New Physics at the End of the 20th Century

- **1. The "impossible" Magnetic Superconductor**
- In 1957 V L Ginsburg "proved" that ferromagnetism and superconductivity are incompatible
- In 1999 it was demonstrated experimentally that superconductivity and ferromagnetism coexist in $RuSr_2GdCu_2O_8$.
- *"This was not just unexpected; it was highly unlikely... Nature's treasures can be slowly and systematically mined, but from time to time one simply stumbles on a rare nugget of great value"* Jeff Tallon

New Physics at the End of the 20th Century

- **2. Slowing down the speed of Light**
- There is nothing surprising that light travels in a medium slower than in a vacuum.
- What was surprising was the slowing down of the group velocity to just 17m/s.
- Required the use of a Bose-Einstein condensate.
- Would it be possible to use media with a very low group velocity to create a vortex flow that imprints a long-ranging topological effect on incident light?
- Could one create an optical black hole?

New Physics at the End of the 20th Century

- **3. Quantum Interference observed for Fullerenes (Bucky Balls)**
- Matter-wave interferometry surpassed all previous studies with the demonstration of the wave-particle duality of fullerene molecules C_{60}.
- Possibility of studying quantum interference of even larger macro-molecules.
- Maybe even small viruses.