Session of Monday 29 September at 16-18 in aud A315.

1. Analyze the scattering amplitude $A = A_a + A_b$ given by eq. (1) in problem 3 of Discussion session 3.

   (a) Find the leading behavior of the amplitude in the limit $q_\perp \to 0$ at fixed x and $k_\perp$. Does this region give a singular contribution to the cross section? If it does, how is the singularity handled in QED?

   (b) Give a physical interpretation to the singular behavior of the amplitude in the limit $k_\perp \to 0$ with x and $\boldsymbol{q}_\perp$ fixed. How is this singularity regularized in the physical QED cross section? What is the interpretation of the $\boldsymbol{k}_\perp \to x\boldsymbol{q}_\perp$ singularity?

2. Verify the "Cutkosky rule" for the discontiuity of a Feynman graph corresponding to a particular cut through the diagram: The denominator of the propagator of each cut line is to be replaced by $-2\pi i\delta(k^2 - m^2)$, where k is the momentum of the line and m its mass. It suffices that you consider the free electron propagator and the electron propagator with a photon loop correction (as in the *rhs.* diagram below). (Remember that the Feynman rules give the amplitude multiplied by i).

3. The diagram below illustrates the optical theorem: The cross section is given by the discontinuity of the forward amplitude. T represent an amplitude which emits an electron with momentum k ($k^2 > m_e^2$ and $k^0 > 0$). $T^\dagger$ is its time-reversed counterpart. The cut on the rhs. represents the discontinuity.

   (a) Use the QED Feynman rules to write the expression for the squared diagram on the *lhs*.

   (b) Express your result in a form which corresponds to the discontinuity of the forward amplitude on the *rhs*.