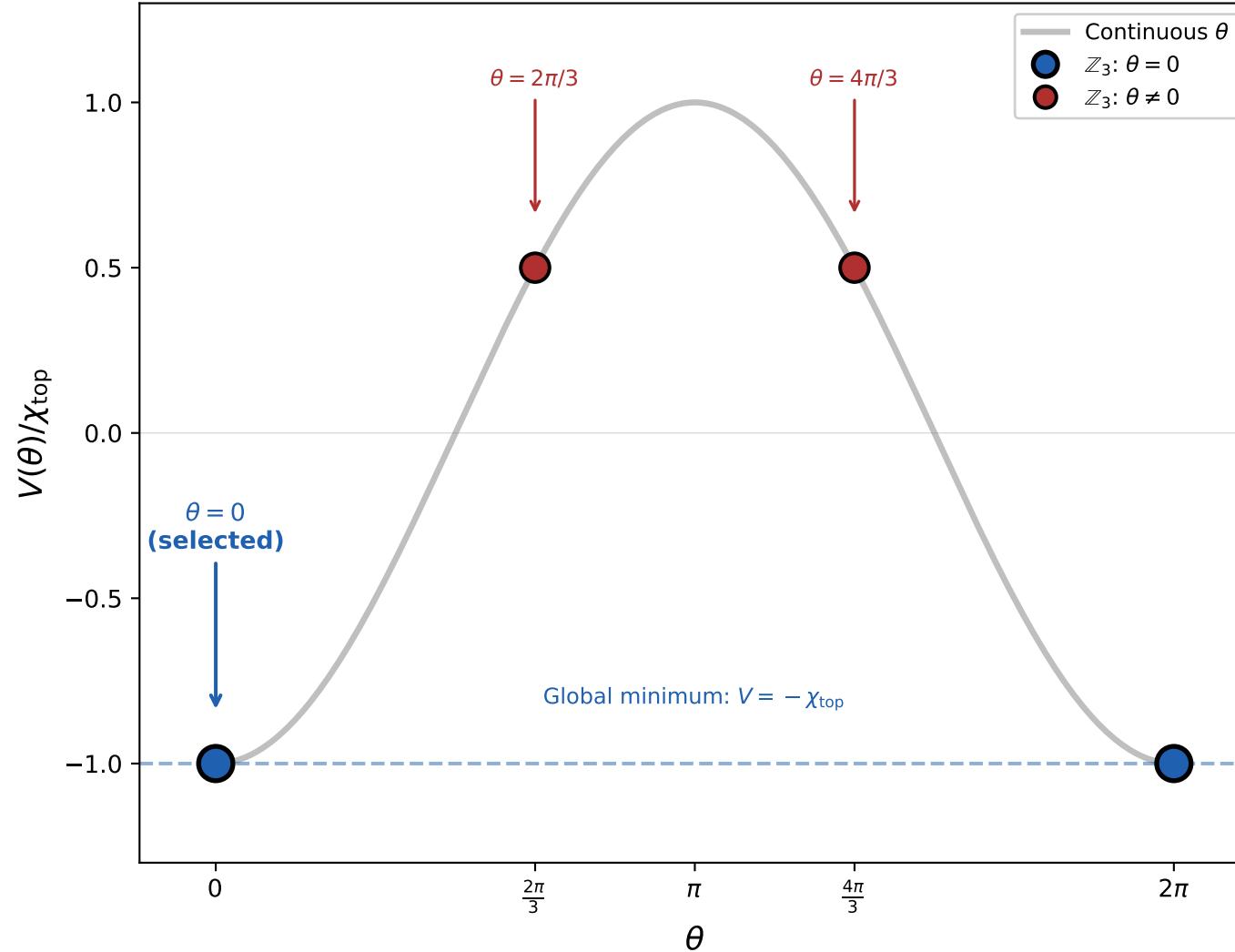


(a) Vacuum Energy:  $V(\theta) = -\chi_{\text{top}} \cos \theta$

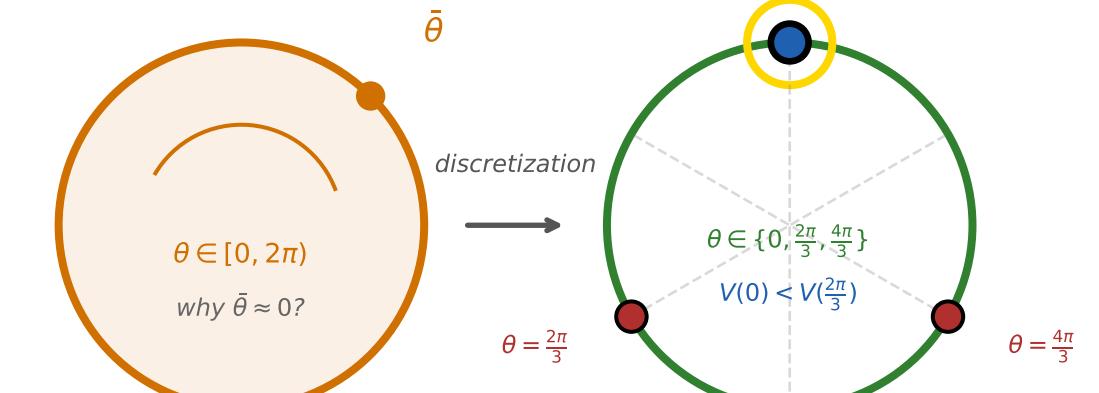


(b)  $\mathbb{Z}_3$  Discretization vs Continuous  $\theta$

No fine-tuning: geometric quantization

Standard QCD  
(continuous  $\theta$ )

Chiral Geometrogenesis  
(discrete  $\mathbb{Z}_3$ )



Peccei-Quinn Mechanism:

- Introduces axion field  $a(x)$ 
  - $\theta_{\text{eff}} = \theta + a/f_a$
- Axion relaxes to minimum
- Requires new particle (axion)

Chiral Geometrogenesis:

- $\mathbb{Z}_3$  from stellar geometry
- $\bar{\theta}$  quantized ab initio
- Vacuum selects  $\theta = 0$
- No new particles needed