Large Binocular Camera
@ LBT since 2004, what's next...

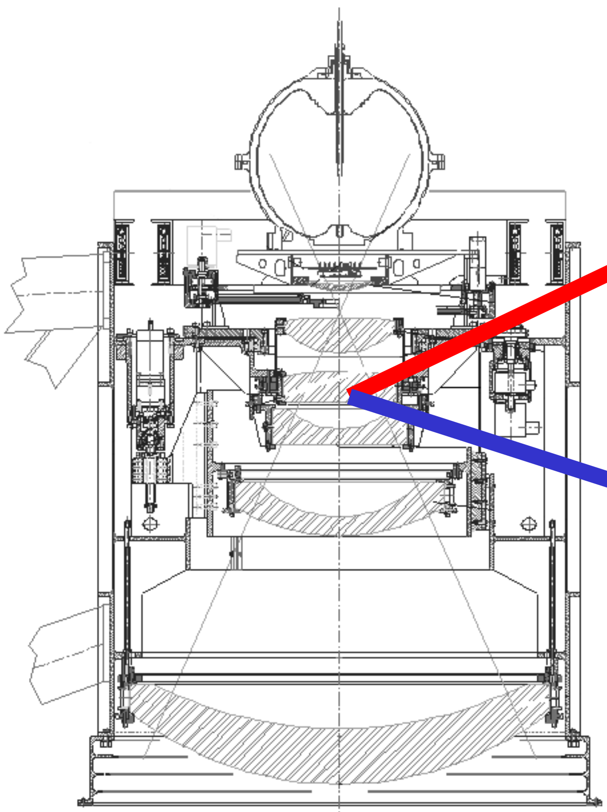
F. Pedichini, E. Cappellaro, E.Giallongo, and the italian LBT science team

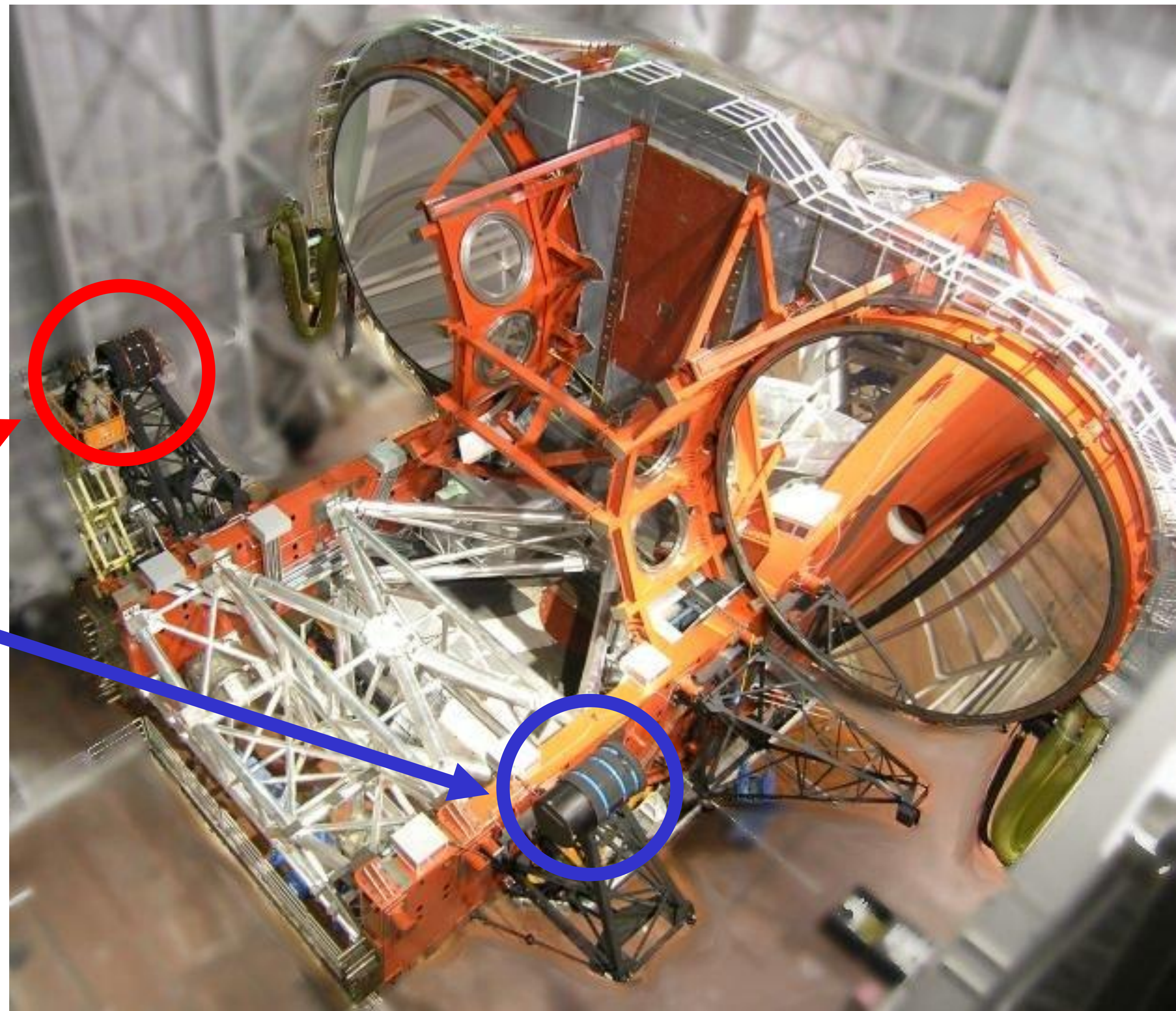
LBT users meeting Tucson– 22-25 March 2014

