

Selecting ICRF-2 defining sources based on source structure

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¹ Observatoire de Bordeaux

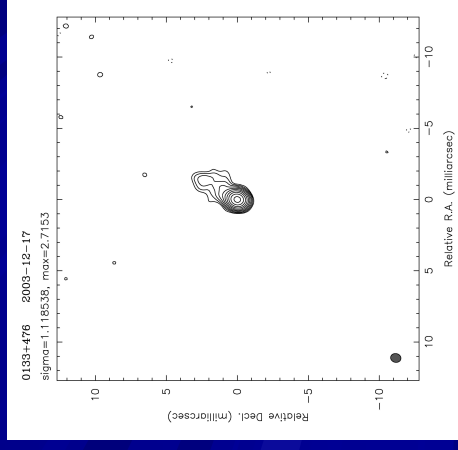
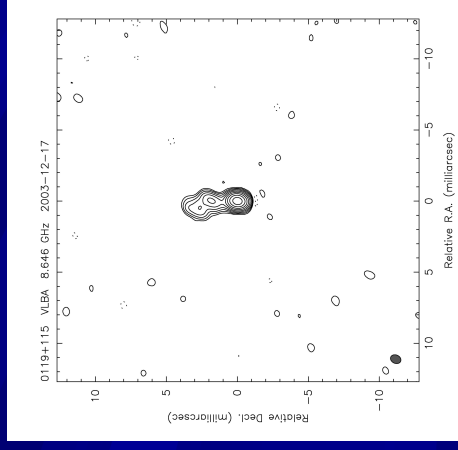
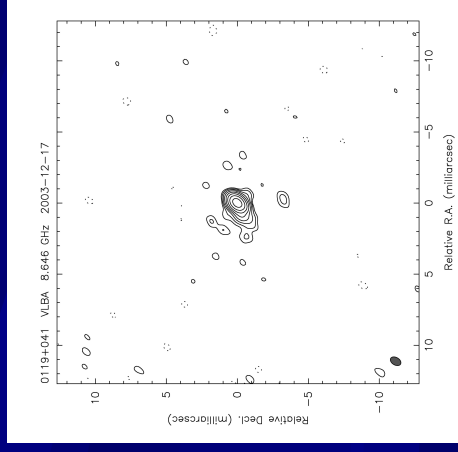
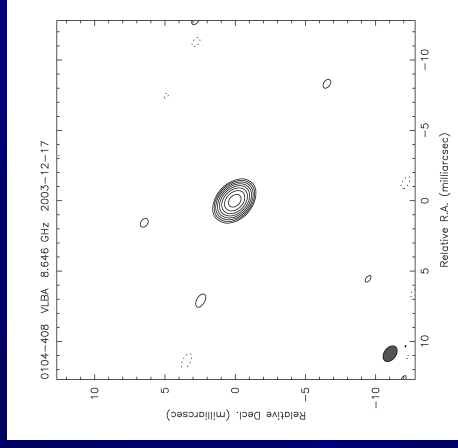
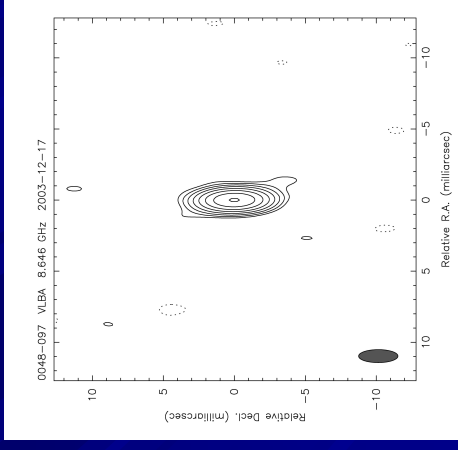
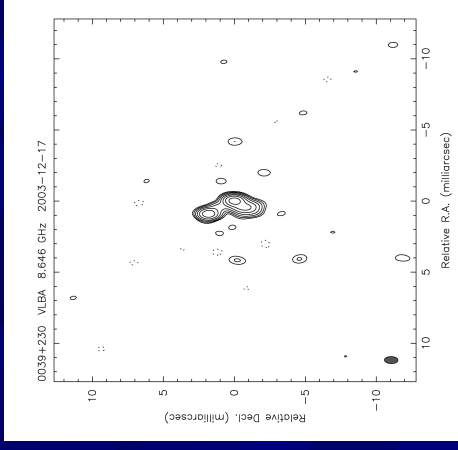
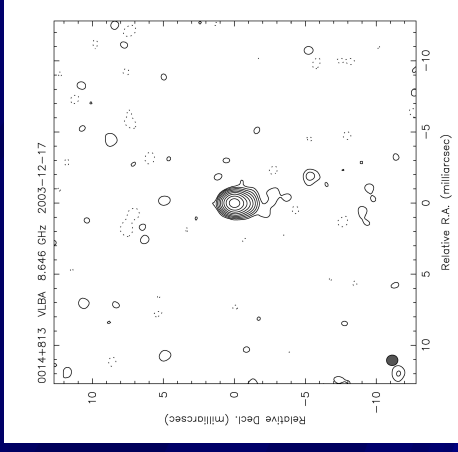
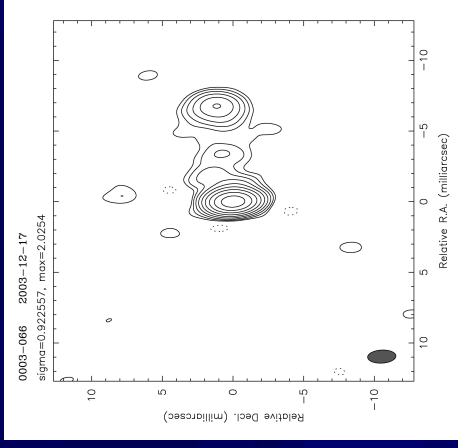
² US Naval Observatory

