Letters

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The editor welcomes letters, by e-mail to ped@iop.org or by post to Dirac House, Temple Back, Bristol BS1 6BE, UK.

Microwave ovens aren't as unreliable as they seem

I was looking through some back issues of *Physics Education* recently and came across the article 'More experiments with microwave ovens' (July 2004, **39** (4) 346–51), which I found interesting. I would like, however, to make the point that the experiment described on p 348 (leakage of radiation from a microwave) is not all it seems at first and might give people the impression that their ovens are more 'leaky' than is in fact the case.

Leakage of microwaves round the edge of the oven door is prevented by a design feature known to radio engineers as a 'quarter wave choke' (see, for example, www.freepatentsonline.com/3956608.html). The operation of such a choke is explained in various sources for microwave engineers, such as www.microwaves101.com/encyclopedia/quarterwave.cfm.

The basic idea is that a quarter wavelength of transmission line will transform an open circuit (infinite impedance) to look like a closed circuit (0 impedance) at the other end. This is a commonly used technique when joining sections of waveguide together because it avoids depending on the reliability of metal to metal contact. The same technique is used in the microwave oven, where the path between the door and the body is designed to be a quarter wavelength from inside to outside at the operating frequency of 2.45 GHz. This means that, from both the inside and the outside, the door and the oven body look like continuous metal, but only at this frequency.

Below this frequency, at 0.9–1.8 GHz (which is where mobile phones operate), the door path is less than a quarter wavelength, and the choke section is so far from its designed operating conditions that this electromagnetic radiation can penetrate it much more easily.

So, the experiment works well but may make people think that they are at more risk from radiation leakage than they are.

Dr John Parkin *Birmingham*

Reply to the above letter from the authors of 'More experiments with microwave ovens'

We wish to thank Dr Parkin for pointing out this important safety issue of microwave ovens. We have to admit that we were aware of quarter wave chokes, which very effectively prohibit any leaking radiation at the designed wavelength from microwave oven door assemblies. However, we unfortunately decided not to mention this aspect due to space limitation and trying to keep the argument as simple as possible.

We agree that our experiments might lead to a slight misjudging of safety issues. This was not intended and we emphasize again—as mentioned in the article—that all commercial microwave ovens do fulfil strict regulations and they are of course safe if properly used, in particular due to the device known as a quarter wave choke.

Michael Vollmer, Klaus-Peter Möllmann and Detlef Karstädt

Corrigendum

Simplifying modelling can mislead students

M R Khoshbin-e-Khoshnazar 2007 *Phys. Educ.* **42** 14–15

The author has asked us to draw readers' attention to two corrections to his paper:

1. In relation to (1), p 15, second column, there is a typographical error:

$$\frac{\sigma}{\rho hg} = N + 1 - \frac{1}{2}(1 + \frac{1}{2} + \frac{1}{4} + \ldots + \frac{1}{N})$$

should be changed to:

$$\frac{\sigma}{\rho hg} = N + 1 - \frac{1}{2}(1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \ldots + \frac{1}{N})$$

2. In the RHS formula on p 15, second column, there is a mathematical error that fortunately does not change the concluding result of the paper:

$$RHS \cong N - \frac{1}{2}\ln N + \frac{1}{2}$$

should be changed to:

$$RHS \cong N - \frac{1}{2}\ln N + 1$$