INAF
ISTITUTO NAZIONALE DI ASTROFISICA
NATIONAL INSTITUTE FOR ASTROPHYSICS

UNIVERSITÀ DEGLI STUDI DI PADOVA

GTC optical spectroscopy of TeV blazars

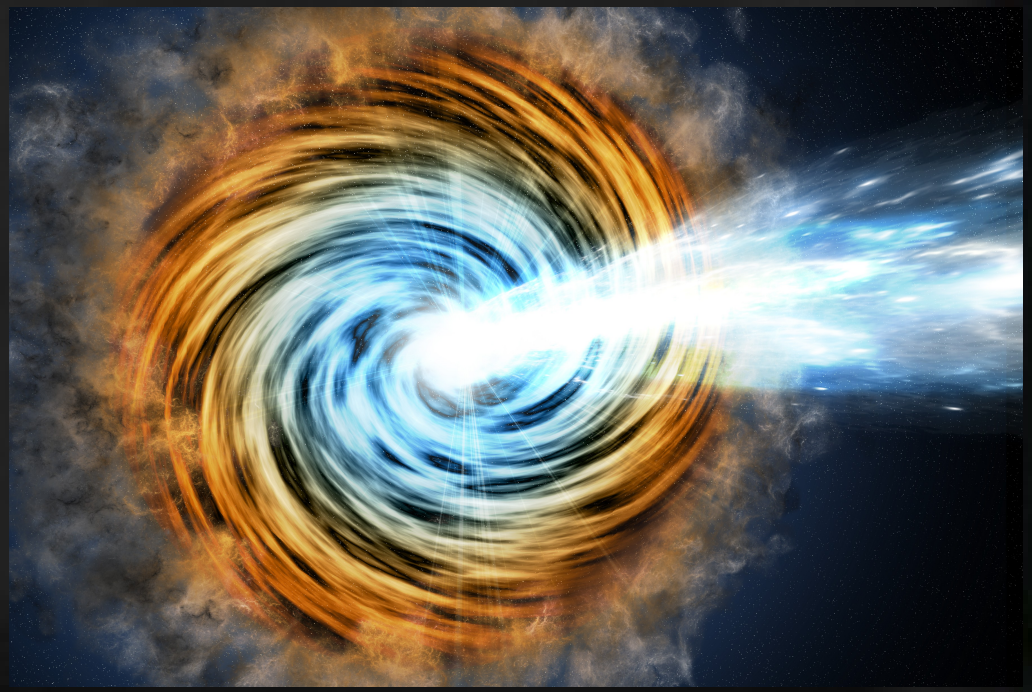
Speaker: S. Paiano – (INAF–OAPD)
Collaborators: R. Falomo, A. Treves, M. Landoni, R. Scarpa, C. Righi

AGN12 meeting – Napoli – 29 Settembre 2016

Aim of the work

Blazars represent the most abundant extragalactic population at GeV–TeV energies

Contrary to most AGNs
with prominent emission features,
Blazars/BL Lacs often
lack its redshift
(or it is very uncertain)
[see Landoni's talk]



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- For the interpretation of emission models
- To study the EBL

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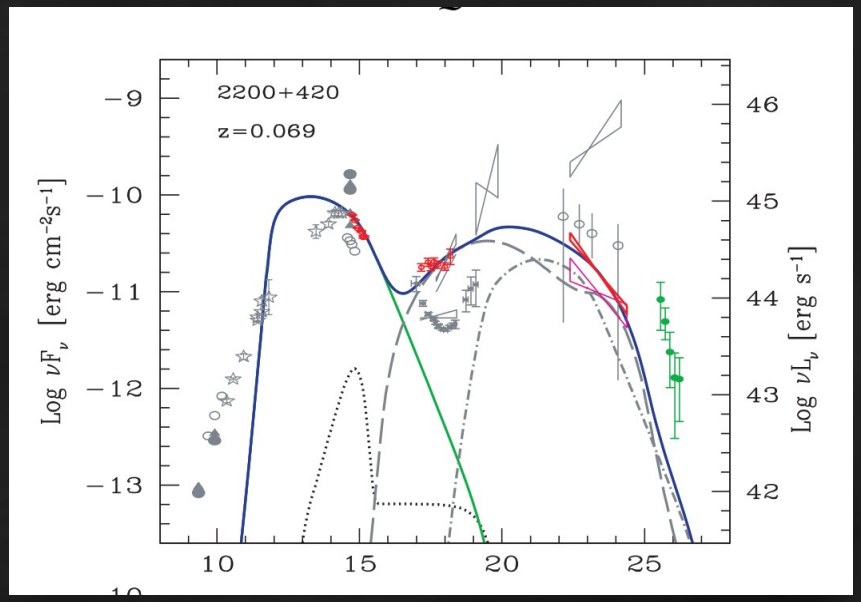

Ghisellini+2011

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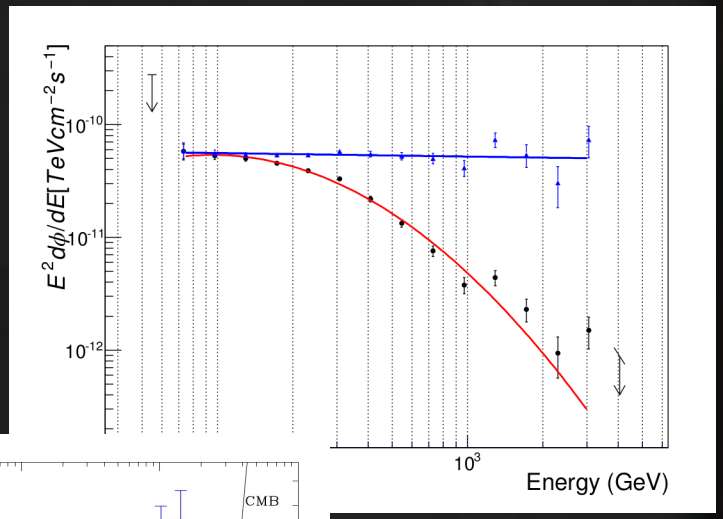
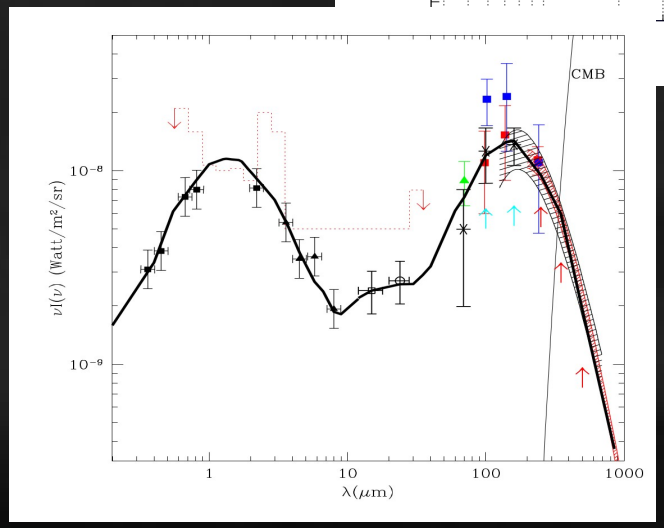


Ahnen+2016
(MAGIC coll.)