³ Observatorio do Valongo

Outline

- Impact of source structure on VLBI data
- Status of current VLBI image data base
- Evaluation of structure index
- Conclusion

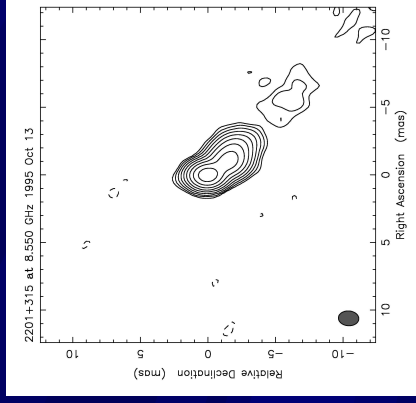
Source structure: a few examples



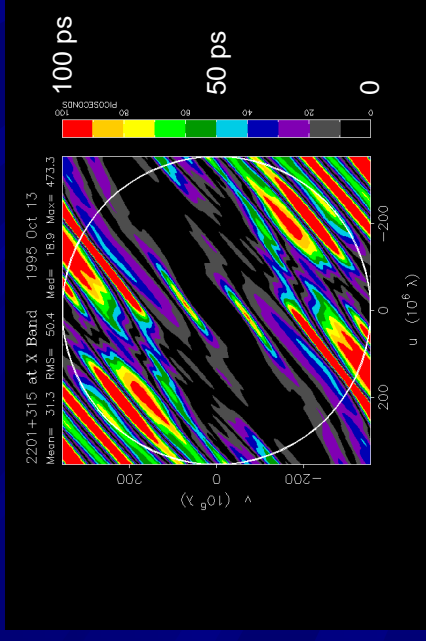
A sample of randomly-selected ICRF sources (by increasing RA)

