A 5 sqdeg spectrograph at an 8 m telescope: HOW and WHY

(LBT/VLT)

Adriano Fontana
Roberto Ragazzoni

How: Hardware team:

Ragazzoni et al. (Padova Obs)
Overall design; optomechanics

Pedichini et al. (Rome Obs)
Focal plane detectors; Data acquisition

Zerbi et al. (Milano)
Dispersing elements

Why: Science cases:

Cosmology Amendola, Branchini, Guzzo, Radovich, Scaramella

Galaxy evolution Bettoni, Cimatti, Fasano, Fontana, Garilli, Giallongo, Grazian, Held, Maccagni, Pentericci, Poggianti, Rampazzo, Renzini, Zamorani

AGNs Cristiani, Fiore, Maiolino,

SN Benetti, Cappellaro, Turatto,

Stellar populations Bellazzini, Bono, Bragaglia, Bucciarelli, Piotto, Randich, Vallenari, Zaggia

Star forming regions Alcalà, Covino, Gandolfi, Leto, Pagano, Spezzi, Scandriato

In summary..

http://lbc.oa-roma.inaf.it/5sqdeg

- We are exploring a technical concept that will enable us to build a 3-5sqdeg spectrograph at an existing 8m telescope (switching M2!!!).
- Current baseline design for LBT, but optically doable at VLT
- Keywords: modular concept, "sparse" sampling (1000 obj/sqdeg)
- Phase A starting, feasibility assessed in ~1yr

- Long-standing science cases:

"Legacy" Surveys addressing fundamental questions

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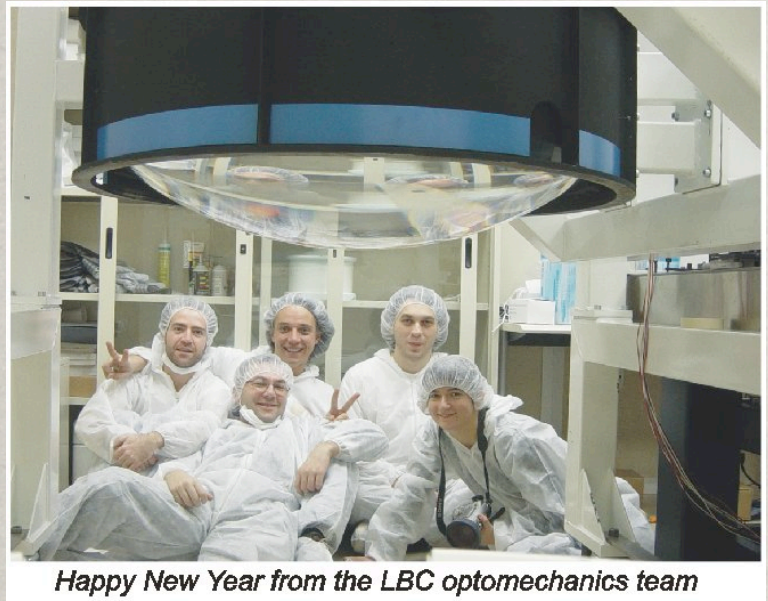
"normal" programs in all fields of astronomy:

- clear evidence for the need of a new generation of spectrographs for European astronomy

Going beyond the Prime Focus approach..

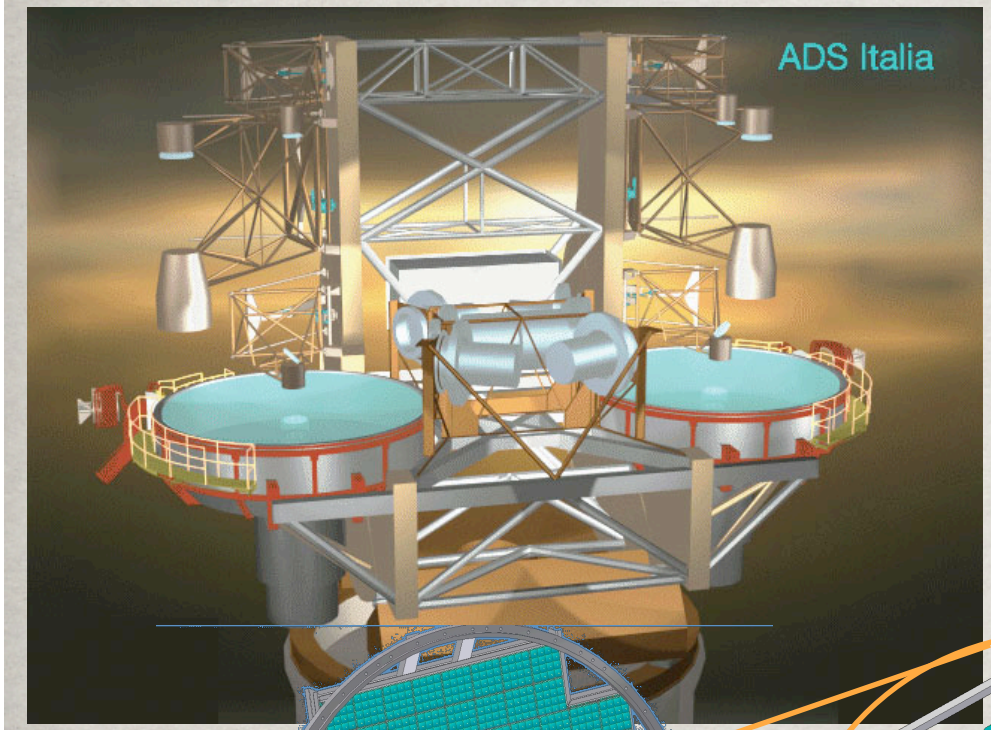
LBC@LBT: 2 PF cameras, each 1/6 sqdeg, lenses 0.9m diam.



