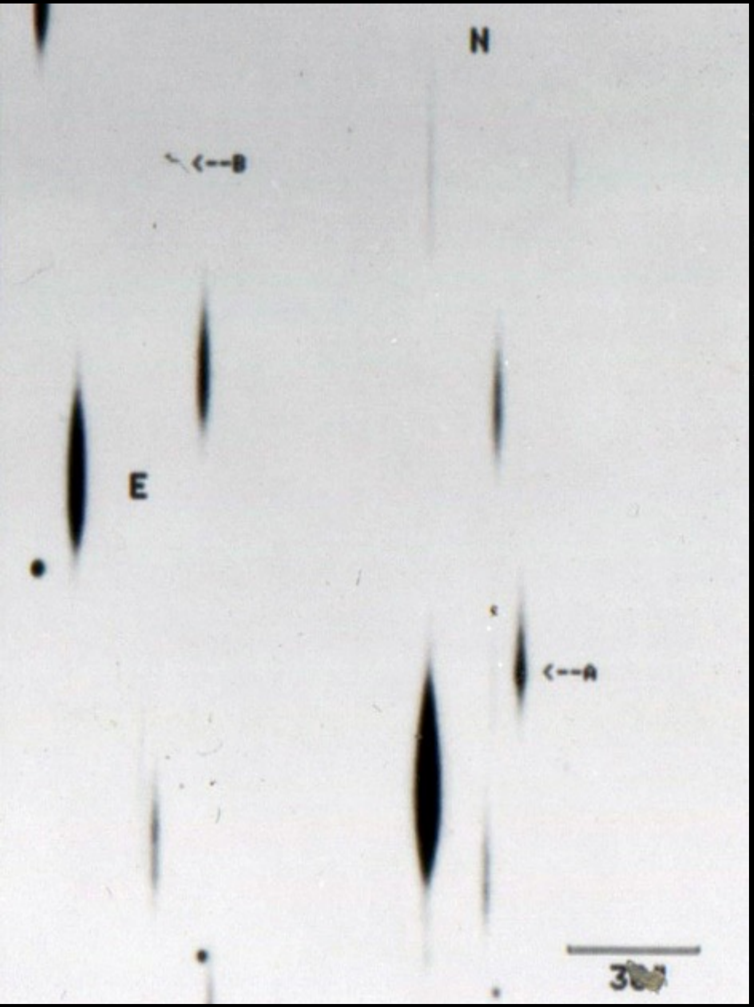
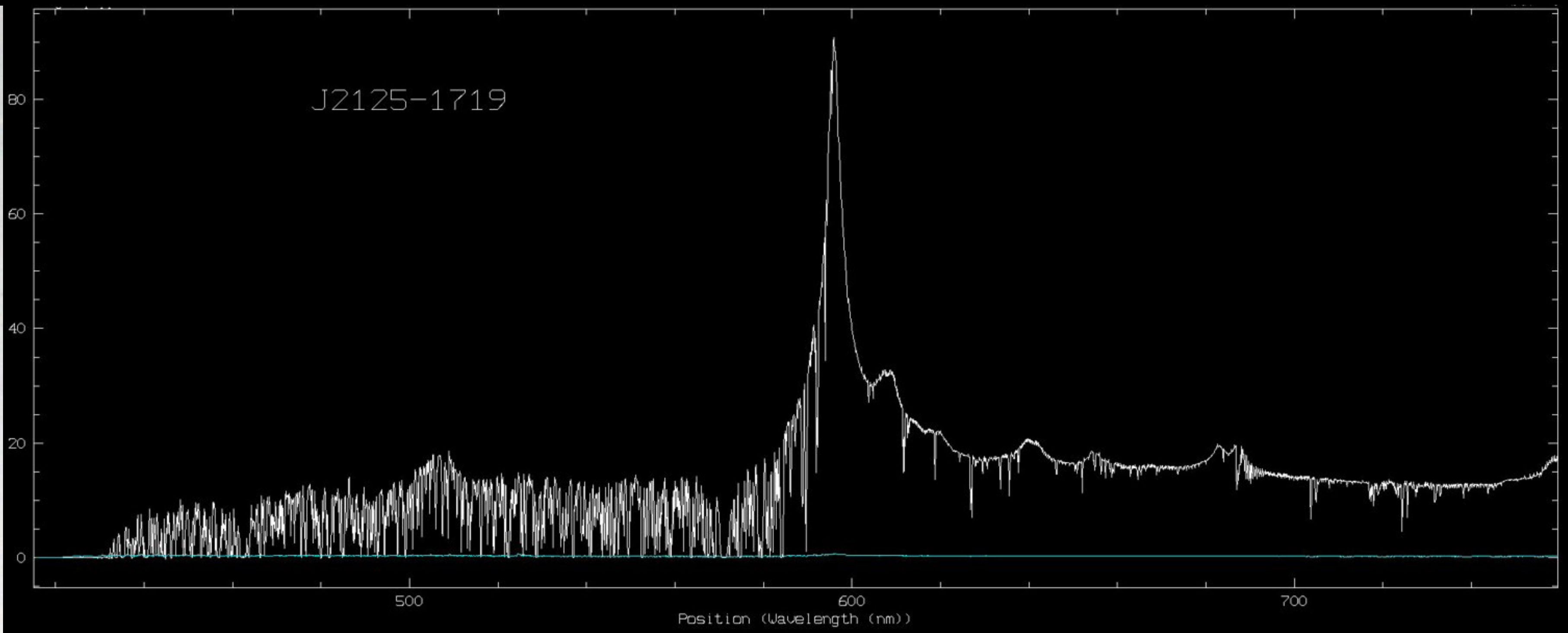
TNG in the Italian tradition of the surveys for radio-loud and radio-quiet quasars.





Stefano Cristiani
INAF OATs

AKA

How to fulfill the dreams of a kid

or

When did I hear first of a

Telescopio Nazionale?

Asiago in the ‘70s

UNIVERSITA' DEGLI STUDI DI ROMA

FACOLTA' DI SCIENZE MM. FF. NN.

CORSO DI LAUREA IN FISICA

Tesi di Laurea

OSSERVAZIONI FOTOMETRICHE E SPETTROSCOPICHE DI NUCLEI GALATTICI ATTIVI

Relatori:

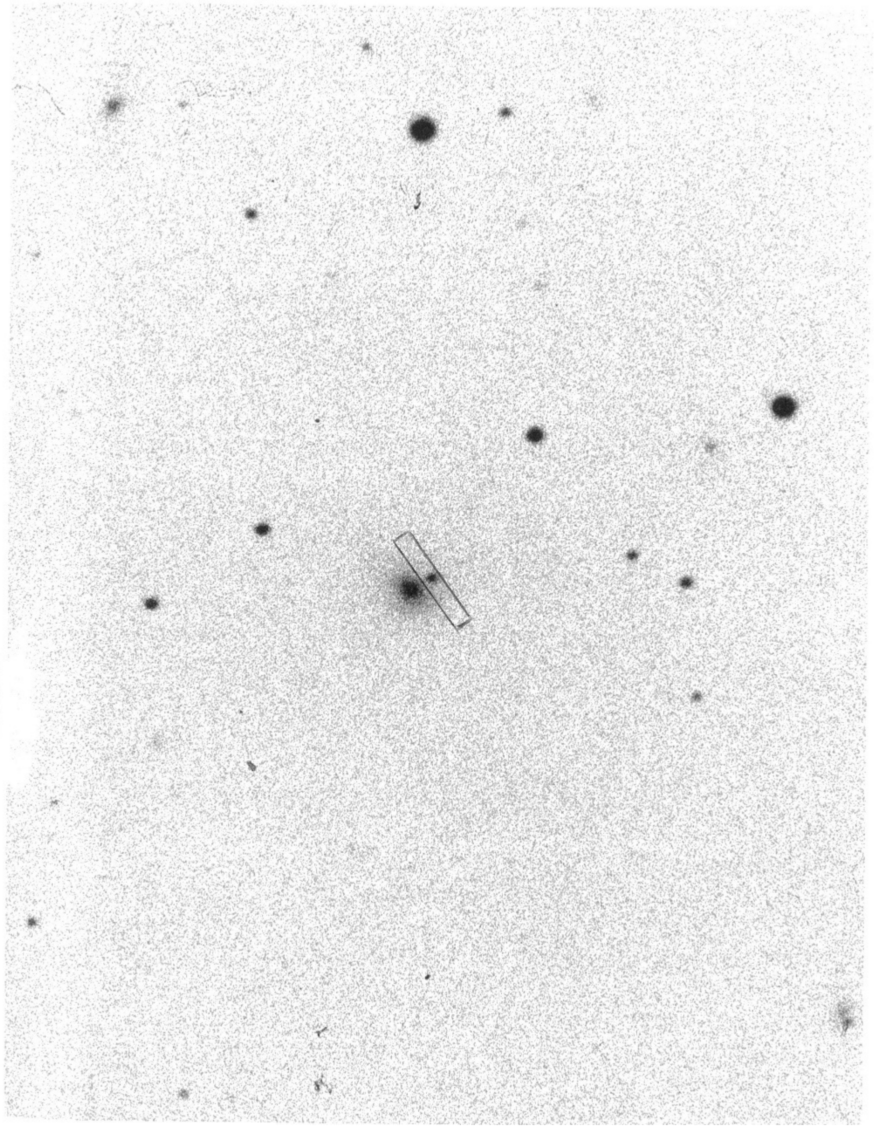
Chiar.mo Prof. C. BARBIERI

Chiar.mo Prof. A. CAVALIERE

Laureando:

Stefano CRISTIANI

Anno Accademico 1980/81




UNIVERSITÁ DEGLI STUDI DI PADOVA

FACOLTA' DI SCIENZE MM. FF. NN.

ISTITUTO DI ASTRONOMIA

TESI DI LAUREA

Righe di assorbimento negli spettri degli Oggetti Quasi-Stellari

RELATORE: Ch.mo Prof. CESARE BARBIERI

LAUREANDO: GIULIO NARDON

ANNO ACCADEMICO 1980-81

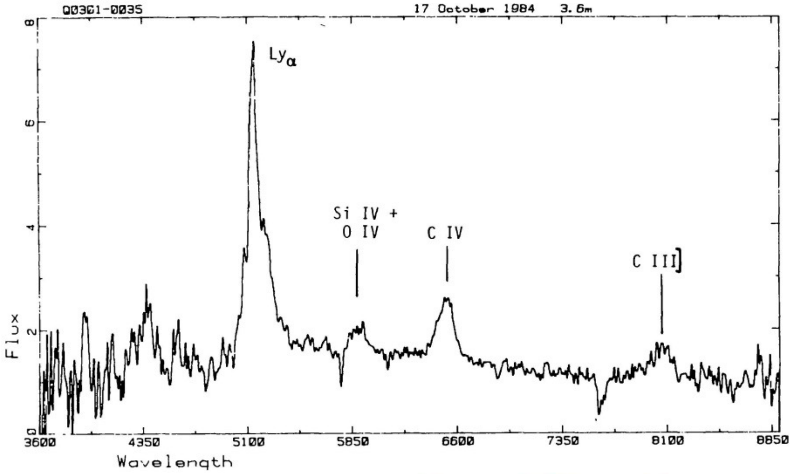
Quasar candidates in the field of SA 94 (2^h53^m, + 0°20′) (*)

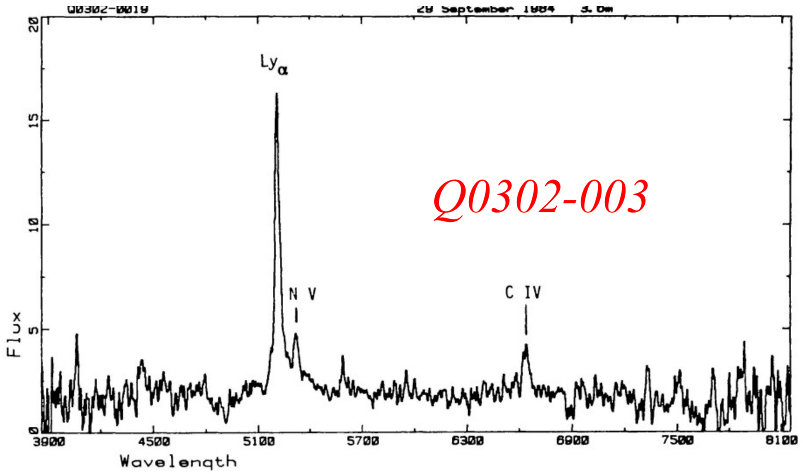
C. Barbieri [1] and S. Cristiani [1,2]

[1] Istituto di Astronomia, Università di Padova, Vicolo dell' Osservatorio 5, I-35100 Padova, Italy
[2] European Southern Observatory, Casilla 19001, 19 Santiago, Chile

Received March 18, accepted May 20, 1985

Summary. — A survey of quasars has been carried out in the field of SA 94 on UK Schmidt objective-prism plates, selecting 208 candidates in 39 sq. deg. Magnitudes for those located in the central 22.9 sq. deg. of the field and slit-spectroscopy information for 44 of them are provided. The characteristics of the survey are analyzed in comparison with other previous samples.





THE ASTROPHYSICAL JOURNAL, 784:42 (18pp), 2014 March 20
doi:10.1088/0004-637X/784/1/42

HUBBLE SPACE TELESCOPE/COSMIC ORIGINS SPECTROGRAPH OBSERVATIONS OF THE QUASAR Q0302−003: PROBING THE He II REIONIZATION EPOCH AND QSO PROXIMITY EFFECTS

DAVID SYPHERS AND J. MICHAEL SHULL
CASA, Department of Astrophysical and Planetary Sciences, University of Colorado, Boulder, CO 80309, USA; David.Syphers@colorado.edu
Received 2013 October 6; accepted 2014 January 31; published 2014 March 3

ABSTRACT

Q0302−003 ($z = 3.2860 \pm 0.0005$) was the first quasar discovered that showed a He II Gunn–Peterson trough, a sign of incomplete helium reionization at $z \gtrsim 2.9$. We present its *Hubble Space Telescope*/Cosmic Origins

ESO
La Silla
La Serena
Santiago

EL MENSAJERO

No. 28 – June 1982

ITALY, Member of ESO

On May 24, 1982, the Italian Ambassador in Paris deposited the instrument of accession with the Ministry of Foreign Affairs of the French Republic, as foreseen by Art. 13 of the ESO Convention. With this act Italy has become a member of ESO.

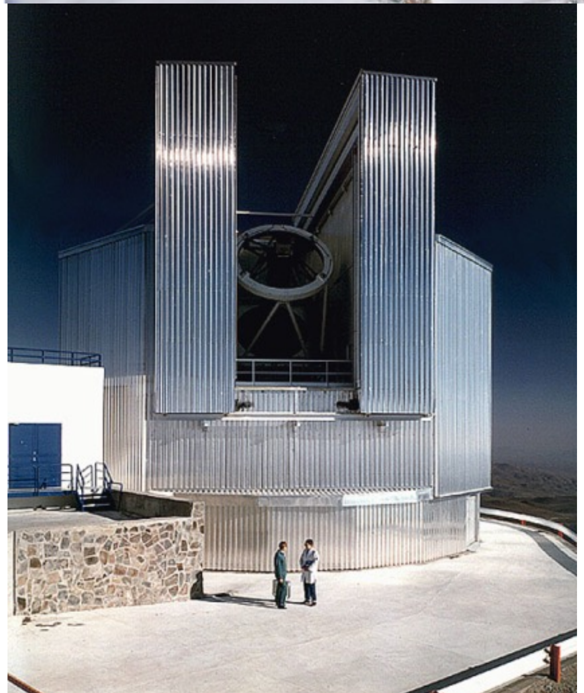
Perhaps it is of some interest to summarize the main historical steps which in the end led to this very positive conclusion. Apparently the main reason why Italy did not participate in the foundation of ESO is because Italian astronomers in the early '60s were essentially divided between the desire to participate in the founding of ESO and the equally strong desire to have a national telescope. It was of course believed, and perhaps rightly so, that the Italian Government was not willing to finance both enterprises. Eventually, priority was given to the national telescope project. This turned out to be a historical mistake. Ironically enough, it is the participation in ESO which will probably permit funding of the Italian national telescope (3.5 m) in the northern hemisphere. However, subsequently many Italian astronomers maintained a strong interest in ESO but no real step forward was taken until late 1977 when for the first time an Italian representative named by the Italian Research Council (CNR) was allowed to participate in the ESO Council meetings as an observer. This was a very important decision which finally led to a meeting between an Italian delegation headed by the Minister of Research and Technology, Mr. V. Scalia, and an ESO delegation headed by the President of Council, Prof. F. Denisse. The meeting took place in January 1980 in the town of Taormina (Sicily), the beautiful and inspiring surroundings of which assisted in the signing of the basic agreement for the participation of Italy. The detailed agreement was ready by May 1980, and on December 19 of the same year the Italian Government approved and sent to Parliament the law establishing the participation of Italy to ESO. The formal approval of the Italian Parliament was obtained on March 2, 1982 and the law published in the "Supplemento ordinario alla Gazzetta Ufficiale No. 92" (Legge 10 Marzo 1982, n. 127).

The hope and wish is that the new membership of Italy will not only satisfy the legitimate wishes of the Italian astronomers and astrophysicists who will now have access to the optical observations in the southern hemisphere, but will also contribute to strengthening the Organization and to further increase its basic role in the development of European astronomy.

Per aspera ad astra! G.S.

With Italy and Switzerland as new members of ESO, the annual contribution level has been increased from 32.5 to 40 million DM and the shares of the contributions of the various countries have changed as follows:

	Before	Shares in %	Now
Belgium	8.81		6.28
Denmark	4.71		3.35
France	33.33		26.75
Fed. Rep. of Germany	33.33		26.75
Italy	–		17.16
Netherlands	11.68		8.33
Sweden	8.14		5.81
Switzerland	–		5.57
	100.00		100.00



NTT

Astron. Astrophys. 135, 122–128 (1984)

ASTRONOMY AND ASTROPHYSICS

The completeness of the Braccesi deep quasar survey

S. Cristiani*, M. P. Véron-Cetty, and P. Véron*****

European Southern Observatory, Karl-Schwarzschild-Strasse 2, D-8046 Garching bei München, Federal Republic of Germany

Received November 15, 1983; accepted January 9, 1984

Summary. All quasar surveys are incomplete. The only way to find out by how much is to reobserve the same fields by other methods.

We have made a slitless spectroscopic survey of a 0.46 deg^2 area included in the Braccesi 1.72 deg^2 quasar field. Magnitudes and colours of the candidates have been measured on the Schmidt plates used by Formiggini et al. (1980) for the original survey. A catalogue of 75 candidates brighter than $B=20.1$ is produced. Its analysis shows that the Braccesi survey is probably complete down to $B<19.9$ ($b=20.0$), but significantly incomplete for fainter objects.

Key words: quasars – surveys

I. Introduction

A number of surveys, carried out with several techniques and with limiting magnitudes ranging from $B=16.0$ to $B=23.5$, have yielded in the last years a considerable insight into the quasar cosmic evolution. The present status of the matter is, however, far from satisfactory, being based on a fairly small number of observed quasars (for instance all the published surveys for ultraviolet excess quasars with spectroscopical confirmation include a total number of less than 100 objects); moreover the evaluation of the incompleteness of the various samples is a vital as well as a debated question (Véron, 1983).