Impact on VLBI delay measurements

VLBI image



Structure delay as a function of the sky-projected VLBI baseline



Medium correction: 19 ps

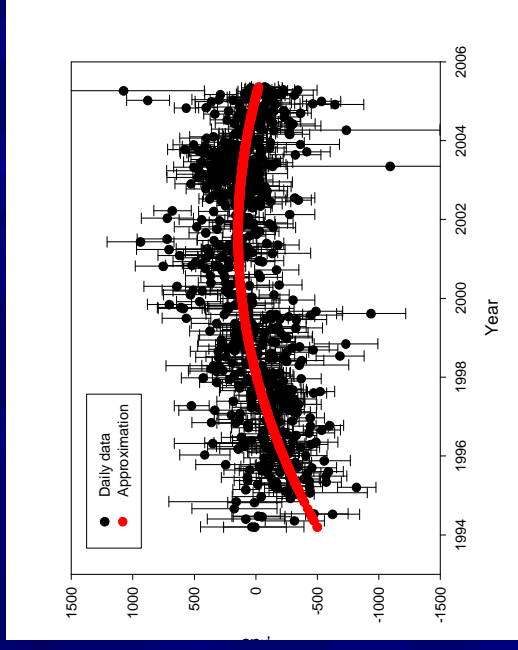
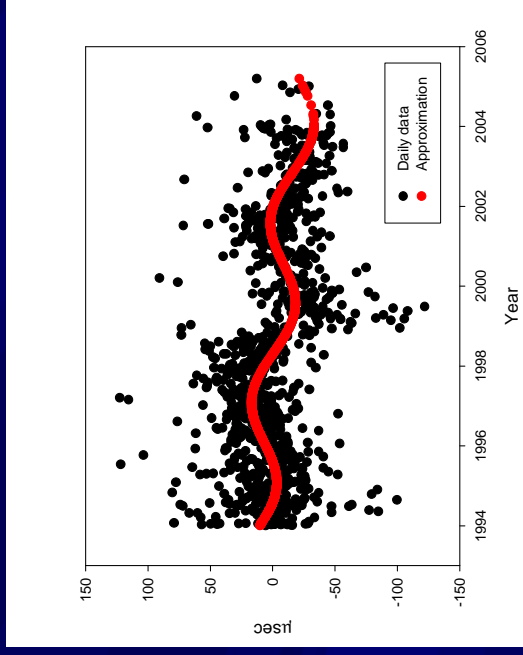
$$\text{Source structure delay: } \tau_{\text{str}} = f(\vec{S}, \vec{B}, \vec{k})$$

\vec{S} = brightness distribution

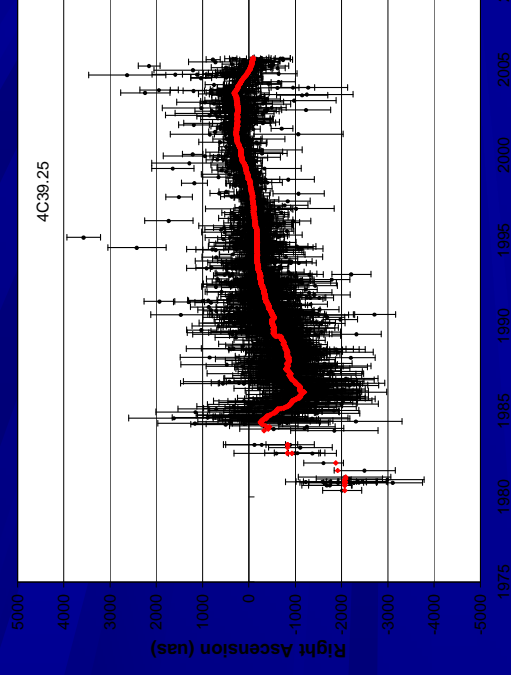
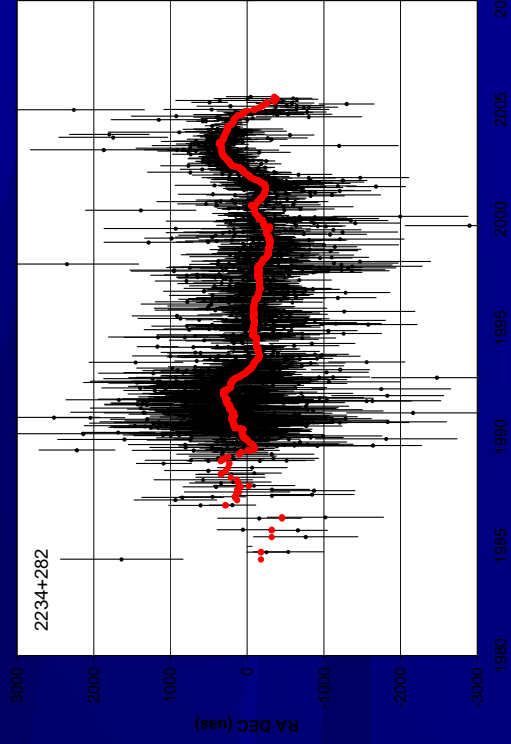
\vec{B} = VLBI baseline vector

