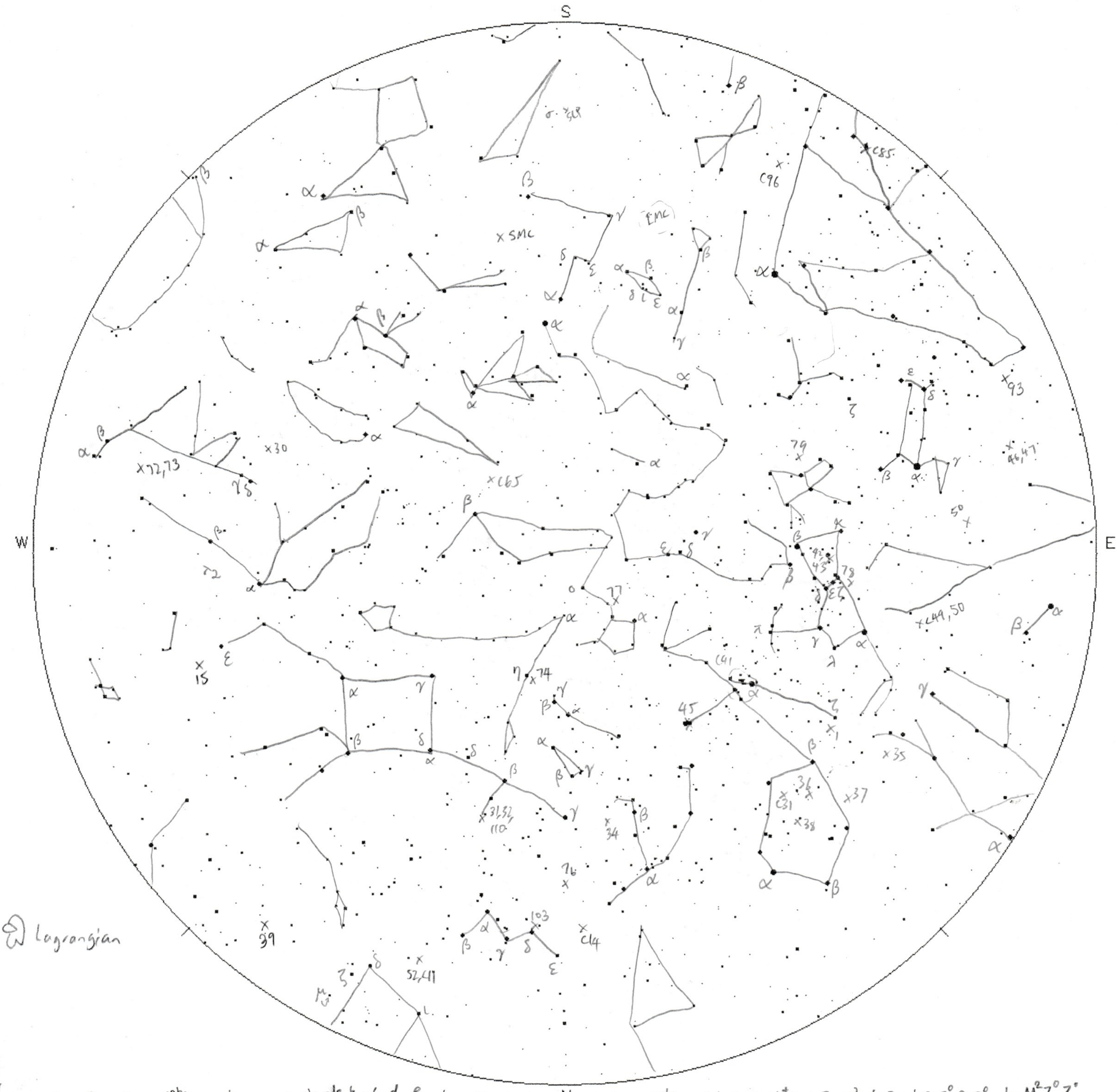

$$
\begin{aligned}
\mathcal{L}_{SM} = {} & -\tfrac{1}{2}\partial_\nu g^a_\mu \partial_\nu g^a_\mu - g_s f^{abc}\partial_\mu g^a_\nu g^b_\mu g^c_\nu - \tfrac{1}{4}g_s^2 f^{abc}f^{ade} g^b_\mu g^c_\nu g^d_\mu g^e_\nu + \tfrac{1}{2}ig_s^2(\bar{q}^\sigma_i \gamma^\mu q^\sigma_j) + \overset{N}{G}{}^a \partial^2 G^a + g_s f^{abc}\partial_\mu G^a G^b g^c_\mu \\
& - \partial_\nu W^+_\mu \partial_\nu W^-_\mu - M^2 W^+_\mu W^-_\mu - \tfrac{1}{2}\partial_\nu Z^0_\mu \partial_\nu Z^0_\mu - \tfrac{1}{2c_W^2} M^2 Z^0_\mu Z^0_\mu \\
& - \tfrac{1}{2}\partial_\mu A_\nu \partial_\mu A_\nu - \tfrac{1}{2}\partial_\mu H \partial_\mu H - \tfrac{1}{2}m_h^2 H^2 - \partial_\mu \phi^+ \partial_\mu \phi^- - M^2 \phi^+\phi^- - \tfrac{1}{2}\partial_\mu \phi^0 \partial_\mu \phi^0 - \tfrac{1}{2c_W^2} M \phi^0\phi^0 - \beta_h\left[\tfrac{2M^2}{g^2} + \tfrac{2M}{g}H + \tfrac{1}{2}(H^2 + \phi^0\phi^0 + 2\phi^+\phi^-)\right] + \tfrac{2M^4}{g^2}\alpha_h \\
& - igc_W\Big[\partial_\nu Z^0_\mu (W^+_\mu W^-_\nu - W^+_\nu W^-_\mu) - Z^0_\nu (W^+_\mu \partial_\nu W^-_\mu - W^-_\mu \partial_\nu W^+_\mu) + Z^0_\mu (W^+_\nu \partial_\nu W^-_\mu - W^-_\nu \partial_\nu W^+_\mu)\Big] \\
& - igs_W\Big[\partial_\nu A_\mu (W^+_\mu W^-_\nu - W^+_\nu W^-_\mu) - A_\nu (W^+_\mu \partial_\nu W^-_\mu - W^-_\mu \partial_\nu W^+_\mu) + A_\mu (W^+_\nu \partial_\nu W^-_\mu - W^-_\nu \partial_\nu W^+_\mu)\Big] - \tfrac{1}{2}g^2 W^+_\mu W^-_\mu W^+_\nu W^-_\nu + \tfrac{1}{2}g^2 W^+_\mu W^-_\nu W^+_\mu W^-_\nu \\
