Magnetic Braking II – Magnets in Pipes

Apparatus

copper pipe, copper pipe with slit along length, plastic pipe (all pipes should have similar diameters), small magnets which fit into pipes easily , retort stands and clamps to support the pipes
Rare earth magnets are good because they have a very strong magnetic field. It helps to put a cushion of some sort, e.g. a jumper, under the pipes so the magnets don't get lost or damaged.

Action

The students drop the magnets through the different pipes and compare the time taken to fall through.

The Physics

The movement of the magnet creates currents in the copper pipe, which produce magnetic fields, which act to oppose the motion which causes them, slowing the fall of the magnet. The plastic pipe is an insulator, so no current flows and hence the magnet is not braked. In the pipe with the slit there are still currents produced in vertical loops, but not in horizontal loops around the pipe as the slit prevents this. So the fall is slowed, but not as much as in the complete pipe.

Students the University of Sydney experimenting with magnets and a selection of copper and plastic pipes

Accompanying sheet

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Predict what will happen as the magnet falls through the pipes.
What will happen in the pipe with the slit?

Drop the magnets through the pipes.
In which pipe is the magnet most slowed?
Were your predictions correct?