- For the interpretation of emission models
- To study the EBL



Franceschini+2016

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- For the inte
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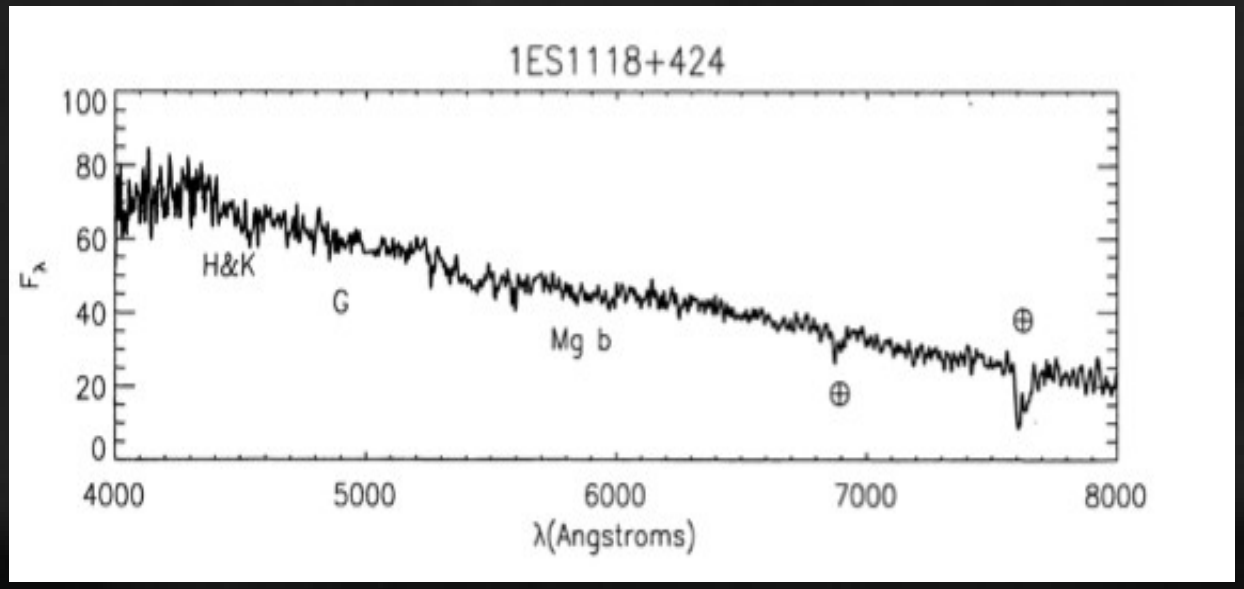
- To study

We present the results of a spectroscopical campaign carried out at the GTC for a sample of 21 TeV (or candidate TeV) blazars with unknown/uncertain redshift

The Sample

14 TeV blazars and 7 TeV candidates of BZCAT
with unknown or uncertain redshift

BZB J1120+4212 (RBS0970) → z=0.124 (?)



Perlman+1996

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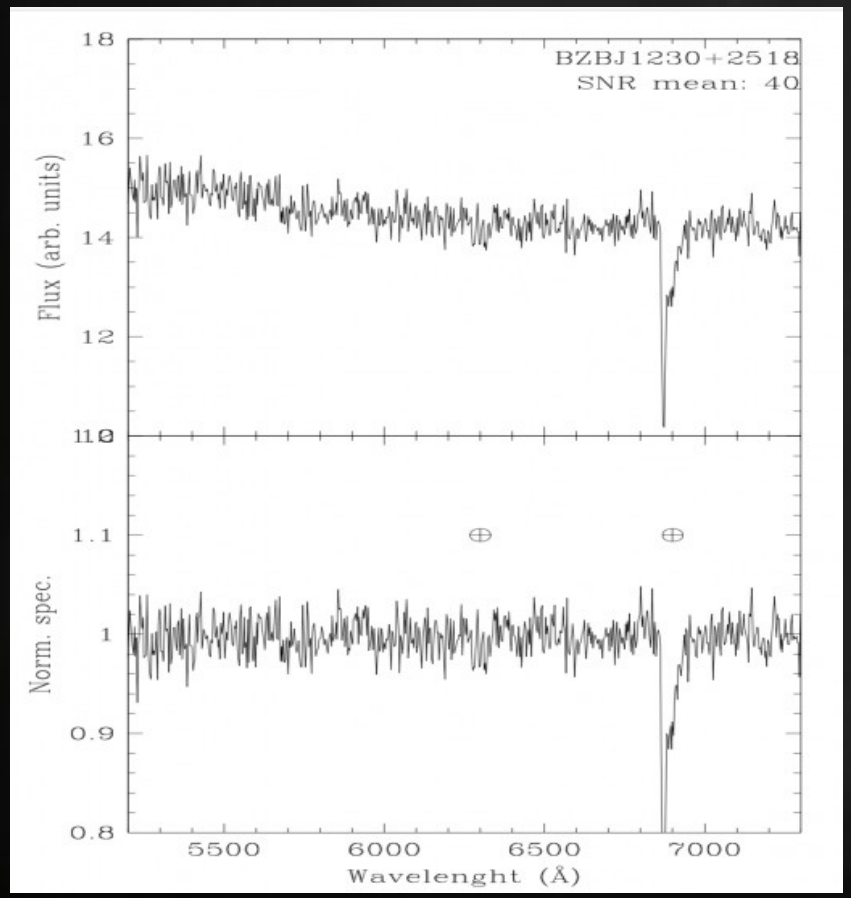
14 TeV blazars and 7 TeV candidates of BZCAT with unknown or uncertain redshift



Massaro+2015

S3 1227+255

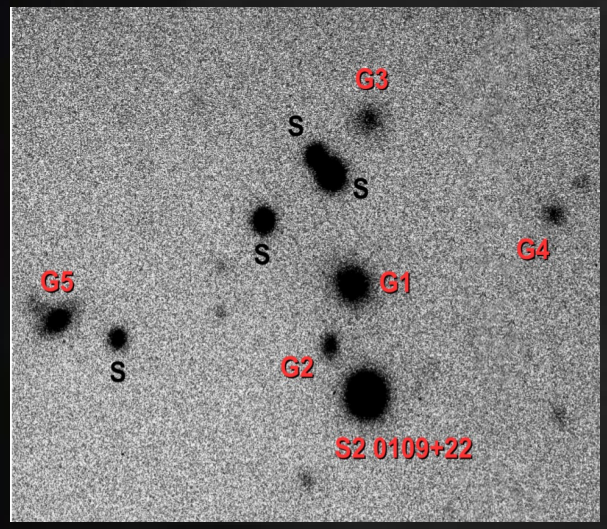
Z=0.135 (?)

