# COMPTON SCATTERING TO FOURTH ORDER

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As an example of fourth order Feynman diagrams, we'll extend our study of Compton scattering, in which a photon scatters off an electron, to the next level. We'll look at the diagrams in several stages.

Fig. 1 shows the second order diagram at the top, with seven fourth order extensions. Diagram (a) shows the incoming photon splitting into a virtual electron-positron pair, which recombines into a virtual photon, which then scatters off the incoming electron. Diagram (b) shows the same thing, except that it is the outgoing photon that splits into an electron-positron pair, which recombines into the final outgoing photon.

Diagrams (c), (d) and (e) show one of the three electrons emitting and then reabsorbing a virtual photon. Diagram (f) shows the incoming electron emitting a virtual photon which is absorbed by the virtual electron in the middle. Diagram (g) shows the virtual electron emitting a virtual photon which is absorbed by the outgoing electron.

Fig. 2 shows the analogous diagrams for the other second order diagram. The diagrams represent the same processes as in Fig. 1, except that the order of the incoming and outgoing photons is swapped.

Finally we look at some more exotic fourth order diagrams, in Fig. 3.

Diagrams (a) and (b) show a virtual photon (in red) emitted by the incoming electron which is absorbed by the outgoing electron. Diagram (c) shows the incoming photon splitting into an electron-positron pair. The electron (top edge of the triangle) emits a photon (which becomes the outgoing photon) and then (at the bottom vertex of the triangle) recombines with the positron to create a virtual photon which is absorbed by the incoming electron along the bottom line. Diagram (d) is similar, and is essentially diagram (c) reflected about a vertical axis.

Keep in mind that these diagrams represent terms in the expansion of the S matrix in perturbation theory. All internal edges are virtual particles which are not observable in experiments. The actual mathematical expressions of these diagrams can be constructed using the Feynman rules, which we've examined earlier for the cases without loops and with loops.

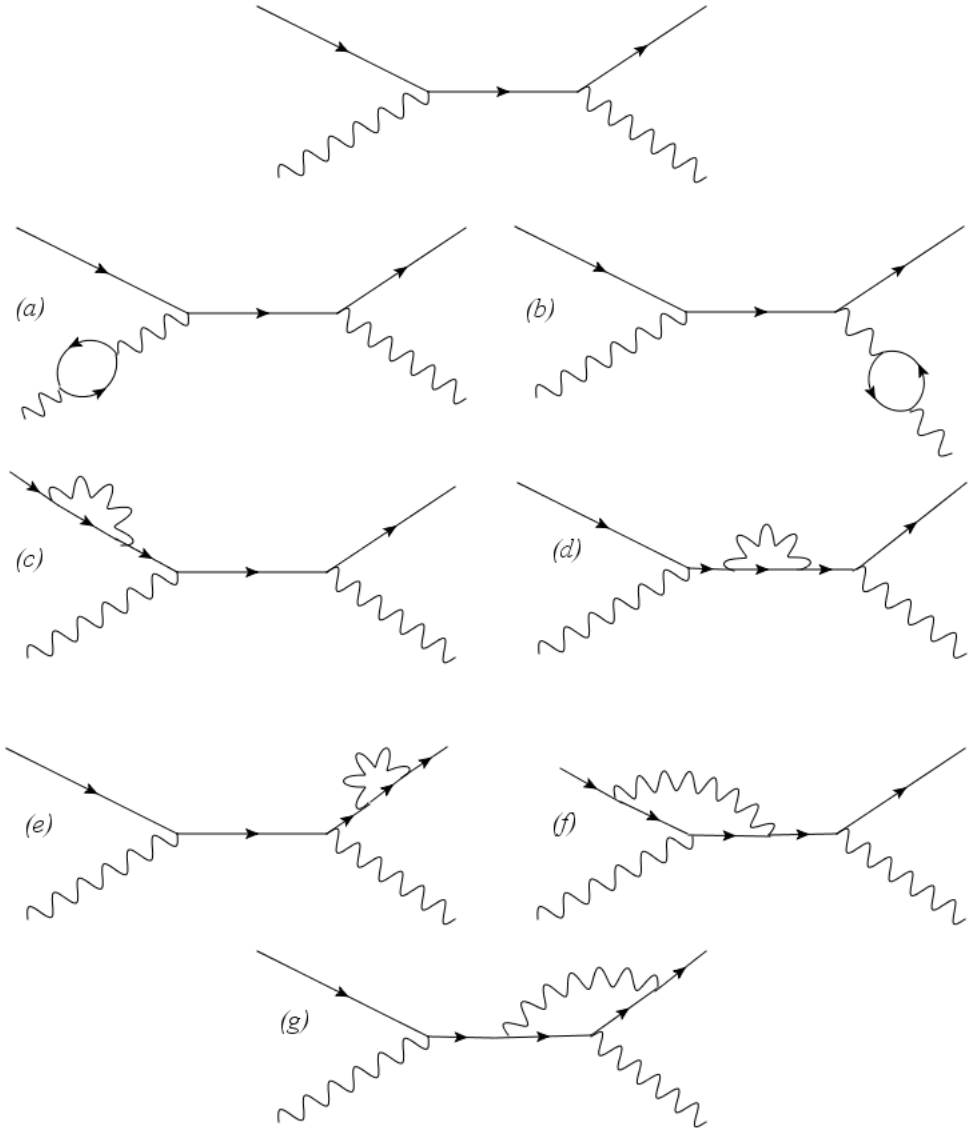


FIGURE 1. Loop diagrams, part 1.

