Research School of Physical Sciences and Engineering
Research Highlights

THE AUSTRALIAN NATIONAL UNIVERSITY

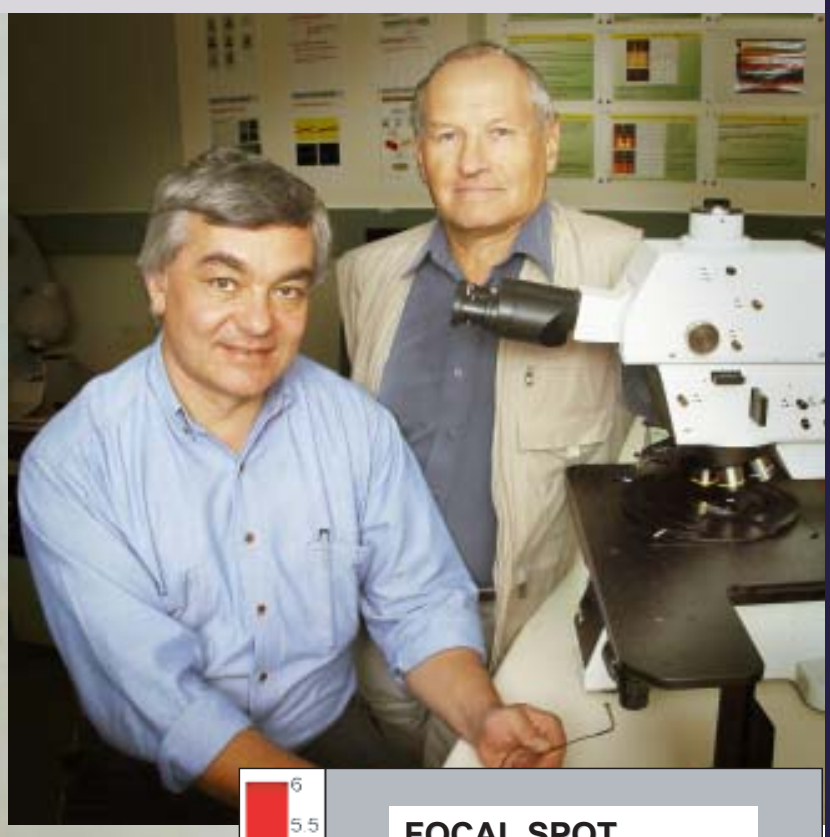
Ultrafast Lasers Drill Teeth and Improve Memory

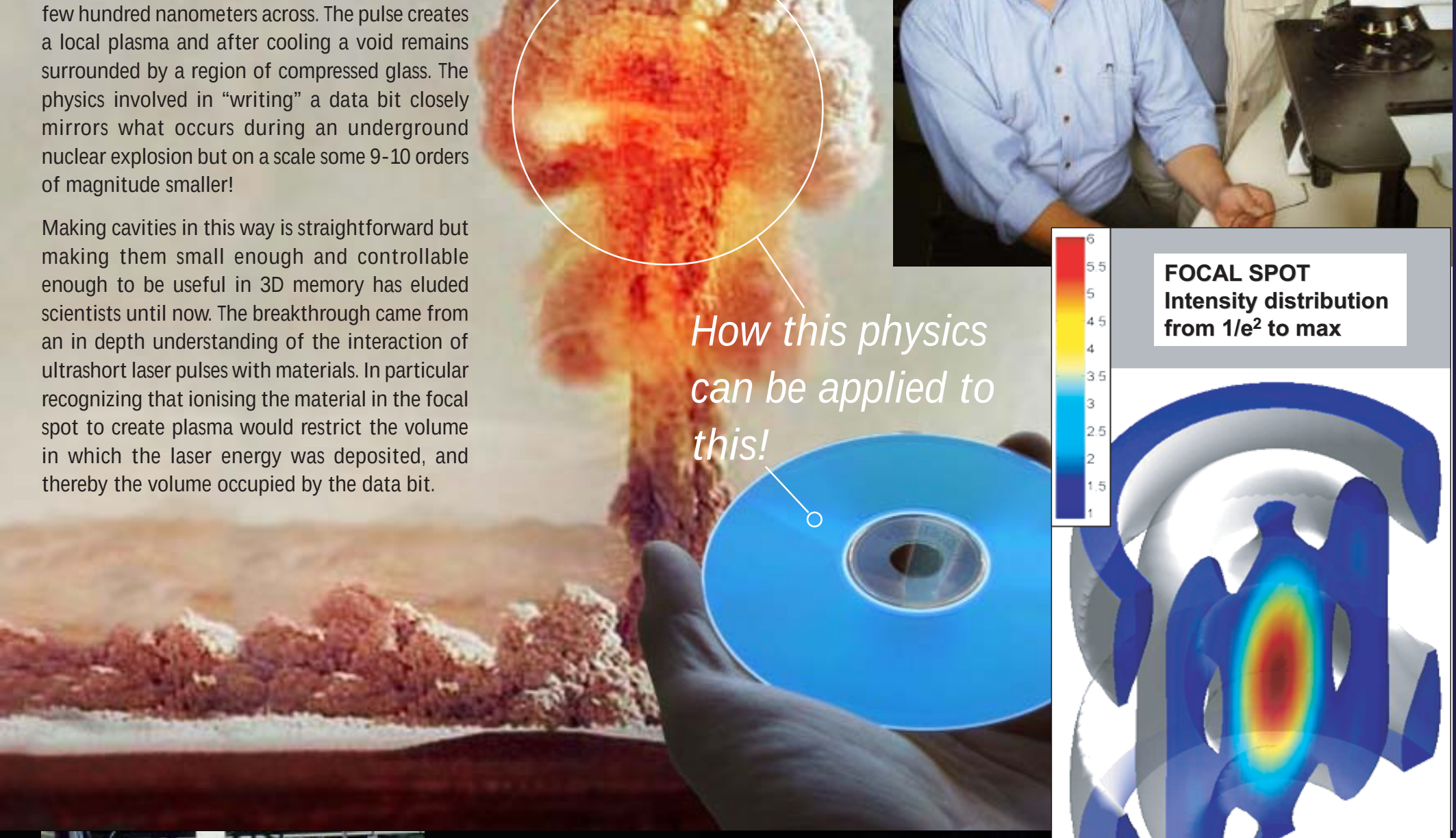
Eugene Gamaly, Saulius Juodkazis, Andrei Rode, Barry Luther-Davies, Hiroaki Misawa, Bronwen Taylor

