

$$\begin{aligned}
\ln[1398] &= \lambda_h = 0.01; \\
\lambda_s &= 0.01; \\
\lambda_{hs} &= \sqrt{4 * \lambda_h * \lambda_s}; \\
\theta_0 &= \text{Arctan}[(4 * \lambda_h - \lambda_{hs}) / (\lambda_s - \lambda_{hs})]; \\
v_{tree} &= \lambda_h * (\phi * \text{Cos}[\theta_0])^4 + (\lambda_{hs} / 2) * (\text{Sin}[\theta_0] * \text{Cos}[\theta_0])^2 * \phi^4 + (\lambda_s / 4) * (\phi * \text{Sin}[\theta_0])^4;
\end{aligned}$$

$$g_1 = 0.648;$$

$$g_y = 0.358;$$

$$y_t = 0.936;$$

$$M_{higgs} = 3 * \lambda_h * (\phi * \text{Cos}[\theta_0])^2 + (\lambda_{hs} / 2) * (\phi * \text{Sin}[\theta_0])^2;$$

$$M_{singlet} = (\lambda_{hs} / 2) * (\phi * \text{Cos}[\theta_0])^2 + (3 * \lambda_s) * (\phi * \text{Sin}[\theta_0])^2;$$

$$M_{goldstone} = \lambda_h * (\phi * \text{Cos}[\theta_0])^2 + (\lambda_{hs} / 2) * (\phi * \text{Sin}[\theta_0])^2;$$

$$\begin{aligned}
B &= \left((M_{higgs} / \phi)^4 + 3 * (M_{goldstone} / \phi)^4 + \lambda_{hs}^2 + (3 / 16) * (\text{Cos}[\theta_0])^4 * (g_1^2 + g_y^2)^2 + \right. \\
&\quad \left. (3 / 8) * (\text{Cos}[\theta_0])^4 * g_1^4 - 3 * (\text{Cos}[\theta_0])^4 * y_t^4 \right) / (32 * \pi^2);
\end{aligned}$$

$$v_\phi = 246;$$

$$v_{loop} = B * \phi^4 * (\text{Log}[\phi / v_\phi] - 1 / 4);$$

$$\gamma_E = 0.5772;$$

$$b_1 = M_{higgs}^2 / T^2;$$

$$b_2 = M_{singlet}^2 / T^2;$$

$$b_3 = M_{goldstone}^2 / T^2;$$

$$M_{W^+} = \frac{1}{2} * g_1 * \phi;$$

$$M_{W^-} = \frac{1}{2} * g_1 * \phi;$$

$$a_w = (M_{W^+})^2 / T^2;$$

$$M_z = \frac{1}{2} * (g_1^2 + g_y^2)^{1/2} * \phi;$$

$$a_z = (M_z)^2 / T^2;$$

$$M_{top} = \frac{1}{\sqrt{2}} * y_t * \phi;$$

$$a_{top} = (M_{top})^2 / T^2;$$

$$C_B = 3 / 2 - 2 * \gamma_E + 2 * \text{Log}[4 * \pi];$$

$$C_F = 3 / 2 - 2 * \gamma_E + 2 * \text{Log}[\pi];$$

$$\begin{aligned}
iB_{higgs} &= \left(1 - \text{Exp}[-(b_1 / 6.3)^4] \right) * \\
&\quad \left(-\sqrt{\pi / 2} * b_1^{3/4} * \text{Exp}[-\sqrt{b_1}] * \left(1 + (15 / 8) * b_1^{-1/2} + (105 / 128) * b_1^{-1} \right) + \right. \\
&\quad \left. \left(\text{Exp}[-(b_1 / 6.3)^4] \right) * \left(-\pi^4 / 45 + (\pi^2 / 12) * b_1 - (\pi / 6) * b_1^{3/2} - (b_1^2 / 32) (\text{Log}[b_1] - C_B) \right) \right);
\end{aligned}$$

$$\begin{aligned}
iB_{singlet} &= \left(1 - \text{Exp}[-(b_2 / 6.3)^4] \right) * \\
&\quad \left(-\sqrt{\pi / 2} * b_2^{3/4} * \text{Exp}[-\sqrt{b_2}] * \left(1 + (15 / 8) * b_2^{-1/2} + (105 / 128) * b_2^{-1} \right) + \right. \\
&\quad \left. \left(\text{Exp}[-(b_2 / 6.3)^4] \right) * \left(-\pi^4 / 45 + (\pi^2 / 12) * b_2 - (\pi / 6) * b_2^{3/2} - (b_2^2 / 32) (\text{Log}[b_2] - C_B) \right) \right);
\end{aligned}$$