LBC: ***binocular optmized*** *prime foci* *BLUE* & *RED*

Wide Field - Fast & Deep - Wavelenght coverage U → Z

field of view ~ 23' x 23‘
2 x 37.7 Megapixel
sampling 0.23 arcsec/px





LBC story……

2001 Hardware starts with CCD sensor procurement

2004 Blu channel delivery at LBT

2004 Blu channel and LBT first light

2005 Blu channel commissioning starts

2006 Red channel delivery at LBT

2006 Blu channel starts the SDT

2007 Red channel first light

2007 “Binocular” first light

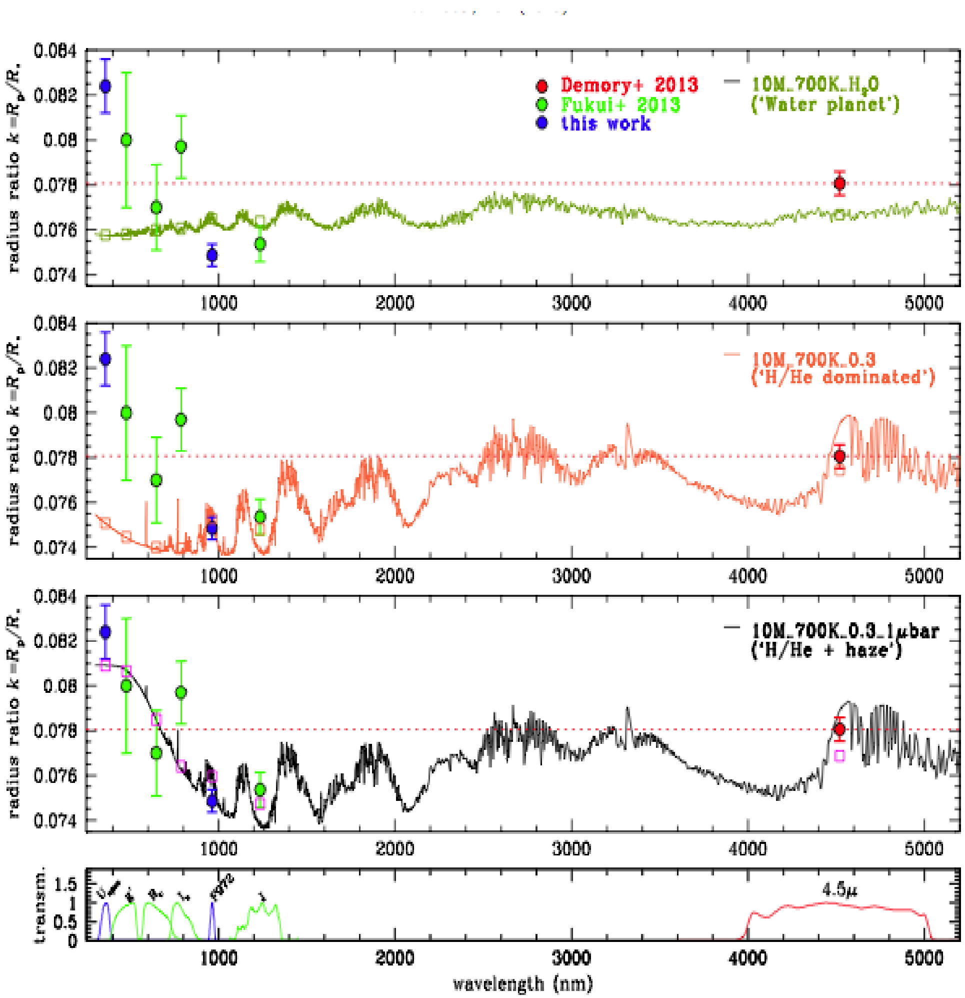
2008 “Binocular SDT”

2014 Now…!

What did we learn from the science with LBC ?

Exoplanetary Atmospheres

Nascimbeni et al. 2013 A&A 559,32



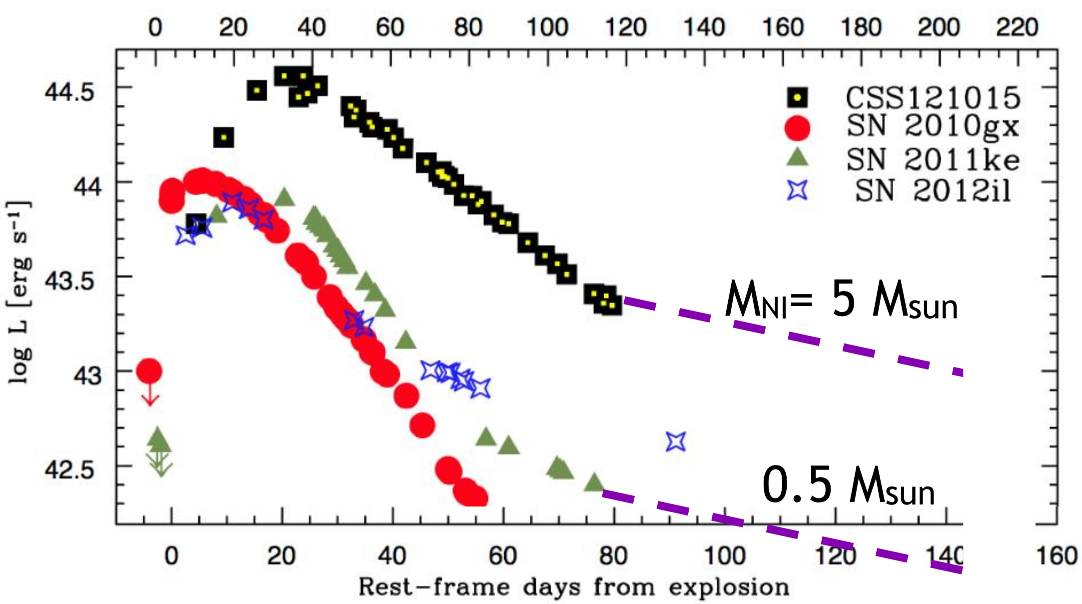
Accurate multi-band photometry of exoplanet transits can bu used to detect atoms, molecules and features like clouds and haze

Best targets are very late-type stars (K7V-M55). Simultaneous multi-band observations are used to correct for stellar activity effects.

