Homework on *ep* Scattering and Ronsbluth Cross Section

Level 1

1) Demonstrate that for elastic scattering from the proton:

$$\int \frac{d^3P_X}{2E_X}\,\delta^4(q+P-P_X) = \delta((P+q)^2 - M^2) \tag{1}$$

How does the equation transform for inelastic scattering?

2) Demonstrate that the following relation for the incident flux in the reaction $1+2 \to 3+4$:

$$F = \left((p_1p_2)^2 - m_1^2m_2^2\right)^{1/2} = v_1 2E_1 2E_2$$

is valid in the laboratory system.

Level 2

1) The most general form of the nucleon electromagnetic current in elastic scattering is:

$$\Gamma_\mu = \Gamma_1(Q^2)\gamma_\mu + \Gamma_2(Q^2)\frac{i}{2}\sigma_{\mu\nu}q^\nu + \Gamma_3(Q^2)q_\mu$$

Demonstrate that because of current conservation, $\Gamma_3(Q^2) = 0$.

2) Compare once more the duration of the $\gamma^* p$ interaction with the duration of the partonic interactions inside the proton (as the inverse of the energy fluctuation), in the IMF.
(1) What is the role of the IMF?
(2) What is the role of time dilation?
(3) What is the role of the kinematical variables: x, ν and Q^2?
(4) At this stage, can one figure out any role of space contraction?
Write half to one page.