Braneworld bounce

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Do we live in a 'braneworld'? A brane is four-dimensional time-like hypersurface; in a braneworld model, the brane that is our Universe is embedded in a higher-dimensional spacetime bulk — a tantalizing representation of the extra dimensions that seem necessary in superstring theory, hence the popularity of the model for theoretical investigation. Hideki Maeda and colleagues have analysed the dynamics of a braneworld under 'Einstein–Gauss–Bonnet' gravity and discovered some interesting features, with links to current cosmological observations.

EGB gravity includes the usual Einstein term plus a Gauss–Bonnet term — a combination of the Ricci scalar, Ricci tensor and Riemann tensor that arises naturally in superstring theory. Maeda *et al.* find that such a treatment produces a universe that does not have an initial singularity (the Big Bang), but rather a bounce. Moreover, there emerges the possibility of late-time acceleration, such as is indicated in recent observations and currently attributed to the existence of 'dark energy'.

Golden mean

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Charged particles serve as nucleation sites for water condensation. This phenomenon has long been used for 'rainmaking' as well as in cloud chambers. The details of the nucleation process, however, are quite subtle, and depend on the quantum-chemical nature of the ionic species involved, as J. Ulises Reveles and colleagues underline with a theoretical study of water nucleation around a gold ion.

In their first-principles electronic-structure calculations, Reveles *et al.* confirm that only two water molecules bind directly to the gold ion. But they then go on to show that the next six H_2O molecules added to the cluster are arranged in two rings, one at each end of the central $[H_2O–Au–H_2O]^+$ unit. The ninth and tenth water molecules take up places in between the rings, and the cluster begins to adopt the shape of a droplet. This way of building up $[Au(H_2O)_n]^+$ clusters (which is distinctly different from H_2O nucleation around cations of alkali atoms, where multiple water molecules bind to the ion) could explain the binding energies that are observed experimentally.

Relaxation technique

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From condensed matter to cosmology, strange things happen when symmetry is broken. The Kibble–Zurek mechanism describes how a linear defect, or string, can form at a symmetry-breaking phase transition. But there could be other effects involved in string formation — particularly in brane models of inflation, in which the Kibble–Zurek mechanism may be suppressed — such as the 'flux trapping' investigated by Jose J. Blanco-Pillado and colleagues.

Flux trapping can occur when a gauge symmetry is broken: a stochastic magnetic field (due to thermal or quantum fluctuations) becomes squashed into quantized flux tubes after the phase transition. In their 3D simulations, Blanco-Pillado *et al.* use a lattice-theory-inspired approach, placing the magnetic field on a lattice and allowing it to relax into a stringy state, and then tracing the strings by following the flux lines from cell to cell on the lattice.

The crucial parameter determining the formation and evolution of the string network is the r.m.s. magnetic flux through an area defined by the square of the correlation length of the magnetic field. When this flux is large, a tangled web forms, as strings bundle together but then branch away and join other bundles; when it is small, only closed loops of string are formed, which disintegrate rapidly.

Efficient images

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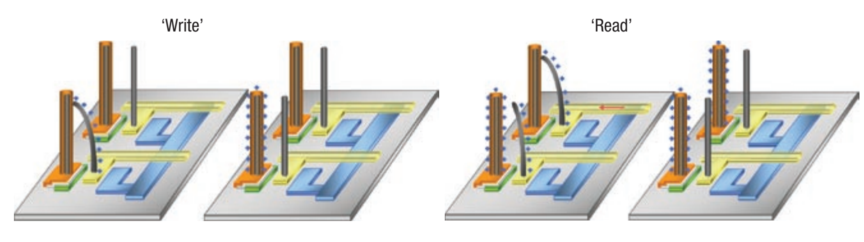
Most digital video projectors work by passing light through (or reflecting it from) a screen made up of an array of pixels whose optical transmittance (or reflectance) can be individually controlled. In practice, this means that at least half of the light generated is blocked by the screen and wasted.

A more efficient approach could be to modulate the phase rather than the amount of the light passing through each pixel of an array. This forms an image as a result of the interference of the light that emerges from different parts of the array — a process that could in principle be almost lossless.

Jesper Glückstad and colleagues now demonstrate a solution to one of the key challenges in developing phase-contrast image projection: calculating the necessary phase pattern needed to produce a given image. Using a previously proposed simple algorithm (*New J. Phys.* **9,** 132; 2007), they have realized a laser-based grey-scale image-projection system that uses 74% of the incident light.

A bender to remember



Nature Nanotech. **3,** 26–30 (2008)

Dynamic random access memory (DRAM) — the bulk of the memory in a modern personal computer — works by storing information in the form of electrical charge on an array of tiny capacitors, each of which is addressed by a single transistor. Such simplicity has enabled the capacity of DRAM chips to be increased substantially with improvements in chip fabrication, while their cost has fallen dramatically. But, as the size of an individual bit shrinks to meet the demand for ever greater capacity, it becomes difficult to build structures that store charge for long enough before it leaks away.

Jae Eun Jang and colleagues demonstrate a memory cell based on an electromechanical switch formed by two carbon nanotubes grown vertically next to each other on a silicon substrate (pictured). The switch works by applying voltage between the two nanotubes and a third electrode, causing one of the nanotubes to bend towards and touch the other, transferring charge in the process. The mechanical isolation of charge in the device could overcome the leakage associated with the transistors of conventional DRAMs.