Happy New Year from the LBC optomechanics team

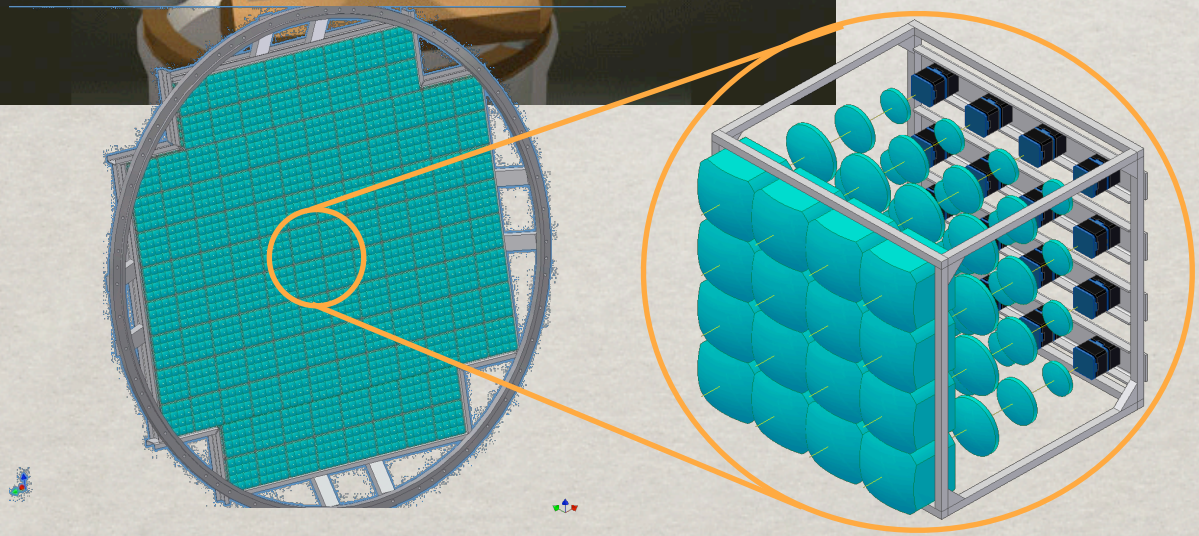
Would you really allow this person to do a WFoV camera for you???

"How"



