

## Problem Set 4 - Scalar field dynamics during inflation

1. Using Eqs. (190) and (185), or otherwise, show that eternal inflation occurs at the maximum of a potential of the form

$$V = V_0 - \frac{1}{2}m^2\phi^2 + \dots$$

if  $m^2 \leq 6V_0$ .

2. Consider a quantized real scalar field  $\phi$  with slow-roll potential  $V(\phi)$  in de Sitter space. Split the scalar field into two parts, a short wavelength approximately free and massless quantum part  $\phi_s(t, \mathbf{x})$  containing the Fourier modes with  $k \gtrsim aH$ , and a smoothed approximately classical part  $\phi_1(t, \mathbf{x})$  containing the Fourier modes with  $k \ll aH$ . Use appropriate approximations to derive the classical stochastic equation of motion for  $\phi_1(t, \mathbf{x})$  in a simple and compact form.