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Jodrell Bank Observatory

e-MERLIN upgrade

Mike Garrett
Sir Bernard Lovell Chair of Astrophysics,
Director Jodrell Bank Centre for Astrophysics (JBCA).

e-MERLIN

e-MERLIN (SKA Pathfinder) operating at cm-wavelengths and ~10-220 km baselines.

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Current performance

	1.23-1.74 GHz (L-band)	4.3-7.5 GHz (C-band)	21-24 GHz (K-band)	
Maximum angular resolution	~150	~40	~12	(milliarcsec)
RMS level for 12 hr on source	~14/7**	~13/7**	~55	(uJy/bm)
Maximum bandwidth/polarization	512	512*	512*	(MHz)

** Lovell Telescope included

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Proposed Upgrade Plan

Full integration of Lovell Telescope into e-MERLIN.

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Full integration of Lovell Telescope into e-MERLIN.

Lovell Telescope & e-MERLIN combined into one big dish.

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Proposed Upgrade Plan

Full integration of Lovell Telescope into e-MERLIN.

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New telescopes:

- addition of Goonhilly (CUGA)
-

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Modular Development Plan

Full integration of Lovell Telescope into e-MERLIN.

Lovell Telescope & e-MERLIN combined into one big dish.

New telescopes:

- addition of Goonhilly (CUGA)
- replacement of Defford antenna with SKA telescope.

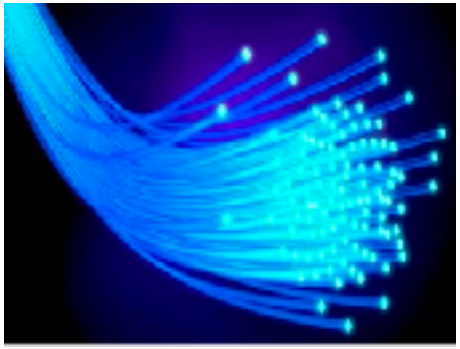
Modular Development Plan

New receivers, new frequency ranges:

Modular Development Plan

New receivers, new frequency ranges:

New broader bandwidths:

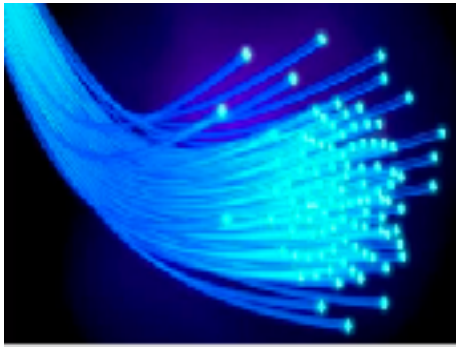


2 GHz => 8 GHz

Modular Development Plan

New receivers, new frequency ranges:

New broader bandwidths:

