LINEARLY POLARIZED PROPETIES AND ROTATION MEASURE STUDY OF PARSEC-SCALE AGN JETS

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KEY ASPECTS OF THE STUDY

GOAL:

STUDYING MAGNETIC FIELD STRUCTURE OF THE AGN JETS

BY ANALYSING:

FRACTIONAL POLARIZATION:

RE/DEPOLARIZATION EFFECTS

FARADAY ROTATION

TRANSVERSE RM GRADIENTS

INTRINSIC ELECTRIC FIELD STRUCTURE

SAMPLE & OBSERVATIONAL SETUP

20 SOURCES:

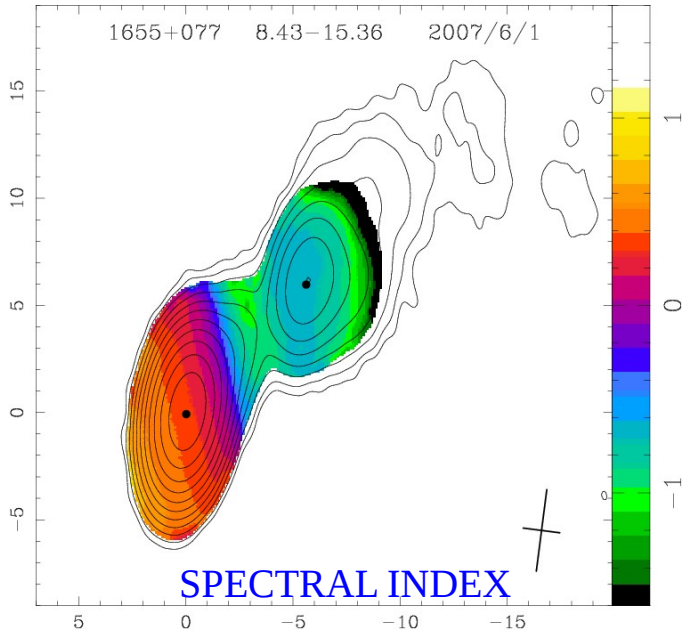
	z	
0148+274	1.260	QSO
0341+147	1.556	QSO
0425+048	0.517	AGN
0507+179	0.416	AGN
0610+260	0.580	QSO
0839+187	1.272	QSO
0952+179	1.478	QSO
1004+141	2.707	QSO
1011+250	1.636	QSO
1049+250	1.300	QSO
1219+285	1.161	BLL
1406-076	1.493	QSO
1458+718	0.904	QSO
1642+690	0.751	QSO
1655+077	0.621	QSO
1803+784	0.680	QSO
1830+285	0.594	QSO
1845+797	0.056	AGN
2201+315	0.298	QSO
2320+506	1.279	QSO

9 VLBA FREQUENCIES: 1.41, 1.66, 2.28, 2.39, 4.60, 5.00, 8.11, 8.43 (16 MHZ BANDWIDTH) & 15.4 (32 MHZ BANDWIDTH) GHZ

SINGLE EPOCH **VLBI PARSEC-SCALE** OBSERVATIONS IN 2007

SOURCES WITH HIGH CORE SHIFTS (SEE SOKOLOVSKY ET AL. 2011)

