

SKA-VLBI

WP10 leaders: Antonio Chrysostomou (SKA), Z. Paragi (JIVE),
SKA-VLBI liason: Cristina García-Miró (SKA/JIVE/OAN)

Contributions from Shari Breen (SKA)
and the SKA VLBI SWG



JUMPING JIVE
Joint Institute for VLBI
ERIC



Joining Up Users for Maximising the Profile, the Innovation and the Necessary Globalisation of JIVE

JUMPING JIVE -730884

The Square Kilometre Array



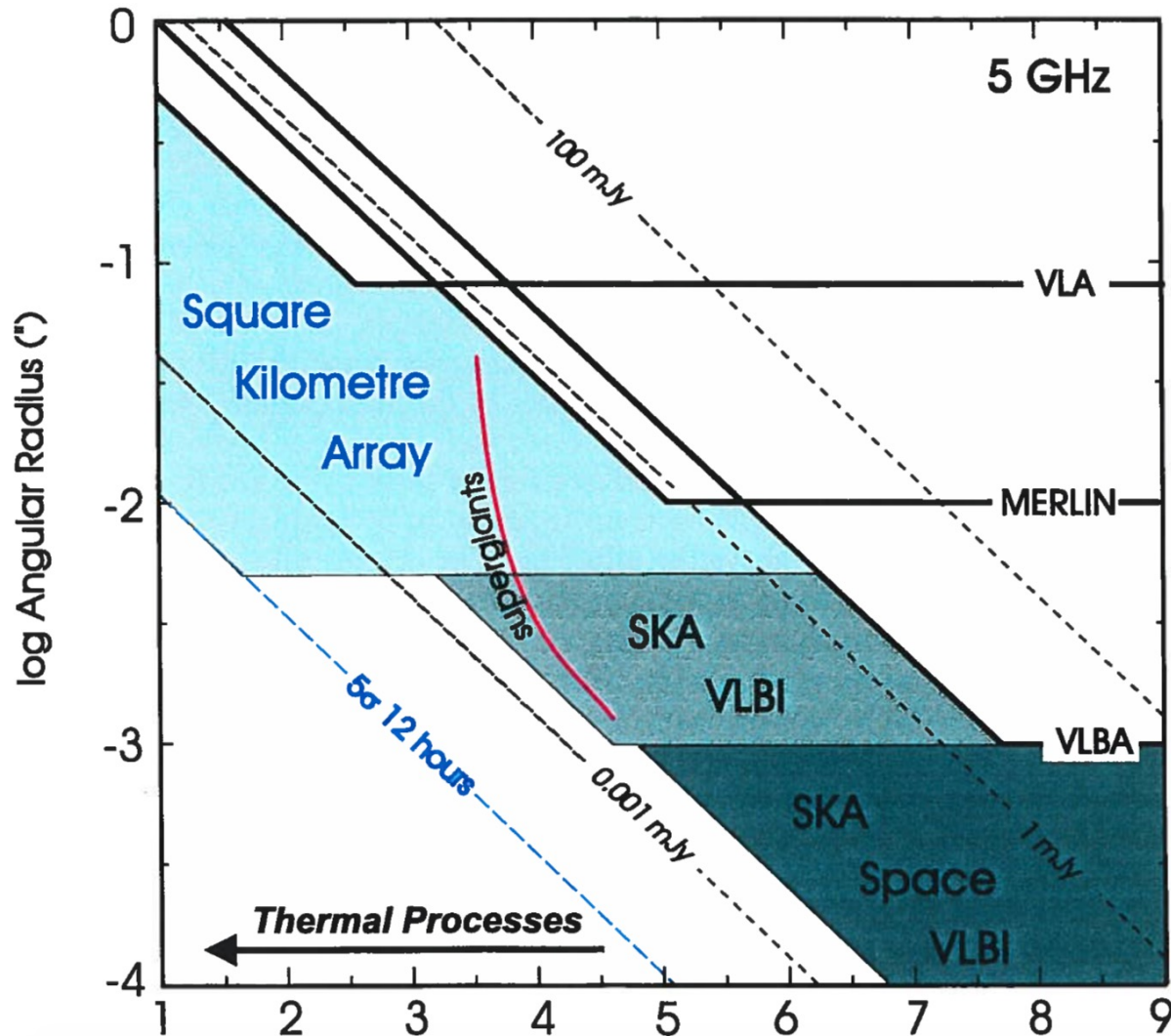
The “ultimate” radio telescope

- *A 2 billion Euro investment, a truly global effort by several countries*
- *To survey millions of radio sources*
- *But to study individual sources in greater detail, one would need a telescope 100-1000 times bigger*
