Disclaimer

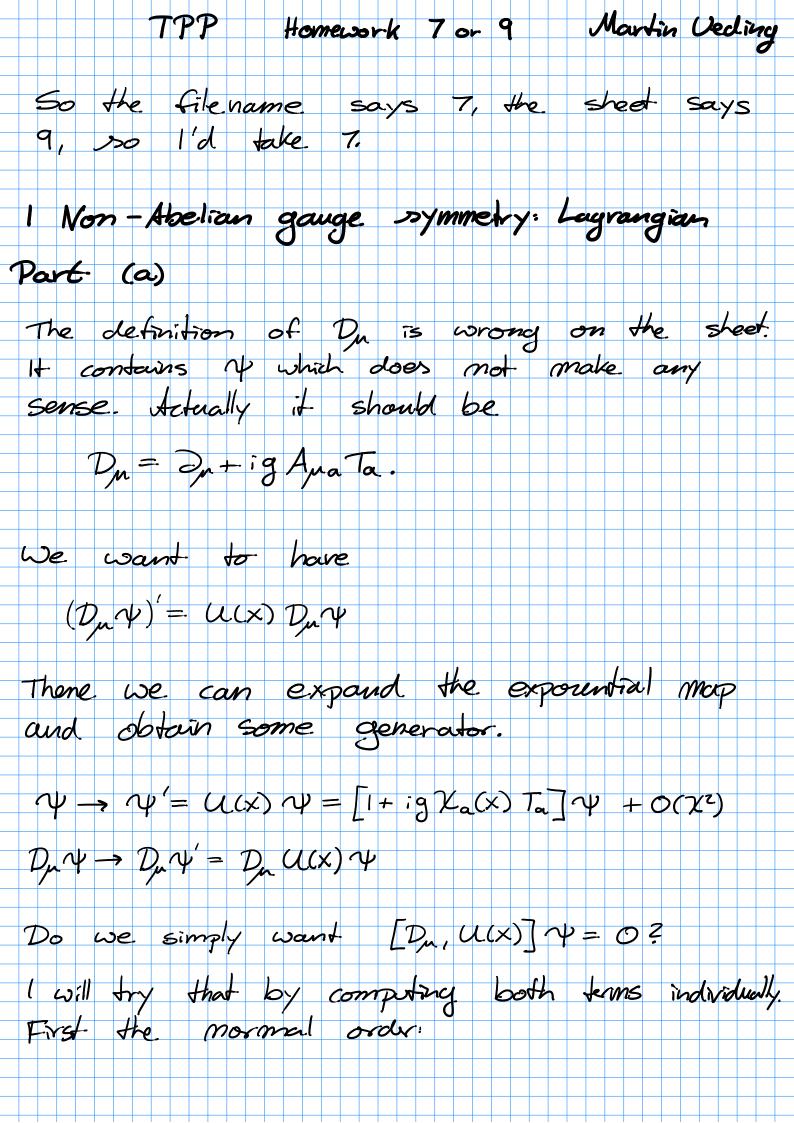
This is a problem set (as turned in) for the module physics615.

This problem set is not reviewed by a tutor. This is just what I have turned in.

