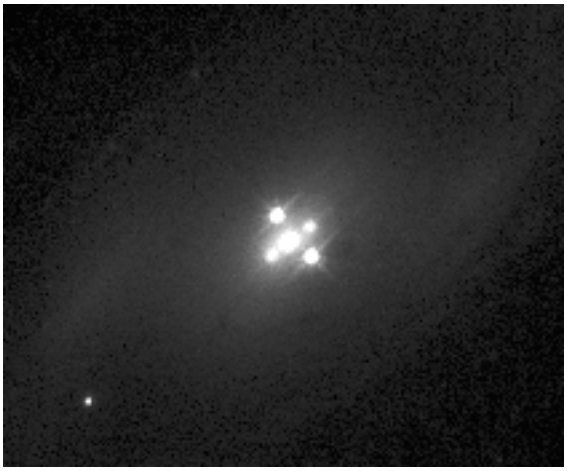
THE UNIVERSITY OF QUEENSLAND DEPARTMENT OF PHYSICS

Quasar

Issue 1



The Einstein Cross: four images of a quasar surrounding the nucleus of a spiral galaxy that is much nearer to us. This is observational evidence of gravitational lensing, predicted by Einstein's theory of relativity. Massive bodies curve space-time, & so bend lightrays that pass nearby. The multiple images are caused by light from the quasar passing around the massive galactic centre. Image courtesy of Bill Keel, University of Alabama.

UQ Astrophysics

You could call Roy Duncan Astroboy. Not only does his favourite T-shirt feature the Japanese cartoon hero, but after doing his Bachelor of Science at UQ, Roy decided to stay on to do astronomy research. He became involved in sensitive radio-imaging of the southern Milky Way, using the Parkes radio telescope. This survey revealed many new and interesting Galactic features. After his PhD, Roy worked in Germany for a year doing high-resolution, multi-frequency observations to investigate newly discovered supernova remnants and the diffuse Galactic polarisation. Another astronomy research student is American Aimee Norton. Due to satellite technology, she was able to use our facilities to download her data & continue working on her research topic (observing the solar spectrum to analyse the composition of gases in the outer layers of the sun) while temporarily living in Australia.

The next lecturer to be appointed in the Department will be an astrophysicist. The future is bright for astronomy.

Welcome ...

The Department of Physics at The University of Queensland hosts the Quasar Club to encourage and support talented, enthusiastic students to achieve their full potential in physics. Our aim is to nurture your ability and help you to explore your interest in physics. We'll introduce you to a variety of cutting-edge physics topics. Participating Departmental members range from students doing their degrees to established professional physicists.

It's hoped that readers of Quasar will go on to higher studies in physics, and may be potential world leaders in the physical science professions.

So, what's the significance of the name?

Quasars (aka Quasi Stellar Objects) at first appear to be stars. However, the redshift of the electromagnetic spectrum they emit tells us that there is something unusual about them - they're travelling really fast. They are also near the edge of the observed universe. On standard assumptions, this means they are among the most mature things we have observed. And if we can see them from such a distance, they must be very bright & energetic. Quasars are a dynamic area of research today.

Australia's part in the discovery of quasars

A starlike object was first proved to coincide with an intense source of radio waves by observations at Parkes in NSW. Because of its fundamental importance, astronomers were keen to get this data. But the object was very close to the horizon. They cut down trees, then had to override the safety mechanism on the telescope dish to tilt it over enough for a clear view.

At UQ

The Quasar program hopes to present to you the breadth, depth and excitement of physics at The University of Queensland.

