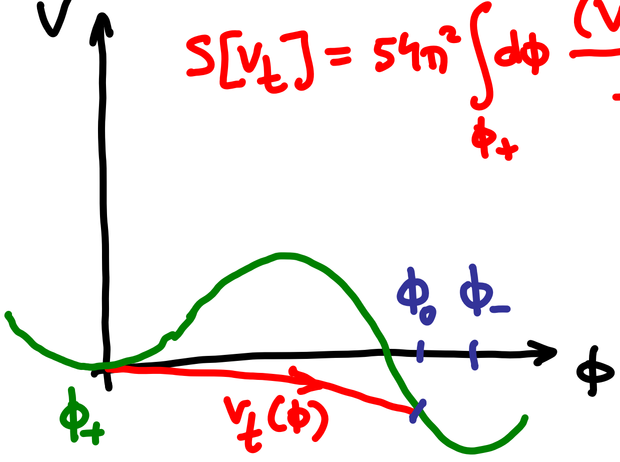
TUNNELING ACTIONS

EUCLIDEAN WAY

Coleman

$$S[V_t] = 54\pi^2 \int_{\phi_+}^{\phi_0} d\phi \, \frac{(V - V_t)^2}{-V_t'^{\,3}}$$



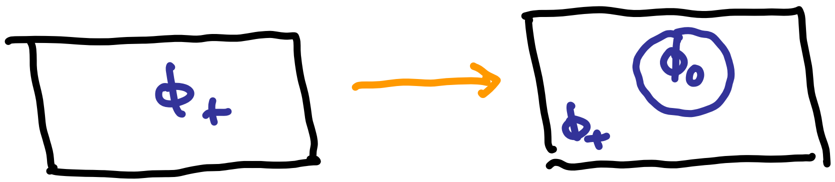
$O(4) \qquad \phi(r)$

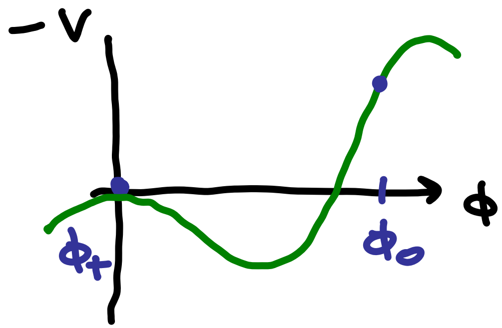
$$S[\phi] = 2\pi^2 \int_0^\infty dr \, r^3 \left[\frac{1}{2}\dot\phi^2 + V(\phi) \right]$$

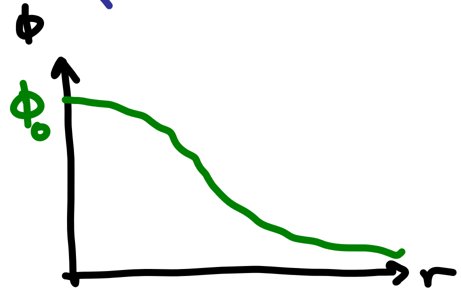
$$V_t = V - \frac{1}{2}\dot\phi^2(\phi)$$

$$\ddot\phi + \frac{3}{r}\dot\phi = V'$$

$$\begin{cases} \phi(0) = \phi_0 \\ \dot\phi(0) = 0 \\ \phi(\infty) = \phi_+ \end{cases}$$







$$\Gamma/V = A e^{-S/\hbar}$$

PROPS

1) $V_t \leq V$

2) $V_t' \leq 0$ monotonic

3) $S[V_t]$ is a minimum

APPS

1) Quartic polynomial V_t $\delta S/S < 1\%$

2) Multifiel potentials $V(\phi_i)$

3) Ph. Tr. at finite T

$$\frac{S}{T} \propto \int_{\phi_+}^{\phi_0} d\phi \, \frac{(V-V_t)^{3/2}}{V_t'^2}$$

4) Analytical V

$$(4V_t' - 3V')V_t' = 6(V_t - V)\left[V_t'' + \frac{3V - 2V_t}{m_\phi^2}\right]$$

GRAVITY

$\Delta V \sim m_p^4$ $\quad$ $\Delta\phi \sim m_p$

Coleman, De Luccia

$O(4)$ $\quad$ $\phi_B(r)$ $\quad$ $\rho_B(r) \rightarrow ds^2 = dr^2 + \rho_B^2 d\Omega_3^2$

$$\Delta S_E = S_E(\phi_B, \rho_B) - S_E(\phi_+, \rho_+)$$

V_t appr:

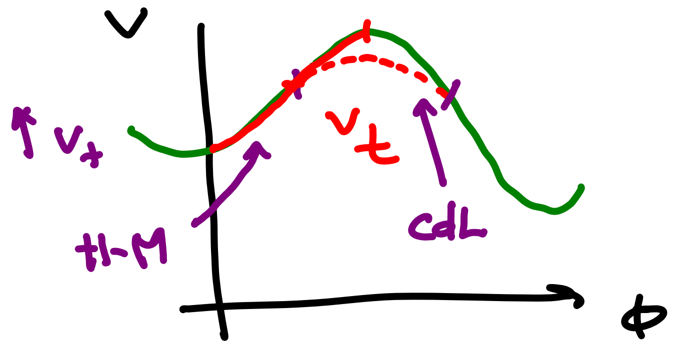
$$S[V_t] = 6\pi^2 m_p^4 \int_{\phi_+}^{\phi_0} d\phi \frac{(D + V_t')^2}{D V_t^2}$$

$$D = \sqrt{V_t'^2 + 6(V - V_t)V_t / m_p^2}$$

PROPS

1) dS, Mink, AdS (V_+)

2) dS $(V_+ > 0)$ $\quad$ $V_+ \uparrow$ $\quad$ Hawking-Moss



3) Mink, AdS $(V_+ \leq 0)$

Gravitational quenching. $D^2 < 0$