Radio characteristics of Broad Absorption Lines (BAL) quasars

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Overview

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- Unified model for active galactic nuclei

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- Evolutionary track of AGN

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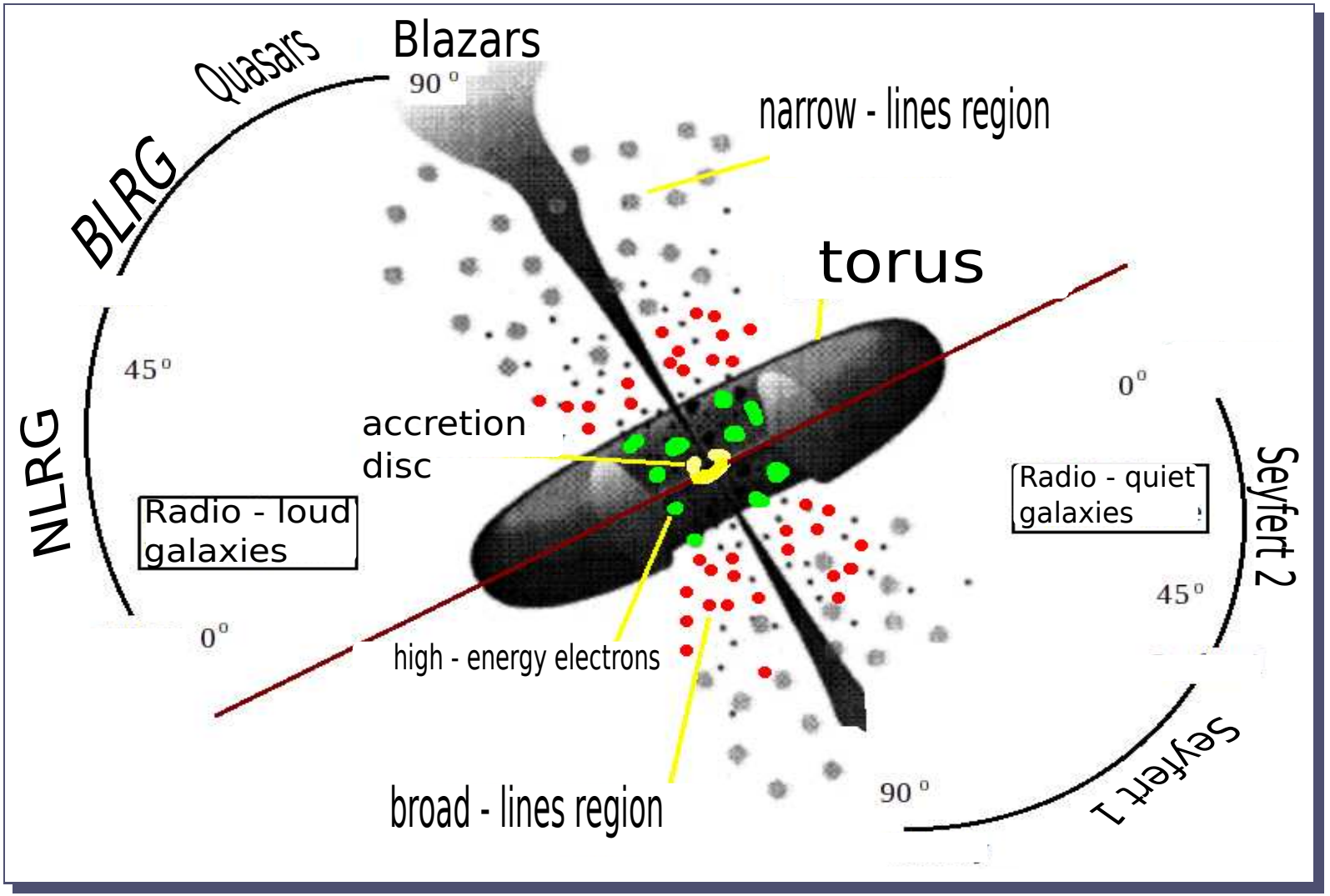
5. Conclusion

AGN Unification Model



(Urry & Padovani 1992)

