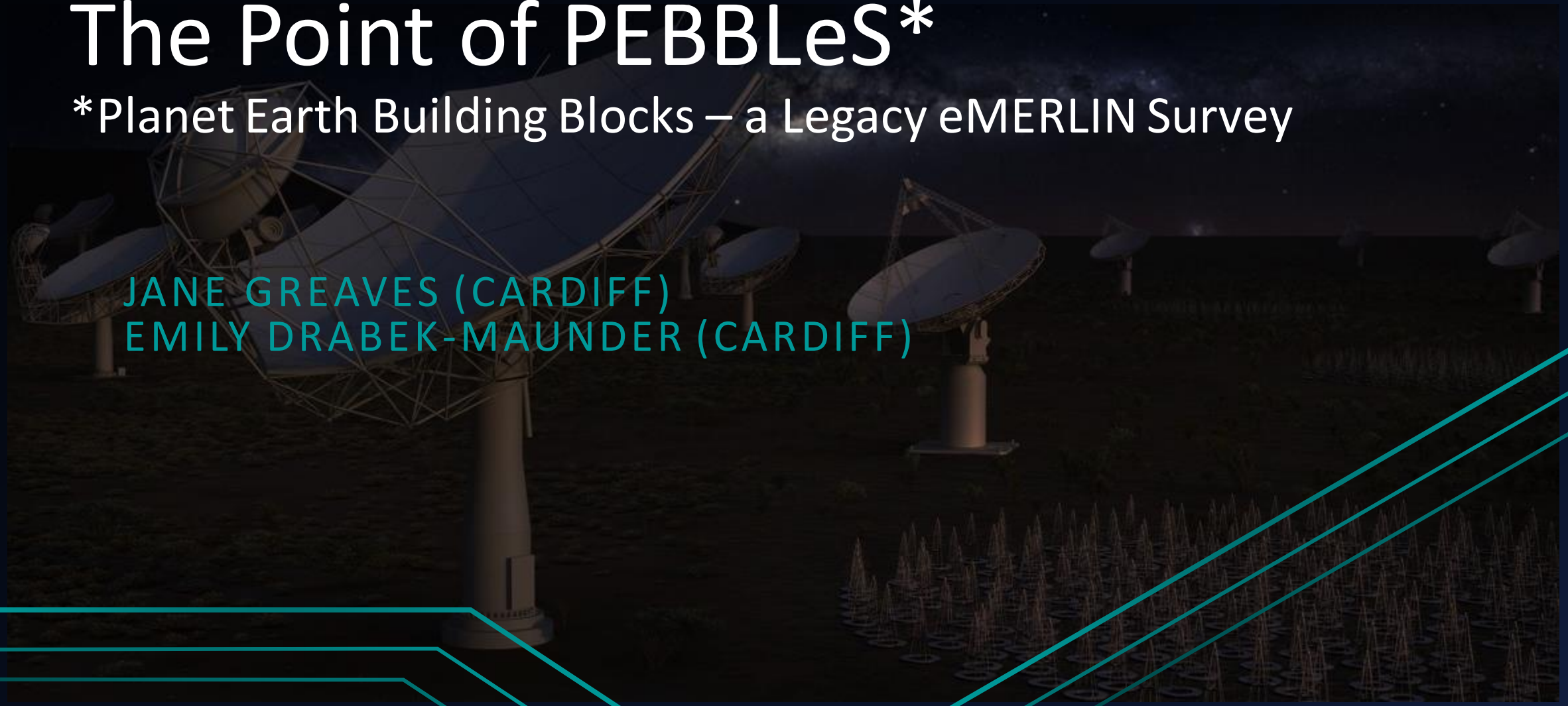
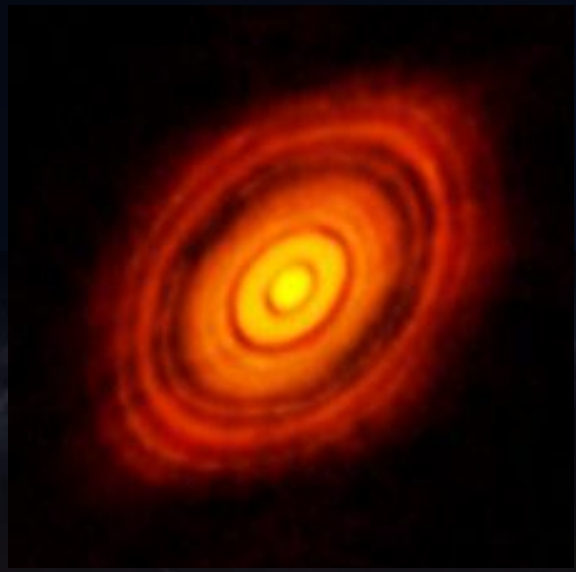
The Point of PEBBLeS*

