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SKA1-Low Science

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The SKA1-Low telescope will enable transformational progress within an extremely broad range of scientific areas as captured within the two volume SKA Science Book [1] shown in Figure 1. What makes this possible is about an order of magnitude higher sensitivity, coupled with a one to two order of magnitude improvement in image quality over current radio telescopes together with a state-of-the-art non-image processing system, all working in the frequency range of 50 to 350 MHz [2]. Some of the unique science contributions will come from the first direct imaging of atomic hydrogen structures in the early Universe at red-shifts between 6 and 12. This should allow determination of not only the time when the Universe became predominantly ionized, but also pinpoint, both morphologically and in red-shift, the individual ionizing sources. Other breakthroughs will result from a ten-fold increase in the known population of Galactic pulsars that will be enabled by a sensitive, wide-area pulsar search capability. This should vastly increase the sample size of the precision timing pulsars that can be used for nHz Gravitational wave detection as well as allow discovery of the most rare and extreme binary systems, such as a neutron star – black-hole binaries, that would uniquely test gravity theories and General Relativity. Important advances are also anticipated to flow from the ability to provide high fidelity images of diffuse structures as well as precision low frequency polarimetry. Some 50% of the baryonic matter in the Universe is thought to be bound up in diffuse filaments that connect individual galaxies and clusters of galaxies. Some of the best prospects for direct visualization of this elusive "Cosmic Web" come from either the direct detection of their diffuse synchrotron emission or differential detection via a dense grid of Faraday Rotation Measures toward background synchrotron sources. Both of these approaches are enabled by the capabilities of SKA1-Low. Another key area of scientific discovery will be that of the time variable Universe. Transient detection capabilities will be available to allow detection of impulsive astrophysical events with characteristic timescales anywhere in the range of milliseconds to years, while "custom experiment ports" will provide opportunities to extend this down to the nanosecond regime. Some key targets will include nearby stellar systems where one will hope to detect the equivalent of Jovian radio bursts that signal the existence of exoplanets with significant magnetic fields, such as are known to shield life on Earth from possible extermination by cosmic ray bombardment.

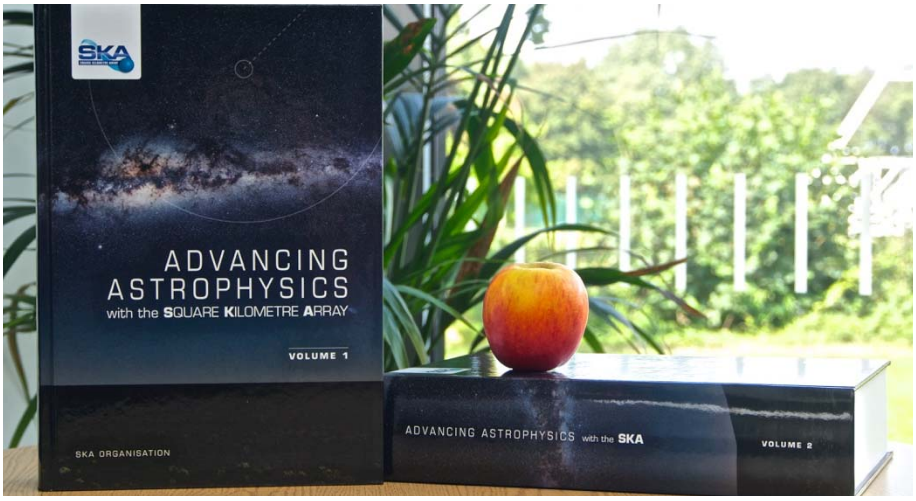

Figure 1. The SKA Science Book: "Advancing Astrophyics with the SKA".

1. R. Braun et al., "Advancing Astrophysics with the SKA", Proc. AASKA, 2015.

2. R. Braun et al. "Anticipated SKA1 Science Performance", SKA-TEL-SKO-0000818, 2017.