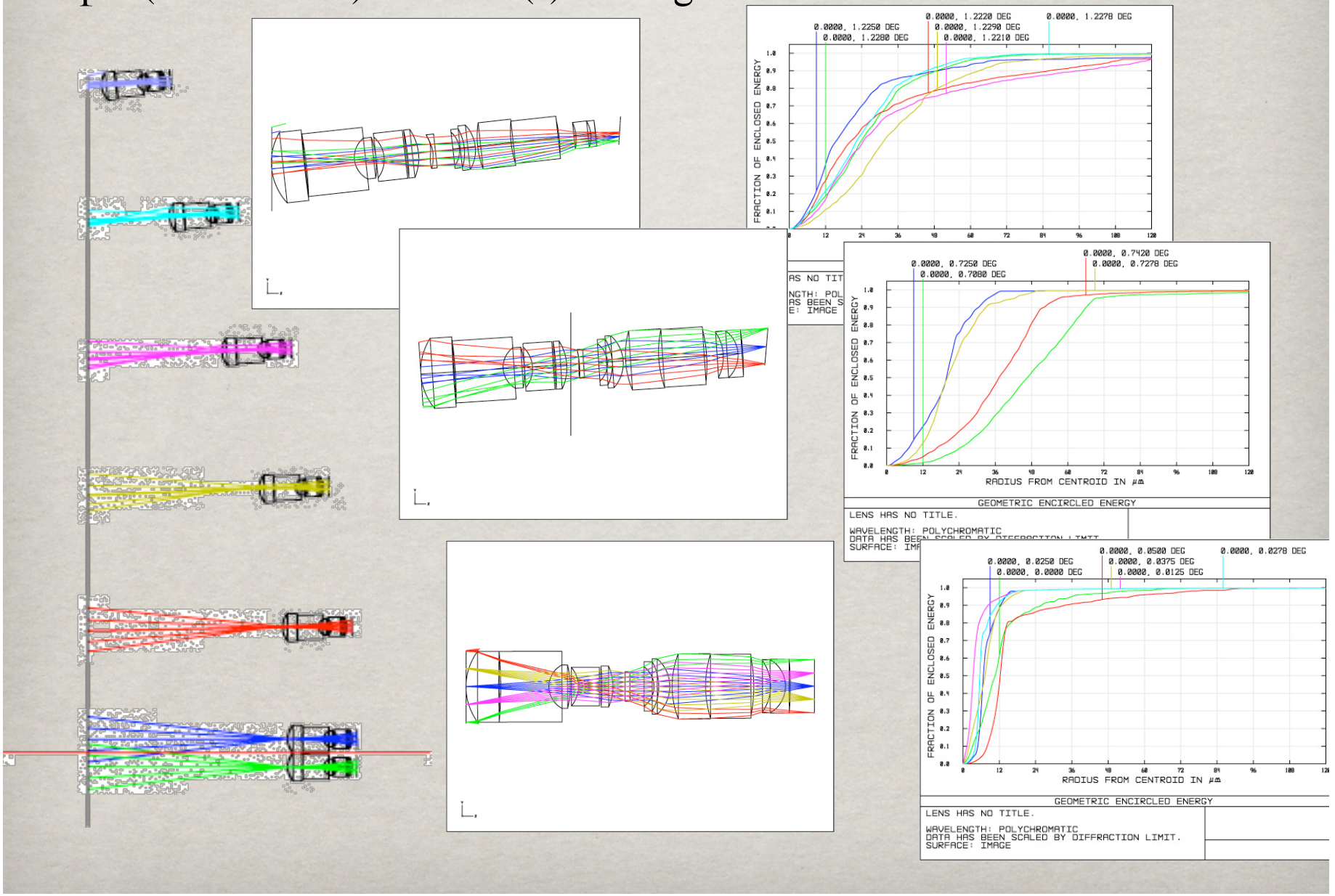
- Take an *existing* 8m telescope (currently: **LBT** or **VLT**) and change(!) the secondary -> wider FoV