*Planet Earth Building Blocks – a Legacy eMERLIN Survey



JANE GREAVES (CARDIFF)
EMILY DRABEK-MAUNDER (CARDIFF)

why ***radio***??



- resolution at planetary-system scales
- dust emission optically thin
- matched to ‘pebble’-sized grains

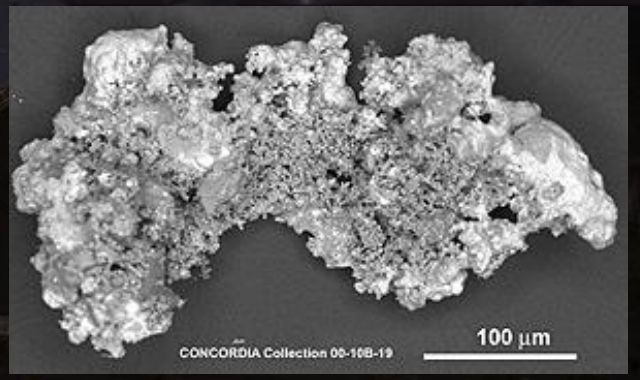
but

- steep dust spectrum

= sensitivity challenge

why dust growth and trace gases (are really interesting)

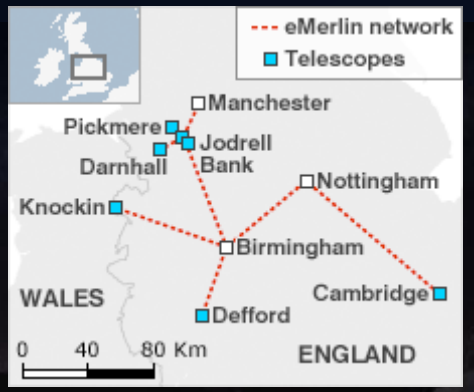
- overcoming the millimetre barrier (no bodies > few-mm!)
- basic processes of planet building are uncertain
  - direct collapse?
  - pebble vortex?
  - Aggregation?



- needs to happen fast (<0.05% of $t_{solar\ system\ today}$)

the UK context: dust

- eMERLIN is the only pre-SKA facility worldwide to hit the sweet-spot for imaging pebbles growing in discs
  - 100s-km baselines = few-AU at few-cm at ~100 pc
    - JVLA etc. too short, VLBI too long