SEPARATE ANALYSIS FOR THE MODELLED OPAQUE CORE AND TRANSPARENT JET COMPONENTS, VISIBLE ACROSS 9 OBSERVABLE FREQUENCIES

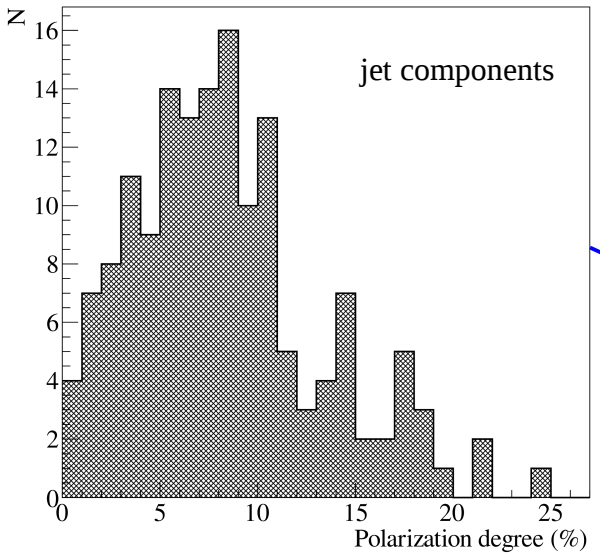


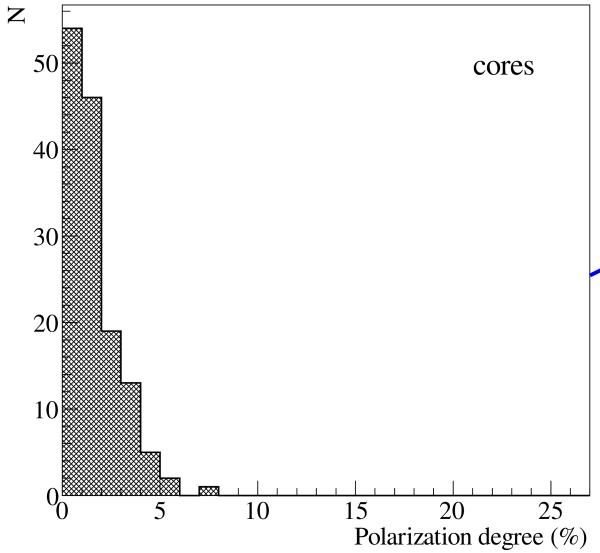
SPECTRAL INDEX

SIMILAR KPC STUDIES:
FARNES+ 2014
PASETTO+ 2015
ANDERSON+ 2016

FRACTIONAL POLARIZATION

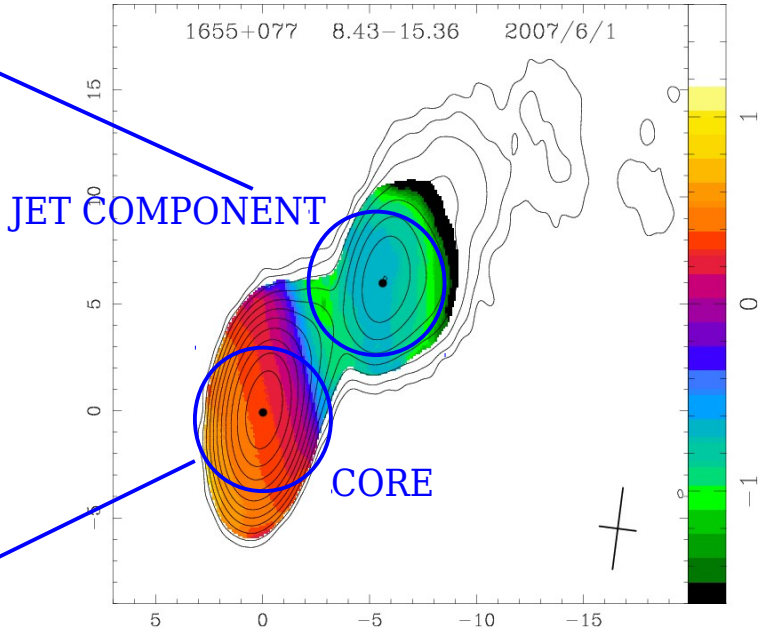
RESULTS: STATISTICS





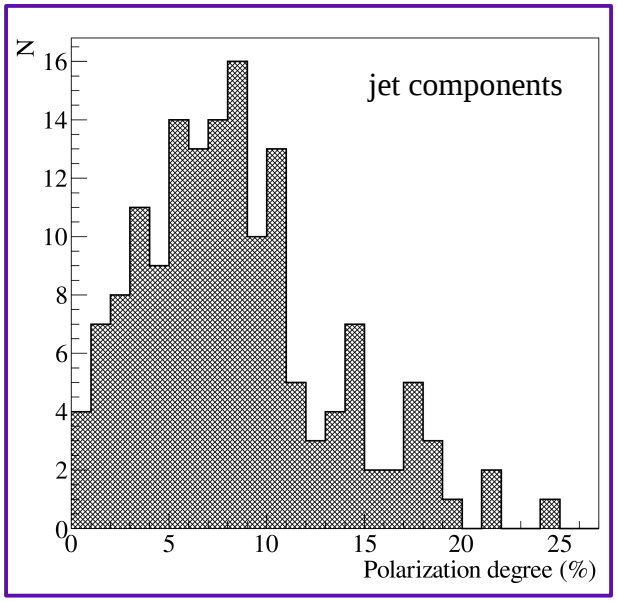
DISTRIBUTION ACROSS 9 FREQUENCIES IN 20 SOURCES

SPECTRAL INDEX

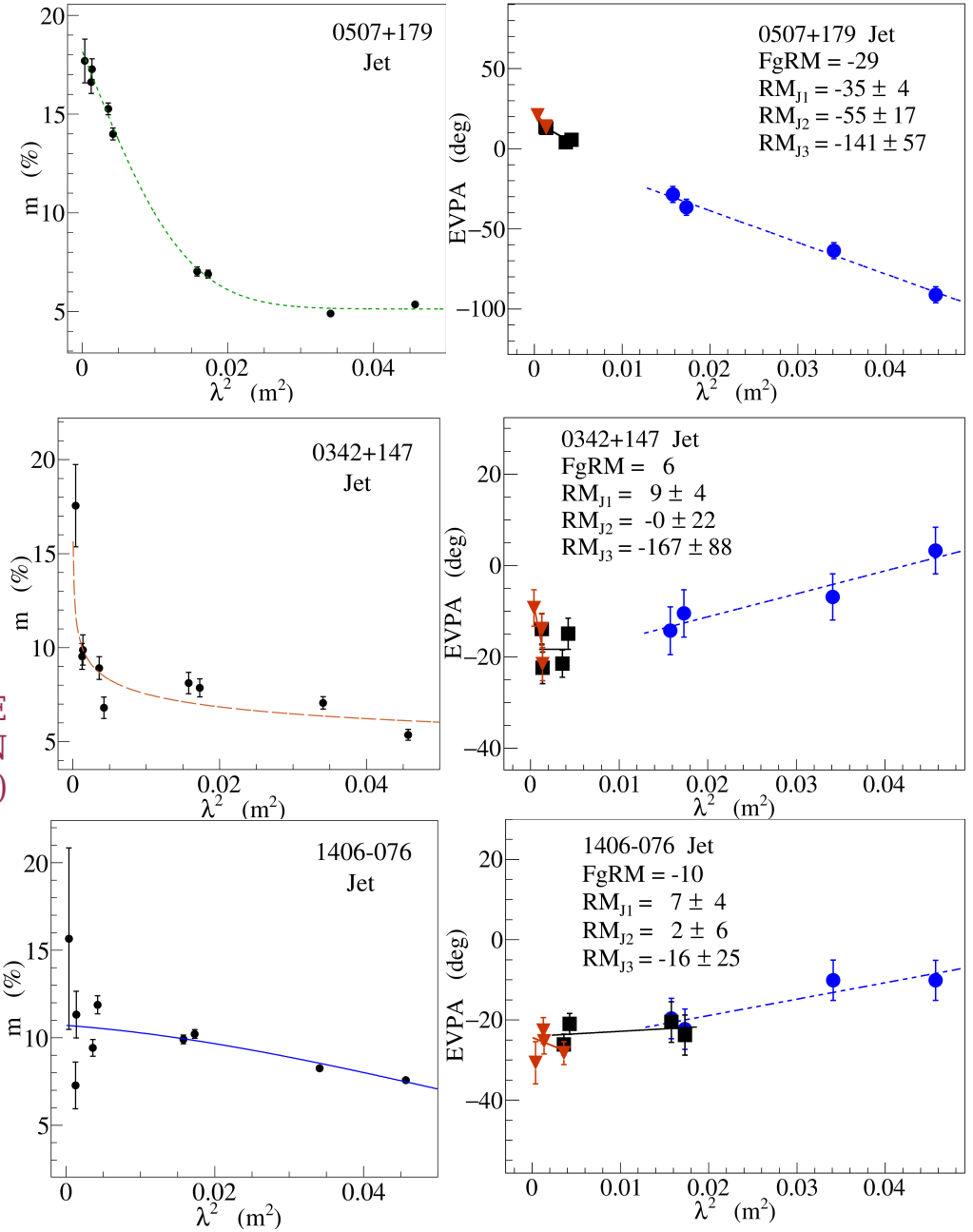


FRACTIONAL POLARIZATION & EVPA

EXTERNAL ROTATION: **TRANSPARENT** JET COMPONENTS



THIS DATA AND FIGURES ARE MADE FOR MODELLED OPTICALLY THIN JET COMPONENTS (PIXEL VALUES)

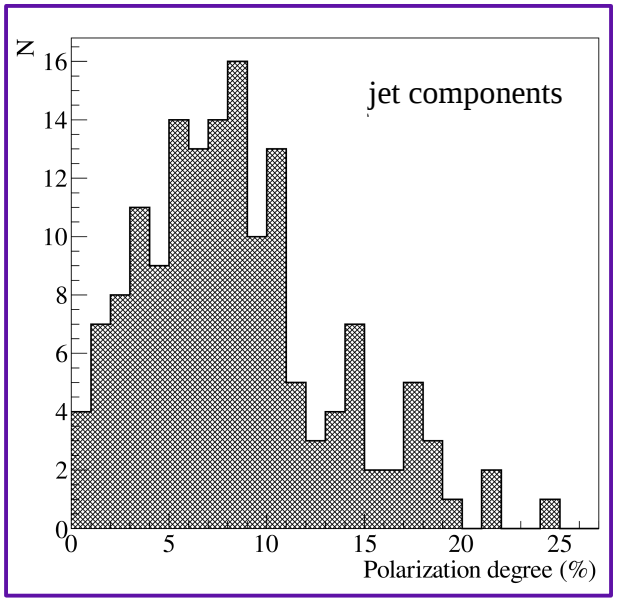


MAJORITY TRANSPARENT JETS EXHIBITS ROTATION ON EXTERNAL FARADAY SCREENS, WHILE FEW SOURCES SHOW INTERNAL ROTATION

EXTERNAL ROTATION - RANDOM (TURBULENT) OR REGULAR MAGNETIC FIELDS IN INHOMOGENOUS INOZED MEDIUM

FRACTIONAL POLARIZATION & EVPA

INTERNAL ROTATION: **TRANSPARENT** JET COMPONENTS



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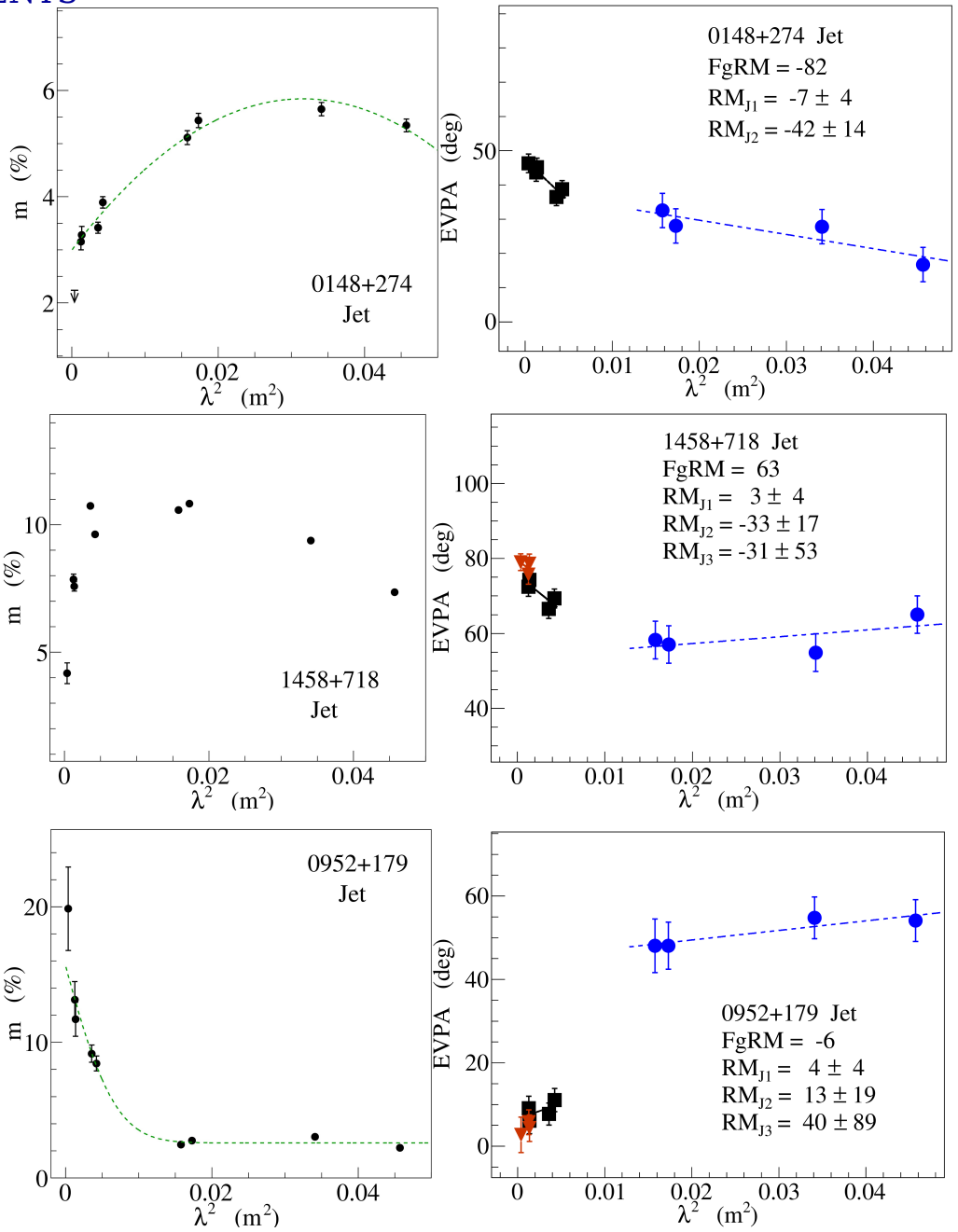


