

# 3 minutes talk

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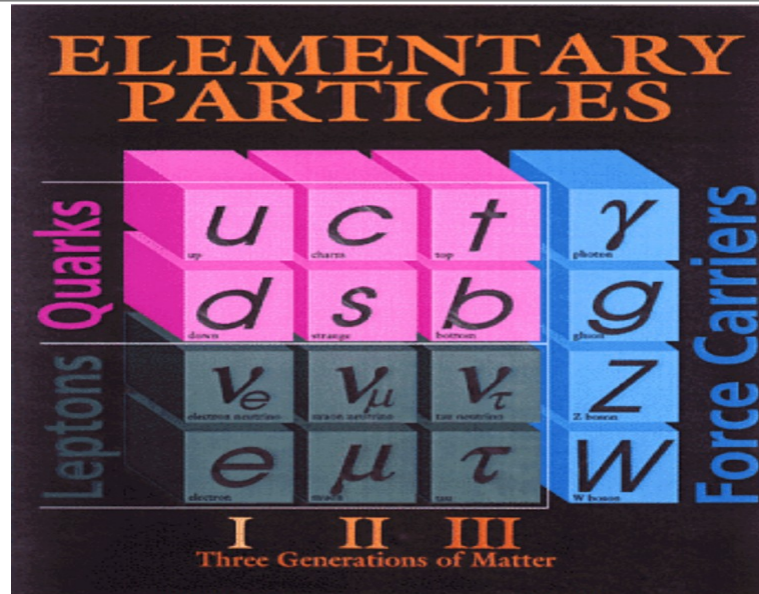
**Research Area: Theoretical Particle Physics**

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# Particle physics: where are we

SM proposed by  
Glashow, Weinberg, Salam  
during the sixties



+ Higgs boson

- **Standard Model (SM)** theory successfully describes all known **interactions** between fundamental matter constituents: **quarks and leptons**
- All SM particles acquire masses by the Higgs mechanism **that predicts the Higgs boson (spin-0)**
- **Higgs boson discovered in 2012** at the Large Hadron Collider (LHC) at CERN with **mass  $\sim 125$  GeV**
- **All measurements in perfect agreement with SM predictions !**
- **NO signals of New Physics so far**

# Why do we need New Physics then ?

Mystery in Hierarchy of SM Yukawa's

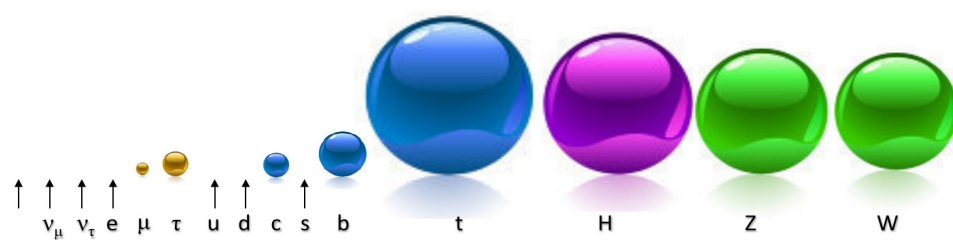
■ SM does not explain:

- origin of **Dark Matter**

- mass hierarchy of SM fermions →

$$\mathcal{L}_{Y_f} \sim \frac{m_f}{v} \bar{f} f H$$

$m_f$ 's span many orders of magnitudes...



- baryon-antibaryon asymmetry in the Universe (requiring add. CP violation)

- why Higgs boson mass is so light (large UV corrections expected)

■ Many New Physics (NP) models proposed: **Supersymmetry, composite Higgs, extra-dimensions, etc.** well explored at the LHC

■ **Maybe NP could be more exotic → ultralight and feebly coupled**

■ Possible candidate the **Dark Sector**

# voyage into the dark sector..



- Dark sector made of new particles neutral to SM interactions
  - dark-fermions, dark-scalars, dark-gauge-bosons, higher spins...
- It can have its own interactions (mediated by dark-photons, etc..)
- Can explain the origin of Dark Matter and Flavor hierarchy problem

# Current research projects

national and international  
collaborations

- Exploring phenomenological implications of **Dark Sector** models and their **SM** portals at the **LHC** and future  **$e^+e^-$**  and **muon - antimuon colliders**
- Analyzing signatures and production mechanisms for **dark-bosons** , **dark-fermions**, **axion-like particles**, **massive gravitons**
- Searching for direct and indirect effects of Dark Sector in low energy experiments:
  - **$g-2$**
  - **light meson decays**
  - **neutron lifetime puzzle**

# Other theoretical research lines

- B meson and top-quark physics
- testing QM and New Physics with Bell inequalities at high energy
- Searching for NP in the Higgs boson rare decays
- Electro-Weak radiative corrections to gravitational processes (including FCNC graviton interactions)