

atomic physics

particle physics

new physics

discrete spectra

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Maxwell  
Oskar Klein  
Gordon  
Dirac  
Weyl  
Elie Cartan  
Majorana  
Yukawa  
Brout  
Englert

$G$

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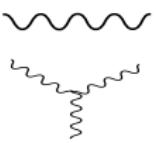
$$\overset{\Rightarrow}{\longrightarrow}\quad \overset{\Leftarrow}{\longleftarrow}$$

$$\varphi\in \mathcal{H}_S$$

$$\textcolor{blue}{g},\lambda,\mu\in\mathbb{R}_+$$

$$\textcolor{blue}{g}_Y\in\mathbb{C}$$

$$\mathcal{L}[A, \psi, \varphi] = \frac{1}{2} \text{tr} (\partial_\mu A_\nu \partial^\mu A^\nu - \partial_\mu A_\nu \partial^\nu A^\mu)$$



$$+ g \text{ tr} (\partial_\mu A_\nu [A^\mu, A^\nu])$$



$$+ g^2 \text{ tr} ([A_\mu, A_\nu] [A^\mu, A^\nu])$$



$$+ \bar{\psi} \not{\partial} \psi$$



$$+ i g \bar{\psi} (\tilde{\rho}_L \oplus \tilde{\rho}_R)(A_\mu) \gamma^\mu \psi$$

$$A_\mu \in \text{Lie}(\textcolor{red}{G})^\mathbb{C}$$



$$+ \frac{1}{2} \partial_\mu \varphi^* \partial^\mu \varphi$$

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$$+ \frac{1}{2} g \{ (\tilde{\rho}_S(A_\mu)\varphi)^* \partial^\mu \varphi + \partial_\mu \varphi^* \tilde{\rho}_S(A_\mu)\varphi \}$$

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$$+ \lambda \varphi^* \varphi \varphi^* \varphi$$



$$g, \lambda, \mu \in \mathbb{R}_+$$



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$g_Y$ 's  $\leadsto$  fermion masses and mixings.

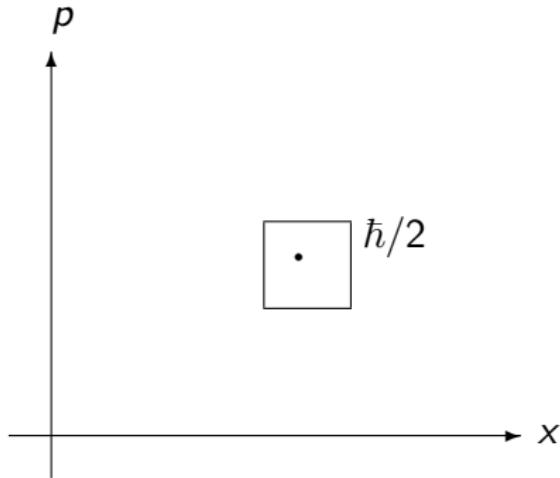
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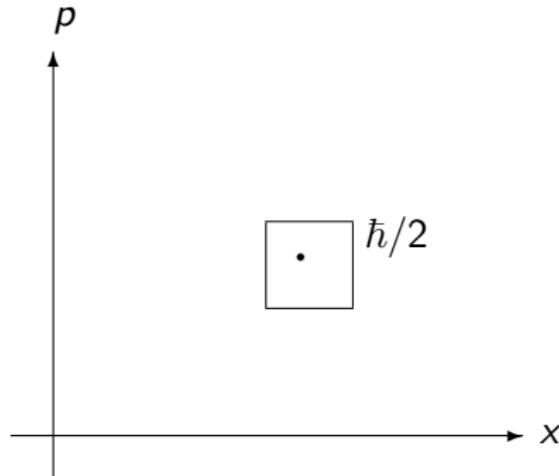
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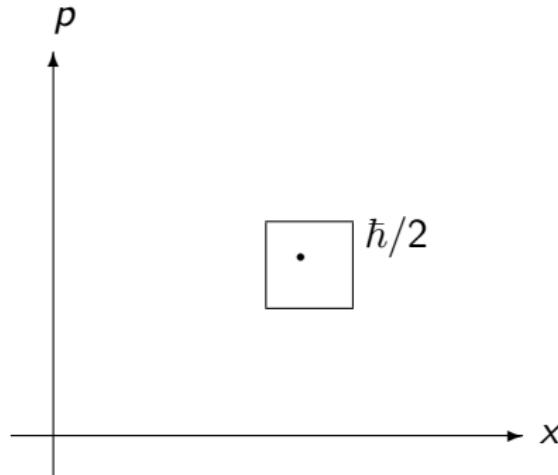