& + g^2 c_W^2 (Z^0_\mu W^+_\mu Z^0_\nu W^-_\nu - Z^0_\mu Z^0_\mu W^+_\nu W^-_\nu) + g^2 s_W^2 (A_\mu W^+_\mu A_\nu W^-_\nu - A_\mu A_\mu W^+_\nu W^-_\nu) + g^2 s_W c_W \left[A_\mu Z^0_\nu (W^+_\mu W^-_\nu - W^+_\nu W^-_\mu) - 2A_\mu Z^0_\mu W^+_\nu W^-_\nu\right] \\
& - g\alpha\left[H^3 + H\phi^0\phi^0 + 2H\phi^+\phi^-\right] - \tfrac{1}{8}g^2\alpha_h\left[H^4 + (\phi^0)^4 + 4(\phi^+\phi^-)^2 + 4(\phi^0)^2\phi^+\phi^- + 4H^2\phi^+\phi^- + 2(\phi^0)^2 H^2\right] \\
& - gMW^+_\mu W^-_\mu H - \tfrac{1}{2}g\tfrac{M}{c_W^2} Z^0_\mu Z^0_\mu H - \tfrac{1}{2}ig\left[W^+_\mu(\phi^0\partial_\mu\phi^- - \phi^-\partial_\mu\phi^0) - W^-_\mu(\phi^0\partial_\mu\phi^+ - \phi^+\partial_\mu\phi^0)\right] + \tfrac{1}{2}g\left[W^+_\mu(H\partial_\mu\phi^- - \phi^-\partial_\mu H) - W^-_\mu(H\partial_\mu\phi^+ - \phi^+\partial_\mu H)\right] \\
& + \tfrac{1}{2}g\tfrac{1}{c_W}(Z^0_\mu(H\partial_\mu\phi^0 - \phi^0\partial_\mu H) - ig\tfrac{s_W^2}{c_W} M Z^0_\mu (W^+_\mu\phi^- - W^-_\mu\phi^+) + igs_W M A_\mu (W^+_\mu\phi^- - W^-_\mu\phi^+) - ig\tfrac{1-2c_W^2}{2c_W} Z^0_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) \\
& + igs_W A_\mu(\phi^+\partial_\mu\phi^- - \phi^-\partial_\mu\phi^+) - \tfrac{1}{4}g^2 W^+_\mu W^-_\mu\left[H^2 + (\phi^0)^2 + 2\phi^+\phi^-\right] - \tfrac{1}{4}g^2\tfrac{1}{c_W^2} Z^0_\mu Z^0_\mu\left[H^2 + (\phi^0)^2 + 2(2s_W^2 - 1)^2\phi^+\phi^-\right] \\
& - \tfrac{1}{2}g^2\tfrac{s_W^2}{c_W} Z^0_\mu \phi^0 (W^+_\mu\phi^- + W^-_\mu\phi^+) - \tfrac{1}{2}ig^2\tfrac{s_W^2}{c_W} Z^0_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) + \tfrac{1}{2}g^2 s_W A_\mu \phi^0(W^+_\mu\phi^- + W^-_\mu\phi^+) + \tfrac{1}{2}ig^2 s_W A_\mu H(W^+_\mu\phi^- - W^-_\mu\phi^+) \\