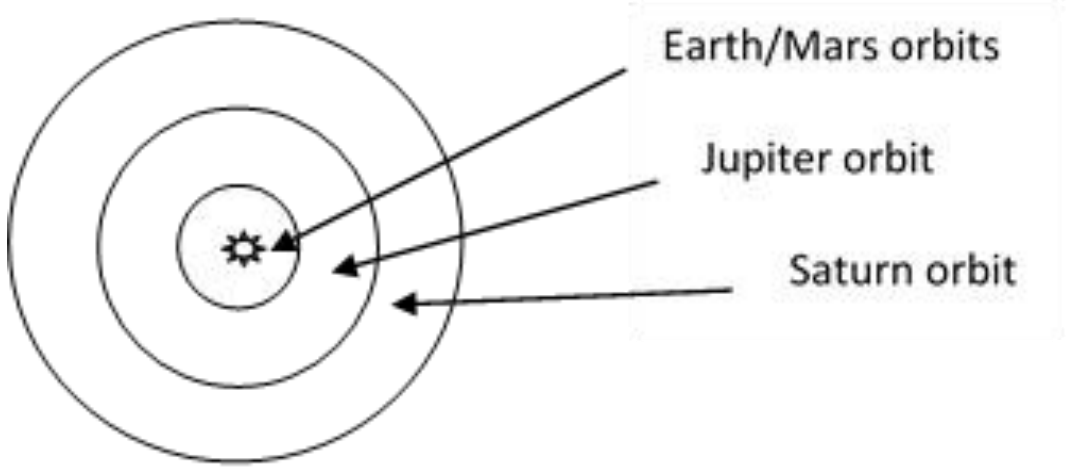


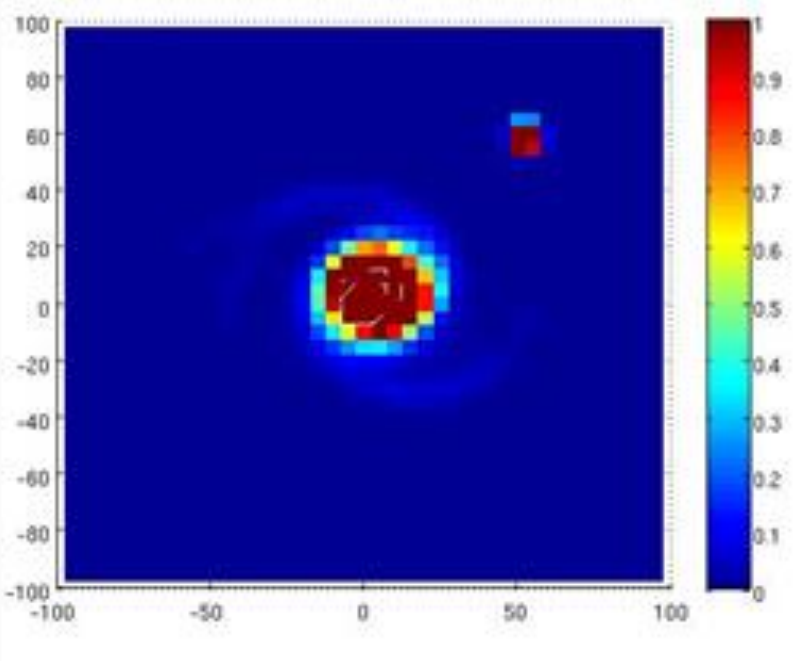
- **P**lanet-
  Earth
  Building-
  Blocks
  Legacy
  eMERLIN
  Survey

approved Sep. 2017
for 330+72 hours

PEBBLeS science capability

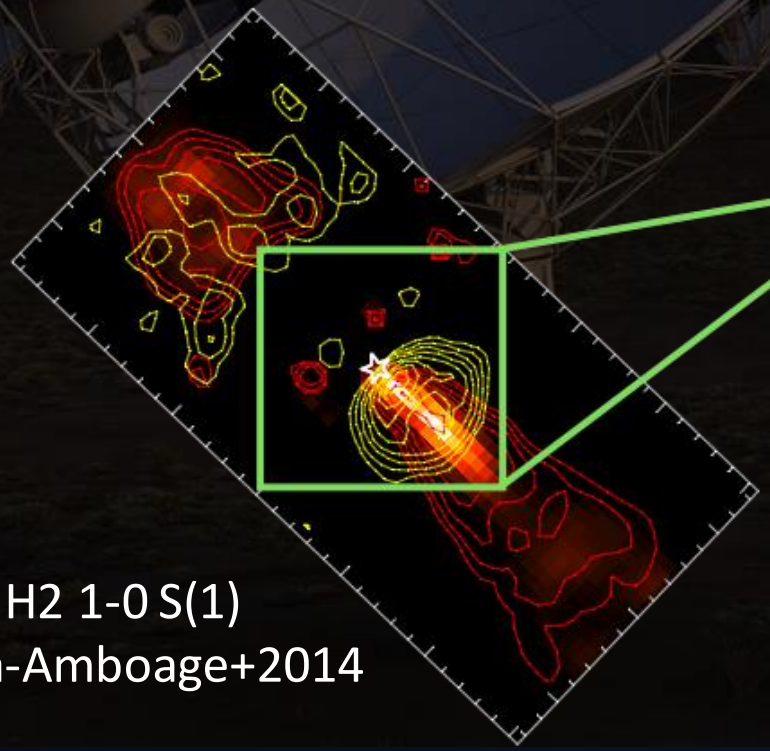
- resolve orbits of terrestrial planets from giants
- image massive proto-planets