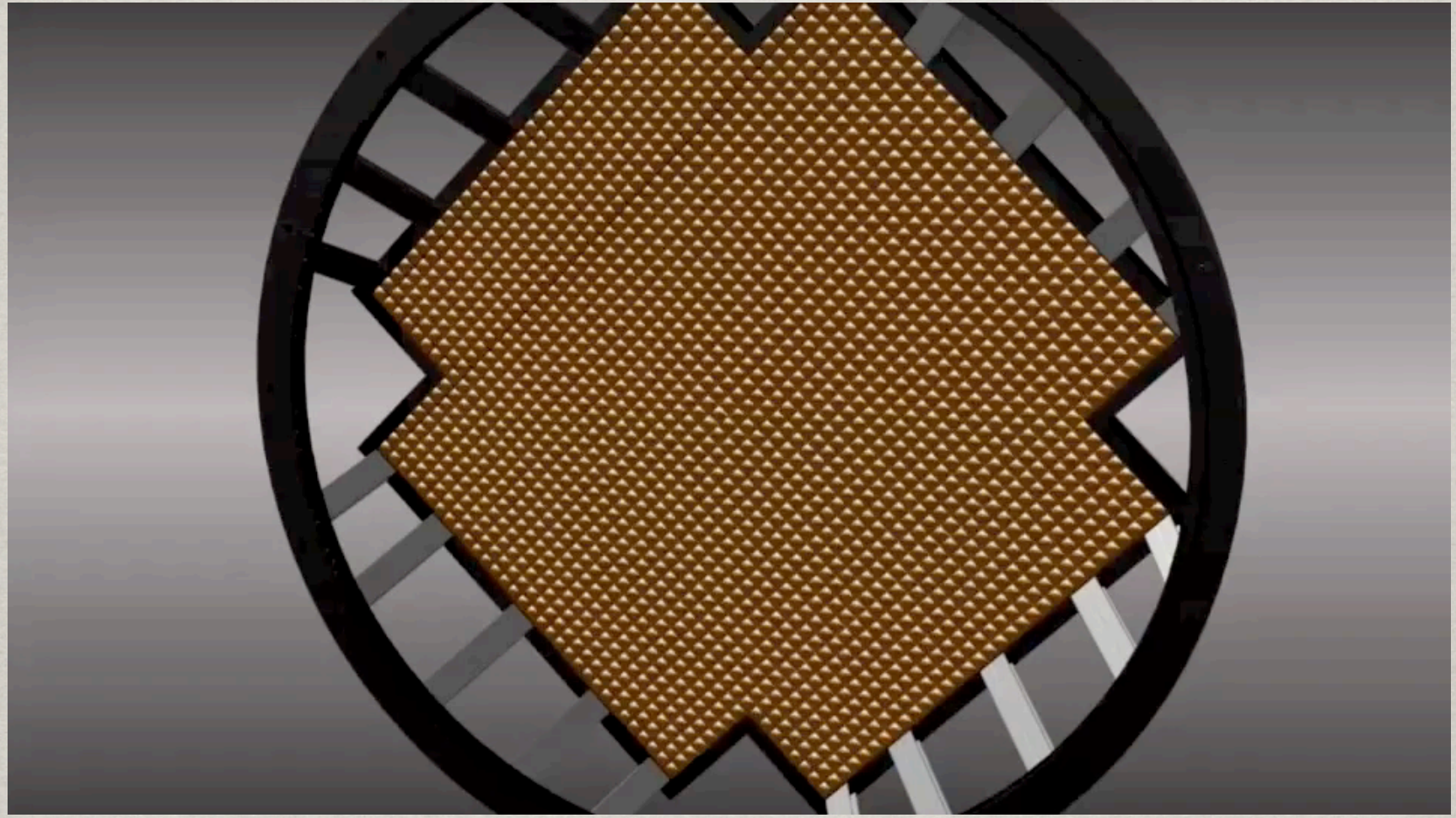
- Fill the Focal Plane with an array of small, packed spectrographs