Evolutionary track of AGN’s

AGN’s spectrum

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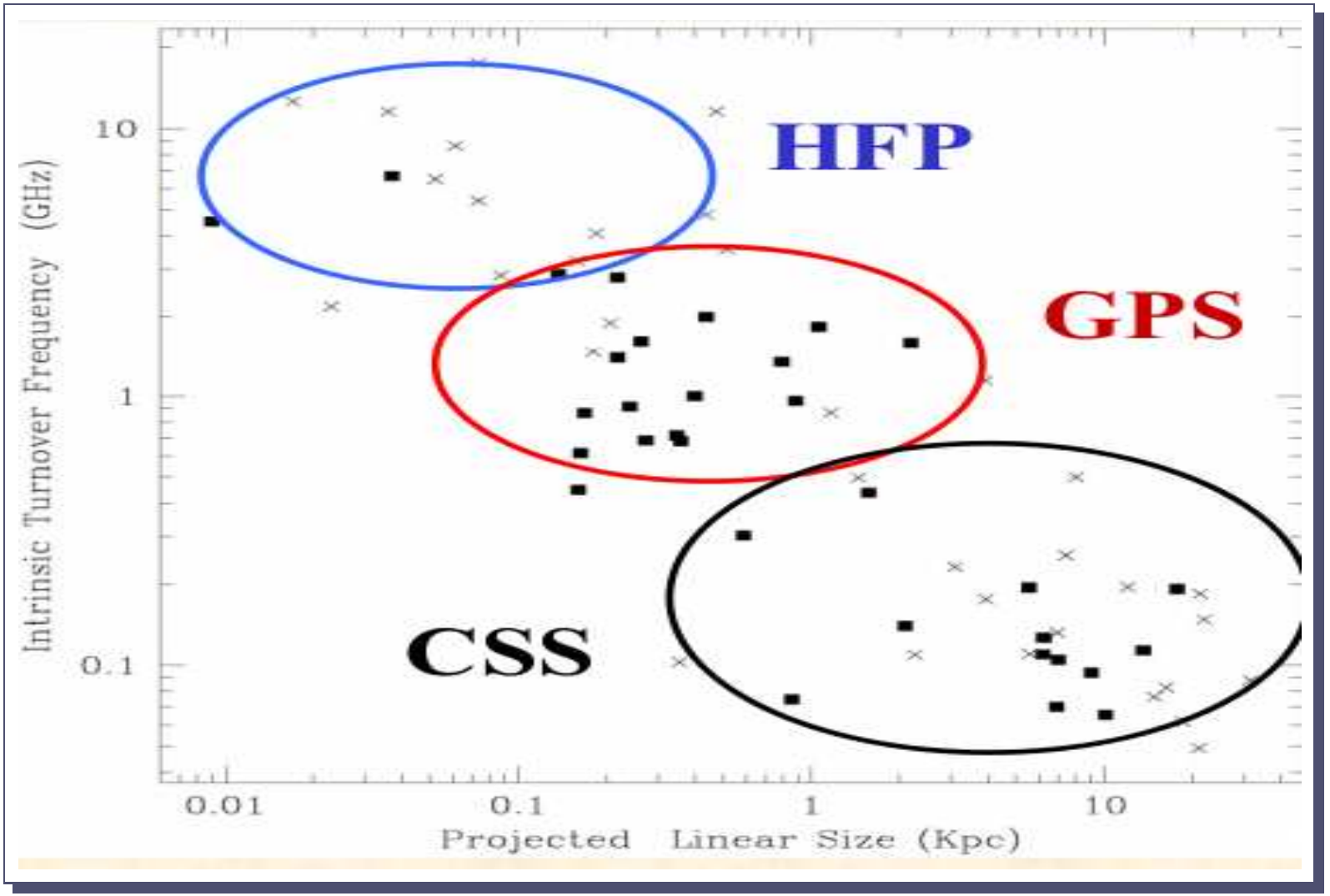
Sources	Projected Linear Size	turnover frequency
HFP	$\sim$ 10 pc	$\sim$ 4 GHz
GPS	1 kpc	$\sim$ 1 GHz
CSS	> 20 kpc	$\sim$ 100 MHz

(O'Dea & Baum, 1997)

PLS vs Turnover Frequency



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Evolution

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- $$\textbf{HFP} \Longrightarrow \quad \textbf{CSO/GPS} \Longrightarrow \quad \textbf{MSO/CSS} \Longrightarrow \quad \textbf{FR 1 / FR 2}$$

  Readhead et al. (1996)