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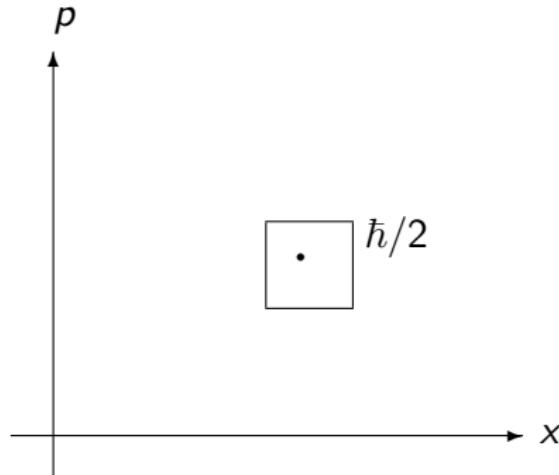
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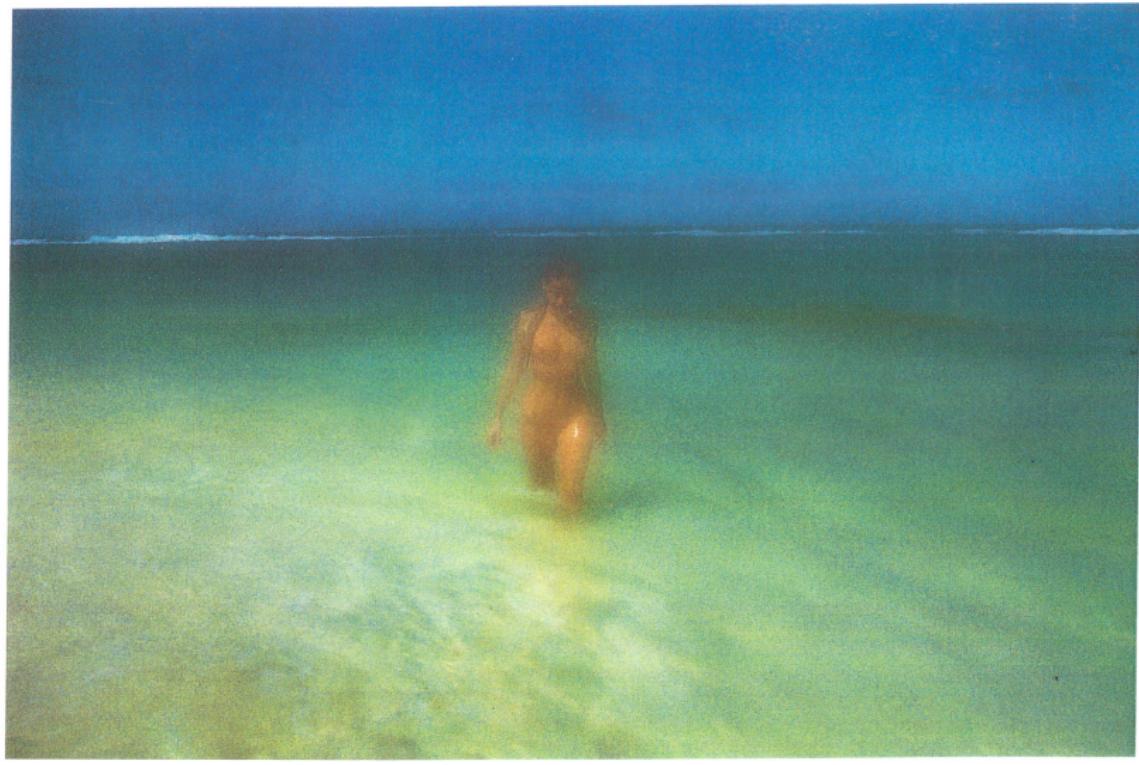
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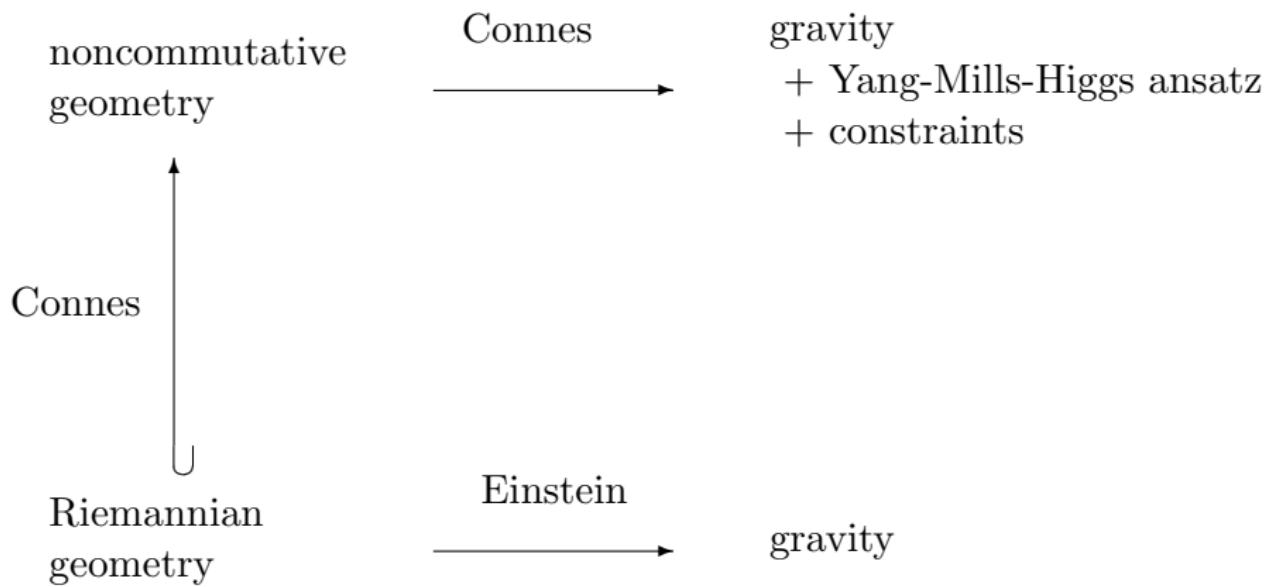
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Example (D. Hamilton, 1996)