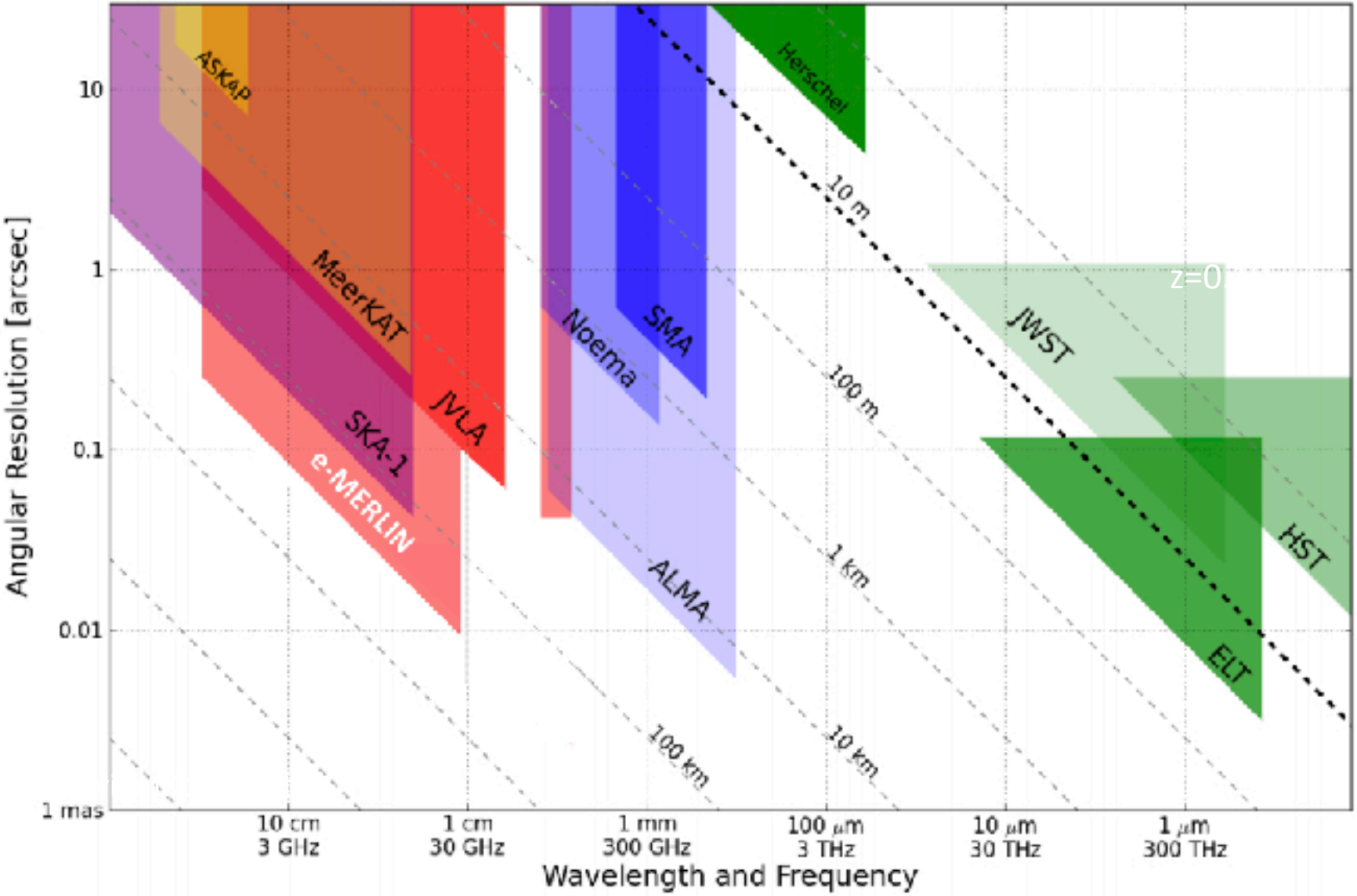


2 GHz => 8 GHz

Wider Field of View:

FoV ~ x9

With apologies…



e-MERLIN upgrade performance

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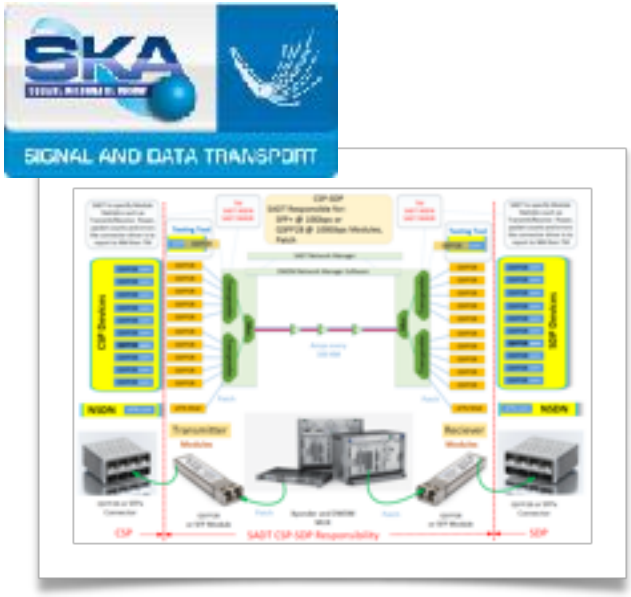
Table 3: Operational capabilities of e-MERLIN following upgrade work packages. Notes (1) Pre-upgrade capabilities, (2) Assuming the inclusion of Goonhilly telescope at L- and C-band initially, (3) FWHM of field viable of either 25-m telescopes (no-LT), or with the Lovell telescope incorporating a PAF at S and L-band, (4) Tuneable frequency range, (5) available bandwidth per polarisation, (6) optimum sensitivity dependent on observing conditions and available bandwidth.

