FEYNMAN DIAGRAMS

These diagrams were introduced by Richard Feynman as a short-hand way to represent calculations of the amplitudes for processes in quantum field theory. We shall be drawing these diagrams for processes in nuclear and particle physics, but without using their mathematical interpretations.

Each particle, initial, final or intermediate (virtual), is represented by a line. The notation I use in these lectures for labelling differed types of particle is:

spin-0 bosons (pions, Higgs)	dashed
photons	wavy
weak vector bosons	zigzag
gluons	springy
fermions	solid with arrows

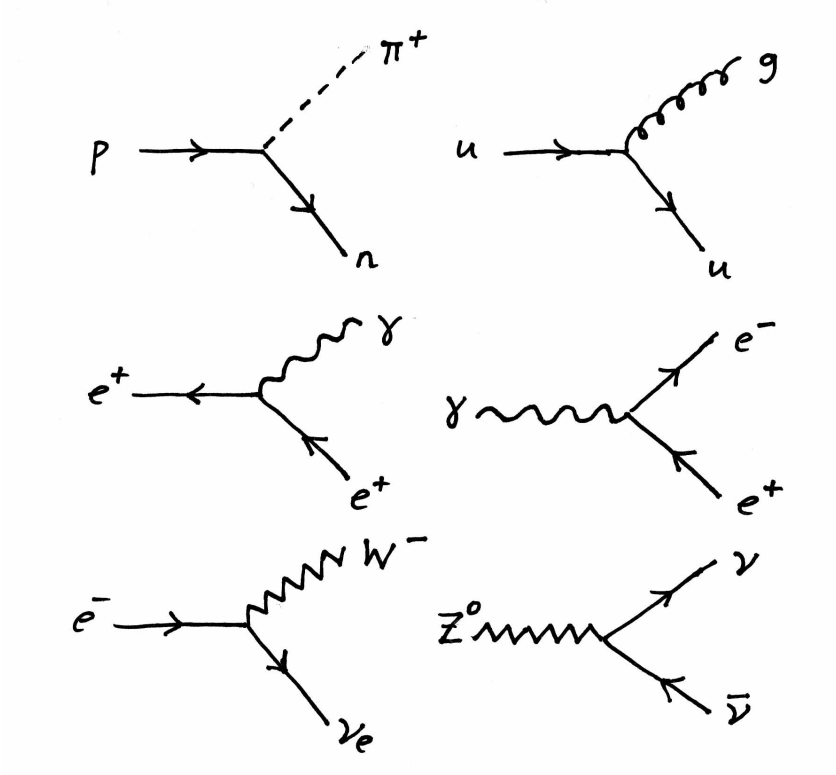
The arrows for fermions point in the direction of particle flow: forwards for electrons, neutrinos, nucleons and quarks, and backwards for their antiparticles. These lines are joined at vertices representing the interactions.

At each of these vertices, charge, baryon number and lepton number are conserved. You should check that the total charge etc. of all the particles before an interaction vertex equals the total charge after. Interactions with neutral bosons (photons, gluons, Z^0s) should also conserve quark and lepton "flavours".

Examples of possible vertices are shown on the next page: two strong, two electromagnetic and two weak. Only one of these could occur as a physical process on its own, as opposed to part of some more complicated diagram. (Which one?)

Following the convention used in the books by Martin and by Martin and Shaw, I draw these diagrams with time flowing to the right. Other authors draw them with time flowing up the page; if there is a danger of confusion, use an arrow to make it clear which convention you are using.

The time order of the interactions is not important – in many cases that can depend on the choice of inertial frame. What does matter is the order of the interactions as you follow a continuous line through the diagram (the "topology" in particle physicists' jargon).



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