- ***We cannot build such an instrument with our current technology and resources!***

➤ The solution our work package offers (and a very cost effective one!):

*Phase-up the SKA1 telescopes to be a single instrument, and connect them with existing infrastructure using the Very Long Baseline Interferometry (VLBI) technique, to realize **SKA-VLBI***

SKA & SKA-VLBI in 1999



The first SKA science book:

An array of 200m (possibly 70m) dishes, most in a circle of 50 km, plus three arms, each 500km long.

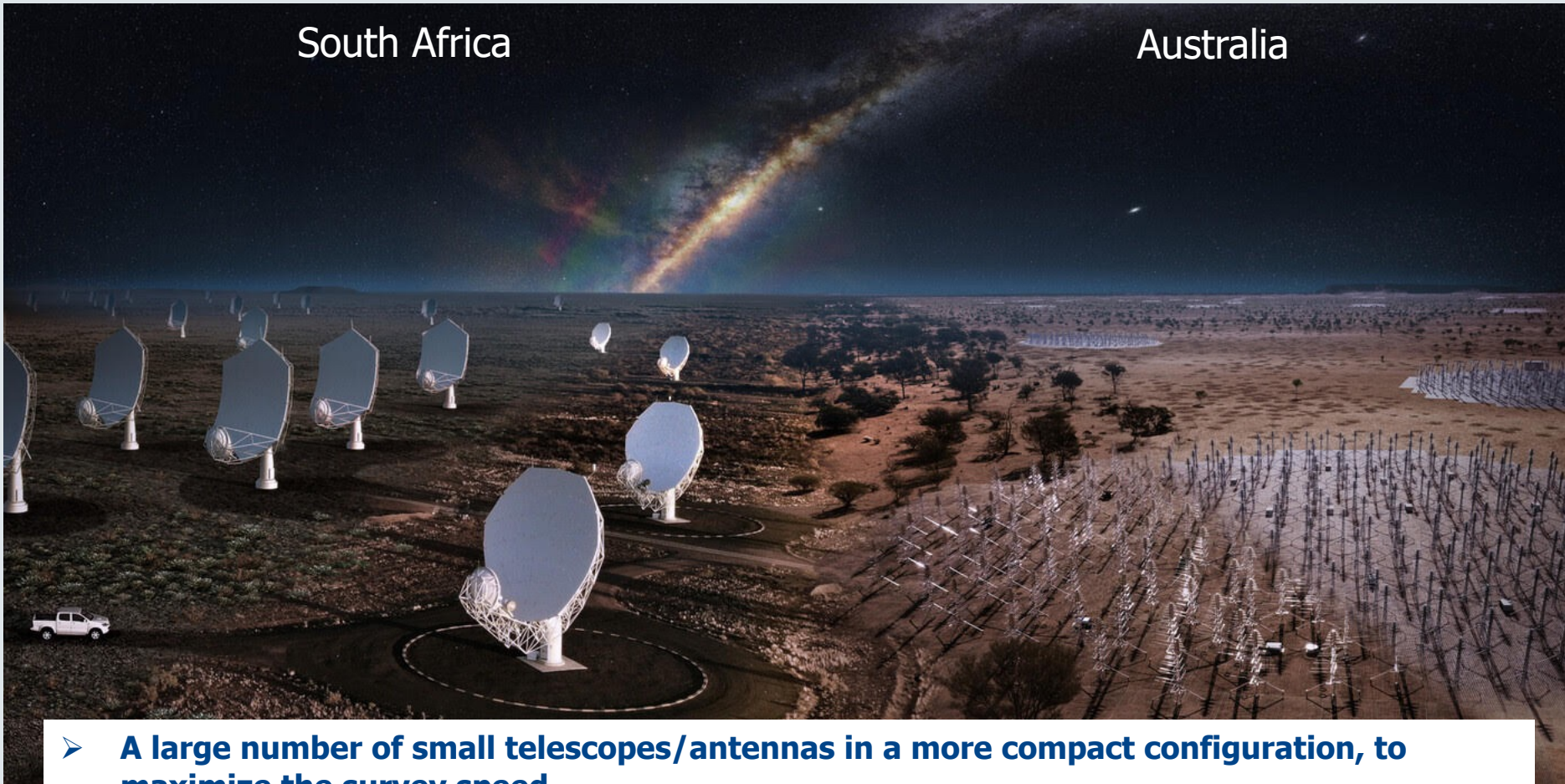
"Science with the Square Kilometer Array"