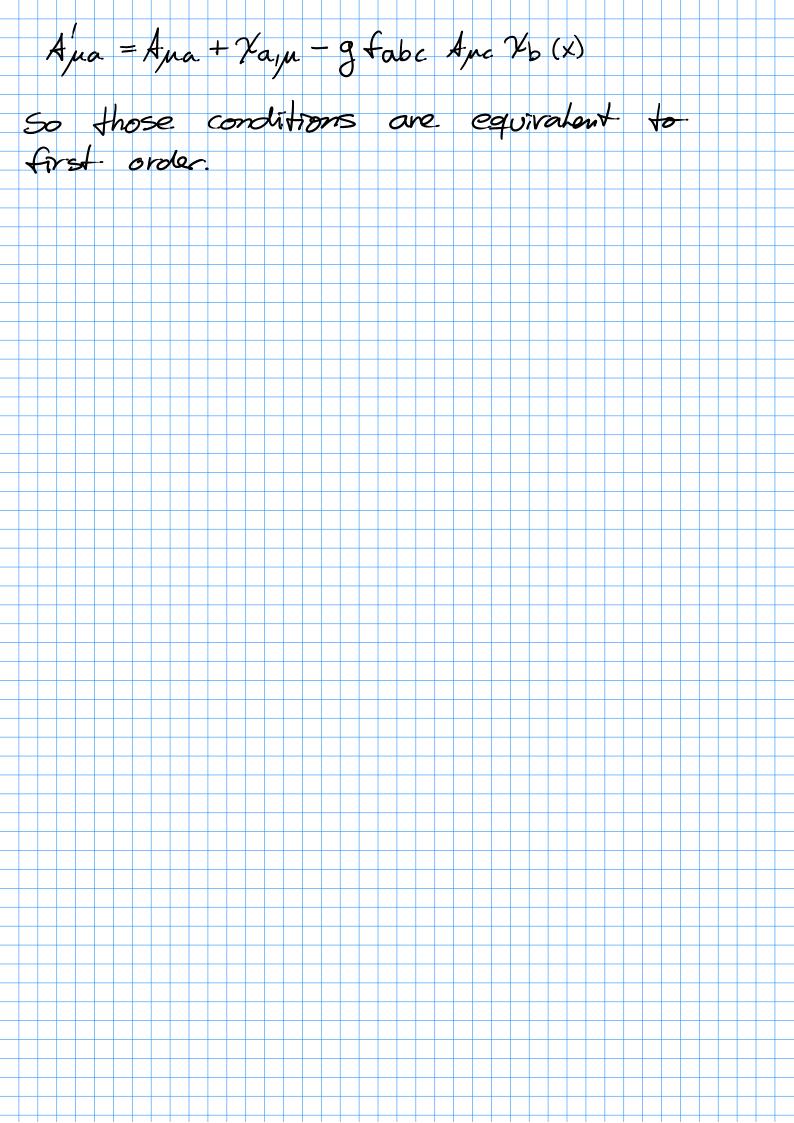
All problem sets for this module can be found at http://martin-ueding.de/de/university/msc_physics/physics615/.

If not stated otherwise in the document itself: This work by Martin Ueding is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

[disclaimer]



Du U(X) y = [Dn + ig Ana Ta] U(X) y = U,n(x) y + U(x) y,n + ig Ana Ta U(x) y Insert U(x) and factor that out. = U(x) [ig No, u(x) To V+ V, u]+ ig Anata U(x) V Now the other side. U(x) Dury = U(x) [Dn + ig Anata] Y The commutator than is: U(x) ig Nb,n(x) Tb N+ ig Ana Ta U(x) N - U(x) ig Ana Tay We can drop the 4 mow. This shall be Zero. There fore we move u(x) A to the other side. other side. U(x) Ana Ta = U(x) Nb, n(x) Tb + Ana Ta U(x) [Ta, 1+ ig /c(x) Te] = ig /c(x) [Ta, Te] = -g facd Td U(x) Ana Ta = U(x) 7b, 1 Tb + Ana U(x) Ta 50 from here we have after index exchange

