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FOCUS

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TIME TRAVEL

The first time machine might already be with us...

Time travel: never be late for an appointment again

Ronald Mallett was 10 years old when his father died of a massive heart attack, aged just 33. He was devastated. A year later he read *The Time Machine* by HG Wells, and resolved, there and then, to build a time travel device so he could go back and prevent his father's premature death.

That was over 50 years ago. Mallett is now Professor of Physics at the University of Connecticut, but his childhood ambition to travel into the past burns as bright as ever.

"Early on, I didn't tell people what I was doing because I didn't want it to affect my career – so I studied black holes as a cover story," he says. "But, on the side, I was always trying to understand more about time and how you might go about building a time machine."

Over the years, Mallett has perfected what he now believes is a valid design for his device. It works using circulating beams of light to drag space and time around into closed loops, like coffee stirred around in a mug. The idea is that as time spins in a closed loop, some of it has to whirl into the past.

Mallett is now working with an experimental physicist –Professor Chandra Roychoudhuri, also at the University of Connecticut – to test the design. They plan to use an elaborate set-up of lasers to create circulating loops of light, which they hope will be powerful enough to send subatomic particles briefly back through time. They propose to measure the effect by using particles that decay naturally over a well-defined timespan. For example, pion particles have a lifetime of just 26 billionths of a second. If these particles are made to travel back through time then their observed decay lifetime should get shorter. The researchers are now seeking funds for the work, which Mallet estimates will take around 10 years to complete.

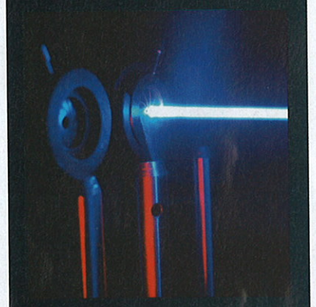
Subatomic particles are one thing, but what about sending people back? "That would require international cooperation," he says. "But I think if we were given unlimited funds we could see this machine in action within this century."

Mallett's story is currently being adapted for the screen by Spike Lee.

Prediction 2100

TELEPORTATION

Just flip a switch and go anywhere – in an instant



Will we ever be able to leave our cars at home once and for all, and teleport from A to B like Captain Kirk?

Various theoretical schemes have been suggested, and some even tested out experimentally, with scientists successfully beaming individual subatomic particles from one side of a lab to the other. But there's a gaping chasm between sending subatomic particles and sending people.

In 2007, a team from the University of Queensland, Australia, proposed a new method of teleportation that could transmit thousands of particles of matter in one go –a big step in the right direction.

"We showed a scheme that was able to turn the whole quantum state from one system of matter into light, and then back again," says team member Dr Joseph Hope.

"We feel our scheme is closer in spirit to the original fictional concept," adds his colleague Dr Simon Haine.

Researchers at the Australian National University, in Canberra, plan to test the idea over the coming years. Though full-on teleportation of people is still a lifetime away.

Prediction 2150

"Beam us down under, Scotty"

SCIENCE PHOTO LIBRARY, ROY KALTSCHMIDT/BERKELEY LB PUBLIC AFFAIRS, REX

INTELLIGENT ROBOTS

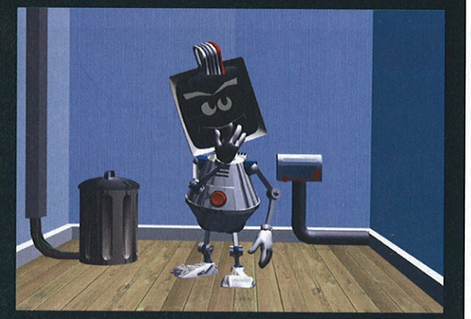
Fluent in over six million forms of communication... well, not quite

How soon will it be before machines can think on our level?

In 1950, British computing pioneer Alan Turing set out a way of gauging a machine's intelligence by literally having a chat with it. The idea is that you hold a conversation with both the machine and a real person. You aren't told which is which, and if you can't figure it out from the conversation then the machine is considered to have demonstrated human intelligence. This has since become known as the 'Turing test'.