Broad Absorbtion Line Quasars

BAL Class

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- **What are BALQSO?**
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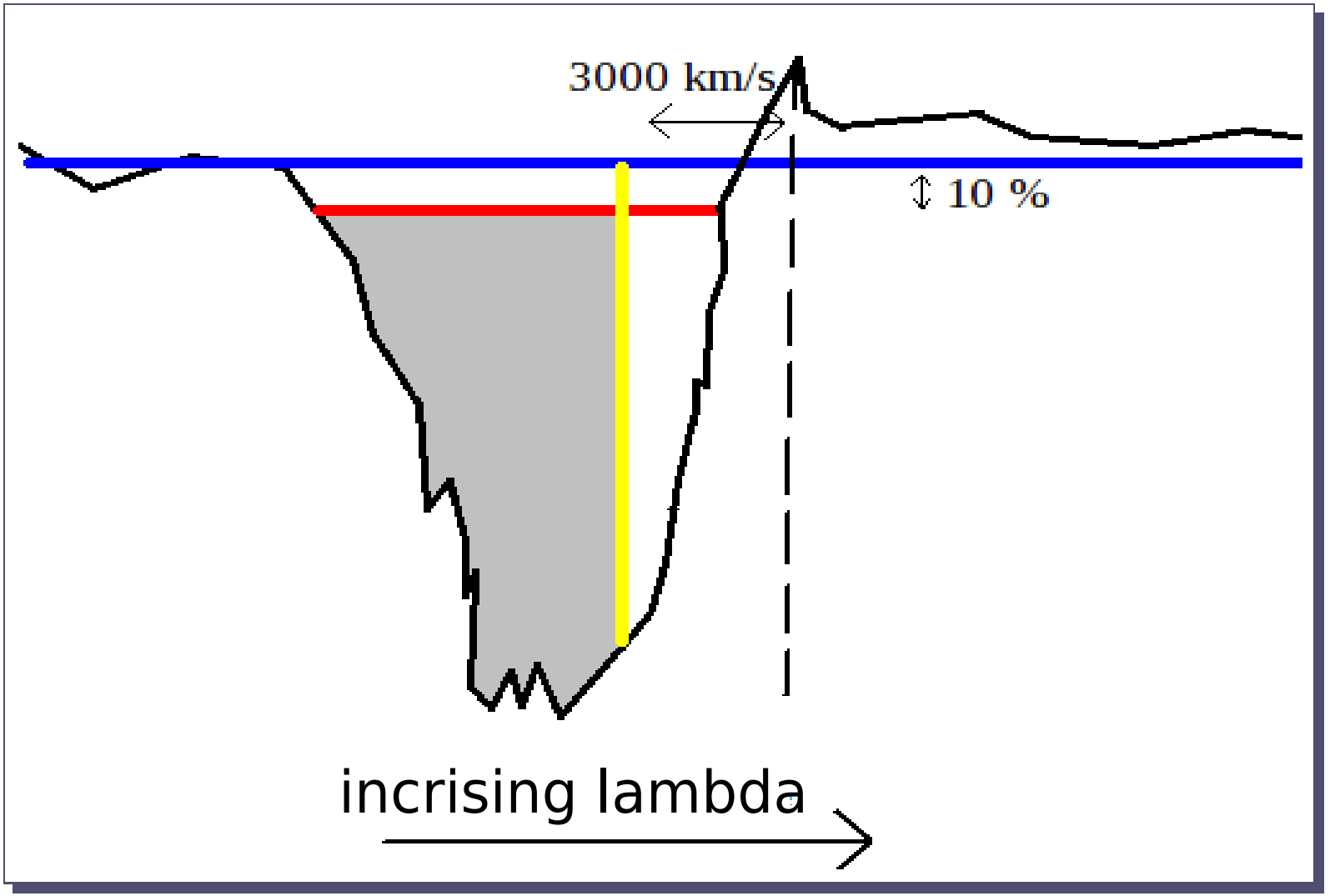
Balnicity Index



(Weymana i in. 1991).

Scenario for BAL phenomenon

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  Every AGN posses high-velocity outflows. When line of sight intercept the outflow broad absorption throughs are to be detected in spectrum. Therefore, the frequency of detection is connected with orientation.

