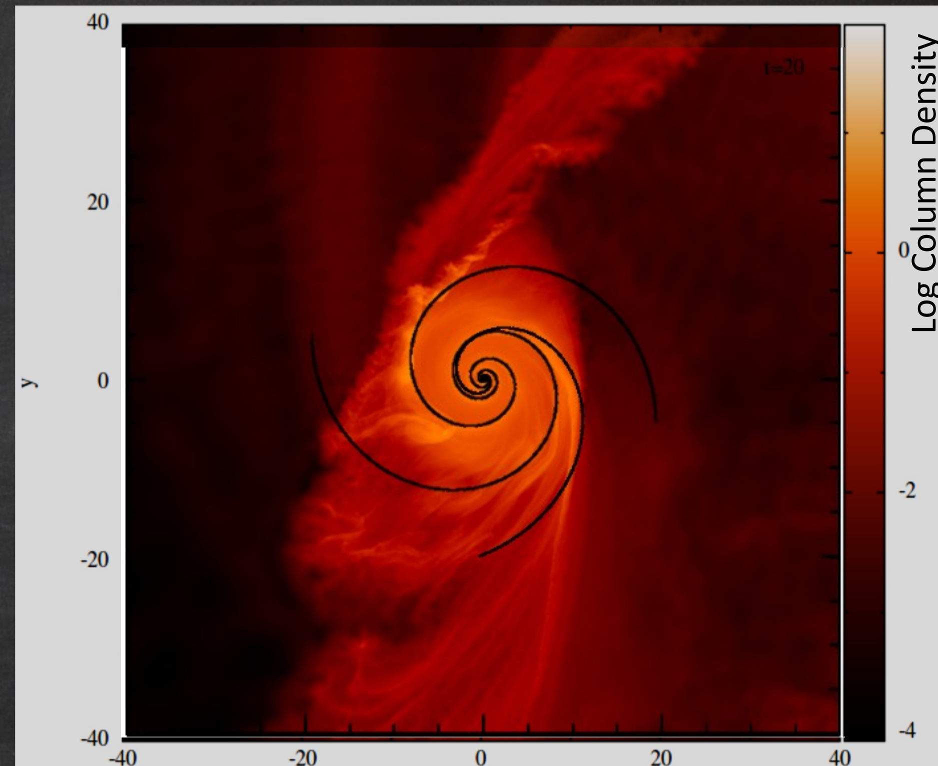
(Sani +12, PdBI data)

SB(r)a morphology

GADGET2 (Springel +05)

- Static axisymmetric potential from SIS
- Implements weak perturbations
  $\Phi_b = \varepsilon(r)\ \Phi(R)\ \cos 2(\vartheta - \Omega_b t)$
- Evolution 40 Myr

✧ Double bar Ω_{b1}/Ω_{b2}=3 (resonances)



R. Fanali's PhD thesis

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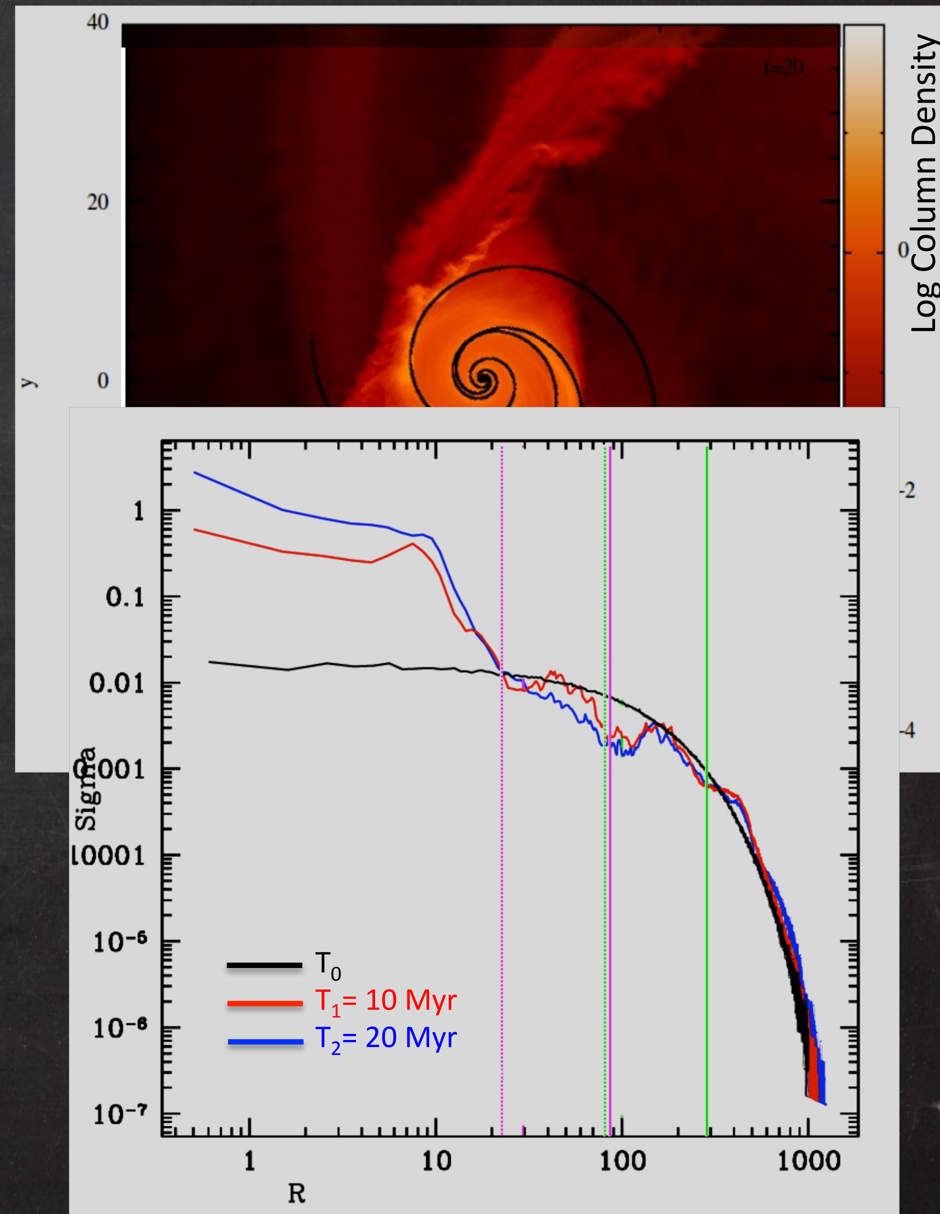

