# Using fireballs to uncover the mysteries of ball lightning

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“People have been pondering ball lightning for a couple of centuries,” says James Brian Mitchell, a scientist the University of Rennes in France. Mitchell says that different theories of how it forms, and why it burns in air, have been considered, but until now there were no experimental indications of what might be happening as part of the ball lightning phenomenon.

Now, working with fellow Rennes scientist LeGarrec, as well as Dikhtyar and Jerby from Tel Aviv University and Sztucki and Narayanan at the European Synchrotron Radiation Facility in Grenoble, France, Mitchell can prove that nanoparticles likely exist in ball lightning. The results of the work by Mitchell and his colleagues can be found in *Physical Review Letters*: “Evidence for Nanoparticles in Microwave-Generated Fireballs Observed by Synchrotron X-Ray Scattering.”

“A group in New Zealand came up with this idea of ‘dusty plasma,’” Mitchell tells *PhysOrg.com*. “They thought that nanoparticles burning in air could cause ball lightning to remain for seconds, rather than disappearing after milliseconds. This was an attractive model.” But the model couldn’t be proved without detecting the nanoparticles.

Mitchell says that he saw a paper by Jerby describing the creation of a fireball in controlled conditions. “These fireballs floated in air,” Mitchell explains. “They resemble ball lightning.” This provided an opportunity to study whether or not nanoparticles were likely to exist in this natural

phenomenon, shedding light on a scientific mystery.

Video of a floating fireball: WMV (610KB)

The work was done at the European Synchrotron Radiation Facility in Grenoble. The facility uses an x-ray that is 10 billion times more powerful than a typical x-ray found in a hospital. Additionally, Mitchell explains, the accelerator for the synchrotron is more than a kilometer in circumference: “We can get measurements here that we couldn’t get in many other places.”

“We passed an x-ray beam through the fireball we made, and saw that it was scattered. This indicated that there were particles inside the fireball.” Not only were Mitchell and his peers able to determine that nanoparticles must exist in fireballs similar to ball lightning, but they were also able to take measurements. “Particle size, density, distribution and even decay rate were measured using this technique,” he says.

Mitchell’s work with fireballs isn’t finished. When *PhysOrg.com* spoke to him for this article, he was back in Grenoble taking more measurements. “This is interesting from a fundamental standpoint,” he insists, “and right now we are more interested in size and structure.” Additionally, he says that some of the particles will be trapped and sent to Tel Aviv in order to study them for composition.

Mitchell hopes that this work will have more practical applications as well. “We are working with coupling the nanoparticles with microwave energy,” he says. “They heat up very quickly. This could be a way of producing catalysts for other experiments.”

Right now, it looks as though one of the mysteries of ball lightning has been solved. This experiment has provided a strong case for the presence of nanoparticles in ball lightning. The next step is discovering what

scientists can do with the information.

More videos can be found at www.eng.tau.ac.il/~jerby/Fireballs.html