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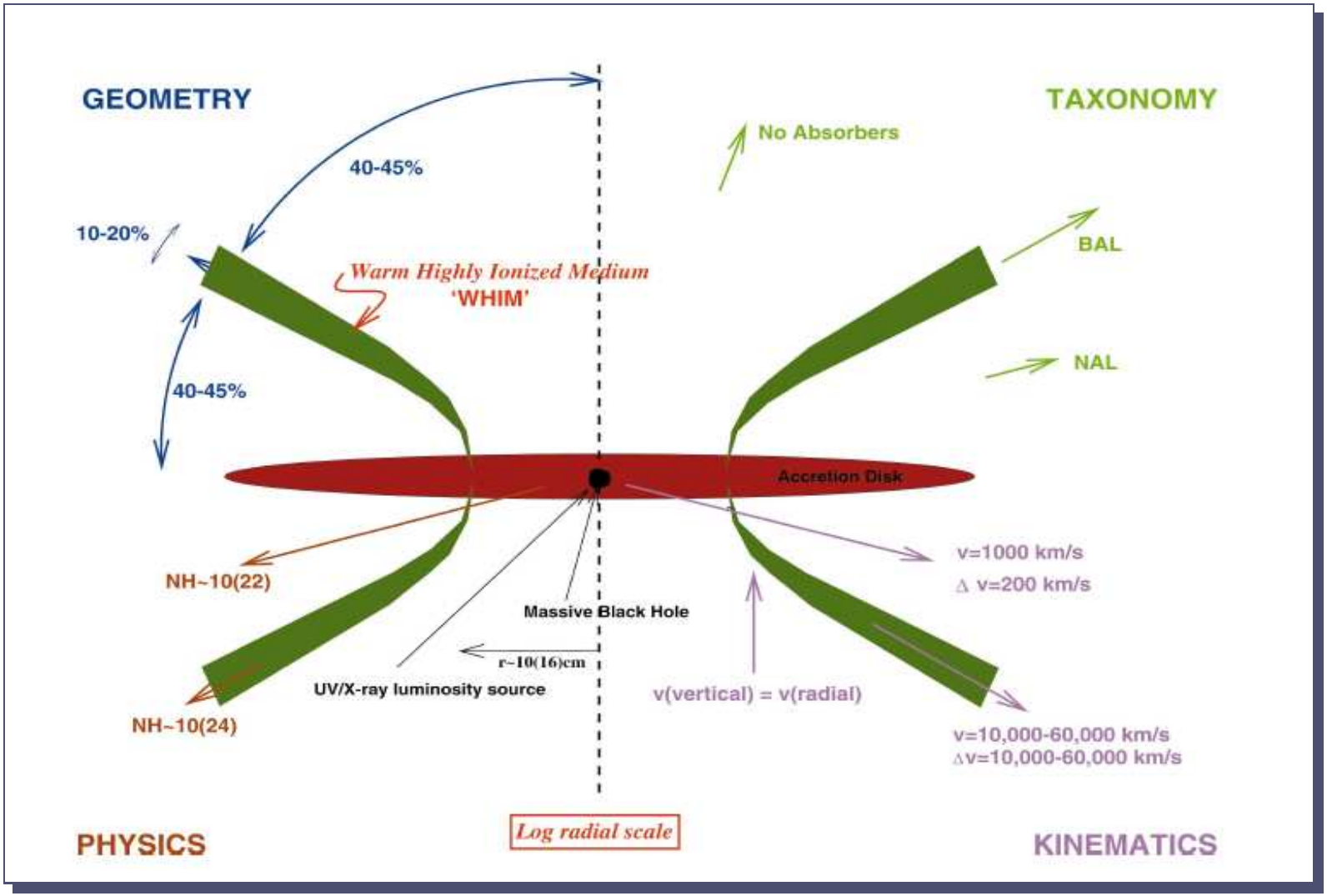

(Elvis 2000)

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  1. **Example of Radio Loud FR 2 morphology (Gregg et al. 2006)**
     Supports Orientation scenario.
  2. **Example of beamed BAL QSO (Zhou et al. 2006)**
     Possible polar outflows.

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- **Young compact radio sources**
  Significant sample of BALQSOs which are beeing identfied with young CSS/GPS sources. (Kunert-Bajraszewska & Marecki, 2007),(Montenegro-Montes et al. 2008)