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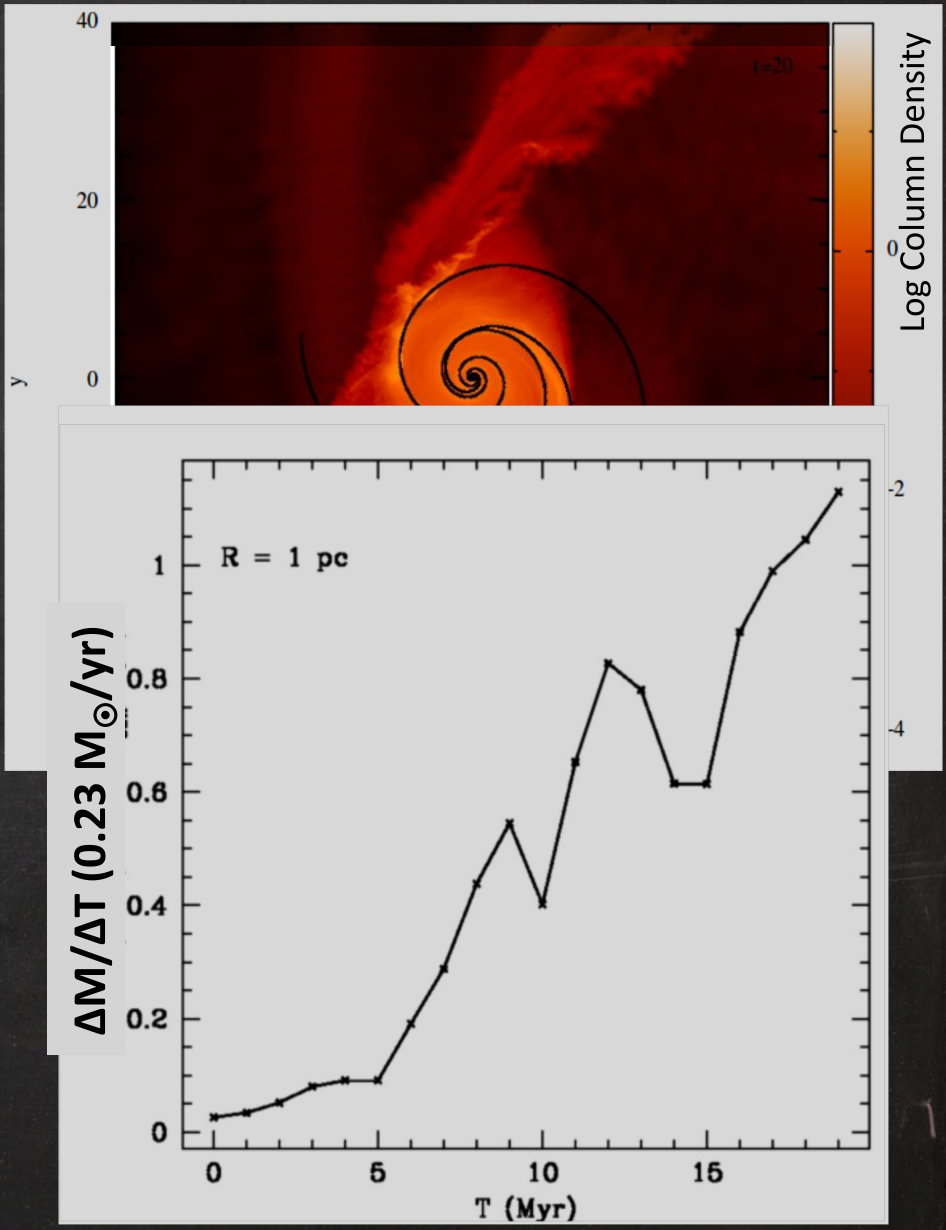

R. Fanali's PhD thesis

Extragalactic science with FLAO

Target	R.A. dec.	z	R+I
NGC 1068$^{\bullet}$	02:42:40.7 -00:00:48	0.0038	11.1+9.9
Mrk 1066$^{\bullet}$	02h59m58.6s +36d49m14s	0.011	13.9+12.3
NGC 2273$^{\bullet *}$	06h50m08.6s +60d50m45s	0.0061	14.5+14.0
NGC 3079	10h01m57.8s +55d40m47s	0.0037	12.2+10
NGC 3227	10h23m30.6s +19d51m54s	0.0038	11.9+11.1
NGC 4051	12h03m09.6s +44d31m53s	0.0023	12.1+11.3
NGC 4941$^{\bullet *}$	13h04m13.1s -05d33m06s	0.0037	10.6+9.9
NGC 5005$^{\bullet *}$	13h10m56.2s +37d03m33s	0.0032	14.1+14.2
NGC 5033	13h13m27.4s +36d35m38s	0.0029	14.5+14.2
NGC 5194	13h29m52.7s +47d11m43s	0.0015	9.5+10.5
NGC 6764	19h08m16.4s +50d56m00	0.0081	13.9+14.3
NGC 6951	20h37m14.1s +66d06m20s	0.0048	14.5+15.1

Sample properties

Extragalactic science with SOUL

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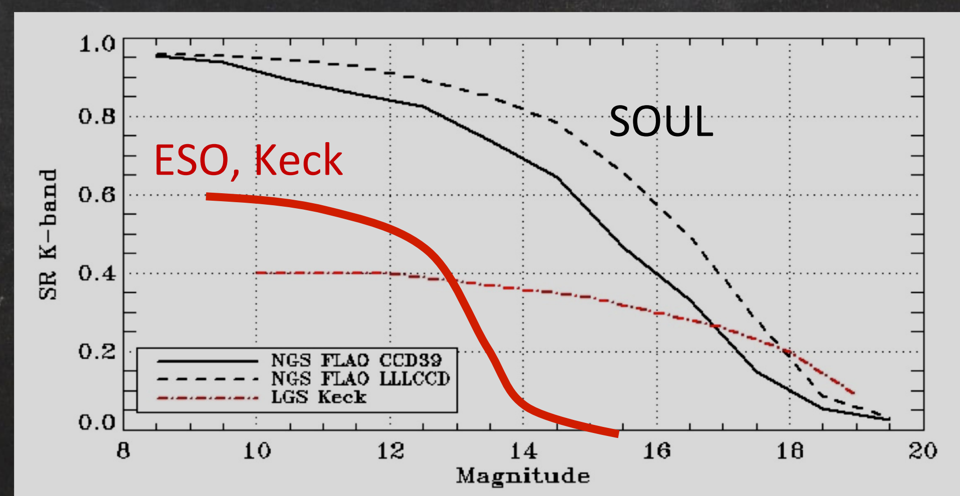
AGN-related topics:

