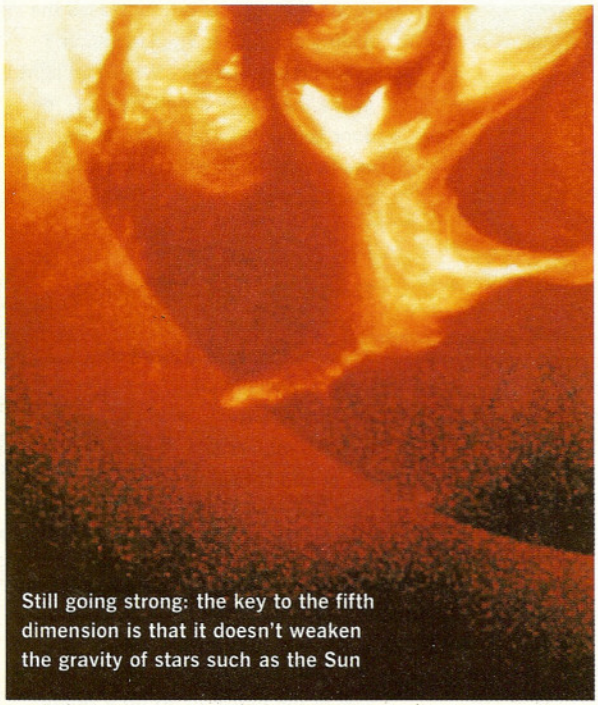
The great beyond

Our Universe could be an island marooned in five-dimensional space

SPACE may have a fifth dimension—one more than the four we are familiar with, say two physicists. And it could be infinite, unlike the tiny extra space dimensions that have been proposed in the past.

"Incredibly, it could have gone completely unnoticed until now," says Raman Sundrum of Stanford University in California. Physicists take extra dimensions seriously because superstring theory, the best candidate for a "theory of everything", requires at least nine space dimensions.

"There are two ways the extra dimensions could conceal themselves from view," says Sundrum. "One is if they are rolled up far smaller than an atom. The other is if the Universe is confined to a kind of lower-dimensional island within higher-dimensional space." An infinitely thin two-dimensional piece of paper would form such an island within normal 3D space.



Still going strong: the key to the fifth dimension is that it doesn't weaken the gravity of stars such as the Sun

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This latter possibility has now been explored by Sundrum and his colleague Lisa Randall of Princeton University, New Jersey. Remarkably, superstring theory requires lower-dimensional islands, or "branes". And in superstring theory, nature's three non-gravitational forces—the electromagnetic, weak and strong forces—can be naturally constrained to operate only within a brane.

Gravity is a problem, however. "Gravity is intimately connected with the dynamics of space-time and so necessarily extends into all extra dimensions," says Sundrum.

Gravity from bodies such as the Sun should theoretically spread into this large extra space dimension, effectively diluting it within our Universe's brane. "It would weaken with distance far faster than the inverse-square law decline that we observe," says Sundrum.

But Sundrum and Randall have discovered this may not be so. "The key is the gravity of the brane itself, which is enormous," says Sundrum.

Gravity pulls on all sources of energy, including the energy contained in a gravitational field. "Consequently, the gravity of the brane pulls on the gravity of objects like the Sun, preventing it from extending very far beyond the brane," says Sundrum.

Crucially, with gravity confined to the brane, the force is undiluted and displays the familiar inverse-square law. And the mechanism for confining gravity works no matter how big the extra space dimension.

"What's so amazing is that the theory mimics familiar four-dimensional gravity so well that it would be very difficult to tell that there is an extra dimension," says Randall. **Marcus Chown**

Source: *Physical Review Letters* (vol 83, p 4690)

Hope revives for divide and die cancer drugs

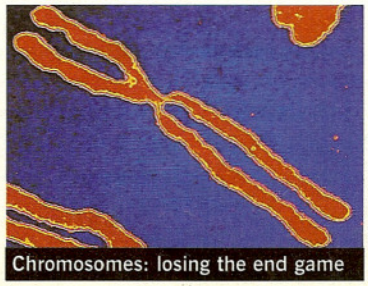
DRUGS that stop cells maintaining their chromosomes may after all help treat cancer in humans—provided they are not used alone. Biologists have found that such drugs are much more effective against human cancer cells than earlier experiments with mice suggested.

Cancer cells need the enzyme telomerase to stop the ends of chromosomes, called telomeres, from shortening with each cell division. This led drugs researchers to look at telomerase inhibitors as a potential cancer treatment. However, mice that lack the enzyme survive for generations and even develop tumours, suggesting that chromosome ends degrade too slowly for telomerase inhibitors to be effective.

"I don't think that's a good argument for them not working in humans," says Jerry Shay at the University of Texas Southwestern Medical Center in Dallas. He points out that human telomeres are shorter than those in mice and so should disappear sooner in a dividing cell deprived of telomerase.

Shay and his colleagues treated cancerous breast and prostate tumour cells with short antisense RNA molecules designed to block telomerase. With each cell division, the telomeres in both types of cell shrank, and after 120 days all the breast cells had died. Some prostate cells survived due to their slightly longer telomeres, Shay says.

Because it takes so long for the cells to die, Shay sees telomerase inhibitors being used to complement other therapies, rather than as a sole weapon against primary tumours. "With chemotherapy and surgery, most people survive their initial cancers," he says. "It's cancer relapse that kills." Shay believes that blocking telomerase might kill any rogue cells before they establish a new tumour.



Chromosomes: losing the end game

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The researchers also found that telomeres grow back in cells that survive the treatment. This means normal cells that need telomerase, like the stem cells that maintain the gut, might recover from an attack by telomerase inhibitors, says geneticist Ronald DePinho of the Dana Farber Cancer Institute in Boston. **Jonathan Knight**

Source: *Proceedings of the National Academy of Sciences* (vol 96, p 14 276)