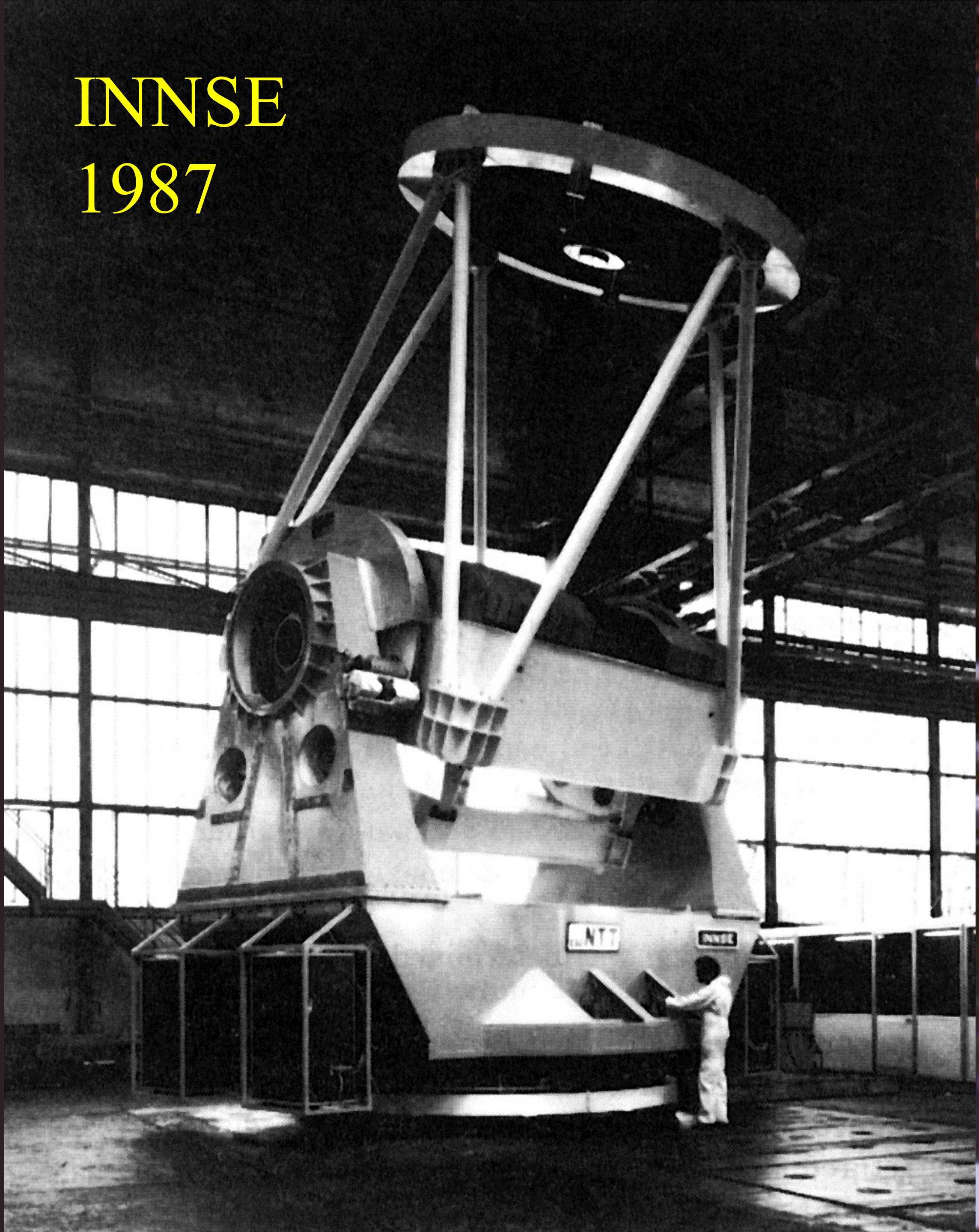
Formiggini et al. (1980) have searched a limited region of 1.72 deg^2 of the $13^h00^m+36°$ Sandage-Véron field (Sandage and Véron, 1965) for ultraviolet excess objects. The result was a list of 298 objects between $b=18$ and $b=20.77$, which is claimed to be complete down to $b=20.2$. [The u, b, v photometric system has been defined by Braccesi and Formiggini (1969).] Using the different location of main sequence stars and quasars in the $(u-b)/(b-v)$ diagram, Braccesi et al. (1980) have extracted from the list 60 candidates of which 53 are brighter than the completeness limit. They believe that almost all the quasars with redshift lower than 2.5 are included in this selection. Marshall et al. (1983a) have checked spectroscopically the 14 candidates brighter than $b=19.33$: 4 are stars, and 10 are quasars, 2 of which are of low

$b=20.2$, 4 are known to be stars. If we assume that all others are quasars, we get a surface density of 28 quasars deg^{-2} brighter than magnitude $b=20.2$ (Formiggini et al., 1980) which corresponds to $B\sim 20.1$ (Setti and Woltjer, 1973). This is a lower limit as there is no way at this stage of knowing how complete the survey is.

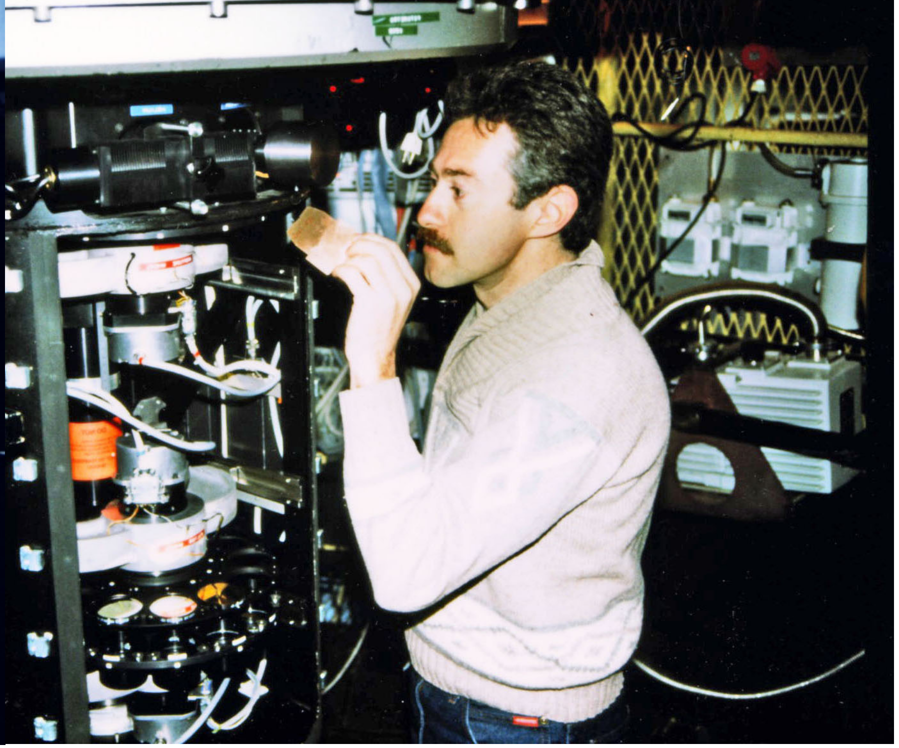
II. Observations

In order to clarify this problem and to extend the survey to larger redshifts and limiting magnitudes several direct and Grens plates (listed in Table 1) were taken at the prime focus of the CFH 3.6 m telescope in Hawaii of a region centered at RA $13^h02^m03^s$, Dec. $+35°54'30''$ (1950.0), in the Braccesi 1.72 deg^2 field. For the Grens plates we used Kodak IIIa-J or IIIa-F emulsions (the F plates were taken with a filter Schott GG 495, so the wavelength range was $\lambda\lambda$4950–7000), the dispersion 2000 Å mm^{-1} and the unignetted field 0.46 deg^2. The plate scale is 14 arc s mm^{-1} giving, with a one arc s seeing, a resolution of 144 Å. Our best IIIa-J Grens plate reaches a continuum magnitude $b\sim 20.8$; it has been searched independently by each of us for emission line and UV excess objects. (All Formiggini et al. QSO candidates in the field have been found.) The final selection was carried out by examining the PDS tracings of these objects on both the IIIa-J and IIIa-F Grens plates. Figure 1 shows the tracings of the spectrum of a blue object (probably a star) from both a J and a F plates. The well known changes of sensitivity with wavelength of the IIIa-F emulsion are well illustrated in this figure; they make the F Grens plates of limited use, although Osmer (1982) has been able to find a few quasars with such grism plates.

The u, b, and v magnitudes of the 185 selected objects were measured on the original 48″ Palomar Schmidt plates (listed in Table 2) used by Formiggini et al.; the images of the objects were digitized with a PDS machine and then reduced using the ESO/IHAP image processing system. The calibration was performed using the magnitudes of the objects published by Formiggini et al. as standard reference. This ensures that the magnitude scale is the same and that the effects of variability are excluded. For a few objects it was not possible to obtain a reliable estimate of the b magnitude from the Palomar plates; in these cases magnitudes have been computed using scans of two CFH direct


INNSE
1987

EFOSC: 1985



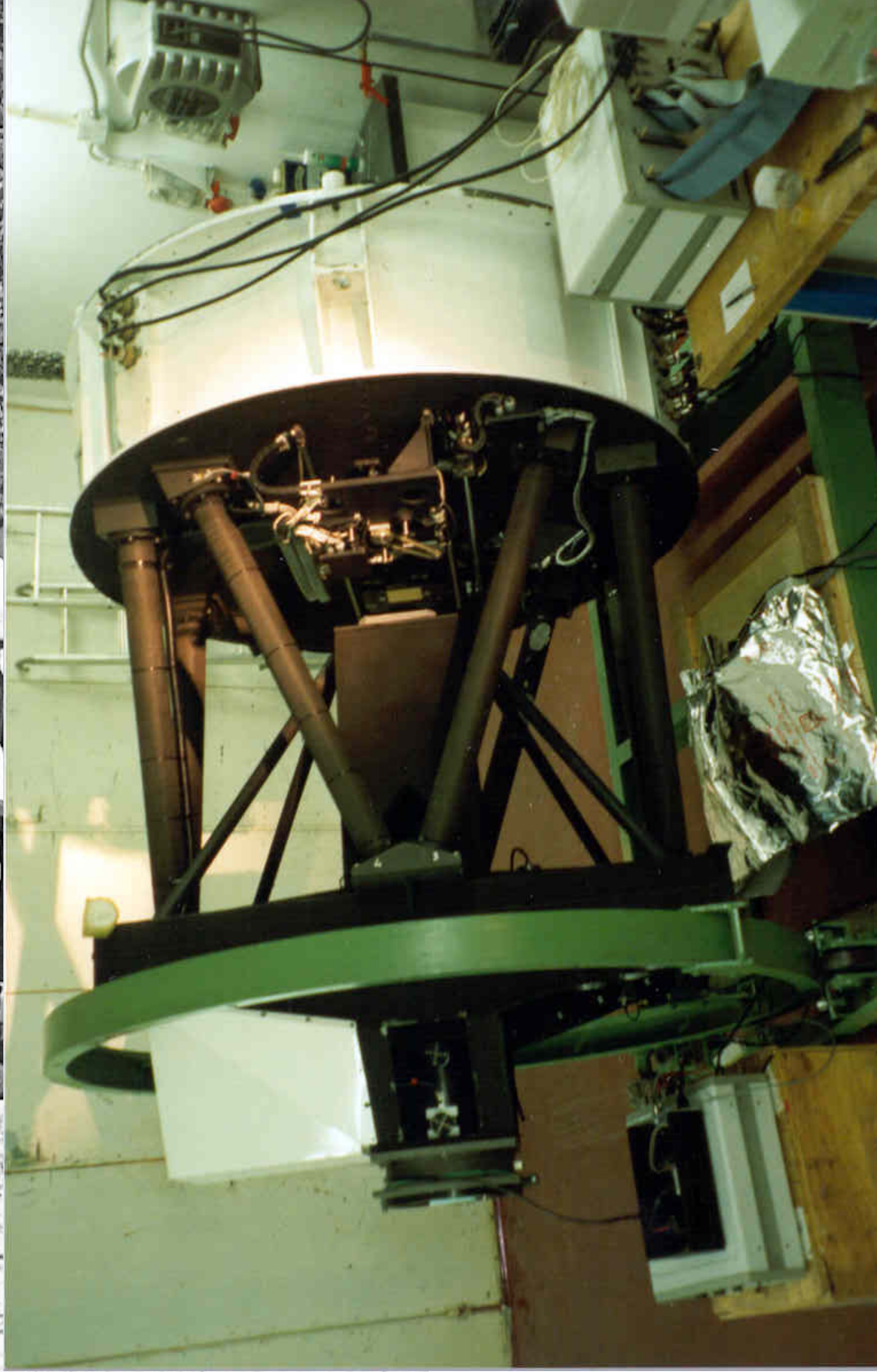
OBSERVATIONS OF QSOs AND RELATED OBJECTS WITH EFOSC, THE ESO FAINT OBJECT SPECTROGRAPH AND CAMERA

1986 IAUS 119 57

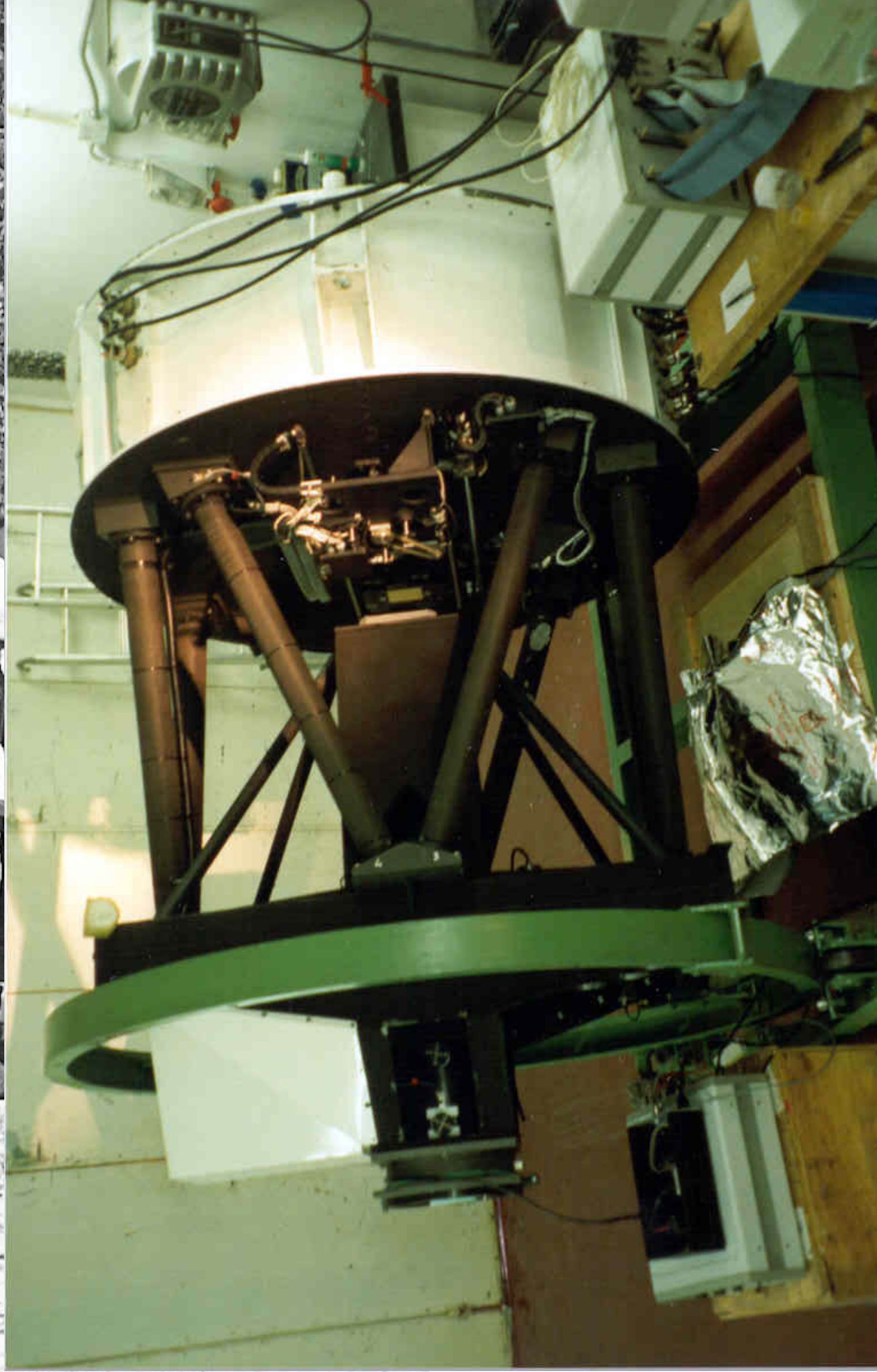
S. D'Odorico[+], S. Cristiani[+], R.G. Clowes* and C.J. Keable*

[+] European Southern Observatory, Karl-Schwarzschild-Str. 2, D-8046 Garching bei München, Federal Republic of Germany
* Royal Observatory, Blackford Hill, Edinburgh EH9 3HJ, U.K.