MAJORITY TRANSPARENT JETS EXHIBITS ROTATION ON EXTERNAL FARADAY SCREENS, WHILE FEW SOURCES SHOW INTERNAL ROTATION

EXTERNAL ROTATION - RANDOM (TURBULENT) OR REGULAR MAGNETIC FIELDS IN INHOMOGENOUS INOZED MEDIUM

INTERNAL ROTATION — HELICAL OR TWISTED MAGNETIC FIELDS

FRACTIONAL POLARIZATION & EVPA

OPAQUE JET COMPONENTS

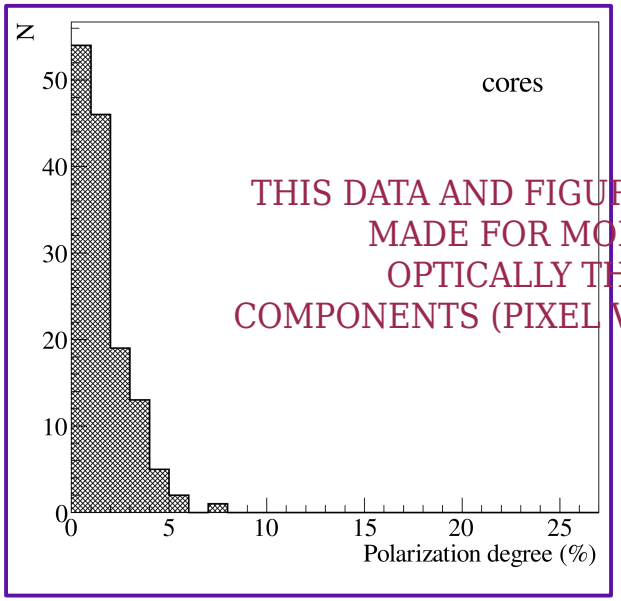
OPAQUE CORES HAVE MORE COMPLEX POLARIZED STRUCTURE, APPLYING THAT POLARIZED FLUX GOES FROM DIFFERENT REGIONS WITHIN A SOURCE

PHYSICAL INTERPRETATION:

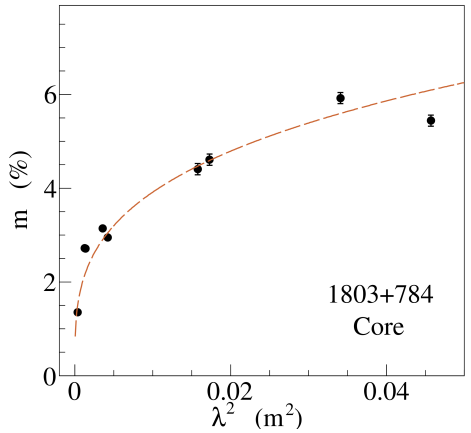
HELICAL/TWISTED MAGNETIC FIELDS

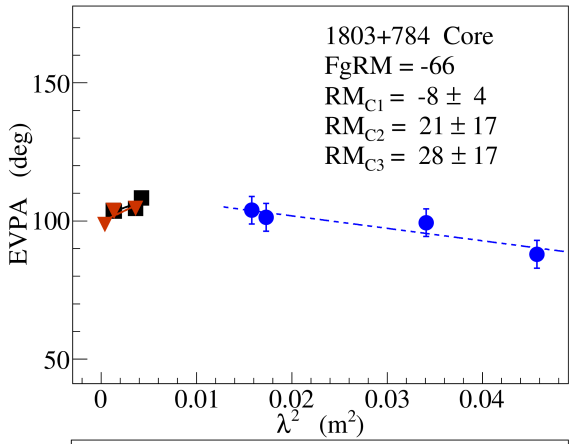
MULTIPLE ROTATION MEASURE OR JET COMPONENTS SMEARED WITHIN A BEAM

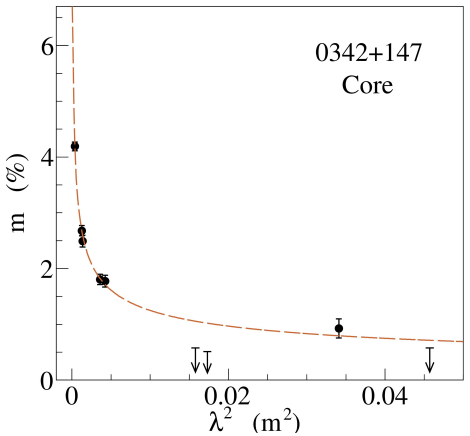
DEPOLARIZATION ON EXTERNAL FARADAY SCREEN

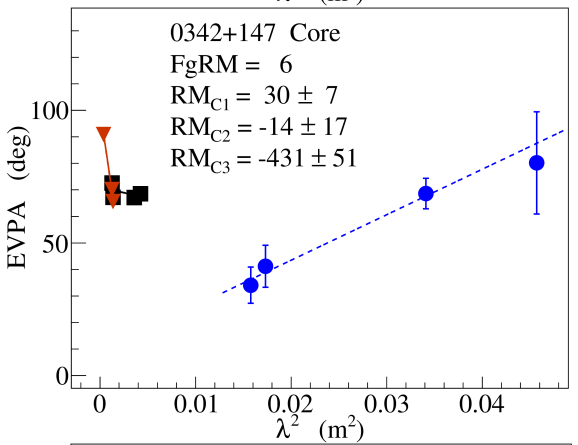


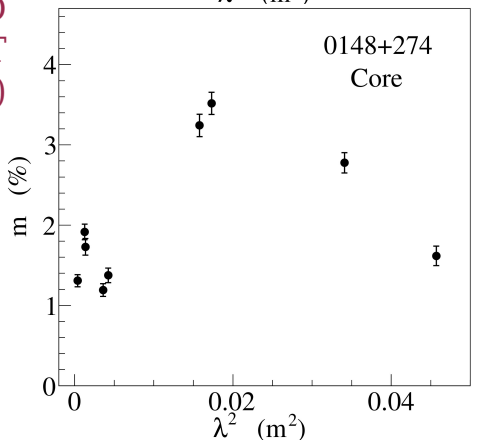
THIS DATA AND FIGURES ARE MADE FOR MODELLED OPTICALLY THICK JET COMPONENTS (PIXEL VALUES)

