The Case for Targeting SETI
Haystacks and Needles

William Edmondson
Honorary Senior Research Fellow
School of Computer Science
University of Birmingham
Life on Other Worlds

Steven J. Dick

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The Haystack – I

• The universe of observable stars and planets.
  ~$10^{22}$ exoplanets

• Interesting objects rendered onto hard-drives via instrumentation (raw data e.g. voltages, or processed – debate?).
  <$10^4$ Exoplanets, 3869 and increasing [exoplanet.eu]
  <$10^4$ Pulsars, 2659 and increasing [ATNF database]
  ~$10^5$ Habstars from the HabCat [17,129] (Turnbull, M. & Tarter, J. 2003)

• Does SKA increase the size of the rendered Haystack in ways which hinder or support SETI?
  • Yes – look at and look for increasing numbers objects of interest, but more at one time.
The Haystack – II

• SKA could look for **life-signatures** from exoplanets:
  • RF studies of transits of known exoplanets could perhaps provide spectroscopic evidence of an atmosphere with a water hole, and/or OH line absorption.
  • Data folding at the known orbital period for an exoplanet would be an obvious processing approach, but very slow.
  • Many targets could be interleaved, with individual exoplanet data sampled and folded.
  • Characterization of exoplanets is important for science.
  • SETI is supported because targets are identified.
The Haystack – III

• SKA could be used to look for techno-signatures such as a Babble-Bubble.

• The style of searching required is probably survey, but with specific signals in mind (e.g. using an RF model of Earth’s Babble Bubble).

  • NB - pulsar searches have found pulsars but no ETIs and no Babble Bubbles.
The Needle – I

• Does SKA increase the size of the Haystack in ways which support or hinder SETI?
  • Refine characterisation of objects such as exoplanets?
  • Helps search for new ones (e.g. pulsars – cf. Edmondson and Stevens).
  • Enlarges the rendered search space.

• Does SKA help refine the search parameters?
  • Better needles?
The Needle – II

• SETI is bedevilled by poorly justified needles.
  • Is the lack of success just a sampling problem or is it poorly justified needles? Will SKA perpetuate the problem?
  • Better needles reduce the relative size of the Haystack. Could SKA help refine needle design – new needles because new ways of targeting?

• Targeting in SETI is interesting for two reasons:
  • Requires good needle justification;
  • Provokes consideration of ETI’s motivation, behaviour and technology.
SKA and ETI – The signals...

- Should be unambiguously artefactual.
- Should be envisaged as a link between two locations in the universe (targeting).
- Should not be challenging (the enterprise is challenging enough). Multichannel pulse trains would be OK.
- Edmondson and Stevens’ Pulsar reference conception is merely one way of envisaging an ETI signal which meets these criteria.
The Habstars are HIP83241 @ ~258ly; HIP83522 @ ~287ly; AND HIP23302 @ ~134ly; HIP23291 @ ~398ly; HIP23438 @ ~714ly;

The 6 Pulsars in M62 (~22,500ly) have periods ranging from 2.3ms to 5.24ms
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• Edmondson and Stevens’ Pulsar reference conception is merely one way of envisaging an ETI signal which meets these criteria.
• SKA technology and configuration could help extend the list of possible signals.
SKA’s contribution to SETI

• More thoroughly investigate existing targets:
  • Examination of technical and observational biases.
• Use signal processing commensal techniques, e.g. to look for pulsar rate signals when looking for/at pulsars.
• Refine potential targets (e.g. exoplanets).
• Explore new target ideas made possible by SKA
  • Instead of simply doing more of the same as we do now.
• Develop new techniques for specifying artefactual signals:
  • Likely to be pulses because S/N more favourable and folding very powerful – and ETI will know this. Anything else?
SKA and SETI

• Does a sensibly nearby ETI have an answer to the Big Question?
  • If yes then they probably know about us through optical telescopes (and want to help us answer the question).
  • If no then they may be searching as we are.

• It is acceptable, even necessary, to try to work out what signals ETI might send, where, and why. SKA can help us think through the issues so we can develop better ideas for targeting.