& - g^2\tfrac{s_W}{c_W}(2c_W^2 - 1) Z^0_\mu A_\mu \phi^+\phi^- - g'^2 s_W^2 A_\mu A_\mu \phi^+\phi^- \\
& - \bar{e}^\lambda(\gamma\partial + m_e^\lambda)e^\lambda - \bar{\nu}^\lambda\gamma\partial\nu^\lambda - \bar{u}^\lambda_j(\gamma\partial + m_u^\lambda)u^\lambda_j - \bar{d}^\lambda_j(\gamma\partial + m_d^\lambda)d^\lambda_j + igs_W A_\mu\left[-(\bar{e}^\lambda\gamma^\mu e^\lambda) + \tfrac{2}{3}(\bar{u}^\lambda_j\gamma^\mu u^\lambda_j) - \tfrac{1}{3}(\bar{d}^\lambda_j\gamma^\mu d^\lambda_j)\right] + \tfrac{ig}{4c_W} Z^0_\mu\Big[(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) \\
& + (\bar{e}^\lambda\gamma^\mu(4s_W^2 - 1 - \gamma^5)e^\lambda) + (\bar{u}^\lambda_j\gamma^\mu(\tfrac{4}{3}s_W^2 - 1 - \gamma^5)u^\lambda_j) + (\bar{d}^\lambda_j\gamma^\mu(1 - \tfrac{8}{3}s_W^2 - \gamma^5)d^\lambda_j)\Big] + \tfrac{ig}{2\sqrt{2}} W^+_\mu\Big[(\bar{\nu}^\lambda\gamma^\mu(1+\gamma^5)e^\lambda) + (\bar{u}^\lambda_j\gamma^\mu(1+\gamma^5)C_{\lambda\kappa}d^\kappa_j)\Big] \\
& + \tfrac{ig}{2\sqrt{2}} W^-_\mu\Big[(\bar{e}^\lambda\gamma^\mu(1+\gamma^5)\nu^\lambda) + (\bar{d}^\kappa_j C^\dagger_{\lambda\kappa}\gamma^\mu(1+\gamma^5)u^\lambda_j)\Big] + \tfrac{ig}{2\sqrt{2}}\tfrac{m_e^\lambda}{M}\left[-\phi^+(\bar{\nu}^\lambda(1-\gamma^5)e^\lambda) + \phi^-(\bar{e}^\lambda(1+\gamma^5)\nu^\lambda)\right] - \tfrac{g}{2}\tfrac{m_e^\lambda}{M}\Big[H(\bar{e}^\lambda e^\lambda) \\
& + i\phi^0(\bar{e}^\lambda\gamma^5 e^\lambda)\Big] + \tfrac{ig}{2M\sqrt{2}}\phi^+\left[-m_d^\kappa(\bar{u}^\lambda_j C_{\lambda\kappa}(1-\gamma^5)d^\kappa_j) + m_u^\lambda(\bar{u}^\lambda_j