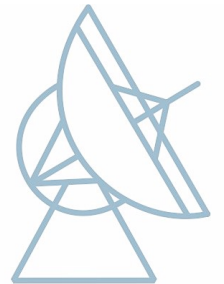


# **SKA1 Cosmic Magnetism Key Science Projects: Discussion Outcomes**

Sui Ann Mao (MPIfR)  
on behalf of the Magnetism SWG



Max-Planck-Institut  
für Radioastronomie

# Polarization & Faraday Rotation

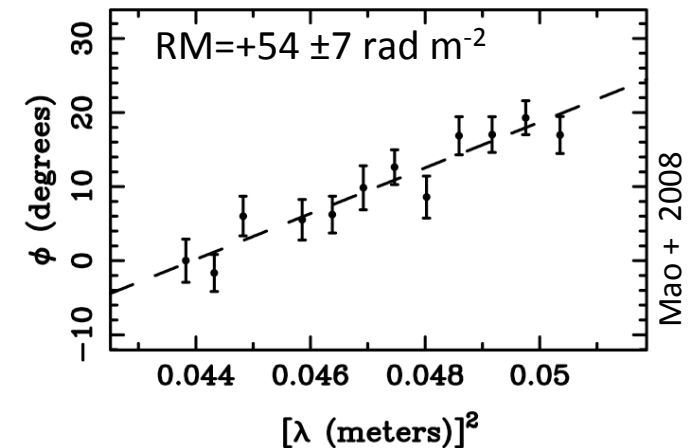


$$\Theta - \Theta_0 = \text{RM} \lambda^2$$

$$\text{RM} = 0.812 \int_{\text{source}}^{\text{observer}} n_e(l) B_{\parallel}(l) dl \text{ rad m}^{-2}$$

$$\text{RM Synthesis: } F(\phi) = K \int_{-\infty}^{\infty} P(\lambda^2) e^{-2i\phi\lambda^2} d\lambda^2$$

Ref: Burn 1966, Brentjens & de Bruyn 2005, Schnitzeler & Lee 2014



## Parameters:

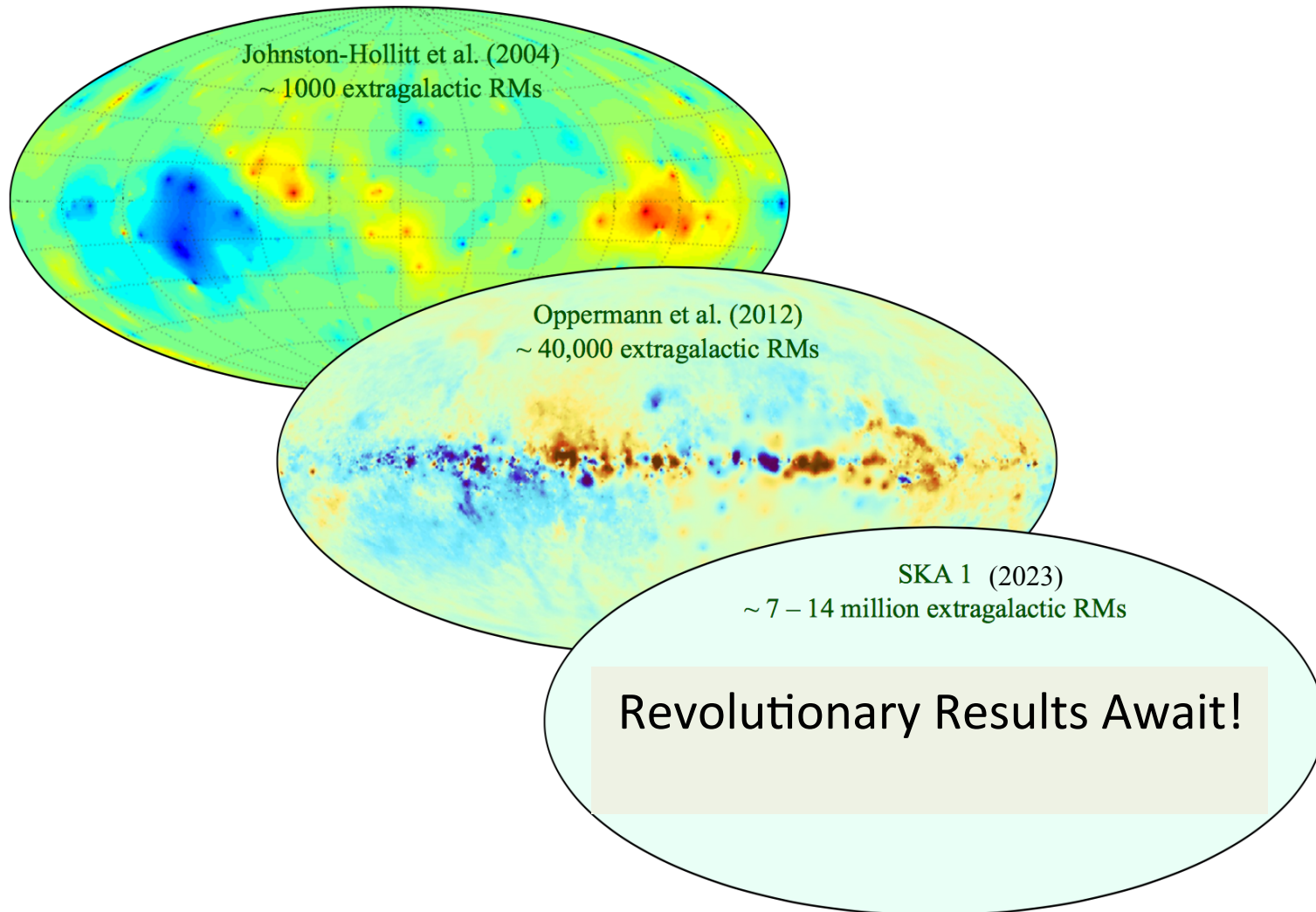
$\lambda_{\text{Max}}^2 - \lambda_{\text{Min}}^2 \rightarrow \Phi \text{ resolution}$  ;  $\delta\lambda^2 \rightarrow \Phi_{\text{max}}$  ;  $\lambda_{\text{Min}}^2 \rightarrow \text{largest } \Phi \text{ structure}$

