Quantentheorie II Übung 11

– Sample solutions –

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2. **Green function and Fourier transformation:**

$$\begin{aligned}\int \frac{d^3q}{2\pi}\frac{e^{i\vec{q}\cdot\vec{k}}}{k^3-q^2-i\epsilon} &= \frac{1}{2\pi}\int dq q^2 d\cos\theta d\phi \frac{e^{iqr\cos\theta}}{k^2-q^2-i\epsilon} \\ &= \frac{1}{(2\pi)^3}\int_0^\infty dq q^2 \int_{-1}^1 d\cos\theta \frac{e^{iqr\cos\theta}}{k^2-q^2-i\epsilon} \\ &= \frac{-1}{(2\pi)^2 ir}\int_{-\infty}^{\infty} dq \frac{q e^{iqr}}{q^2-k^2+i\epsilon} \\ &= \frac{-1}{(2\pi)^2 ir} 2\pi i \frac{e^{-ikr}}{2} \Longleftarrow Residue(-k+i\epsilon) = \frac{e^{-ikr}}{2} \\ &= -\frac{1}{4\pi}\frac{e^{-ikr}}{r}. \end{aligned} \tag{1}$$

3. **S-wave scattering:** see Nolting (9.2.1).

4. **Scattering on sphere:** see Nolting (9.2.3).

5. **Scattering on exponential potential (again):** see Nolting (9.3.2)