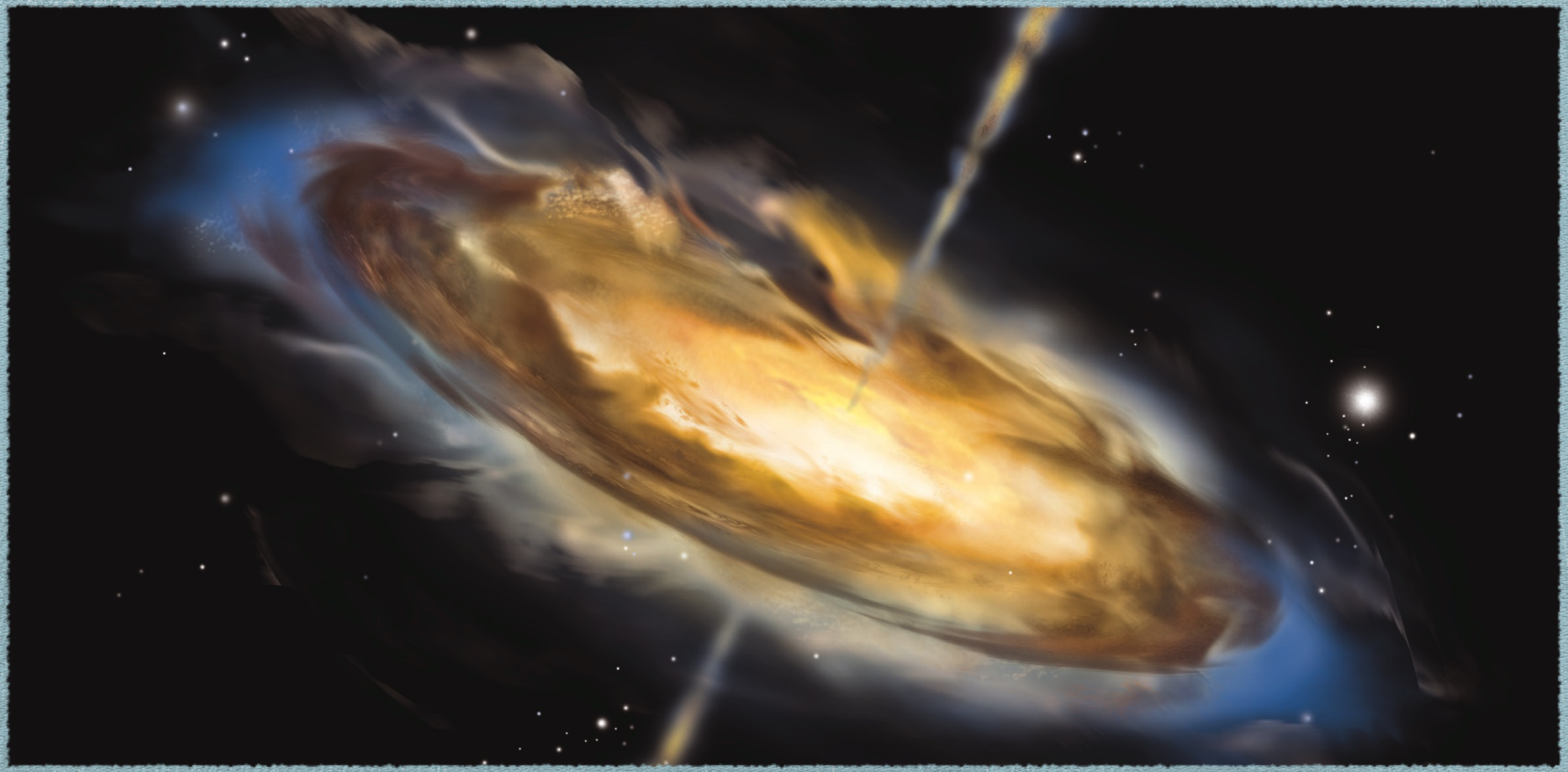
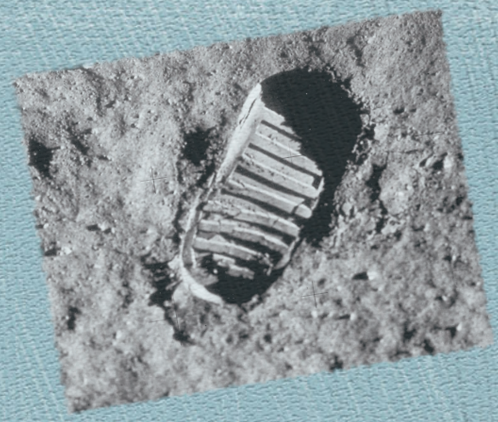


Probing the environment of sources with high Faraday Rotation Measure

- A multifrequency study in the radio band -

Alice Pasetto - A. Kraus (MPIfR), K.H. Mack (IRA-INAF), G. Bruni(MPIfR) and C. Carrasco González (CRyA-UNAM)-

High-RM: why



- The aim

STUDYING THE MEDIUM OF AGN-HOSTING GALAXIES

IN ORDER TO VERIFY IF ANY CONNECTION IS PRESENT WITH

- AN EVOLUTIONARY TRACK

AND/OR

- A PERIODIC RADIO ACTIVITY PHASE OF THE CENTRAL AGNS

(FERRARESE ET AL. 2001, SAIKIA & JAMROZY 2009, O'DEA 1998)

One step forward into AGNs characterisation…

Polarisation properties are powerful tools to study the medium:

- Faraday Rotation

- Faraday Depolarisation

High-RM: why

- *Faraday Rotation*

FARADAY ROTATION

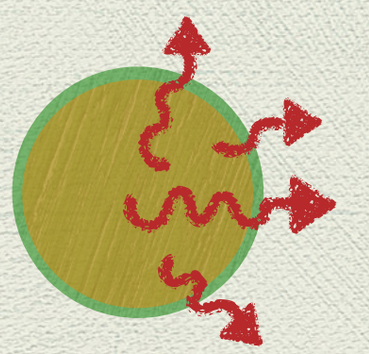
ROTATION OF THE POLARISED PLANE OF AN
ELECTROMAGNETIC WAVE
PASSING TROUGH A MAGNETISED PLASMA

$$\chi(\lambda) = RM\lambda^2 + \chi(0)$$

$$RM = 0.81 \int n_e B_{||} dl$$

High-RM: why

- *Faraday Depolarisation*



DEPOLARISATION

REDUCTION OF THE POLARISATION PERCENTAGE WITH INCREASING WAVELENGTH
IT CAN BE INTERNAL OR EXTERNAL:

Internal:

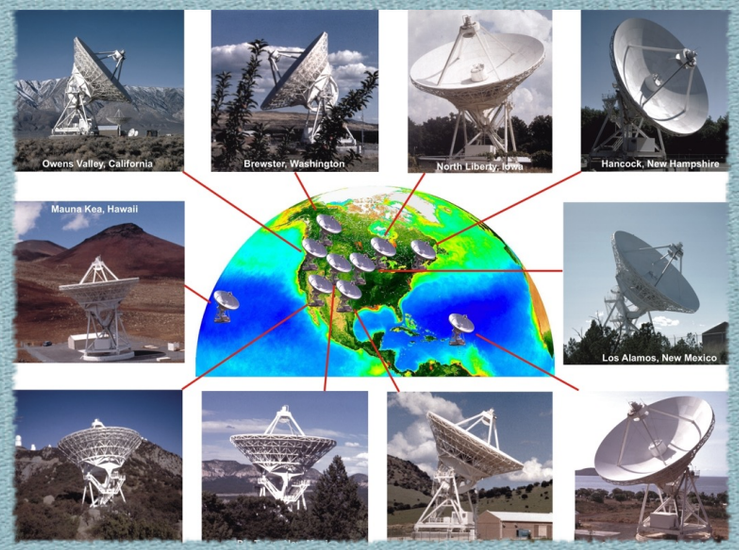
when the emitting AND Faraday rotating regions WITHIN the source are intermixed (Burn 1966)

$$m(\lambda) = m_0 \cdot sinc[\lambda^2 \cdot RM_{int}]$$

External:

When there is/are Faraday screen/s (magneto-ionic region) intervening material along the line of sight (Burn 1966)

$$m(\lambda) = m_0 exp(-2\sigma_{rm}^2 \cdot \lambda^4)$$



The instruments

broad-band observations

from single-dish to high resolution VLBI technique

High-RM: where

The source selection:

OBJECTS SUFFERING FROM STRONG DEPOLARISATION AT 20CM (1.4GHZ)

- BRIGHT SOURCES WITH NO POLARISATION DETECTION AT 20 CM IN THE NVSS SURVEY (FWHM 45”)
- CROSS CORRELATED WITH FIRST SURVEY (20 CM, FWHM 5”)