We require:

- wide  $\lambda^2$  coverage with fine spectral resolution
- excellent polarization calibration
  - can also benefit other key science areas (EoR, Pulsar)

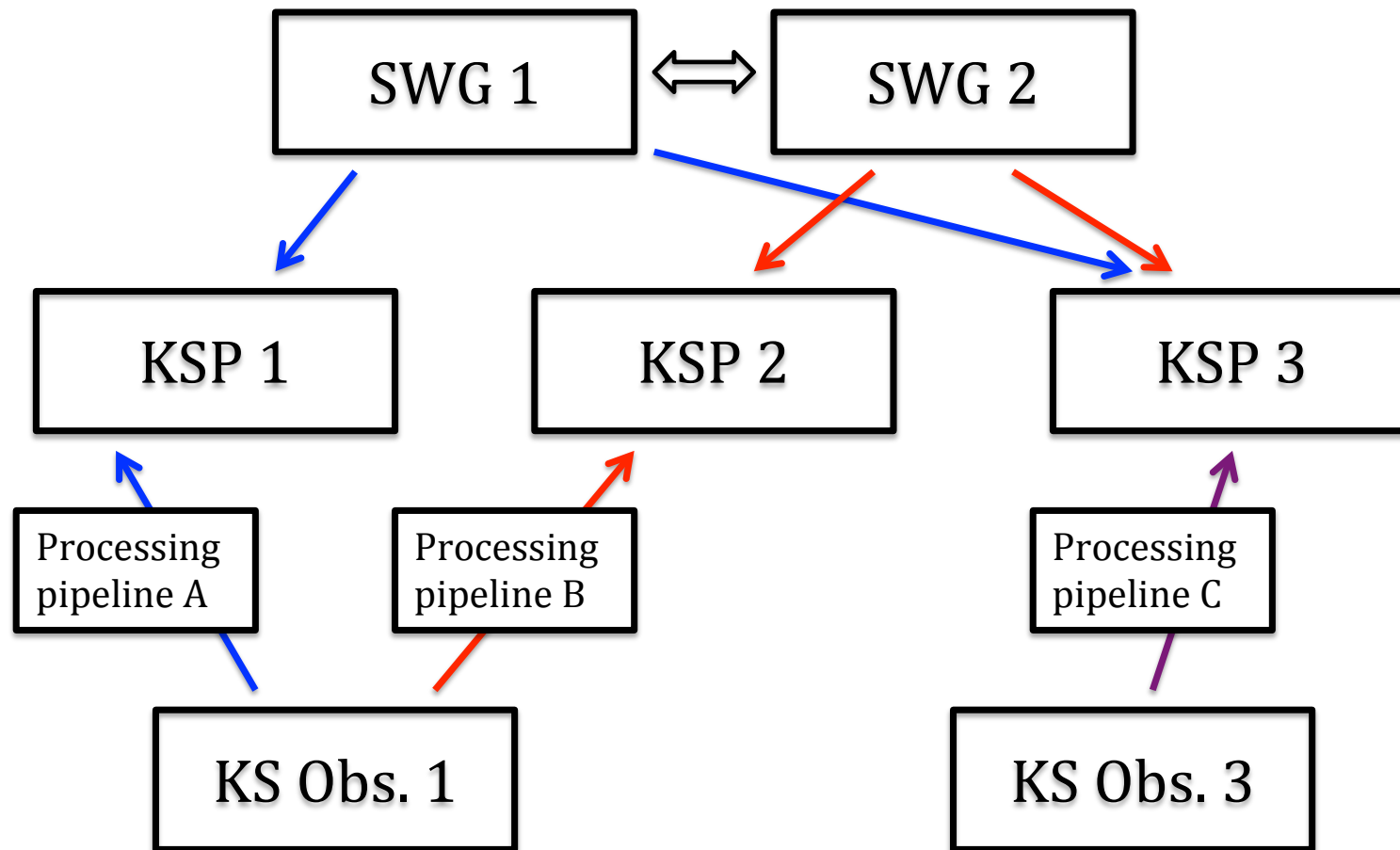
# Science Highlight: The All Sky RM grid