\vec{k} = source direction

Source position instabilities

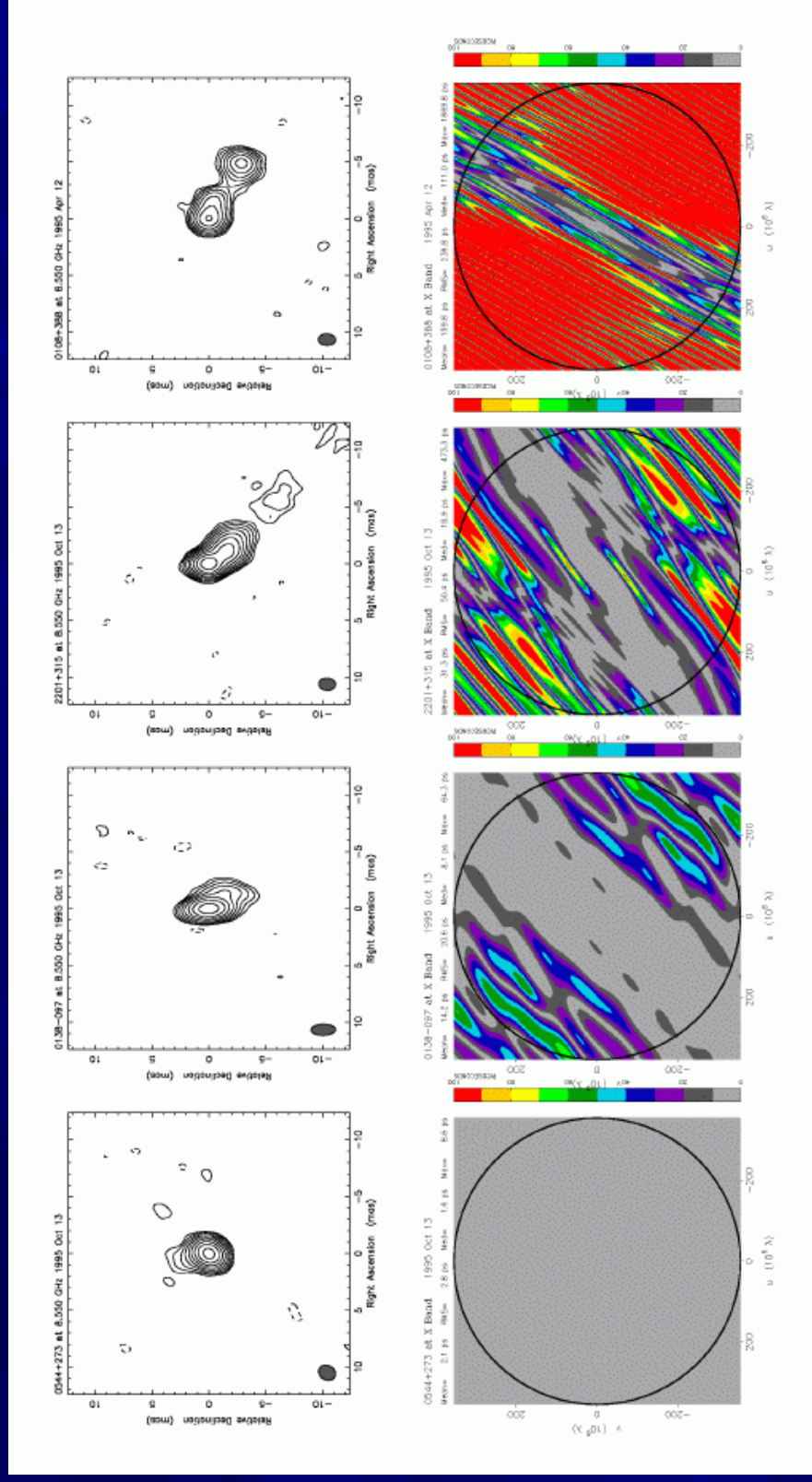


Titov (2006)



