reveal ways to improve MyShake's accuracy.

Particle physicist Daniel Whiteson of the University of California, Irvine, is also tackling data reliability. He and his colleagues have developed an app called CRAYFIS (Cosmic Rays Found in Smartphones) that enables smartphone users to observe and record the particle debris that is generated when high-energy cosmic rays strike Earth's atmosphere (D. Whiteson *et al.* Preprint at http://arxiv.org/abs/1410.2895; 2014). If several hundred smartphones in a kilometre radius simultaneously detect a signal, or 'blip', the app registers the event as a cosmic-ray shower. The more blips that occur in a given radius, the greater the energy of the primary cosmic ray. But there is still the possibility that synchronous blips could originate from sources other than cosmic rays — including detector noise or ambient light.

Whiteson and his team hope to rule this out by recording the metadata that accompany blips, such as their time and location. If a smartphone is left in one place to record data, the researchers will be able to characterize sources of ambient light and noise so that genuine cosmic-ray signals become readily apparent. More than 150,000 people worldwide have already signed up to participate in the CRAYFIS study, but before they release the app officially, the researchers want to make sure it is free of performance issues that could drive contributors away. The team is currently running a test version of the app on 1,000 phones worldwide.

"Smartphones are very powerful and very flexible."

Despite the glitches, apps that crowdsource data are especially attractive for researchers because they can overcome issues that might prevent the collection of data. "The prospect that seismic data in large earthquakes can be obtained from consumer electronics is potentially transformative," says Tom Heaton, a seismologist at Caltech. "One major obstacle to acquiring seismic data in a building is that the building owners are frightened by the prospect that researchers will uncover a critical safety issue."

Just as smartphones have become indispensable for many scientists' day-to-day lives, they might also prove to be transformative vehicles for some experiments. "Gone are the days when governments would invest US$10 billion to $15 billion on new types of infrastructure, so it's important to think about the infrastructure that's already been built," Whiteson says. "Smartphones are very powerful and very flexible. It's an enormous platform that we're only now beginning to think about for science." ■

Jon Cartwright *is a freelance journalist in Bristol, UK.*

TURNING POINT
Reactor manager

Last December, plasma physicist Thomas Klinger saw almost 15 years of work come to life when the Wendelstein 7-X 'stellarator' — an experimental nuclear-fusion reactor — was turned on in Greifswald, Germany. The initiative had to overcome numerous challenges, but Klinger now thinks that the once-troubled project is on a solid footing.

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How is plasma physics contributing to the promise of nuclear fusion?

Fusion needs a hot ionized gas known as a plasma, so basic research on high-temperature plasmas is needed for their application in fusion-based power plants. The fusion process that happens in the Sun is very difficult to realize on Earth. We must rely on magnetic fields to keep smaller fusion reactions under control.

What challenges has the Wendelstein 7-X (W7-X) stellarator faced?

When I joined the Max Planck Institute for Plasma Physics in Greifswald in 2001, the plan was to produce the first plasmas around 2007. By 2003, everybody realized that the W7-X project was in deep trouble, suffering from serious technical and management issues. The institute started to introduce reforms but they were not sufficient. So in 2005, I was put in charge of the construction project.

How did you move the W7-X project forward?

We hired an outstanding technical director and engineer, Remmelt Haange. For the first two weeks, we sat together and scratched our heads. We identified three areas to address: the most pressing technical problems; a reorganization that would involve hiring 100 engineers; and a review of the assembly plan. I got a crash course in fusion engineering. In September 2007, a new plan was accepted and a decision was made to continue the project. It was pivotal because we were in danger of being stopped.

Did you require any further skills to bring the W7-X into operation?

Our team had to learn about industrial professionalism. There are certain well-established principles, requirements and documentation practices that were not part of our management system at the institute. We had to completely reinvent ourselves.

Compare the stellarator and tokamak nuclear-fusion technologies.

Both use a magnetic field to isolate the plasma and to control its temperature. The fundamental shape of this magnetic field must be a doughnut, or a ring. In a tokamak, such as the one being built for the ITER project near Cadarache, France, the magnetic field lines are twisted into shape by inducing a strong current in the plasma. But in a stellarator such as the W7-X, there is no current in the plasma. The twisting is done by the shape of the external coils of wire. Because it doesn't need a current, the stellarator is much more stable than the tokamak, and it can operate without interruptions — desirable for a power plant. The ITER and W7-X projects are very different. ITER is an international project with seven partners on a giant machine, so its management scheme is unusual and complex compared to that of the W7-X.

Will the W7-X be competitive with ITER?

The ITER tokamak is a fantastic machine, and it still delivers the best performance. The project is far ahead. But stellarators can catch up.

What are the next steps for the W7-X?

There will be two major shutdowns in which we will integrate large and complex components into the machine to enhance its performance. After 2020, we aim to produce high-performance plasmas. Our fundamental goal is to demonstrate that these plasmas can be created and kept stable for half an hour. That would be a breakthrough, and we hope to achieve this by 2025.

Why do humans need to harness fusion?

It's the only new primary source of energy that researchers are working on, and I'm convinced that it will be needed in the long run. The quest for energy will affect everything — from water to mobility. Sufficient energy means peace. ■

INTERVIEW BY VIRGINIA GEWIN

This interview has been edited for length and clarity.