Cosmic wormholes: key to the universe

ADRIAN BERRY examines a blueprint for instantaneous travel anywhere in space

FORGET the Channel Tunnel: cosmologists have a much more far-reaching idea — an instant trans-universe transport system. It would get you from here to Vega in no time at all.

This feat, long held to be impossible, would enable our descendants to build a galactic empire, assuming there is no-one out there to object. It has now received strong backing from leading space scientists, who have produced — on paper at least — an engineering model to show how it could be done.

At the speed of light, so Einstein's 1905 special theory of relativity goes, the length of a spaceship would shrink to zero, time on board would be eternally frozen, and any further acceleration would require infinite energy. Thus it is impossible to go any faster.

But there is a theoretical let-out: Einstein's much more subtle and complex general theory of relativity of 1916 states that matter creates the space and time which surround it.

This indicates that space has an elastic, or warped character. A large mass, such as a star, causes space to curve in the region immediately surrounding it. This has long raised speculation that a spaceship could disappear in one part of space and reappear immediately in another, without passing any point in between.

At the sub-microscopic level, according to Einstein's 1916 equations, space has a "foam-like" structure. Down at the scale of the Planck constant, the smallest distance that can exist, a billionth of a trillionth of a trillionth of a centimetre, space is permeated with tunnels or "wormholes" like a Swiss cheese. Through one of these, if one could make oneself small

What happens if you're half-way to Vega and the fuse goes?

enough, one could travel across light-years through the hidden dimension of "hyperspace".

This idea led Einstein and his colleague Nathan Rosen to propose in 1935 the idea of an "Einstein-Rosen bridge": that the normal space in which we live could be represented as a curved piece of paper folded over upon itself.

One dot on the paper could represent the Earth and another, say, the star Vega, 26 light-years away. To travel between Earth and Vega along the surface of the paper could take centuries. But to go through the paper, from dot to dot, through a wormhole bridge, would take no time at all.

The most obvious mechanism for a journey through hyperspace seemed to be via black holes. These collapsed relics of stars, with such huge gravitational fields that not even light can escape from them, are true space warps. But it became clear that there was no way a spaceship could escape being crushed into nothingness by the point of infinite density that lies just inside the hole. Scientists turned back to wormholes.

Prof Kip Thorne, of the California Institute of Technology, who had long dismissed the feasibility of hyperspace journeys, changed his mind two years ago while helping the astronomer Carl Sagan with technical details for his science-fiction novel, Contact. He followed this with an exercise in rigorous theoretical form. With Dr Michael Morris, of the University of Wisconsin, he has published a paper in Physics Review Letters, a leading journal of theoretical physics, showing how it could be done.

The Thorne-Morris solution is not to shrink the spaceship, but to force open the "mouth" of the wormhole and the passage beyond. Wormholes have a positive electric charge, and positive charges repel one another. A sufficiently strong electric field, forced down the wormhole, could open it until wide enough to admit a spaceship.

This could be achieved by building two gigantic metal spheres, both of them perfect conductors of electricity, and placing them several light-years apart in space. The electric field generated by each of them would keep the tunnel open.

There are two snags. First, each sphere would have to be some 50 million miles wide, half the distance between the Earth and the Sun. Morris believes in treading cautiously. "Before sending people in a spaceship through an enlarged wormhole, one would experiment by sending a radio message," he says. "The wormhole could be much narrower and the metal spheres much smaller. The successful transmission of a message could be the prelude to widening the hole further to send people."

The second snag is that one of the spheres would have to be installed at the other end of the planned journey to generate the exit point. And it would have to get there the long way round...