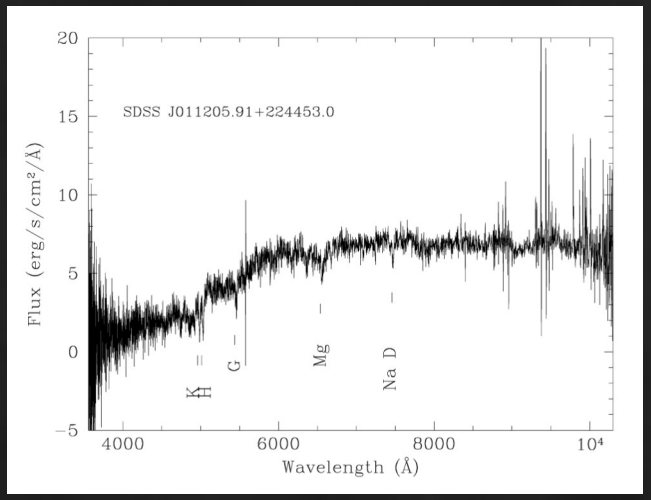
So far no spectrum published

The Sample

14 TeV blazars and 7 TeV candidates of BZCAT with unknown or uncertain redshift

S2 0109+22 z=0.26





SDSS spectrum, Healey+2008, Shaw+2012

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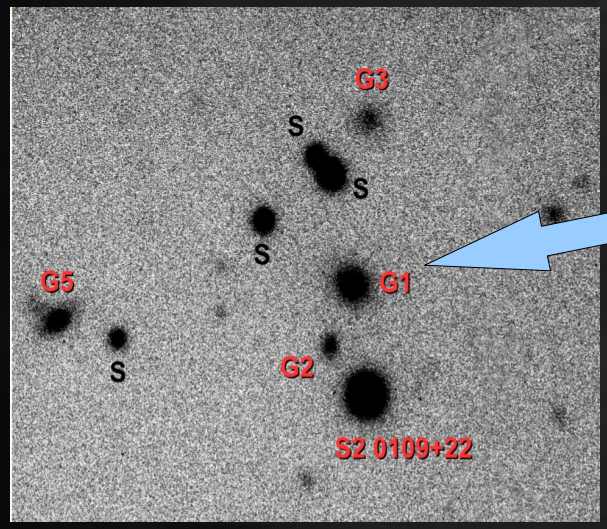
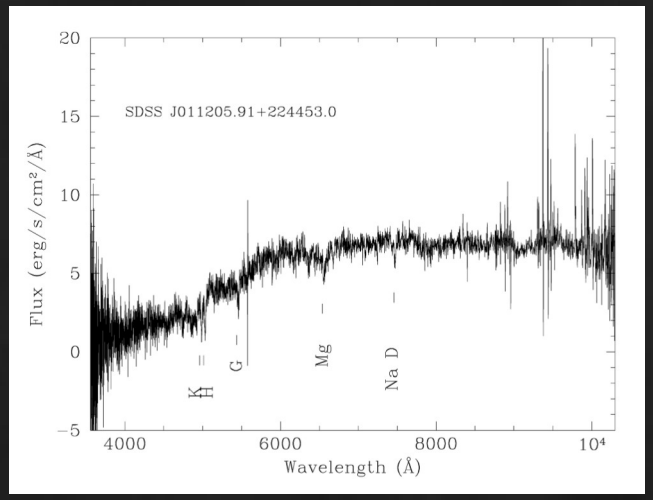