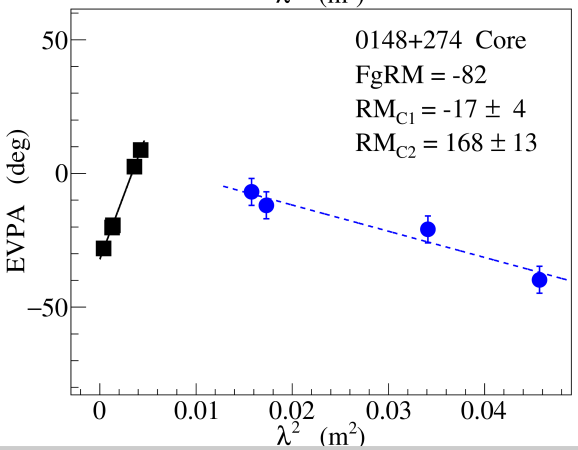






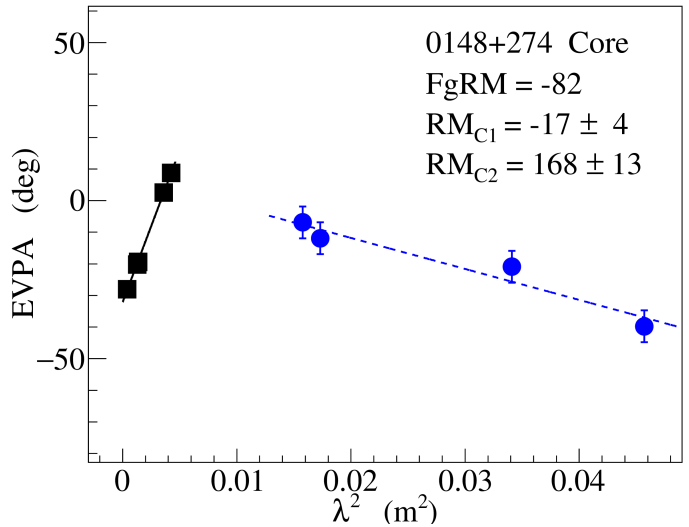


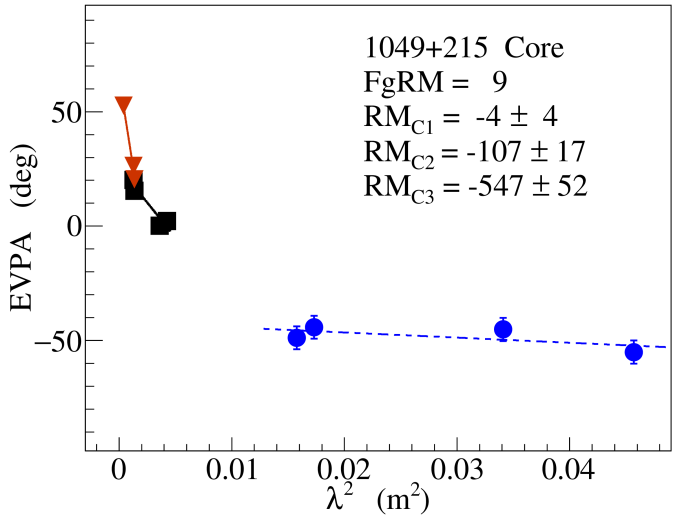


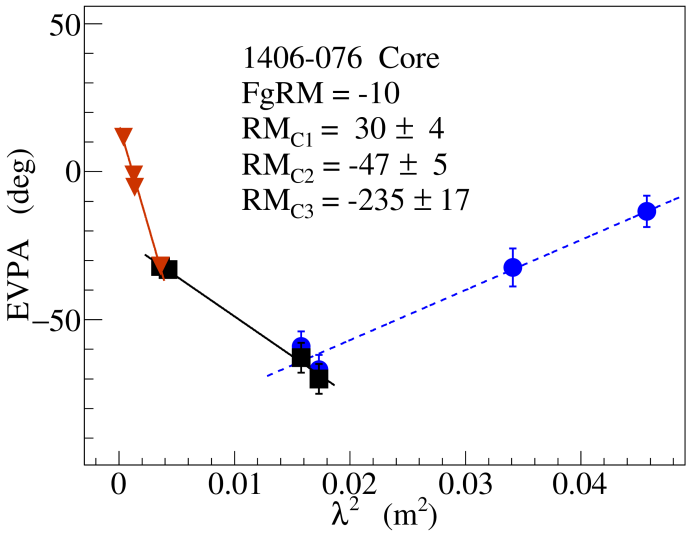


EVPA IN THE CORES

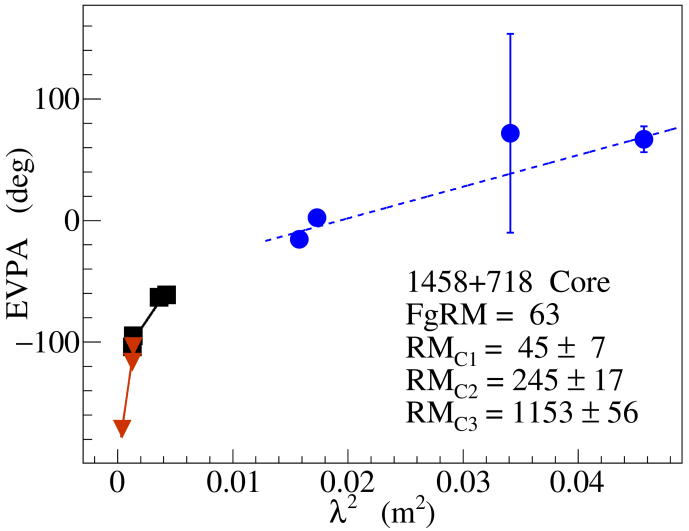
RM INCREASE TOWARDS SHORTER WAVELENGHTS: CORE SHIFTS

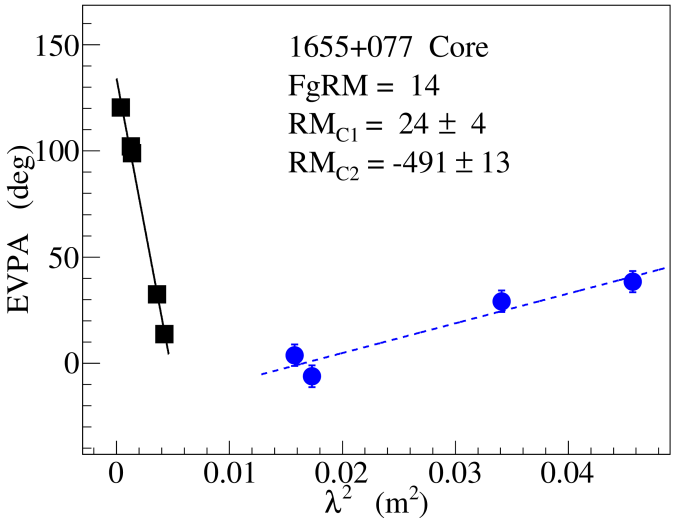


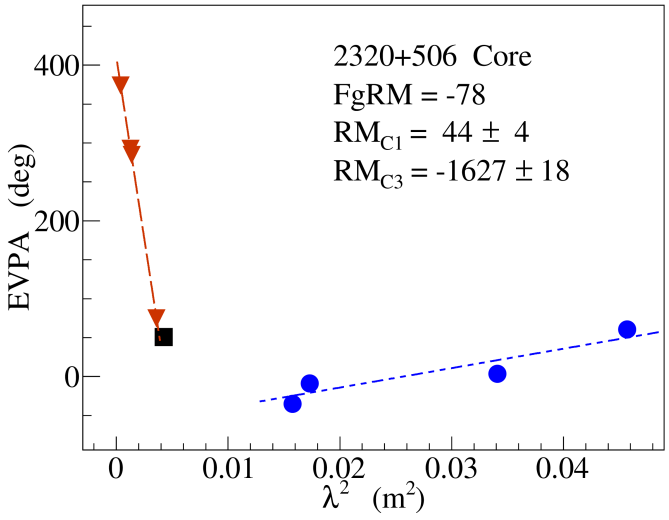




THIS DATA AND FIGURES ARE MADE FOR MODELLED OPTICALLY THICK JET COMPONENTS (PIXEL VALUES)