- ✧ Feeding/fedback processes at low-z
- ✧ AGN close pairs (useful byproduct)
- ✧ QSO host galaxies at high-z
- ✧ DLA systems



Extragalactic science with SOUL

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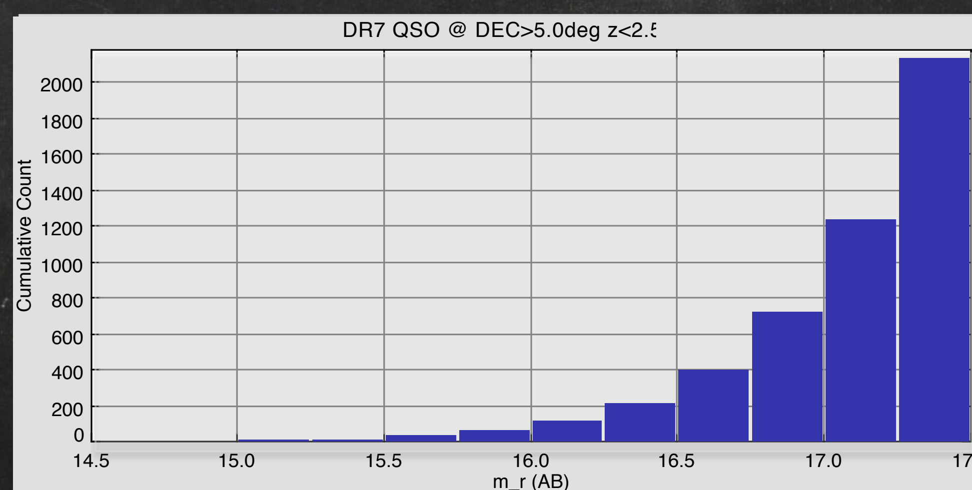
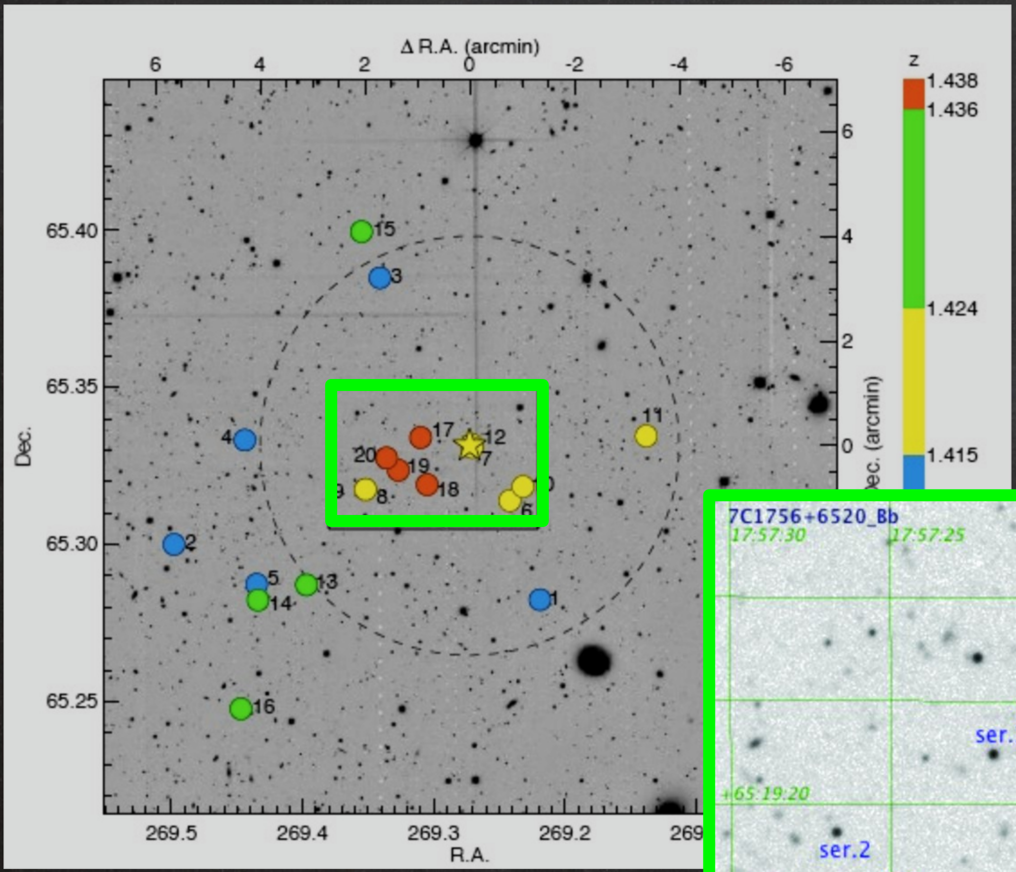
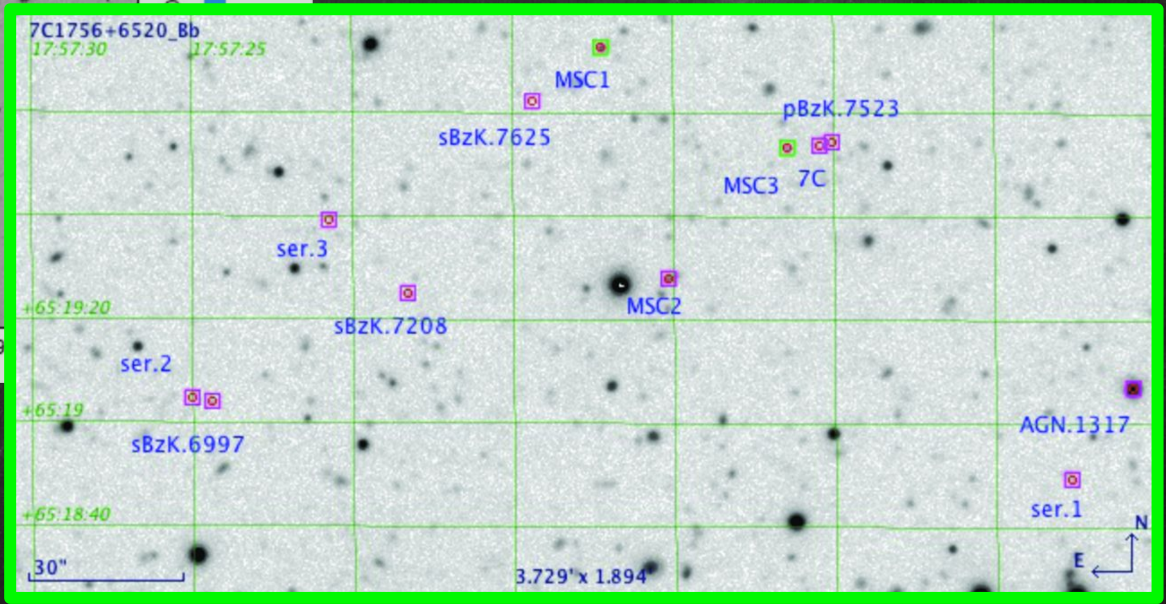


