SUSY BSM

Thomas Hebbeker

Aachen IIIA

FSP-CMS

DESY-Zeuthen

Sept. 2007

C.A.Savoy

world

germany

cms

cms germany

world

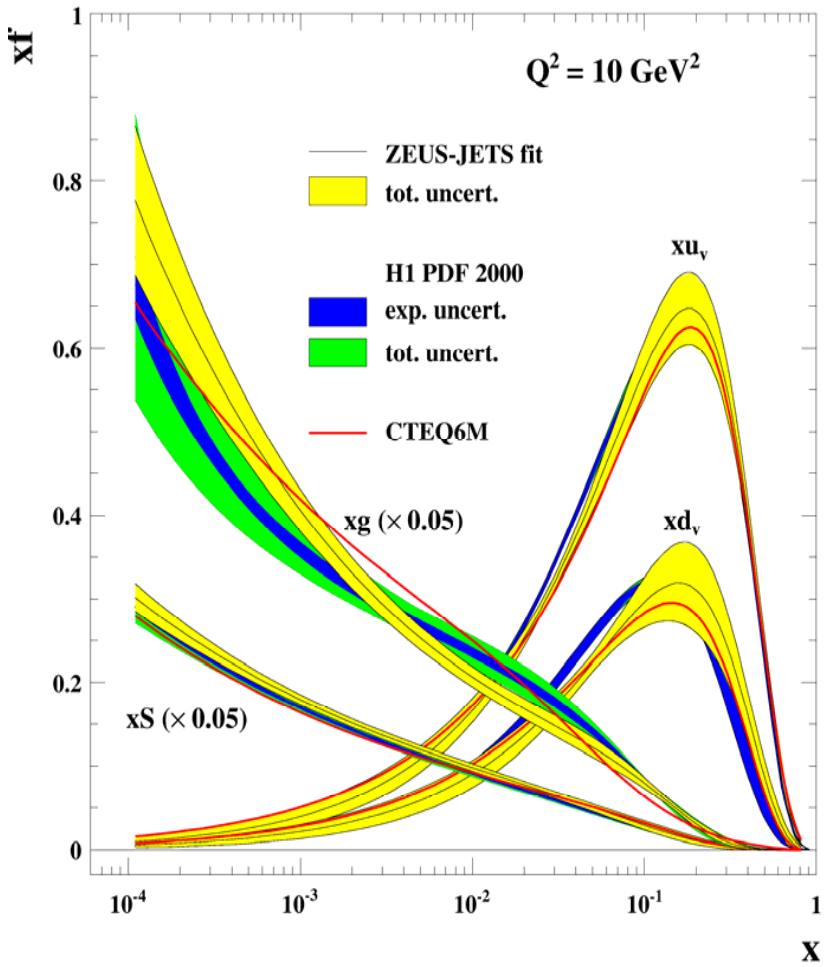
news from conferences, preprints…

SUSY 2007 Karlsruhe EPS 2007 Manchester Lepton Photon 2007 Korea

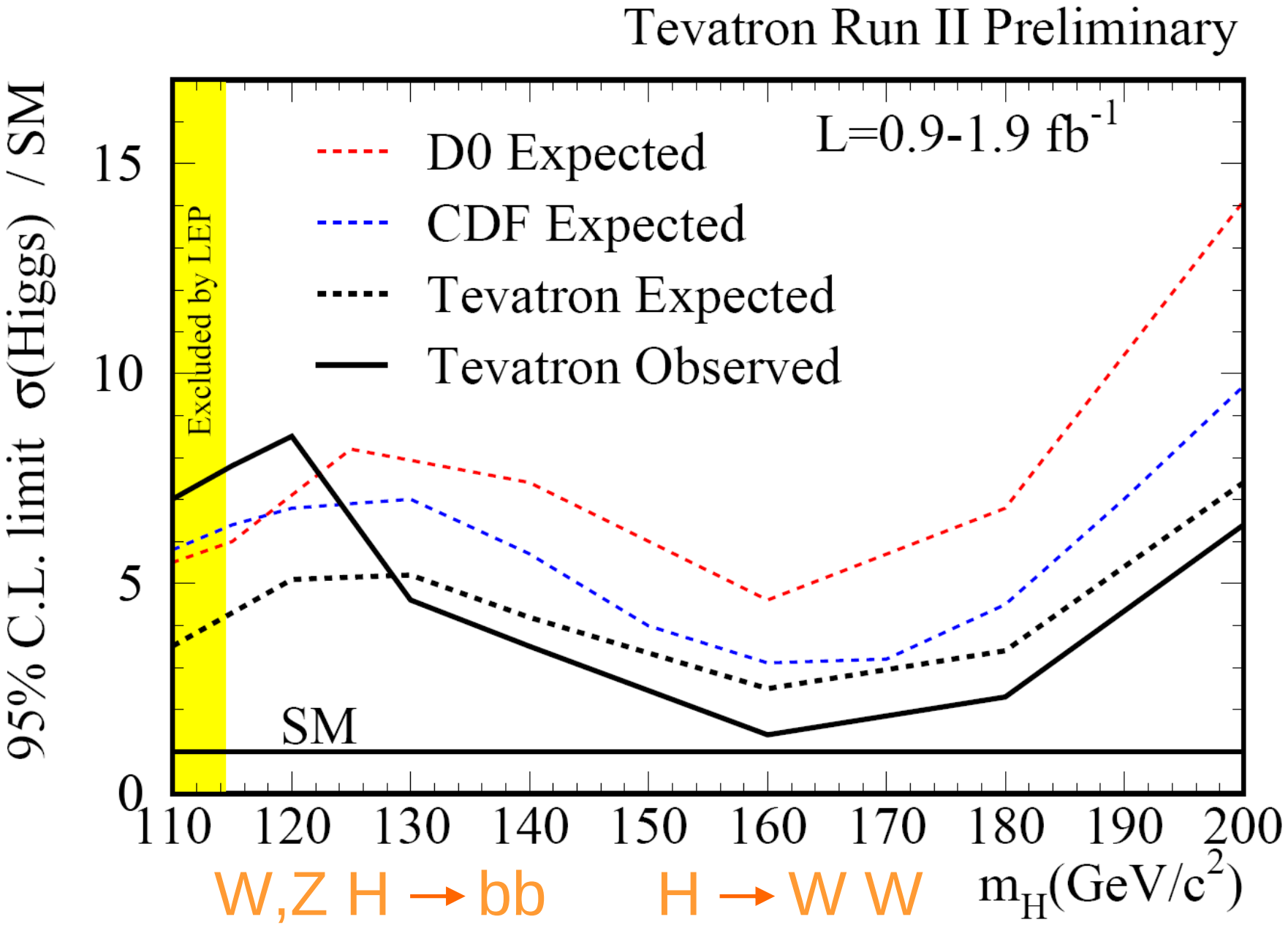
- **experiment**
  - Hera end
  - Tevatron:
    - (SUSY) higgs ?
    - first limits > 1 TeV
  - indirect limits !