A combination of modules

- All modules are identical, needed only to focus an opto(mechanical) element(s) during installation





Option #1 (baseline??) **slit-fed spectrographs with imaging capabilities**		Option #2: **fiber-fed spectrographs**
5	slit/camera	*5*
1000	objects/sqdeg	*1000*
2-3 filters	Imaging	NO
R=300-600 + R=11000 (CaII)	Resolution	*R=300-600 + R=5000-12000*
0.4-0.8 μm	Range	*0.4-0.8 μm*

Starting: Phase A study to assess most critical issues:

- Full opto-mechanical design (Optical chain, dispersing elements)
- Prototype of optical corrector
- Prototype of slit mechanics
- Lab testing of CMOS-based detectors
- Evaluate extension to YJ (Alvio's prompting..)
- ESTIMATE OF TOTAL COST (critical: evaluation of savings due to mass-production)

"Why ?"

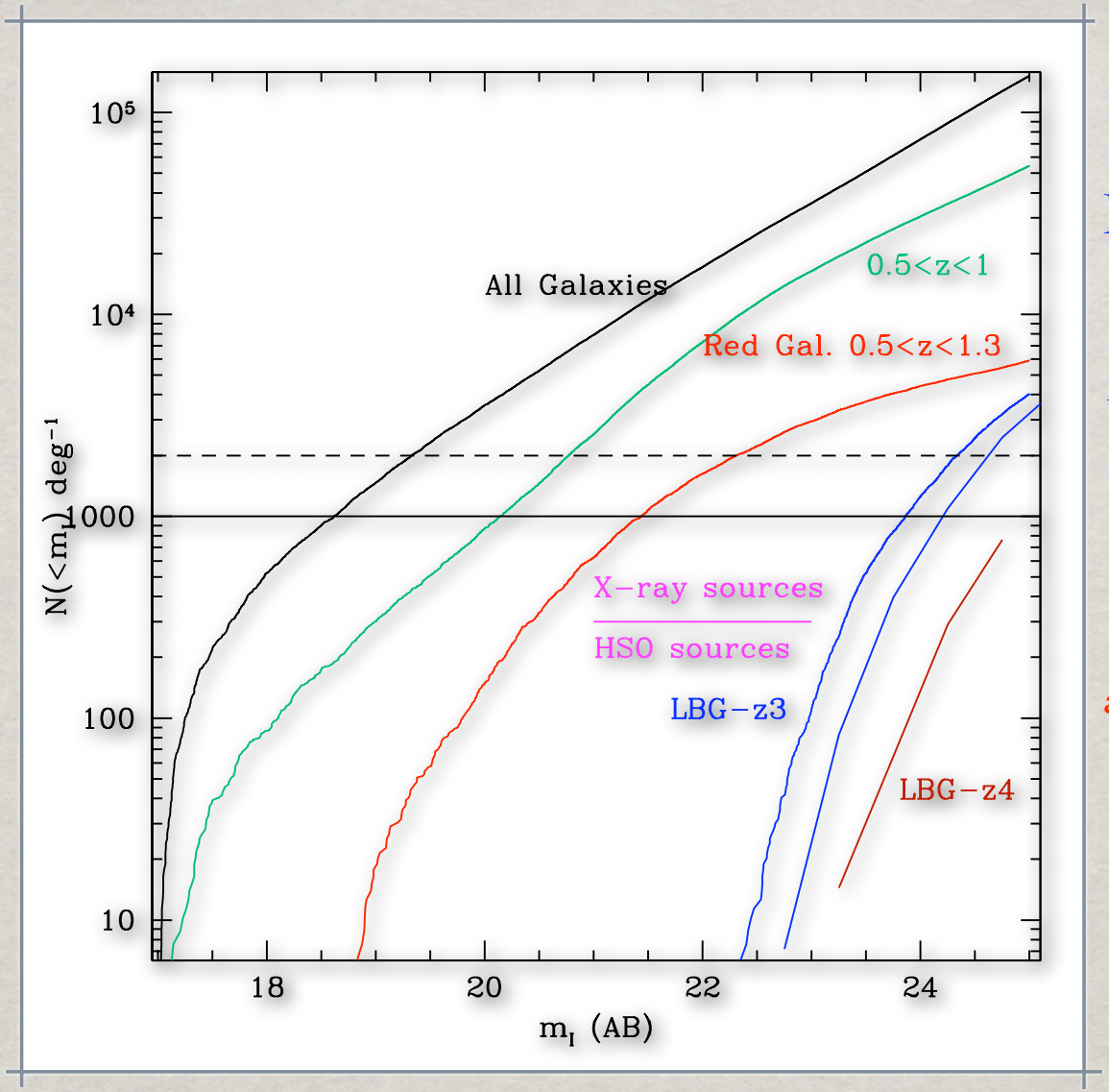
5sqdeg @ LBT vs VIMOS @ VLT

	VIMOS-LR	5 sq deg
# cameras	4	1000
# slits	500	5000
FOV	224 arcmin^2	18,000 arcmin^2
slit density	2.25 / arcmin^2	0.3 arcmin^2

Dense targets (#/arcmin^2 > 2) On areas <<5sqdeg: not competitive

Dense targets (#/arcmin^2 > 2) On areas >= 5-sq-deg = VIMOS x 10

"Sparse" targets (#/arcmin^2 =0.3) 5-sq-deg = VIMOS x 100 !!



Dense targets (#/arcmin^2 > 2) 5-sq-deg = VIMOS x 10

"Sparse" targets (#/arcmin^2 =0.3) 5-sq-deg = VIMOS x 100 !!

"Legacy" surveys

- All sky surveys for Dark Energy
- Radial velocities and abundances for faint stars in our Galaxy (GAIA)
- Follow-up of LSST, PANSTARRS etc
- Follow-up of space missions: HSO, E-ROSITA; Simbol-X, EUCLID

"Targetted" programs

- High z QSOs
- The brith of massive structures at z>3
- Weak lensing on VST and VISTA surveys
- A Galaxy+Environment survey at z>0.5
- Nearby Galaxy Clusters
- Systematic follow-up of SN to probe evolution of SNI
- Star-forming regions in our Galaxy

Designing cosmological surveys @LBT:

a) OptA (conservative): 4 years, 50 nights/year, 8hr/night
b) OptB (aggressive): 6 years, 100 nights/year, 8hr/night