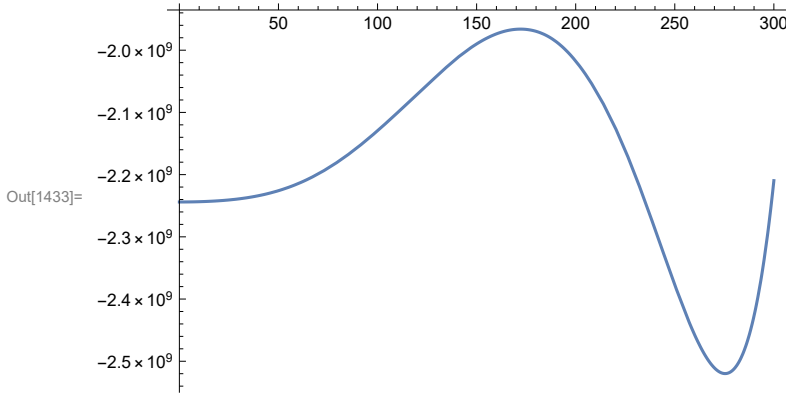
$$\begin{aligned}
iB_{gold} &= \left(1 - \text{Exp}[-(b_3 / 6.3)^4] \right) * \\
&\quad \left(-\sqrt{\pi / 2} * b_3^{3/4} * \text{Exp}[-\sqrt{b_3}] * \left(1 + (15 / 8) * b_3^{-1/2} + (105 / 128) * b_3^{-1} \right) + \right. \\
&\quad \left. \left(\text{Exp}[-(b_3 / 6.3)^4] \right) * \left(-\pi^4 / 45 + (\pi^2 / 12) * b_3 - (\pi / 6) * b_3^{3/2} - (b_3^2 / 32) (\text{Log}[b_3] - C_B) \right) \right);
\end{aligned}$$

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iBw = (1 - Exp[-(aw/6.3)^4]) * (-sqrt(pi/2) * aw^(3/4) * Exp[-sqrt(aw)] *
      (1 + (15/8) * aw^(-1/2) + (105/128) * aw^(-1))) +
      (Exp[-(aw/6.3)^4]) * (-pi^4/45 + (pi^2/12) * aw - (pi/6) * aw^(3/2) - (aw^2/32) (Log[aw] - CB));
iBz = (1 - Exp[-(az/6.3)^4]) * (-sqrt(pi/2) * az^(3/4) * Exp[-sqrt(az)] *
      (1 + (15/8) * az^(-1/2) + (105/128) * az^(-1))) +
      (Exp[-(az/6.3)^4]) * (-pi^4/45 + (pi^2/12) * az - (pi/6) * az^(3/2) - (az^2/32) (Log[az] - CB));
iF = (1 - Exp[-(atop/3.25)^4]) * (-sqrt(pi/2) * atop^(3/4) * Exp[-sqrt(atop)] *
      (1 + (15/8) * atop^(-1/2) + (105/128) * atop^(-1))) +
      (Exp[-(atop/3.25)^4]) * (-7/360 * pi^4 + (pi^2/24) * atop + (atop^2/32) * (Log[atop] - CF));
vFT = (T^4 / (2 * pi^2)) * (iBhiggs + iBsinglet + 3 * iBgold + (3 + 3) * iBw + 3 * iBz + (3 * 4) * iF);

V = Vtree + Vloop + vFT;
Plot[v /. T -> 170, {phi, 0, 300}]

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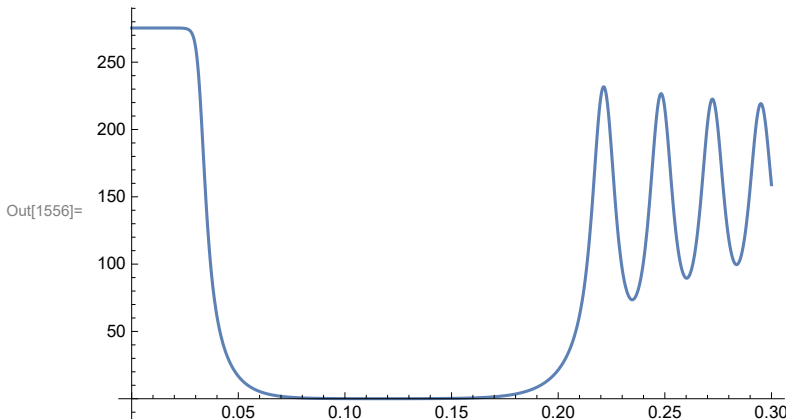
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In[1554]= DV := D[v, phi] /. phi -> phi[r]

Sol1 = NDSolve[{phi''[r] + (2/r) * phi'[r] - DV == 0,
               phi'[0.1 * 10^-16] == 0.1 * 10^-16, phi[0.1 * 10^-16] == 275.40156614835765} /.
           T -> 170, phi[r], {r, 0.1 * 10^-16, 10}];

Plot[phi[r] /. Sol1, {r, 0.1 * 10^-16, 0.3}, PlotRange -> Full]

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```
Plot[{ $\phi[r]$  /. Sol1}, {r, 0.001, 5}, ImageSize  $\rightarrow$  400,  
Epilog  $\rightarrow$  Inset[Plot[{ $\phi[r]$  /. Sol1}, {r,  $0.1 * 10^{-16}$ , 2.5},  
Frame  $\rightarrow$  True, Axes  $\rightarrow$  False, ImageSize  $\rightarrow$  400/2], {1.5,  $-1 * 10^{84}$ }]]
```