\[ \sum_{n=1}^{\infty} \frac{1}{n^2} \]  

Hierarchical Problem

CSABA CSÁK

Model

Beyond the Standard
V represents the contributions of very heavy particles.

(607 bosons) (...)

At small V there will be few particles.

Validity of V

A cutoff scale of V

Meaning of V^2

Sensitivity?

\( \frac{dM_\mu}{dM_\mu} \log \left( \frac{M_\mu}{\mu} \right) \)

Gauge bosons:

A is a muon, \( \eta \) is a new symmetry. 

Fewer than \( 10^{-7} \) GV

V > 10 TeV
\[
V = 24 GeV
\]

\[
\text{is splitting}
\]

\[
\frac{m_{t}^{2}}{\text{GeV}^{2}} \sim 1.6 \text{ GeV}^{2}
\]

\[
\frac{m_{W}^{2}}{\text{GeV}^{2}} \sim (10 \text{ GeV})^{2}
\]

\[
\sqrt{m_{W}^{2}} \sim (10 \text{ GeV})
\]

\[
\sqrt{2} m_{t} \sim 10 \text{ GeV}
\]

\[
\left( \frac{m_{t}}{V} \right)^{2} \text{ Log} \left( \frac{m_{W}}{m_{t}} \right) \approx \frac{6 \text{ GeV}}{10 \text{ GeV}} m_{t} \text{ Log} \left( \frac{m_{W}}{m_{t}} \right)
\]

\[
\frac{2 m_{s}^{2}}{\text{GeV}^{2}} \approx \text{ C.m.t.}
\]

\[
\frac{2 \text{ GeV}^{2}}{\text{GeV}^{2}} \approx \text{ c.m.t.}
\]

\[
\frac{\text{Log} (\frac{m_{t}}{m_{W}})}{\text{GeV}} \approx \frac{m_{W}}{m_{t}} \text{ Log} \left( \frac{m_{W}}{m_{t}} \right)
\]

\[
\frac{\text{GeV}^{2}}{\text{GeV}^{2}} \approx \frac{\text{GeV}^{2}}{\text{GeV}^{2}}
\]

\[
\frac{1}{2 \text{GeV}^{2}} \approx \frac{1}{2 \text{GeV}^{2}}
\]

\[
\text{very heavy scalar}
\]

\[
\chi^{2} \approx \chi^{2}
\]
Large extra dimensional models
- Fundamental scale $V = \text{TeV}$ (no other high scale)

Higgs
- Composite Higgs

Scalar
- Technicolor, 11ngsless
- Pseudo-GF Higgs
- Little Higgs models
- Gauge Higgs models
- Gauge $\rightarrow$ Higgs
- Higgs unif.
- Relate scalar to gauge boson
- SUGR
- Relation between scalar & fermion
- No additional large contributions

$V \sim \text{TeV}$ - New physics $\rightarrow$ New physics is special!

Usual solutions to hierarchy
Shymanov

Clemen - Handula: no way to mix internal & space-time

mix fermions & bosons among each other

Sush: generators of symmetry are fermionic

non-syst: spin does not change


boson

down

g: et al?

Ordinary symmetries:

\( \text{Invariance of Lagrangian} \)

Intro to Sush
Basic building blocks by SUSY theories.

If SUSY unbroken \( \langle \Omega_{1110} \rangle = 0 \)

mass fermion = mass of boson

# fermions = # of bosons

SUSY algebra

\[ \text{gr} \{ c_\alpha, c_\beta \} = 2 \delta_{\alpha \beta} \]

2 fermion of T's
1) chiral superfield

2) vector superfield

2) component spinor (Weyl spinor)

- massless gauge boson

2) component spinor (Weyl spinor)

- A complex scalar

- A complex scalar

3) A complex scalar

- scalar objects, "representatives"

Superfields:

- Chiral superfields

Vector superfield:

- A complex scalar

- A complex scalar

- massless gauge boson

- component spinor (Weyl spinor)

- component spinor (Weyl spinor)

(grav. + threel.)

2 DOF

2 DOF

2 DOF

2 DOF

2 DOF

1) A complex scalar

3 DOF

2 DOF

1 DOF

4 DOF

4 DOF

Vector SF

 auxiliary field F

Weyl spinor

scalar

complex

Chiral SF

- Off-shell
Only consider the # of particles.

Fermionic function $f(x, \theta, \phi)$.

Superspace

Lagrangean?
\[ \Gamma (\theta') = \gamma (\gamma) + \theta \gamma (\hat{r}) + \theta^2 \hat{r}(\gamma) \]

\[ D \phi = 0 \rightarrow \text{Chiral SF} \]

\[ \phi = \phi \rightarrow \text{Vector SF} \]

\[ V = V \rightarrow \text{Vector SF} \]

Imposing a condition that is such that continuous both vector obtained

\[ \theta = \theta' \]

\[ \theta \]

\[ \frac{x}{\theta} \]

\[ \theta \gamma (\hat{r}) + \theta^2 \hat{r}(\gamma) + \theta \gamma (\hat{r}) + \theta^2 \hat{r}(\gamma) \]

\[ f(x, \theta', \hat{r}) = f(x) + \theta y(x) + \theta \tau(x) \]