

## **Challenges and Solutions: Designing the Pulsar Search Subelement for the SKA**

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From observing the very first stars and galaxies to improving our understanding of dark energy to revolutionizing our understanding of fundamental physics, the Square Kilometre Array (SKA) is poised to usher in a new era of radio astronomy. The SKA will not only be the world's largest telescope, made up of dishes and dipoles spread over two continents, it will be one of the largest scientific endeavors ever undertaken and will also push the boundaries of current scientific research, possibly providing data volumes of up to 100 times the current global internet traffic. Among the key science goals of the SKA are discovering pulsar/black-hole binary systems, detecting gravitational waves, and testing general relativity. Each of these challenges will owe their success to observations of pulsars, either through increasing the number of known pulsars by an order of magnitude or discovering pulsars in seldom-searched parameter spaces.

The Time Domain Team, of which I am a member, are developing the Pulsar Search Subelement for the SKA. This system will receive data and, in real time: dedisperse, perform an acceleration search, fold candidates, and also detect transients. Most of these tasks are normal for pulsar/transient searches, however, this search must be done for at least 1500 beams, which is two orders of magnitude more than has ever been done before, and those surveys did not include acceleration searches. To achieve this, we are investigating software and hardware solutions, including GPUs and FPGAs. A prototype for the transient search is already in use on the Lovell telescope. This backend, called Apollo, searches for transients with DMs up to  $3500 \text{ pc cm}^{-3}$  in real time using two GPUs. I will discuss the challenges related to reaching the real-time processing goals of pulsar search observations with the SKA, describe the solutions we are investigating for achieving the required 10 petaops of processing, and present some results of benchmarks, as well as mentioning our future plans.