Editors:
A. R. Taylor & R. Braun
March 1999

The SKA evolution

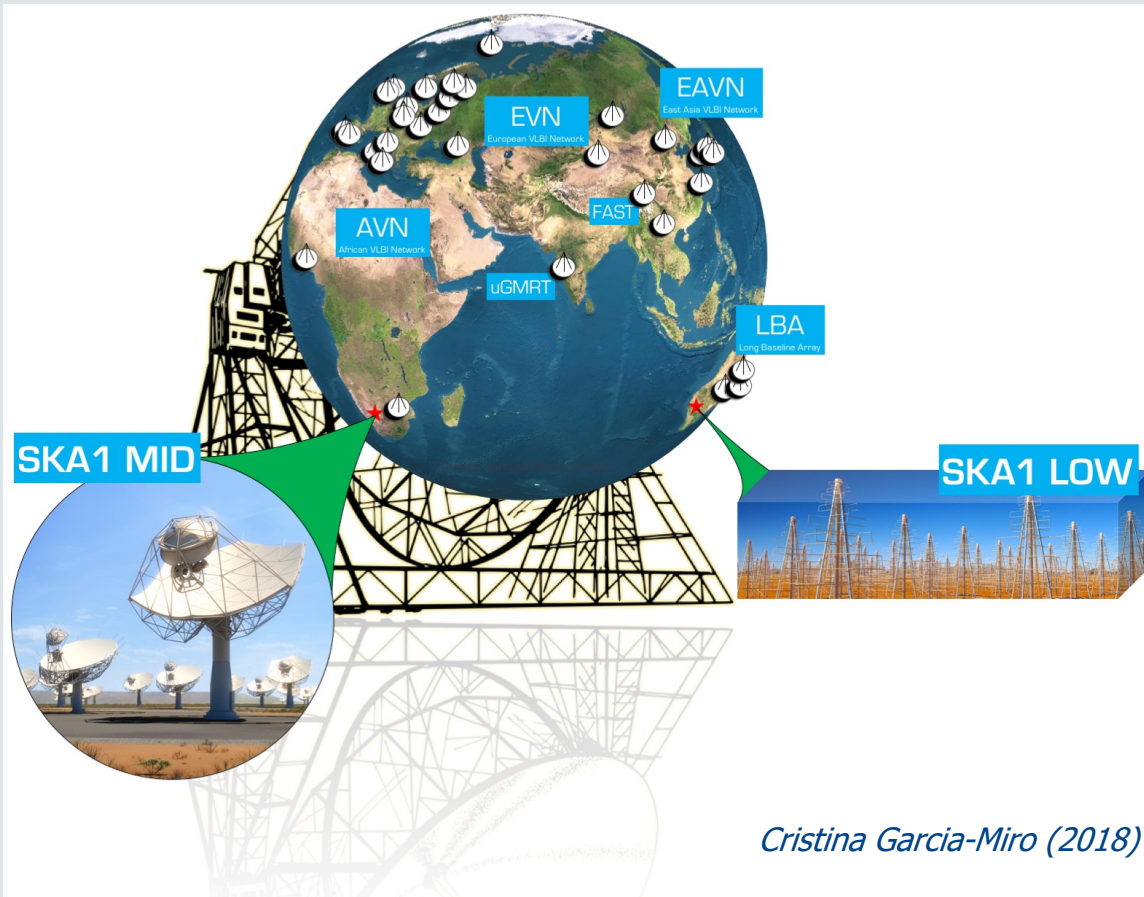
South Africa

Australia



- **A large number of small telescopes/antennas in a more compact configuration, to maximize the survey speed**
- **The design was largely driven by pulsar and EOR/HI science. BUT: Some of the high-impact science cases require complementary high-angular resolution studies, i.e. VLBI**

JUMPING JIVE WP10: VLBI with the SKA



Cristina Garcia-Miro (2018)