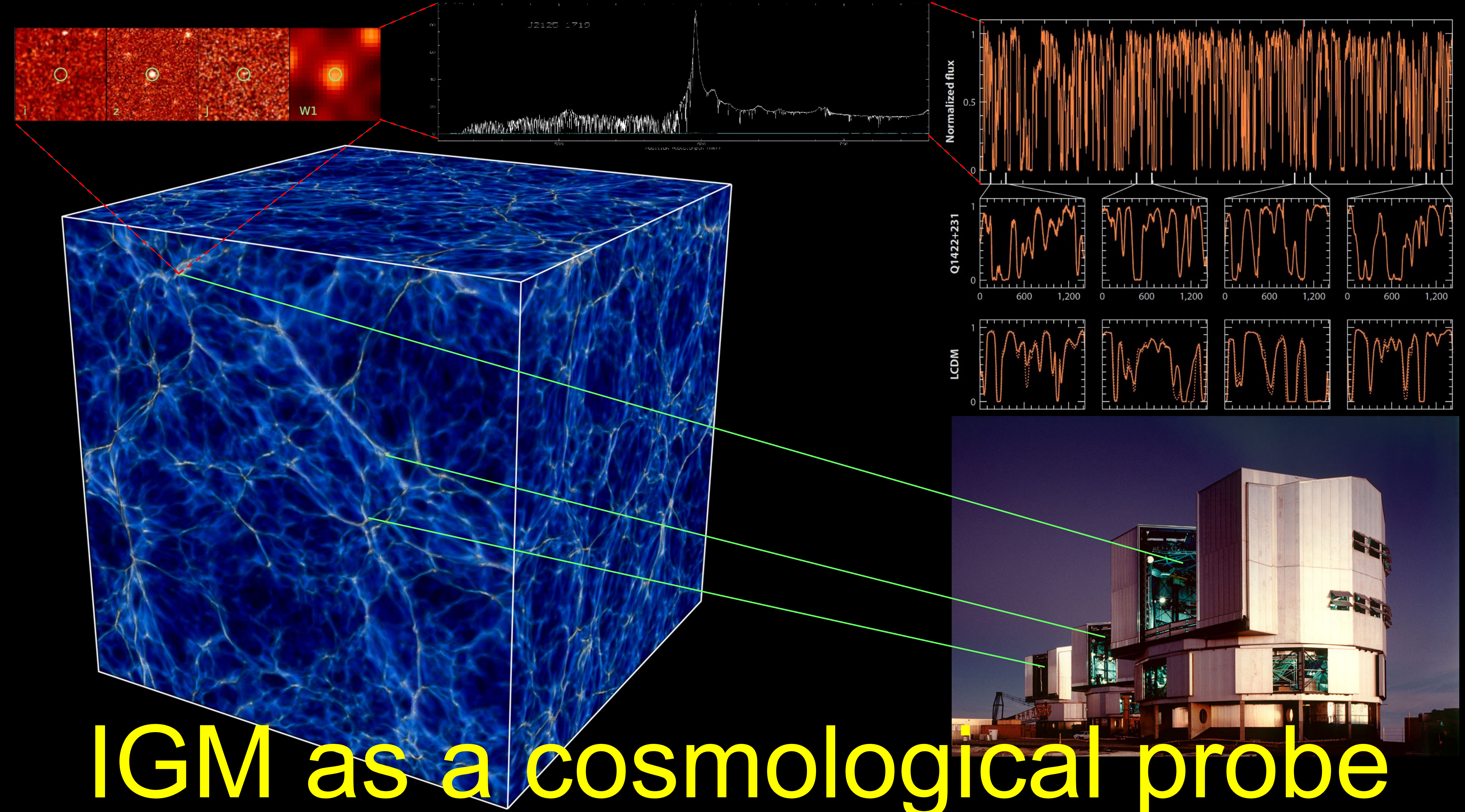
EFOSC is a standard ESO instrument operating at the Cassegrain focus of the 3.6 m telescope since April 1st, 1985. A description of its optical design and operating modes is given in Enard and Delabre (1982) and Dekker and D'Odorico (1985). Briefly, it is a focal reducer with spectroscopic capability. The collimator produces a collimated beam with a diameter of 40 mm which passes through a filter and/or grism. The f/2.5 camera focusses the beam on the detector which is at present a thinned, back-illuminated RCA CCD with 320×512 pixels. The pixel size is

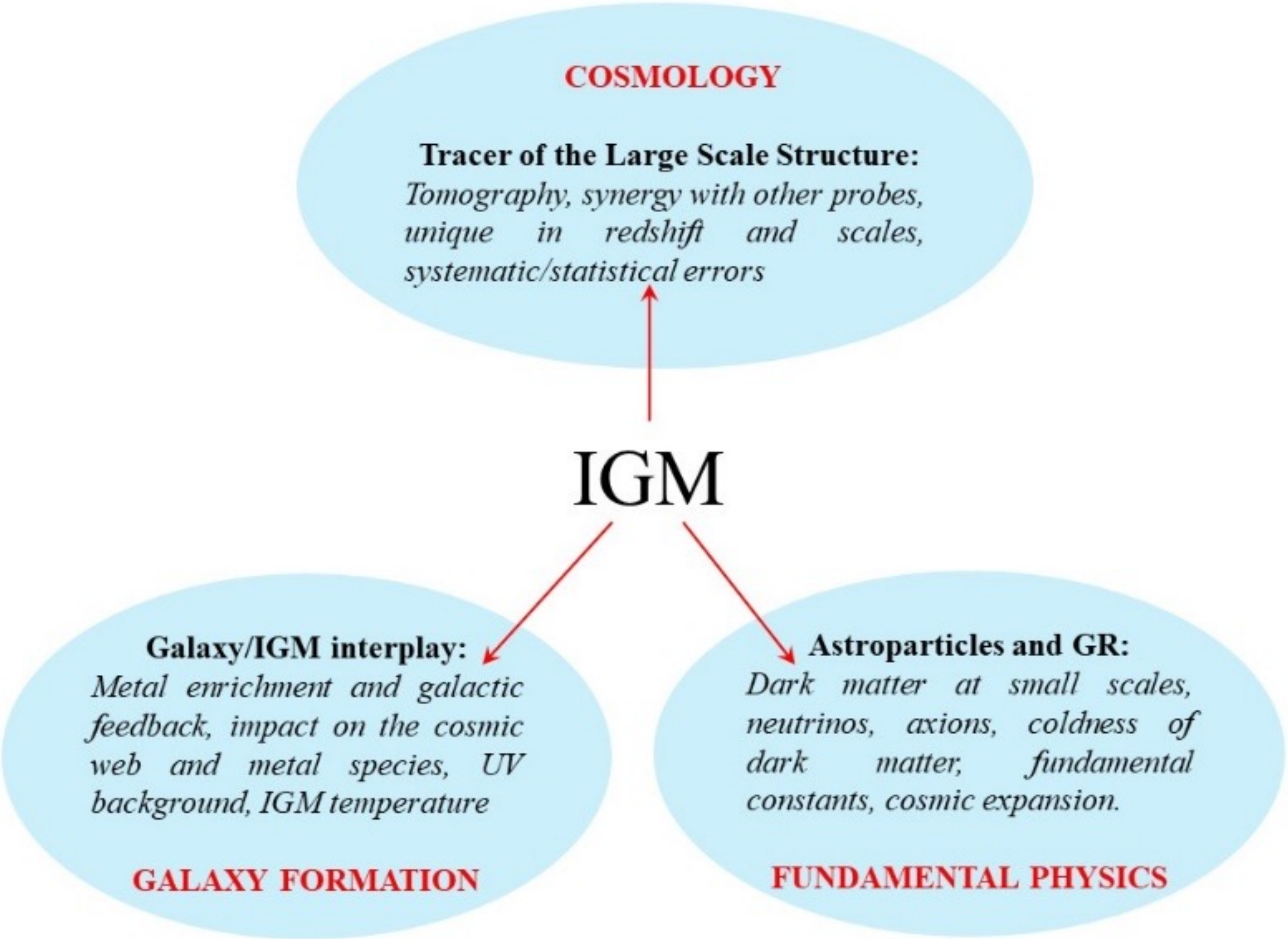

1986 OHP



1986 OHP

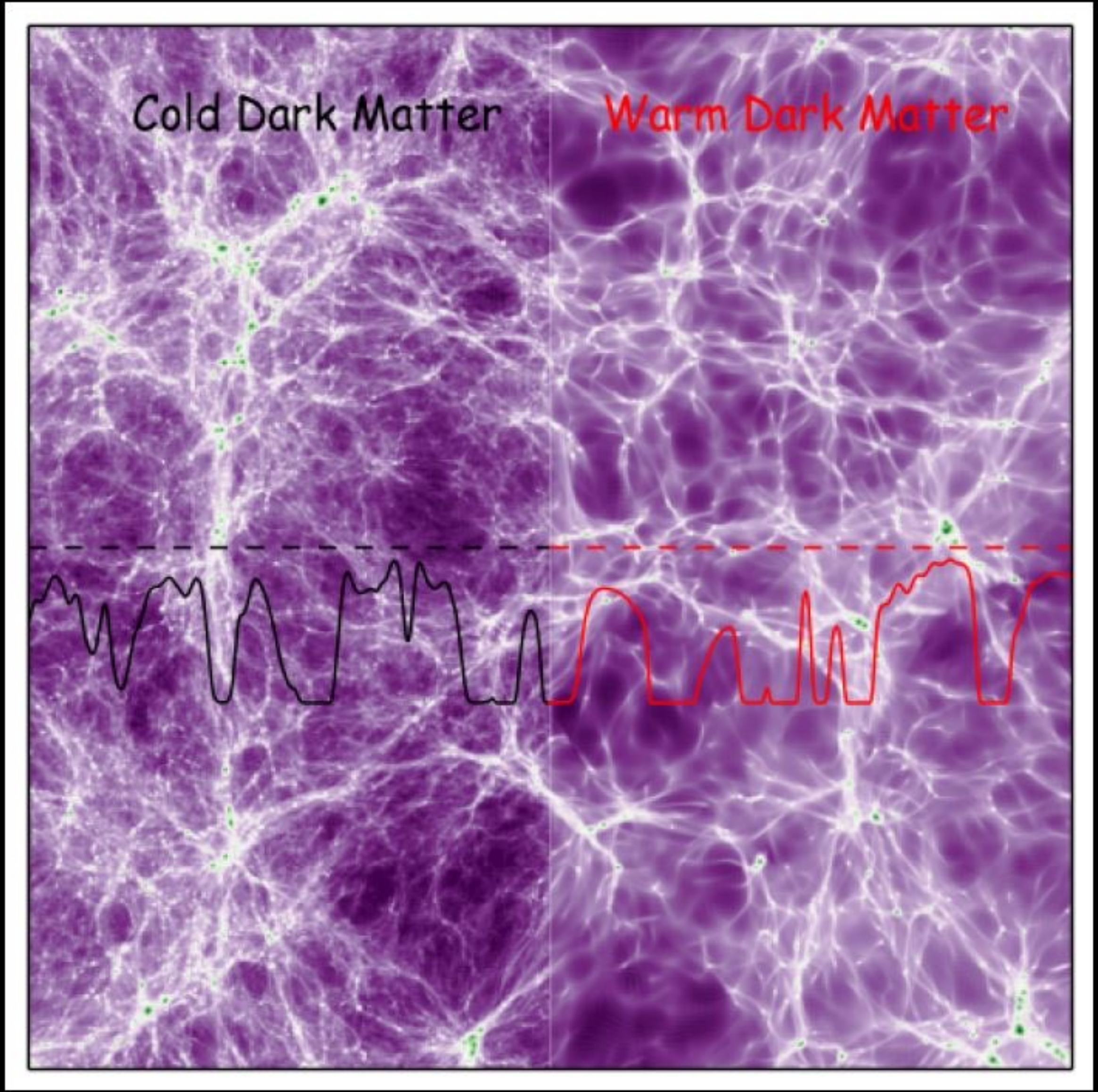


IGM as a cosmological probe




COSMOLOGY
Tracer of the Large Scale Structure:
Tomography, synergy with other probes, unique in redshift and scales, systematic/statistical errors
IGM
Galaxy/IGM interplay:
Metal enrichment and galactic feedback, impact on the cosmic web and metal species, UV background, IGM temperature
GALAXY FORMATION
Astroparticles and GR:
Dark matter at small scales, neutrinos, axions, coldness of dark matter, fundamental constants, cosmic expansion.
FUNDAMENTAL PHYSICS

Non-CDM erases small scale structure



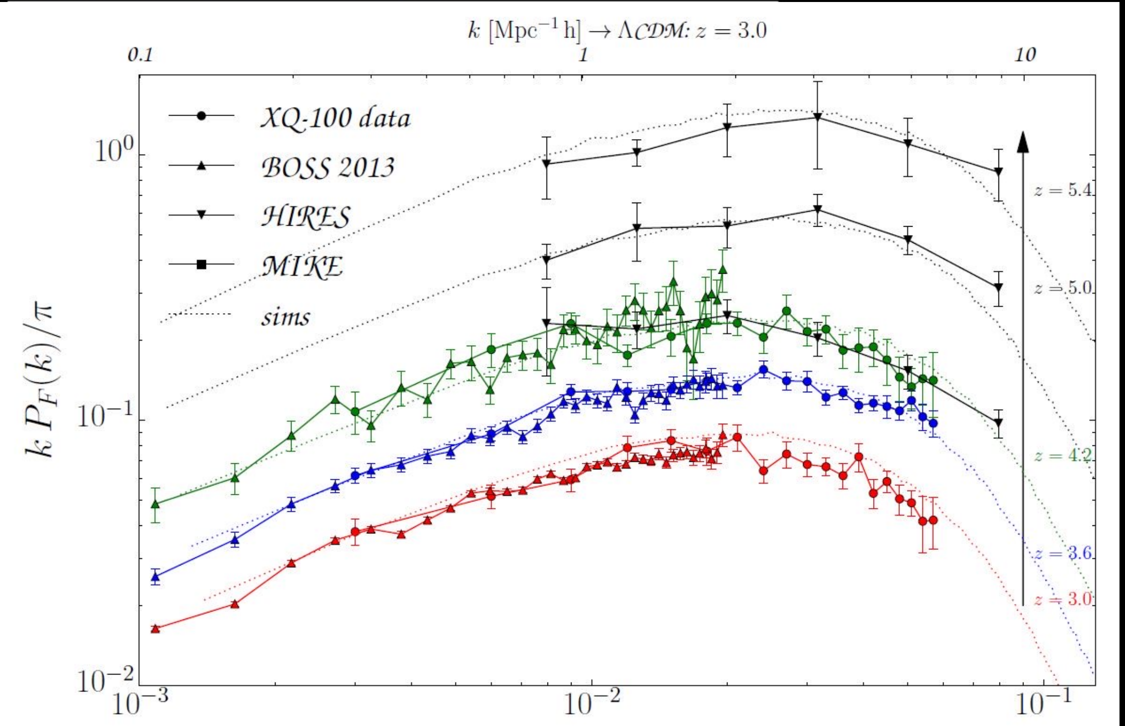
Courtesy of Vid Iršič

Warm Dark Matter (WDM):

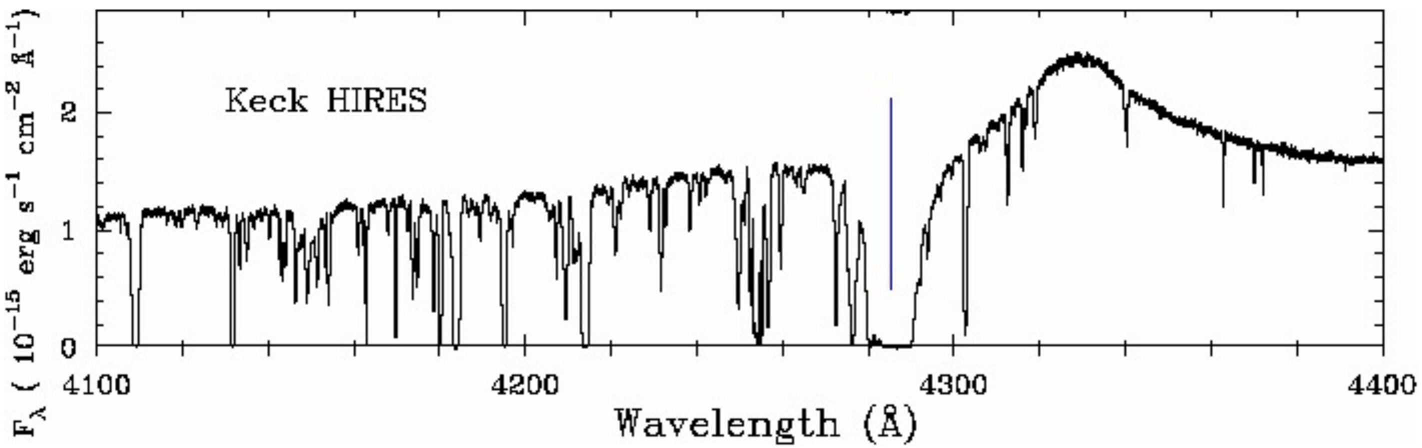
Free-streaming of DM particles
(From the time they decouple
until they become non-relativistic)

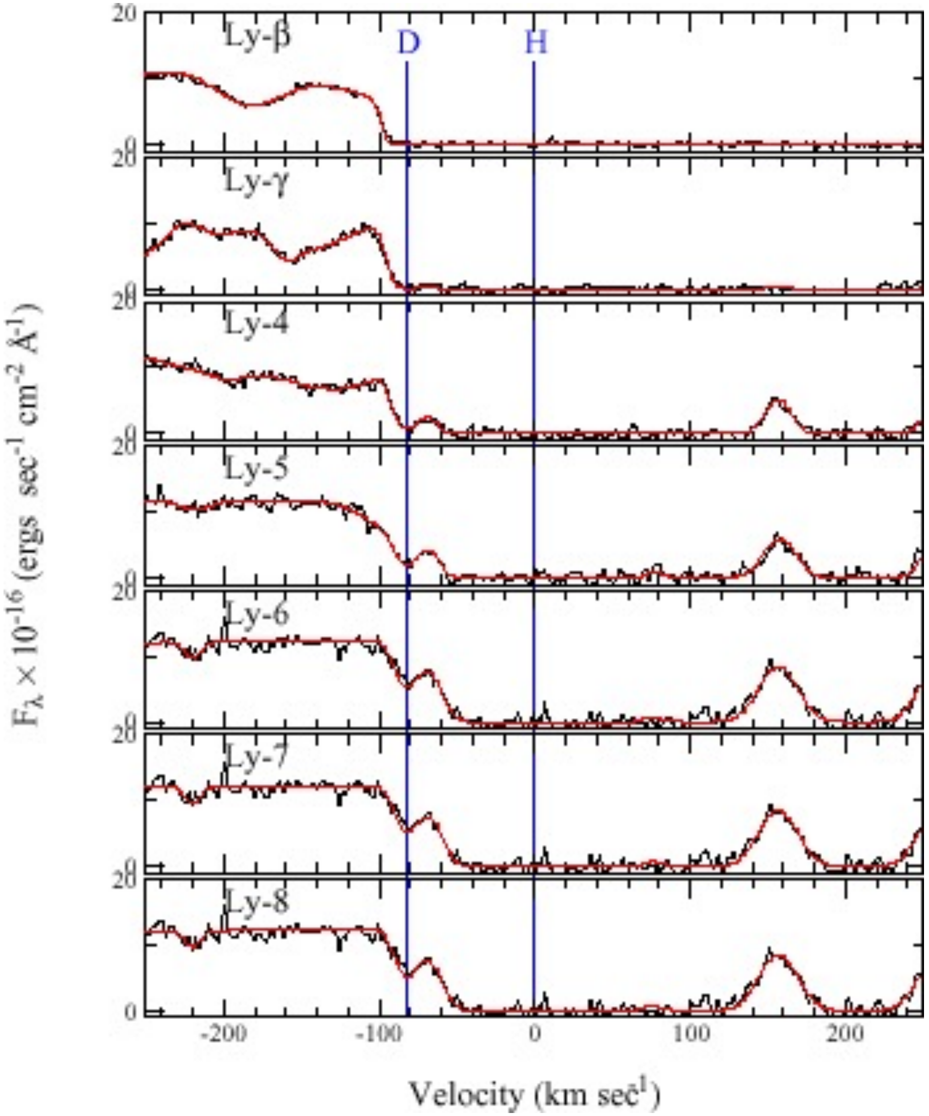
$\Longrightarrow$ erases small scale structure