502 BRIGHT UNPOLARISED AND POINT-LIKE SOURCES

High-RM: how

- Effelsberg the beginning

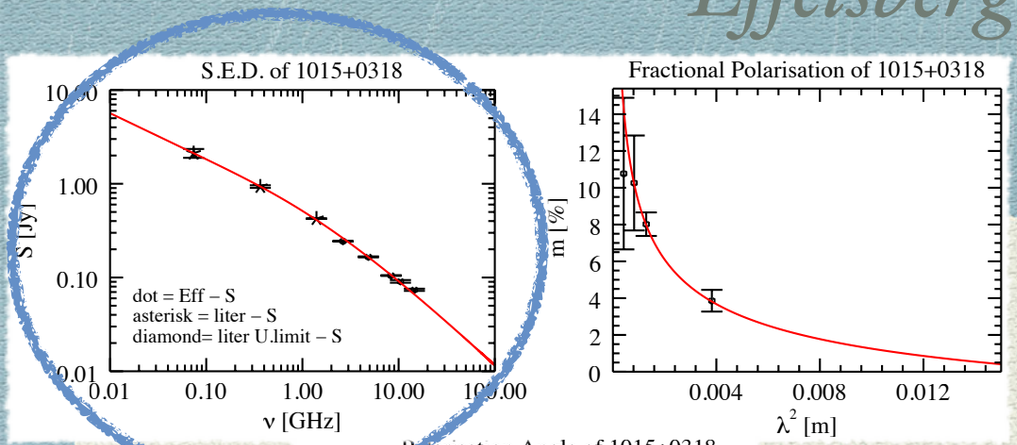
- Single dish (Effelsberg 100-m) observation at **10.45 GHz** searching for polarisation: **30** are the **CANDIDATES** for high-RM

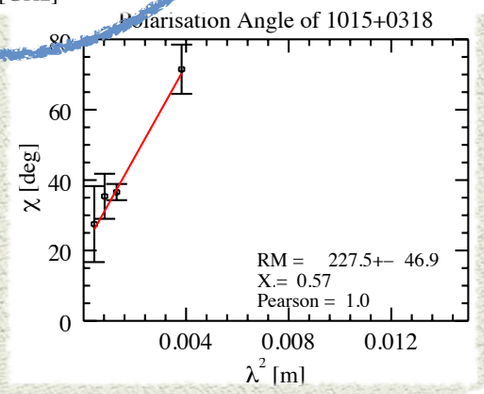
- Single dish (Effelsberg 100-m) Follow-up programme:

observations at 2.6, 4.8, 8.6, 10.45, 15 GHz to determine the RM as a linear regression fit

High-RM: how

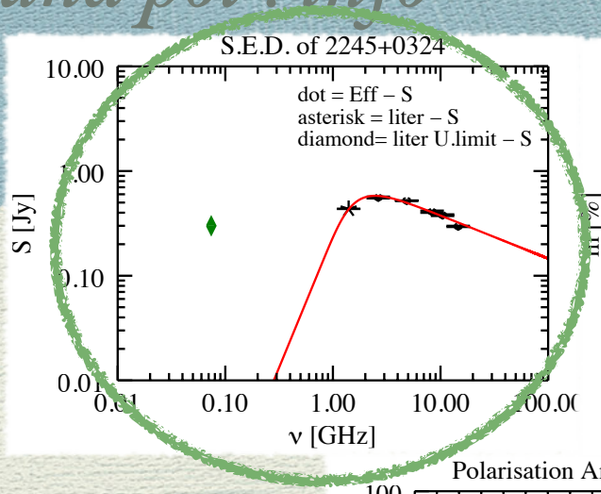
- *Effelsberg results: SEDs and pol . info*

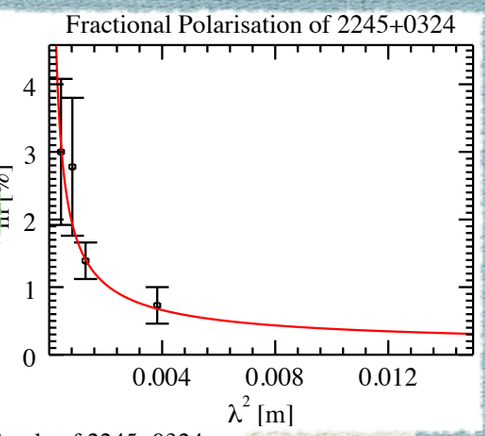


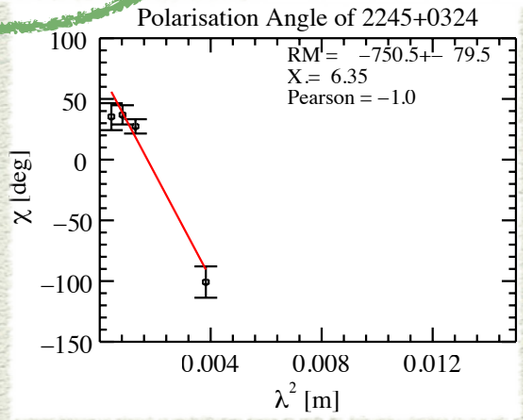


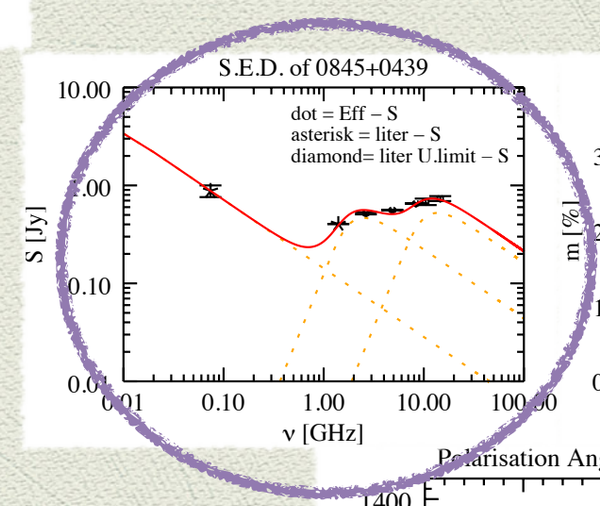
SEDs 3 objects types:

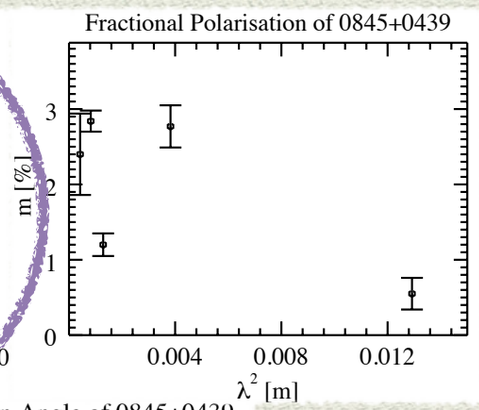
- Old (steep)
- GPS-like (compact)
- Mixed (several sync. comp.s)