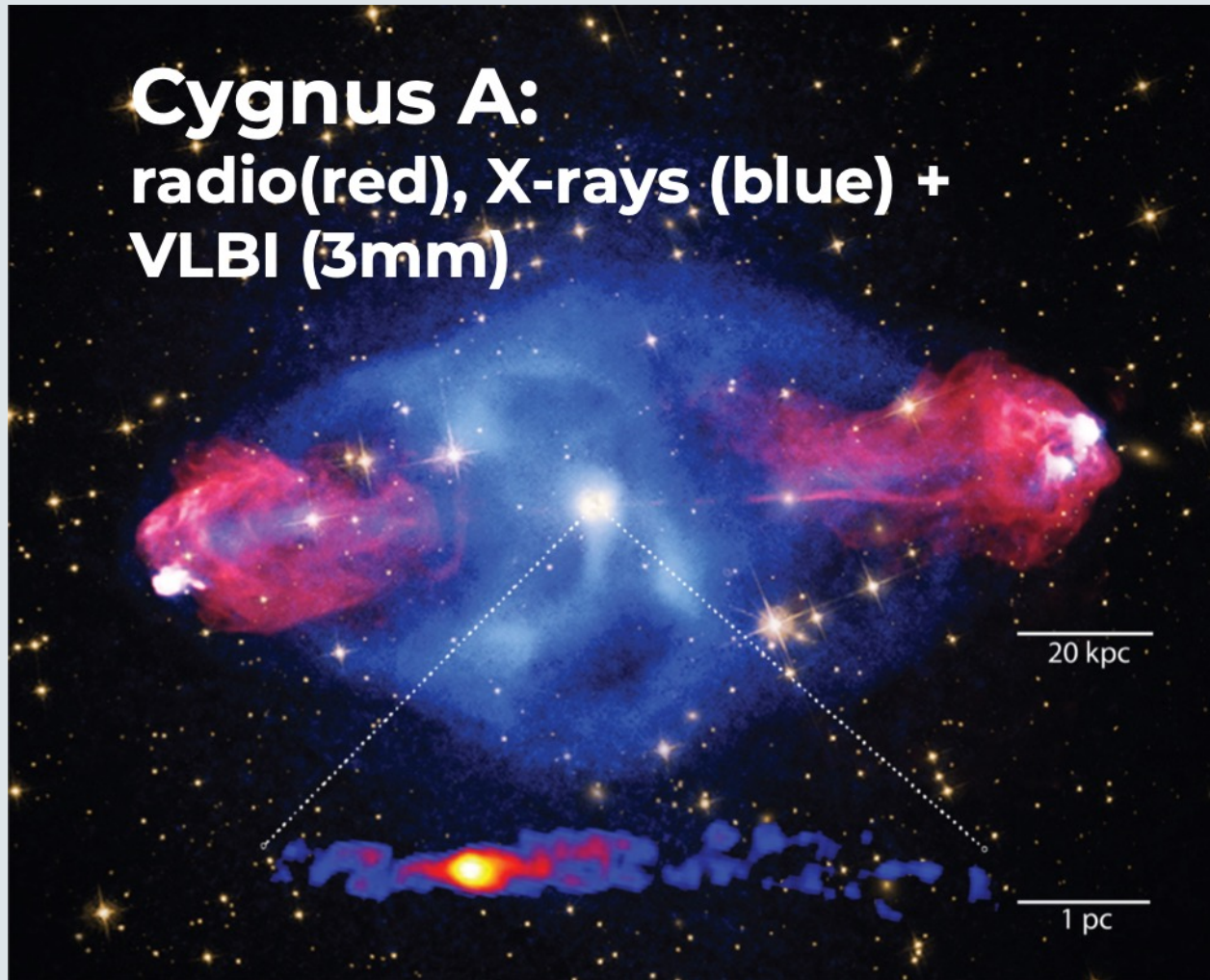
Project deliverables

- *D10.1 Details on VLBI Interfaces to SKA Consortia*
- *D10.2 Operational model for inclusion of SKA in Global VLBI*
- *D10.3 Portfolio of SKA-VLBI Science Cases*
- *D10.4 Key Science Projects*

➤ **EC supported program to aid the realization of VLBI with the SKA1 telescopes**