Typical $\lambda_{\mathrm{FS}} \sim \mathrm{Mpc/h}$



D/H from IG Abs. QSO 1243+3047



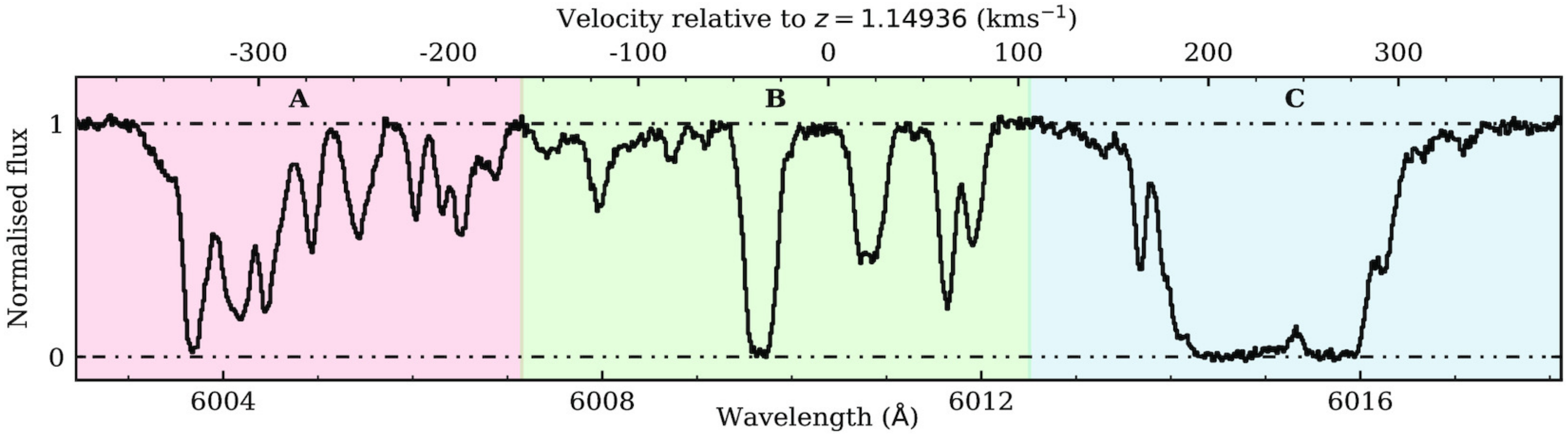


$$D/H = 2.53 \pm\ 0.03 \times 10^{-5}$$

(average of 7 QSOs)

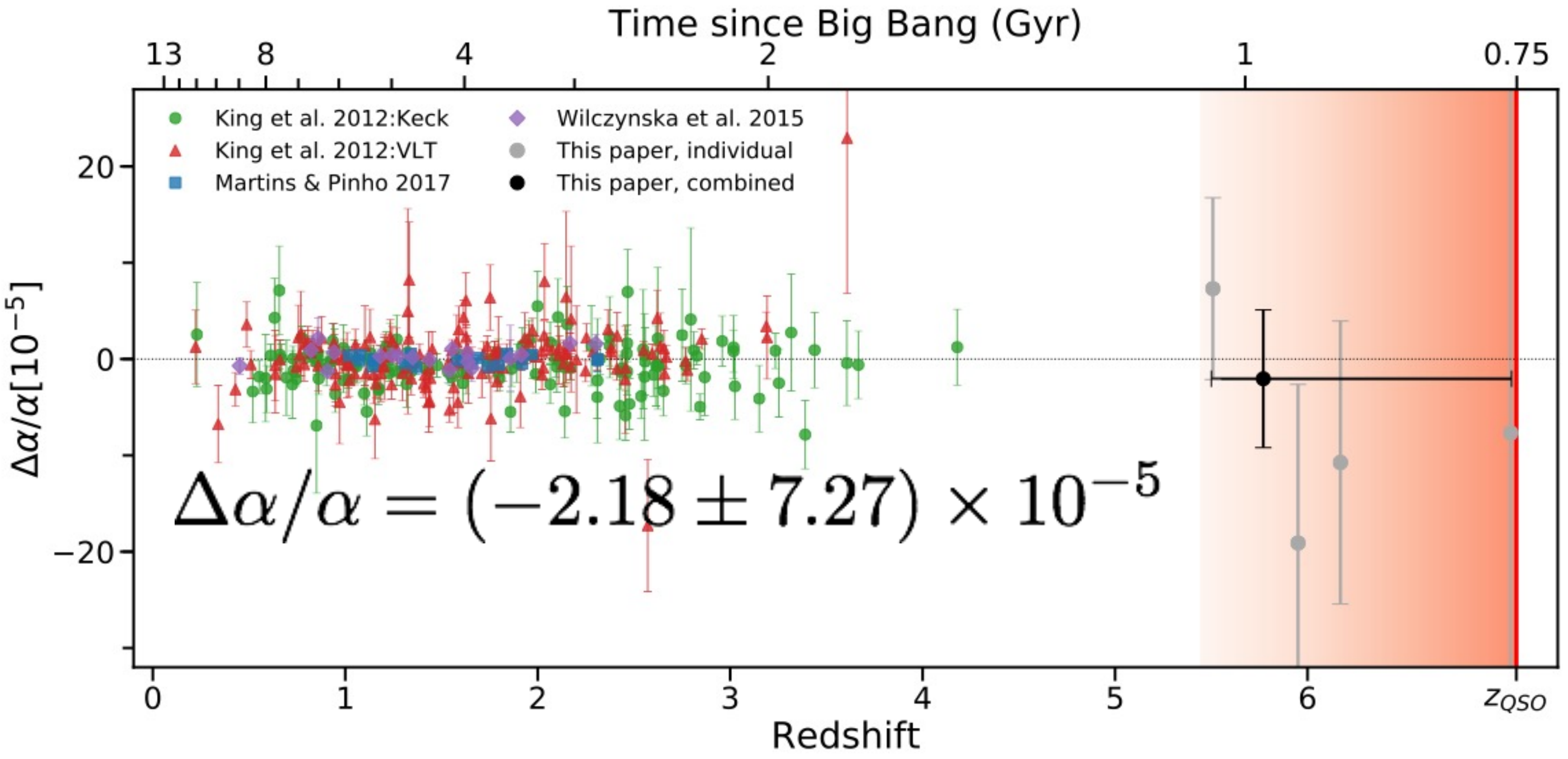
Cooke + 2018

Variation of fundamental constants: α, μ

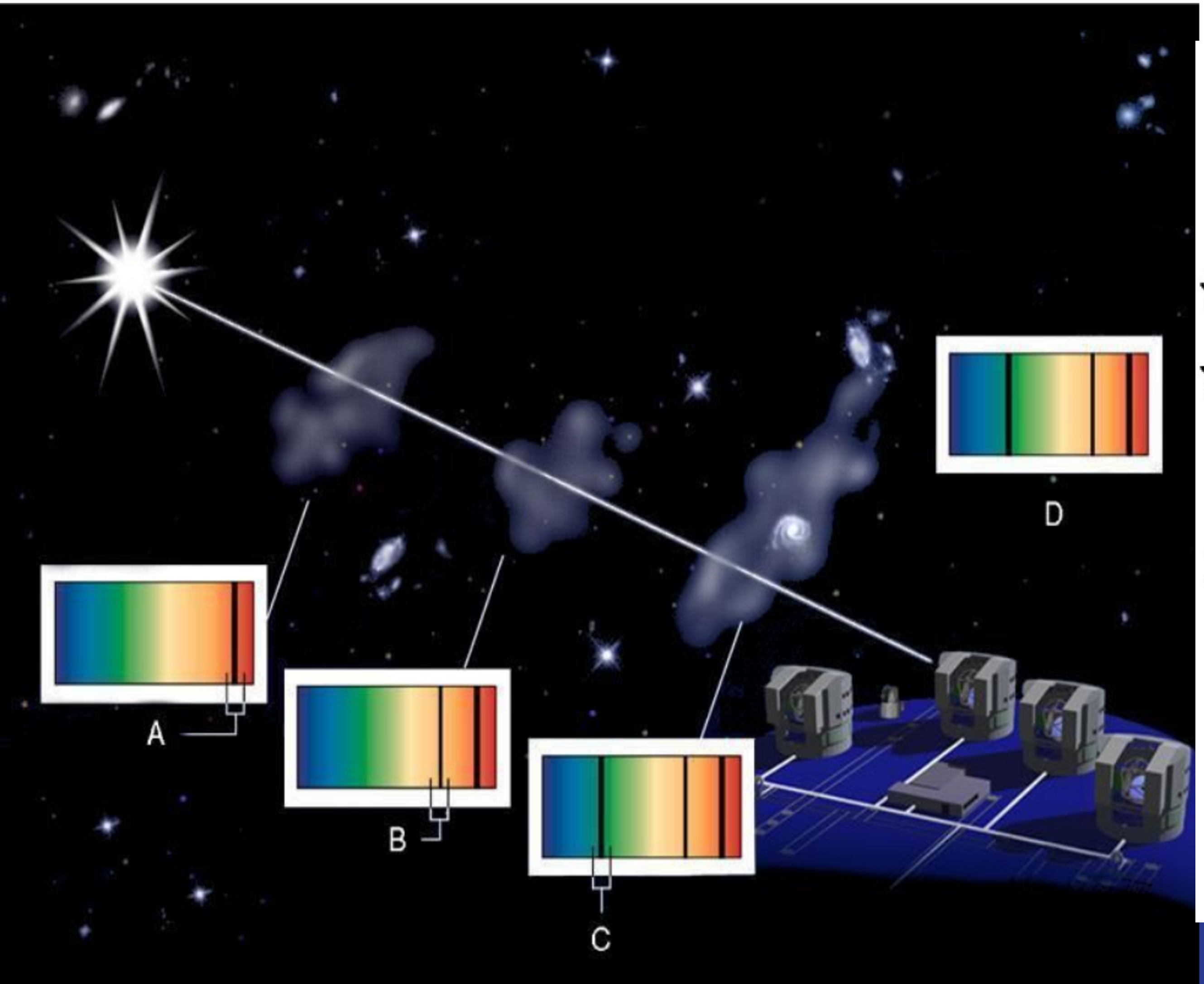


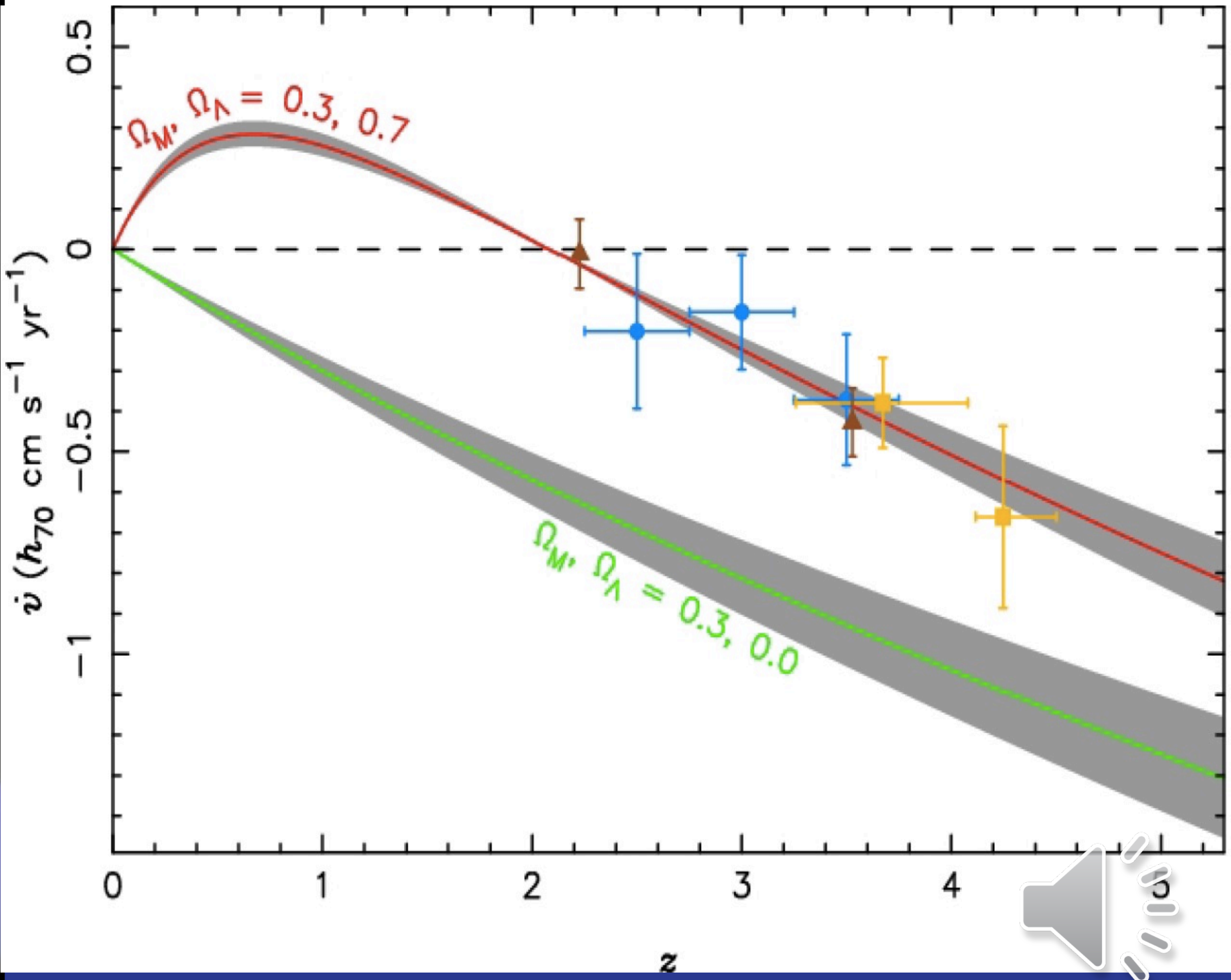
Milaković+2021

Wilczynska+2020



Sandage Test (Liske+2008, Cristiani+2007, Loeb 1998, Sandage 1962)



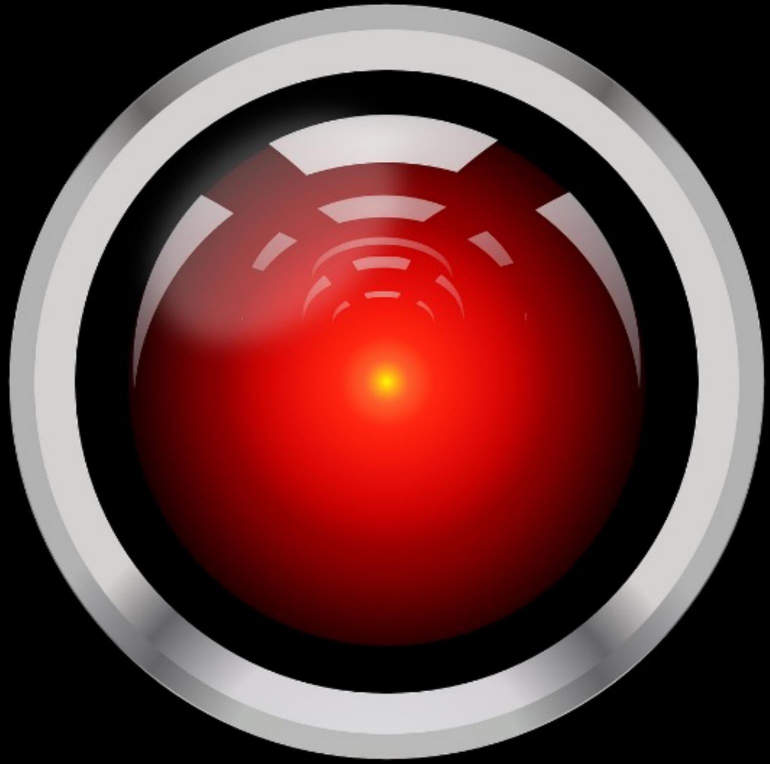


$$\sigma_v = 1.35 \left(\frac{\mathrm{S/N}}{3350} \right)^{-1} \left(\frac{N_{\mathrm{QSO}}}{30} \right)^{-1/2} \left(\frac{1 + z_{\mathrm{QSO}}}{5} \right)^{-1.7}$$

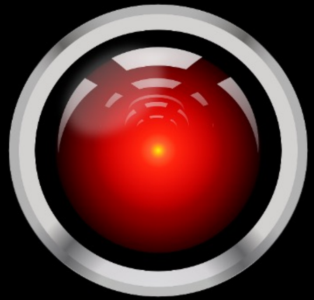
~2000h of observations required over 20-30 yrs

QUBRICS – finding the beacons

QUasars
BRIllanti
per la
Cosmologia
nel
Sud



QUBRICS



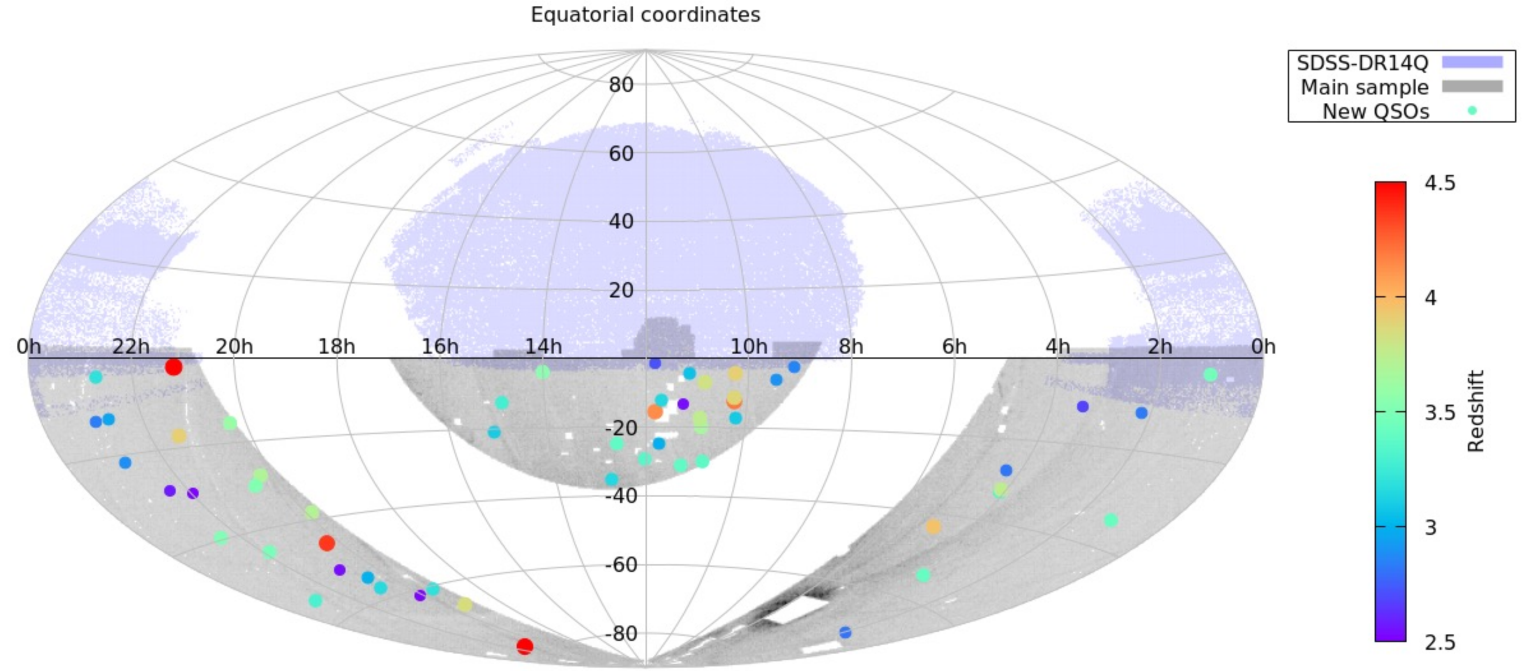
Konstantina Boutsia, Giorgio Calderone, Stefano Cristiani, Andrea Grazian