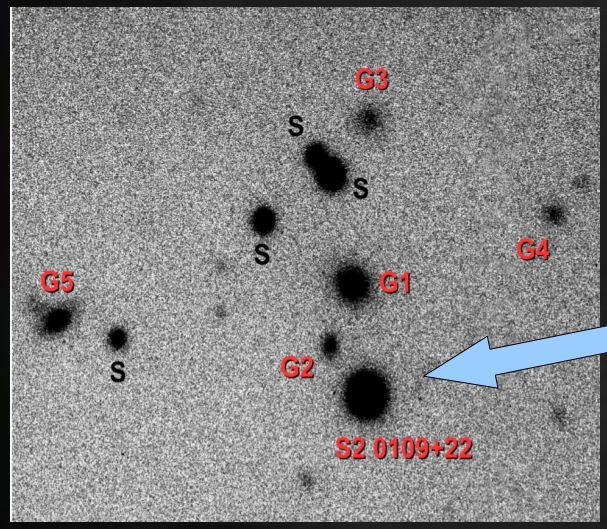


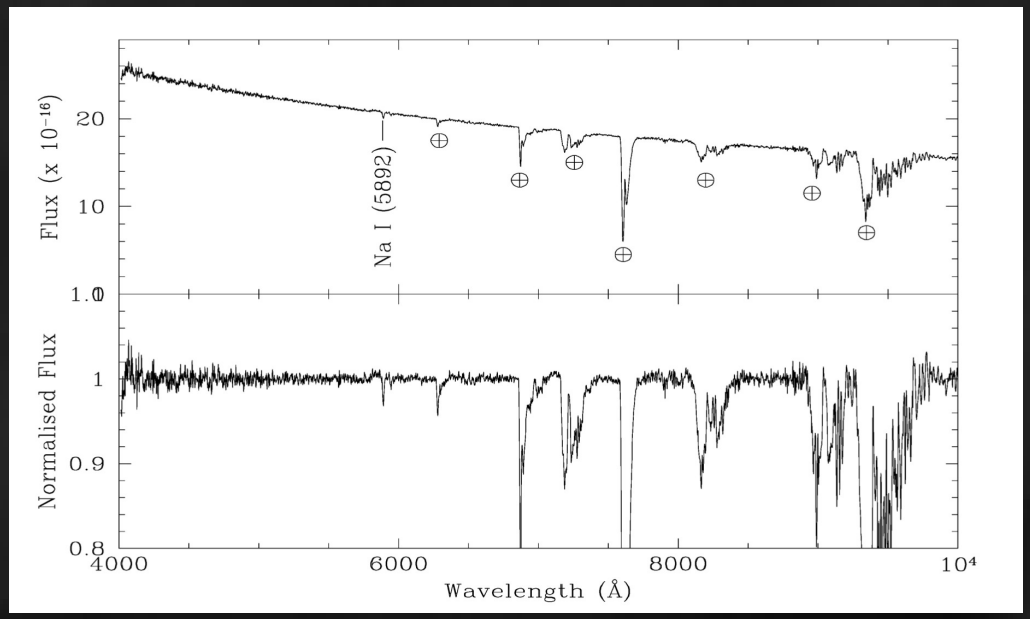
SDSS spectrum, Healey+2008, Shaw+2012

The Sample

14 TeV blazars and 7 TeV candidates of BZCAT with unknown or uncertain redshift

S2 0109+22 ~~z=0.126~~ = still unknown



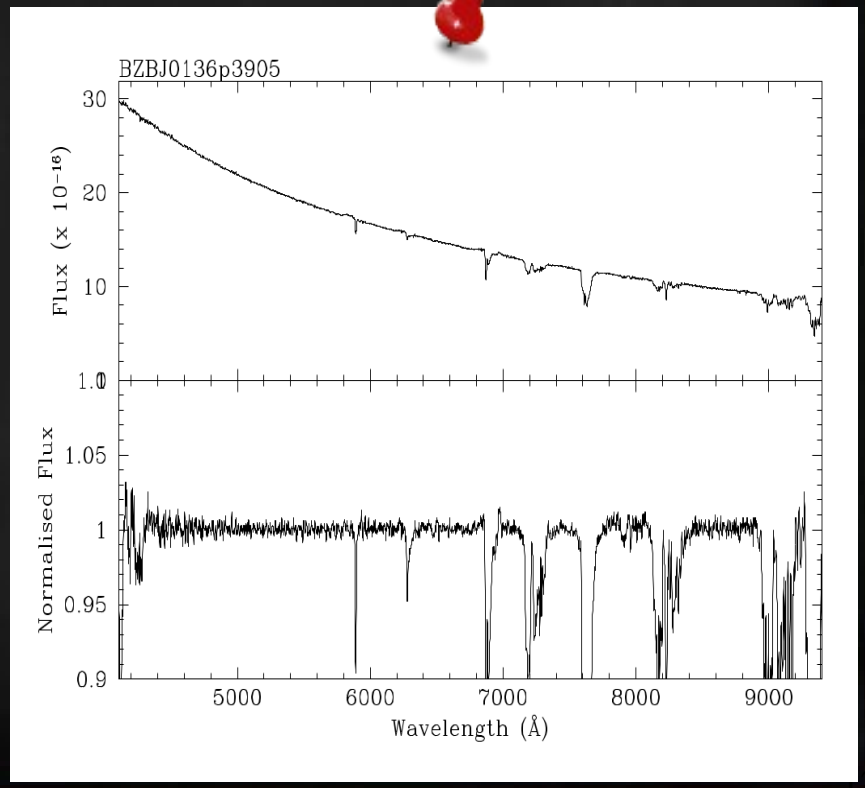


Paiano+2016

GTC observations

Spectra (4000–10000 A) obtained with OSIRIS@GTC

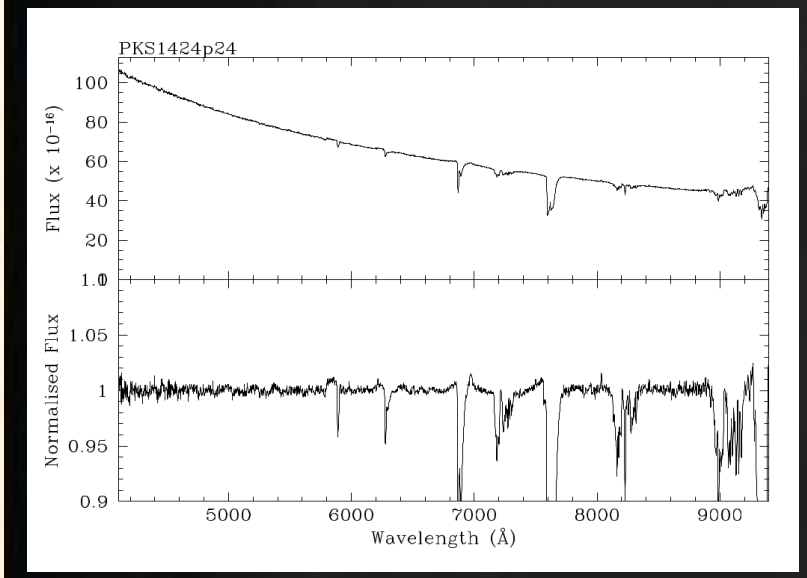
Details in Landoni's talk



Spectra with high SNR → ~ 100–500

Results: search for em/abs features

New Redshift for PKS 1424+240



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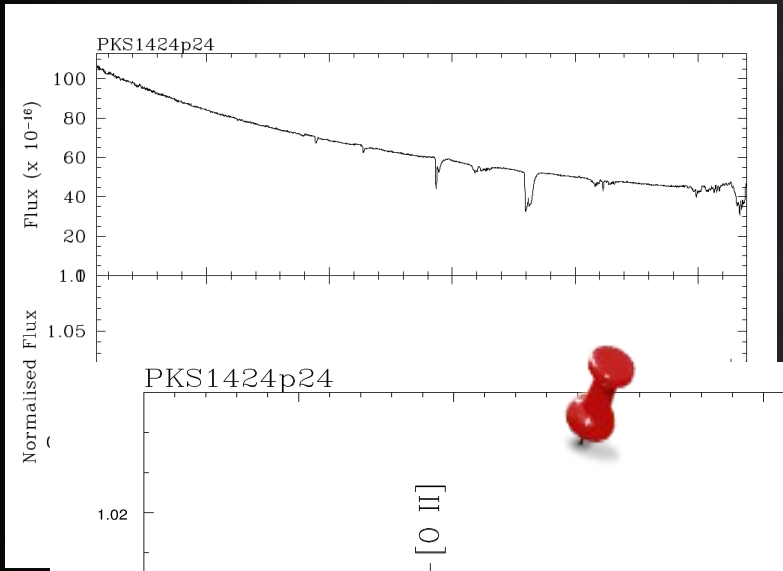
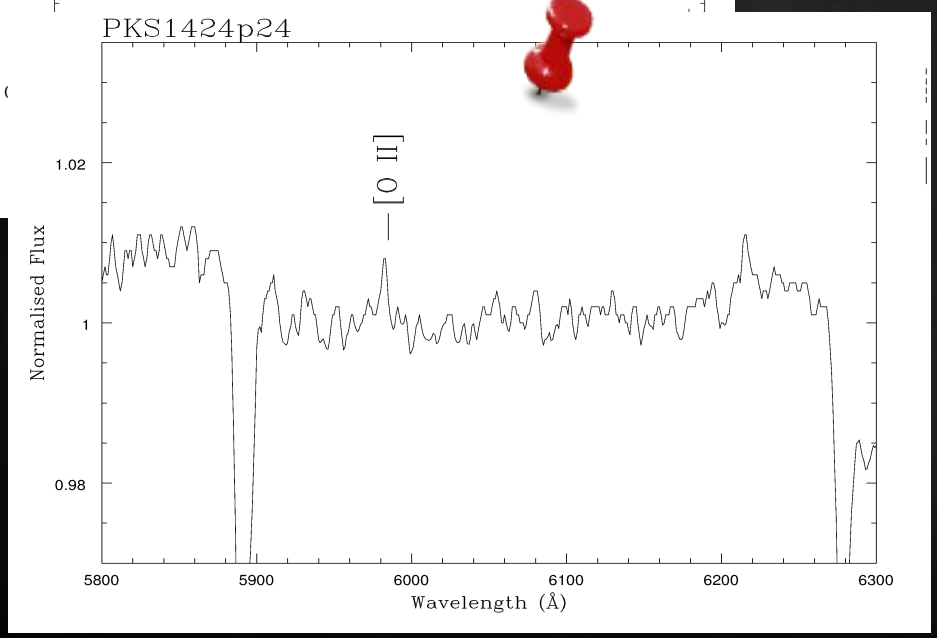
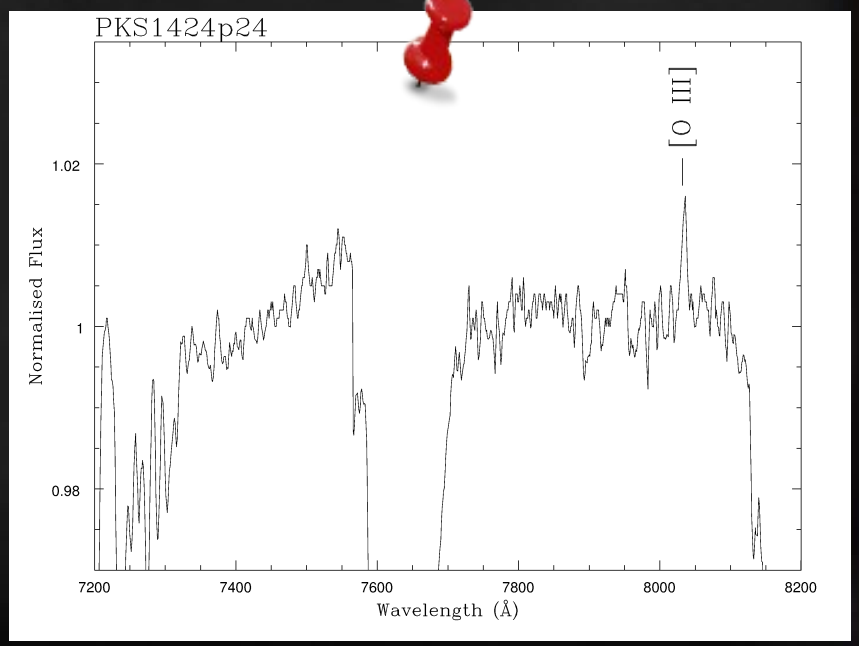