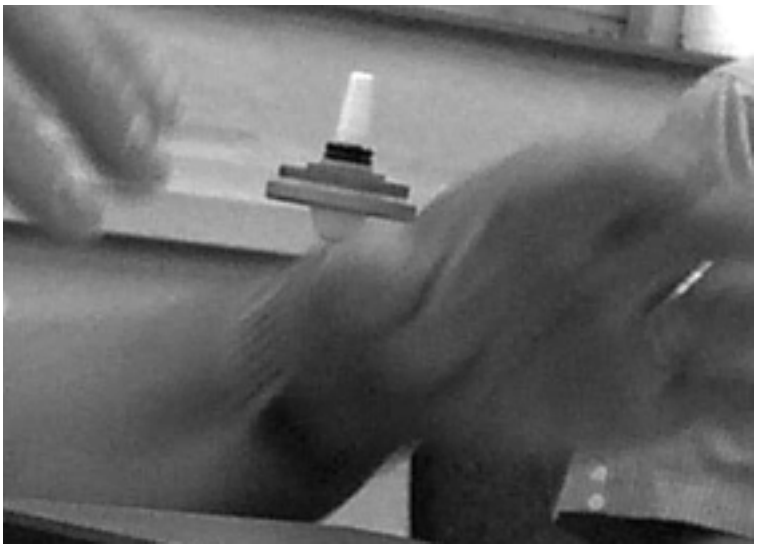
Check out the website: www.physics.uq.edu.au/quasar

NOBEL PRIZE WINNER

Winner of the Nobel Prize in Physics for 1997, Dr Bill Phillips, visited us recently.

Keen senior school students from around Brisbane were invited to meet Bill (pictures above).
This was a chance for discussion in a small informal group. Students questioned Bill about his work, and he talked with them about his life in science leading up to the Nobel Prize.

He shares this award with Steven Chu and Claude Cohen-Tannoudji for developing methods to cool and trap atoms with laser light. By shining laser beams on a substance, it can be chilled to ultra-cold temperatures of a few millionths of a degree above absolute zero. Under these conditions, the atoms are confined to a tiny region of space, where they rest almost without motion.



Bill Phillips trapping with a magnetic field.
Repulsive forces between magnets provide the levitation. It's easy to arrange 2 magnets so they repel each other.
But stability is a problem. We need a force to hold them if they start to stray from the equilibrium position.
In the Super Levitron™ a spinning magnet utilises the laws of gyroscopic motion for stability. Like a top, if the magnet starts to fall, conservation of angular momentum causes a force that pushes it back to its original orientation.

One of the essential techniques used in the research of Bill Phillips is magnetic trapping. To help his explanations, he demonstrated magnetic trapping with a Super Levitron™ toy: a magnet in the form of a spinning top levitates above a magnetic base.

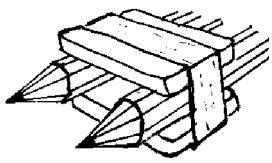
Bill did some more demonstrations, with liquid nitrogen, later in a lecture for the general public. “Almost Absolute Zero: The Story of Laser Cooling and Trapping” showed how matter changes dramatically even at liquid nitrogen temperatures. At 77 K, or about -200°C, this is the coldest most people are likely to experience. He compared this with conditions produced in the Nobel Prize-winning research work.

Bill Phillips works for the USA's National Institute of Standards and Technology. They're interested in trapped atoms for creating more accurate atomic clocks. Some other possible applications are making “atom lasers”, and fabricating extremely small structures.

Particles that are cooled and trapped with laser light can be manipulated to observe their properties. These sorts of experiments in Atomic Physics have allowed scientists to observe phenomena that seem to defy the physics principles governing our everyday large-scale world, and have enabled the creation of a strange new form of matter, the Bose-Einstein condensate.

How else can you stabilise magnetic levitation?

You can create stable magnetic levitation with just ordinary flat magnets, pencils & sticky tape.
Sandwich 2 pencils between identical magnets, arranged to repel each other. Secure with sticky tape. This will introduce sufficient stabilising force.



Remove the pencils:
one magnet should be floating above the other
(Buy magnets from hardware or craft shops for under 50c

Created by Margaret Wegener (Quasar Club Co-ordinator), with input from John Ross, Roy Duncan, Amanda Smith, ...