4. Generation

- Experimentally not excluded

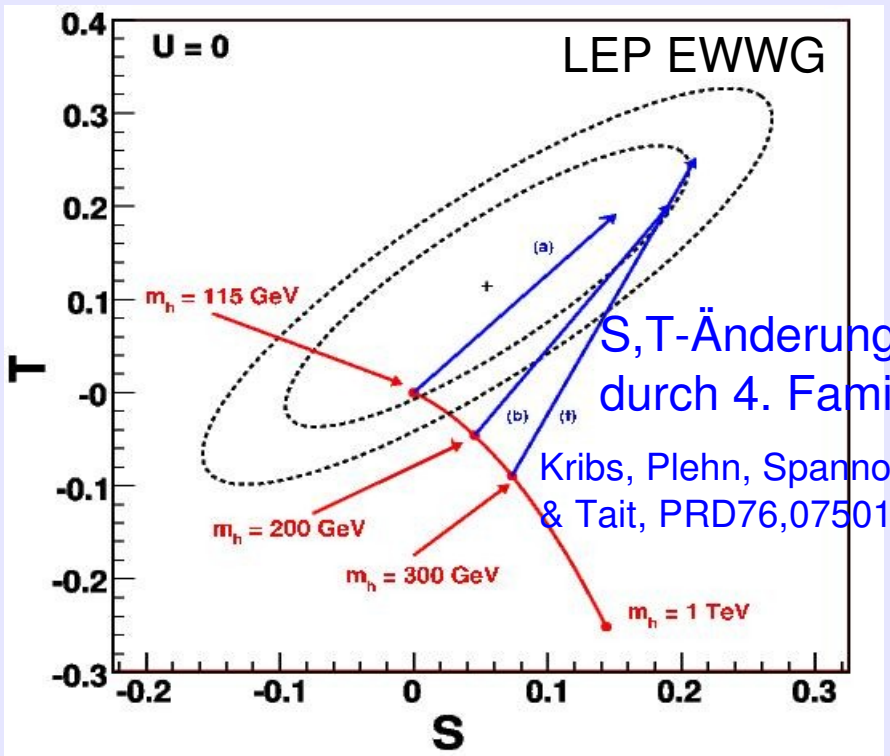
  ... and LHC can rule it out or find it

LEP2: $m_{\nu_4, l_4} > 100$ GeV

Tevatron: $m_{u_4, d_4} > 258$ GeV

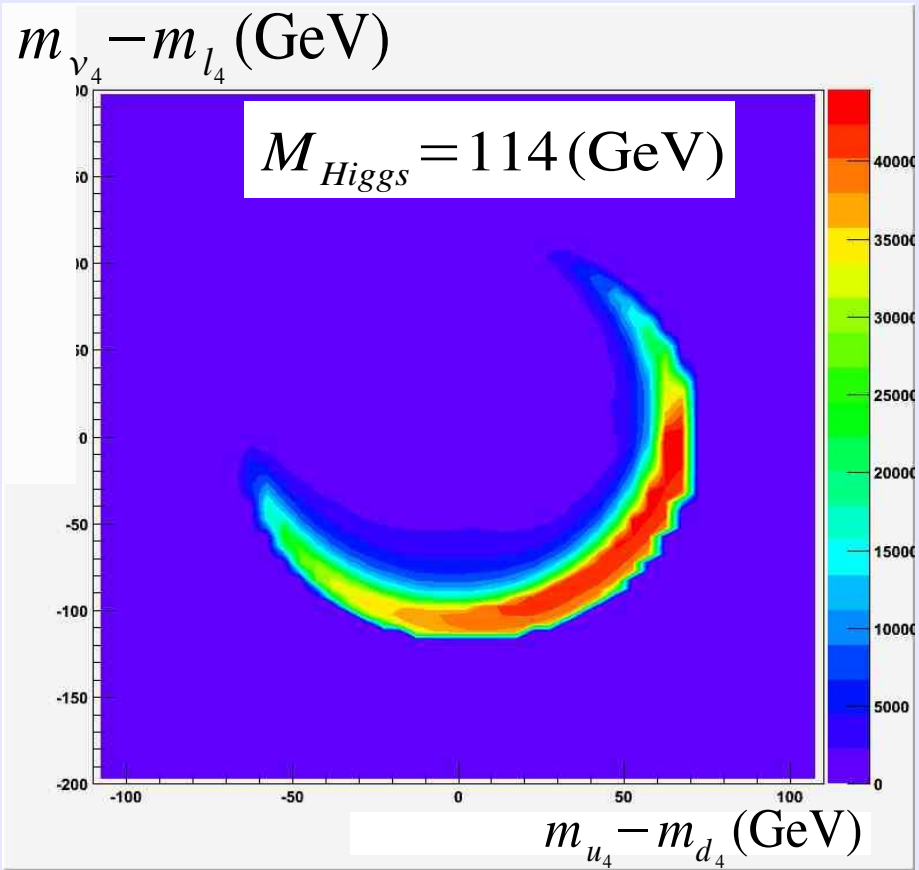
- Theoretically interesting (Baryogenesis, EW Symmetry Breaking, gauge coupling unification)