The flux of these cool objects in the ***U-band***, where Rayleigh scattering is observable, is very faint requiring large telescopes, large field for comparison stars and **high blue Q.E. efficiency to achieve high-precision photometry (σ < 0.001 mag).**

Superluminous SN

Benetti et al 2014 MNRAS in press



Light curves of three Superluminous Sne. The dashed lines show the predicted luminosity evolution if the light curve is powered by radioactive Ni, for two different masses.

Late time photometric evolution constraints the source of energy (radioactive Ni, magnetar, CSM-ejecta interaction ??) hence the progenitor scenario and explosion mechanism

Host galaxy SED to constraint SF history and metallicity of the progenitor parent population

typical redshift 0.1-0.3

↓

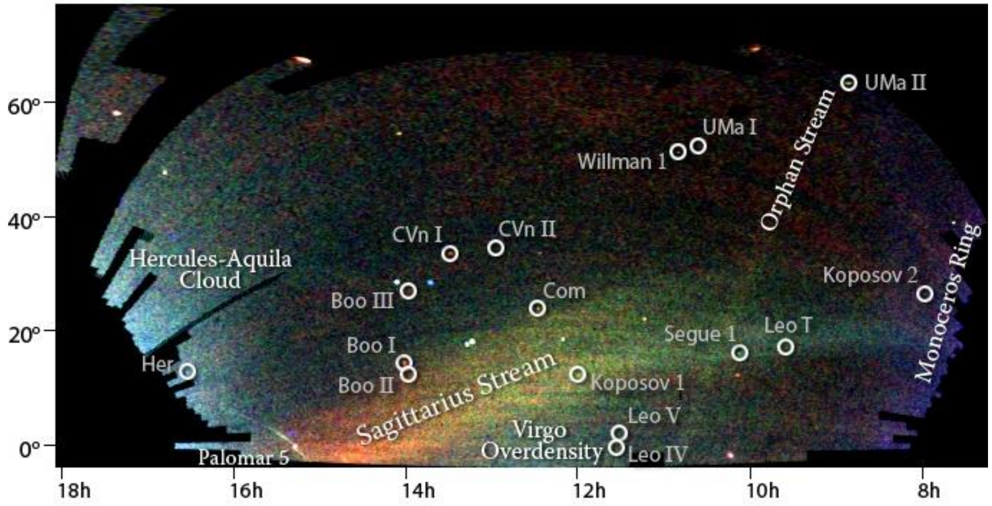
SN optical mag at late phases 23-27

Typically very faint host galaxies

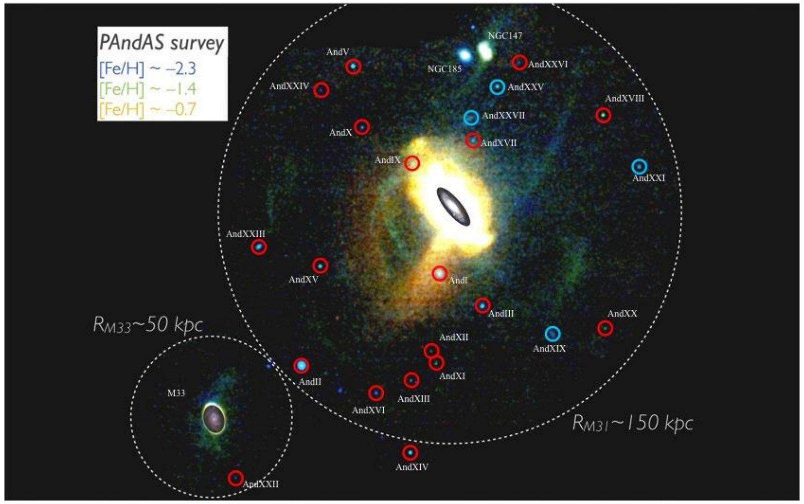
AbsMag ~ -15/ -17 (mag 22-26)

MW and M31 merger histories

Martin et al. 2013, ApJ 776, 80; Belokurov 2013, NewAR 57, 100;
Cusano et al., 2013, ApJ 779, 7; Garofalo et al. 2014, ApJ



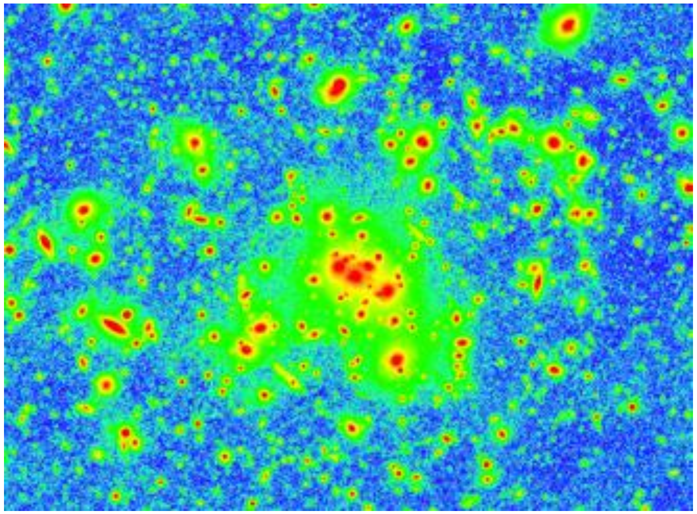
Very faint dwarf galaxies in the outskirts and halos of the Milky Way (MW) and M31, or flying around in the Local Group (LG) along with low surface brightness structures (star clouds, tidal streams) are the relics of the build-up of the MW and M31 via hierarchical merging. These are clues on theories of galaxy formation and on the shape and mass of the dark matter halos.