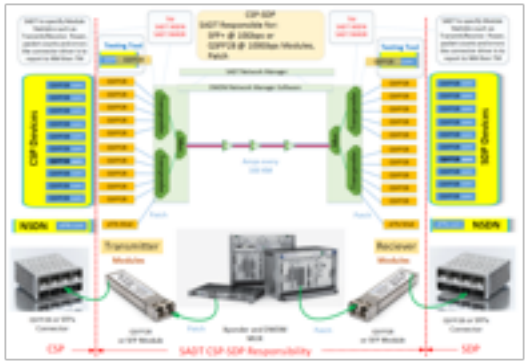
	1.5GHz (L-band)	3GHz (S-band)	5GHz (C-band)		10GHz (X-band)		22GHz (K-band)	Notes	
		WP3			WP4 & WP7				
Resolution (milliarcseconds)	150	-	40		-		12	(1) no Goonhilly	
	75	75	20		20		12	(2)	WP3,4
Field of View (arcmin)	LT (No-LT)11 (30)	-	LT (No-LT)3 (9)		-		2	(1)	
Field of View (arcmin)	With LT PAF	With LT PAF	LT	No-LT	LT	No-LT	No LT	(3)	WP5
	30	15	3	9	1.5	4.5	2		
Frequency range (GHz)	1.25-1.75	2-4	4-8		8-15		21-24	(4)	WP3,4
Bandwidth (GHz)	0.5	2	2		2		2	(5)	WP3,4
Sensitivity (μJy/bm) in a full imaging run	6-7	3-4	4-5		4		15	(6)	WP3,4
Bandwidth (GHz)	0.5	2	4		4		4	(5)	WP3,4, 6,7
Sensitivity (μJy/bm) in a full imaging run	6-7	3-4	2-2.5		4		4	(6)	WP3,4, 6,7