[OII] 3727 A ; [OIII] 5007 A

@z = 0.604



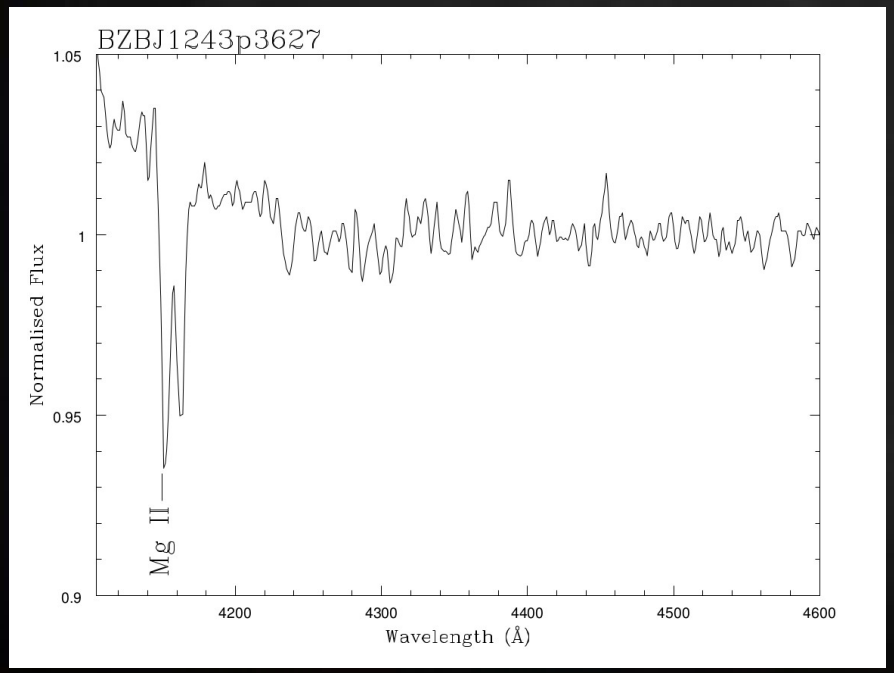


Results: search for em/abs features

MgII abs lines for BZB1243 & BZB1540

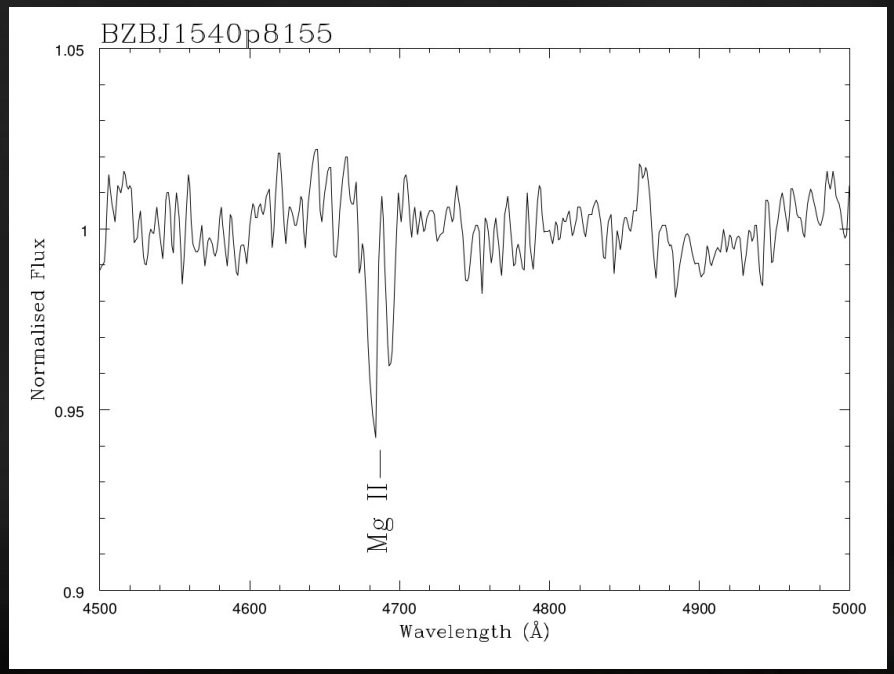
BZBJ1243+3627

MgII 2800A @ z > 0.48



BZBJ1540+8155

MgII 2800A @ z > 0.67

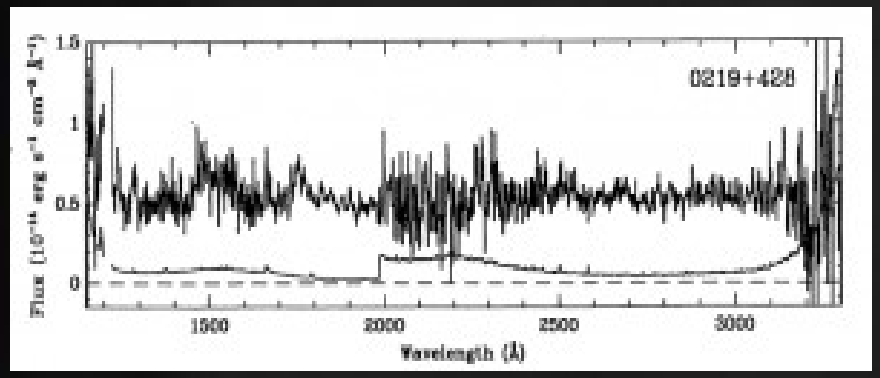


Results: search for em/abs features

4 targets with confirmed redshift

6 targets with no-confirmed redshift and still unknown

3C 66A → z=0.444(?)