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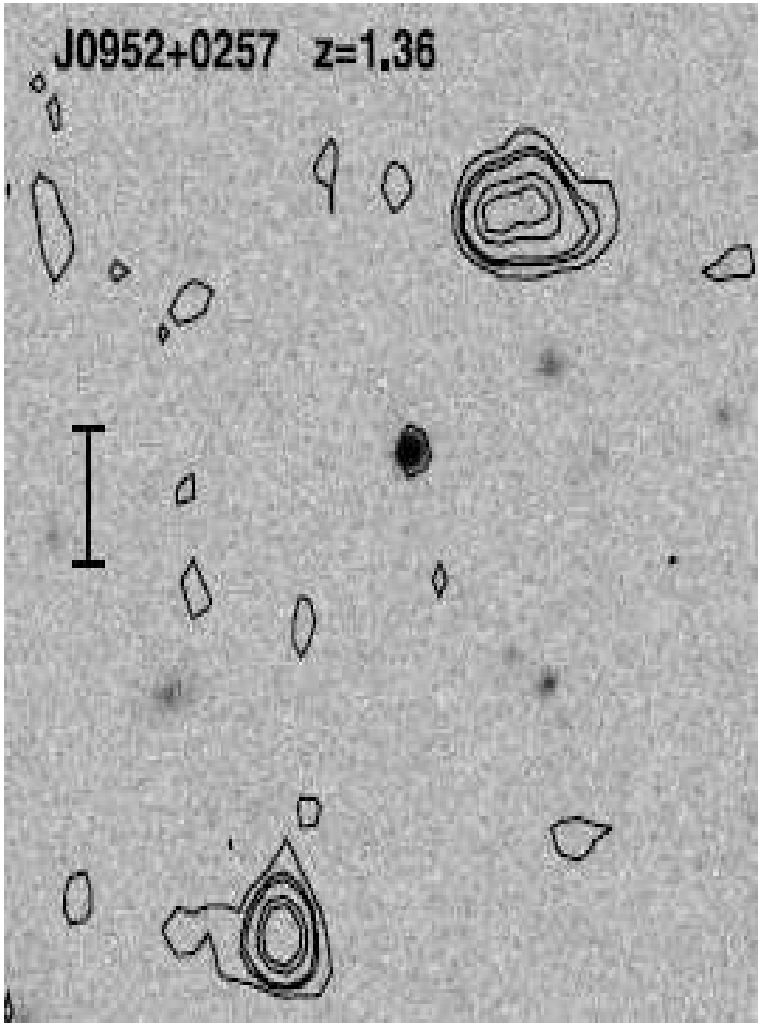
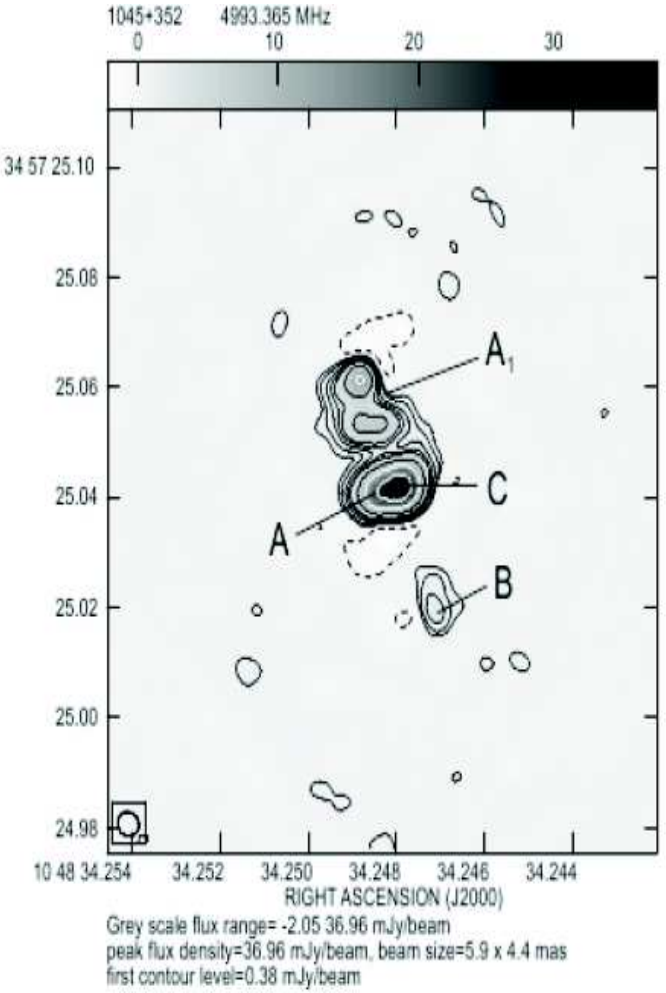
  Significant sample of BALQSOs which are beeing identfied with young CSS/GPS sources. (Kunert-Bajraszewska & Marecki, 2007),(Montenegro-Montes et al. 2008)
- **Recently refueled**
  Radio Loud FR 2 morphology (Gregg et al. 2006)
  Strong anticorrelation between radio-loudness and the strength of the BAL features. (Greeg et al. 2000,2006)

BAL Morphology





(Greeg et al. 2006)(Kunert-Bajraszewska & Gawronski, 2008)





New sample of compact radio-loud BAL QSOs

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  Using the final release of FIRST survey combined with a A Catalog of BAL QSOs (SDSS/DR3), a new sample of compact radio-loud BAL QSOs, has been constructed.

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- **My contribution**
  Dr. Kunert-Bajraszewska & Dr. Gawronski constructed a sample and wrot the proposal. I jonied in in 2010.

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- The flux density was greater then 150 mJy at 1.4 GHz,