Building on UK SKA Investment/Expertise

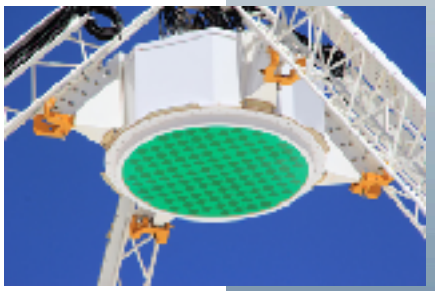


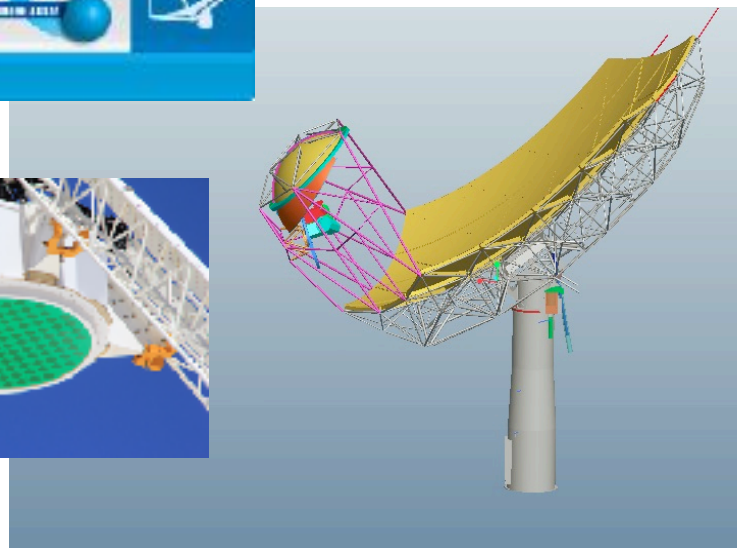
Building on UK SKA Investment/Expertise

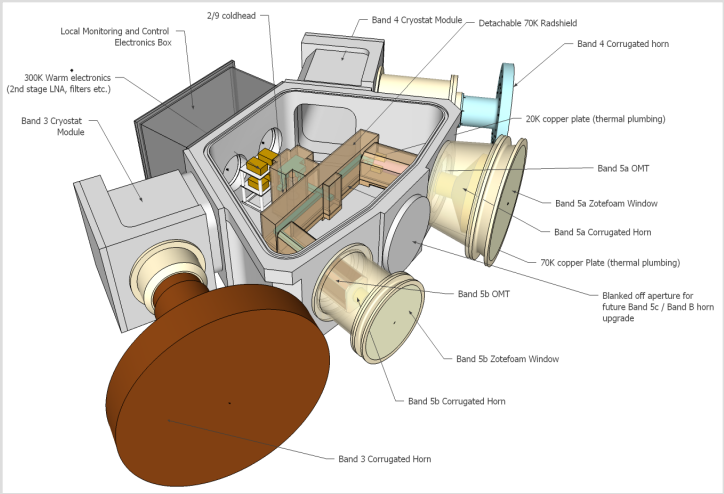
SIGNAL AND DATA TRANSPORT



DISH







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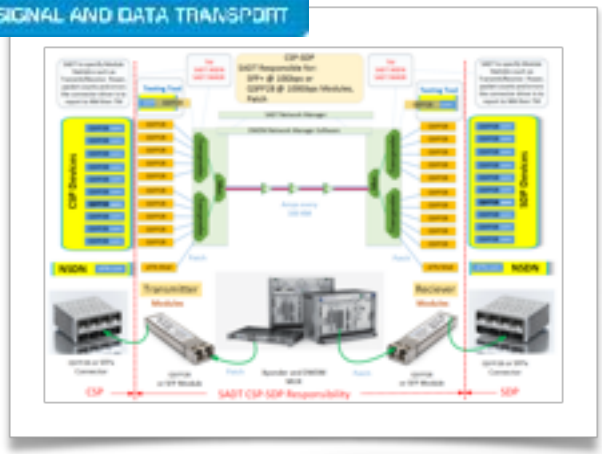

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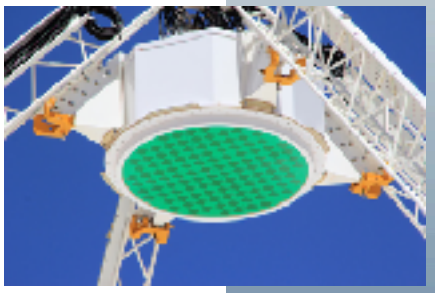
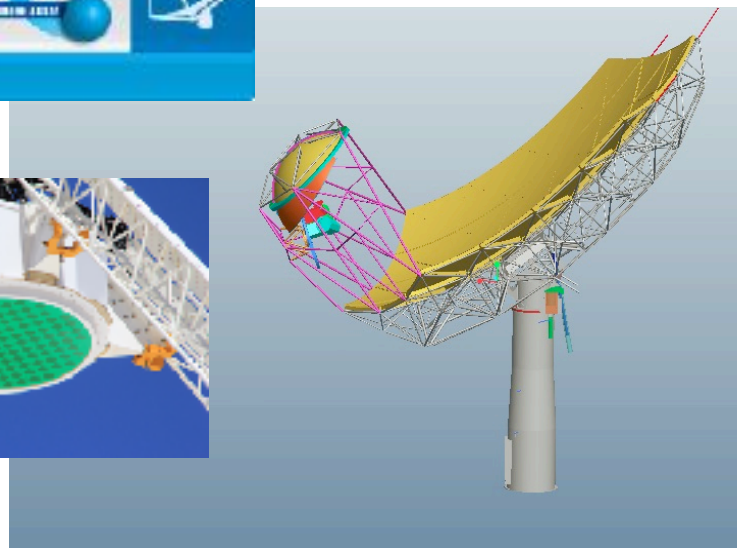
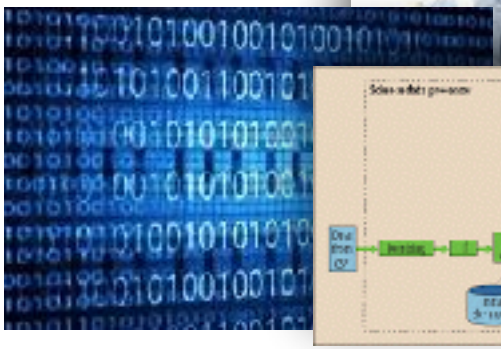
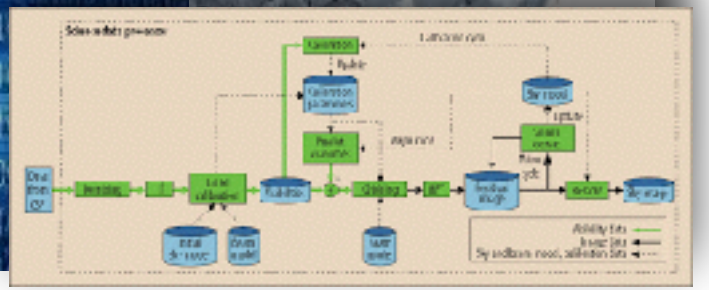