JIVE and the SKAO teamed up to achieve these goals; we have reached out to a wide range of partners and lots of scientists

The impact of our work



➤ **SKA-VLBI will allow us to do something like this, for a much fainter source population!**

VLBI “Focus group” → Science Working Group

SKA Science meeting, Stockholm, 2016
(Some of us present...)

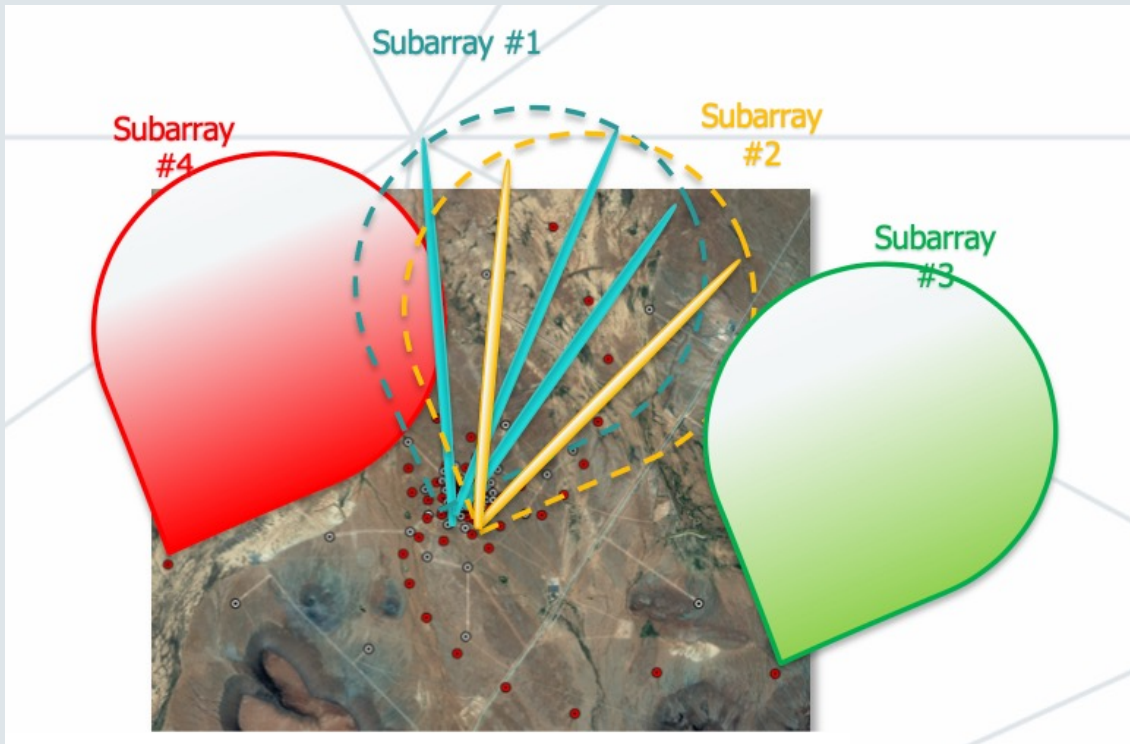


SKA Science meeting, Alderley Edge, 2019
(More of us present...)