7C 1756+6520 z~1.4 cluster: LUCI-MOS



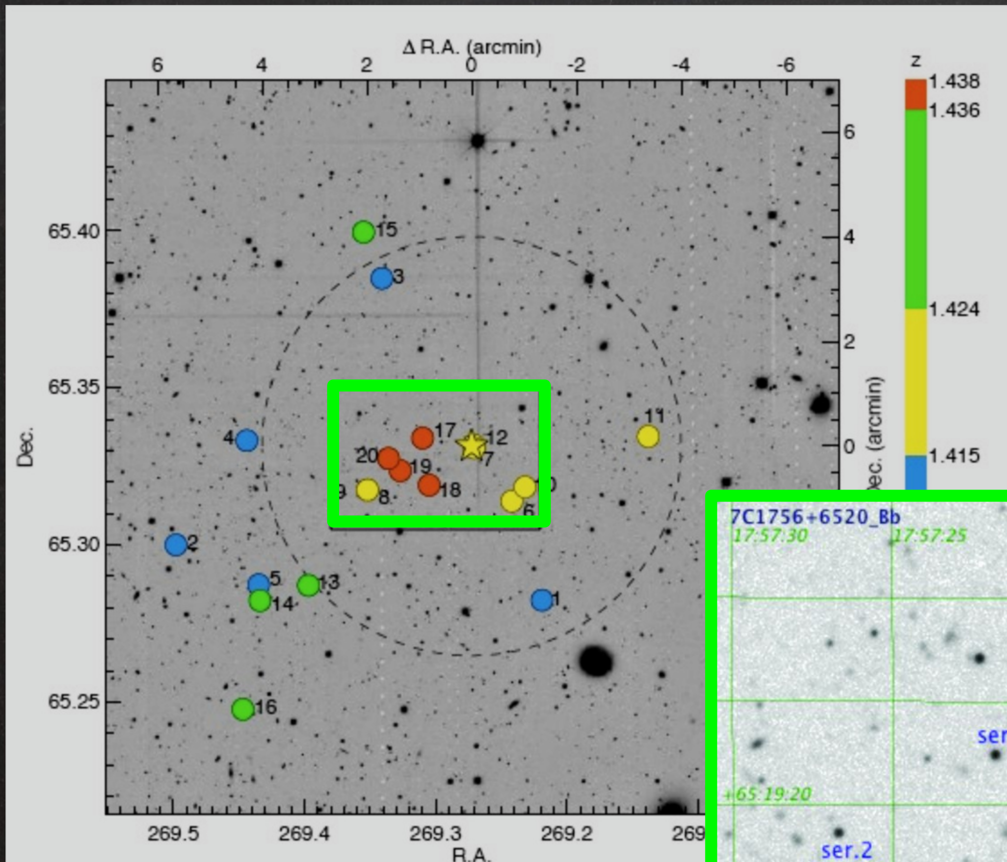
1. Gas and stellar content, and radial profiles
2. Radial metallicity gradient (flatter or steeper than in isolated galaxies?), average and maximum central metallicity
3. Star formation history (SF triggered or depressed by interactions?)



LBT/LUCI observations of several star-forming galaxies located in one of the farthest spectroscopic confirmed clusters, around the radio galaxy 7C 1756+6520 at z~1.4

from Galametz et al. 2010

7C 1756+6520 z~1.4 cluster: LUCI-MOS



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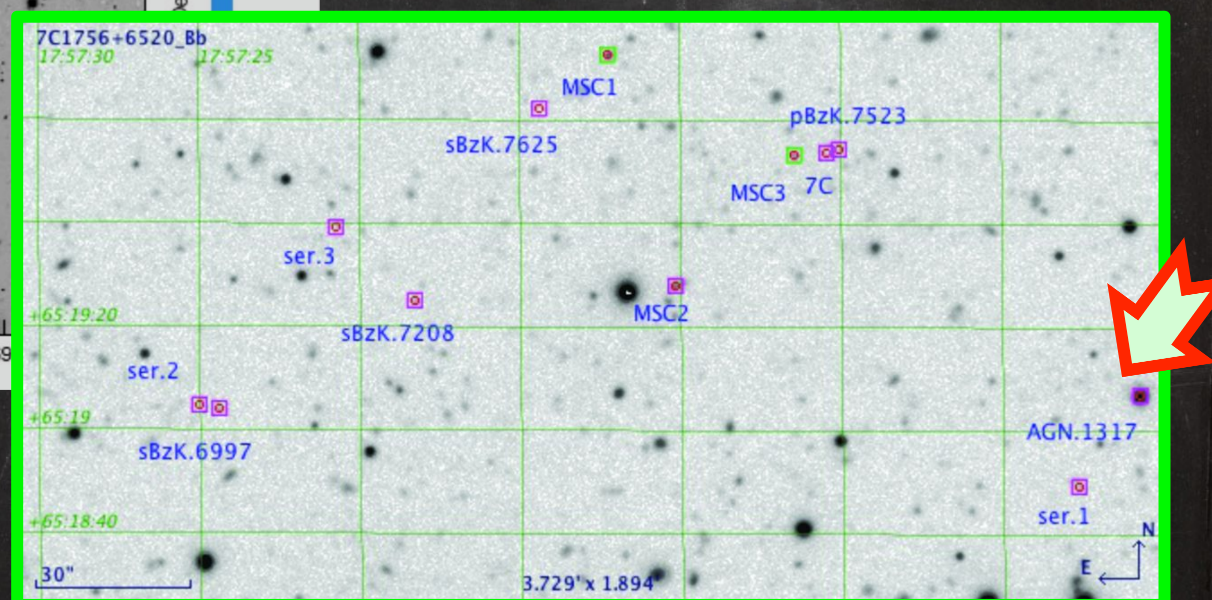

