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Particle Physics and Climate Change

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Accelerator Mass Spectrometry (AMS) is an applied particle physics technology that is playing an important role in understanding the trajectory of climate change in southern Africa. The Inter-governmental Panel on Climate Change (IPCC) advocates the use of past climate history as a test of the skill of climate models, but the instrumental record of climate variability in southern Africa is short in duration and patchy in distribution. An approach to climate reconstruction where instrumental records are inadequate is dendrochronology: the recording of climate in the ring widths of trees, but in southern Africa this approach is limited to short-lived tree species. At iThemba LABS we have been attempting to reconstruct past climate using the isotopic chemistry of wood from long-lived trees. The focus has been on baobab trees that can achieve ages in excess of 1000 years, but the ring structures preserved in the wood are not annually formed. Understanding the growth structure of the trees is critical to climate reconstruction. By measuring the rare isotope ^{14}C using AMS it has been possible to radiocarbon date baobabs. The approach is complicated by the "Suess Effect" where atmospheric ^{14}C levels were diluted by the addition of "^{14}C-dead" fossil fuel carbon to the atmosphere since the start of the industrial revolution. It is also complicated by the effect that above ground nuclear testing had on ^{14}C concentrations in the atmosphere. These effects are overcome and the results show that baobab growth is complex, but it can be unraveled with AMS dating. By measuring the stable isotope ratios (^{13}C/^{12}C) of the baobab wood, it has been possible to reconstruct rainfall variability over southern Africa from Namibia to Madagascar over the last 600-1000 years. This record reveals the underlying forcing of climate, and approximately 4 variables control most of the droughts (including the "day-0" drought in Cape Town) in the region. Using this to test climate models shows that the models accurately predict the effects of the 4 underlying variable, and so the alarming climate change forecasts for the region should be given high priority at policy level.

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No

Level for award
 (Hons, MSc,
   PhD, N/A)?

N/A

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