Phy 523
PARTICLE PHYSICS
Problem sheet VI

17th February 2009

24th February 2009

26. Show that the free particle Green's function is given by

$$G_0(\vec{x}', t'; \vec{x}, t) = -i \left(\frac{m}{2\pi i(t'-t)} \right) e^{\frac{im|\vec{x}'-\vec{x}|^2}{2(t'-t)^2}} \theta(t'-t)$$

27 Show that

$$\int d^3x' G^*(\vec{x}', t'; \vec{x}, t) G(\vec{x}', t'; y, t) = \delta^3(\vec{x} - \vec{y})$$

28 Use the expression from the previous problem to show

$$i \int d^3x \phi^*(\vec{x}, t) G_0(\vec{x}, t; \vec{x}', t') = \phi^*(\vec{x'}, t')$$

29. Using

$$S_{fi} = \int d^3x' d^3x \phi_f^*(x') G(x, x') \phi_i(x)$$

show that S is unitary.

30 Verify using the explicit expression for G_0 (Problem 26) that

$$G_0(x_2, x_1) = i \int d3^x G_0(x_2, x) G_0(x, x_1)$$

with $t_2 > t_> t_1$