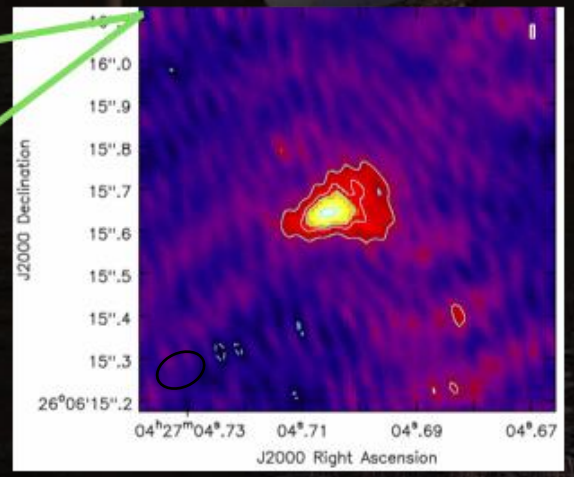


PEBBLeS early science

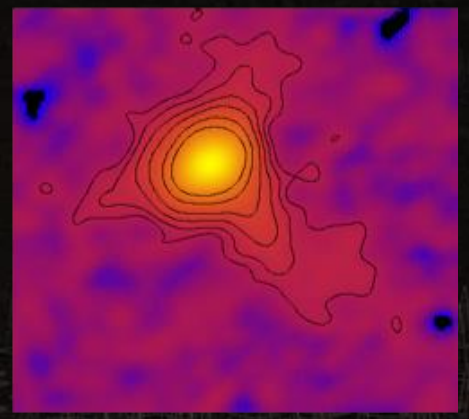
- Commissioning on DG Tau A, epochs in 2014 and 2016
  - Class II disc, substantially brighter than expected
  - 4.13 - 4.61 cm
  - Current work is still being done on separating the jet, disc-wind and disc signals