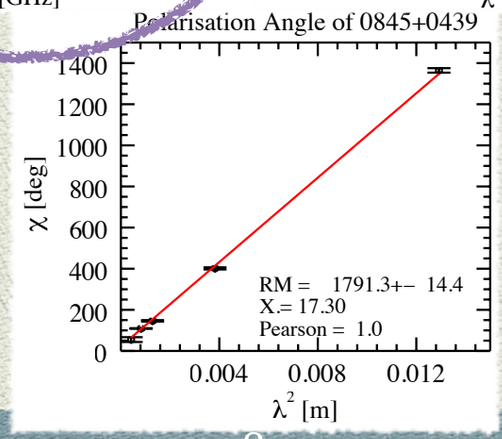








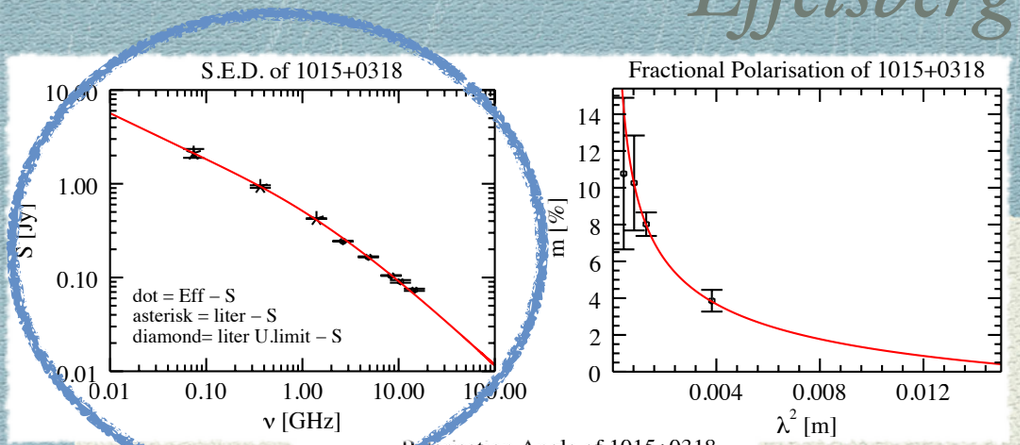


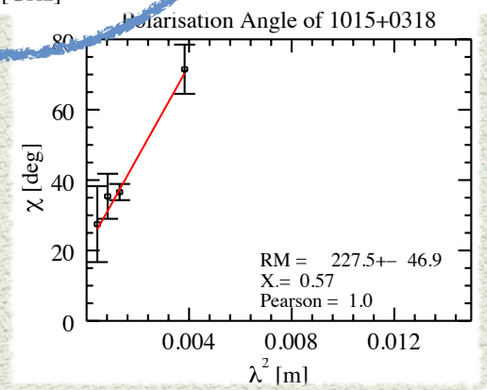


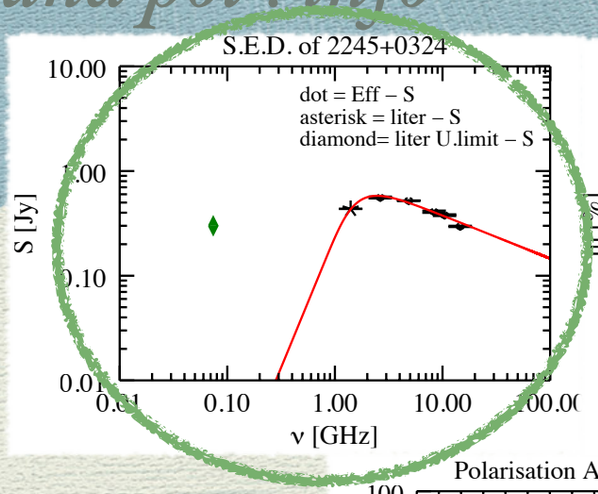
(Pasetto et al. 2015, in prep.)

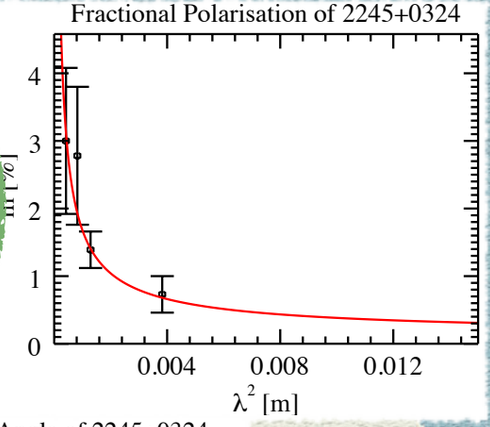
High-RM: how

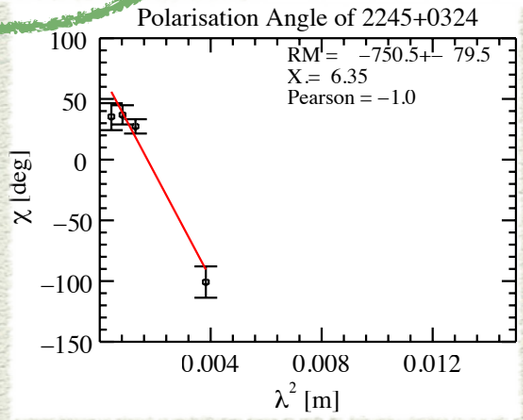
- *Effelsberg results: SEDs and pol . info*





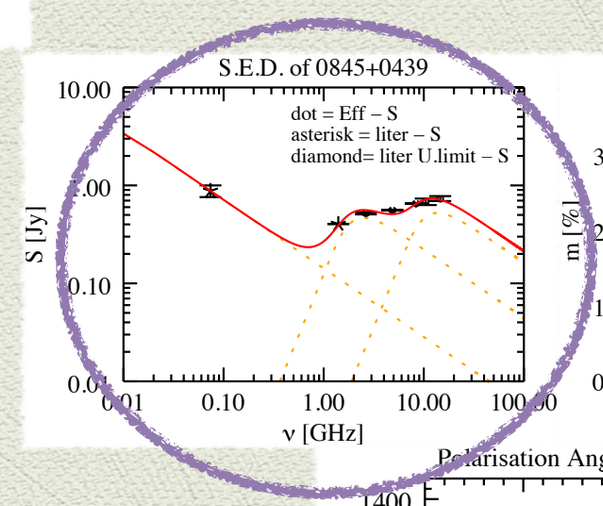


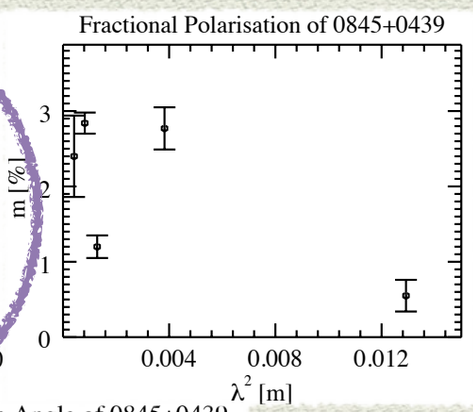


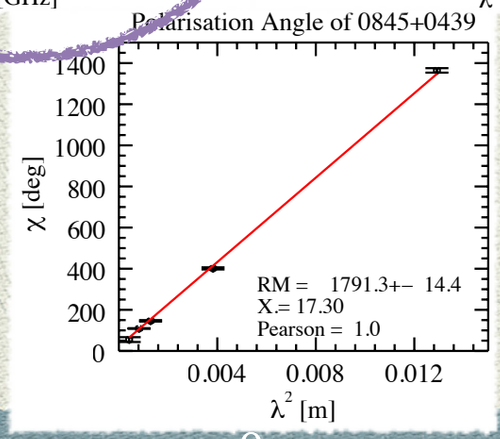


SEDs 3 objects types:

- Old (steep)
- GPS-like (compact)
- Mixed (several sync. comp.s)





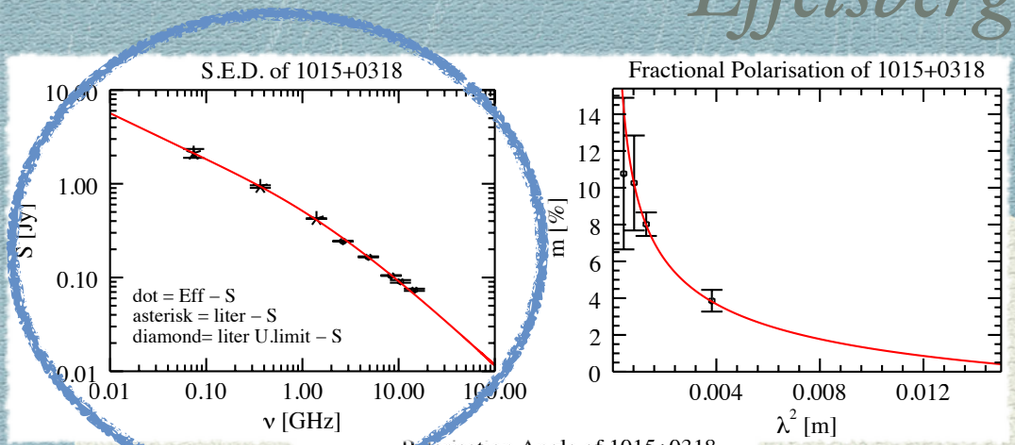


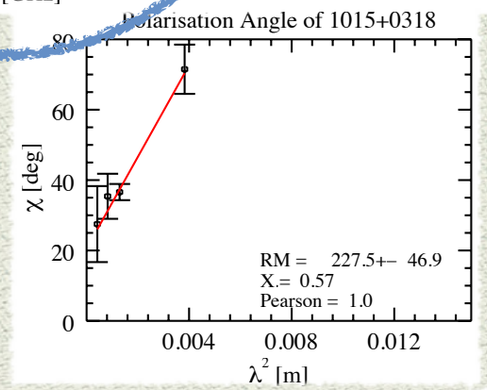
Start to model the depolarisation behaviours (but sometime complex)
INTERNAL or EXTERNAL?!
ONE or SEVERAL F.screens?!

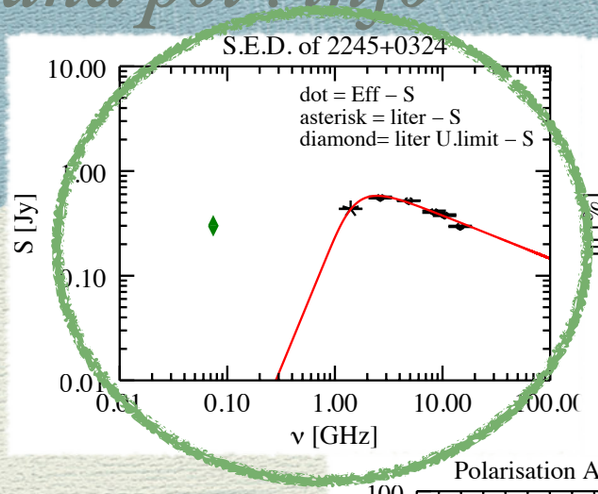
(Pasetto et al. 2015, in prep.)