Constraints:



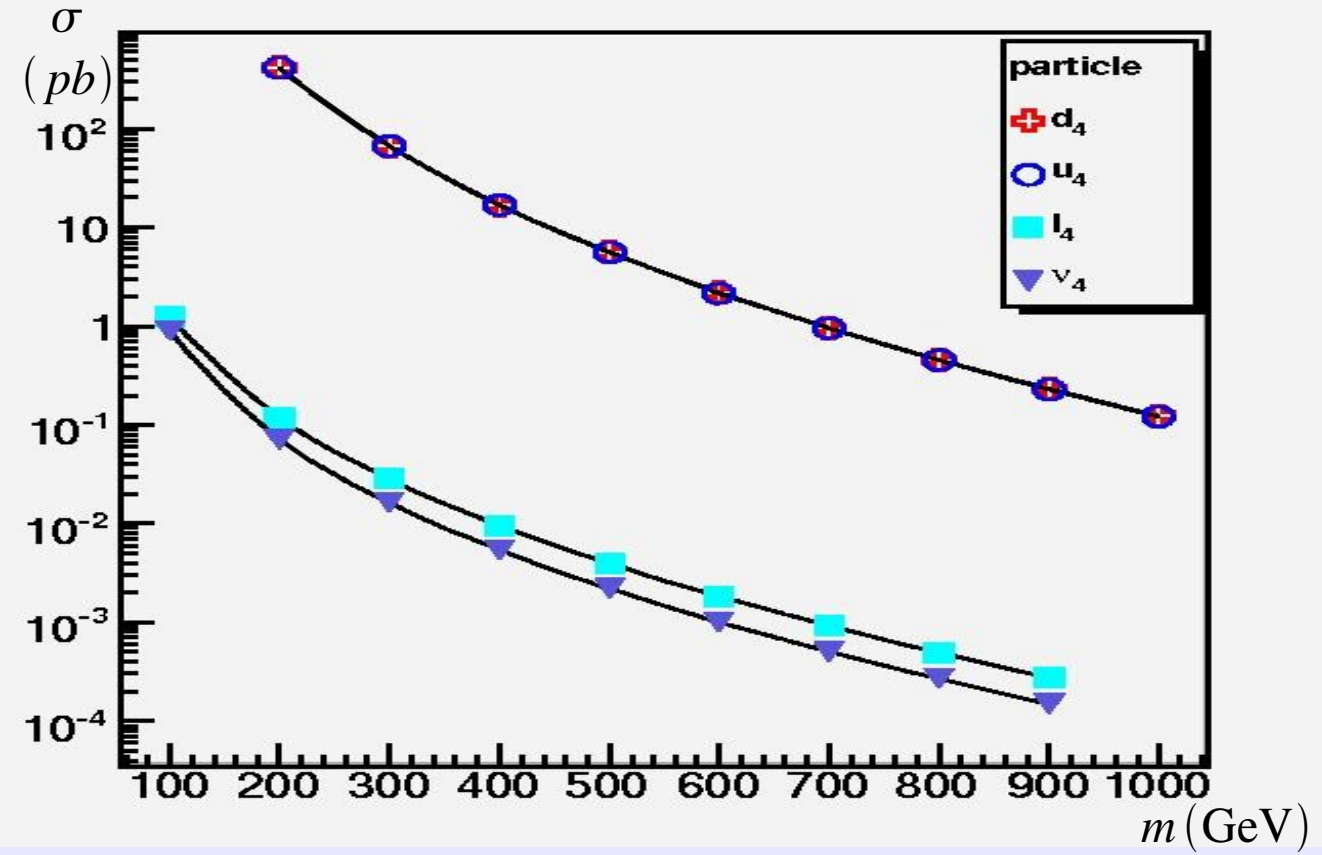
S,T-Änderung durch 4. Familie

Kribs, Plehn, Spannowsky & Tait, PRD76,075016 (2007)



4. Generation

- Production at LHC:



- First studies with 4 bachelor theses (March 08 - July 08):

  cross sections, mixing angles, decay widths, branching fractions

  with theoretical support from Tilman Plehn and Michael Spannowsky

- Current man Power (HU Berlin): Rocco Mandrysch, Heiko Lacker
  Malik Aliev (starting in June 2008)

