

Challenging Einstein

Professor Justin Jonas - Associate Director for Science and Engineering of South Africa's SKA programme and Professor of Physics and Electronics at South Africa's Rhodes University.

Professor Justin Jonas, the Chief Scientist behind Africa's bid to put itself at the centre of discovery about the universe, is positive that the Square Kilometre Array (SKA) will achieve its ambitions. It will shed light on how the universe evolved after the Big Bang, how black holes work, and what that mysterious dark energy - which makes up 70% of the universe and is driving its continuous expansion - really is. It may even detect intelligent life elsewhere in the universe.

It's fascinating stuff, but what most excites Prof Jonas is the chance to prove Albert Einstein wrong. "Frankly, it would be fantastic if Einstein's theories about gravity were invalidated," says Prof Jonas, Associate Director for Science and Engineering of South Africa's SKA programme and Professor of the Physics and Electronics at South Africa's Rhodes University.

"Any scientist would tell you it is a disappointment if a discovery proves an existing theory." Einstein's Theory of General Relativity, which details how massive objects affect space and time, is now almost a century old and could be disproved by SKA research into pulsars.

Scientists will test Einstein's theory by examining how these spinning dead stars react in the proximity of black holes. Einstein would have been intrigued by SKA's potential, just as he would have been impressed by the speed, energy and gravitational pull of 53-year old Prof Jonas, who has played a crucial part in establishing an African country with limited resources as a global leader in radio astronomy within a very short space in time.

Only a decade ago, Prof Jonas sent a tentative email to the International SKA Steering Committee asking whether South Africa could join in discussions on the project. The country was not only a late entry in the race to host the SKA (consultations on the project already started in 1993), but at that stage its only ambition was to be considered as a host site.

Prof Jonas, together with colleagues and students, explored the country looking for a suitable site, eventually settling on a desolate patch of land, 90km northwest of Carnarvon in the Northern Cape, which has a very dry climate, with a small population and almost no radio frequency interference from cellular phones and broadcast transmitters.

The site was perfect, but Prof Jonas and his colleagues didn't feel it was enough. For the bid to succeed, they needed to demonstrate that South Africa had technical capability in the field. They worked with government to develop a plan to grow radio astronomy in South Africa, and in record time Karoo Array Telescope (KAT-7) was built.

While the radio telescope has already started to deliver images of a galaxy 14-million light years away, it is only a frontrunner for MeerKAT - the largest and most sensitive radio telescope in the southern hemisphere - which is currently being constructed.

To support these telescopes, human capital was needed. Hundreds of bursaries were made available and within a couple of years, the number of radio astronomers increased by a factor of ten, says Prof Jonas with great satisfaction.

“Prof Jonas has been an invaluable guide and mentor to all the scientists and engineers who have been designing and building the MeerKAT telescope and infrastructure” comments Dr Bernie Fanaroff, Director of the SKA South Africa Project. “He combines an outstanding understanding of physics with an equally outstanding understanding of electronics, telecommunications, computing and engineering principles.”

While Prof Jonas is playing a major role in pushing the frontiers of knowledge, he also has an ability to excite people - from all walks of life - about science, says Rhodes University Vice-chancellor, Dr Saleem Badat. “He truly is a great ambassador for Rhodes, and for the country.”

Prof Jonas’s interest in radio astronomy was triggered in the early seventies as a thirteen-year-old fan of David Bowie. It wasn’t the Thin White Duke’s penchant for space-themed lyrics that hooked young Jonas on the galaxy; it was that he wanted to build a hifi to do justice to the music.

“For me, it was never about the stars. I wanted to build equipment - that’s what I found satisfying and useful.” His father, a toolmaker who never had the chance to go to university, helped him to understand the basics of machinery, which proved invaluable later in life when he had to deal with equipment as a scientist.

Prof Jonas went to Muir College Boys High School in the industrial town of Uitenhage in South Africa’s Eastern Cape Province, where he joined the radio club and explored science and electronics. His science teachers, some of whom were graduates of Rhodes University in nearby Grahamstown, which had a radio astronomy unit, were a source of inspiration, and encouraged him to explore this relatively new scientific field.

Before the 1930s the universe was only explored by optical telescopes. Then it was discovered that stars and galaxies emitted electromagnetic radiation across the entire spectrum, which meant that they could also be studied via radio frequencies. Radio astronomy was born and immediately painted a much clearer picture of the universe because cosmic dust, weather and other optical obstructions were no longer a prohibiting factor.