MacMillan (2006)

Structure index (SI) based on observed VLBI structure



Structure

Index

SI = 1

excellent

SI = 2

good

SI = 3

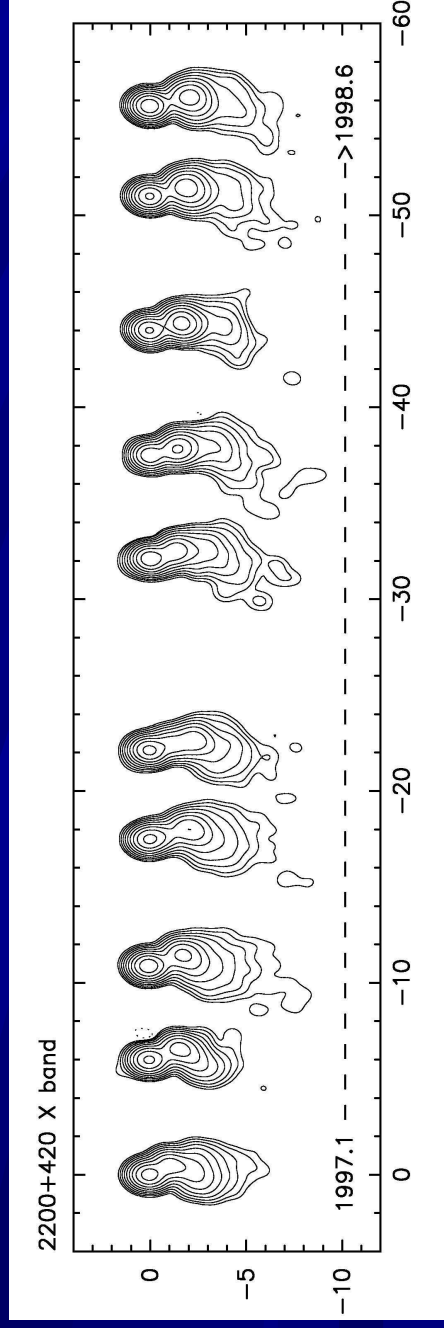
poor

SI = 4

very bad

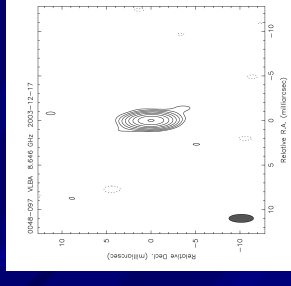
VLBI image data base

- 38 sessions imaged (10 VLBA, 23 VLBA+geodetic stations, 5 southern-hemisphere) [1994-2007]
 - 2697 maps at X band (577 ICRF + 98 non-ICRF sources)
 - 2388 maps at S band (492 ICRF + 66 non-ICRF sources)
- Between 1 and 28 epochs available per source.

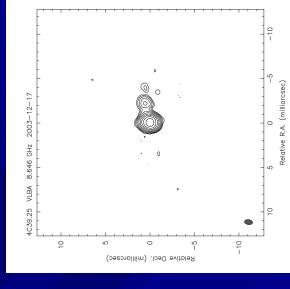


Time series of structure indices

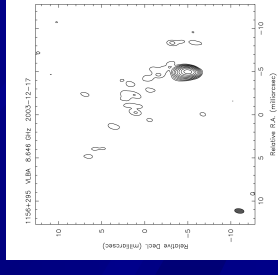
0048-097: 1111111111111122122...
(compact source)



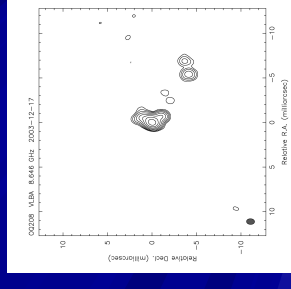
4C39.25: 2222222222222233333...
(long-term motion)