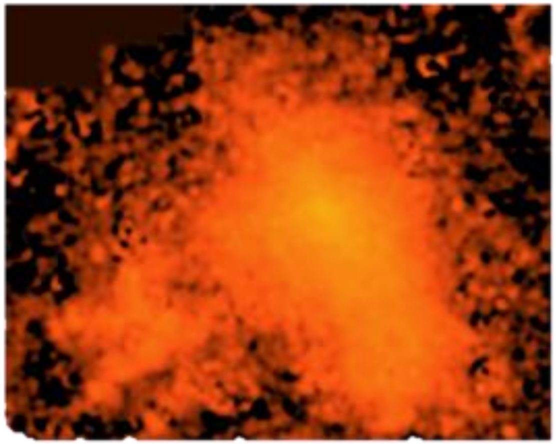
- **Multi-color wide field deep survey** of selected regions of the M31 halo, to study on-going galaxy mergers (using M31 satellites) as well as past tidal disruption events (using stellar streams)
- Prompt follow up of new dwarf galaxies and tidal streams in the surrounding of dwarfs and/or globular clusters

Extragalactic Topics

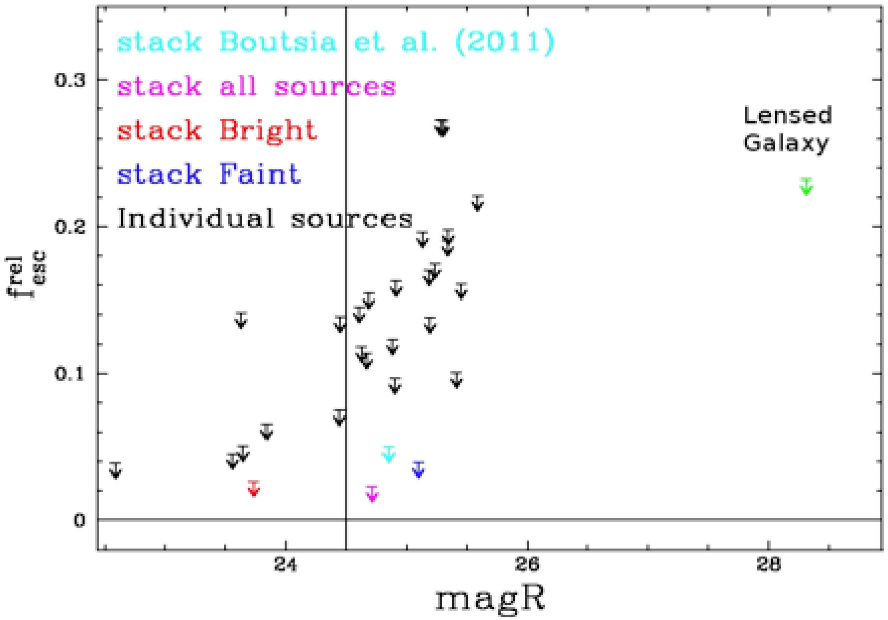
(Giallongo and Grazian talks)



Giallongo et al. 2014 ApJ, 781, 24



CL0024+17 (z=0.4). Top: cluster core; the FoV is 3x2.4 arcmin^2. Bottom: ICL after removing the galaxy contribution (LBC rGunn).



Grazian et al. in preparation; Vanzella et al. 2010; Boutsia et al. 2011

With high sensitivity (>28 mag/arcsec^2) from UV to the Z-band we can reach clusters up to at redshifts z~1

it is time for upgrade…

Improving the reliability in collaboration with LBTO:

2013 New mechanics for filter wheels

2014 New CMU computer (multi core Linux)

2014 Improved Active Optics closed loop control

2014-15 New shutters

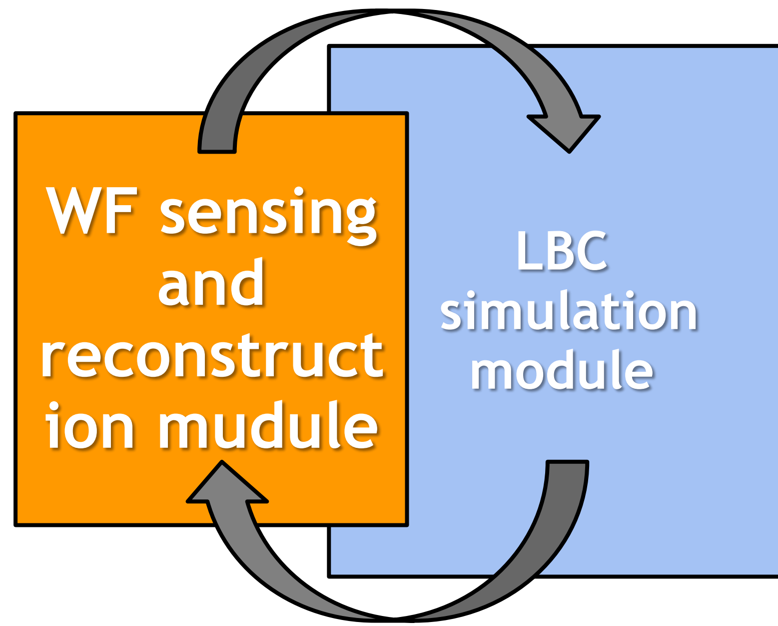
2014-15 New CCD controllers (ETH-Web interface)