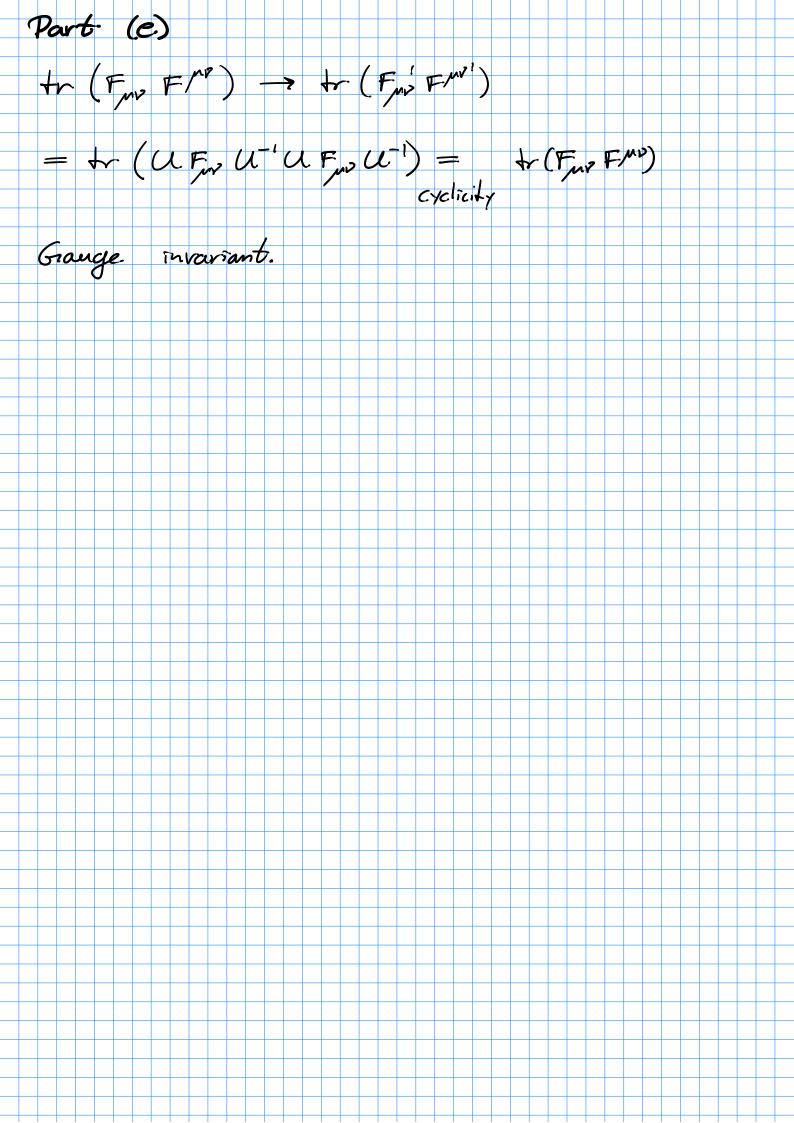


Part (b) That's easy. Dury transforms like 14. Then THIDY - TUCK) UCK) I DAY

Part (c) Plug in and evaluate. We use the commutator to make it more compact. [Du, Dv] = [Du + ig Ava Ta, Dv + ig Avb Tb] $= [\partial_n, \partial_v] + ig[\partial_n, Avb] Tb$ O die to + ig [Ana, Ov] Ta - g2 Ana Avb [Ta, Tb] = ig[dn, Avb]Tb - ig[dv, Ana]Ta-igAna AvbfabeTe ign, Avb] Tb - [Dv, Ana] Ta - g Ana Avb fabe Te Du Arb 4 - Arb Du 4 = Arb, u = Ava, uTa - Ana, vTa - g Anb Avc Fabe Ta Exteact Ta and voila: Fix = Avain - Anair - gtub Arc Fabe