In 1990, the annual Loebner Prize began, where computer scientists come together to apply the Turing test to their conversational software creations. Each year, the best of these 'chatterbots' receives a small cash prize, with $100,000 set aside for the first machine that is able to fool at least four of the contest's 12 judges.

To date, nobody has scooped the big money yet. However, the 2008 winner, Elbot (www.elbot.com), developed by Hamburg-based programmer Fred Roberts, convinced three of the judges – just one shy of the main prize.



"I believe that the Turing test will be passed regularly by 2015," says British programmer Rollo Carpenter, whose chatterbots won the Loebner Prize in 2005 and 2006. "We will genuinely be talking to machines, and think they understand."

Will these machines really be intelligent? Probably not. "They will be imitating thought," says Carpenter. "But can we really say where imitation ends and intelligence begins?"

Prediction 2015

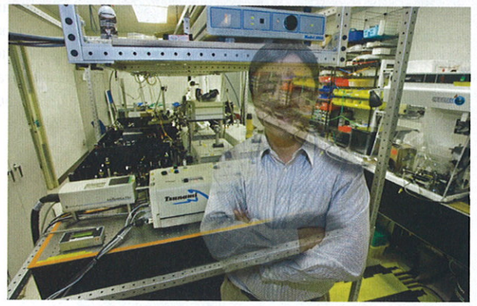
INVISIBILITY

Now you see it, but soon you won't

It's the ultimate in camouflage technology – an invisibility cloak that makes anything placed under it literally vanish from view. And it was recently demonstrated by researchers at the University of California, Berkeley.

The cloak, developed by UC Berkeley's Professor Xiang Zhang and colleagues, consists of a piece of silicon that's been engineered on tiny scales to give it some unusual optical properties. By perforating the silicon with a carefully designed pattern of holes – each just 110 nanometres in diameter, about one 10,000th of a millimetre – the team were able to reflect light in just the right way to conceal the bulge created by objects beneath it. The cloak can still be seen, but shining a beam of light on it produces a reflection identical to the reflection you would see from a flat surface.

For the time being Prof Zhang's cloak only works in two dimensions, meaning that it can conceal objects placed on flat surfaces, but not something floating mid-air. "In this experiment, we have demonstrated a proof for the concept of optical cloaking that works well in two dimensions," says Zhang. "Our next goal is to realise a cloak that works in all three dimensions."



Professor Xiang Zhang hopes to make 3D objects disappear

This will require developing a new cloak that can deflect light around a three dimensional object – rather like water flowing around a rock in a stream. Zhang's colleague Dr Jensen Li, also at UC Berkeley, thinks this could happen very soon. "We expect invisibility to be demonstrated by coating a small object with a bulk, three-dimensional metamaterial, hopefully within a few years," he says.

Prediction 2012

TELEPATHY

One day soon, we'll all have voices in our heads

Imagine being able to communicate with anyone, simply by the power of thought. This is the promise of telepathy. But while many entertainers and self-proclaimed psychics claim telepathic abilities, there's little evidence to support them. Now though, some technologists believe humans could become telepathic using artificial brain implants.

Dr Robert Freitas, Senior Research Fellow at the Institute of Molecular Manufacturing in California, imagines a swarm of microscopic nanorobots that could sit inside the human brain, monitoring neural activity. "10 billion two-micron-wide nanorobots – one to monitor each neuron – would add just 200mg to the brain's overall weight, and add two Watts to its heat output," says Dr Freitas. That's small beer compared to the 1.4kg weight of an unmodified brain and the body's 90W nominal rate of heat loss.

The nanobots then transmit their data as ultrasound to a hub, also within the skull, where any signals intended for transmission are converted to radio and beamed out. The reverse process allows signals to be received. Users would have to train themselves to use the technology, much like paraplegic patients who successfully use brain interface technology to control a computer.

Telepathy would then play out like a Skype call that exists only in your head. You'd select somebody to 'call' from a mental address book, and the technology would interpret your desire to speak with them. "As the nanorobots manipulate cochlear nerves directly, the recipient would experience a 'voice inside their head' that nobody else could hear," says Dr Freitas. "Or a video signal could be retinally displayed in their field of view, like a heads-up display."

He estimates that with suitable funding, so-called synthetic telepathy could be a reality within 40 years.

Prediction 2050