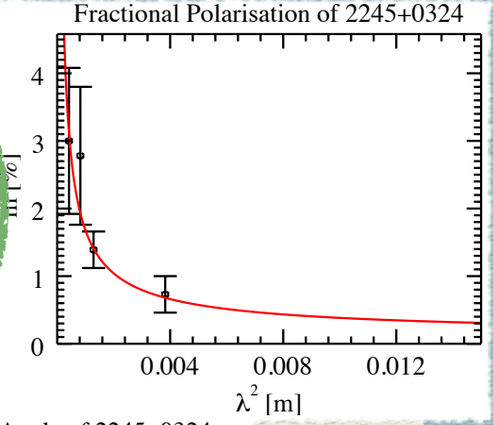
High-RM: how

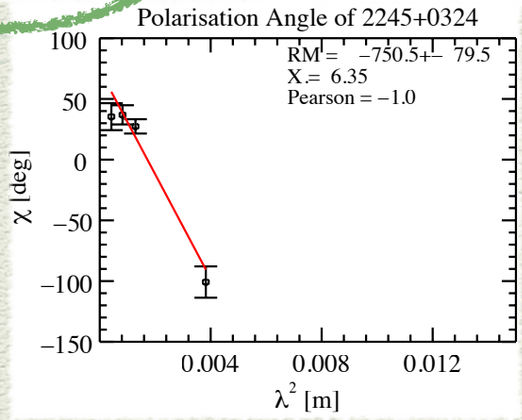
- *Effelsberg results: SEDs and pol . info*





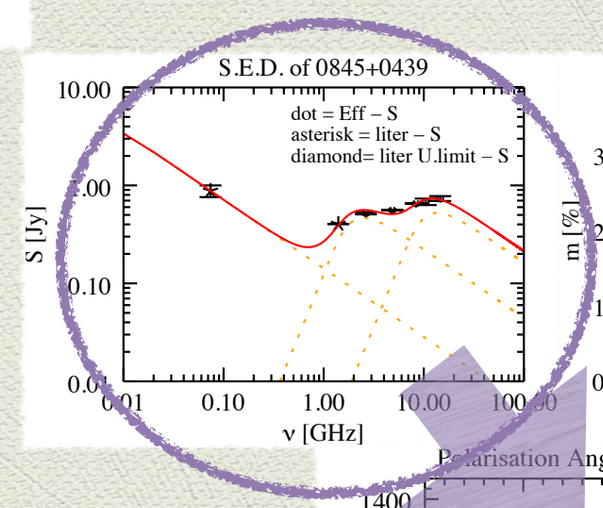


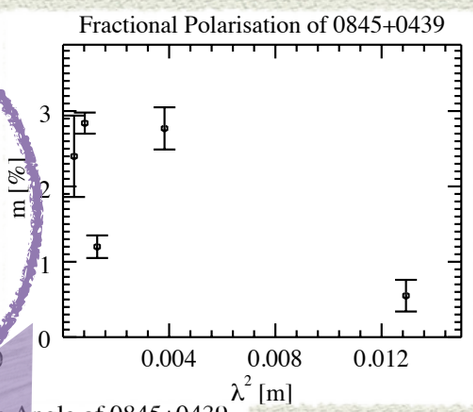


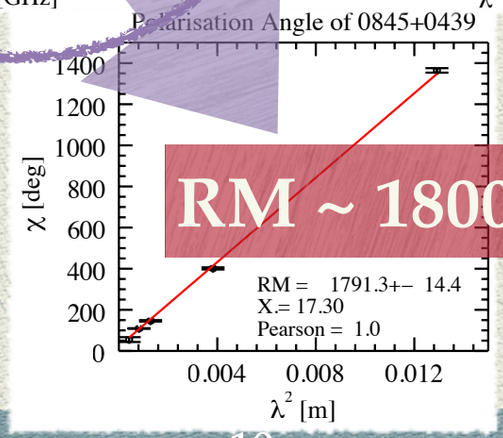


SEDs 3 objects types:

- Old (steep)
- GPS-like (compact)
- Mixed (several sync. comp.s)







RM ~ 1800 rad/m^2

Start to model the depolarisation behaviours (but sometime complex) INTERNAL or EXTERNAL?! ONE or SEVERAL F.screens?!

(Pasetto et al. 2015, in prep.)

RM shows a deviation from the linear fit

ALL the targets with a mixed (OLD +YOUNG components) SED have HIGH RMobs (> 500 rad/m^2)

High-RM: how

- *Effelsberg results: RM values*

- Contributions from the Milky Way and from the Cosmic web are a few rad compared with the measured RM
- Correction of the RM with z: $RM_{int} = RM_{obs} \cdot (1+z)^2$

Source	α 1.4–10.45	err	RM_{obs} [rad/m^2]	err	RM_{mw}	z	RM_{rf} [rad/m^2]
0239-0234	0.45	0.013	-43.1	6.1	7.0	1.1	-224.5
0243-0550	-0.06	0.015	625.7	55.1	9.0	1.8	4852.6
0742+4900	0.16	0.015	-199.644	33.6	5.0	2.3	-2228.6
0751+2716	-0.98	0.027	462.3	50.3	12.0	1.5	2814.5
0845+0439	0.22	0.013	1923.5	15.4	31.0	1.5	11828.4
0925+3159	-0.84	0.037	-56.2	50.1	19.0	1.5	-470.5
0958+3224	-0.31	0.012	2201.9	64.8	18.0	0.5	5116.4
1015+0318	-0.83	0.056	245.9	50.9	3.0	1.5	1518.5
1043+2408	0.53	0.015	-62.5	7.4	-4.0	0.6	-142.8
1044+0655	-0.15	0.023	-215.5	16.8	15.0	2.1	-2177.3
1048+0141	-0.06	0.017	-2510.8	32.4	11.0	0.7	-7194.0
1146+5356	0.20	0.047	-446.1	8.0	9.0	2.2	-4663.1
1213+1307	-0.57	0.016	19.0	1.8	-10.0	1.1	132.8
1246-0730	0.26	0.014	882.8	10.5	1.0	1.3	4608.3
1311+1417	-0.67	0.023	566.5	11.2	4.0	1.9	4907.7
1312+5548	-0.76	0.054	-967.4	160.8	10.0	1.5	-6109.3

- Further interferometric observations: sources with

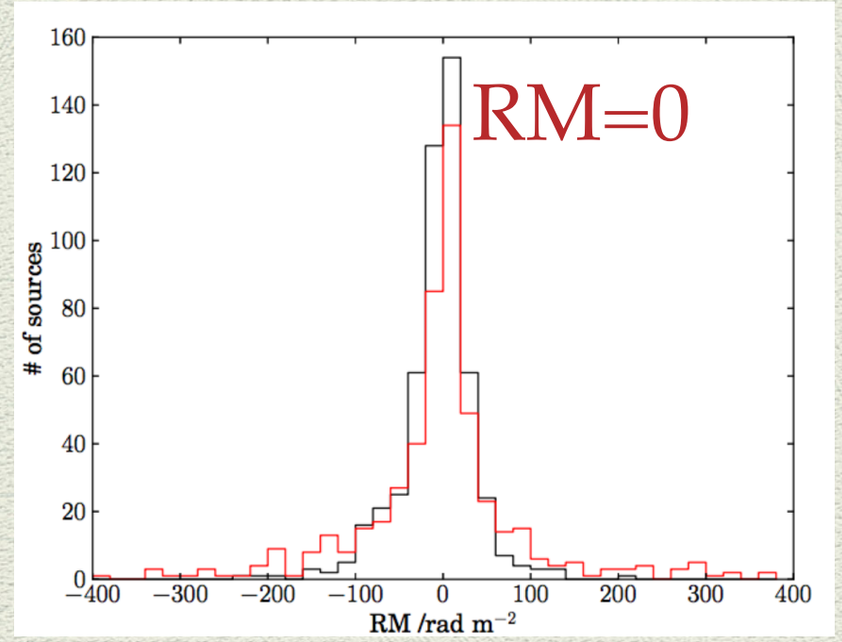
$$RM_{obs} \geq 500 \quad rad/m^2$$

(Pasetto et al. 2015, in prep.)