C_{\lambda\kappa}(1+\gamma^5)d^\kappa_j)\right] + \tfrac{ig}{2M\sqrt{2}}\phi^-\left[m_d^\lambda(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1+\gamma^5)u^\kappa_j) - m_u^\kappa(\bar{d}^\lambda_j C^\dagger_{\lambda\kappa}(1-\gamma^5)u^\kappa_j)\right] - \tfrac{g}{2}\tfrac{m_u^\lambda}{M}H(\bar{u}^\lambda_j u^\lambda_j) \\
& - \tfrac{g}{2}\tfrac{m_d^\lambda}{M}H(\bar{d}^\lambda_j d^\lambda_j) + \tfrac{ig}{2}\tfrac{m_u^\lambda}{M}\phi^0(\bar{u}^\lambda_j\gamma^5 u^\lambda_j) - \tfrac{ig}{2}\tfrac{m_d^\lambda}{M}\phi^0(\bar{d}^\lambda_j\gamma^5 d^\lambda_j) \\
& + \bar{\chi}^+(\partial^2 - M^2)\chi^+ + \bar{\chi}^-(\partial^2 - M^2)\chi^- + \bar{\chi}^0(\partial^2 - \tfrac{M^2}{c_W^2})\chi^0 + \bar{Y}\partial^2 Y + igc_W W^+_\mu(\partial_\mu\bar{\chi}^0\chi^- - \partial_\mu\bar{\chi}^+\chi^0) + igs_W W^+_\mu(\partial_\mu\bar{Y}\chi^- - \partial_\mu\bar{\chi}^+ Y) \\
& + igc_W W^-_\mu(\partial_\mu\bar{\chi}^-\chi^0 - \partial_\mu\bar{\chi}^0\chi^+) + igs_W W^-_\mu(\partial_\mu\bar{\chi}^- Y - \partial_\mu\bar{Y}\chi^+) + igc_W Z^0_\mu(\partial_\mu\bar{\chi}^+\chi^+ - \partial_\mu\bar{\chi}^-\chi^-) + igs_W A_\mu(\partial_\mu\bar{\chi}^+\chi^+ - \partial_\mu\bar{\chi}^-\chi^-) \\
& - \tfrac{1}{2}gM\left[\bar{\chi}^+\chi^+ H + \bar{\chi}^-\chi^- H + \tfrac{1}{c_W^2}\bar{\chi}^0\chi^0 H\right] + \tfrac{1-2c_W^2}{2c_W} igM\left[\bar{\chi}^+\chi^0\phi^+ - \bar{\chi}^-\chi^0\phi^-\right] + \tfrac{1}{2c_W} igM\left[\bar{\chi}^0\chi^-\phi^+ - \bar{\chi}^0\chi^+\phi^-\right] \\
& + igMs_W\left[\bar{\chi}^0\chi^-\phi^+ - \bar{\chi}^0\chi^+\phi^-\right] + \tfrac{1}{2}igM\left[\bar{\chi}^+\chi^+\phi^0 - \bar{\chi}^-\chi^-\phi^0\right].
\end{aligned}
$$