2014-15 New control architecture layout

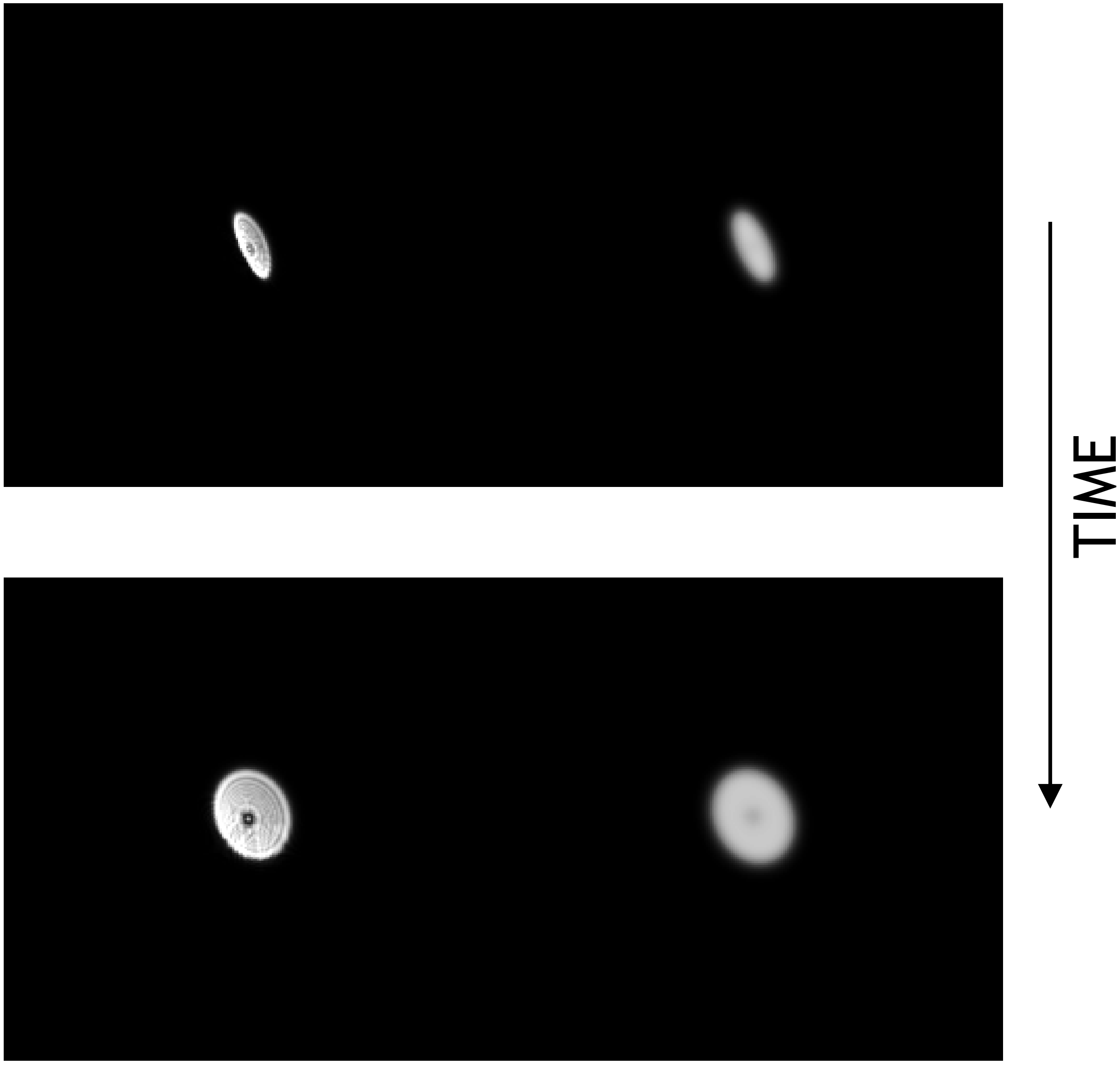
M1 control software upgrade

An new LBC simulation code was developed in collaboration between INAF OAPD and INAF OAR to simulate the LBT M1 correction loop scheme with the aim to improve :

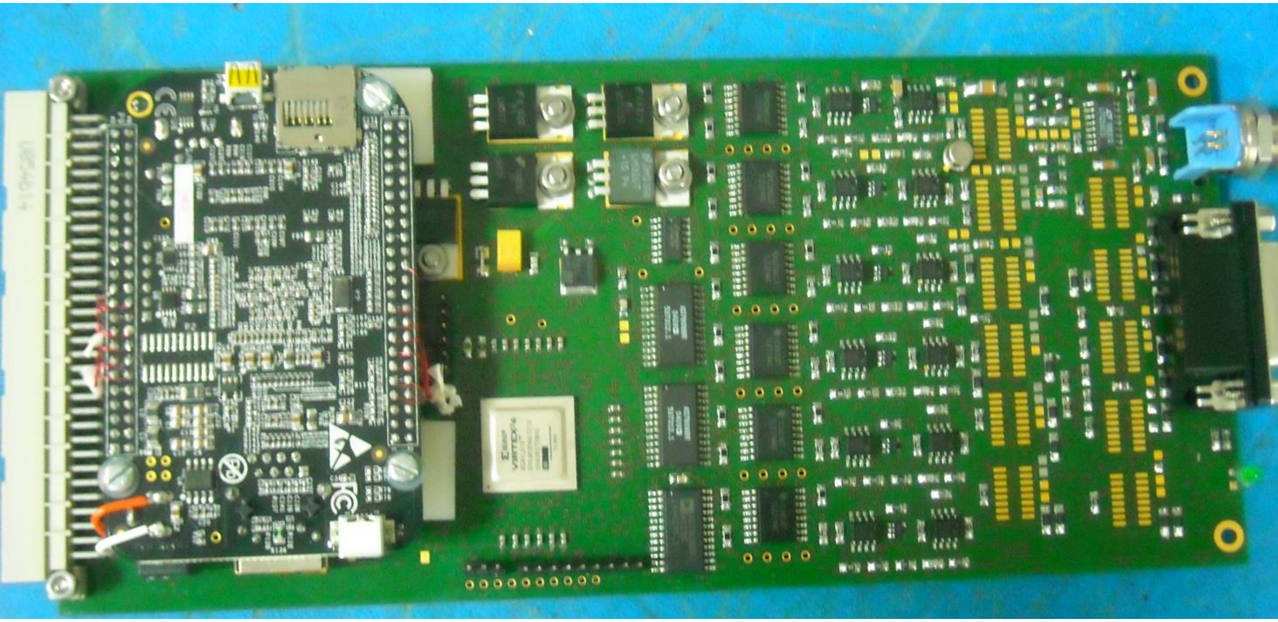
1. Complete system **information log** for offline debugging
2. New **bootstrapping** procedure
3. Algorithm parameters **optimization**
4. Algorithm **refinement**



This simulation code allows us to easily test new integrated solutions and software upgrades aimed at improving the system performances.