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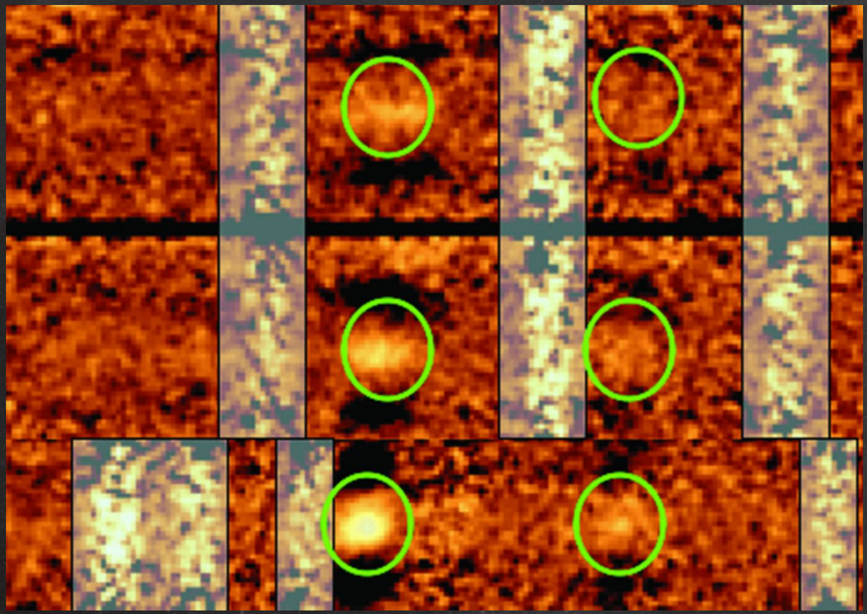
from Galametz et al. 2010

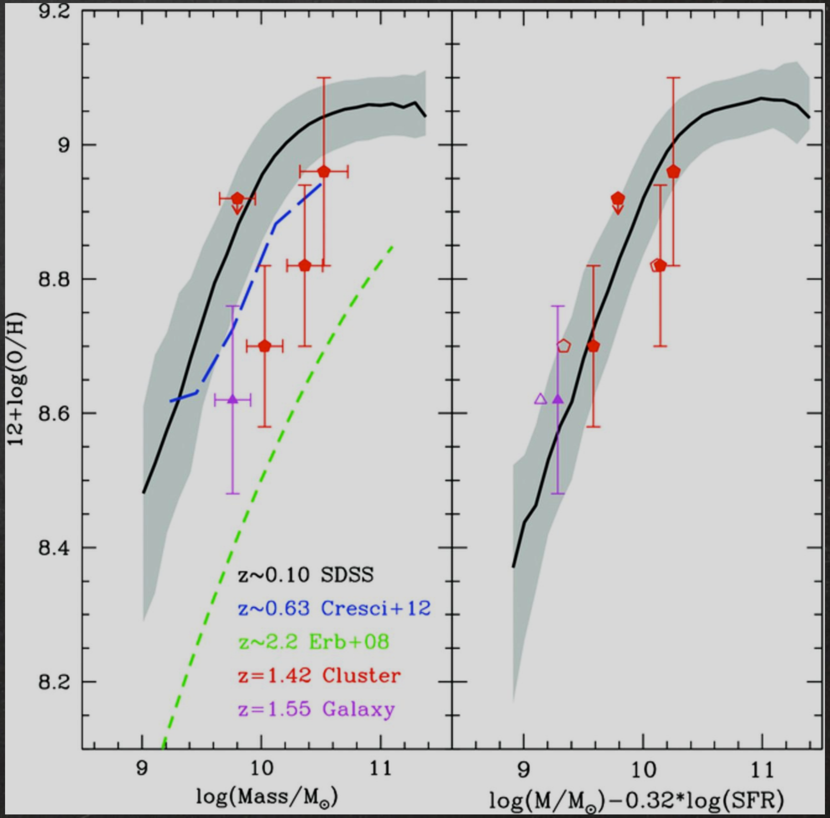
7C 1756+6520: high spectral resolution obs



Hα and [NII] lines to derive the galaxy Z and SFR.

