The Cradle of Life SWG
Matthijs van der Wiel

current SWG chairs: Izaskun Jimenez-Serra, Doug Johnstone

SKA NL science meeting, 2018 May 24
Dwingeloo
1. how does planet formation start?

2. How did the first prebiotic compounds form?

3. what are exoplanets like?

4. SETI: find signals from technological civilizations
### CoL Working Group Membership

<table>
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<tr>
<th>Name</th>
<th>Institution</th>
<th>Country</th>
<th>Membership Type</th>
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+ 40 associate members, including Michiel Hogerheijde, (Leiden/Amsterdam)
• radio emission from exoplanets: 30–70 MHz with LOFAR
• developed pipeline to flag rfi, calibrate time-freq response, search for bursty exoplanet signal
• no detection yet .. but continue to stack exposures..
recent highlights (2)

- ‘Breakthrough listen’ project used GreenBank Telescope (L, S, C, X-bands) to search for weak radio emission from 1IʻOumuamua, a solar system object of interstellar origin
- they found nothing, but were sensitive to a 0.08W transmitter
CoL science plans (with SKA precursors and pathfinders)

- ongoing JVLA survey of Ophiuchus A star forming region at X band (10 GHz), beam ~0.3”  
  [Coutens et al, in prep.]
- continuing hunt for long-wavelength radio signal from exoplanets  
  [Zarka, Grießmeier, et al.]

- theory / simulations:
  - radiative transfer models of thermal dust grains
  - astrochemical models coupled with (evolved) protoplanetary disks:  
    for example formamide (NH$_2$CHO), Quenard & Jimenez-Serra
Cradle-of-Life science goals and observing modes are very diverse, 
—> multiple KSPs conceivable

- **1. young stellar cluster deep field to map dust spectral index**
  (cm-size dust grains)
  - Oph A star-forming cluster, 1000 hours in SKA1-mid, band 5
  - need angular resolution ~0.04 arcsec to probe solar system scales (5 au at 120 pc)
  - as 'additional science': complex molecules, jets (free-free), ..

- **2. stars, planets and civilizations**
  - SKA1-low
  - all sources within 25 pc (2500h), selected sample beyond 25 pc (1500h), ..
  - includes SETI
  - good chance of overlap (‘commensality’) with other SWG: Our Galaxy, Epoch of Reionization, Cosmology, Transients
concerns about SKA1 capabilities for Cradle of Life science

- Cradle of Life SKA1-mid cases depend critically on band 5:
  - high-frequency cut-off at 13.8 GHz is workable, but not ideal
  - having band 5 receivers on only half of the dishes reduces the spectral line sensitivity of the total SKA1 array to a point where detecting new molecular species will become a big challenge
  - the main science theme, observing grain growth, needs band 5 at 120+ km baselines. Currently unclear which dishes will be equipped with band 5 receivers
- some of the Cradle of Life science (e.g., disk structure at 2 cm) would greatly benefit from being able to analyze data in visibility domain. Currently not foreseen that SKA will deliver (raw) visibility data to users.