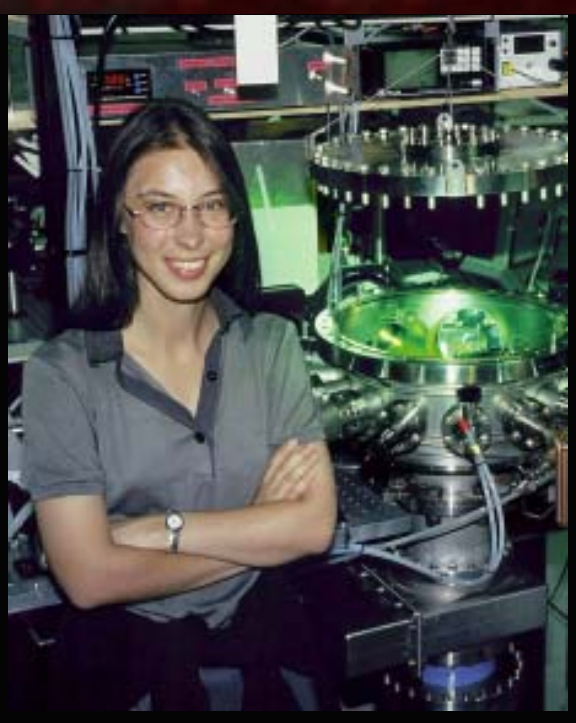
Applying the physics of underground nuclear explosions to 3D optical super-memories and laser dentistry.

ANU scientists, in collaboration with researchers in Japan, have been working on a 3-D optical memory based on creating very small three-dimensional "data bits" within a transparent solid. A single short laser pulse tightly focused inside the solid modifies the material in a region only a few hundred nanometers across. The pulse creates a local plasma and after cooling a void remains surrounded by a region of compressed glass. The physics involved in "writing" a data bit closely mirrors what occurs during an underground nuclear explosion but on a scale some 9-10 orders of magnitude smaller!

Making cavities in this way is straightforward but making them small enough and controllable enough to be useful in 3D memory has eluded scientists until now. The breakthrough came from an in depth understanding of the interaction of ultrashort laser pulses with materials. In particular recognizing that ionising the material in the focal spot to create plasma would restrict the volume in which the laser energy was deposited, and thereby the volume occupied by the data bit.







Anyone who has sat in a dentist's chair will be well aware of the problems with conventional drills. Lasers offer the potential of much cleaner and more precise tissue removal but until recently the heat dissipated in the process makes it totally impossible to use in dental applications. However, with the right control of conditions, the laser can be made to turn the decay directly into plasma, vastly reducing the heat transferred into the surrounding healthy tissue.