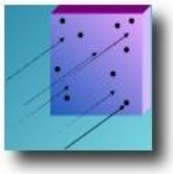
January 2001
Features



The limit as the thickness of the slice tends to zero

by Ian Garbett

The physical implications of limiting processes

This limiting process, where the slice is shrunk down to arbitrarily small thicknesses, really provokes some deeper questions!

Physics tells us that we cannot have a slice less than an atom thick, but the limiting process of the calculus involves shrinking the thickness down to zero. No problem arises when we can assume a physical continuum of values (for example the exponential law of radioactive decay involves time as the independent variable − and few would argue that a time interval cannot be made arbitrarily small). However, in some physical situations this is not the case. In fact, to paraphrase the great Austrian physicist Erwin Schrodinger "the differentials we use in physics must not be too small, but small enough". Such a problem also arises in fluid mechanics, where the volume elements must necessarily contain a certain number of molecules.

However, the "no shadowing" criterion can always be met for any density (any number of material entities per unit volume) as long as we pretend the material can be slices arbitrarily thinly.

The typical approach taken is to accept the idealisation of matter as continuous (no atoms) and accept the differential equation for radiation attenuation as being accurate in most cases and applications. A high−class fancy statement (again by Schrodinger) that means the same thing is that "we accept the postulate of continuity of description"!

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About the author

Ian Garbett lectures in applied radiation/radiological physics within the Medical Radiation Science courses at Charles Sturt University, Wagga Wagga NSWAustralia.

He graduated in 1977 with a BSc Honours in Applied Physics from the University of Lancaster, and obtained an MSc in Medical Physics from the University of Leeds in 1987.

He is interested in various theoretical aspects of radiation and radiological physics, with an interest in mathematical modelling in general.

Current research involves a theoretical description of X−ray beam spectra.

Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.