The young Jonas was particularly fascinated by the iconic Lovell Telescope at Jodrell Bank in Cheshire, built in 1957. He still has a big poster of the “very cool” enormous telescope in his offices at the Rhodes Physics and Electronics Department, which he first visited while still at school.

“The department’s laboratory, which had a strong focus on both physics and electronics, fulfilled all my wishes. It was exactly what I wanted; and it held my interest throughout my studies.”

Prof Jonas flourished at Rhodes, the smallest university in South Africa, but one of country’s top rated research institutions. The size of the department meant that lecturers took a personal interest in him - and that there was a direct involvement in his projects and mentorship,

specifically from Professors Eddie Baart, a physicist, and Pat Terry, a physicist turned computer scientist.

“From second-year level on, the department encourages all students to take tea with their lecturers. This way you feel part of the department very quickly,” says Prof Jonas. Crucially, Rhodes is also a recognised brand overseas, adds Prof Jonas. The department is well known at other universities for its work in radio astronomy, and had links to other institutions, which made international research stints - including at the Lovell Telescope - possible.

“I learned a lot from the generosity of my own lecturers, who introduced me to opportunities outside of the university and encouraged me to pursue them. This proved a very valuable lesson to me not to try and keep my students under my wing, but to support them to go out into the world and explore for themselves.”

Rhodes academics also have firm ties with the Hartebeesthoek Radio Astronomy Observatory (HartRAO), which was built around a radio antenna handed over by NASA in 1974. Prof Jonas used the Hartebeesthoek Radio Astronomy Observatory - www.hartrao.ac.za Thomas Abbott equipment to plot the Rhodes/HartRAO SKYMAP survey - a map of the radio emission of the entire southern sky, which formed the basis of his PhD.

Commenting on Prof Jonas, Dr Michael Gaylard, Managing Director of HartRAO and a Rhodes alumnus, said he'd developed a lot of his skills in the technical aspect of radio telescopes while working on the Rhodes/HartRAO map - which made him well suited to leading the scientific and technical processes in South Africa's bid for the SKA.

“Justin is a classic example of an experimentalist radio astronomer, combining a deep understanding of the technicalities that have to be got right for the radio telescopes to get the data that is wanted, and extracting the desired information from the data.”

The survey - which took 15 years to complete – is still in use, which gives Prof Jonas some satisfaction. “After all, my PhD took forever!”

The renowned C-BASS project, which is currently close to the MeerKAT and SKA sites, is a return to his roots, says Prof Jonas. Rhodes University, together with Caltech in the United States, the Universities of Oxford and Manchester in the United Kingdom, and Saudi Arabia's King Abdulaziz City for Science and Technology, is mapping the Milky Way in order to better understand the cosmic microwave background (CMB) - the very faint afterglow of the Big Bang.

Prof Jonas's involvement in the SKA project was more by luck than design, he says. In its 1996 White Paper on Science and Technology, the Department of Science and Technology (DST) highlighted astronomy as one of its focus areas - due in large part to South Africa's advantageous geographical location for star-gazing.

Resources were allocated to astronomy and when Prof Jonas - following the prompting of some of his colleagues - pushed involvement with the SKA at a 2001 workshop held by the DST and the National Research Foundation, he found immediate support.

Prof Jonas was seconded by Rhodes to work on the SKA, and has spent the past five years crossing continents to present bid documents as well as sharing research with overseas academics and the SKA fraternity. He now serves on the executive of the SKA Science and Engineering Committee (SSEC).

Dr Faranoff says Prof Jonas has been acknowledged for his deep understanding and incisive analysis by the international SKA consortium. "He is widely recognised by them as an invaluable leader of the global SKA project."

Between overseas trips - his frequent flyer status is the stuff of legend among academic colleagues - Prof Jonas makes frequent trips to SA's SKA site in the Northern Cape, and shuttles between the SKA offices in Cape Town and Johannesburg.

As the bid announcement date drew closer, the travelling intensified to the degree that he had to schedule a trip to his home in Grahamstown because he "ran out of laundry".

Wiry and suntanned from long stretches spent in the Karoo, this focused, mild-mannered, straight talker is seemingly inexhaustible. When his reserves are running low, he doesn't show it. He does admit, however, that navigating the international politicking involved in getting the bid was not easy for him.

"Everyone wants something. It's not something that as a scientist I had any training in." In the end, however, hosting the massive telescope on African soil is worth all the hours, the toil and travel, and the politics. The hazy cosmic vibe, to paraphrase his childhood musical hero, may very likely blow our minds.