High-RM: how

-Histograms

(Farnes et al. 2014)



RM distribution:

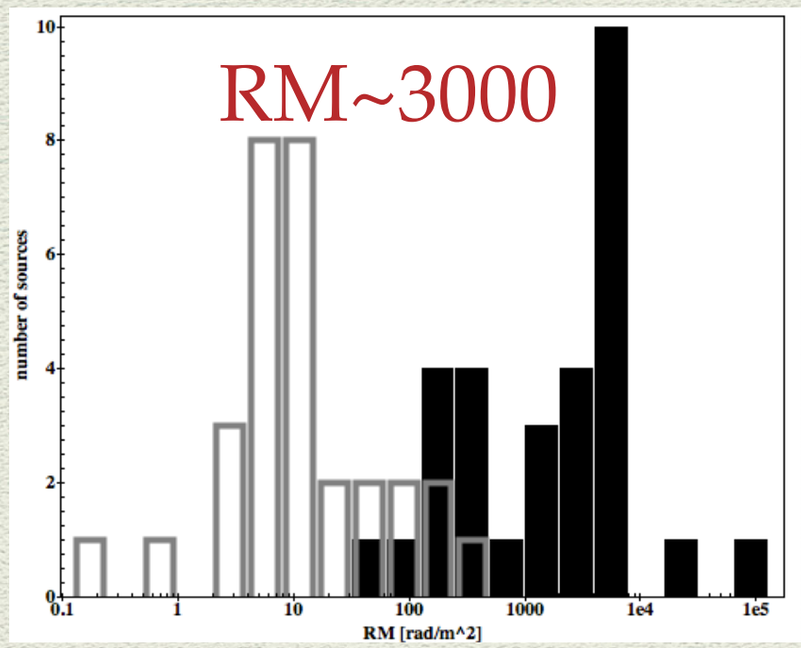
- HighRM object:

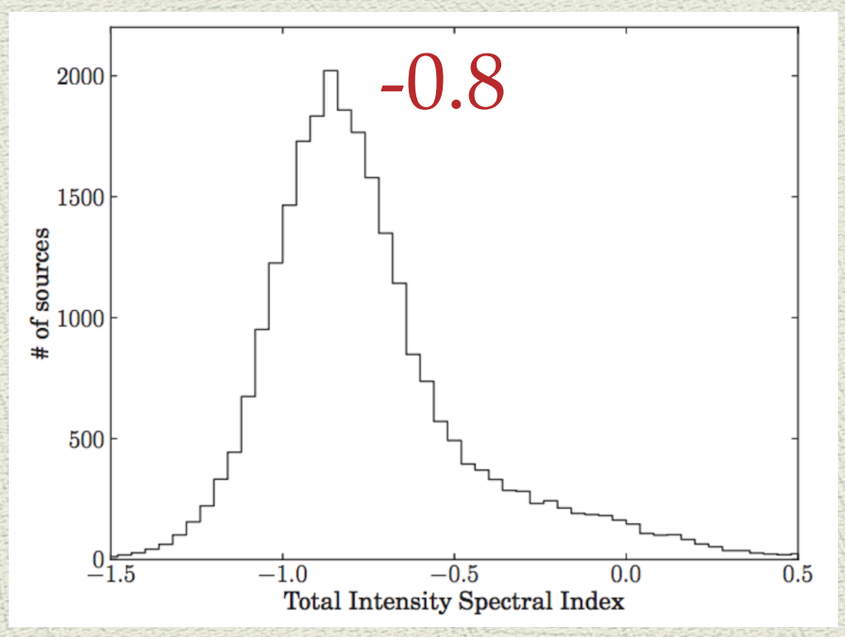
RMobs: 3000 rad/m^2;

-Farnes RM ~ 0

The two distributions are different at a confidence level > 95%

(Pasetto et al. 2015, in prep.)

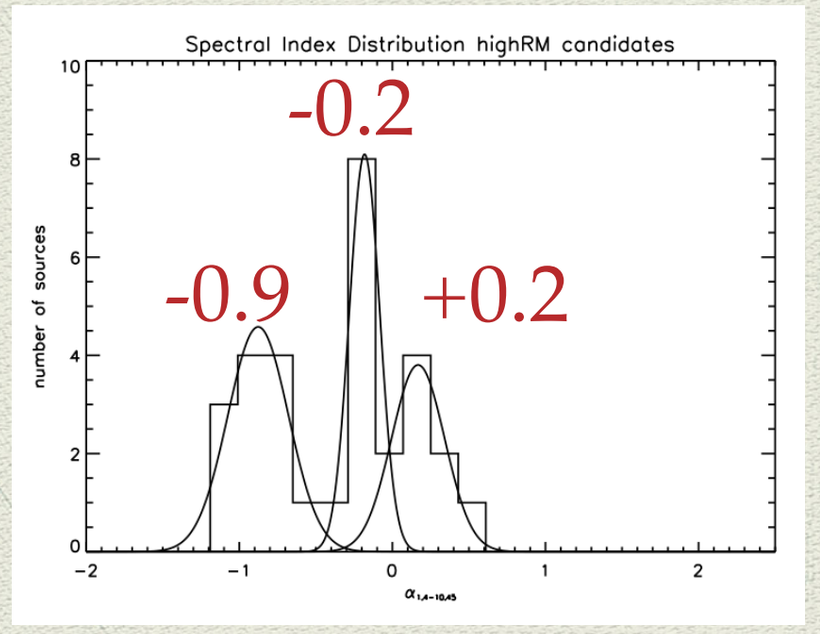




Spectral index distribution:

HIGH-RM are mostly flat and inverted;

Farnes targets are steep



High-RM: how

- *Effelsberg conclusions*

	Obs RM > 500 rad/m^2	Rest Frame RM > 500 rad/m^2
OLD	30%	50%
GPS-like	10%	50%
Mixed	80%	100%
Total	40%	67%

- The existence of compact components at high frequency (2-10 GHz) suggest the presence of a DENSE MATERIAL end/or an INTENSE MAGNETIC FIELD that could be the cause of the peculiar behaviour that we are seeing in polarisation.

- Single dish data seem to indicate that high-RM AGNs could be characterised by some evolutionary track and/or they could experience some restarting activity. Higher resolution observations are crucial.

Current work: going deeper...

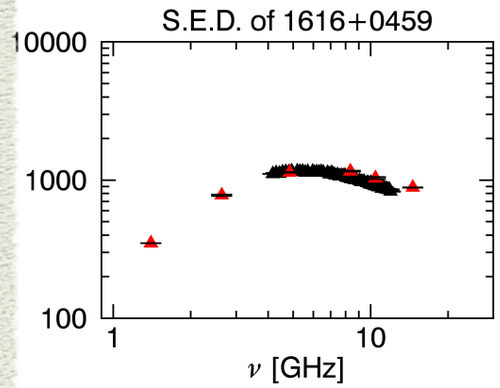
JVLA OBSERVATIONS

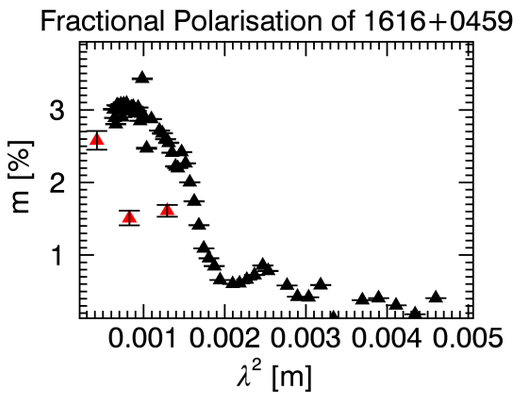
(PRELIMINARY RESULTS)

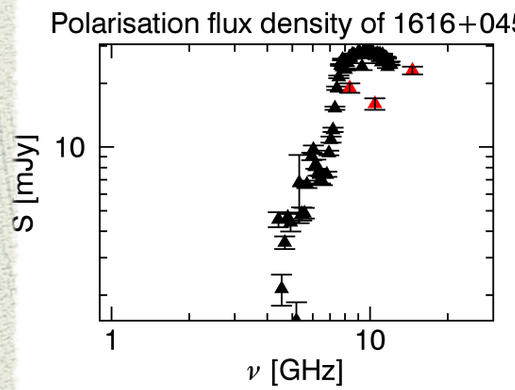
OBSERVATIONS AT HIGHER RESOLUTION

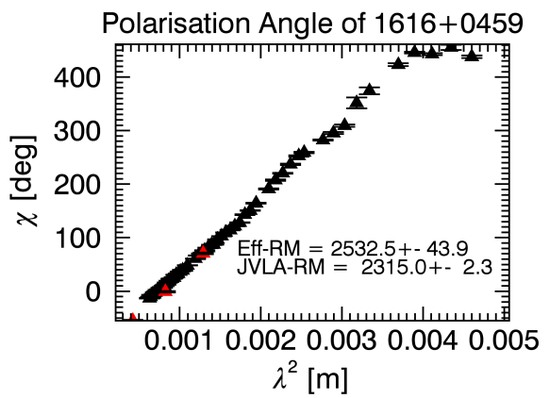
WIDEBAND L,C AND X-BAND FULL POLARISATION FOR THE

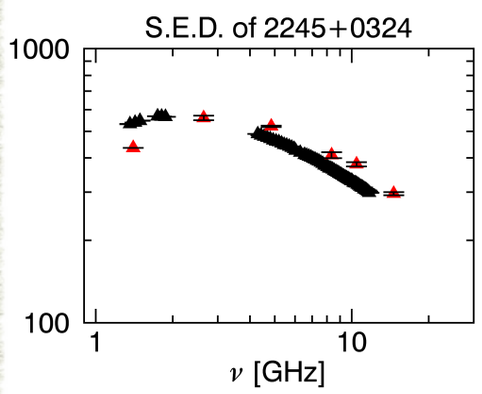
MOST EXTREME OBJECTS: **12** SOURCES $RM_{obs} \geq 500 \quad rad/m^2$