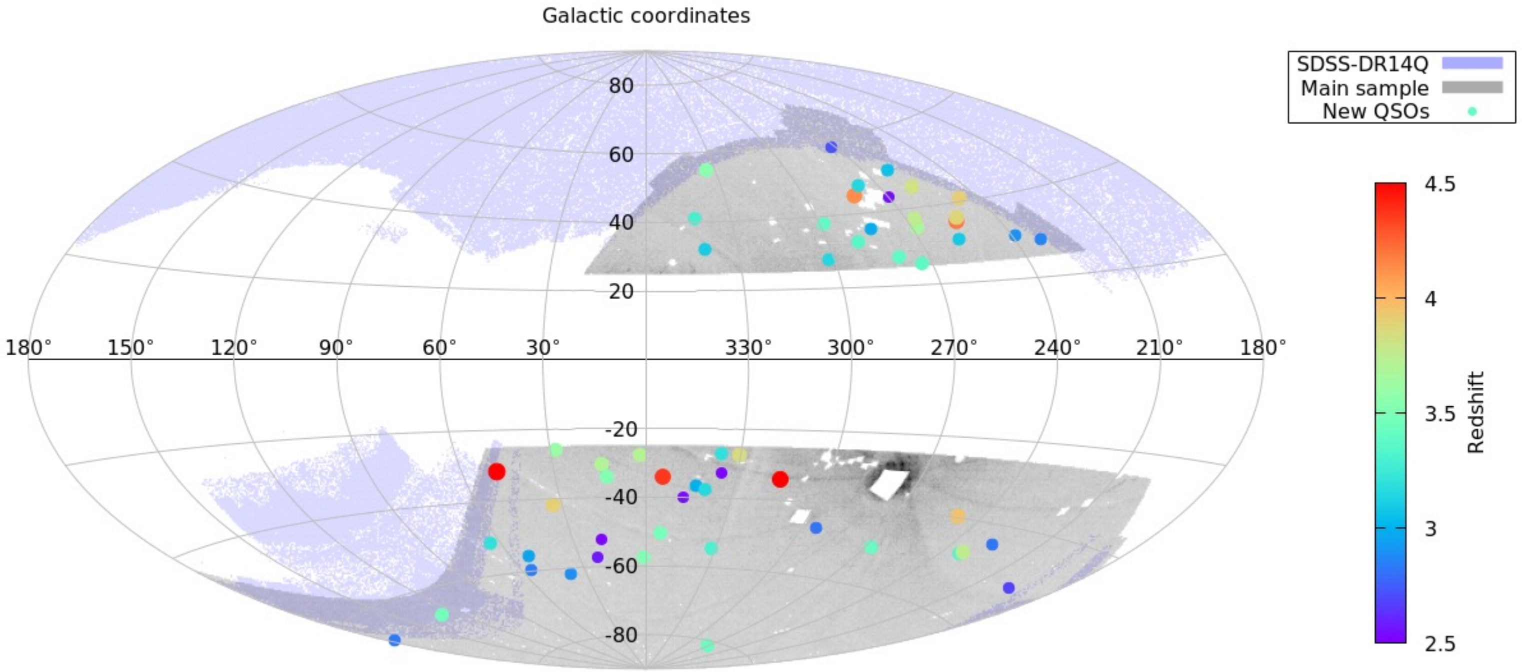
Guido Cupani,Valentina D'Odorico, Fabio Fontanot

Calderone G., et al., 2019, ApJ, 887, 268

Main goal:

- Identify bright, high-redshift QSOs using data from publicly available photometric survey:
  - SkyMapper
  - Gaia
  - 2MASS
  - WISE
- Two-fold problem: first identify QSOs, then remove low-redshift objects





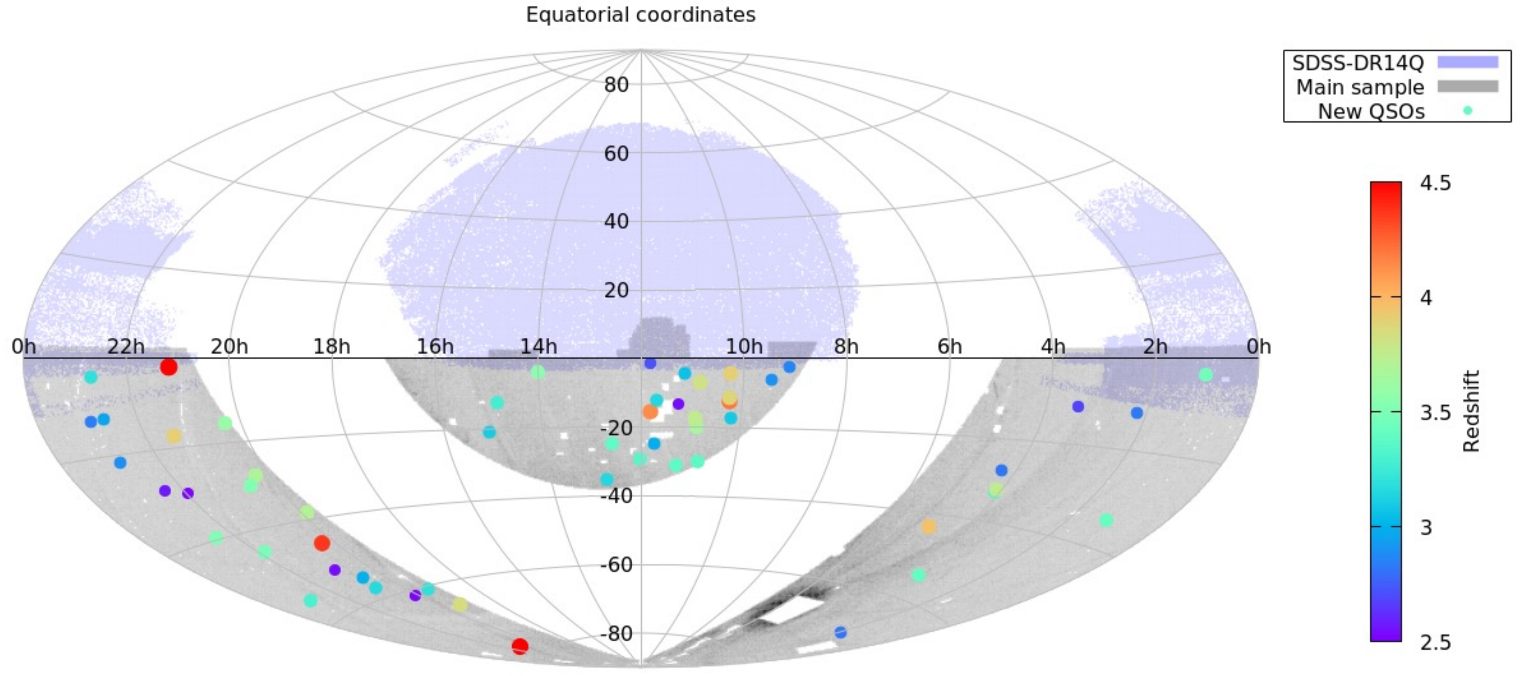

My God
It's full of stars
quickmeme.com

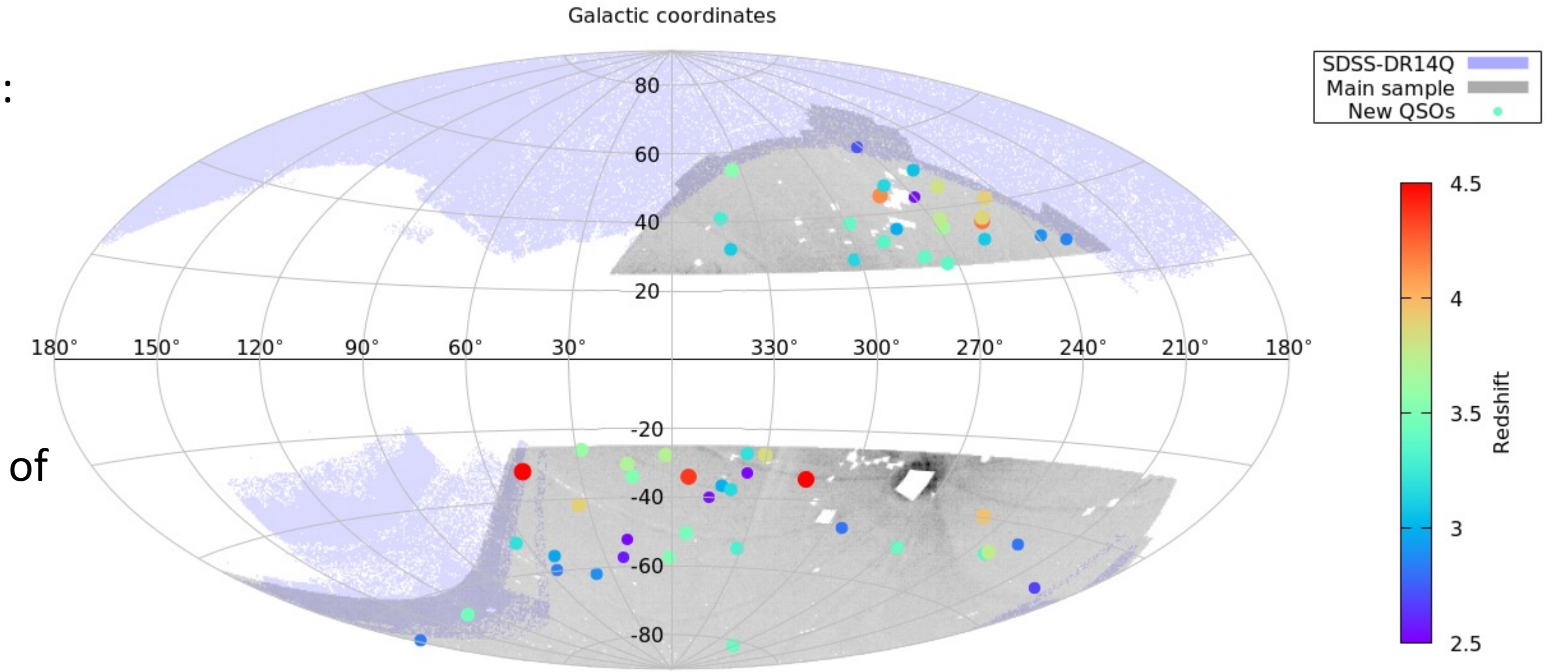
Main goal:

- Identify bright, high-redshift QSOs using data from publicly available photometric survey:
  - SkyMapper
  - Gaia
  - 2MASS
  - WISE
- Two-fold problem: first identify QSOs, then remove low-redshift objects

Method:

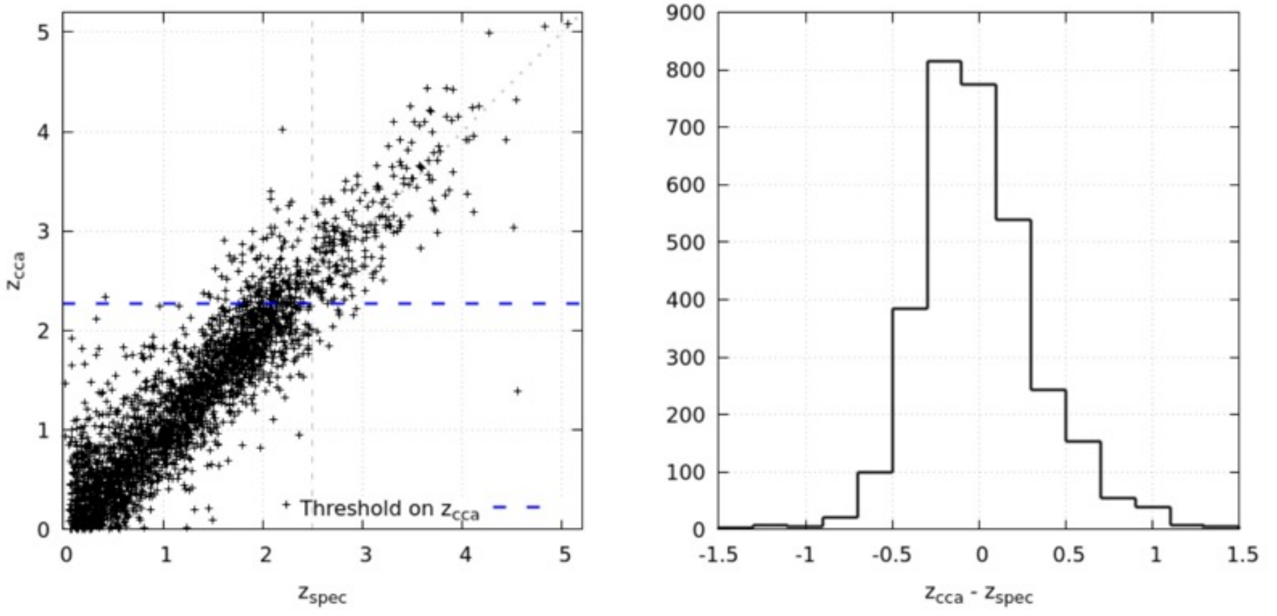
- Apply ML techniques on photometric datasets:
  - Canonical Correlation Analysis (CCA)
    - Calderone et al 2019 *ApJ* 887 268
    - Boutsia et al 2020 *ApJS* 250 26
  - Probabilistic Random Forest (PRF)
    - Guarneri et al 2021 MNRAS 506 2
  - XGB (stay tuned)
- Spectroscopic follow-up to confirm the nature of high-redshift candidates



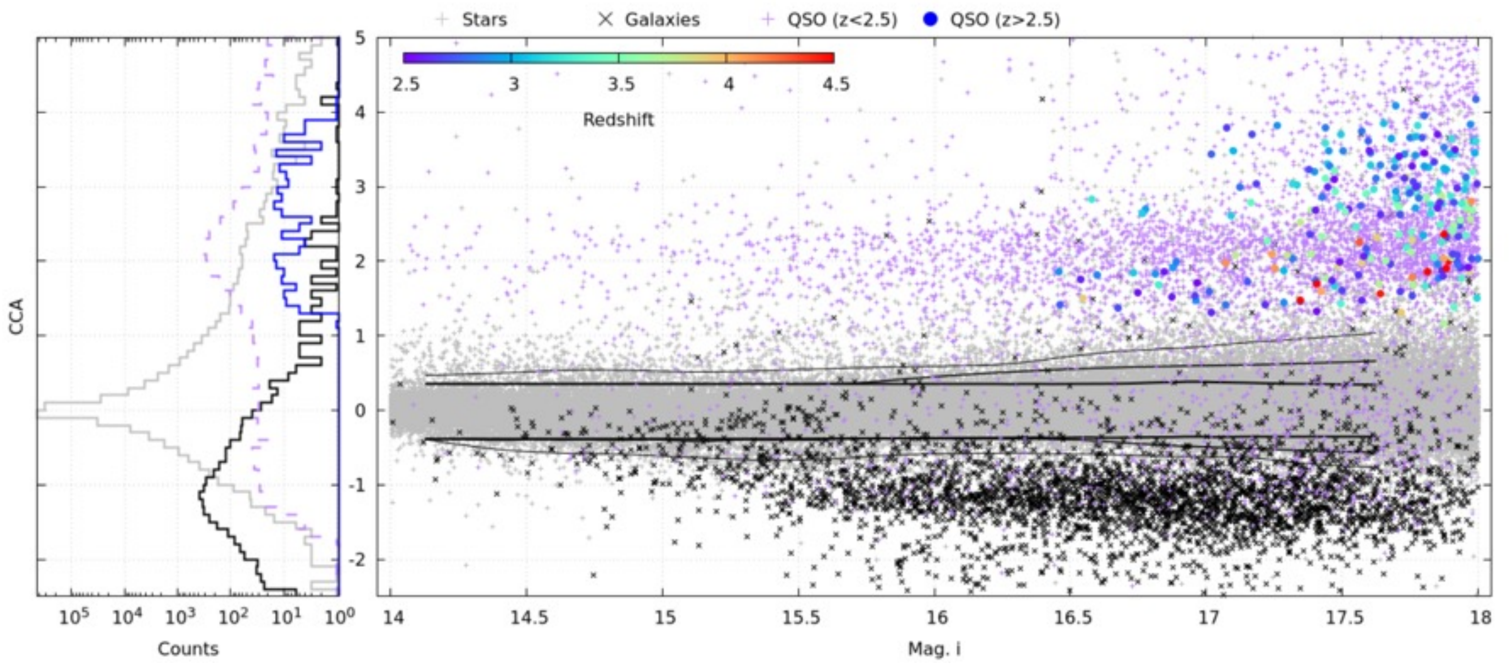


The QUBRICS survey: Canonical Correlation Analysis

(Calderone et al. 2019)



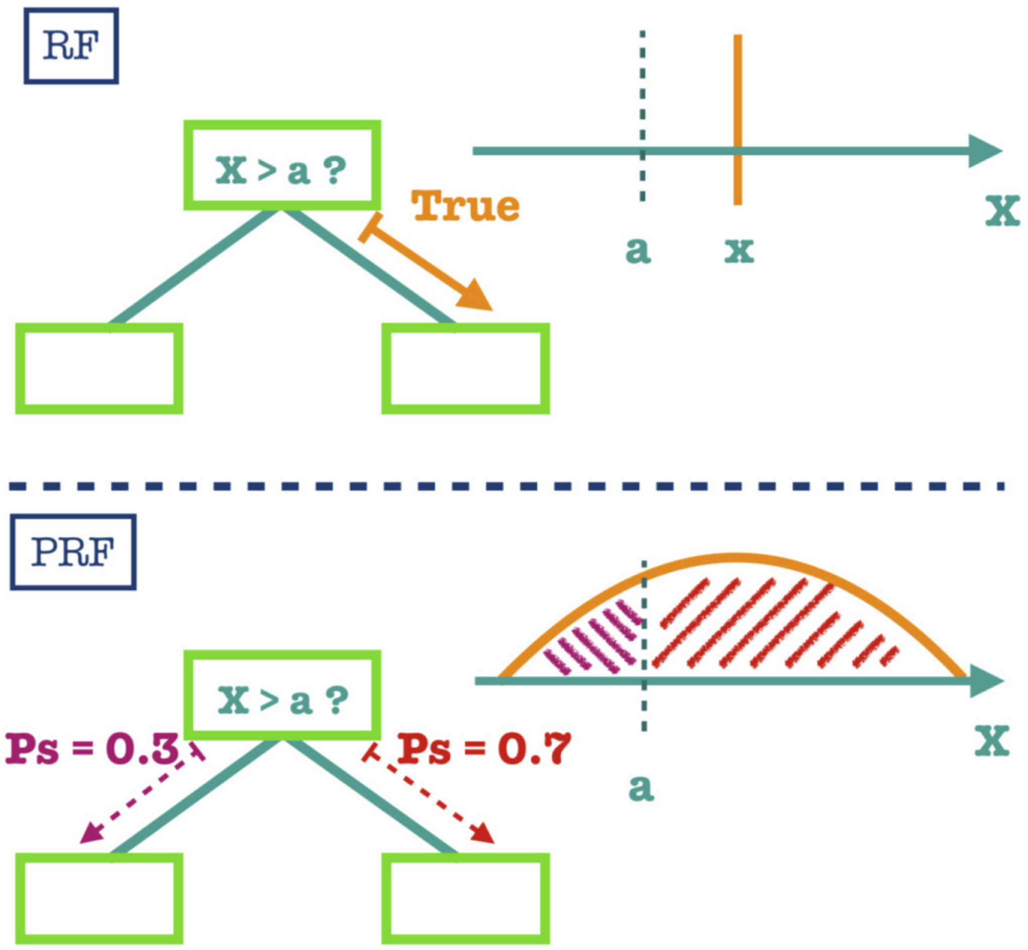
- High dimension selection process based on linear combination of colours
- Used for classification and regression
- Measurement uncertainties are not included in the model, and missing data can't be dealt with