M* comes from SED fitting

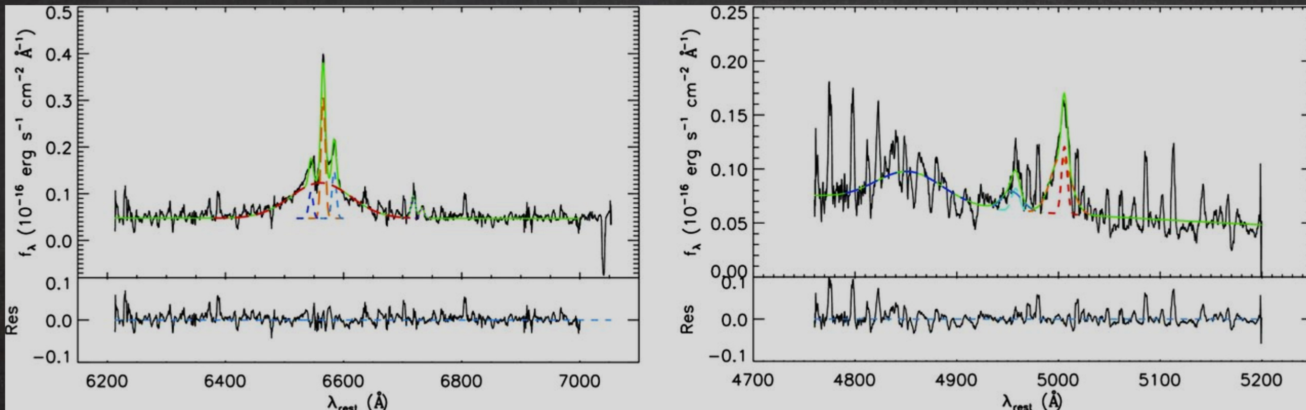
NO J-band flux calibration



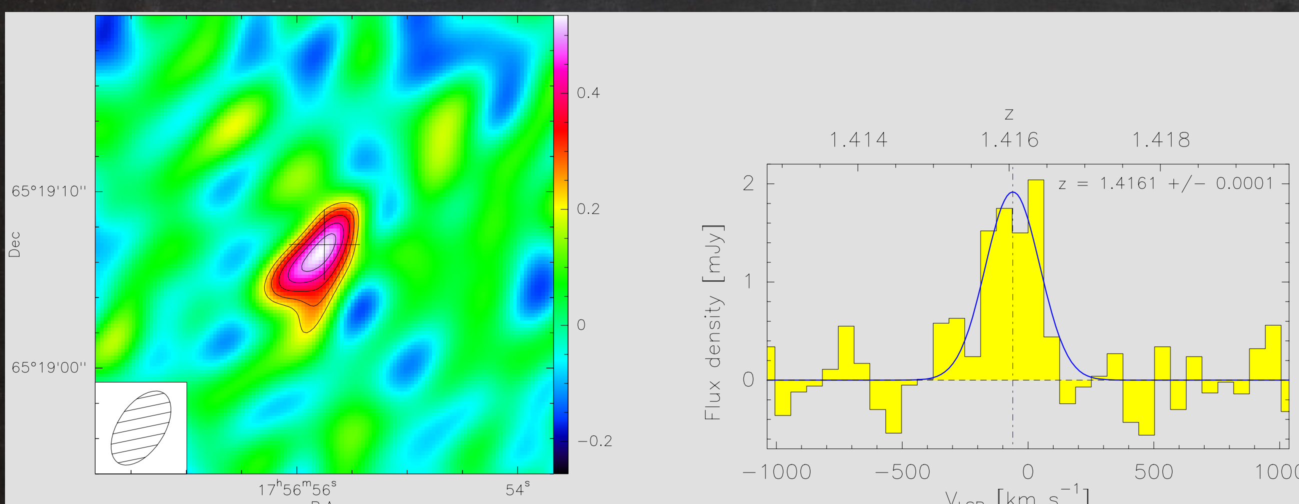
The galaxies in the z ~ 1.4 cluster are consistent with the FMR, suggesting that the effect of the environment is not dominant in the early phases of their evolution, at least in the considered mass range.

Magrini L., E. S., et al. MNRAS 2012, 42, 1195

AGN.1317: a bright, gas-rich AGN in the cluster



LBT observations reveal a strong gas outflow reaching velocities ~1800 km s^{-1} that is possibly driven by the AGN radiation pressure



IRAM PdBi follow-up:
Aiming to find a trace of the high molecular gas content in primeval clusters, we searched for the $^{12}CO(2-1)$ line emission in AGN.1317, detecting indeed a large amount of molecular gas of the order $10^{10} M_\odot$

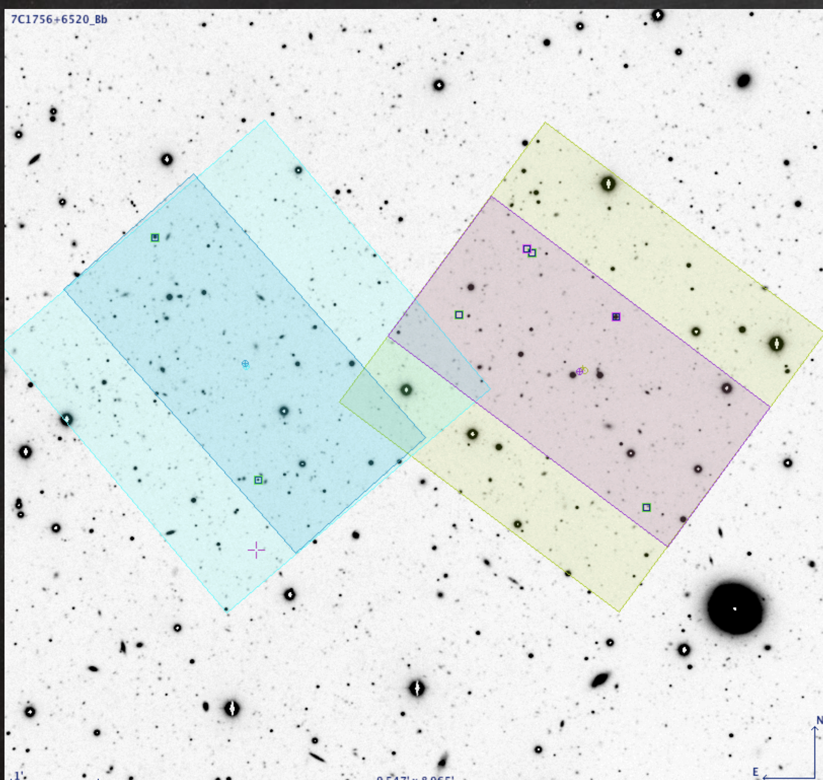
Casasola, L. M., E. S., et al. (2013)

New LUCI-MOS: due in spring 2014

Is AGN.1317 special or all AGN in high-z clusters are characterized by strong outflows and high gas content?

AIM: to observe the population of known AGN in the z=1.4 galaxy cluster to find:

- the contribution of star formation and nuclear activity;
- relate them to the location in the cluster;
- to study gas outflows;
- select candidates for mm observations, as already done for AGN.1317.



List of the spectroscopically confirmed AGN

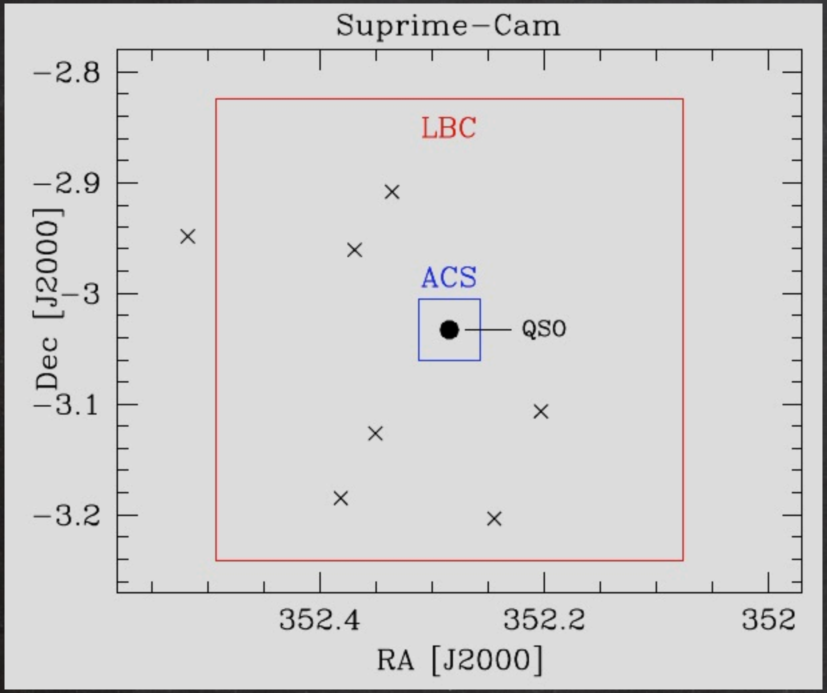
Name	RA	Dec	z_{spec}	B	z	K
AGN.1110	17:56:52.56	65:16:56.65	1.3935 ± 0.0012	23.21	22.14	20.89
sBzK.7556	17:57:46.54	65:20:00.48	1.4081 ± 0.0007	20.97	20.77	20.35
AGN.1354	17:57:04.98	65:19:51.00	1.4153 ± 0.0003	26.34	22.03	-
7C 1756+6520	17:57:05.48	65:19:53.75	1.4156 ± 0.0001	>27.1	21.40	20.17
AGN.1317	17:56:55.75	65:19:07.00	1.4162 ± 0.0005	20.16	19.46	19.01
sBzK.5860	17:57:35.34	65:17:14.39	1.4268 ± 0.0005	22.96	22.35	21.31
AGN.1206	17:57:13.08	65:19:08.37	1.4371 ± 0.0002	>27.1	>25.0	21.49