VLT: H2 1-0 S(1)
Agra-Amboage+2014



eMERLIN: 4.13-4.61cm



VLA: 9mm

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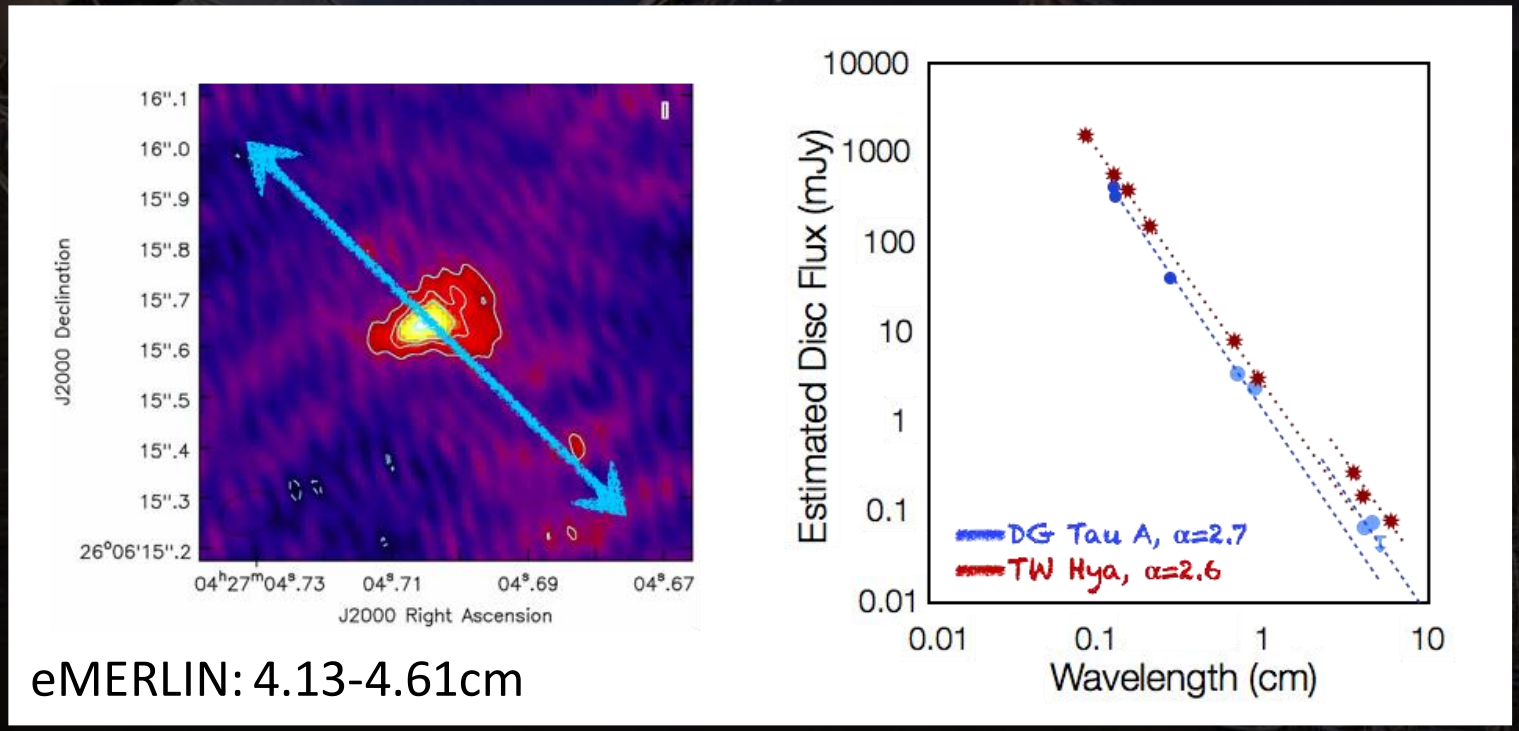

eMERLIN: 4.13-4.61cm

PEBBLeS summary

- head start on SKA-1 science and the 'cradle of life' goal
- eMERLIN is the best option for these observations
  - winning combination of frequency, resolution and sensitivity
- paper on the commissioning data is currently in progress (on DG Tau A with new 2017 data)
- observations for the full survey will hopefully start in Autumn 2017

PEBBLeS limits

FIELDS: *(primary disc)*	*IRAS4A1*	*L1448 mm*	*IRAS2A, SVS13B*	*Perseus emb-50*	*DG Tau*	*RY Tau*	*GV Tau S*	*Haro 6-13*	*MWC 480*	*HL Tau*
$F_{0.9cm}$ (mJy)	*1.81*	*1.81*	*1.51, 1.12*	*1.27*	*2.70*	*1.94*	*1.65*	*1.53*	*1.18*	*1.14*
M_{disc} ($M_\odot$)	*0.27*	*0.27*	*0.23, 0.18*	*0.19*	*0.14*	*0.10*	*0.08*	*0.08*	*0.06*	*0.06*
F_{5cm} (μJy) for $\nu^{2.3}$ [$\nu^{2.0}$]	*35 [59]*	*35 [59]*	*29 [49], 22 [36]*	*25 [41]*	*50 [84] (70 obs.)*	*36 [60]*	*31 [51]*	*28 [47]*	*22 [37]*	*21 [35]*
Class	*0*	*0*	*0/I*	*I*	*II*	*II*	*I*	*II*	*II/HAe*	*II*
$T_{bol,eff}$ (K)	*29*	*47*	*69*	*128*	*4200*	*4900*	*3800*	*3800*	*8300*	*4000*
L_{bol} ($L_\odot$)	*7*	*8*	*19*	*23*	*2*	*5*	*6*	*2*	*14*	*11*
other discs in field	*IRAS4A2, IRAS4B-I,II*		*IRAS2B, SVS13A*		*DG Tau B*		*GV Tau N*			*XZ Tau (binary)*

- modest number of fields
- only discs ≥2.5x MMSN
- not quite at habitable-zone resolution