The QUBRICS survey: Probabilistic Random Forest (Reis et al. 2019)

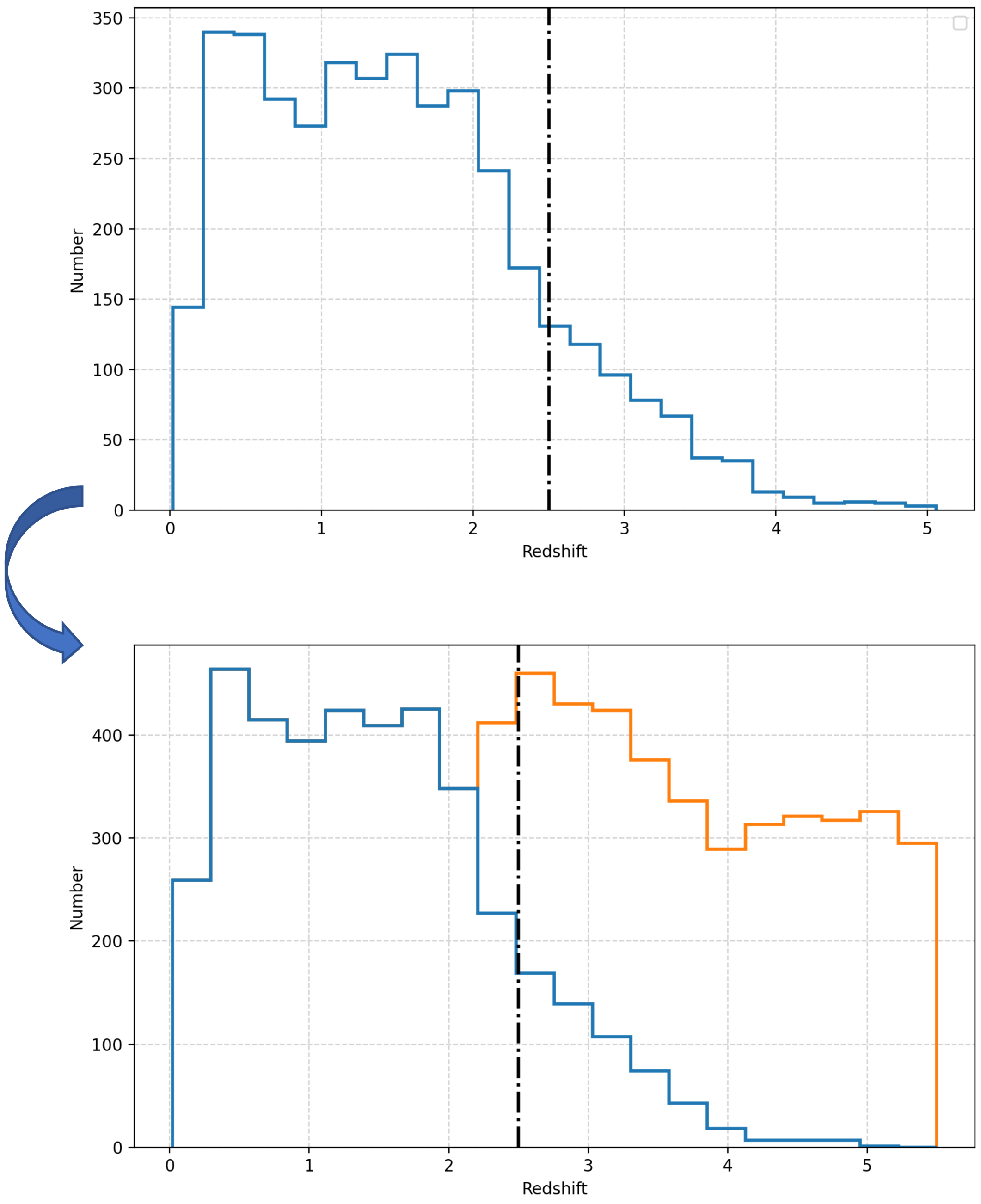
- Generalization of the original Random Forest (RF) to account for measurement uncertainties
- In the PRF each feature is a probability distribution function: this improves performances and considers errors as variance of the distribution
- Naturally handles missing data!

(Guarneri et al 2021 MNRAS 506 2)



Reis et al. 2019 - arxiv:1811.05994

Good training produces good predictions



- Very few high redshift QSOs with respect to those at low and intermediate: training dataset is unbalanced
- Currently two possible solutions:
  - over/under-sampling techniques
  - synthetic data generation
- Simple oversampling strategy: draw multiple copies of objects in the minority class
- Misclassification in literature need to be identified and addressed

Learning (many) lessons about ML

Beware of:

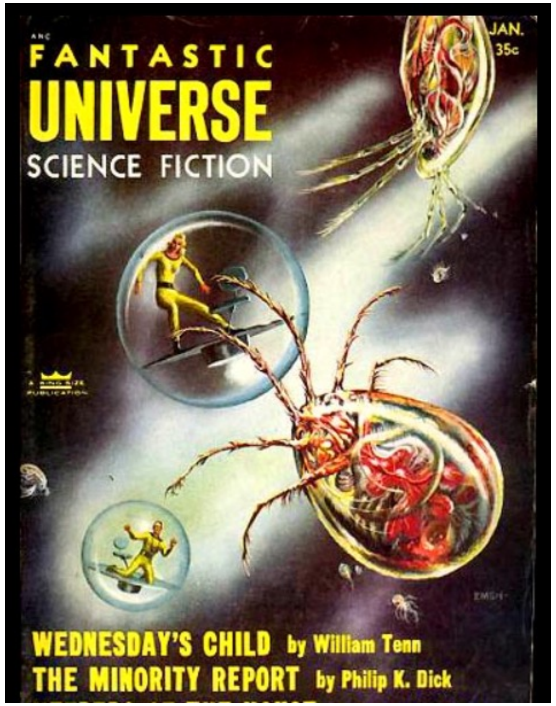
- Black box syndrome
- Overfitting (complementary methods)
- Fancy interpretation of unphysical features
- Amazing success rates and completeness

Consider that:

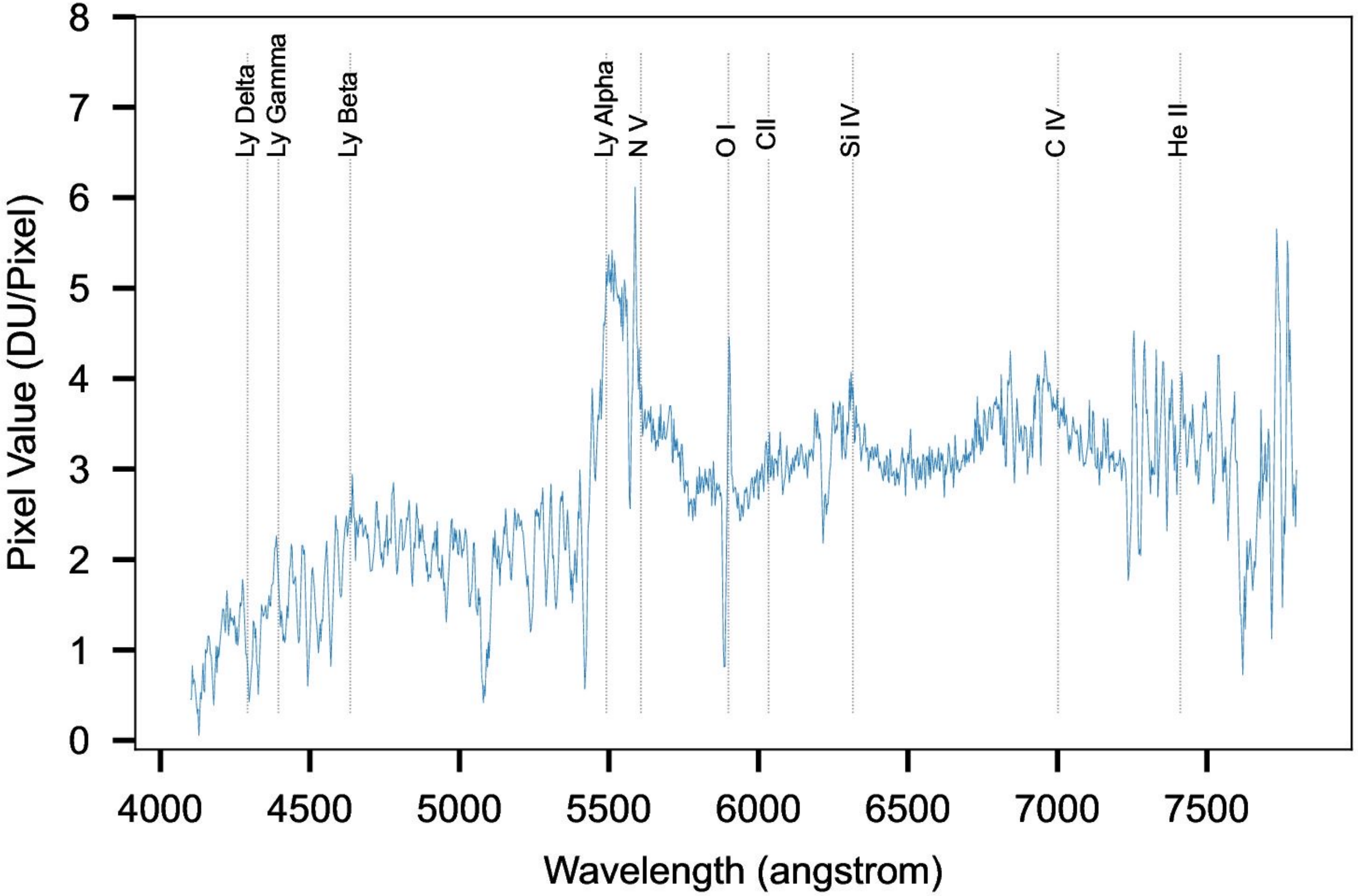
- Good for classification may be less good for regression
- On a well defined class, fitting a model may be fine

Need for:

- Large and balanced training sets (synthetic data)
- Proper error treatment
- Physical insight

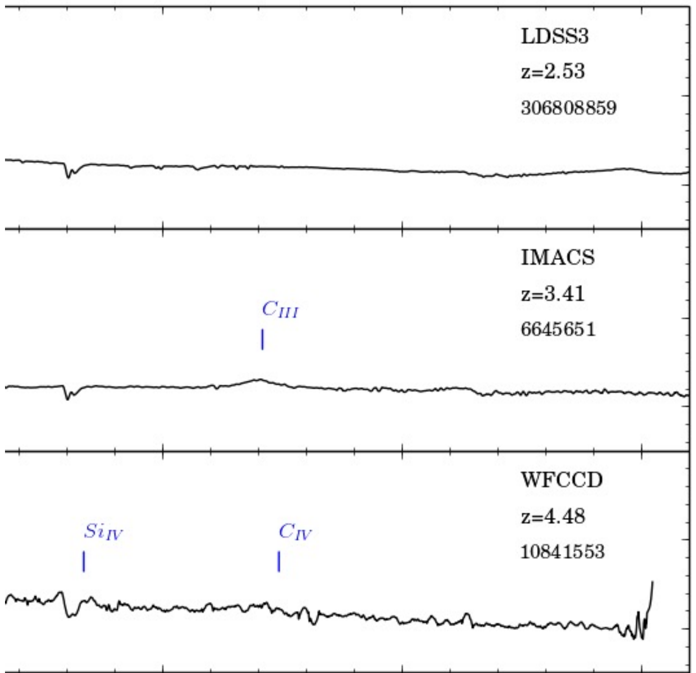


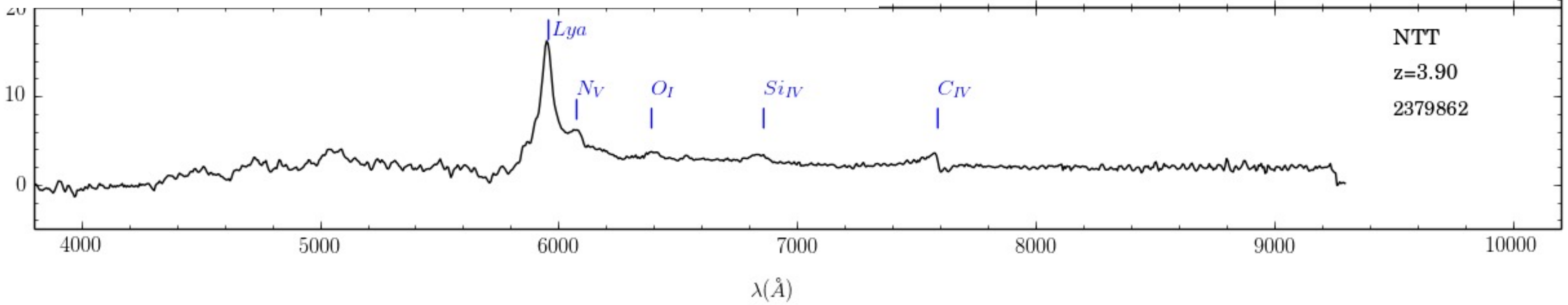
Remember *Minority Report (Dick, 1956)*



z= 3.519 i= 17.65

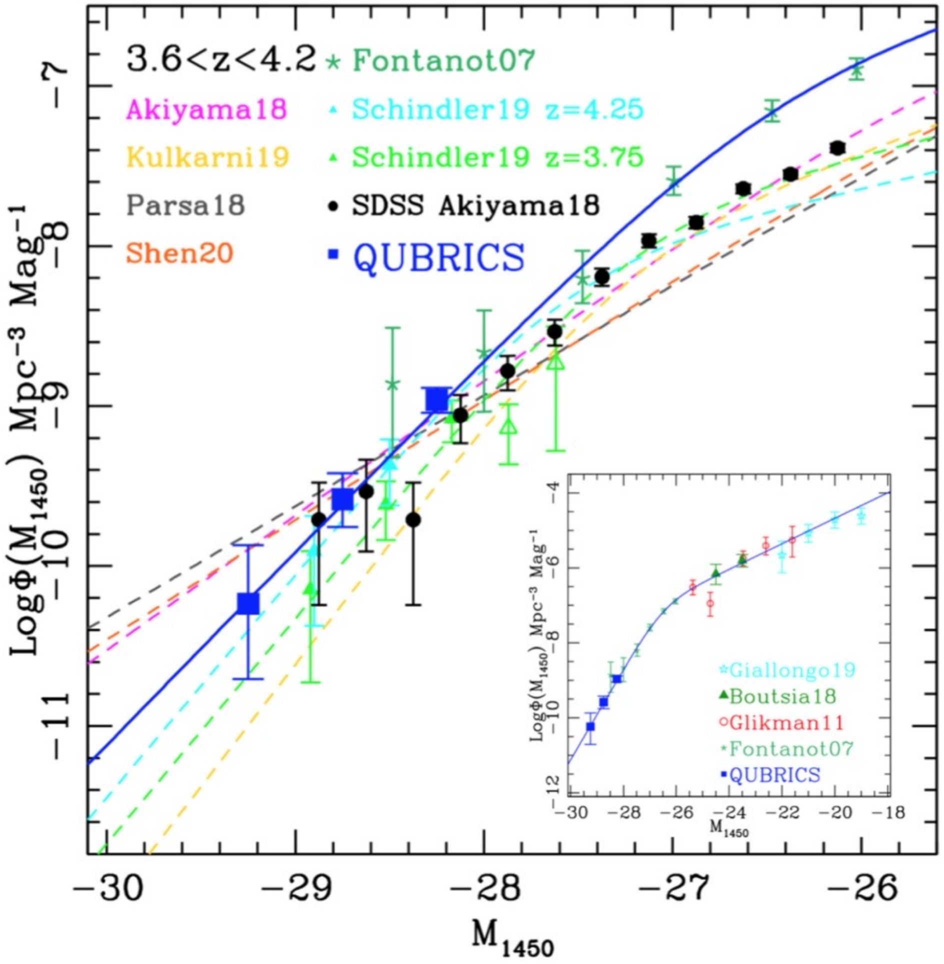
TNG Oct 23, 2020

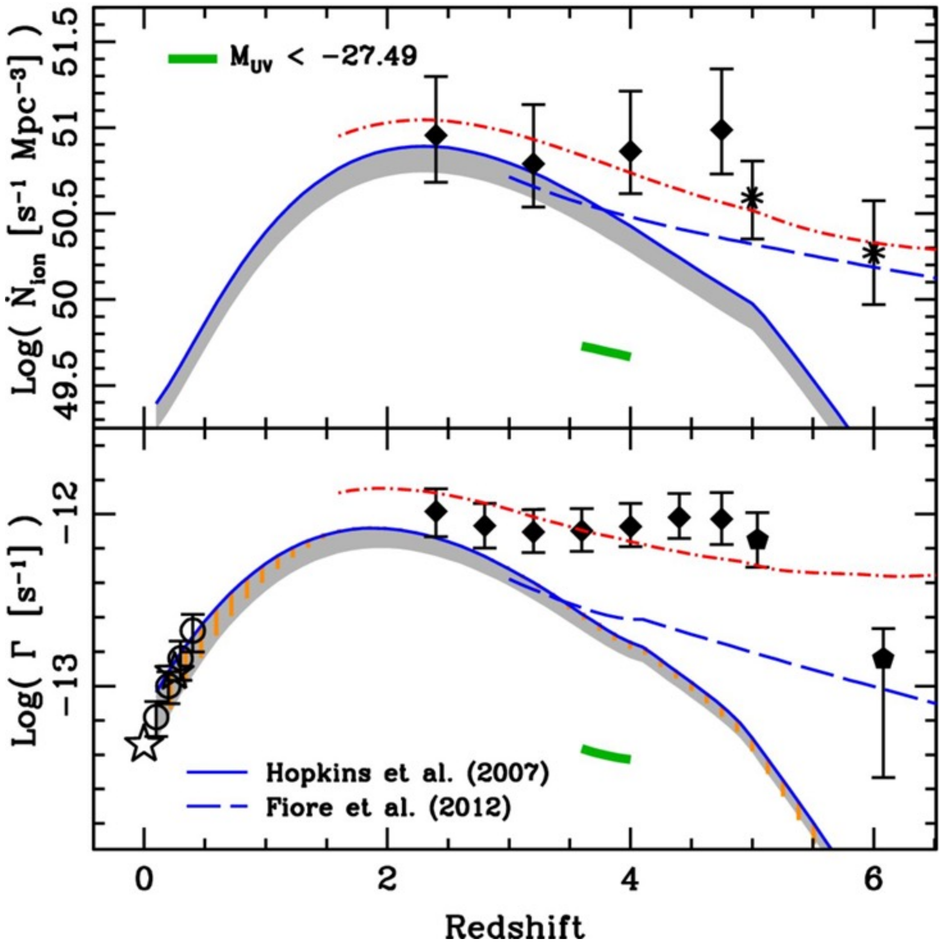




WP4 - High-z AGN: ionization

The Luminosity Function of Bright QSOs at z∼4 and Implications for the Cosmic Ionizing Background: Boutsia, Grazian+2021

