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FLASH and a potential Murriyang-ASKAP baseline

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Overview



- 1. ASKAP-FLASH
 - The survey
 - Understanding our detections

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- 2. VLBI with a single baseline
 - A historical precedent
 - A previous proposal



- 3. Murriyang-ASKAP: the science case
 - Continuum
 - Spectral line

ASKAP-FLASH

FLASH (Allison+2022):





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FLASH detections : why we need (VLBI) follow up



Distinguish between HI absorption **associated** with the radio host, and **intervening** along the sightline

- \rightarrow cosmic distribution of neutral Hydrogen
- \rightarrow Requires accurate radio positions (< 100 milliarcsecond accuracy) from VLBI

Understand the **nature of the galaxies** hosting the gas at the frequency of the detection +



Correlation with SED? (My work)





Preferential source size? (Samhita Sodhi: USyd)

Multi-phase ISM? V. Moss (CSIRO) ᠋᠋᠋᠋ᡀᢂᡁᢦ᠊ᡐᢦ᠋ᢩᡁᠲᡄᢦᠣᡆᠧᠳᠯᠣᡗᡆᢂᡁᢘᡙᡫᡗᡊᢦᠧᡊᡳᡁᡛᢔᡀᡟᢧᡊᡊᠼᠣᠬᢞᡊᢍᡘᡀᡎᠣᡐᠷᠱᡀᡗᠧᡎᡄᢥᡆᡄᢦᡧᡆᡘᢍᡐ᠋ᠧᡁᡙᢣᡀᡟᢁᠺᢛᡞᡫᠳᡆᠧᠿᡳᠧᡀᡭᠽᡘᡊᠸ_ᠥᠧᠧ᠘ᡫᡘᢘᢦᡁᡔᡗᡘᡢᡙᡀ᠆ᠾᠵᠴ᠋ᡗᡀᡕ

Single baseline VLBI I : PTI (1983 - 1998)

Norris & Kesteven (2013)

Real-time interferometer, **275km baseline** (Murriyang-ASKAP would be correlated)

"A perception (not necessarily accurate) that VLBI could only be used by 'black-belt VLBI gurus', **whilst PTI could be used by anyone.**"

Produced 24 papers (incl. 3 Nature papers) **beyond the original scope of the instrument** (AGN, pulsars, masers, SNe...)

Parkes





Tidbinbilla



Image credit: ATNF, ABC

Single baseline VLBI II : Murriyang-ASKAP (2019)

PARKES RESOLVES THE COLD GAS DETECTED BY ASKAP IN DISTANT RADIO GALAXIES (P973, PI: Kaczmarek)

~3,000 km baseline (c.f. PTI 275km) to resolve the spatial structure to ~16mas of two HI-detected systems from early FLASH data: PKS 0409-75 and PKS 1740-517

Shared risk observing with Parkes UWL / ASKAP ADE PAF in APRS2019

Awarded all proposed time by the TAC,

- \rightarrow Great science case but 5 years ago was too early
- \rightarrow Is now the right time?



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Murriyang-ASKAP : continuum VLBI



 $0.4 < z < 1 \rightarrow 700$ - 1000 MHz \rightarrow Murriyang-ASKAP is **unique in the Southern Sky**

MRC 0531-237 (Aditya+2024): extremely deep HI z =0.8508 (left) + a broadband radio SED peak (right)



VLBI structure:

800 MHz ??? / 1.4GHz (Aditya, LBA) / 8.4 GHz (astrogeo.com)



ASKAP-FLASH

~16mas corresponds to ~300pc at intermediate redshifts \rightarrow comparable to size of HI clouds

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Murriyang-ASKAP : spectral line VLBI

An **extension** of the continuum science case (but we'd start with continuum!)

Cross-correlation spectra provide

information about the spatial HI distribution from only a single baseline (e.g. Baan+2023 on H_2O megamasers with RadioAstron)

Synergy with **continuum structure measurements**

MRC 0531-237 (Aditya+2024):

extremely deep HI z =0.8508 (left) + a broadband radio SED peak (right)

HI line profile appears to have multiple components



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The big picture

What science we see:

Resolving parsec-scale structure in bright (>500 mJy), intermediate-redshift galaxies (0.4 < z < 1)

A distant analogue to studies of the local Universe (e.g. Morganti+2023)

What instrumentation we'd like:

ASKAP single dish \rightarrow ASKAP tied array (CRACO paved the way for this)

800 MHz continuum→ 800 MHz spectral line (plus you get ASKAP for the LBA!)

Murriyang-ASKAP \rightarrow Murriyang-ASKAP-MeerKAT(?)-uGMRT(?)

What would YOU like to see?



Image credit: ATNF