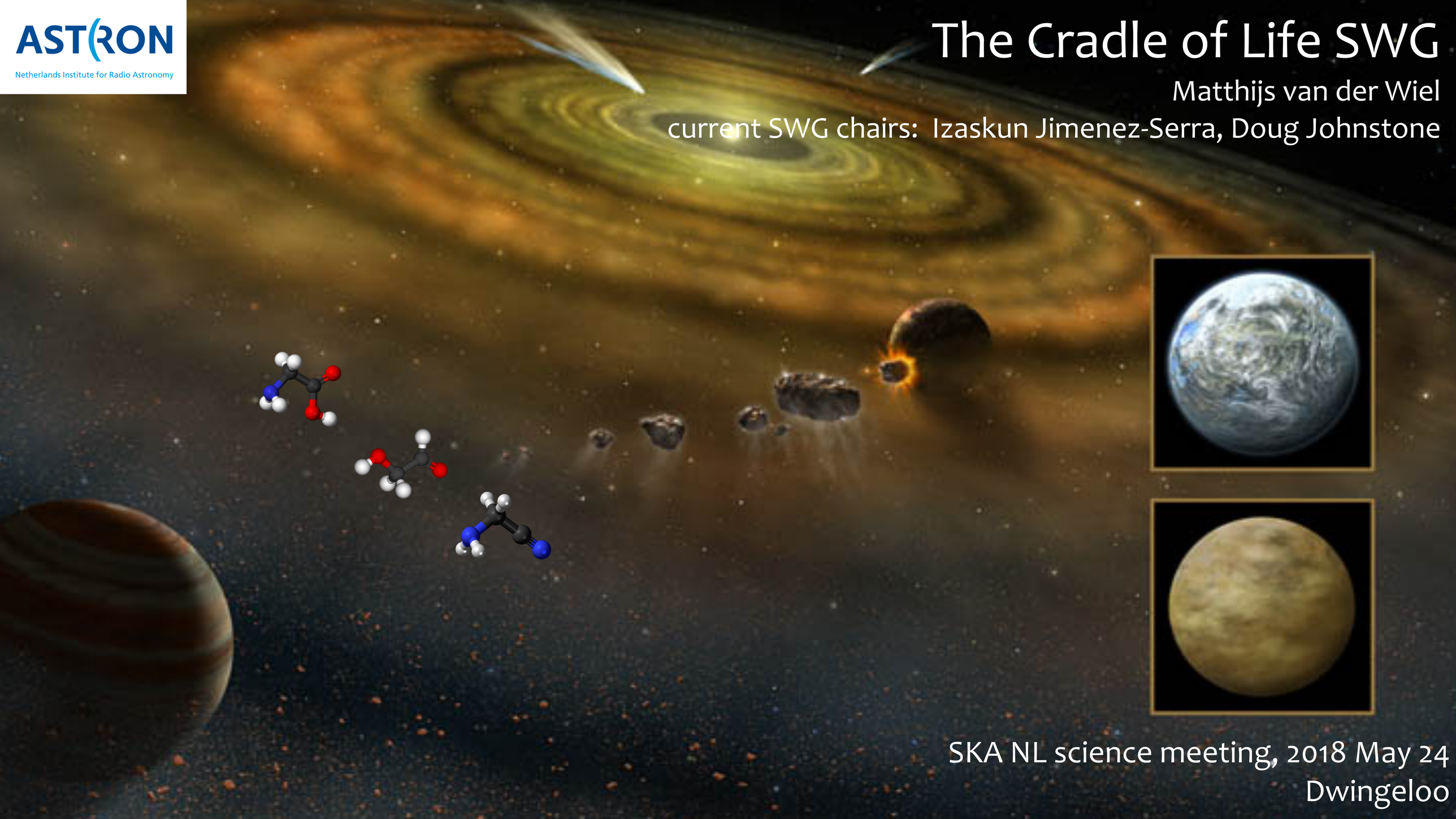
ASTRON
Netherlands Institute for Radio Astronomy

The Cradle of Life SWG

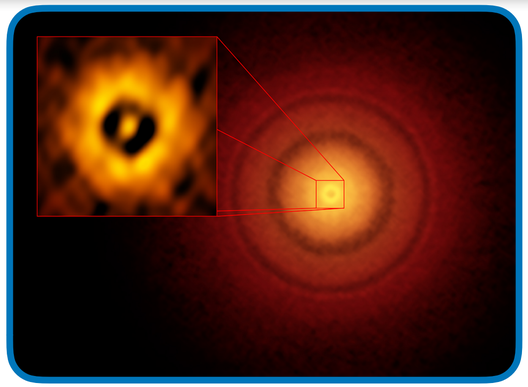
Matthijs van der Wiel
current SWG chairs: Izaskun Jimenez-Serra, Doug Johnstone