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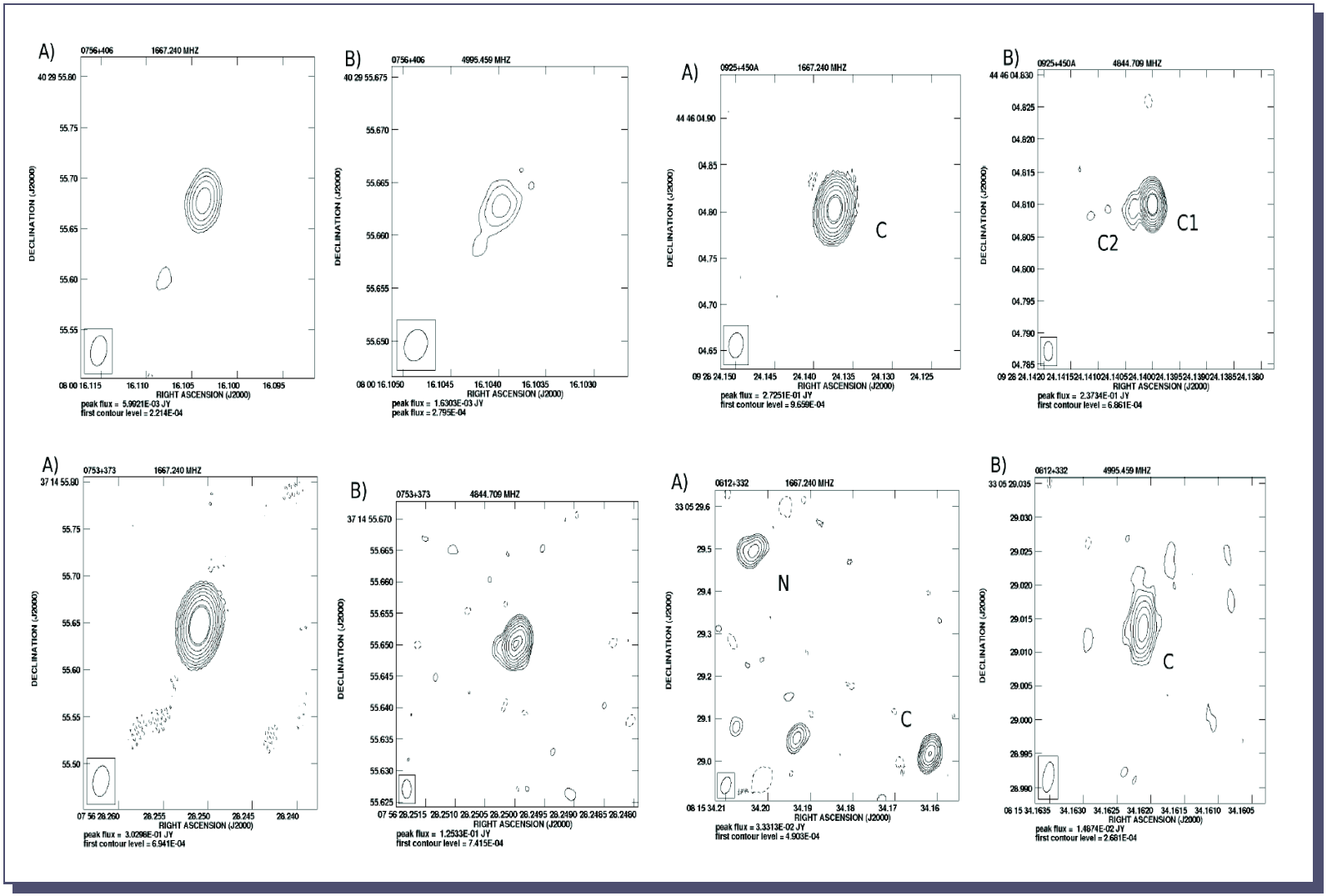
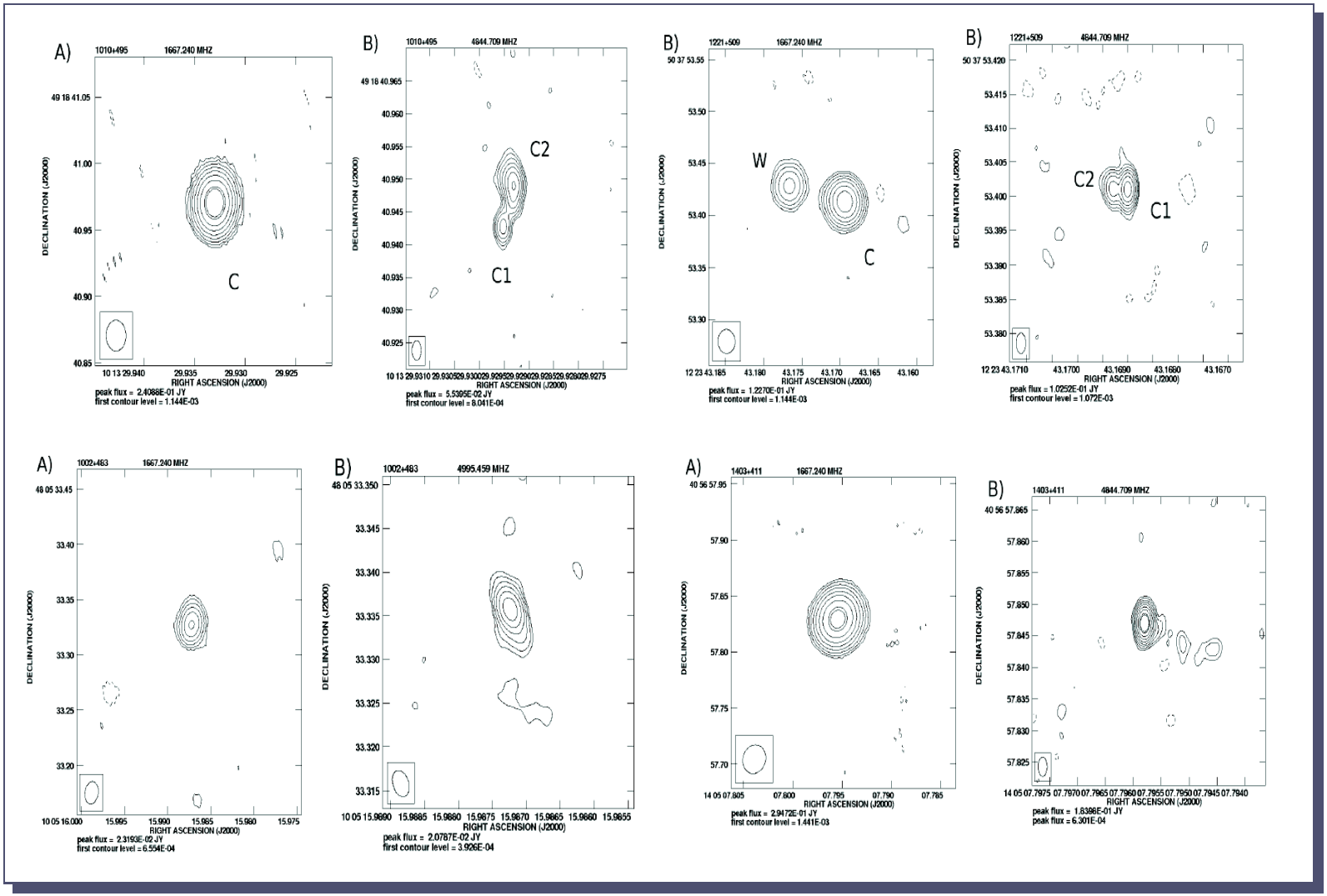
- using EVN at 1.6 GHz and VLBA at 5 and 8.4 GHz
- we compare spectral indecses at three frequences.