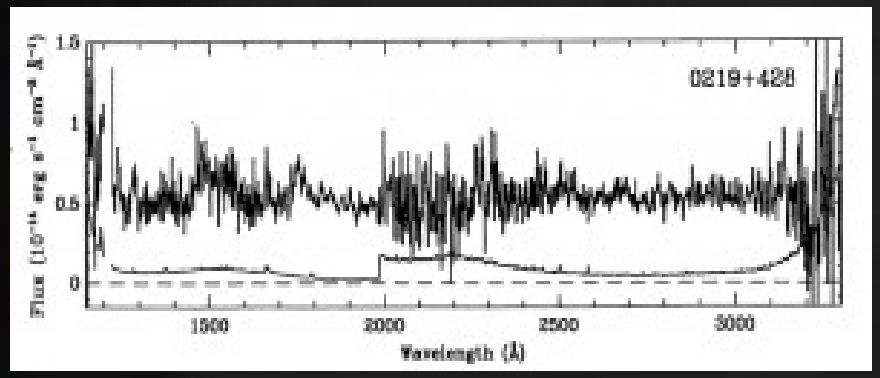
Miller+78 (MgII ?),
Spectrum above from
Lanzetta+1993

Results: search for em/abs features

4 targets with confirmed redshift

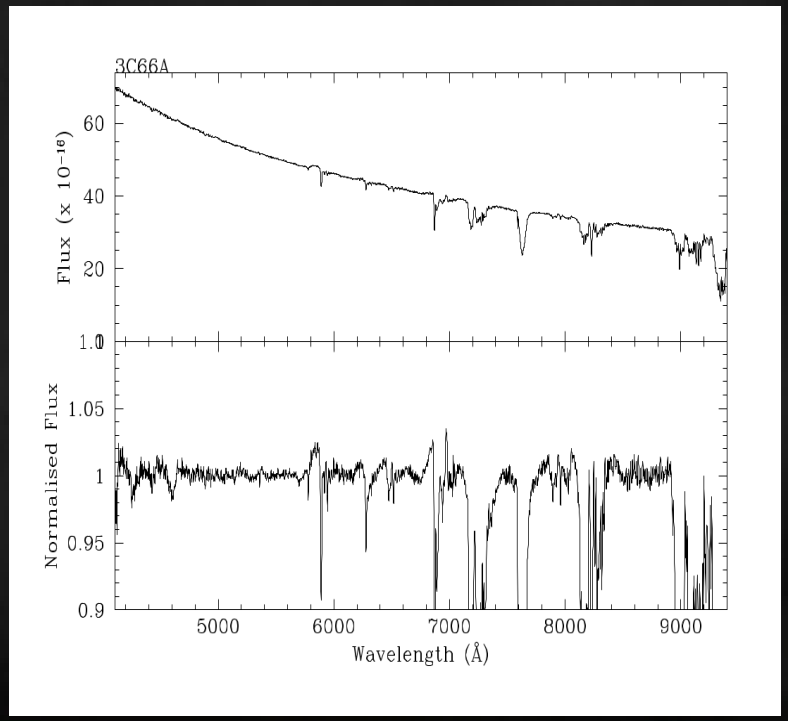
6 targets with no-confirmed redshift and still unknown

3C 66A → ~~z=0.444~~(?) → not confirmed



Miller+78 (MgII ?),
Spectrum above from
Lanzetta+1993

SNR=300 – Ewmin=0,1 A – z>0.1



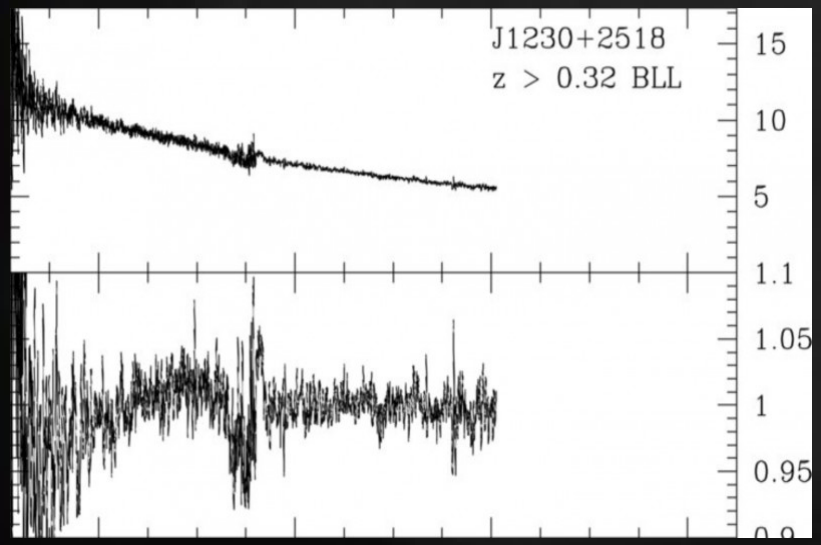
Results: search for em/abs features

4 targets with confirmed redshift

6 targets with no-confirmed redshift and still unknown

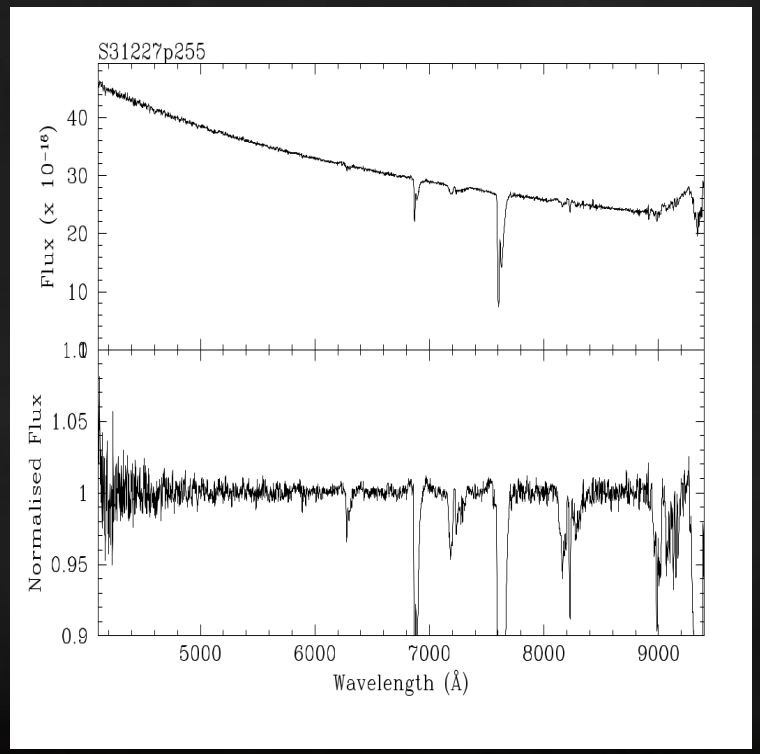
S3 1227+255 → z=0.135(?) → not confirmed