- **Our VLBI community within the SKA has grown, and became stronger!**
- **They are also much more conscious about the opportunities SKA-VLBI will provide, and understand better the instrument we are going to build**

Community: “We need more beams!”

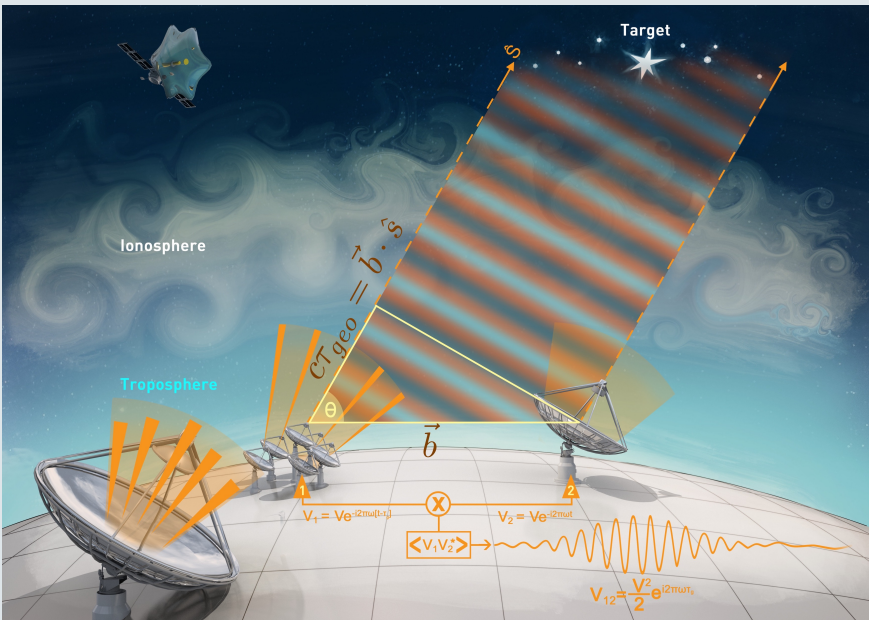


ECP

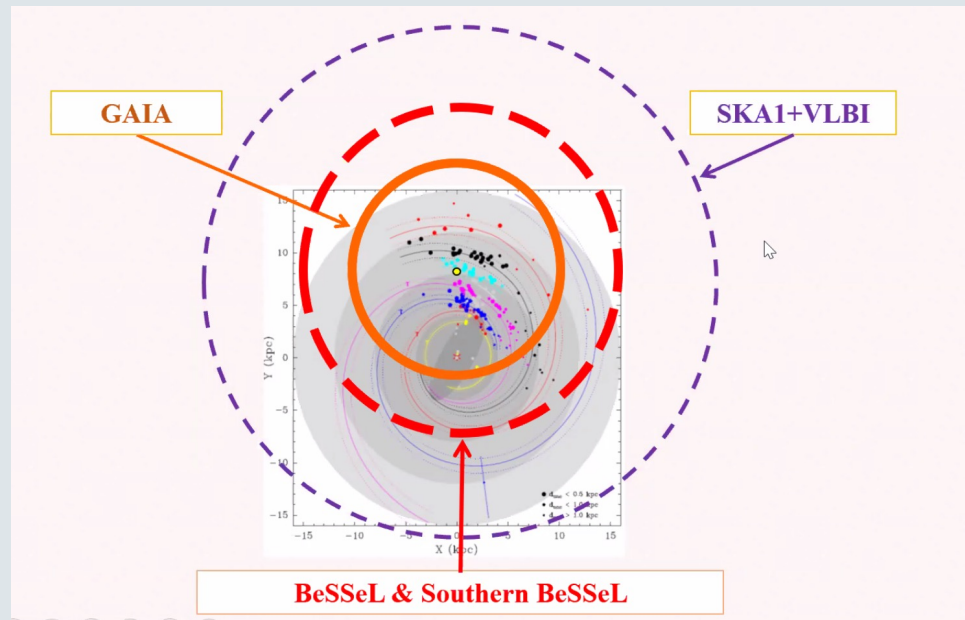
Excellent work by
Cristina García-Miró!

