Solar Neutrinos and Cooking

4 million people die each year from respiratory diseases caused by smoke inhalation from fuel used for cooking. Solar cookers are an innovative solution to this problem, which could enhance the quality of the lives of women and children.

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Field trials of the solar cooker conducted in Tanzania

A new low-cost solar cooker has been developed at the University of Oxford, demonstrating how fundamental Physics research can lead to very practical applications. Originally, Professor Nick Jelley was working on maximising the light collected from solar neutrino interactions in the Sudbury Neutrino Observatory (SNO) by using light concentrators. These concentrators had to survive many years under water. An exhaustive search for a suitably hard wearing and affordable material eventually led to a design with 18 curved reflective strips.

Professor Jelley and his colleagues in the Department of Engineering discovered that a similar design principle might lead to lower cost, durable and more effective solar cookers. An effective low-cost solar cooker would not only cut deaths but would greatly enhance the quality of lives, removing the necessity of long treks to collect ever decreasing amounts of brushwood. Such devices could be used across large parts of Africa, in India, China and elsewhere in the world. The potential humanitarian benefit is significant.

Prototypes showed how two single curvature surfaces can focus sunlight in a suitable way for cooking food. The combination of a conical and a parabolic mirror directs the sun's energy to the underside of a cooking platform. The single curvature surfaces in the concentrator allow the reflective surfaces to be formed from the same type of hardwearing flat reflective sheets used in SNO. This approach could reduce costs and enable the cooker to be flat-packed – an essential requirement for disaster relief operations. The design should be robust and easy to assemble.

With direct sunlight the cooker is designed to provide heating in excess of 200ºC and can be used with a saucepan on a cooking surface, with an oven, or just with a suspended pot, at a standard worktop height. It should be comfortable to use, particularly for the elderly or infirm, and much more hygienic than a cooker placed directly on the ground.

Trials of the solar cooker in Tanzania showed that the cooker performed well, with families boiling rice, beans, potatoes, bananas, and meat. Dazzling by the focussed Sun's rays was a concern to some, but tracking the Sun as it moves across the sky would reduce this possibility, as well as giving more time to do other tasks as the meal cooks.

However, as made, cost is a barrier to many families that need an alternative to the wood or charcoal burning stoves that produce dangerous emissions. The company FuturEnergy is evaluating alternative materials and design with the aim of enabling mass production to make the cooker affordable. FuturEnergy is also designing a larger version to be used as a source of energy in industrial processes. For example, using the concentrator as the energy source in a water desalination system, that is scalable using multiple linked arrays.

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