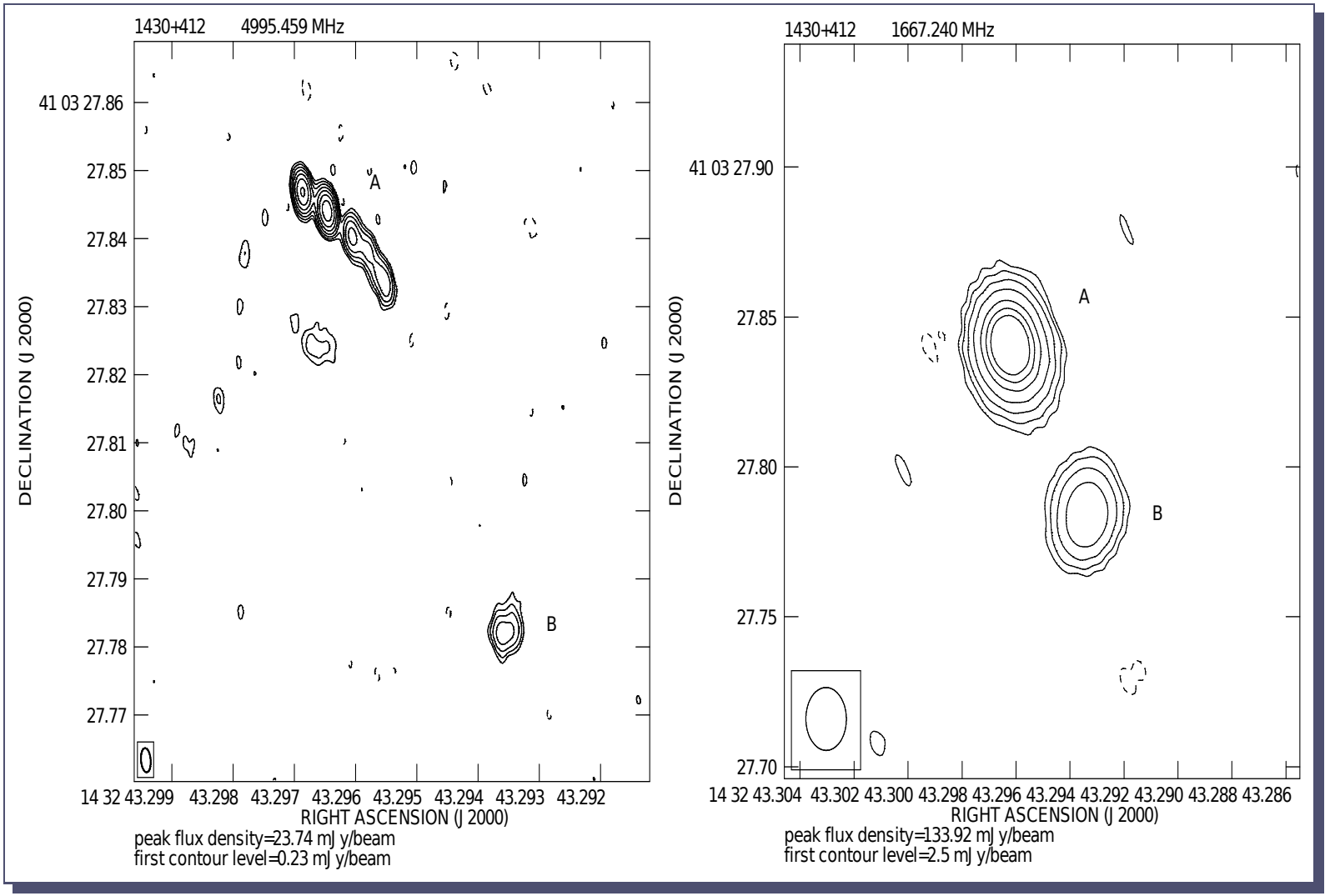
Radio Maps


A) 0756+406 1667.240 MHZ
B) 0756+406 4995.459 MHZ
A) 0925+450A 1667.240 MHZ
B) 0925+450A 4844.709 MHZ
C
C1
C2
A) 0753+373 1667.240 MHZ
B) 0753+373 4844.709 MHZ
A) 0612+332 1667.240 MHZ
B) 0612+332 4995.459 MHZ
N
C
DECLINATION (J2000)
RIGHT ASCENSION (J2000)

Radio Maps


A) 1010+495 1667.240 MHZ
peak flux = 2.4088E-01 JY
first contour level = 1.144E-03
B) 1010+495 4844.709 MHZ
C2
C1
peak flux = 5.5395E-02 JY
first contour level = 8.041E-04
B) 1221+509 1667.240 MHZ
W
C
peak flux = 1.2270E-01 JY
first contour level = 1.144E-03
B) 1221+509 4844.709 MHZ
C2
C1
peak flux = 1.0252E-01 JY
first contour level = 1.072E-03
A) 1002+463 1667.240 MHZ
peak flux = 2.3193E-02 JY
first contour level = 6.554E-04
B) 1002+463 4995.459 MHZ
peak flux = 2.0787E-02 JY
first contour level = 3.926E-04
A) 1403+411 1667.240 MHZ
peak flux = 2.9472E-01 JY
first contour level = 1.441E-03
B) 1403+411 4844.709 MHZ
peak flux = 1.8398E-01 JY
peak flux = 6.301E-04
DECLINATION (J2000)
RIGHT ASCENSION (J2000)

Radio Maps


1430+412 4995.459 MHz
41 03 27.86
27.85
27.84
27.83
27.82
27.81
27.80
27.79
27.78
27.77
DECLINATION (J 2000)
A
B
14 32 43.299 43.298 43.297 43.296 43.295 43.294 43.293 43.292
RIGHT ASCENSION (J 2000)
peak flux density=23.74 mJ y/beam
first contour level=0.23 mJ y/beam
1430+412 1667.240 MHz
41 03 27.90
27.85
27.80
27.75
27.70
DECLINATION (J 2000)
A
B
14 32 43.304 43.302 43.300 43.298 43.296 43.294 43.292 43.290 43.288 43.286
RIGHT ASCENSION (J 2000)
peak flux density=133.92 mJ y/beam
first contour level=2.5 mJ y/beam

Spectral indices

Source	L(1.67GHz) mJy	C(4.99 GHz) mJy	$\alpha_{1.67}^{4.99}$
0753+373	303.4	132.3	0.76
0756+406	6.0	1.5	1.26
0812+332	33.4 (C)	14.9 (C)	0.74
	9.8 (N)	-	-
0925+450A	272.5 (C)	237.6 (C1)	-
	272.5 (C)	10.6 (C2)	-
1002+483	23.2	20.8	0.10
1010+495	238.2	240.8	-0.01
1221+509	129.4 (C)	102.3(C1)	-