EVPAs ARE CORRECTED FOR GALACTIC RM

FARADAY ROTATION MEASURES

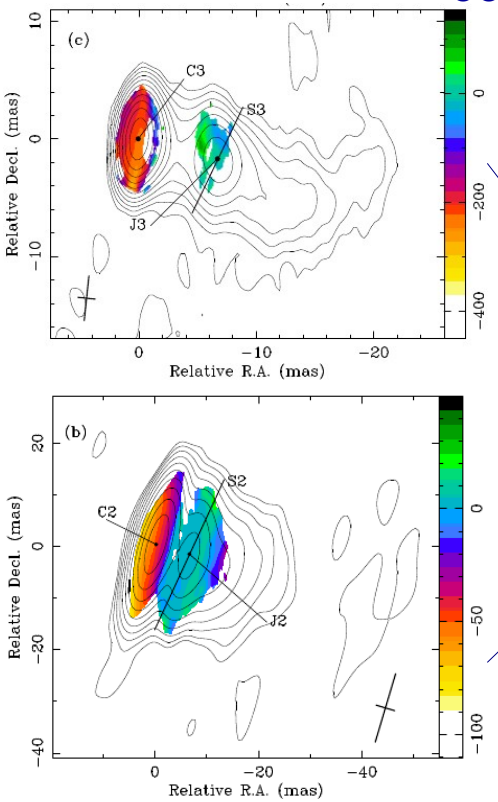
$RM \sim \int n_e B_{\parallel} dl$

CONSTRUCTED 43 ROTATION MEASURE MAPS

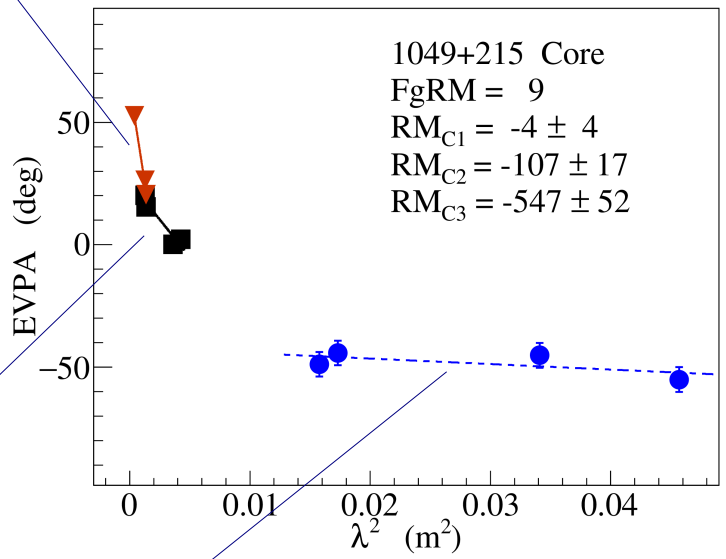
1.4 — 2.4 GHZ

2.4 — 5.0 GHZ

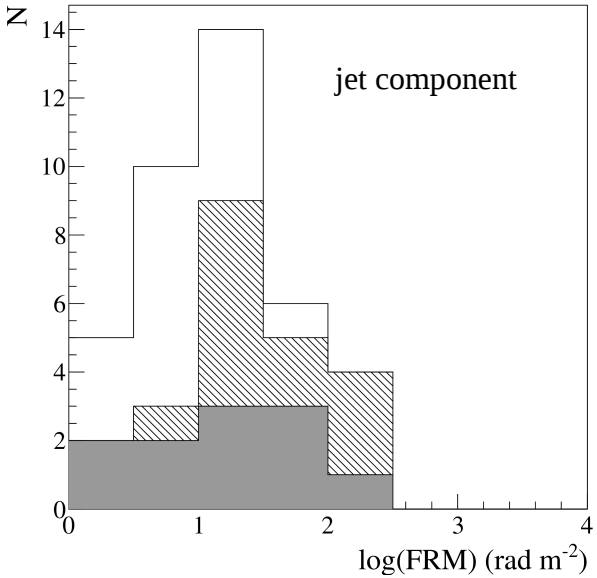
4.6 — 15.4 GHZ



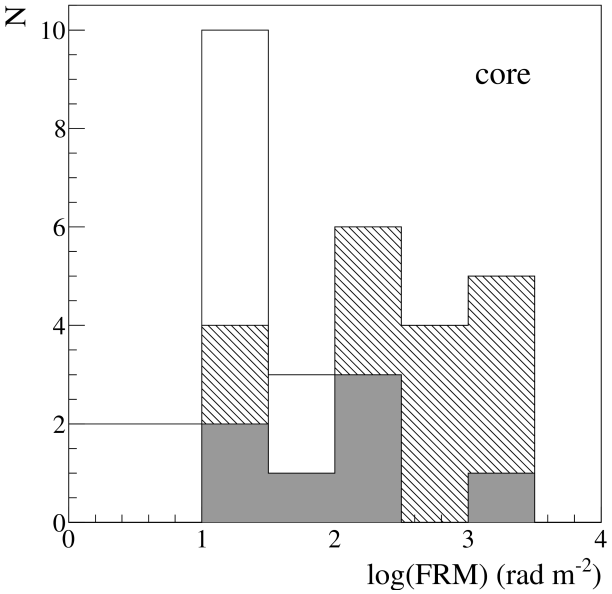
ROTATION MEASURE



ROTATION MEASURE VALUES ARE VARIABLE AT MONTHs — YEARs SCALES, AS SEEN FROM COMPARISON OF OUR VALUES WITH MEASURES MADE BY OTHER AUTHORS