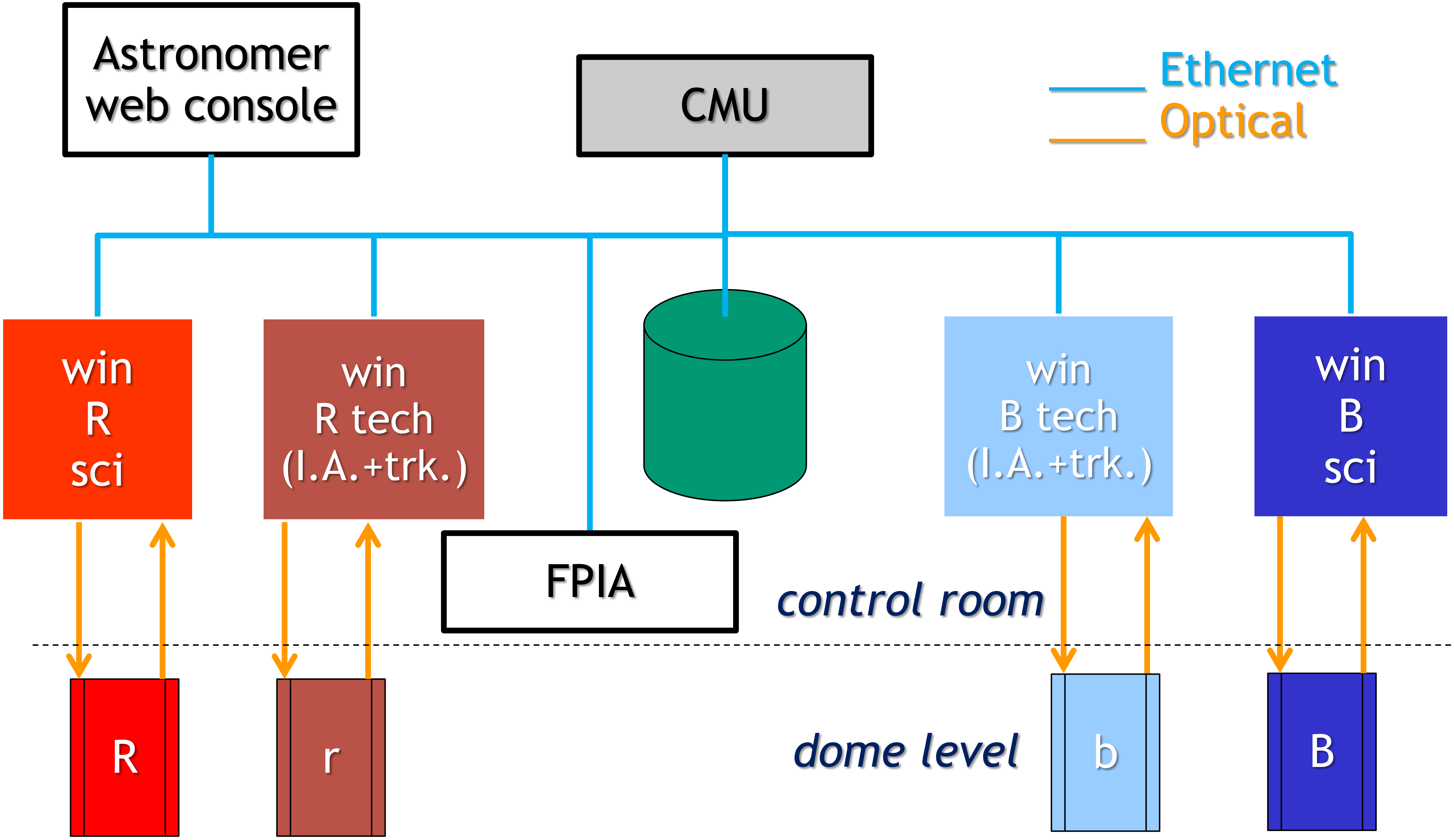
The new CCD controller with Ethernet interface