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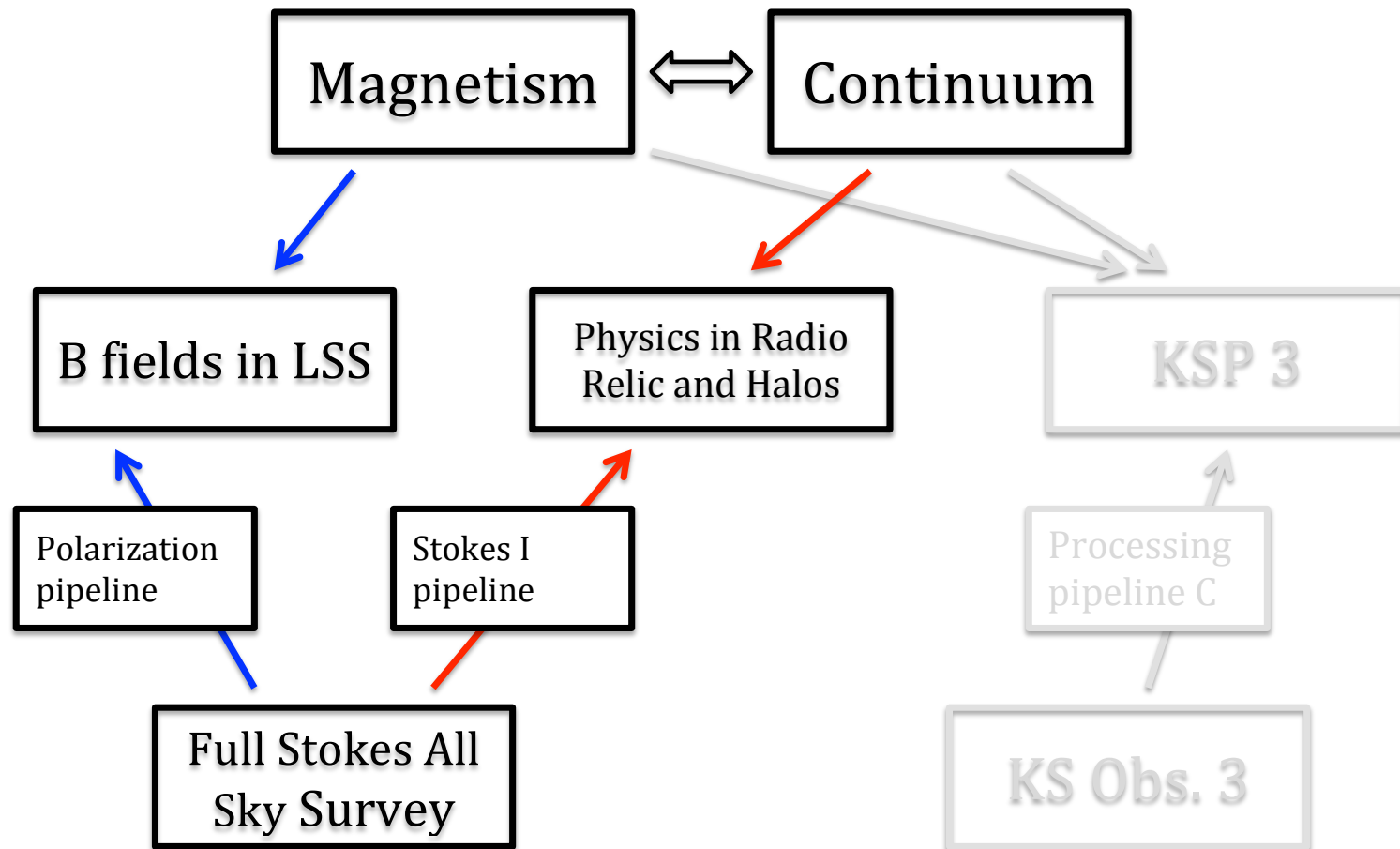
# Our Understanding of a KSP