- **We have been directly involved in the process that lead to the successful transition of the SKA becoming an Observatory!**
- **We significantly contributed to the design of a 2 billion Euros telescope**
- **Our work will allow unique science to be done, with minimal costs/efforts**

A game-changer capability



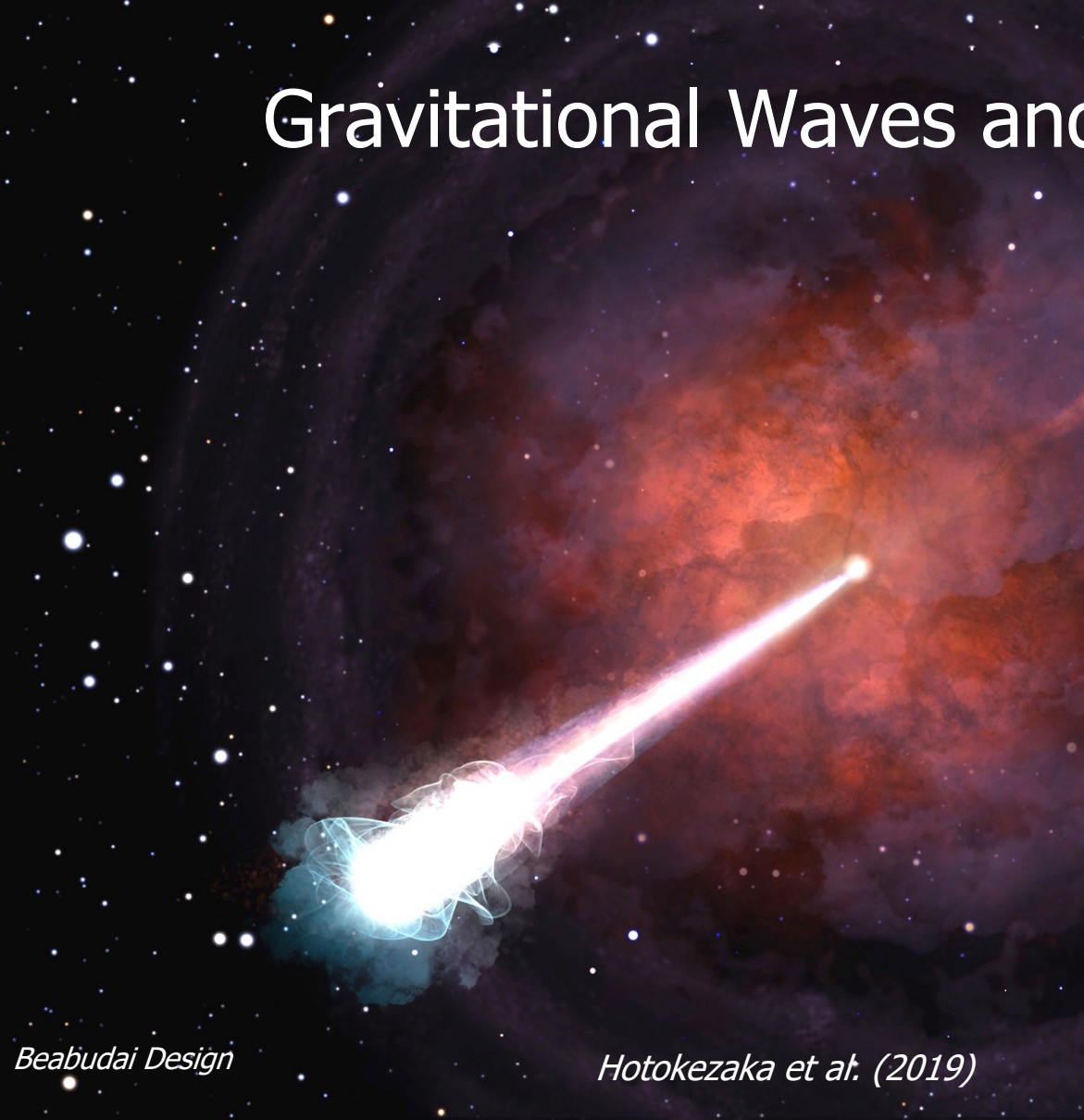
Rioja & Dodson (2020)