Nass+96 → No spectrum
No info



Shaw+2013

SNR=300 – Ewmin=0,09 A – z>0.1

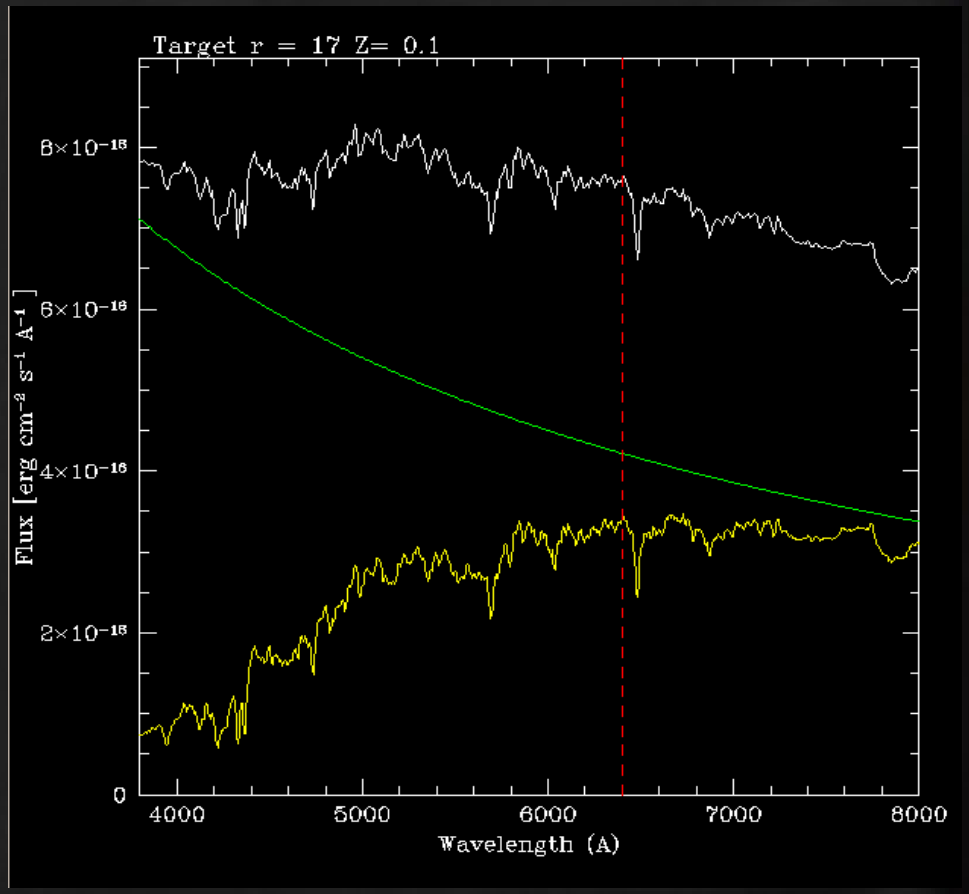


Results: Lower Limits on the redshift

Non-thermal Nucleus +
Elliptical host galaxy =

Spectrum observed !

Mag=17 z=0.10 Diluited EW=1,60A

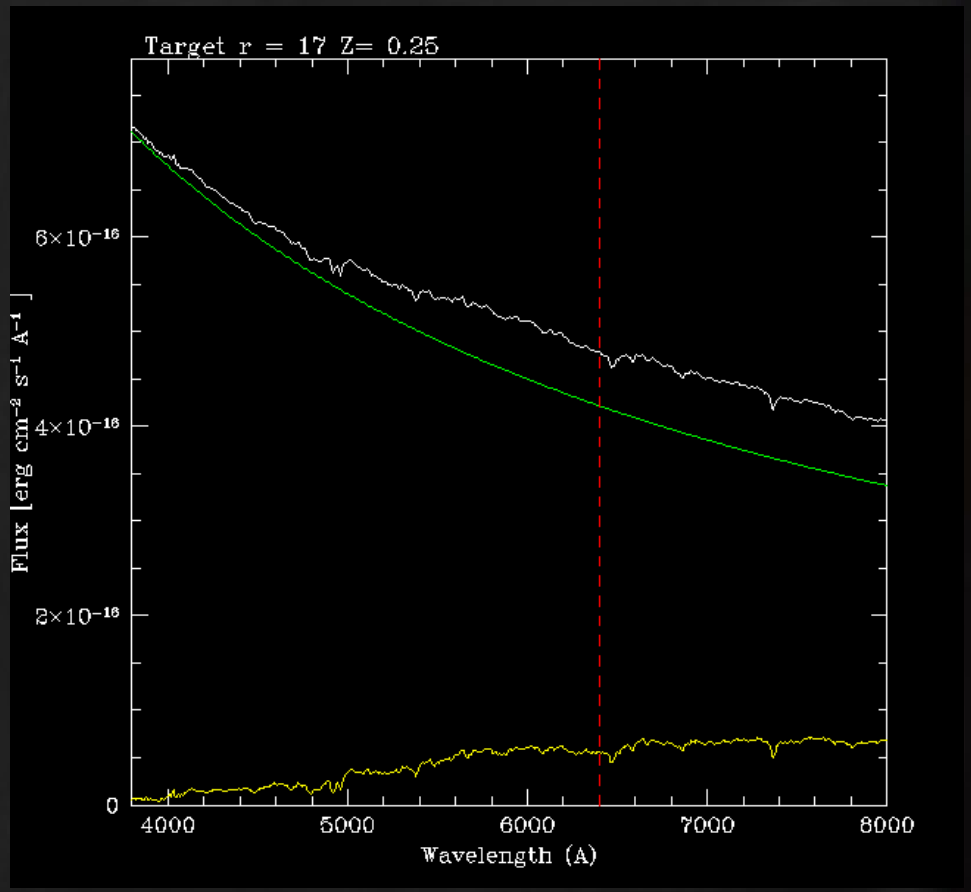


Results: Lower Limits on the redshift

Non-thermal Nucleus +
Elliptical host galaxy =

Spectrum observed !