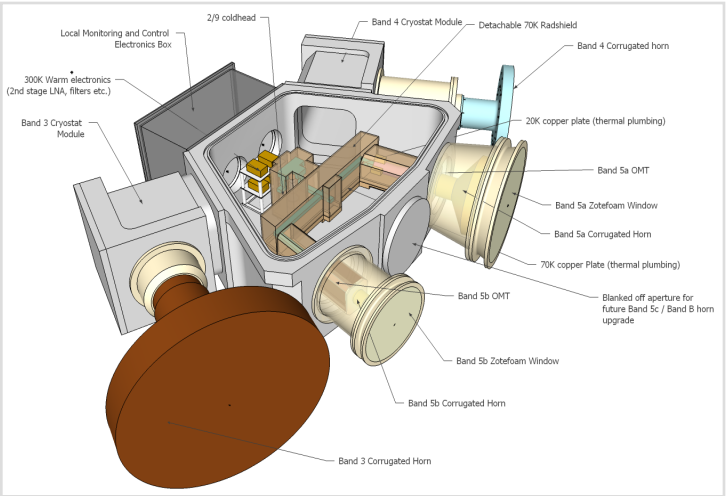


SCIENCE DATA PROCESSOR

UK SKA Regional Science Node







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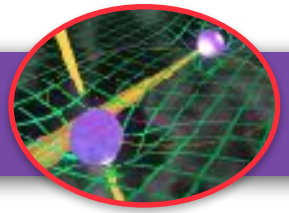
Main Science Case

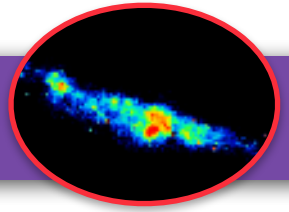
Pulsars, Gravity & Gravitational Waves



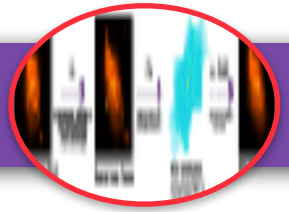
Transients

Planet & Star formation

Galaxy formation & evolution



Cosmic shear & Gravitational lensing



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Science Case

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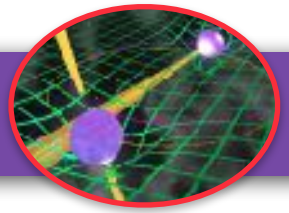

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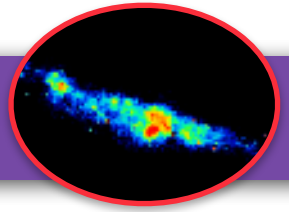

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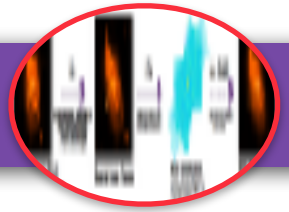

