

Emergence lecture 10.

2011

Standard Model (bottom of chain),

very small.

quantum.

very large  
universe.



Early.

Universe was  
very small  
(dense),

HOT BIG BANG  
general relativity.

and HOT.

difficulty: gravity is left out  
of standard model.

→ NO quantum theory of gravity

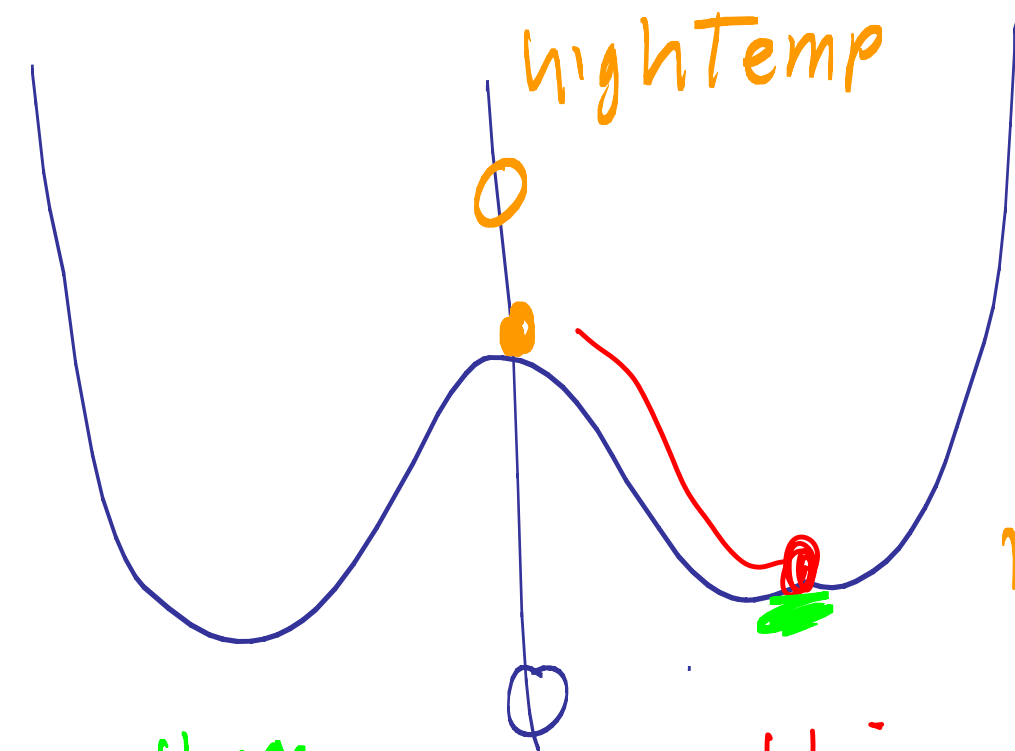
The origin of MASS.

— masses of the quarks etc

$W^\pm$   $Z$  particle masses.

— short range.

Spectrum of masses is Emergent!



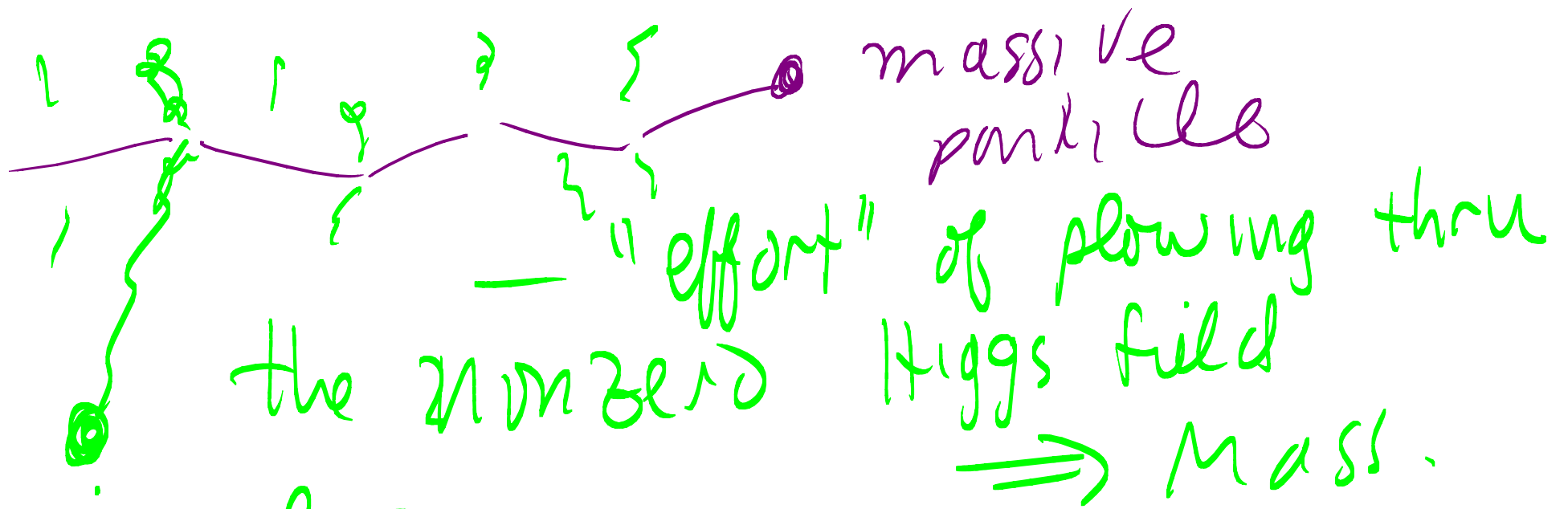
Higgs field  
 → fills the universe.

→ symmetry is broken  
 when  $T$  of universe  
 falls.

Higgs gets a non zero  
 value.

Higgs = 0

→ particle (massless)



Higgs Boson

↑ not found (yet).