Andy Pearson

Strangeness and Charm

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I was recently reminded of the weirdness of subatomic particles when a friend commented that they didn't understand how an electron could be both a wave and a particle at the same time. I had to dredge my memory to the depths of high school chemistry and physics and concluded that this was indeed what we appeared to have been taught. An electron behaves like a particle but also behaves like a wave and so exhibits "wave-particle duality." However, it seems to me that the electron is neither.

I share some characteristics with women (two eyes, two ears, nose, mouth and so on) and also share some characteristics with bicycles (usually when in motion I have two points of contact with the ground, I derive my motive force from calf muscles). However to say that this means I am both a woman and a bicycle at the same time is obviously nonsense. The electron is neither a particle nor a wave, but could perhaps be called a "pave," or maybe a "warticle."

Why all this subatomic chat? The growing understanding of this field, which started 50 years ago with the discovery of quarks and resulted in the recent commissioning of the large hadron collider underneath Geneva, is likely to cause some significant changes to all aspects of life. Sensor and actuator technology is getting cheaper all the time. We already see the result of this in mass-produced items like car engines and washing machines but the continued deployment of ever-cheaper sensors will be seen in refrigeration equipment, too. This could result in the adaptation of existing compressor types into machines that monitor their performance and advise when maintenance is required, or which adapt to different operating conditions to maximise efficiency or even to protect against liquid carryover or changing temperatures.

Captain, my sensors indicate that this pie will go off in 17.4 seconds

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The sensors could also be used to calculate operating efficiency and determine the optimal mode of operation for the system. All aspects of the system will be measurable, enabling easy comparison between different machines or even across different sites.

If, as physicist Michio Kaku predicts, sensors become substantially cheaper than the box they are delivered in how will they be used in practice? It will be more economic to fit a large array of sensors in each monitored location and use software to decide which of the readings is most plausible than to send a technician to site to recalibrate a single sensor each year. Each data point could be monitored by 10 or more instruments, with a multiple voting system to evaluate the actual reading. Sensors will not only be fitted to the compressor; it is likely that food packaging will contain scanable data gatherers that can give the consumer a detailed plot of the time-temperature history of the produce before they lift it off the supermarket shelf. This could reduce food wastage by replacing the "best-before" date with a weighted average shelf life based on the product's temperature history. We might see systems that facilitate dialogue between the food on the shelf and the refrigeration system in the back of the shop. If food is aging too quickly the temperature can be reduced. If new stock is selling rapidly, the operating temperature can be nudged up to make the system more efficient.

However, we need to be careful about how we deploy this extra measuring capability. "Too much information" is a common complaint. If important messages are buried in a blizzard of information then they will likely be ignored. If more sensors equals more calibration this will be an expensive mistake. The incoming technology must be deployed in ways that make operation and maintenance easier, not difficult.

In his recent address to the Cold Chain and Sustainability conference, ASHRAE's Refrigeration Committee chair, Richard Royal said "We need systems to be simpler, but I mean simple like a smartphone, not simple like a hammer." Considering the ways in which cellphones have changed over the last 20 years it looks like an exciting time to be working in refrigeration. ■

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