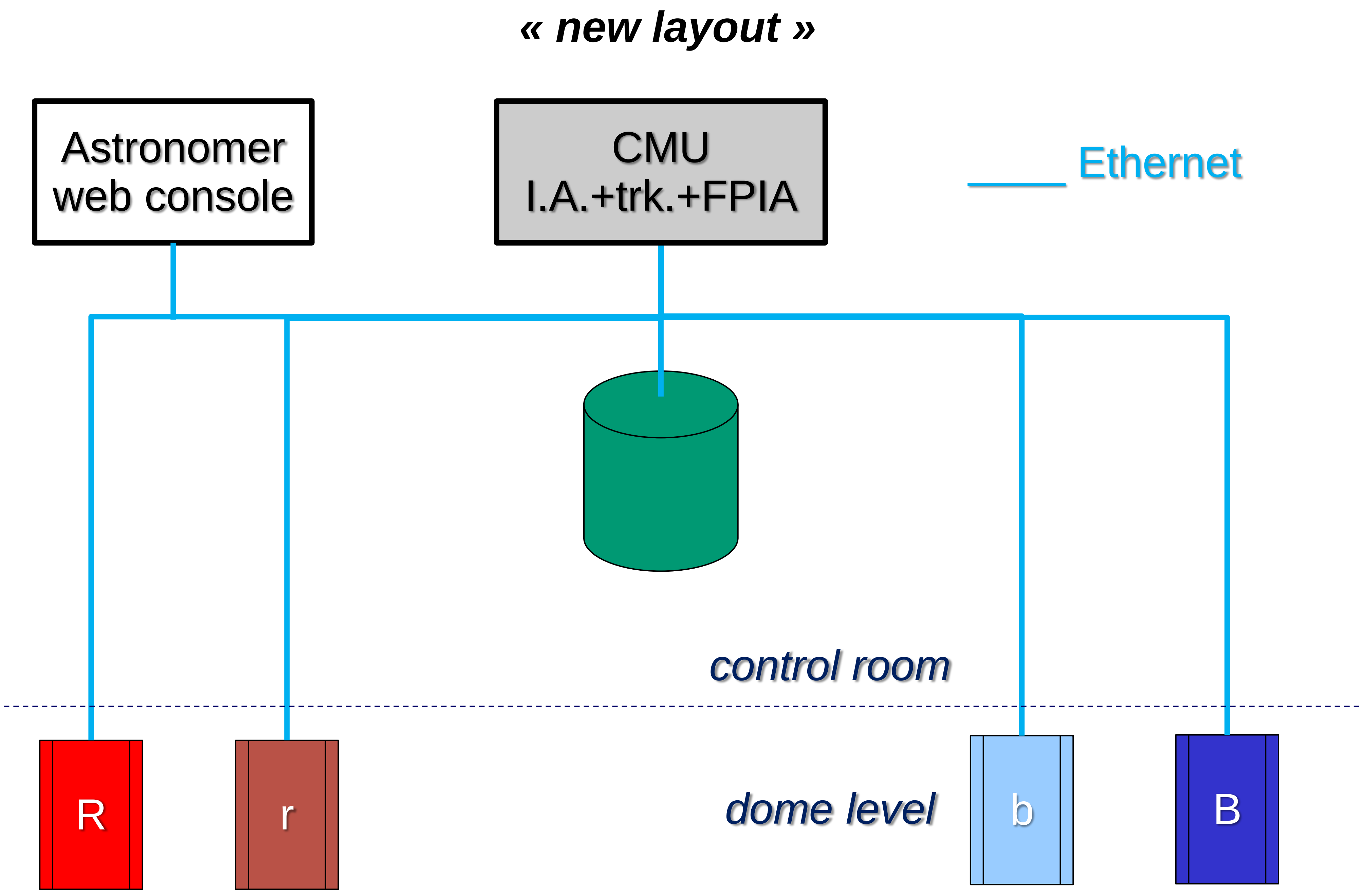
now under tests in Italy
final version ready on June 2014

LBC control architecture

« current layout »