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Examples:  $\text{Aut}(\mathcal{C}^\infty(M))^e = \text{Diff}(M)^e$ ,  $\text{Aut}(\mathbb{H}) = SU(2)/\mathbb{Z}_2$ ,  
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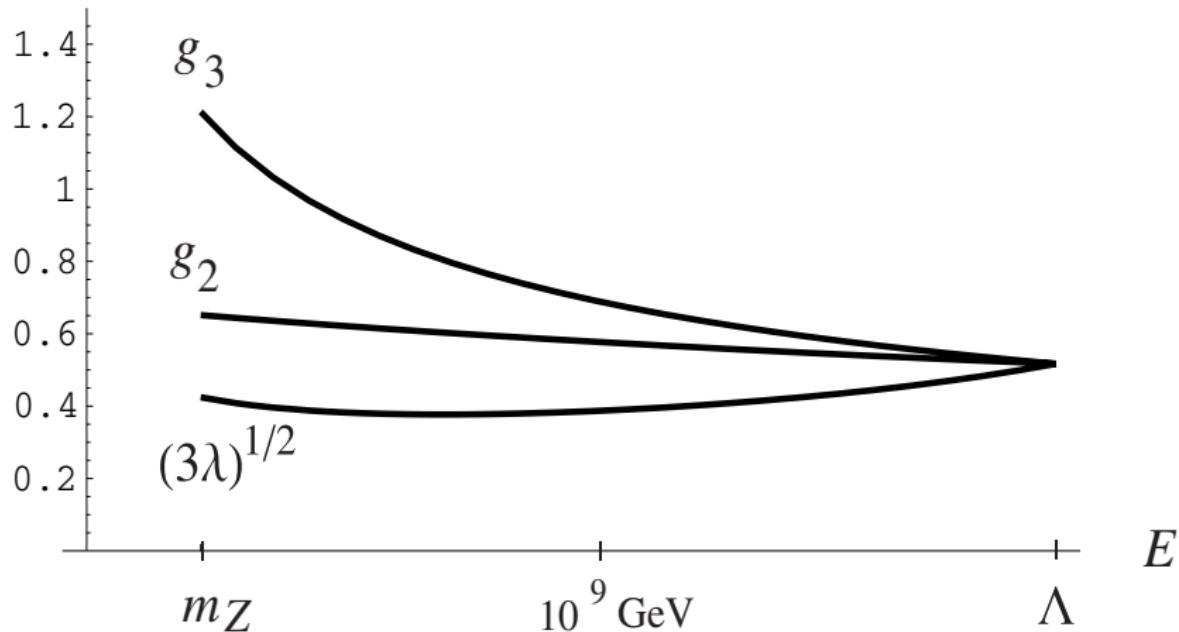
## Constraints on continuous parameters:



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if we believe in big desert and standard renormalisation group flow.



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( $m_t = 171.3 \pm 2.3$  GeV.)