Red Galaxies @z=1
I<22 (AB)
0.5hr integration
efficiency 50%

	galaxies	sqdeg
OptA	1.1E+07	4.7E+03
OptB	3.4E+07	1.4E+04

Red-optimized

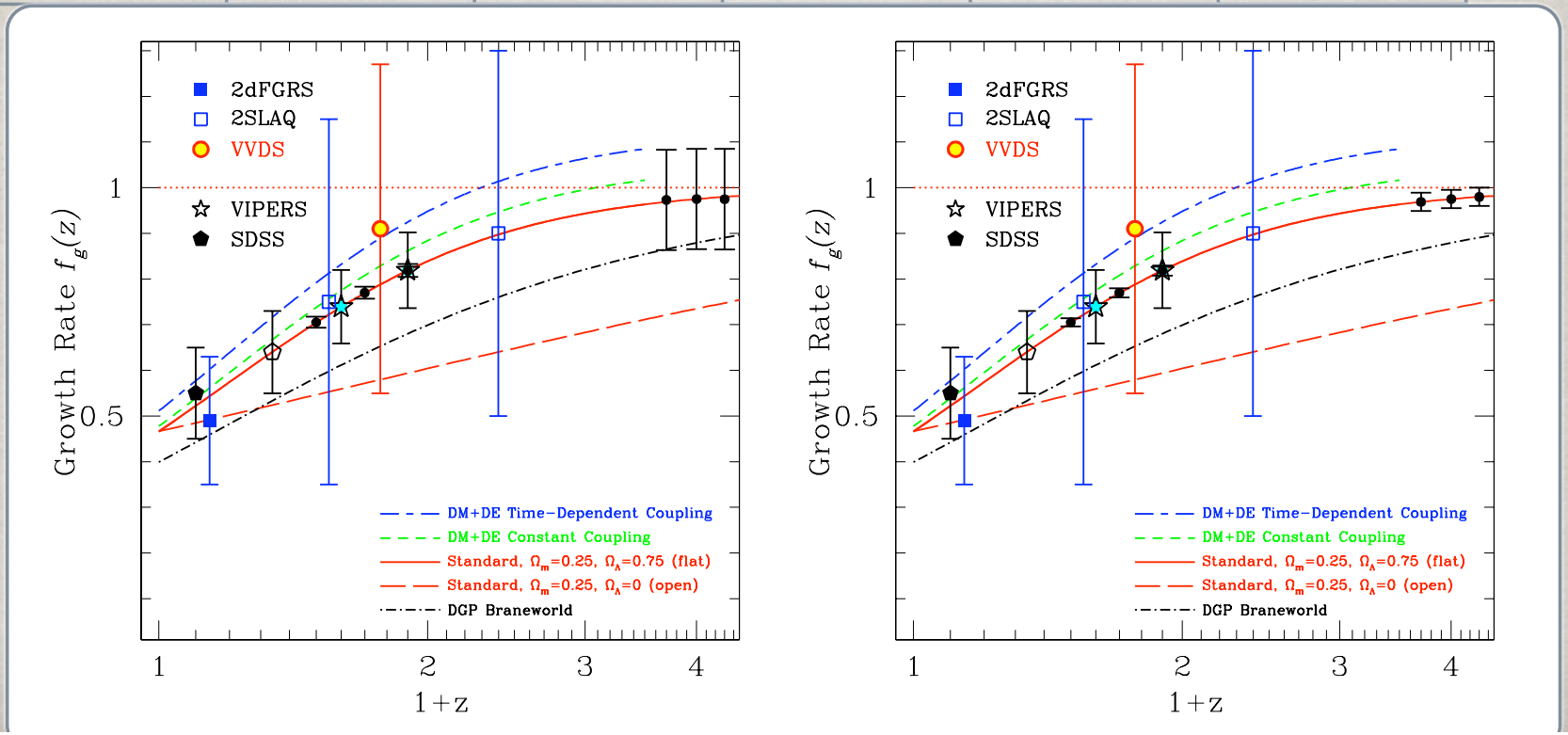
LBG@z=3
I<24 (AB)
4hr integration
effciency 60%

