



Astronomy

What Causes Jets?

Barrie Jones

Some jets extend for vast distances well beyond the confines of even the largest galaxies. Now in this image you can see a curving trail of radio emission and corresponding to that there's a curving trail of electrons extending for perhaps ten million light years - that's a huge distance. Now this curving trail of electrons could be confined magnetically, or by hot gas, or even by both. But as well as the curving trail, we also have to explain the emission itself, the radio waves, the light, and so on; after all, without the emission we wouldn't be seeing the jet at all. Again, we can't be certain of what's causing the emission, but we do have some ideas.

Martin Rees

There are two ways this might happen. One possibility is that there are a lot of weak shockwaves along the path of the jet which managed to convert some of the bulk kinetic energy into random motions of electrons, which then emit the radio waves and the light. The second possibility is that there may be viscous friction where the jet is moving very fast, rubs against the external medium on the sides of it which is, of course, not moving so fast.

Barrie Jones

Astronomers are certainly not short of ideas about how jets from galaxies might be sustained, nor indeed how they radiate, but there are still very few certainties. And this is not only the case regarding jets from galaxies, but also for the far more humble jets from stars at their births and at their deaths. How the jets are produced and how they are confined is still something of a mystery. What we think we do understand is the ultimate power source. In the case of stars this seems to be the compact object at the centre of the accretions disc – that's a proto-star at star birth and a neutron star or a black hole at star death. When it comes to the much larger galactic jets, the ultimate power source is not very different.

Martin Rees

Massive black holes fill this bill. They can convert energy with ten times the efficiency of nuclear power. We believe, in fact, that almost every galaxy may have gone through a phase where a massive black hole formed in the centre and gave rise to a colossal outburst of energy. By studying these jets and the radio sources we therefore have a direct way of probing what goes on deep in the centres of galaxies and the study of these massive black holes is undoubtedly one of the most important and challenging issues in astrophysics today.

Barrie Jones

This field of astronomy is moving very fast. Our ideas about black holes and about jets from stars and from galaxies are constantly being refined as new discoveries are being made with new and more powerful telescopes matched by new and more powerful ideas. What we now know would amaze those radio astronomers of fifty years ago and yet they, too, were working with the best equipment that they then had available. You know it's a remarkable thing but as we solve one set of mysteries, we often uncover others and these will keep generations of astronomers busy for decades to come.