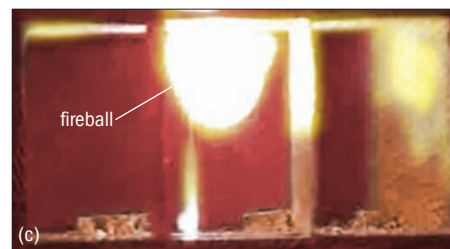
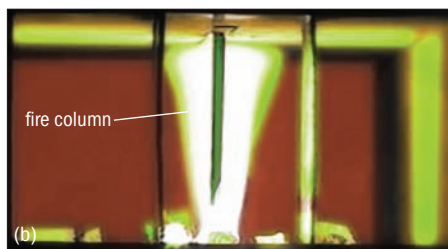
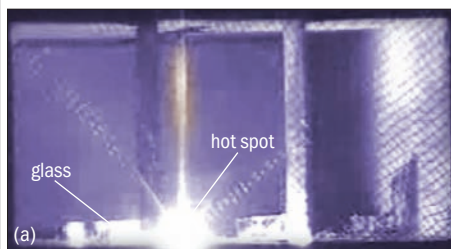


Compiled by Steve Reucroft and John Swain, Northeastern University

Microwaves create ball lightning



The fireball initiation process in a microwave cavity. (a) A molten hot spot is created by the microwave drill in the substrate material. (b) A fire column is ejected from the hot spot. (c) The fireball detaches from the hot spot and floats near the cavity ceiling.

Ball lightning remains a mysterious phenomenon, but now there is something similar that is reproducible in the lab. Vladimir Dikhtyar and Eli Jerby of Tel Aviv University have shown that microwaves can “drill” into silica and eject “fireballs” a few centimetres across. They need a supply of microwaves to keep them going and wink out about 40 ms after the power is switched off. However they

do look rather like ball lightning, and can melt through glass as some ball lightning has been reputed to do.

For a more radical recent theory, Vladimir K Ignatovich of JINR in Dubna has proposed that lightning can trigger laser action in the air. In this way, ball lightning is a ball in which laser light is trapped by internal reflection. This adds to the many explanations proposed

over the years; but with no clear leading contender, research in the field is likely to continue for some time.

Further reading

Vladimir Dikhtyar and Eli Jerby 2006 *Phys. Rev. Lett.* **96** 045002.

Vladimir K Ignatovich 2006 <http://xxx.lanl.gov/abs/physics/0601127>.

Modifying Einsteinian gravity casts light on the dark side

Tweaking Einstein’s general theory of relativity could have important implications for dark matter and dark energy. The existence of both is inferred from observations together with the assumption that we understand gravity at cosmic distance scales. Philip Mannheim of the University of Connecticut has long argued for a change in the behaviour of gravity at large distances, working from a Lagrangian that is the square of the Weyl tensor in place of the curvature scalar. Now he has some recent company in the belief that gravity may not be what we think it is at scales beyond the solar system.

Hong Sheng Zhao of the University of St Andrews in the UK and Benoit Famaey of the Free University of Brussels have suggested a modification of Einsteinian gravity at large distances building on Moti Milgrom’s “modified Newtonian dynamics”, which Jacob Bekenstein has linked to a scalar field not present in normal general relativity. The resulting theory has gravity behaving

differently at large distances – something that would look like dark matter if the data were interpreted with general relativity.

In the meantime, Olga Mena and José Santiago of Fermilab and Jochen Weller of University College London have argued for a modified Lagrangian for gravity with inverse powers of the curvature. This would explain the acceleration of the universe’s expansion without the need for dark energy, although dark matter would still be needed with this theory. It remains to be seen whether any of these ideas stand the test of time, but modifications to gravity seem likely to continue to give theorists food for thought.

Further reading

Philip D Mannheim 2006 *Prog. Part. Nucl. Phys.* **56** 340.

Olga Mena et al. 2006 *Phys. Rev. Lett.* **96** 041103.

H S Zhao and B Famaey 2006 *The Astrophysical Journal* **638** L9.

Lab grows spiky ice

Most forms of ice can be made in the lab, but one has been experimentally inaccessible until now. Penitentes are tall spikes of ice that can grow in high-altitude glaciers, and can reach heights of 4 m. The physics is based on sublimation, with the ice going directly into the gas phase. Initial depressions are subjected to increased sunlight reflected from nearby curved ice surfaces, which speeds up the sublimation leading to these exotic structures.

Vance Bergeron of the Ecole Normale Supérieure in Paris and colleagues have duplicated these structures with a horizontal freezer, liquid-nitrogen-cooled air, controlled humidity and a flood lamp in place of the Sun. Aside from showing how penitentes form, the work could help to unravel the effects of global warming. When temperatures rose above -4°C the growth rate slowed dramatically, and because penitentes cast shadows on glaciers, a reduction in their numbers and/or sizes could accelerate glacial melting.

Further reading

Vance Bergeron et al. 2006 <http://arXiv.org/pdf/physics/0601184>; to be published in *Phys. Rev. Lett.*