Mag=17 z=0.25 Diluited EW=0,49A

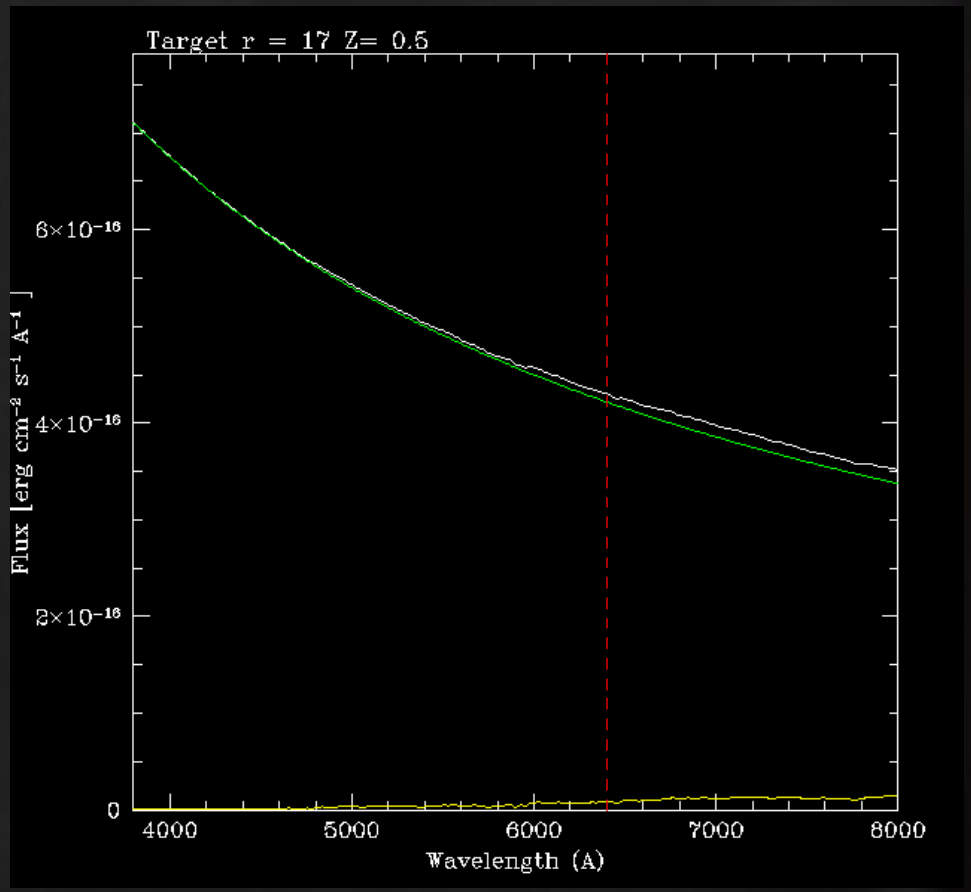


Results: Lower Limits on the redshift

Non-thermal Nucleus +
Elliptical host galaxy =

Spectrum observed !

Mag=17 z=0.50 Diluited EW=0,15A



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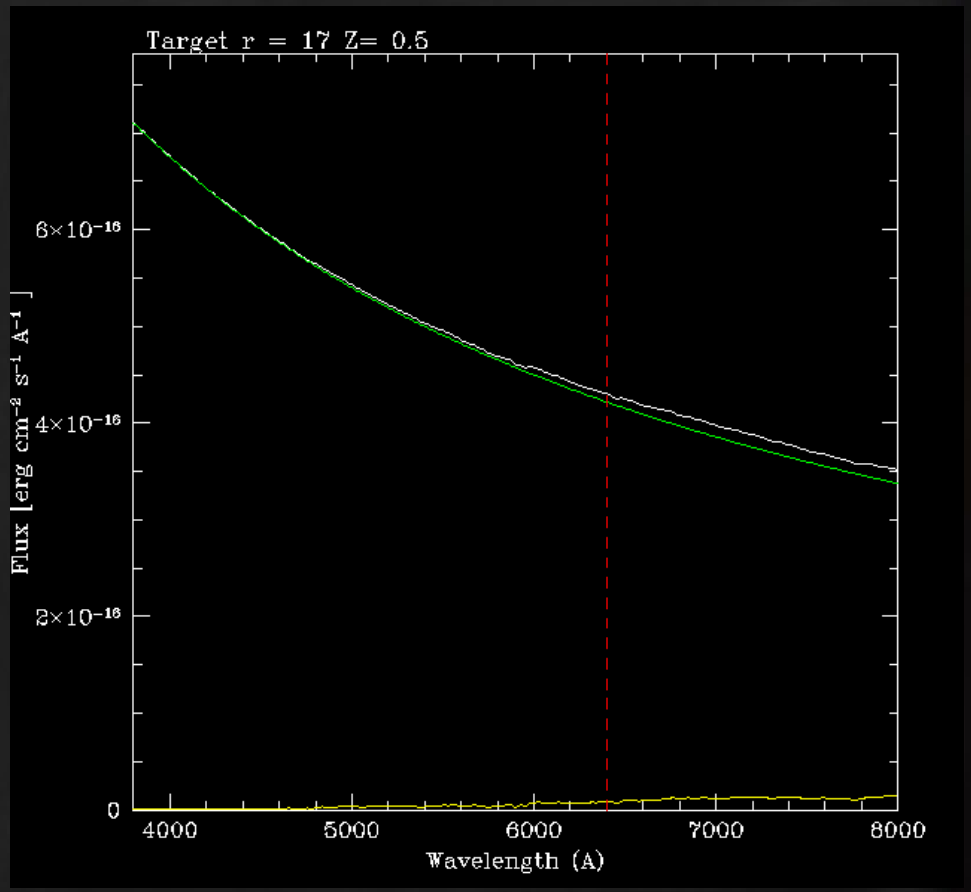
Mag=17 z=0.50 Diluited EW=0,15A



Spectrum observed !

With wide range and
high SNR spectra,
we can derive EW upper limits
and Redshift lower limits

We derive redshift lower limits (>0.1 – 0.90)
for all of our targets with unknown redshift

Towards the Future ..

For our sample we have new redshift,

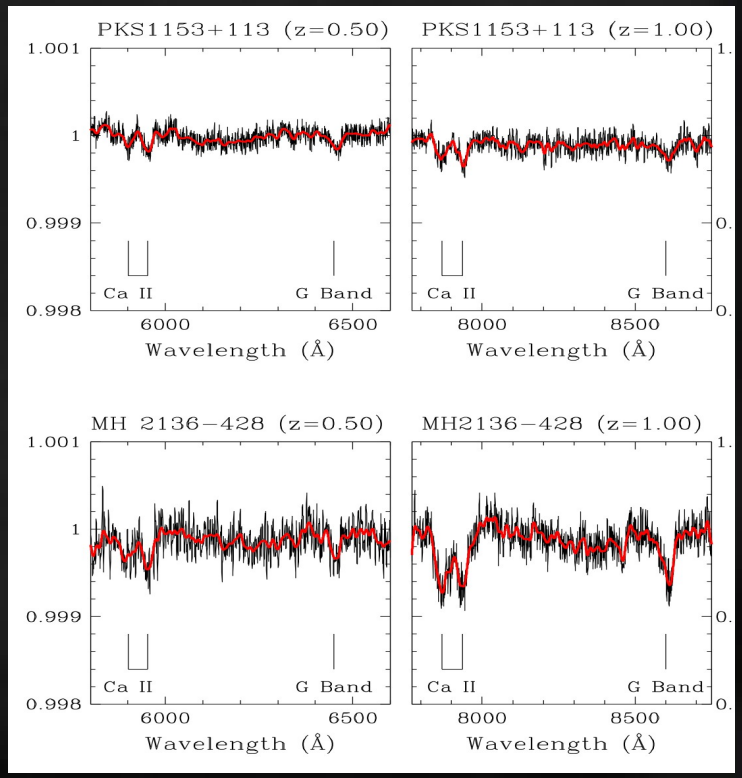
but for many targets the previous values are not confirmed:

Several TeV blazars have still unknown redshift

..Waiting for the EELT(39m) equipped with a Xshooter-like (@VLT) instrument

Texp= 3600 sec

Nuc/Host= 2500



Landoni+2014