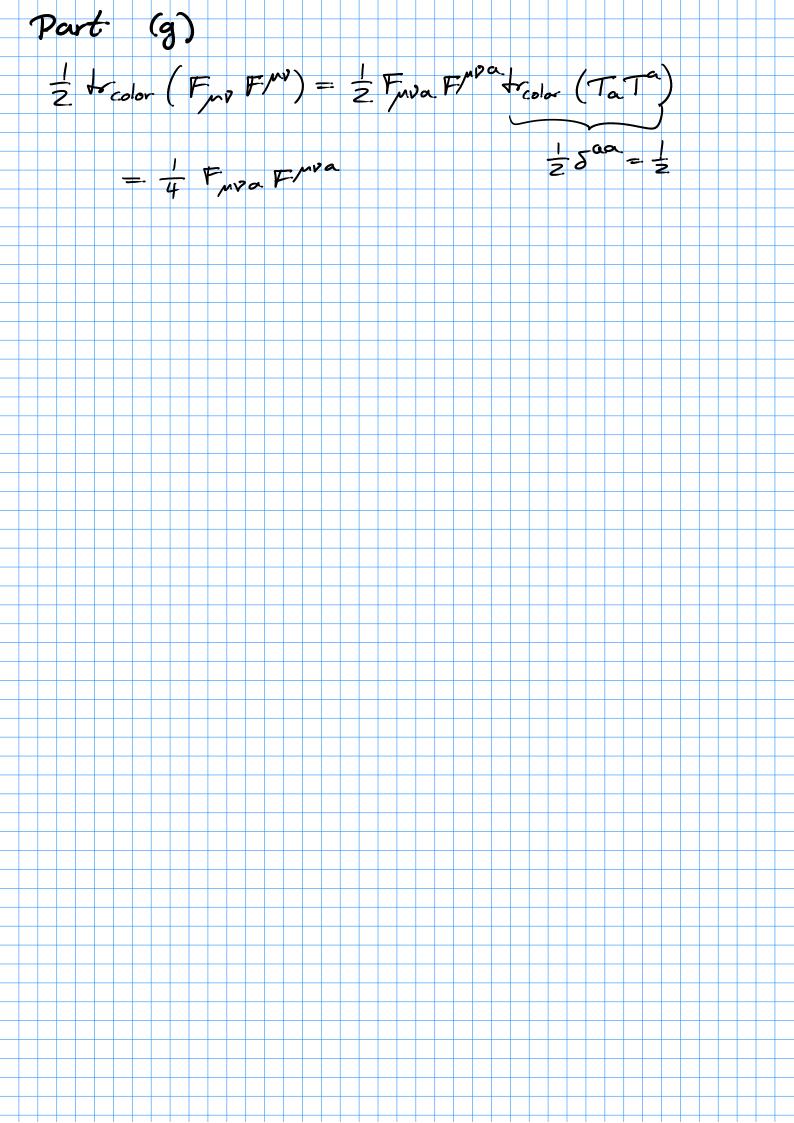
Part (d) [[Dn, Dv]] is [ig Fw 4] And that is ig Fiv y = ig Fiv (LCX) y on the other hand (e(x) [Dn, Do] W = ig (c(x) Fino W Set-both sides equal: ig Fins class y = ig clas Fins y Cancel ig, cancel 14, multiply from right with U(x). Pone. For O(x.a) transformation that is Fir = [1+ ig /a (x) Ta] Fir Tb [1-ig/c(x) Te] (The Ta are hermitizen modifices, X is real). Fus = Fus + ig /a (x) Ta Fiv Tb - ig Fus Tb /c (x) Tc + g2 /a (x) Ta Fur Tb /c (x) Tc = Fr + ig Xa (x) Fru [Ta, Tb] + g2 Xa(x) Xc(x) Fb Ta Tb Tc

= Fun -g fabc 76 (x) Fun Ta + g2 Xa(x) Xc(x) Fib Ta Tb Tc That last summand has to vonish. It is symmetric in the indices a and c. So one can write the intensting terms as 2 Xa Yc | TaTbTc + TcTbTas Tato Tc = TateTb + ifbed Tata = TcTaTb+ if bed TaTd+ ifacd TdTb = TcTbTa+ifbed TaTd+ifacd TdTb+ifabdTcTd Hmm



Part (f)

$$T' = \frac{1}{2} \begin{pmatrix} 1 \end{pmatrix} T^2 = \frac{1}{2} \begin{pmatrix} 1 \end{pmatrix} T^3 = \frac{1}{2} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$
 $\sigma' \sigma' \tilde{J} = \delta' \tilde{J} I_2 + \frac{1}{2} \epsilon i \tilde{J}^{k} \sigma^{k}$
 $+ (\sigma' \sigma' \tilde{J}) = \delta' \tilde{J} + (I_2) + \frac{1}{2} \epsilon i \tilde{J}^{k} + (\sigma^{k})$
 $\delta \tilde{J} \cdot 2$
 $T' = \frac{1}{2} \sigma' \tilde{J}$
 $+ (T' T \tilde{J}) = \frac{1}{4} + (\sigma' \sigma' \tilde{J}) = \frac{1}{2} \delta^{\tilde{J}}$



2. Grange (non-) invariance of hadronic wave functions So what are those 9; things? They need to be from the SU(3) representation space. It the 3-dim representation is chosen, we have 9; $\in C^3$. Then the 9; could be basis vectors in that space? Part (a) When I transform a trilinear, do I transform all of them at once? Eijh 9: 9; 9x -> Eijk U;; Ujj Ukk 9; 9; 9j, 9k It does not hart to insert another antisymmetrization and decouple that. The spinors anticommote anyway n! Eijk Ui;, Uj; Ukk, E; jk! E; ", k" 9; " 7; " 9 w" Original wave fundson. det(u)=1 Part (b) $\overline{q};q; \longrightarrow \overline{q}; U'; U'k qk = \overline{q}; Sik qk = \overline{q}kqk$ Part (c) 4, 9, → 9; Uti, U' K 9K No clear inverse,