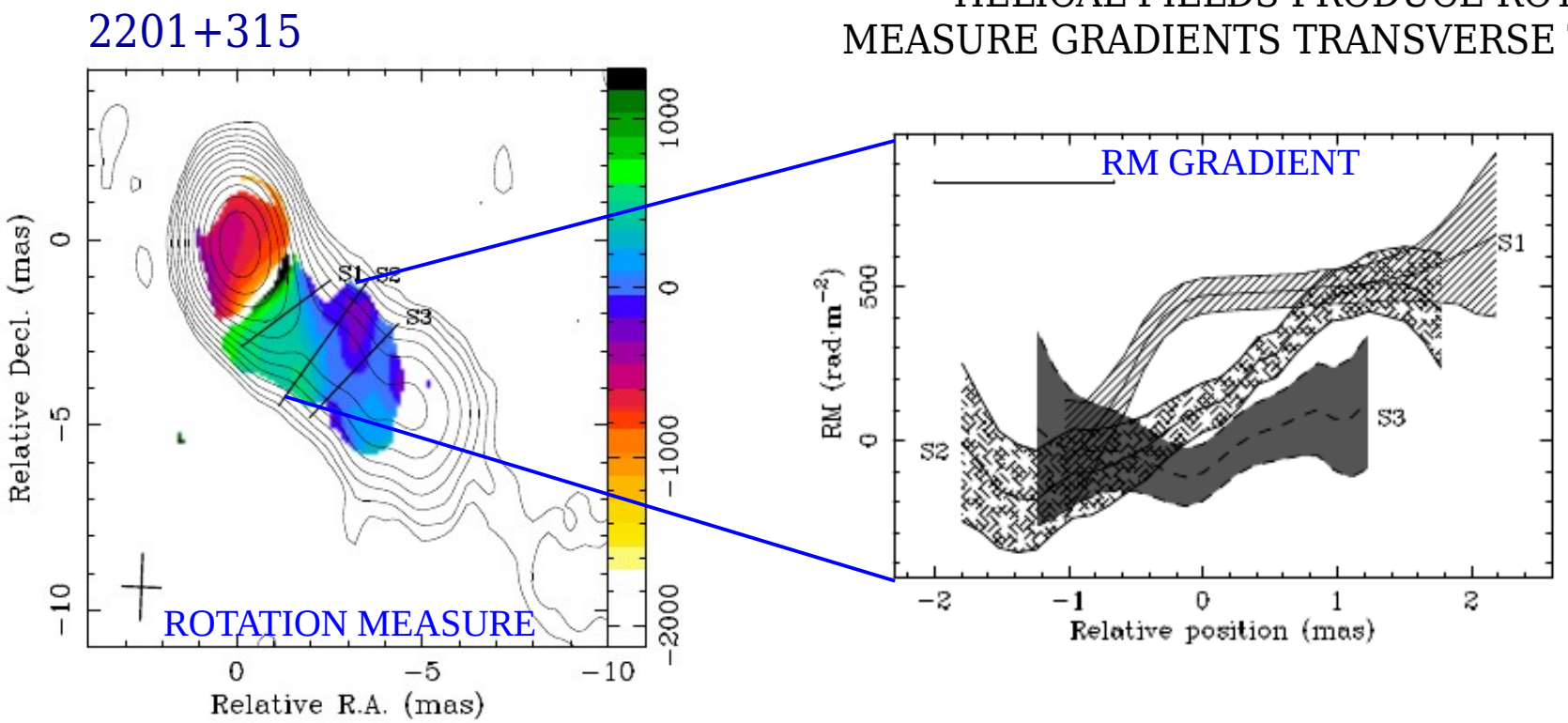


OBSERVABLE ROTATION MEASURE, CORRECTED FOR GALACTIC CONTRIBUTION



TRANSVERSE ROTATION MEASURE GRADIENT

HELICAL FIELDS PRODUCE ROTATION MEASURE GRADIENTS TRANSVERSE TO JET

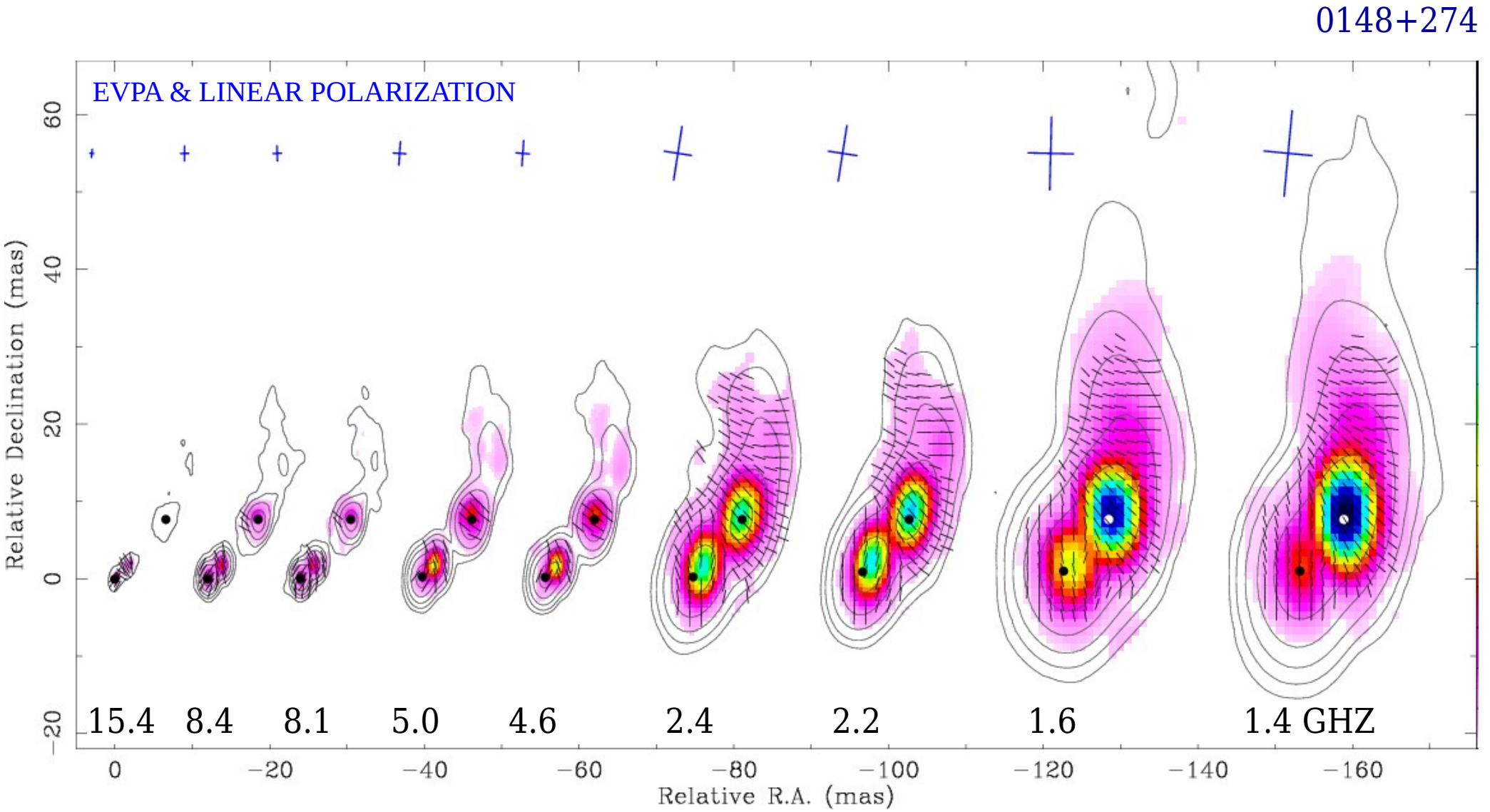


8 OUT OF 20 SOURCES SHOW SIGNIFICANT ROTATION MEASURE GRADIENTS

3 OUT OF THESE 8 MIGHT BE PRODUCED BY N_E and/or $B_{||}$ CHANGE RATHER THAN CHANGE IN ORIENTATION OF B

ELECTRIC FIELD STRUCTURE

CORRECTED FOR FARADAY RM: 0148+274

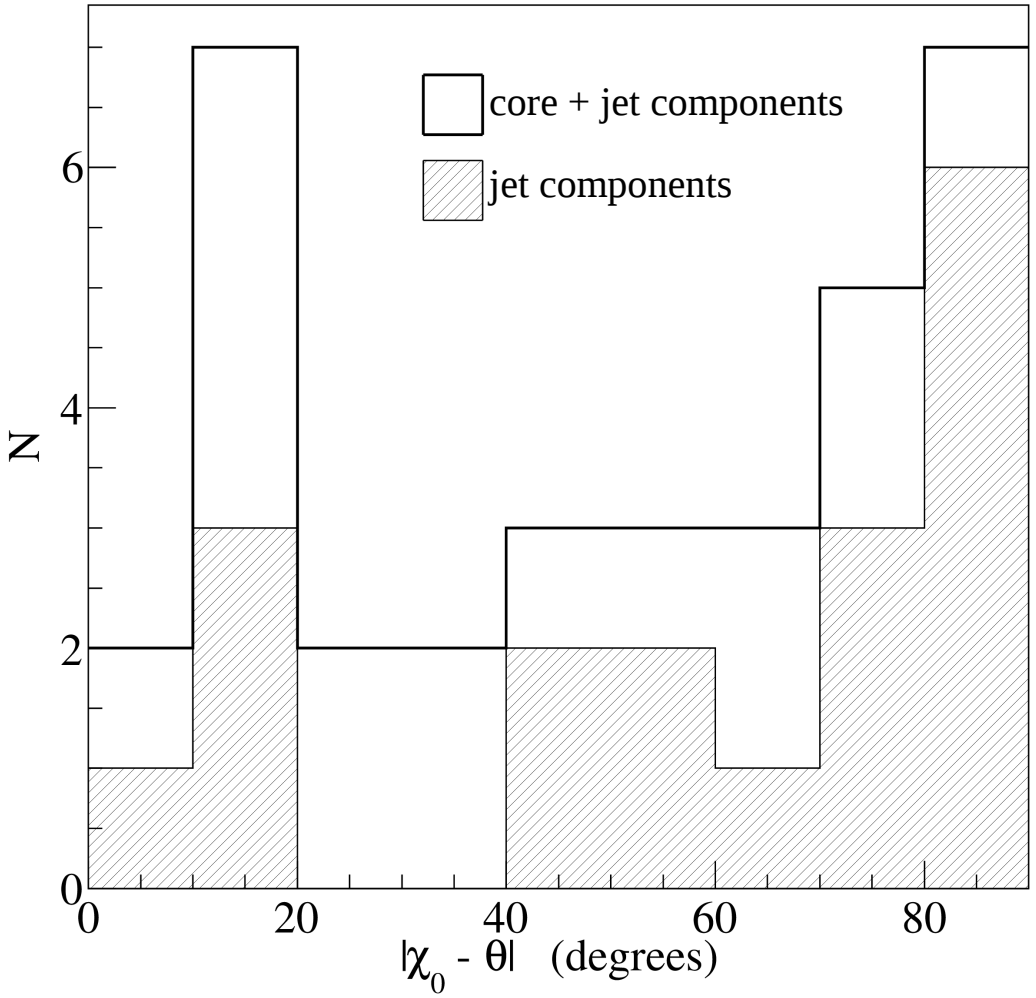


EVPA vs. JET DIRECTION

CORRECTED FOR FARADAY RM

55% OF THE SOURCES HAVE EITHER PARALLEL OR PERPENDICULAR EVPAs RELATIVE TO JET DIRECTION

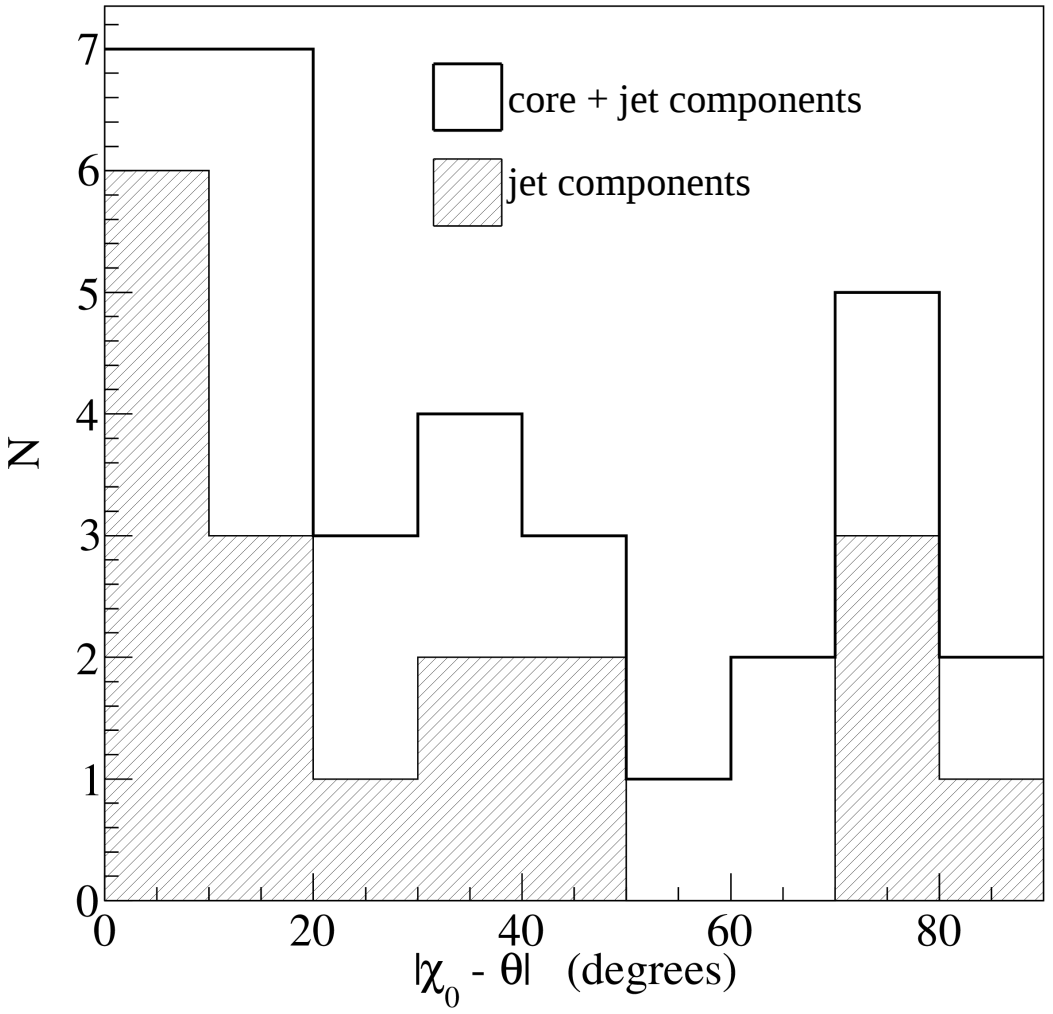
45% OF THE SOURCES INCLINE THEIR EVPAs AT ANGLES >20^0 & <70^0