	129.4 (C)	25.1 (C2)	-
	23.4 (W)	-	-
1403+411	294.7	193.4	0.38

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  2. While at 1.6 GHz there is core and possible hot spot of a 0812+332, there is only core at 5 GHz. It may indicate drop down of injection of energetic electrons from core. Source structure of a core at 5 GHz probably indicates a new jet.
  3. While at 1.6 GHz 1430+412 is double source, it has complex morphology at 5 GHz . Core at 5 GHz is resolved. Structure on a C band may indicate drop down of injection of energetic electrons from core.

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  All sources from the new sample are HiBALs with absorption index AI >0 and balnicity index BI=0.

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  All sources from the new sample are HiBALs with absorption index AI >0 and balnicity index BI=0.
- **Special group of radio-loud BAL quasars**
  automated algorithms used by Trump et al. 2006 could identify HiBALs via CIV from redshift range $1.7 \leq z \leq 4.38$*, therefore the selected sources are probably the most luminous radio-loud BALQSOs.*

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- For some sources the observed flux densities of compact structures account only up to 25% of total flux density at 5 GHz.This may suggest that there are low brightness extended structures in our new selected radio-load BALQSOs and sources may be older and bigger than GPS/CSS objects.

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- Complex morphology of two sources (0812+332, 1430+412) may indicate storng interaction with interstellar medium or jet precesion and rather speaks in favour of Evolutionary Scenario
- Nevertheless 70% of sources from sample at a C band are double or tripple. Four of which has been classified as CJ. It speaks in favour of **Orientation Scenario**





Thank you for your attention