EAVN workshop talk by Ye Xu (2021)

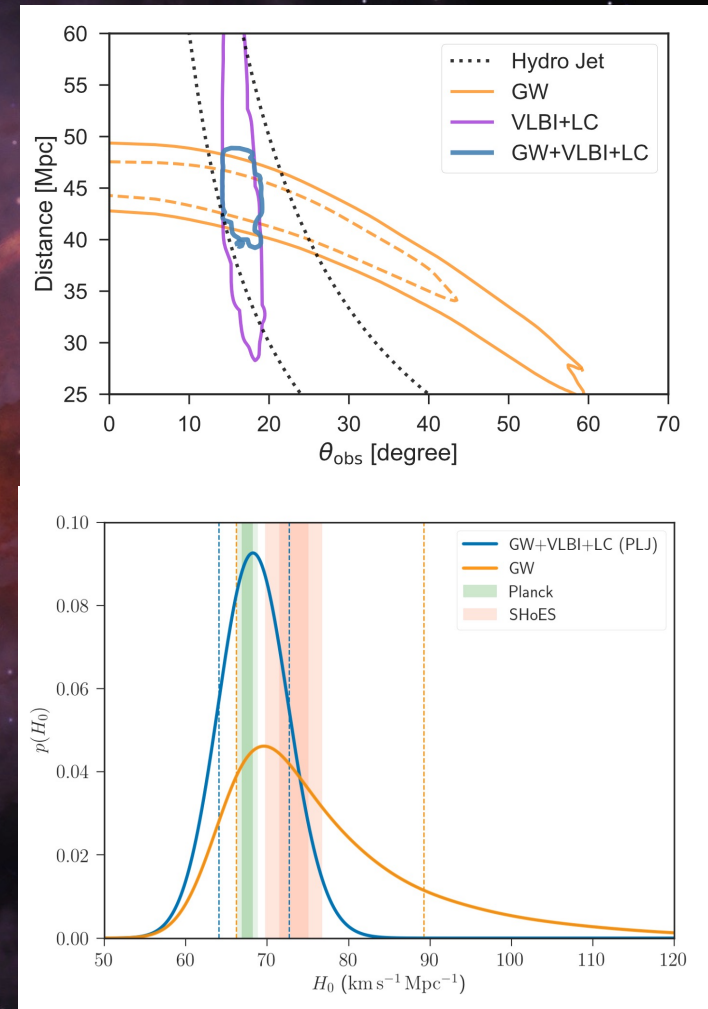
- **Strong science driver is *ultra-precise astrometry* ($\sim 1 \mu\text{as}$; see also Paragi et al. 2015)**
- allowed by $n > 4$ SKA1-MID beams
- **Precise distance and proper motion measurements will now be possible across the whole Milky Way galaxy !**

Gravitational Waves and Cosmology



Beabudai Design

Hotokezaka et al. (2019)



➤ **This will result in cutting-edge science in the era of multi-messenger astronomy**

(see also Sathyaprakash et al. 2019, Astro2020 Science White Paper on binary mergers)

Together for a bright future!



➤ SKA-VLBI Key Science Projects and Operations Workshop, 14-17 October, SKA Global HQ, UK

2021 October 12

JJ Review