Our main questions:

- ✧ How do AGN in high-z clusters behave?
- ✧ What is the contribution of star formation and nuclear activity in AGN belonging to high-z clusters?
- ✧ Is there any relationship between AGN activity and location within the cluster?

The environment of z~6 QSOs: LBC-BIN

Brightest SDSS QSOs ($M_{BH} > 10^9\ M_\odot$) are often thought to reside in the most massive halos at their epoch → likely associated to galaxy overdensities



ACS onboard HST

- ACS imaged J1030, J1148, J1048 -> NO coherent results found (Kim +09). A 3′x3′ FoV covers ~1x1 physical Mpc^2 @ z~6
- Overdensities might extend up to 30′ (Overzier +09)
- Feedback from QSO may also limit galaxy formation in the QSO vicinity (Stromgren sphere ~2-4 Mpc, Fanidakis +13)

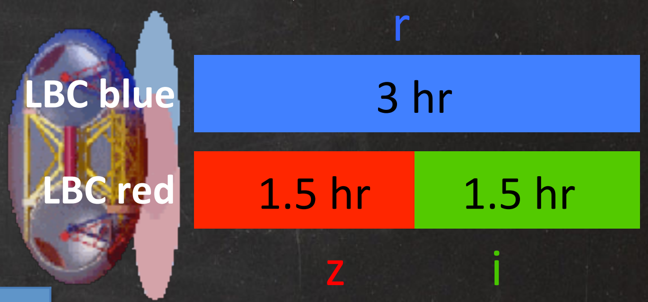
3σ overdensity of i-drops around a z=6.43 QSO found with 34′x27′ Suprime-cam (Utsumi+10)

Etendue: SuprimeCam @ Subaru vs LBC @ LBT

$53\ m^2 \times 0.26\ deg^2 = 13.5\ m^2 \times deg^2$ vs $111\ m^2 \times 0.16\ deg^2 = 17.8\ m^2 \times deg^2$

Currently SuprimeCam is the only possible competitor for LBC

z~6 QSOs: LBC observing strategy



Four SDSS QSOs at z~6 with $M_{BH}>10^9\ M_{sun}$

Target	z	M_{1450}	$M_{BH}\ 10^9 M_{sun}$	z_{AB}
SDSSJ1148+5251	6.41	-27.8	4.9	20.1
SDSSJ1030+0524	6.28	-27.2	3.2	20.0
SDSSJ1048+4637	6.20	-27.6	3.9	19.9
SDSSJ1411+1217	5.95	-26.8	1.2	19.6

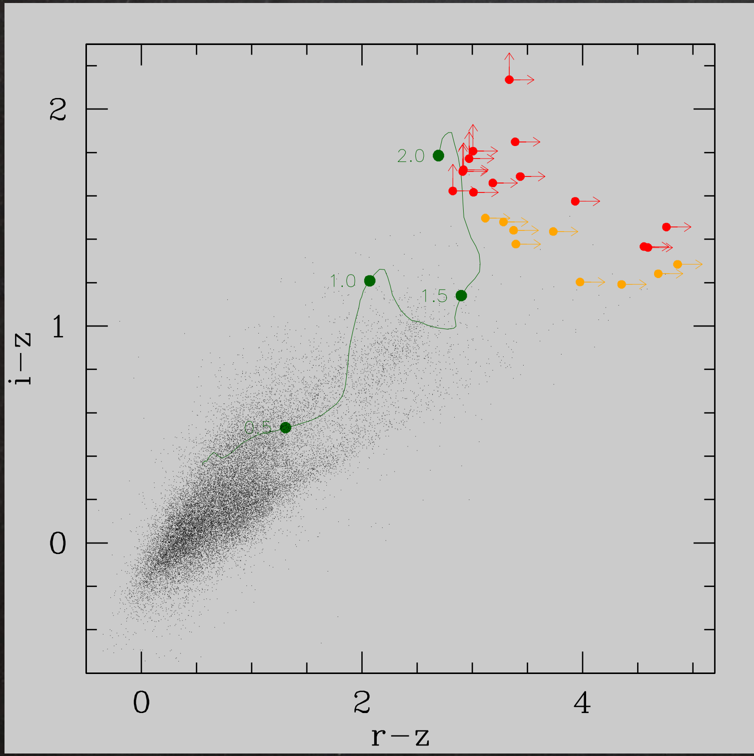
1.5hr z_{SDSS} + 1.5hr i_{SDSS} on the LBC-red channel and simultaneous 3hr in r_{SDSS} on the LBC-blue channel for each field