	galaxies	sqdeg
OptA	1,40E+06	1,40E+03
OptB	4,20E+06	4,20E+03

Blue-optimized

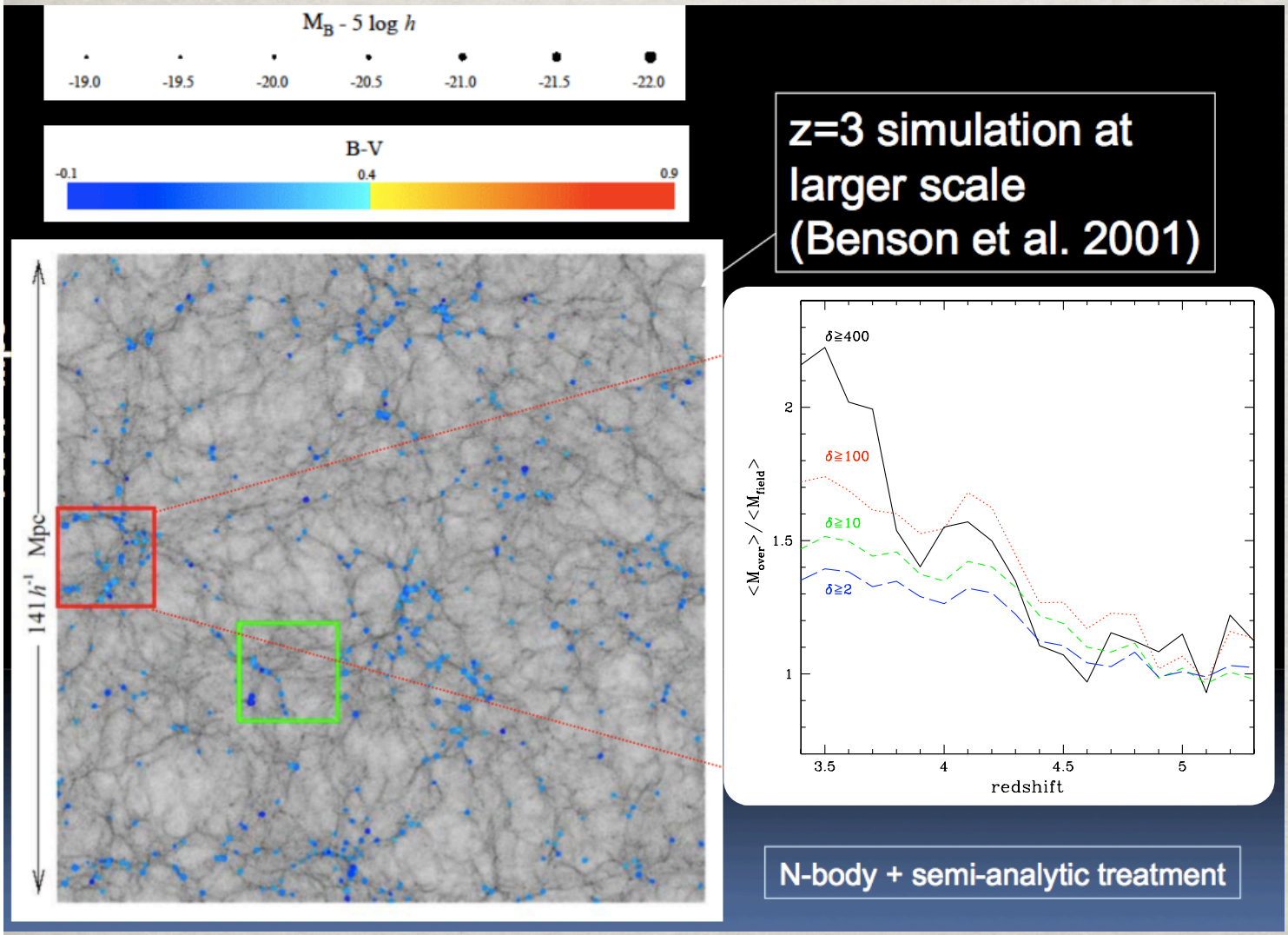
Growth Rate Function @ LBT

	Guzzo et al. 2007 VVDS	Guzzo et al. 2008 z=0.8 VIPERS	LBT-5sqdeg z=1	Shanks et al. 2008 z=3 VIMOS LP	LBT-5sqdeg z=3
# of galaxies	6,00E+03	1,00E+05	1÷3 E+07	25,000	1.4÷4.2 E+06
area	4 deg^2	24 deg^2	4,700÷14,000	25 deg^2	1,400÷4.200
Exposure T...		423hr	1600÷4800	650hr	1600÷4800
Exp. duration		3-4yrs	4-5yr	3-4 yr	4-5yr
% error	40%	10%	3÷1%	10%	5÷2.5%



The birth of clusters in the z>3 Universe

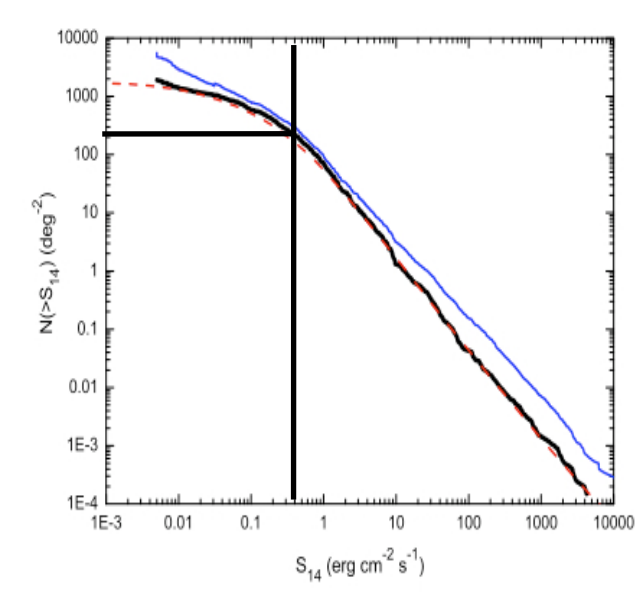
- needs spectroscopic surveys ~100 sqdeg^2