## Higgs-mass predictions in the literature:

- ▶ 93 predictions from 114 GeV to  $10^{18}$  GeV leaving
- ▶ 3 empty intervals: 600 – 739, 781 – 1800, 2000 –  $10^{18}$  GeV
- ▶ E-theory,  $m_H = 161.8033989$  GeV

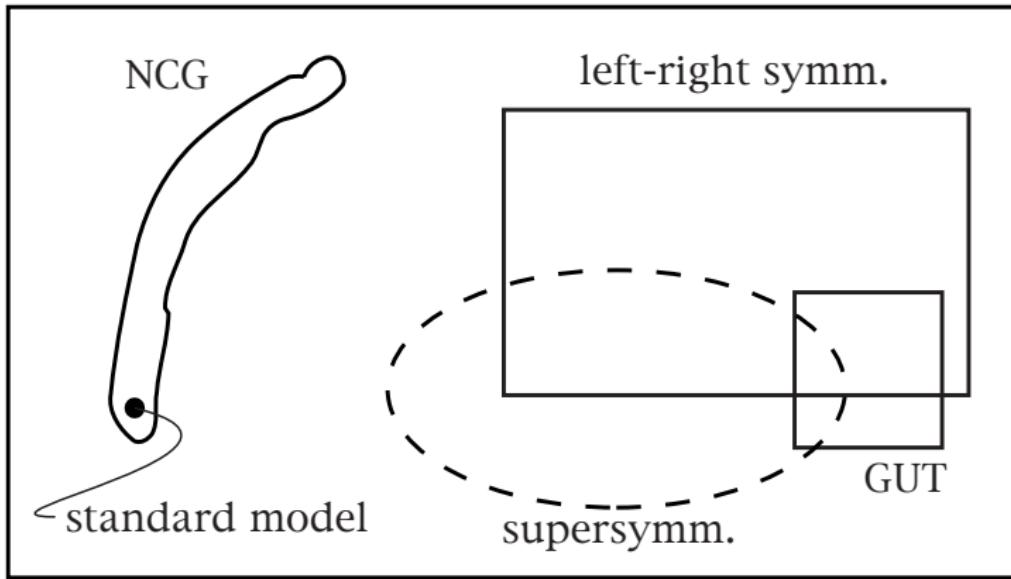
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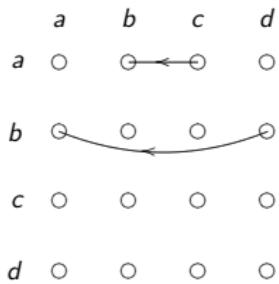
a few classes of models:

- ▶  $su(2) \oplus u(1) \subset su(2|1)$ , 4 predictions
- ▶ super symmetry, 41 predictions
- ▶ super string (inspired), 2 predictions
- ▶ E-theory,  $m_H = 161.8033989$  GeV
- ▶ extra dimensions, 11 predictions
- ▶ cancelation of a particular 1-loop divergence, 8 predictions  
e.g. quadratic: 309 GeV Decker & Pestieau 1979, Veltman 1981
- ▶ lattice gauge theory, 2 predictions
- ▶ cosmology (CMB), 11 predictions

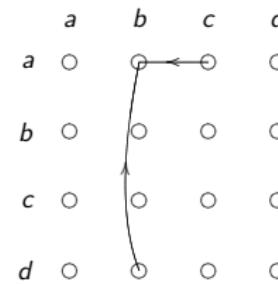
## Yang-Mills-Higgs



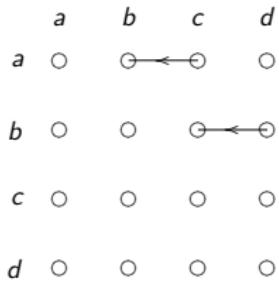
pseudo-force	transformation	simpler force	geometry	time
centrifugal, Coriolis	rotations	0	Euclid	absolute
magnetic	Lorentz	electric	Minkowski	universal
gravitational	general coordinate	0	Riemann	proper $\tau$
elect.-magn., weak, strong	gauge	gravitational	NCG	$\Delta\tau \sim 10^{-41}$ s



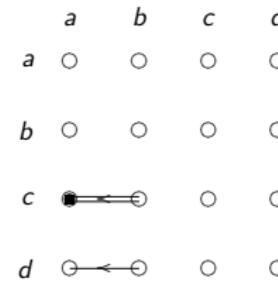
diag. 1



diag. 2



diag. 3



diag. 4

*Jureit & Stephan 2007:* the irreducible Krajewski diagrams (Dynkin and weight diagrams) with 4 or less simple algebras in  $KO$  dimension 6. Diag. 4 yields the standard model with one generation of fermions and a massless neutrino.