EVPA vs. JET DIRECTION

CORRECTED FOR FARADAY RM

JET EVPAs ROTATED BY 90 DEGREES



JET EVPAs ARE ROTATED BY 90 DEGREES (TO ALIGN CORE AND JET EVPAs, CHANGE IN OPACITY)

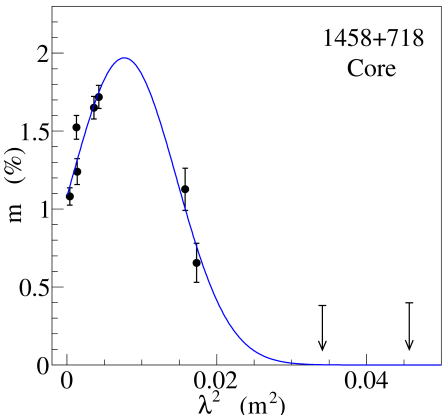
SMALL TENDENCY TO ALIGN EVPAs WITH THE JET DIRECTION

ALIGNMENT DOES NOT IMPLY EXISTENCE OF POLOIDAL MAGNETIC FIELD IN THE JET

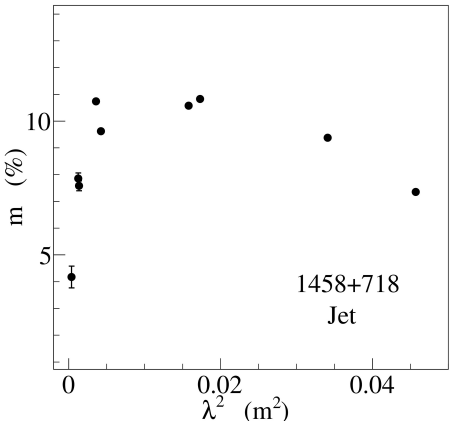
SUCH DISTRIBUTION HAS BEEN OBSERVED BEFORE (E.G. POLLACK+2003, LISTER&HOMAN 2005, AGUDO+2014,)