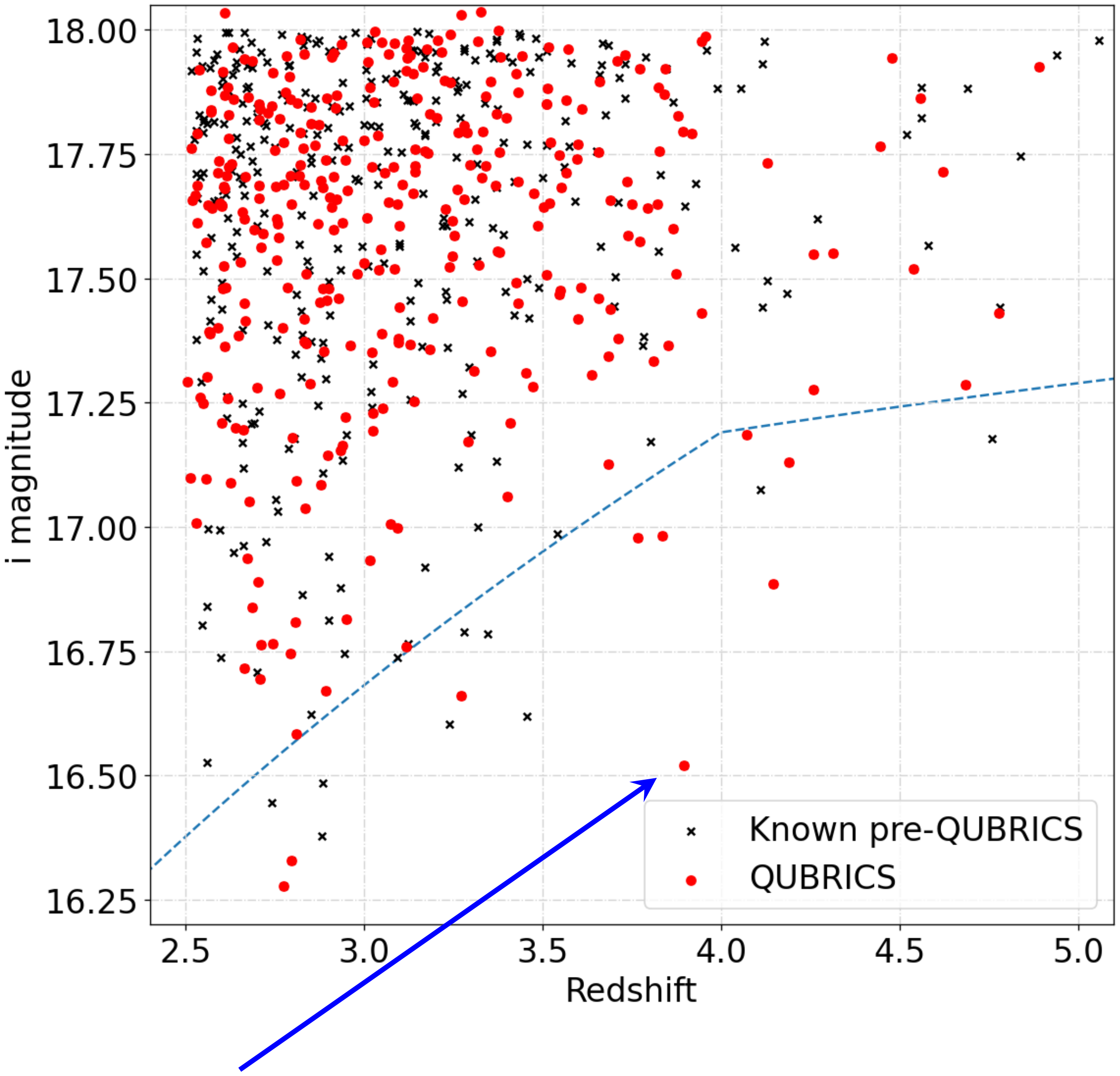


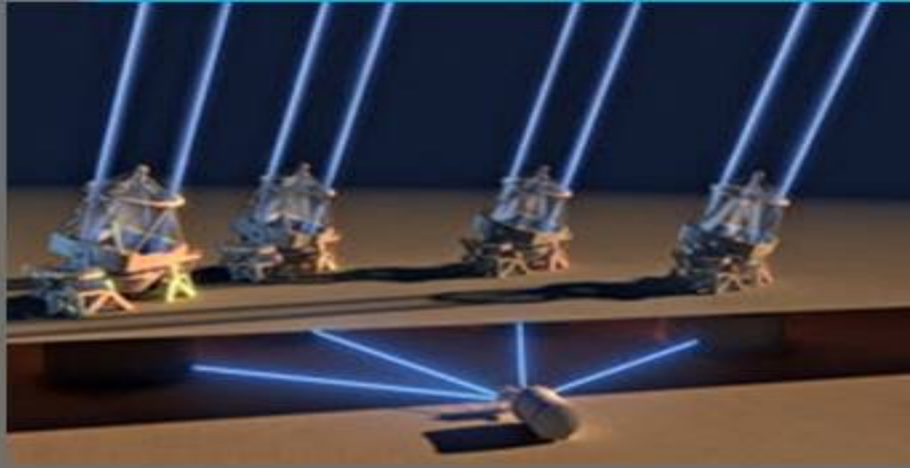


Fontanot+2014-2021

The current state of QUBRICS

- Good success rate, but there is room for improvements: synthetic data are being tested to improve performances
- Main contaminants are low redshift QSOs: galaxies and stars are reliably removed from the candidate sample



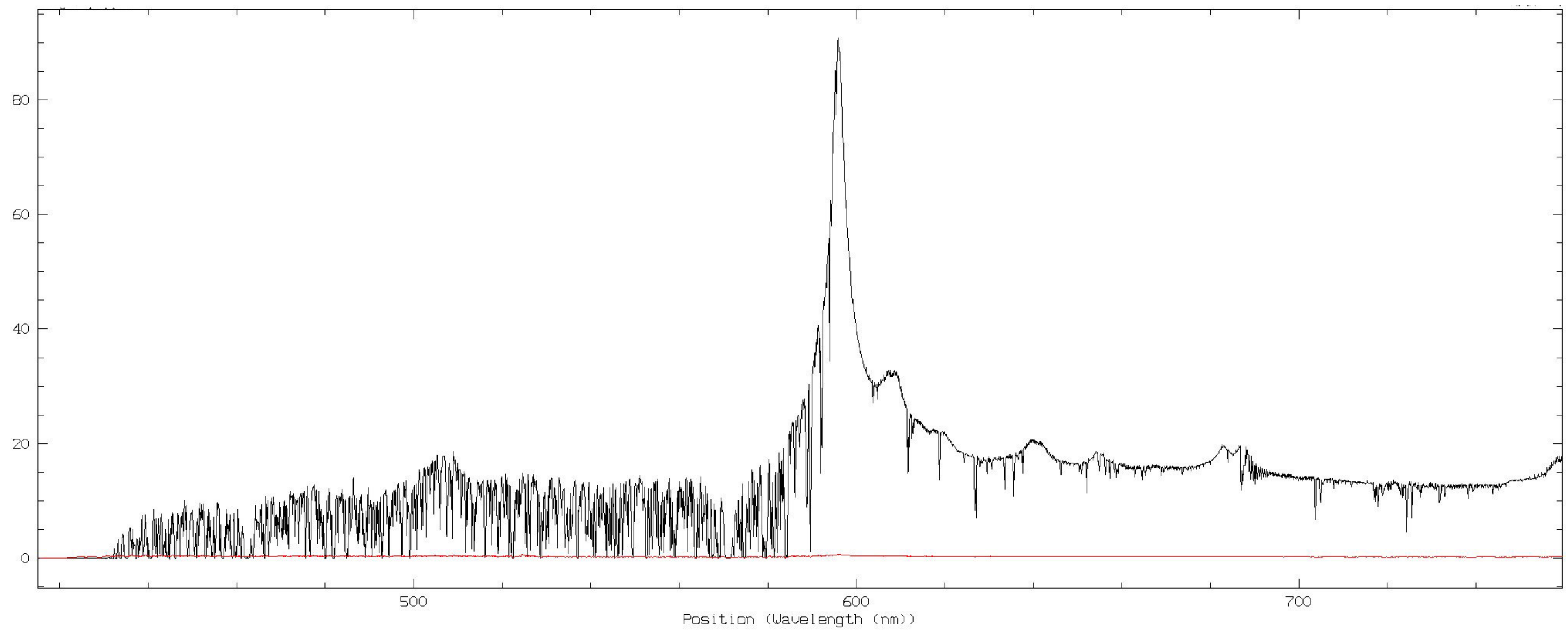


The Echelle SPectrograph for Rocky Exoplanets and Stable Spectroscopic Observations

Francesco A. Pepe, Stefano Cristiani, Rafael Rebolo Lopez, Nuno C. Santos

Matteo Aliverti, Antonio Amorim, Gerardo Avila, Veronica Baldini, Willy Benz, Alexandre Cabral, Giorgio Calderone, Pedro Carvas, Roberto Cirami, João Coelho, Maurizio Comari, Igor Coretti, Guido Cupani, Hans Dekker, Bernard Delabre, Paolo Di Marcantonio, Valentina D'Odorico, Michel Fleury, Ramòn Garcia Lòpez, Matteo Genoni, Ian Hughes, Olaf Iwert, Florian Kerber, Marco Landoni, Jorge Lima, Jean-Louis Lizon, Gaspare Lo Curto, Christophe Lovis, Charles Maire, Antonio Manescau, Carlos Martins, Denis Mégevand, Paolo Molaro, Mario Monteiro, Manuel Monteiro, Christoph Mordasini, Giorgio Pariani, Luca Pasquini, Didier Queloz, José Luis Rasilla, Jose Manuel Rebordão, Marco Riva, Samuel Santana Tschudi, Paolo Santin, Alex Segovia, Danuta Sosnowska, Paolo Spanò, Fabio Tenegi, Stéphane Udry, Maria Rosa Zapatero Osorio, Filippo Zerbi

ESPRESSO MR 4UT Res = 70.000



$$\sigma_v = 1.35 \left(\frac{\mathrm{S/N}}{3350}\right)^{-1} \left(\frac{N_{\mathrm{QSO}}}{30}\right)^{-1/2} \left(\frac{1+z_{\mathrm{QSO}}}{5}\right)^{-1.7}$$

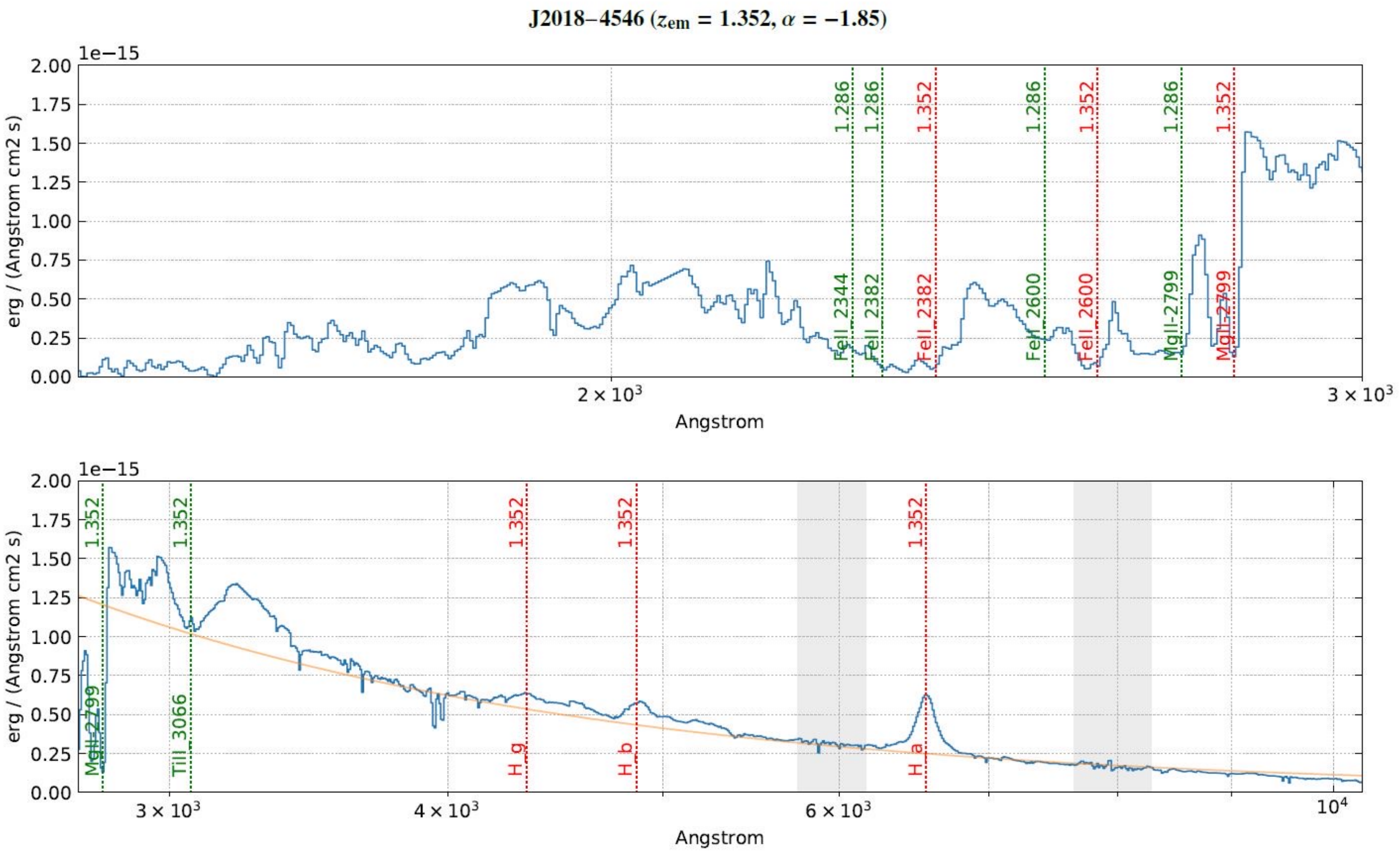
-30 nights

= 15 MEU

(increasing)

QUIPs (QUBRICS Irregular and Peculiar)

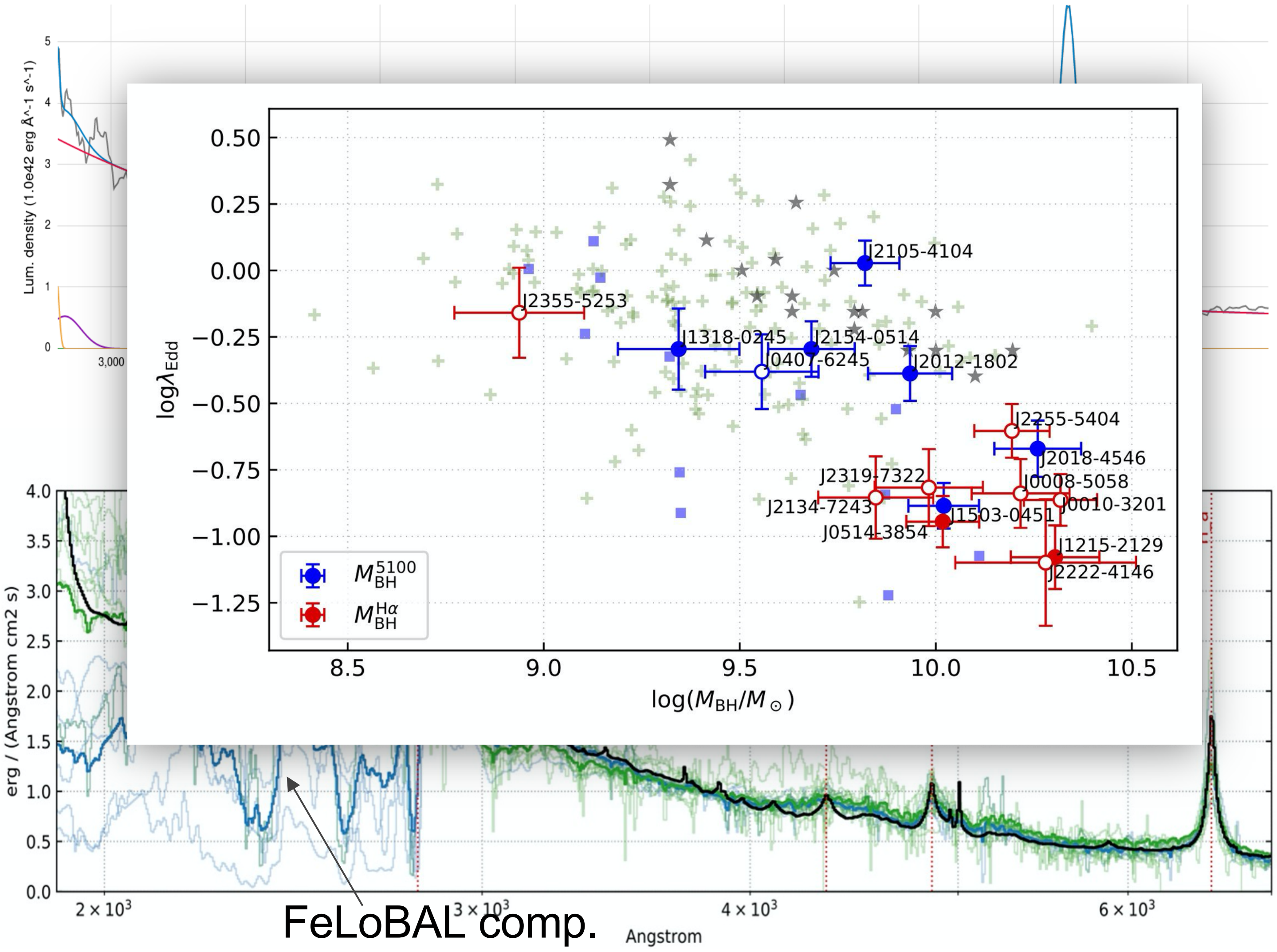
- Peculiar objects, difficult to assess
- NIR spectra taken, Hα/Hβ identified
- Large fraction of FeLoBALs similar to QSOs at higher *z*
- Edd ratios measured, ~normal