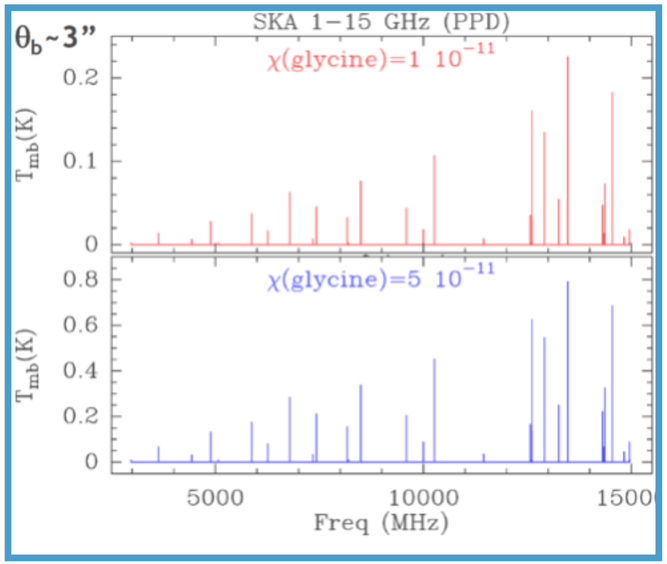
SKA NL science meeting, 2018 May 24
Dwingeloo

Cradle of Life SWG: four themes

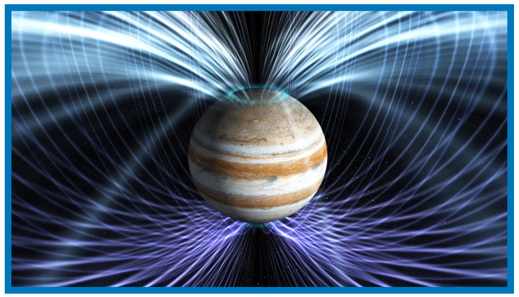
1. how does planet formation start?



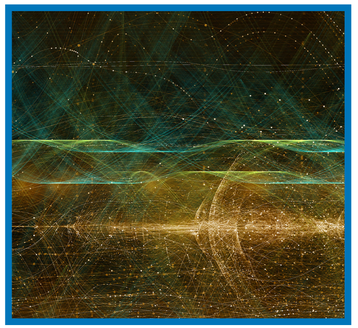
2. How did the first prebiotic compounds form?



3. what are exoplanets like?



