## European Physics Society (EPS) High Energy and Particle Physics Prize

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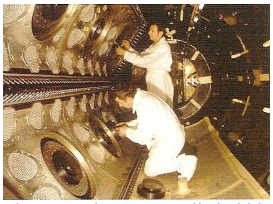

Figure 1. The Gargamelle bubble chamber as seen from the inside

Members of the HEP group circa 1973 have shared the 2009 European Physical Society (EPS) prize for High Energy Physics, together with other members of the Gargamelle collaboration. This prestigious, biennial prize was awarded '[f]or the observation of the weak neutral current interaction'. This was the first evidence of the Z boson, one of the carriers of the weak nuclear force, from a study of the interactions of a neutrino beam in a heavy liquid bubble chamber.

The experiment itself took place 37 years ago and was led by the French physicist Andre Lagarrigue who designed the huge bubble chamber (figure 1).

The discovery was nominated for a Nobel Prize but regrettably he suffered a heart attack and died as he was lecturing to undergraduates at the Ecole Polytechnique.

The UCL HEP group were very much to the fore in this collaboration and members of the group included Fred Bullock, Mike Esten, Tegid Jones, John Mackenzie, Alan Michette (now at King's College), James Pinfold (now at the University of Alberta), and Adrian Segar.

In the experiment the 20 Gev proton beam of the proton synchrotron ((PS) now the injector to the LHC!) was extracted from the synchrotron and passed through a long, thin beryllium target. In the target, pions and a smaller number of kaons, were produced. These were then partially focussed by the large magnetic horn designed by Van der Meer. The particles then decay to muons (heavier versions of the electron) and neutrinos, the muons stopping in an iron shield and the neutrinos head through the bubble chamber.

At the outset of this experiment, it was anticipated there would be interactions where the unseen neutrinos exchanged a charged W boson with either a proton or neutron (nucleons) or more rarely, the electron in the heavy liquid, the neutrino changing into a muon. Thus in every event, however complex, an outgoing muon should be observed. These events were certainly seen, but in addition, events not containing a muon were observed. This is evident in figures 2 and 3 where the unseen neutrino enters the chamber from the left.

This was the discovery of the weak neutral current mediated by the Z boson. It was the first evidence of the partial unification of the weak and electro magnetic interactions and led to the award of the Nobel Prize to Glashow, Salam and Weinberg.

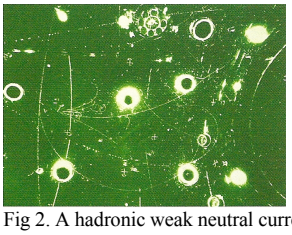

Fig 2. A hadronic weak neutral current event, whereby a neutrino has interacted with a nucleon in the heavy liquid by exchanging the Z boson to yield an event containing a nucleon and pions.

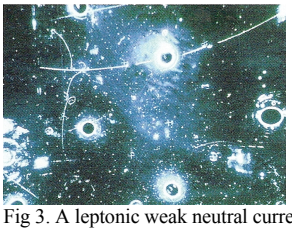

Fig 3. A leptonic weak neutral current event in which the neutrino has scattered off an electron in the heavy liquid by exchanging the Z boson.