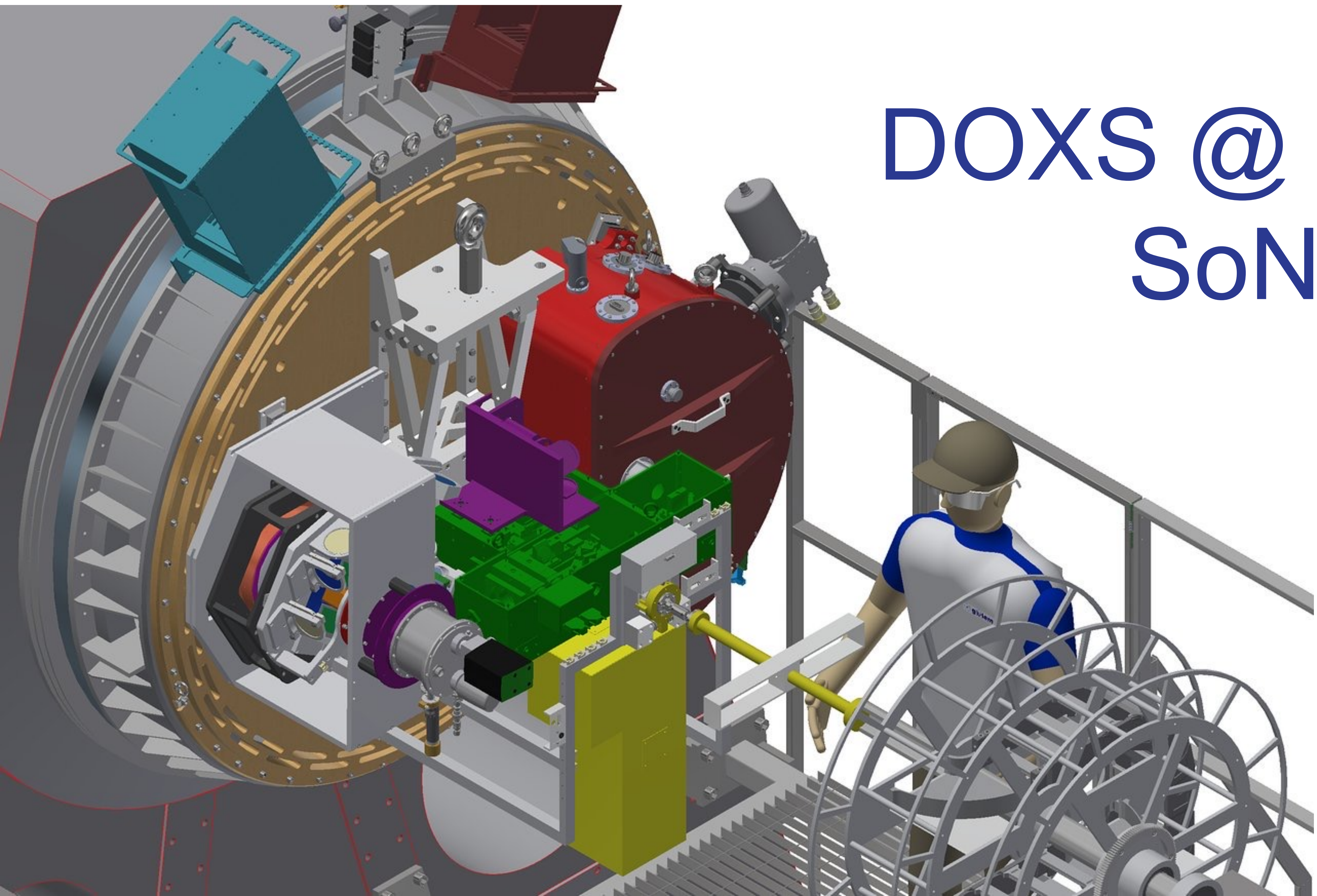
QUIPs

Cupani+21, submitted to MNRAS

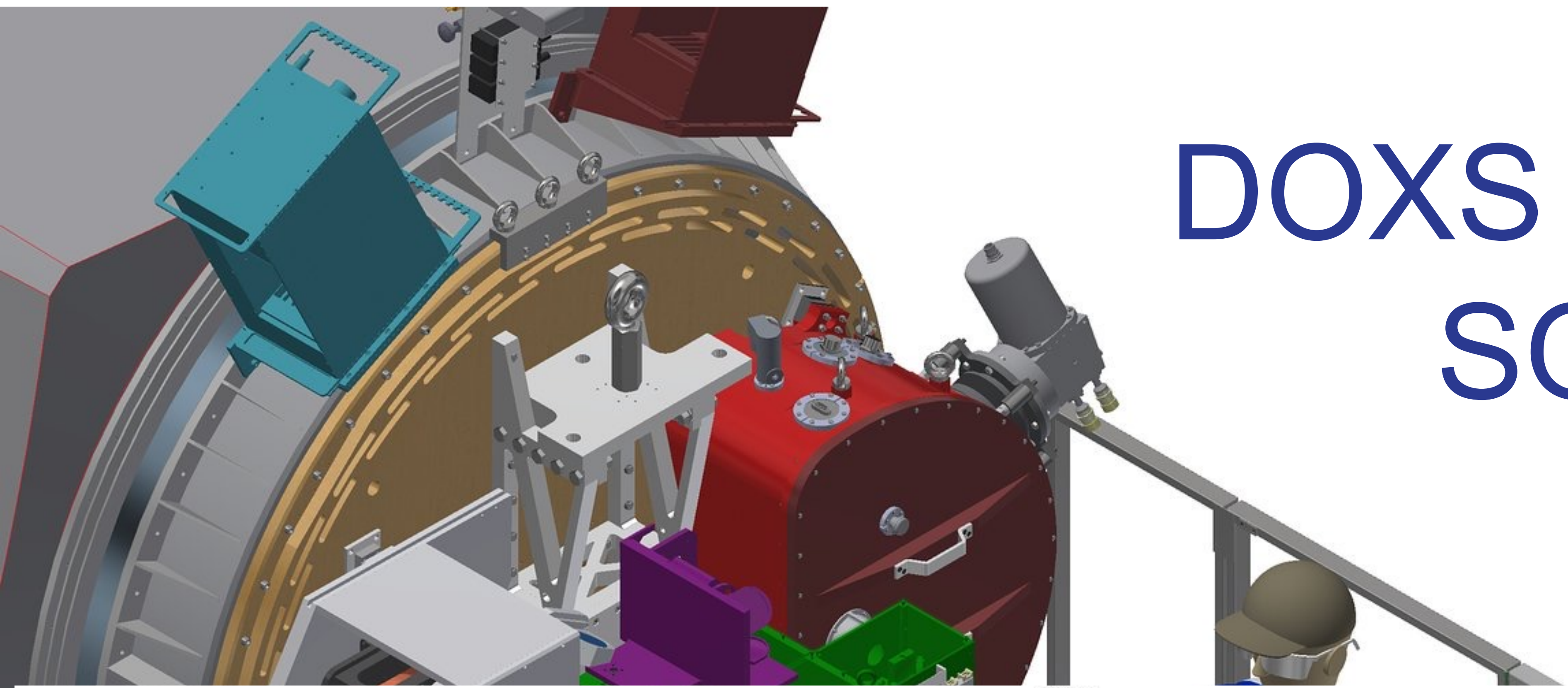
- Peculiar objects, difficult to assess
- NIR spectra taken, Hα/Hβ identified
- Large fraction of FeLoBALs mistaken as QSOs at higher *z*
- Edd ratios measured, ~normal



DOXS @ TNG
SoNiDo?



DOXS @ TNG SONIDO?



Riparto Fondo Ordinario Enti di Ricerca

Ministero dell'Università e della Ricerca

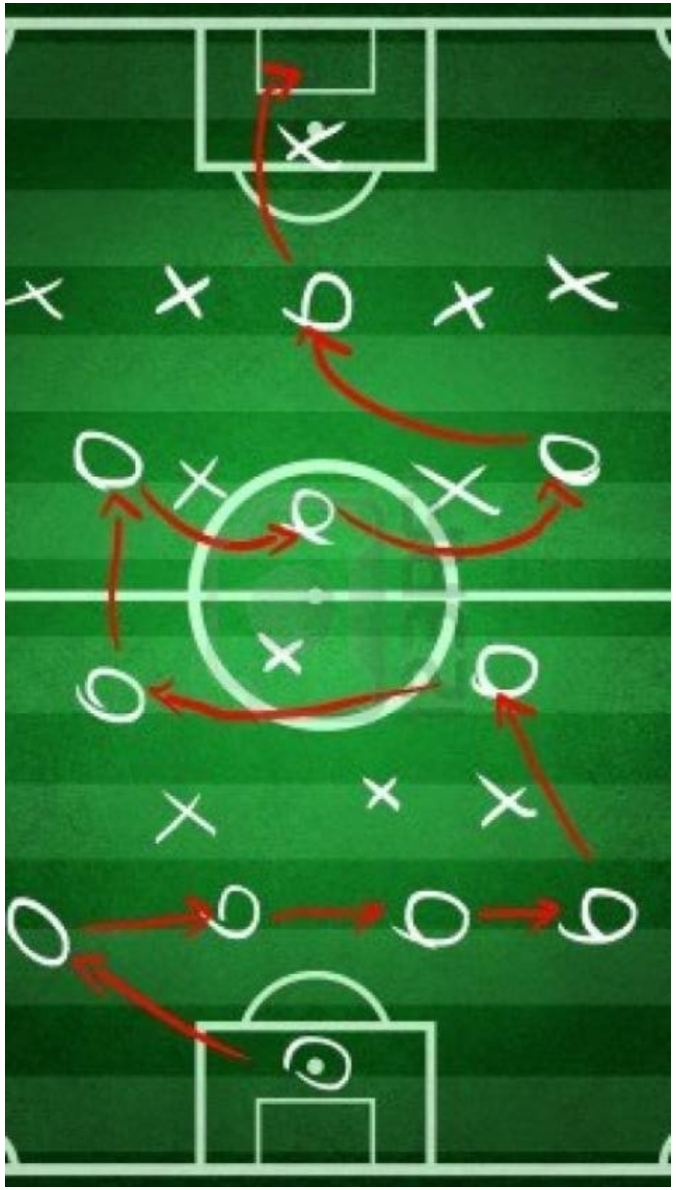
TABELLA 2

Progettualità di carattere straordinario				
Acronimo Ente	Acronimo/Titolo Progetto	Descrizione sintetica	2021	2020
INAF	TNG Telescopio nazionale Galileo)	Il TNG è un telescopio ottico-infrarosso da 3.6 mt di diametro operato dal 1996 presso l'Osservatorio del Roque de los Muchacos a La Palma (Canarie, Spagna), che ha un valore in conto capitale di circa 40 Milioni di Euro. Il continuo upgrade della strumentazione di TNG lo rende oggi uno dei telescopi più efficaci nella ricerca di exo-pianeti, una tematica fra le più prevalenti in campo internazionale.	2.900.000	2.000.000

NewIGM - The Team

Boera E.
Boutsia K.
Calderone G.
Cristiani S.
Cupani G.
D’Odorico V.
De Lucia G.
Di Gioia S.
Di Marcantonio P.
Fontanot F.

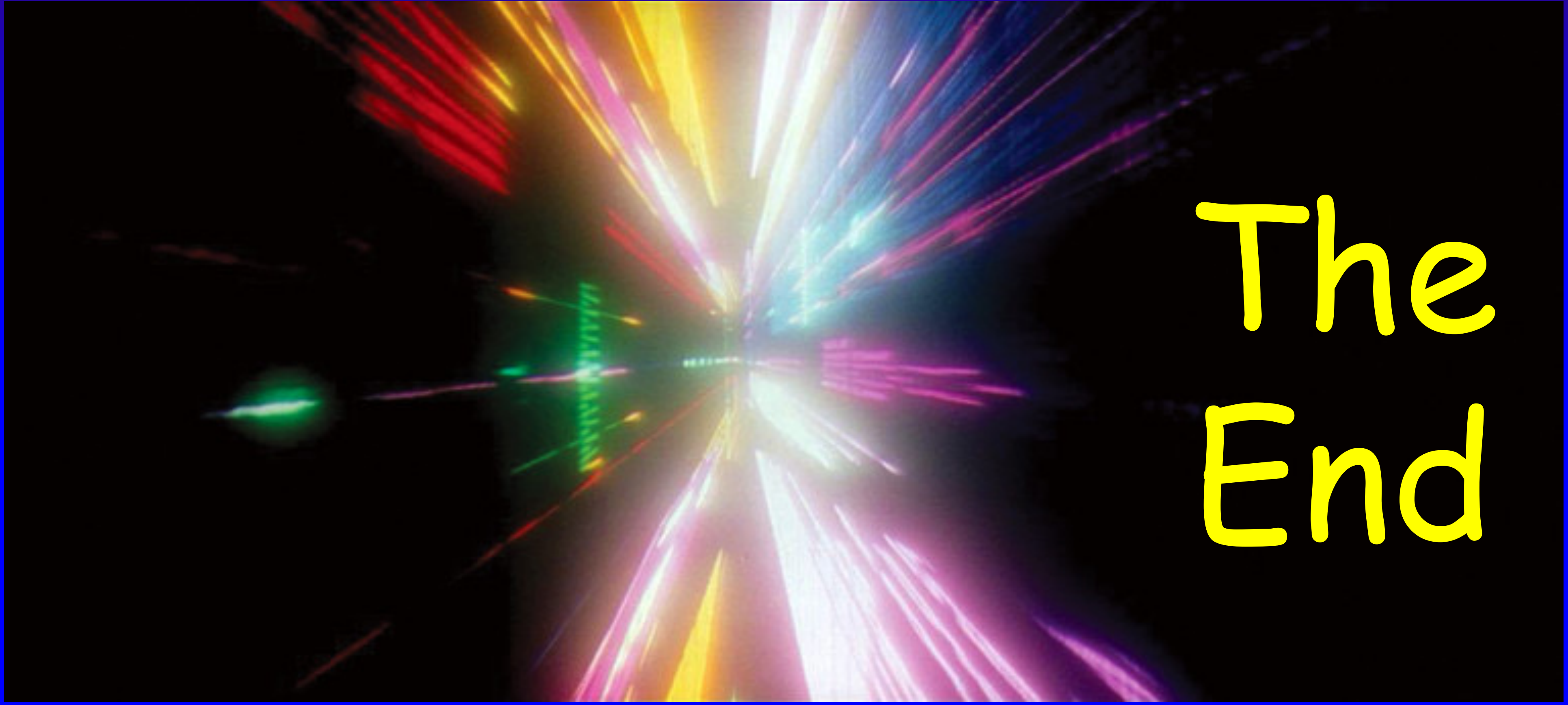
Giallongo E.
Grazian A.
Guarneri G.
Menci, N.
Milakovic D.
Molaro P.
Murphy M.
Omizzolo A.
Romano M.
Vanzella E.
Viel M.



> 15 FTE in 3 years - 10 @ Ts (8 @ OATs)


espresso
What else


Thanks!


The End


100 M
80 M
60 M
40 M
20 M

IGM - Absorption Lines – Why?

What were the physical conditions of the primordial Universe?

What fraction of the matter was in a diffuse medium and how early did it condense in clouds?

Where are most of the baryons at the various redshifts?

How early and in what amount have metals been produced?

Which constraints on cosmology & types of DM (e.g. ν) are derived from the IGM LSS?

What was the typical radiation field, how homogenous, and what was producing it?

When and how, after the Dark Ages following recombination, did the Universe get reionized?

Does the SBBN correctly predict primordial element abundances and CMB T evolution?

Do fundamental constants of physics (e.g. α, μ) vary with time?

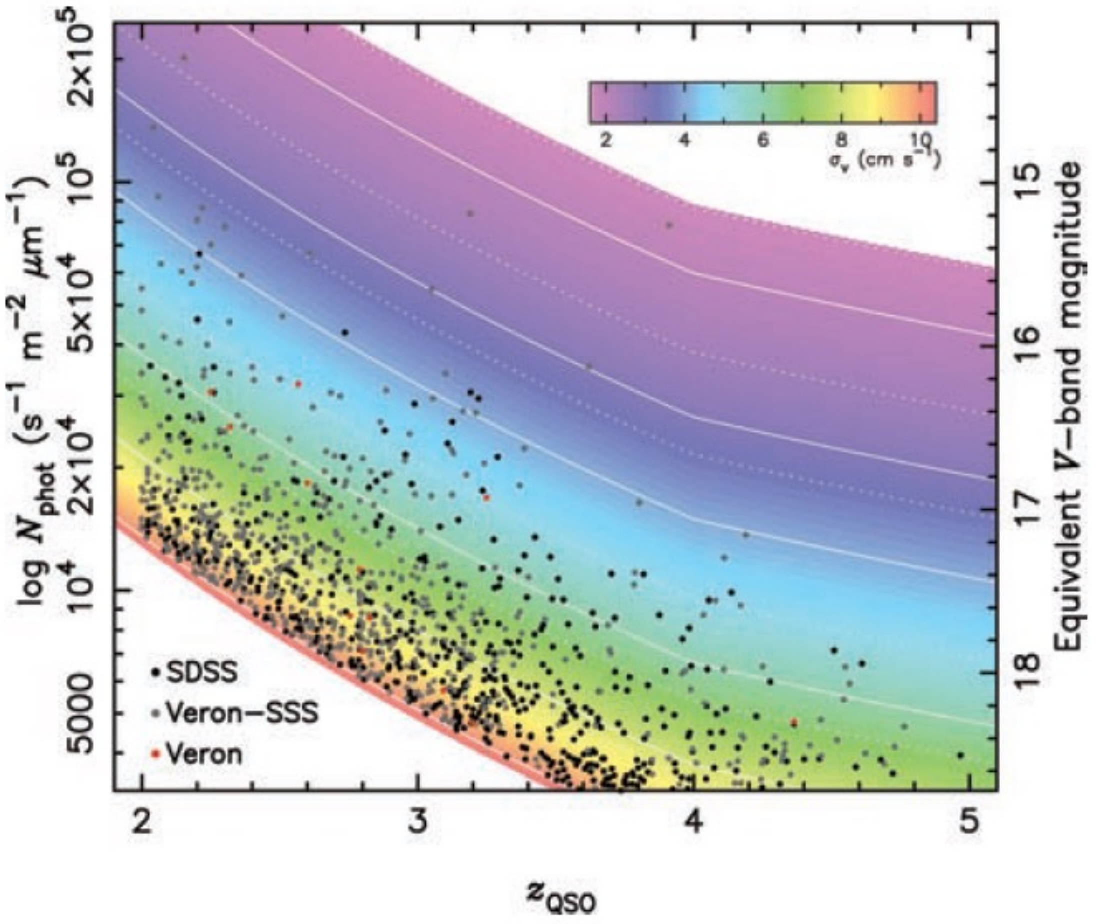


Figure 11. The dots show the known, bright, high-redshift QSO population (separated by subsets as indicated, see text) as a function of redshift and estimated photon flux at the centre of the Lyα forest. Along the right-hand vertical axis we have converted the photon flux to a corresponding Johnson V-band magnitude. The background colour image and solid contours show the value of σ_v that can be achieved for a given photon flux and redshift, assuming $D = 42$ m, $\epsilon = 0.25$ and $t_{int} = 2000$ h. The contour levels are at $\sigma_v = 2, 3, 4, 6, 8$ and $10\,\mathrm{cm\,s^{-1}}$. The dotted contours show the same as the solid ones, but for $D = 35$ m or, equivalently, for $\epsilon = 0.17$ or $t_{int} = 1389$ h.

Liske et al 2008

Sandage test @ ELT