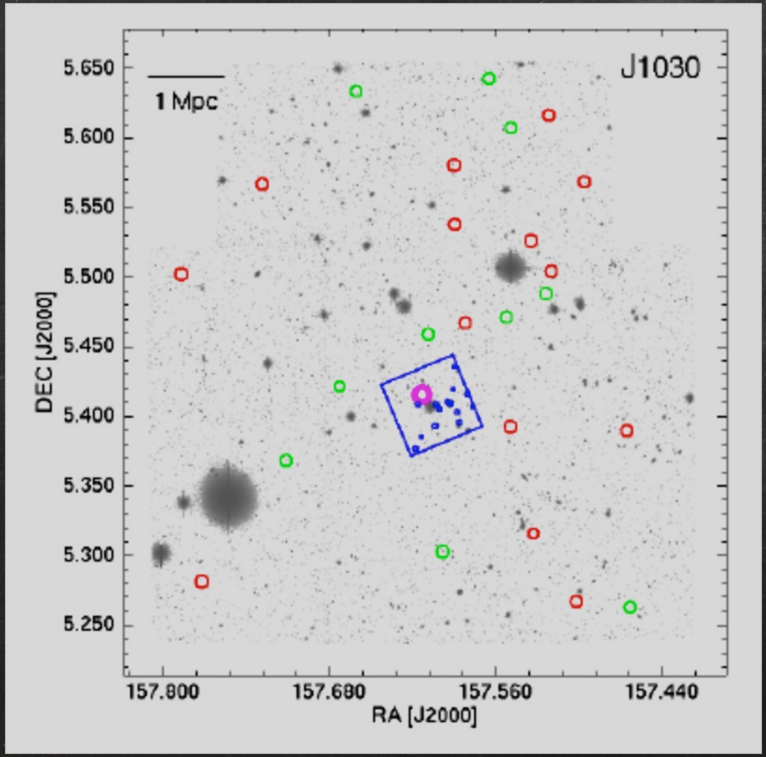
- Good seeing: FWHM ~0.7-0.8 in z-band
- Deep imaging: z=25-25.2 (5σ limits, 50% completeness) i~26.6; r~27.2
- Photometric catalogs: master catalog in z-band, colors computed in dual-mode
  ~ 2.5 x 10^4 z-band selected objects per field

z~6 QSOs: analysis

Dropout selection:
primary $(i-z)-\sigma_{(i-z)} > 1.3$
secondary $1.1 < (i-z)-\sigma_{(i-z)} < 1.3$
comparison $i-z > 1.4$

Field	Primary	Secondary	Comparison
J1030	14	10	16
J1148	8	3	10
J1048	6	9	9
J1411	11	8	12

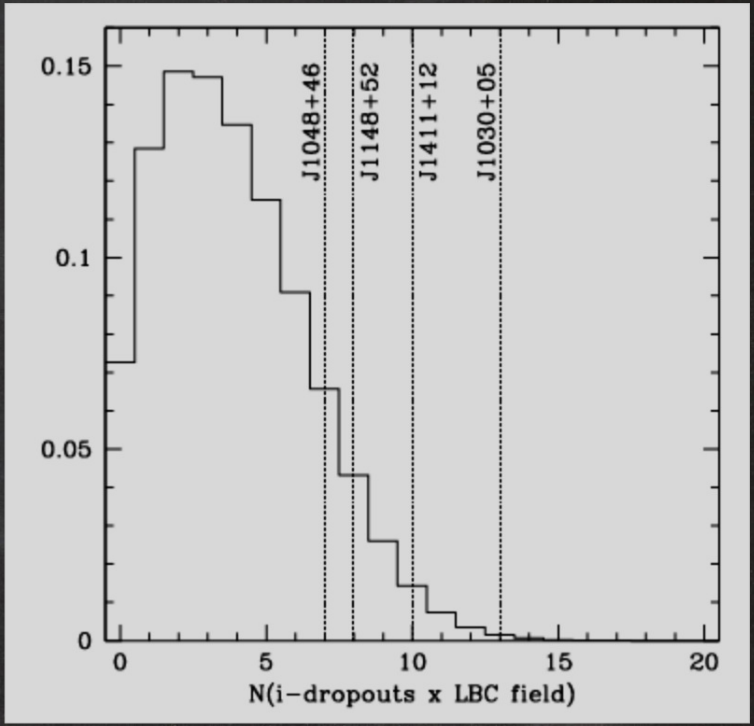




asymmetric distribution in most fields

z~6 QSO Overdensities $\delta=(\rho/\rho_{bf})-1$

Subaru X-ray Deep Survey (SXDS, Furusawa+08)
1) deepest than LBC cats.
2) area SXDS ~ 8xLBC area (1.13 vs 0.144 deg^2)
3) z-band selected catalogs with multiband phot publicly available



Field	ρ	ρ_d	δ	σ_δ
J1030	16	13	2.0	3.3
J1148	10	8	0.9	1.9
J1048	9	7	0.6	1.7
J1411	12	10	1.3	2.5

→ High-z QSOs reside in overdense environments at the 3.7 σ level

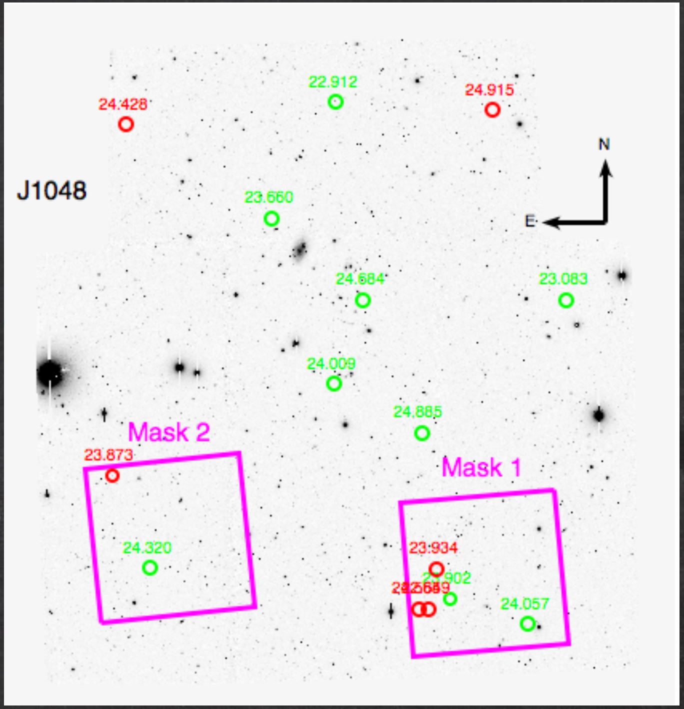
Morselli et al. 2014 submitted
r ,i ,z fits images and catalogs available at:
http://www.oabo.inaf.it/~LBTz6/

z~6 QSO Follow-up

Forthcoming datasets:

- MODS MOS in J1048: 2 masks, 6hr each approved (program 2013B_4)

4.5hr executed on mask1 + 3.5h on mask2 in Jan/Feb2014 run



- CFHT/WIRCAM J-band imaging to J_{AB}=24.2 (3hr on both J1030 and J1048)

Submitted proposals:

VLT/FORS2 on J1030, ~30hr Chandra on J1030 + J1148, Subaru/FOCAS on J1030 + J1048

Other science goals: faint QSO at z=4-5 (r-dropouts)

groups at z=0.7-1.1