

METHODS

The Readiness of EVN Telescopes for the SKA-VLBI Era

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COLLECTING AREA

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Outline

- Motivation for ultra precise astrometry
- Identify origins of current astrometric limits
- Review of the status and the future in the field of astrometry
- Requirements to achieve an order of magnitude improvement (ie ultra precise astrometry) with SKA-VLBI
- Technological solutions to meet requirements

Why we want ultra precise astrometry?

To achieve unique emerging science goals with next generation instruments (Paragi+ 2015, SKA VLBI Science Cases (Garcia-Miro), Kobayashi/Heald talks at SKA-VLBI 2022...)

MultiView provides exactly this

<u>Wish list</u>: widely applicable, to many sources and at wider range of frequencies (100s MHz to 100s GHz), ground&space → ASTROMETRIC SCIENCE SURVEYS ACROSS RADIO SPECTRUM

• Focus: Implementation of Technological requirements for the telescope network

Ultra Precise Astrometry

Very Long Baseline Interferometry with the SKA



Spanish SKA White Book, 2015



Where we come from (Current arrays):



ICRAR

In NextGen telescope Era



Empirical: Ionospheric Spatial&Temporal Structure Studies (Rioja&Dodson 2021)



• Some showed fast (~10sec) changes in phase surface, simultaneous observations important

2000



1000

2000

1000 2000



Feasibility for ultra-precise astrometry at SKA frequencies

Empirical ionospheric studies for estimating MultiView

4

-ω



⁽¹⁾# sources with DR >1000:1 within the beam of 20m antenna if FOV<1°, otherwise 1°. [Sensitivity for SKA-VLBI Phase-1 (Phase-2 in brackets) *García-Miró (2019)*. Source count prediction *Bonaldi (2019)*.]

LEAP ionospheric screens, MWA @150 MHz Dodson+ 2018; Rioja&Dodson 2021) Ionospheric Spatial&Temporal Structu

Residual Phase (deg)

10

20

Technological Solutions for ultra precise astrometry with SKA-VLBI









SUMMARY

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- SKA has implemented all the requirements to perform ultra precise astrometry using MultiView. Now is the time that the partner antennas start the preparations to match this.
- Ultra precise astrometry with SKA will not work without sensitive baselines DR 1000.1

Large European antennas and/or tied arrays are therefore crucial to the SKA-VLBI goals

 Ultra precise astrometry with SKA will not work without simultaneous observations of multiple surrounding calibrators within the sky span of 1 degree METHODS Sufficient calibrators are expected to exist for sensitive baselines

Sumclent camprators are expected to exist for sensitive baselines

 Key Multi-Pixel Technological solutions exist to widen the FoV of large antennas and tied arrays (PAFs, MultiBeam, Multiple Tied-Array Beams, Paired Antennas) to enable simultaneous obs.

It is vital that these technologies are demonstrated **TECHNOLOGY** Europe is very well placed to provide these demonstrations (for example Effelsberg, WSRT)

• For small antennas these multiple calibrators will be in-beam: therefore no additional hardware is required.

All details in Rioja&Dodson A&ARv (2020) Thanks for your attention!