4. SETI: find signals from technological civilizations



the Cradle of Life SWG members

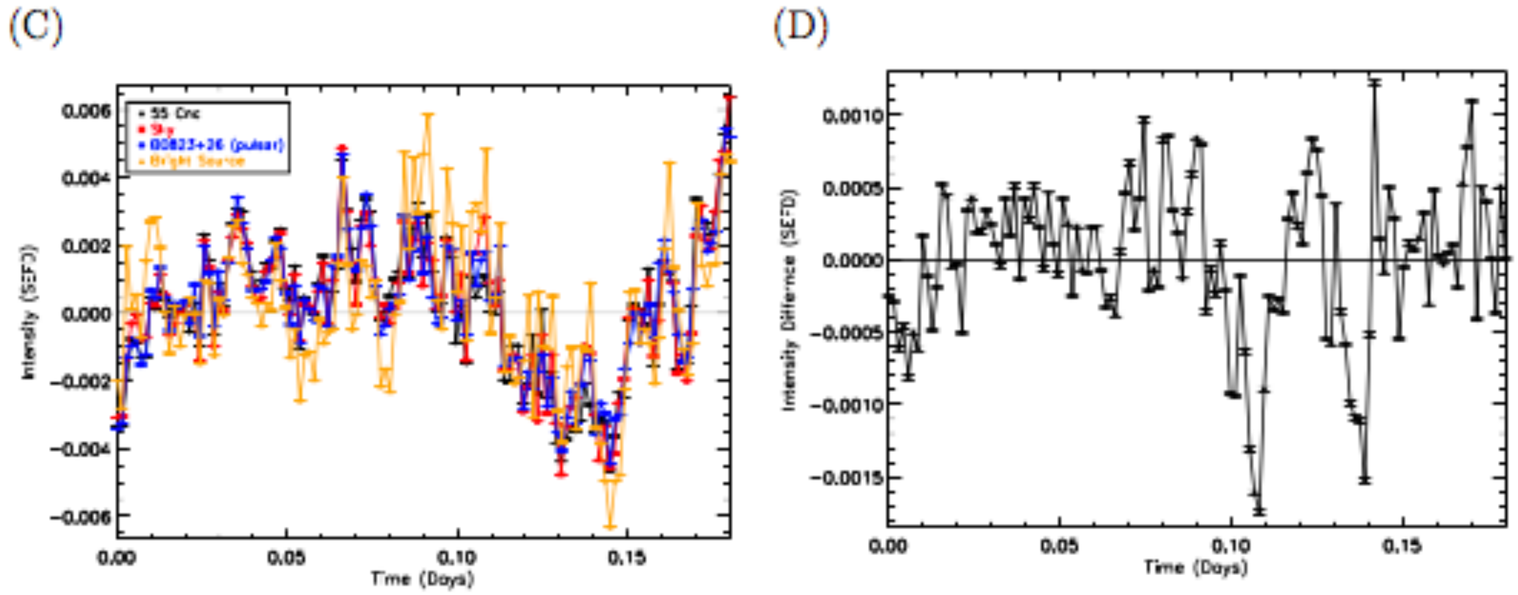
CoL Working Group Membership

Name	Institution	Country	Membership Type
Izaskun Jimenez-Serra	QMUL (Centro de Astrobiología in 2018)	UK (ESP in 2018)	**Co-Chair** (i.jimenez-serra AT qmul.ac.uk)
Doug Johnstone	HIA	Canada	**Co-Chair** (douglas.johnstone AT nrc-cnrc.gc.ca)
Melvin Hoare	University of Leeds	UK	Core
Laurent Lamy	Observatoire de Paris	France	Core
Joseph Lazio	Jet Propulsion Laboratory (JPL)	USA	Core
Di Li	National Astronomical Observatories, Chinese Academy of Sciences	China	Core
Sarah Maddison	Swinburne University	Australia	Core
Subu Mohanty	Imperial	UK	Core
Ian S Morrison	Swinburne University	Australia	Core
Laura Perez	Universidad de Chile	Chile	Core
Andrew Siemion	ASTRON/Berkeley	NL/USA	Core
Josep M. Trigo-Rodriguez	Institute of Space Sciences (ICE)	Spain	Core
Huib van Langevelde	Joint Institute for VLBI in Europe (JIVE)	Netherlands	Core
Matthijs H.D. van der Wiel	ASTRON	Netherlands	Core
Philippe Zarka	Observatoire de Paris	France	Core

+ 40 associate members,
including Michiel Hogerheijde, (Leiden/Amsterdam)

recent highlights (1)

- radio emission from exoplanets: 30–70 MHz with LOFAR
  Turner, Grießmeier, Zarka & Vasylieva (in "Planetary Radio Emissions VIII", 2017)
  - 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)

interstellar asteroid 1I/'Oumuamua
(image credit: ESO)

- 'Breakthrough listen' project used GreenBank Telescope (L, S, C, X-bands) to search for weak radio emission from 1I/'Oumuamua, a solar system object of interstellar origin
  Enruiquez, Siemion, Lazio, et al. (2018, subm.)
- they found nothing, but were sensitive to a 0.08W transmitter

CoL science plans (with SKA precursors and pathfinders)

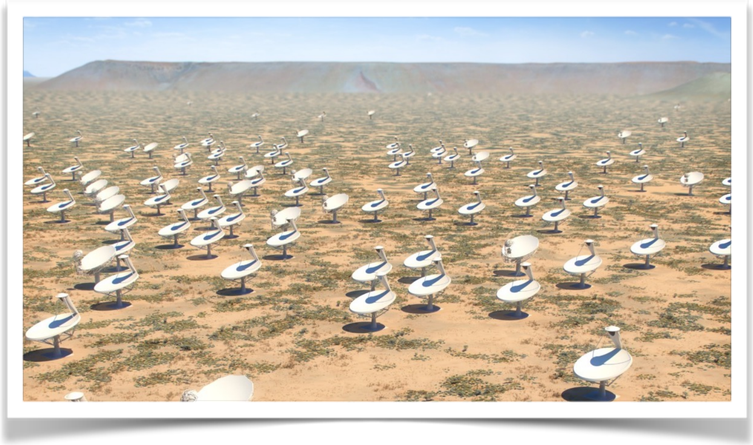
- ongoing JVLA survey of Ophiuchus A star forming region at X band (10 GHz), beam ~0.3”
  [Coutens et al, in prep.]
- continuing hunt for long-wavelength radio signal from exoplanets
  [Zarka, Grießmeier, et al.]

- theory / simulations:
  - radiative transfer models of thermal dust grains
  - astrochemical models coupled with (evolved) protoplanetary disks:
    for example formamide (NH_2CHO), Quenard & Jimenez-Serra

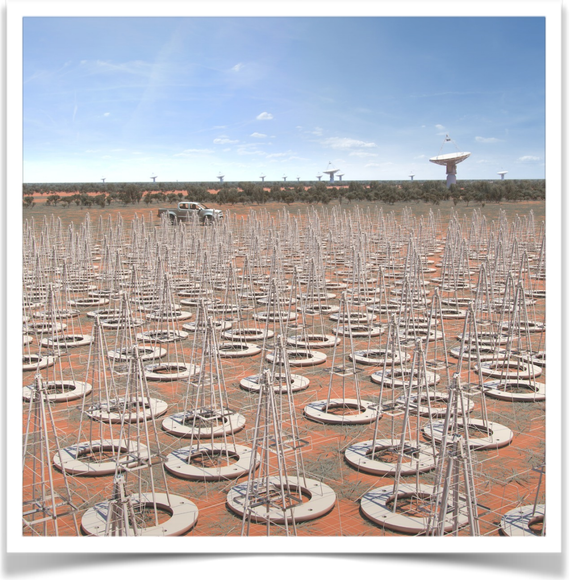
CoL SWG connecting to future Key Science Programs

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 equiped 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.