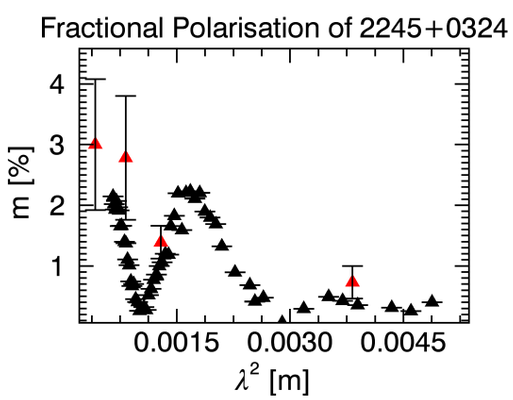


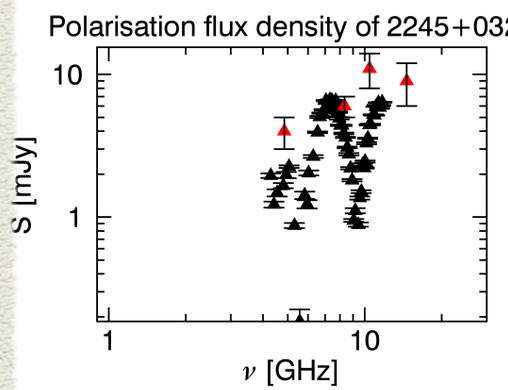


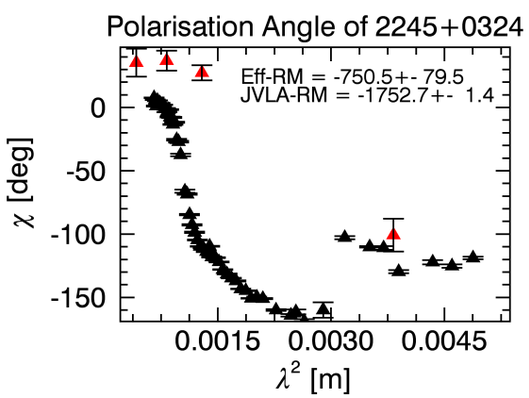








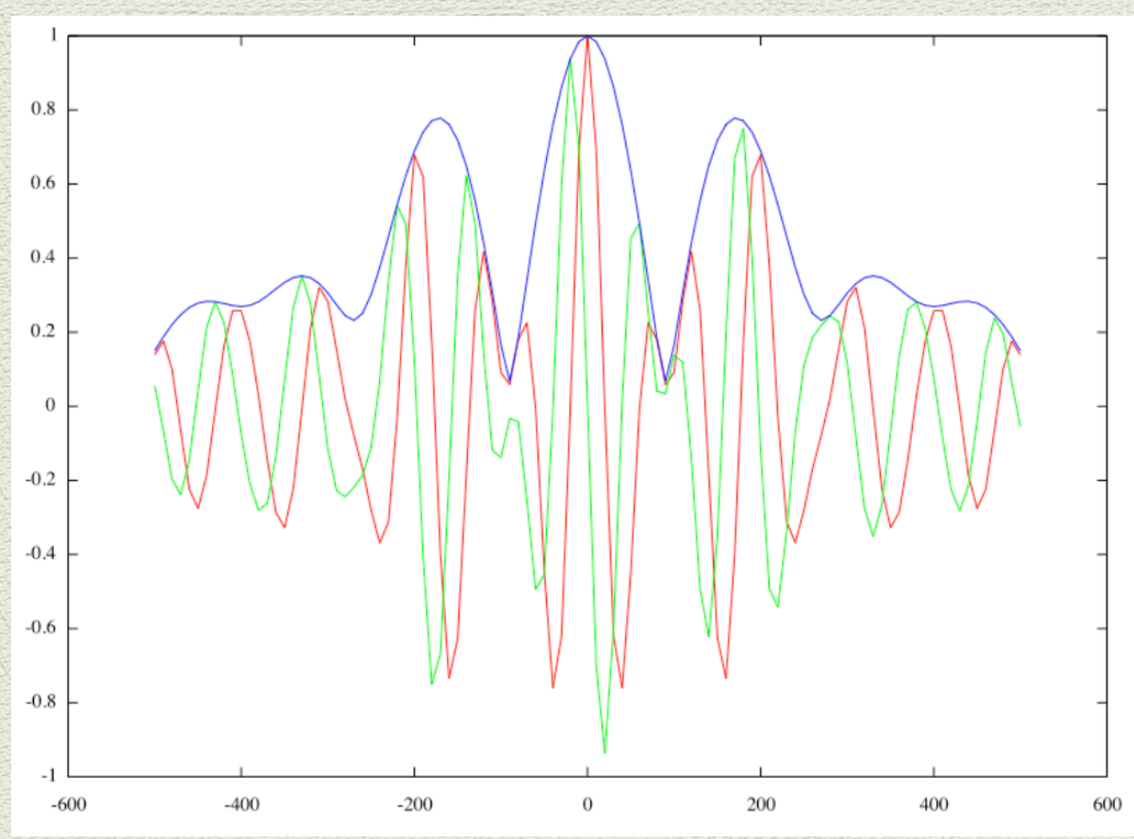




RM-Synthesis Technique

- NO "nπ" ambiguities;
- Recognition of several Faraday depth components within the source;
- The inverted Fourier transform allows one to determine the physical situation from observables;

$$R(\phi) = K \sum_{c=1}^{N} w_c \cdot exp[-2i\phi(\lambda_c^2 - \lambda_0^2)]$$



COMING SOON…

Future work: zoom into the sources

VLBI OBSERVATIONS

- C (5GHZ) AND X (8GHZ) BAND WITH EVN
- U (15 GHZ) AND K (23GHZ) BAND WITH VLBA

- Produce detailed polarisation maps;
- Map the polarisation angle of the different components;
- Identify which are the components contributing to the existing high-RM;
- Magnetic field estimate ;

Observations partly done, partly scheduled

Summary & first conclusion

- Effelsberg observations helped us to define the sample and to give us first hints on the complexity of these peculiar targets - AGNs in an EARLY/PERIODIC activity phase.

- JVLA and VLBI studies will help us to understand IF this assumption could be considered real and add some more solid descriptions and analysis on the knowledge of AGNs.