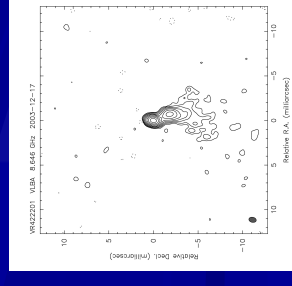
1156+295: 222233332221221222...
(BL Lac object)



1404+286: 3333333333333333333...
(Compact Symmetric Object)



2200+420: 3343333443332333332...
(BL Lac object)

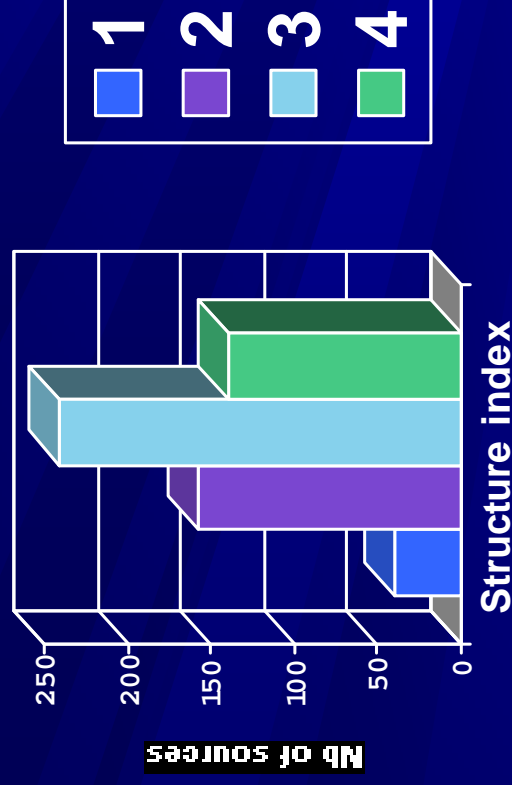


→ Maximum value of SI for source categorisation

Structure index distribution

X band

(577 ICRF sources)



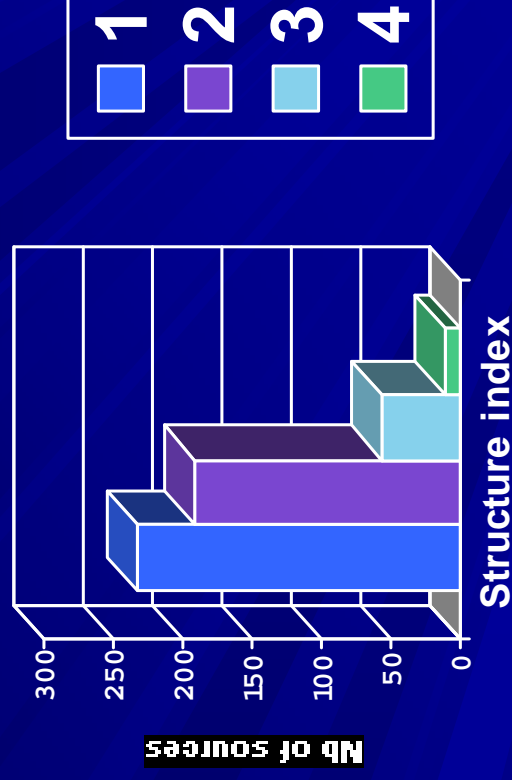
ICRF 80% complete

34% SI=1-2

66% SI=3-4

S band

(492 ICRF sources)



ICRF 69% complete

86% SI=1-2

14% SI=3-4

→ 197 ICRF sources suitable (SI=1 or 2) at both frequencies

Conclusion

- Structure indices evaluated for 577 ICRF sources (80% of the ICRF)
- VLBI image data base covering 1994-2007
- Based on the present analysis, 197 ICRF sources with good structure indices (SI=1 or 2) identified.
- We suggest that the structure index be used as an initial filter to select future ICRF-2 defining sources