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# Our Understanding of a KSP

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# Key Science Projects

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## 1. **Origin and Evolution of Magnetic Fields in Large Scale Structures**

(Mpc scales)

- The Magnetic Field in clusters, filaments and cosmic web and their evolution
- Probing the Nature of Dark Matter and Fundamental Physics

## 2. **Origin and Evolution of Magnetic fields in Galaxies**

(kpc, <kpc scales)

- Emergence and evolution of magnetic fields in galaxies from absorption and emission experiments
- Broad-band polarimetry as a probe of AGN Physics at all redshifts and luminosities
- Magnetic Fields in Nearby Galaxies
- Multi-scale magnetism in the Milky Way

# Key Science Observations

Essential

Less Essential

		All Sky	Band 2	LOW	Band 1	Band 2	Band 5	Area
KSP 1	The magnetic field in clusters and filaments							Band 1 60 sq. deg, LOW all sky
	Probing the nature of Dark Matter							10 fields
	The Magnetic cosmic web							100 sq. deg
KSP 2	Line of sight probes of Evolution of Cosmic Magnetism							All sky
	Evolution of the magnetic fields in galaxy disks							10 sq. deg
	Broad-band polarimetry as a probe of AGN							All sky
	Magnetic fields in AGN at all redshifts and luminosities						VLBI	VLBI follow up
	Emergence of Magnetism fields in the Universe							All sky
	Magnetic fields in nearby galaxies							25 - 30 sources
	Magnetic fields in the heart of the Milky Way							4000 sq. deg
Multi-scale magnetism in the Milky Way							30,000 sq. deg.	

- An All Sky Band 2 polarimetric survey is essential to our KSPs
- To achieve our goals, we require additional KSOs with SKA1 Low, SKA1 MID band 1, 2 and 5 observations as well.

# KSP Collaborations + Commensality

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- Collaborations within and outside the magnetism community
- **Commensality in SCIENCE areas** in addition to sharing DATA
- Joint sessions with Continuum, Our Galaxy SWGs
- Appointed contact persons to act as liaisons between SWGs
- clear KSO commensality with the Continuum SWG
- clear science commensality with Our Galaxy SWG
- HI, VLBI, non-HI spectral line SWGs:
  - initial conversations occurred, continue discussions
- Pulsars+Transients + everyone else:
  - we'll approach in the near future!



# Conclusion + Next Steps

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- **Two KSPs with sub-projects that require the following KSOs :**
  - **All Sky Polarimetric survey SKA-1 MID Band 2**
  - **Additional observations in LOW and MID band 1, 2 and 5**
- Report to all members of the magnetism SWG
- To better explore commensality by:
  - collecting maps of sky coverage/bands/resolution/sensitivity requirements from all SWGs
- Awareness of the KSP process in the wider community
- Continue to work on evolving the KSP ideas within the developed framework
- **QU**estions?