Max-Planck-Institut
für Radioastronomie

INAF ira

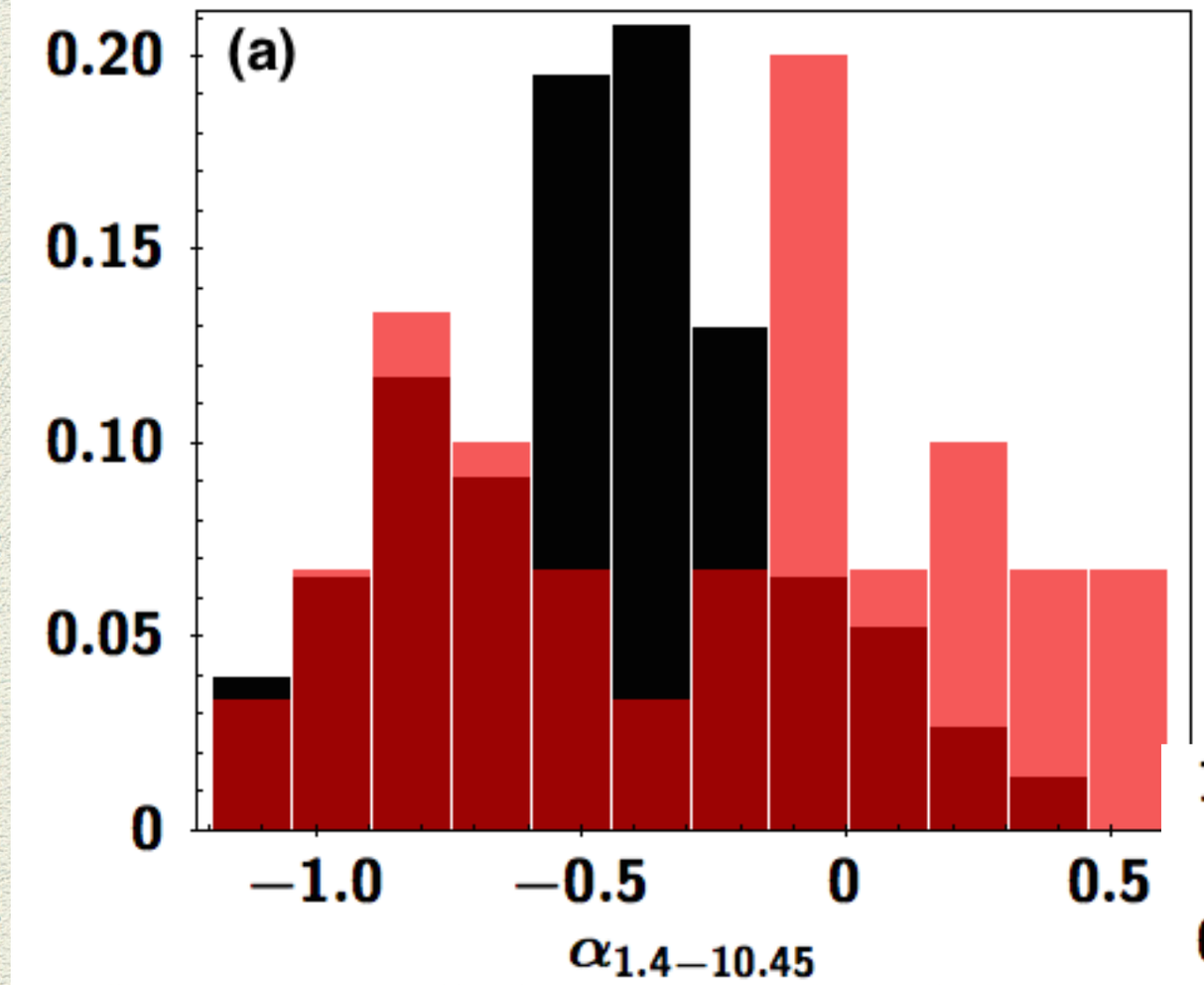
IMPRS
astronomy&
astrophysics
Bonn and Cologne

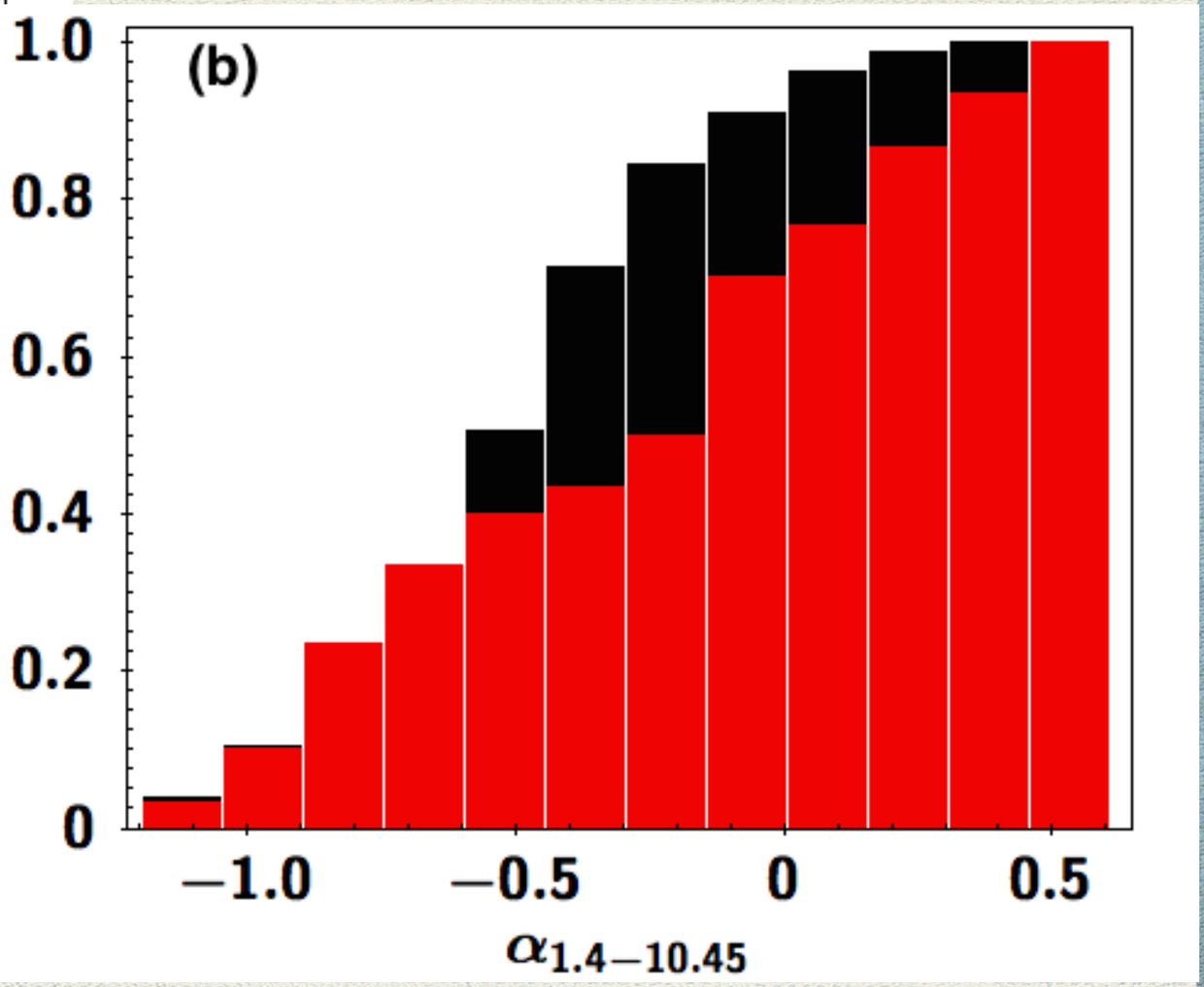
UNIVERSIDAD NACIONAL AUTONOMA Đ MEXICO
POR MI RAZA HABLARA EL ESPIRITV

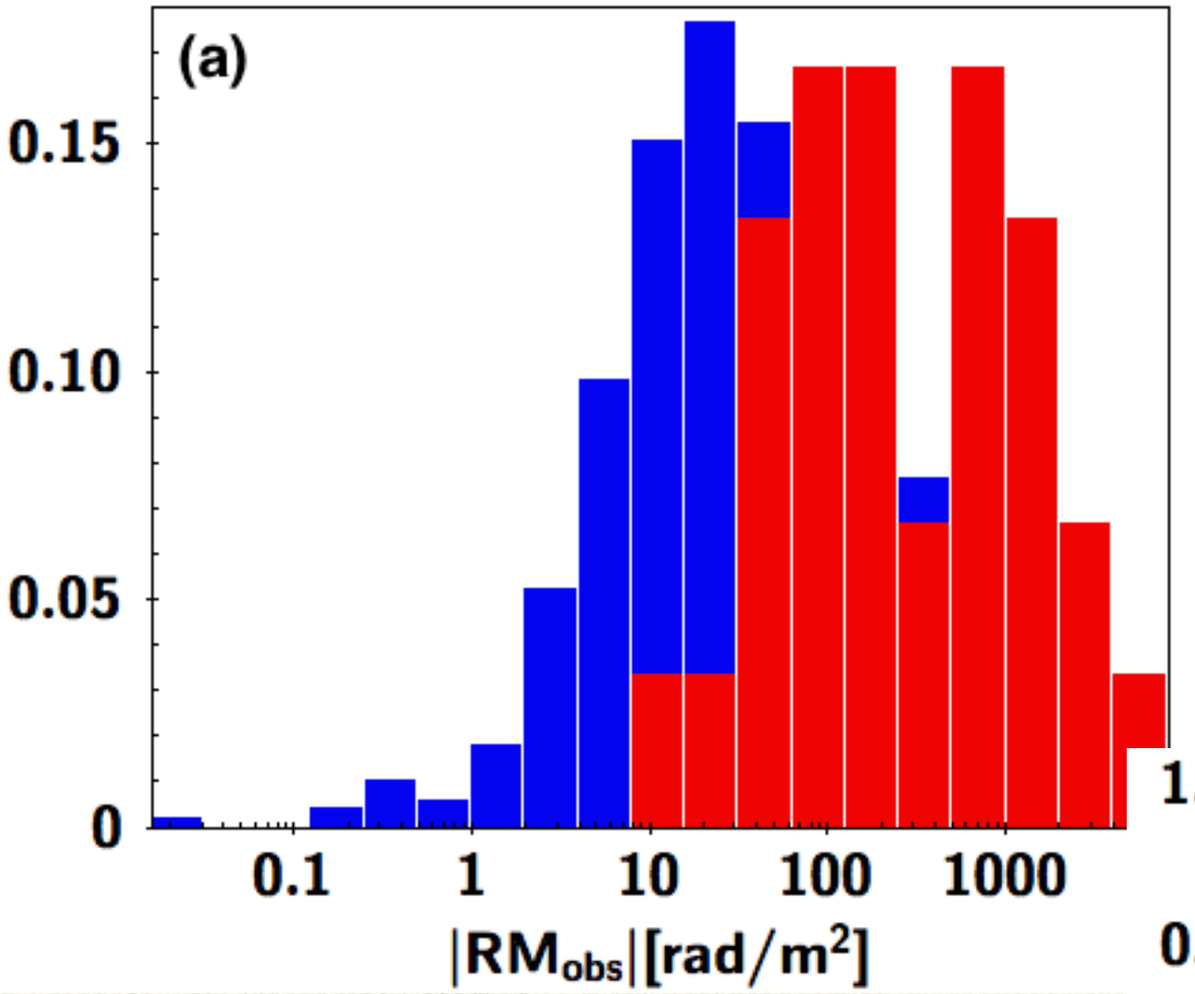
Stay tuned…

Thank you!