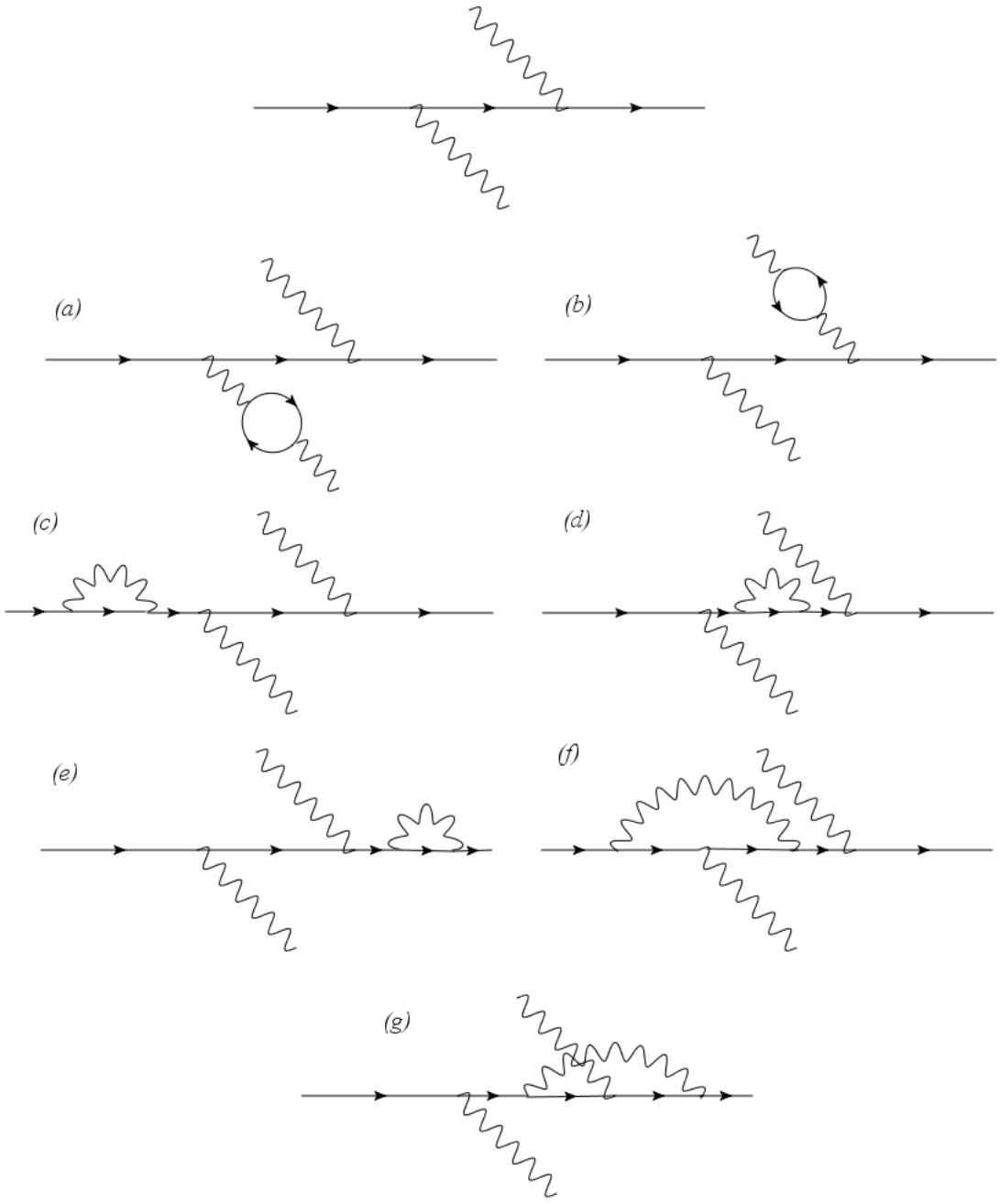


FIGURE 2. Loop diagrams, part 2.

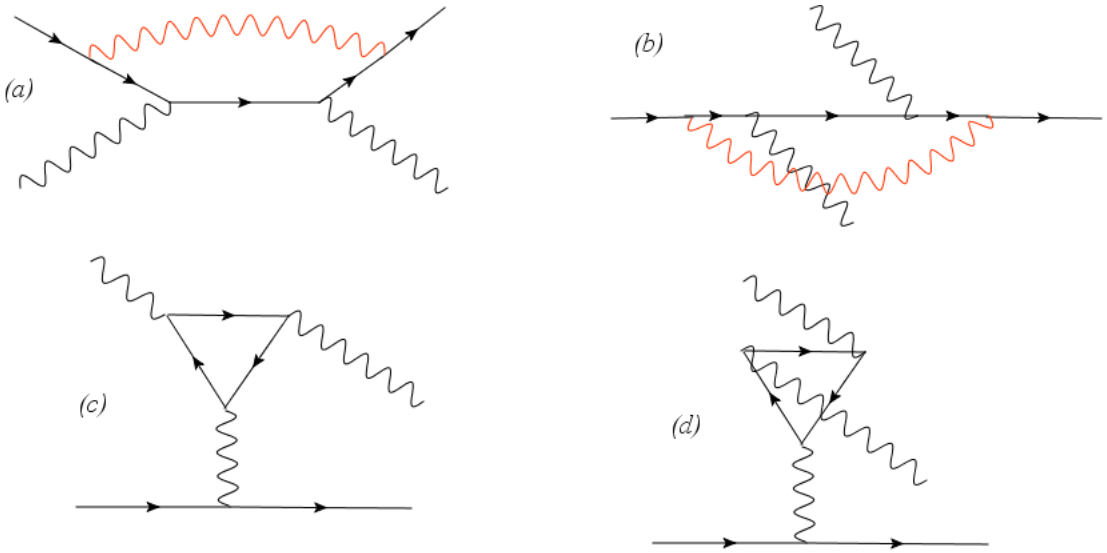


FIGURE 3. Remaining fourth order diagrams.