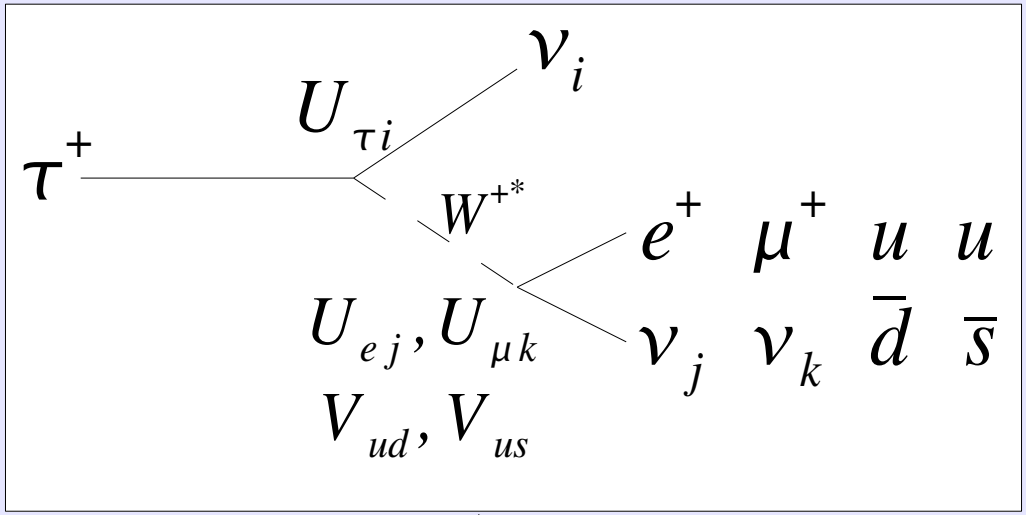
Backup - Mixing in Lepton Sector

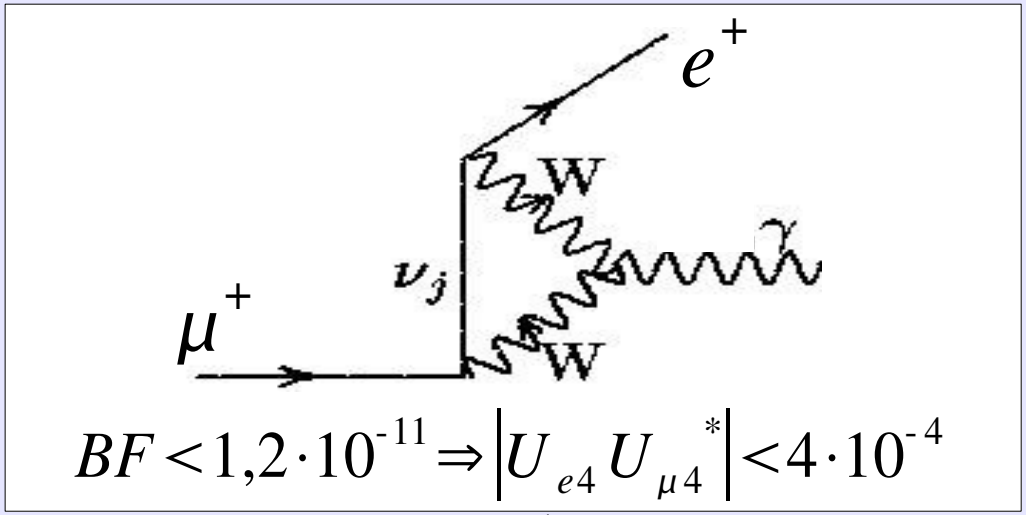
$$|U^{3\times3}| = \begin{pmatrix} 0.85 & 0.5 & <0.18 \\ 0.4 & 0.6 & 0.7 \\ 0.4 & 0.6 & 0.7 \end{pmatrix}$$

Neutrino Oscillations

Weak constraints w/o 3x3-Unitarity!

Constraints on 4th generation from:





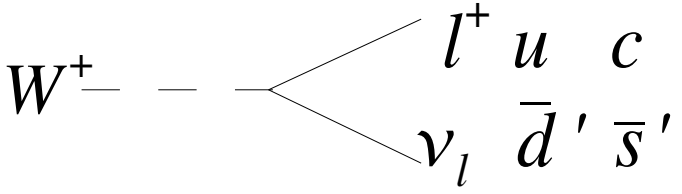
+ Neutrino Oscillations

$$|U^{4\times4}| = \begin{pmatrix} 0.85 & 0.5 & <0.18 & <0.08 \\ 0.4 & 0.6 & 0.7 & <0.05 \\ 0.4 & 0.6 & 0.7 & <0.1 \\ <0.08 & <0.08 & <0.08 & >0.99 \end{pmatrix}$$

Backup - Mixing in Quark Sector

Direct measurements:

$$|V_{CKM}^{3\times3}| = \begin{pmatrix} 0.9738 & 0.225 & 0.0039 \\ 0.22 & >0.85 & 0.041 \\ <0.14 & <0.5 & >0.78 \end{pmatrix}$$



3x3-Unitarity: 1 + 1

$$|V_{CKM}^{4\times4}| = \begin{pmatrix} 0.9738 & 0.225 & 0.0039 & <0.06 \\ 0.22 & 0.96 & 0.041 & <0.22 \\ <0.1 & <0.2 & >0.78 & <0.65 \\ <0.1 & <0.22 & <0.65 & >0.78 \end{pmatrix}$$

Backup - Life times & Branching Fractions

$M_W > m_{u_4} - m_{d_4} > 0$ & sufficient mixing with generation 1-3:

$u_4 \to W + d, s, \underline{b}$

$d_4 \to W + t(u, c)$ dominant at large (small) masses

τ_{u_4}, τ_{d_4}: usually very short

Tiny mixing => macroscopic flight distances in ATLAS (cm-m)

$m_{l_4} - m_{\nu_4} > 0$: $\nu_4 \to W + e, \mu, \tau$ $l_4 \to W + \nu_4(\nu_e, \nu_\mu, \nu_\tau)$

For tiny mixing with Generation 1-3 $\Rightarrow$ Large τ_{ν_4}