ELECTRIC FIELD STRUCTURE

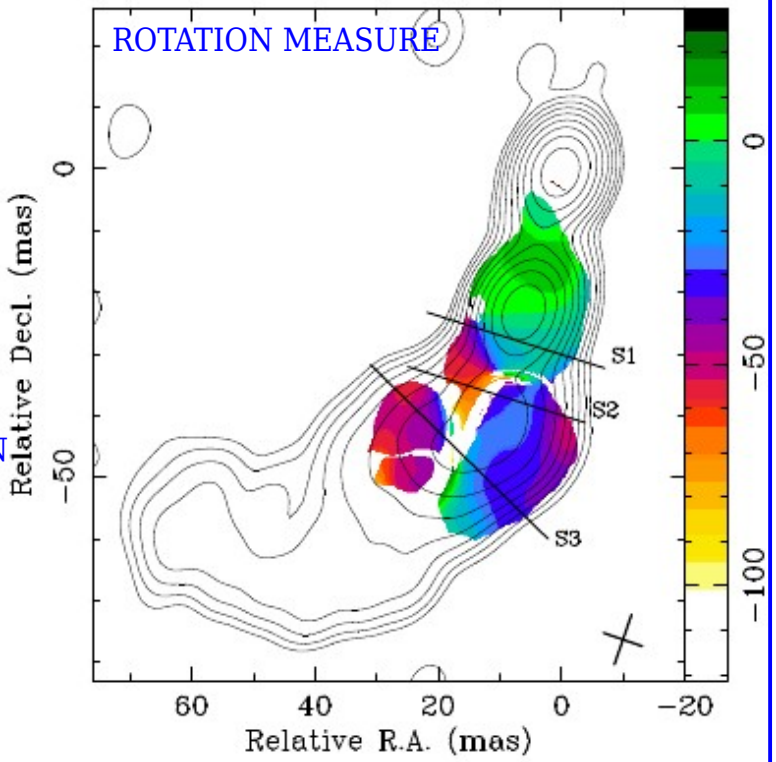
CORRECTED FOR FARADAY RM: 1458+718

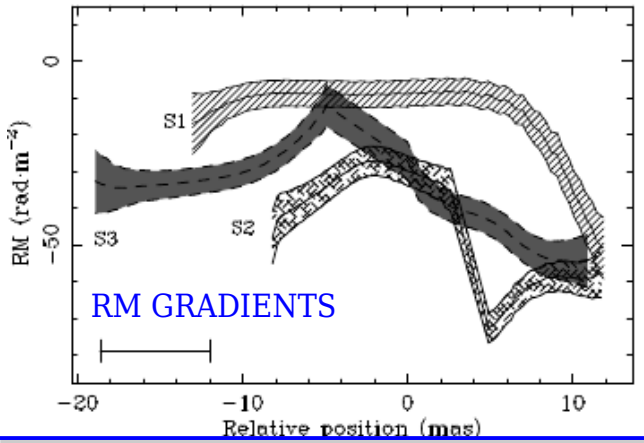


FRACTIONAL POLARIZATION

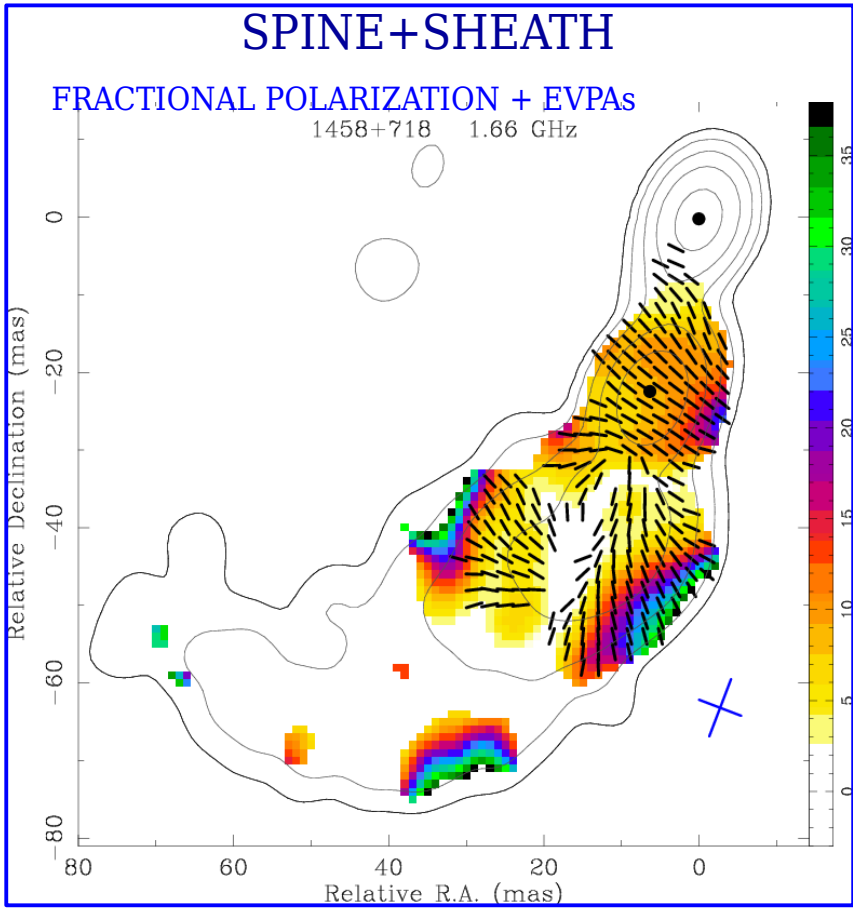


SHEATH



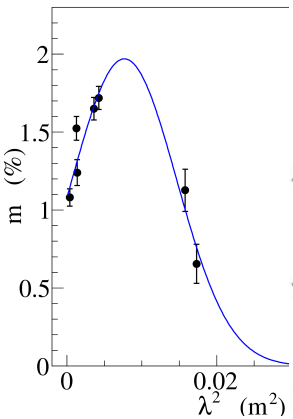


SPINE+SHEATH

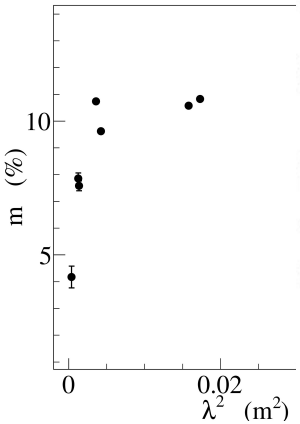


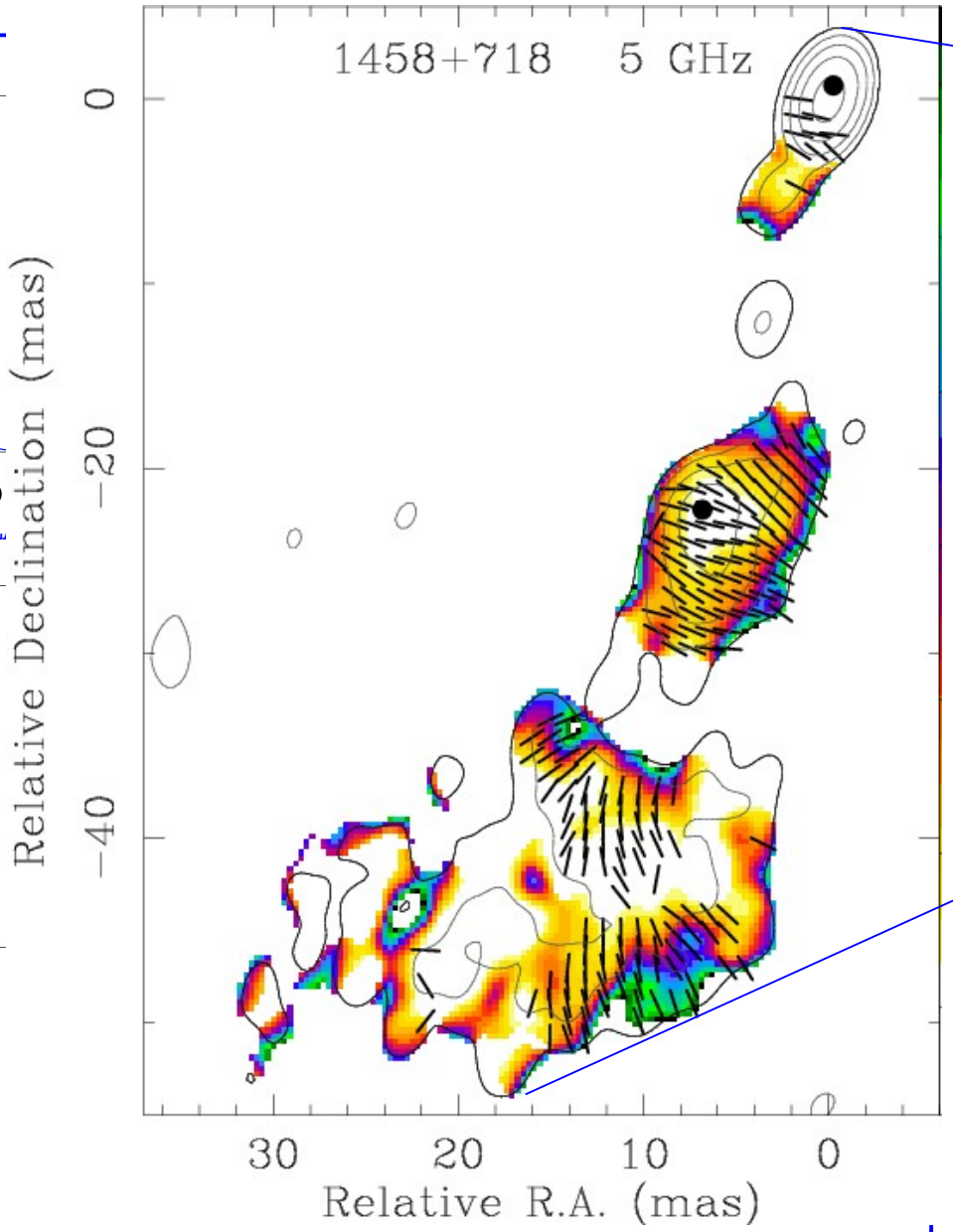
ELECTRIC FIELD STRUCTURE

CORRECTED FOR FARADAY RM: 1458+718



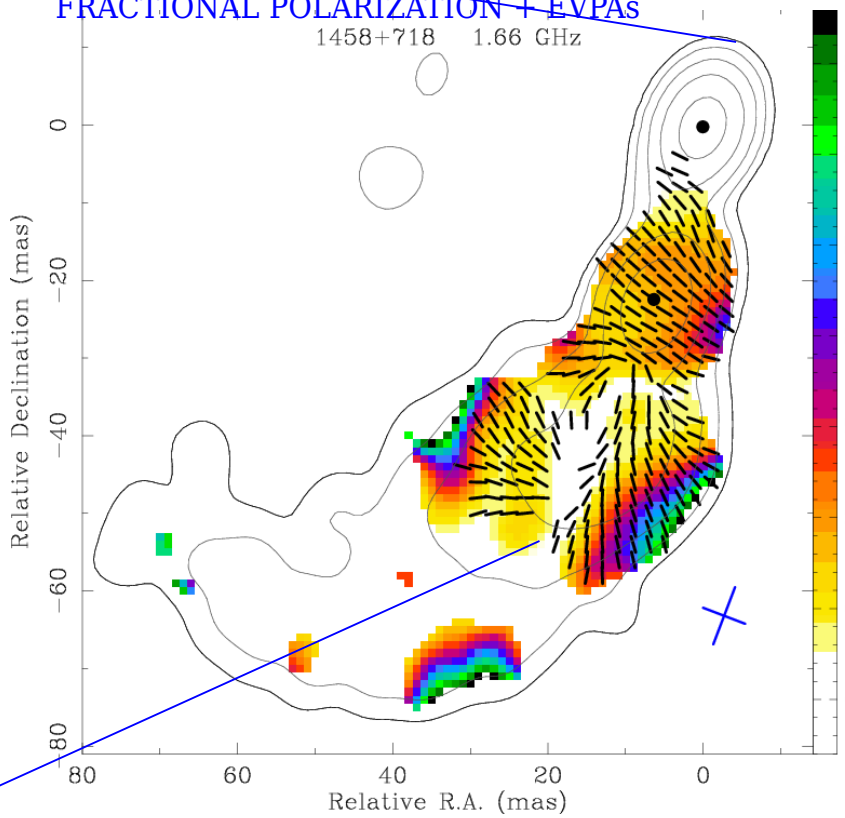
FRACTIONAL POL.





SPINE+SHEATH

FRACTIONAL POLARIZATION + EVPAs



OBSERVED COMPLEX MAGNETIC FIELD GEOMETRY IS DUE TO SPINE-SHEATH JET STRUCTURE AND CHANGE IN LOS AT SOME POINT IN THE JET

SUMMARY

MAJORITY OF THE SOURCES ARE CONSISTENT WITH THE MODEL OF EXTERNAL FARADAY SCREEN, LOCATED CLOSE TO THE JET (MIGHT BE ITS OUTER LAYER, SHEATH, ETC.)

38 CASES (18 SOURCES). OBSERVED MAGNETIC FIELD STRUCTURE:

POLOIDAL in the JET	+++++++++
RANDOM/REGULAR in the SCREEN	++++++++++
HELICAL in the JET	+++++++
HELICAL in the SCREEN	++++++++
UNKNOWN in the JET/SCREEN	++++

THERE IS NO SINGLE, ULTIMATE MODEL OF THE MAGNETIC FIELD STRUCTURE ABLE TO DESCRIBE ALL OBSERVED SOURCES

SPINE (CENTRE) - SHEATH (SURROUNDING MEDIA) STRUCTURE, LOS AND RELATIVISTIC EFFECTS MAY DESCRIBE OBSERVED VARIETY OF POLARIZED CHARACTERISTICS. IN THIS CONTEXT, SHEATH HOLDS TURBULENT, REGULAR POLOIDAL OR TOROIDAL MAGNETIC FIELD. SPINE CONTAINS WEEL-ORDERED, LARGE-SCALE MAGNETIC FIELDS.

POOR SPATIAL RESOLUTION, INSTABILITIES, SHOCKS, JET BENDS, CHANGE IN JET GEOMETRY, JET ASYMMETRY, SOURCE FLARING ACTIVITY AFFECT INTRINSIC MAGNETIC FIELD ORIENTATION