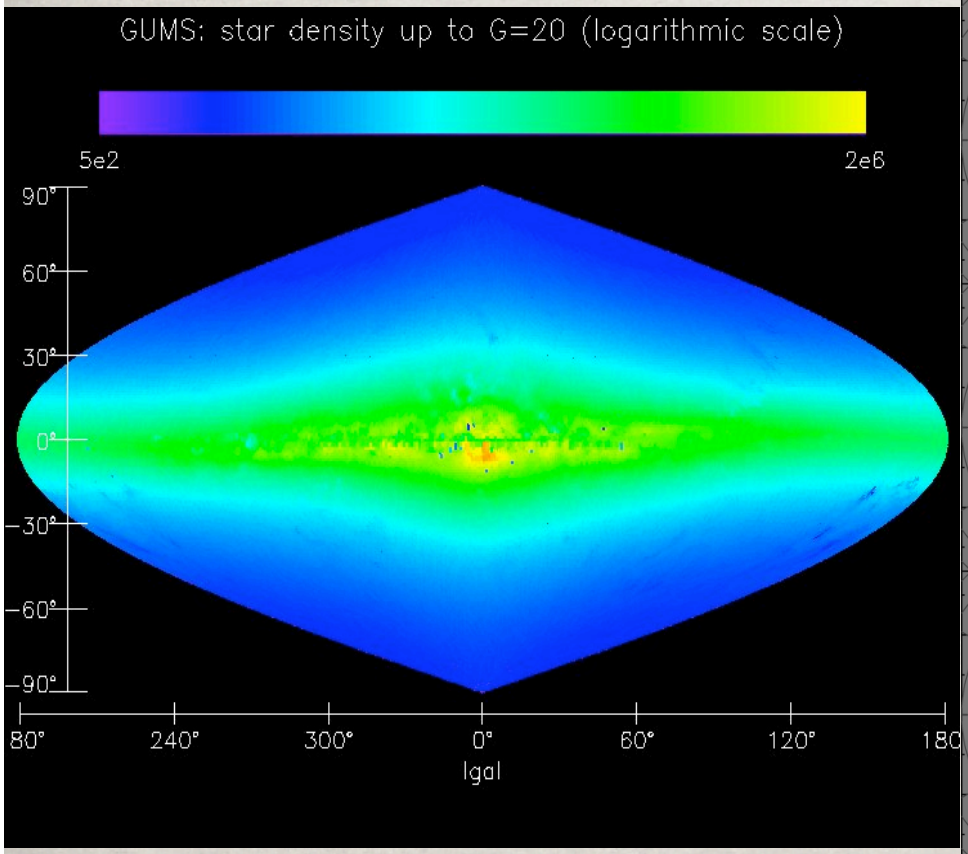
BH / Galaxy co-evolution;
Obscured AGN

- IR surveys: largest imaging surveys with HSO: 550 deg^2 45-60 mJy. Expected density of sources 300-400 /deg^2

- X-ray: F(0.5-2keV)=3×10-15 ~200-300 X-ray sources/deg2 (e.g. E-ROSITA..)

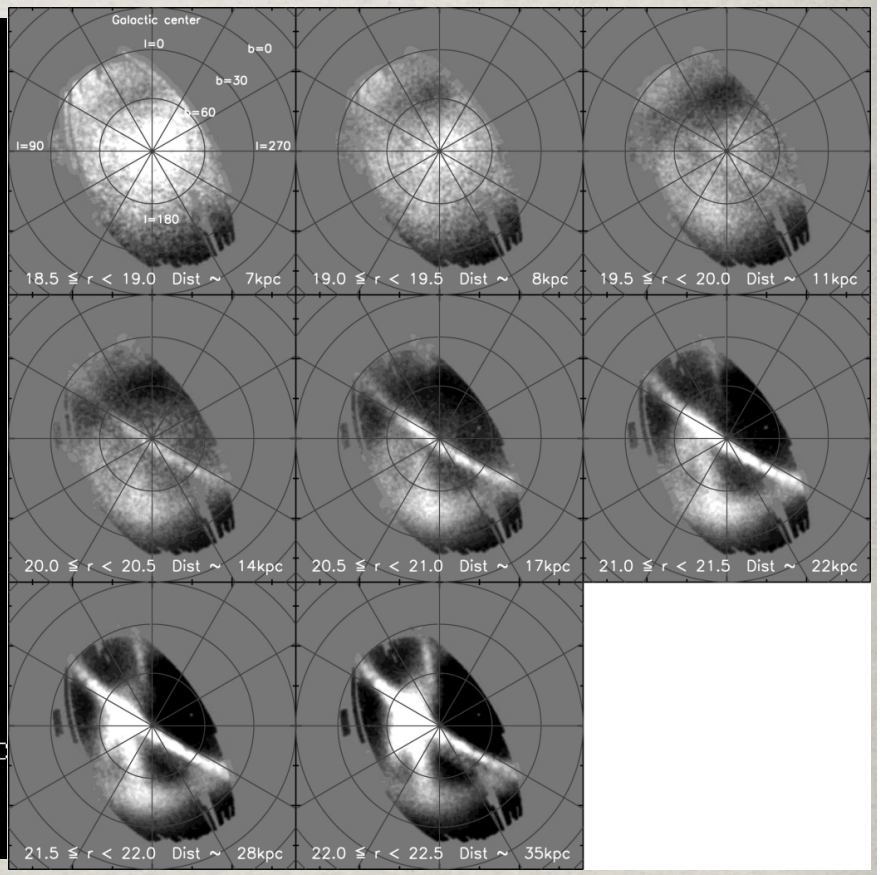


Gaia Follow-up
Radial velocities + metallicity of halo stars
Extending GAIA spectroscopy on CaII to V=20-21



Stellar density at G=20 in the Galaxy

Courtesy Y. Isasi-Parache



Tidal streams in the halo:residuals to the spheroid model

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Criticisms, suggestions and collaborations highly welcome..