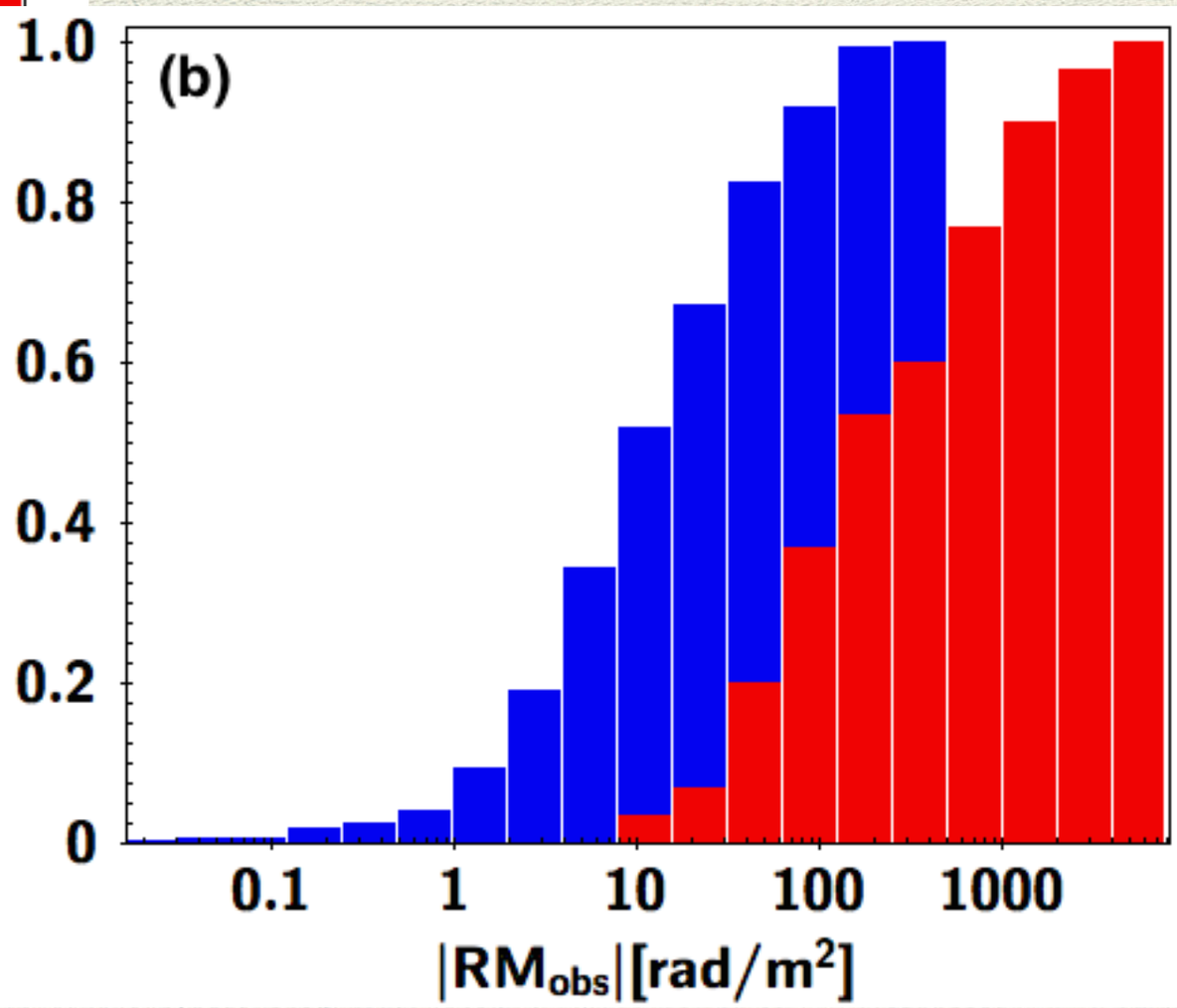
spectral index high-RM
vs
NO pol sources at 10.45 GHz

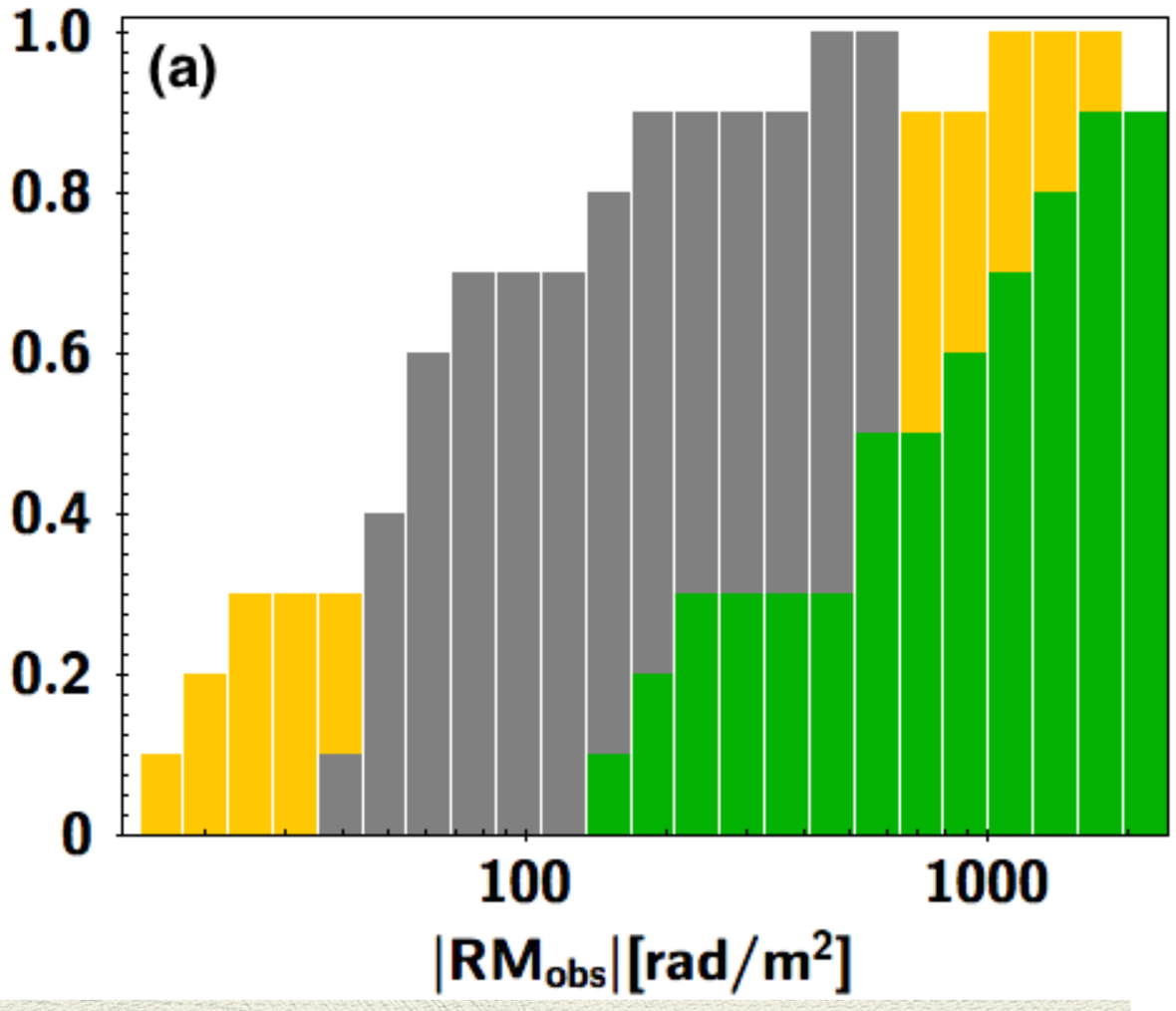






RM obs:
Farnes et al. 2014
vs
high-RM targets





RMobs and RMrf
for the 3 object types.
The MIXED have ALL
really high RM