Proto-planetary Simulations

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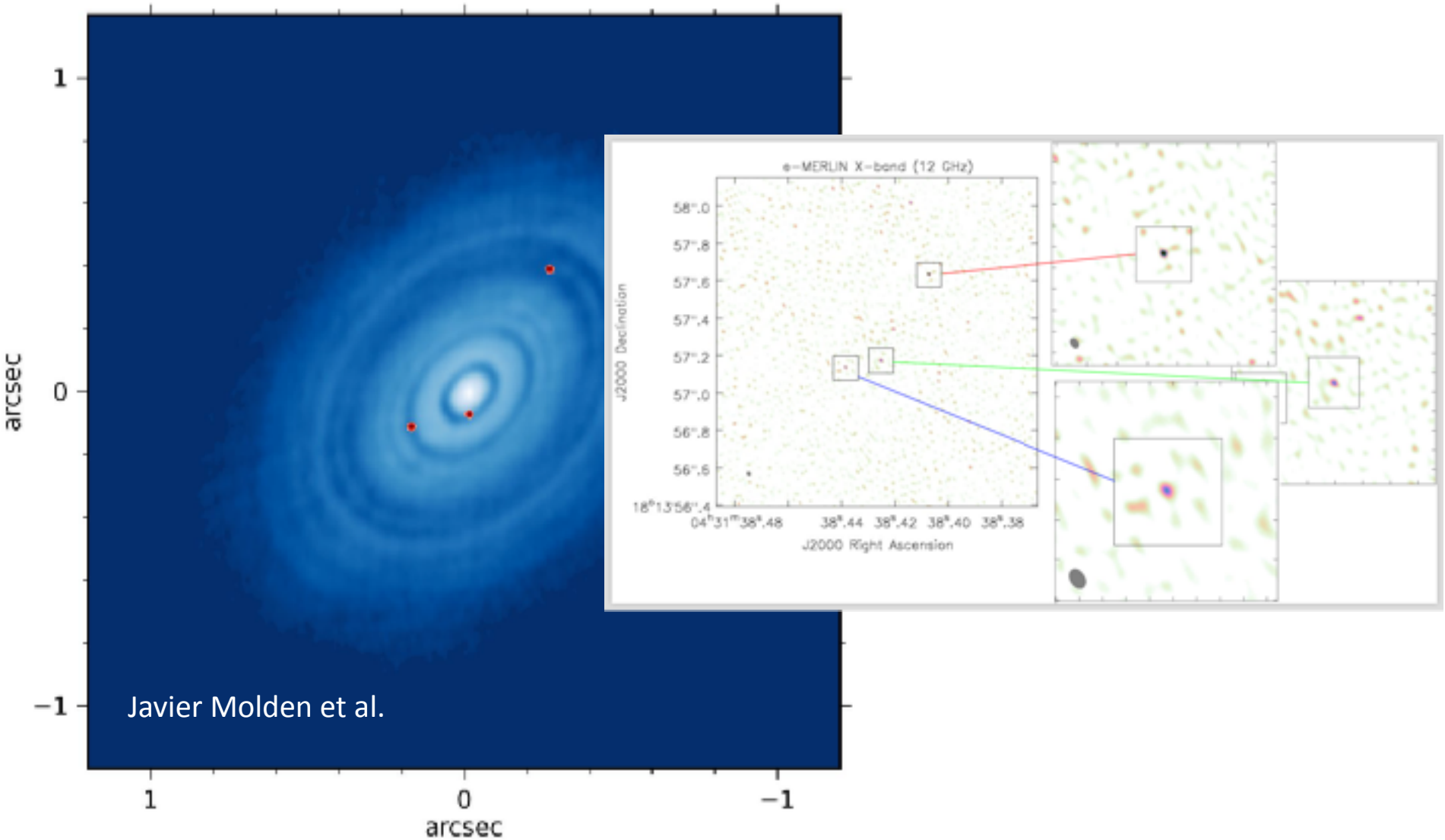
Scaled HL Tau model with pebble concentrations…



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Upgraded e-MERLIN

An interesting *ngVLA* pathfinder telescope!

- 25% of the collecting area of SKA1-mid
- New receivers with broad frequency range: 1-25 GHz
- Instantaneous bandwidth of up to 8 GHz
- Good imaging capability (incl. equatorial fields)
- Superb sub-arcsecond angular resolution
- Accessible to full community - excellent user support
- a factor of 10x better sensitivity at highest frequencies
- a factor of 10x better FoV at lowest frequncies

Proposal submitted - 15 M GBP requested - should know by the end of the year if this will be funded.

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