LBC control architecture

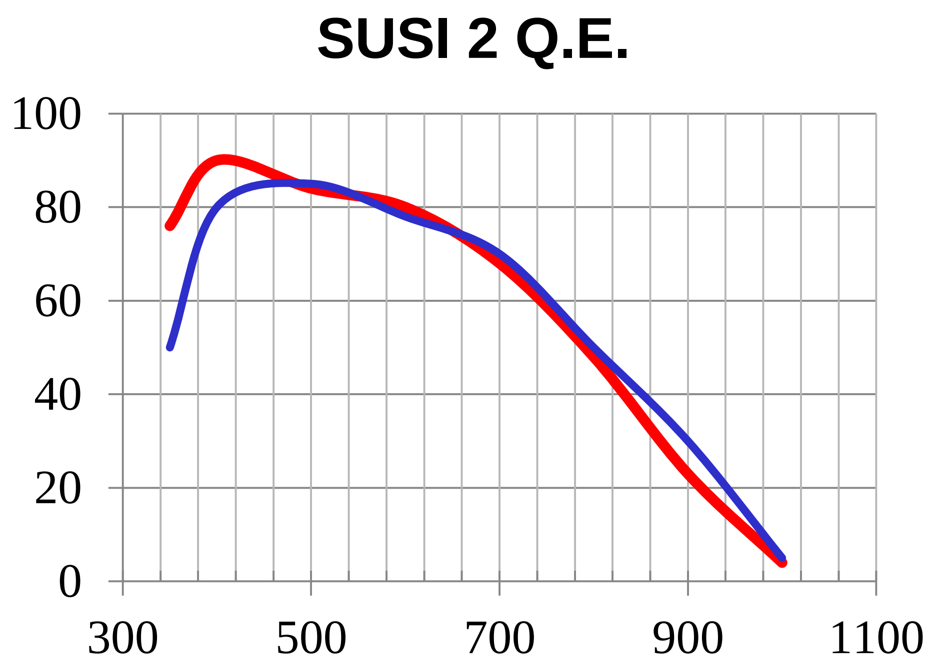


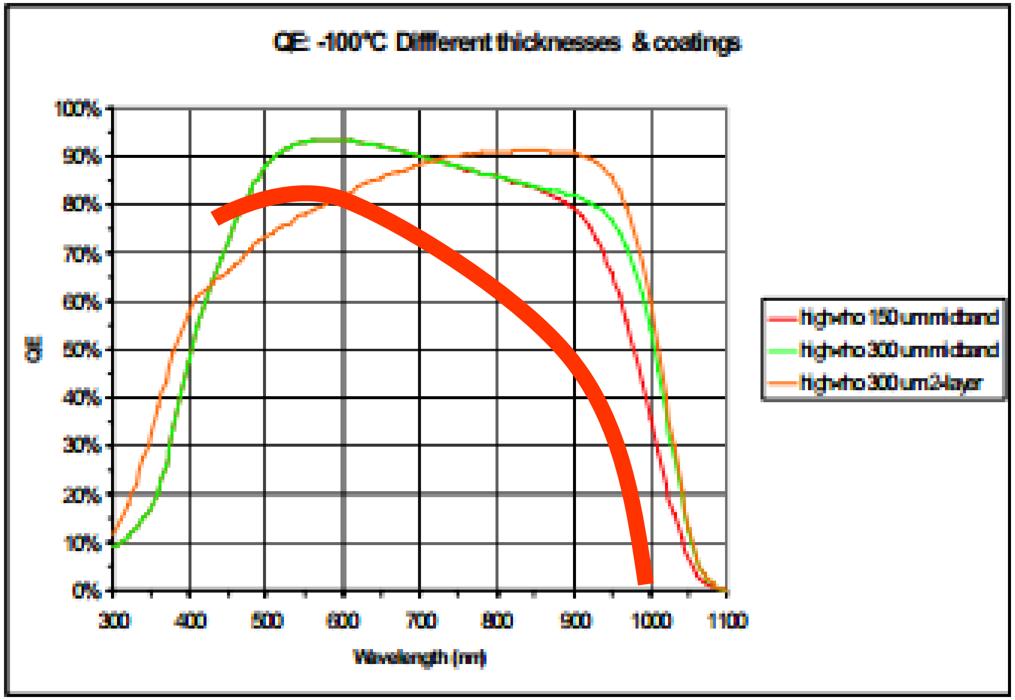
it is time for upgrade…

Improving the science:

2015-16 ***Ehnanced U÷V*** *detector for Blue channel*

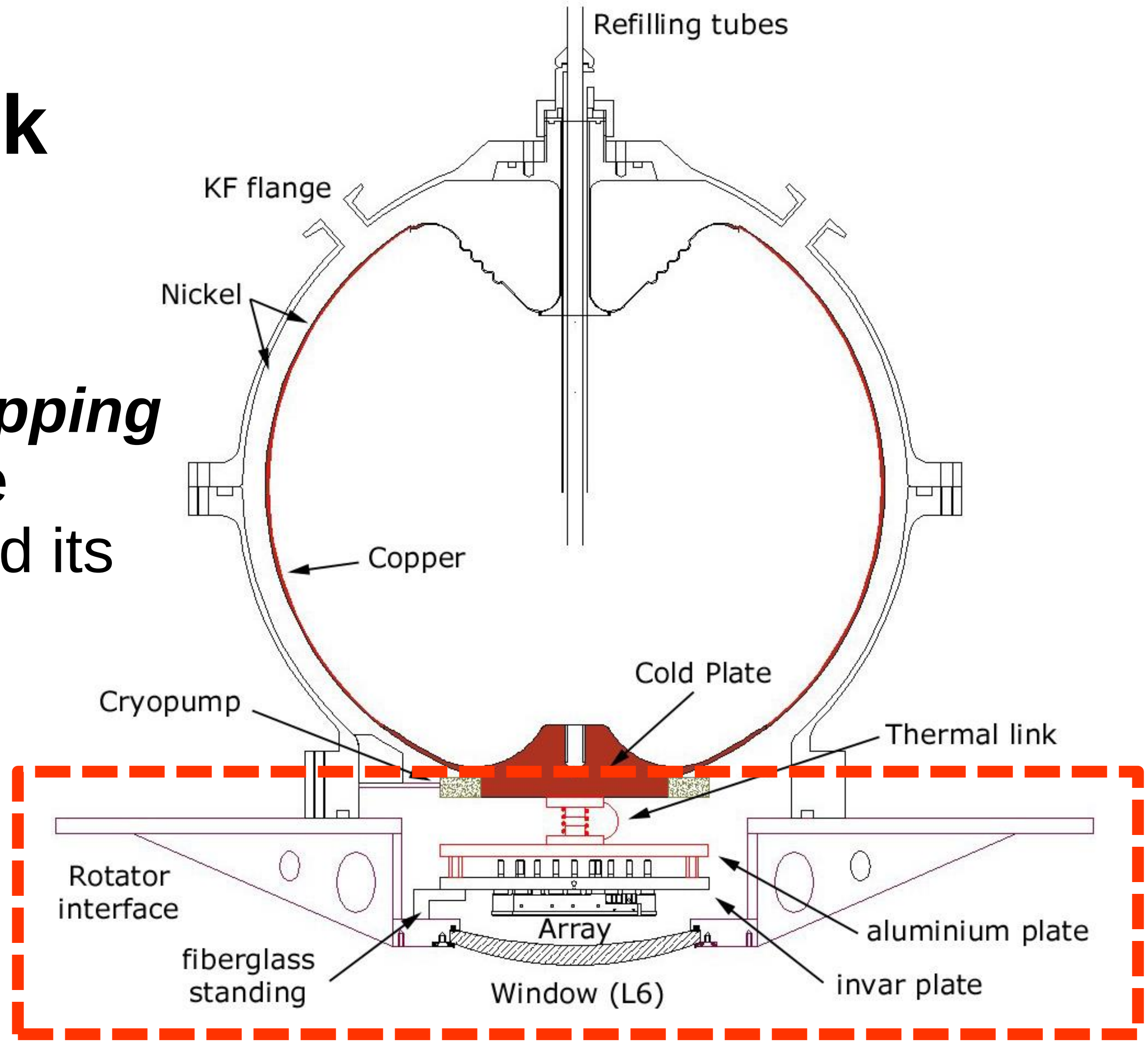
2015-16 ***Ehnanced R÷Z*** *detector for Red channel*





CCD231-C6 6k x 6k
15 µm pixel

Upgrade performed ***without stopping LBC science operation*** with the remaking of the camera head and its substitutionaccomplished during summer stop or full moon



Conclusion:

LBC is still an actual instrument providing good science, science that can improve at a reasonable cost :

- ✓ **BLUE channel** **250÷300 k€ + 1FTE**
- ✓ **RED channel** **250÷300 k€ + 1FTE**

deliverable on 2015 -16

The italian LBC upgrade science TEAM:

Bellazzini, M., Cantiello M., Cappellaro E., Clementini G., Cusano F., Federici L., Fusi Pecci F., Giallongo E., Gilli R., Grazian A., Marconi M., Musella I., Nascimbeni V., Pagano I., Piotto G., Ripepi V., Vanzella E.

thanks INAF and LBTO people for keep up and running LBC since

10 years…