300 GeV e p
2 x 0.5/fb
1992 – 2007

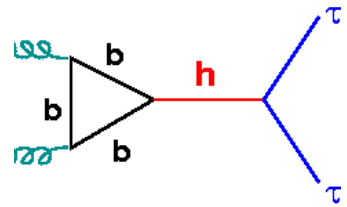
- **theory**
  - little higgs
  - unparticles

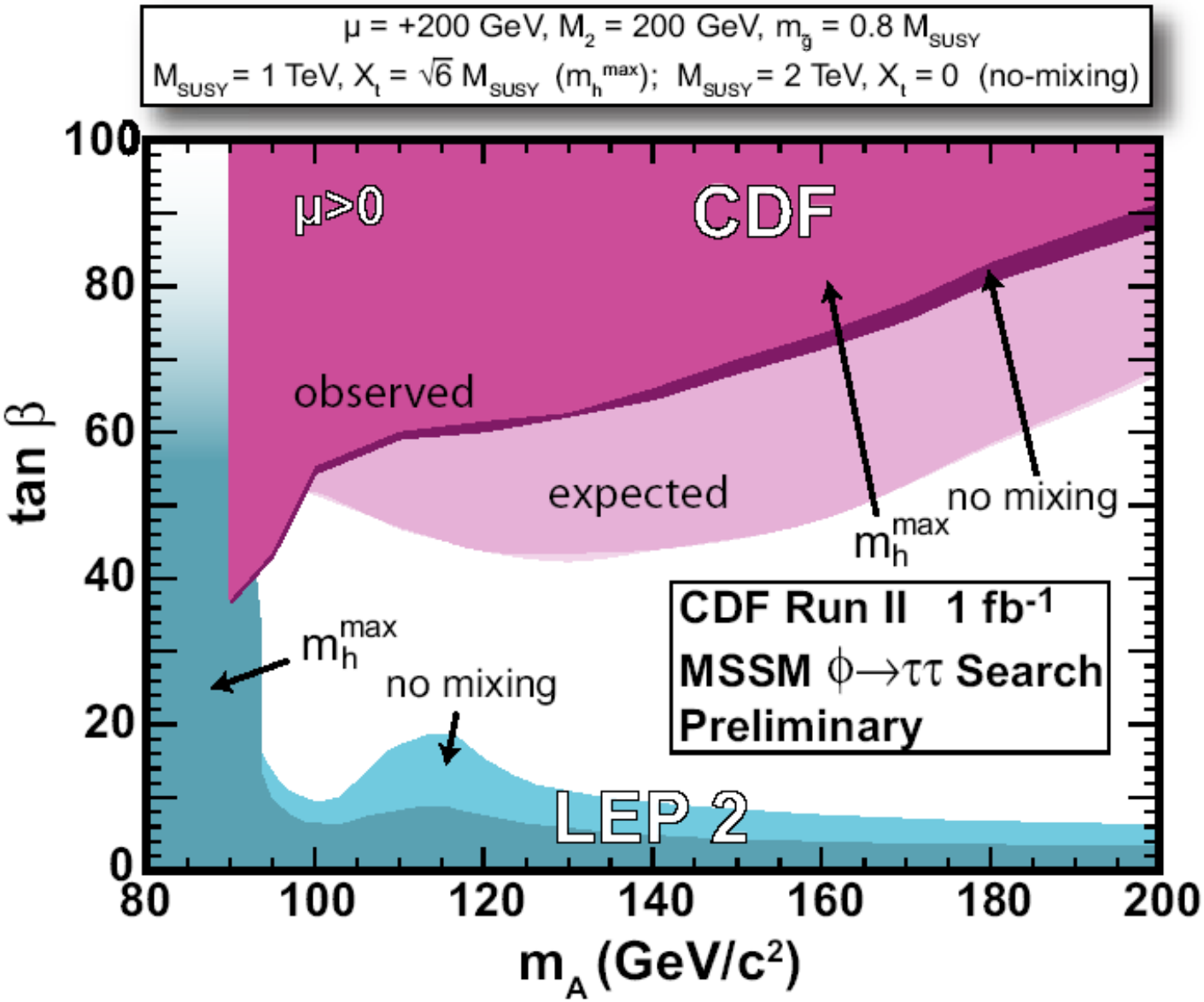


world SM higgs search tevatron



$h, H, A \to \tau\tau$





CDF:

slight excess

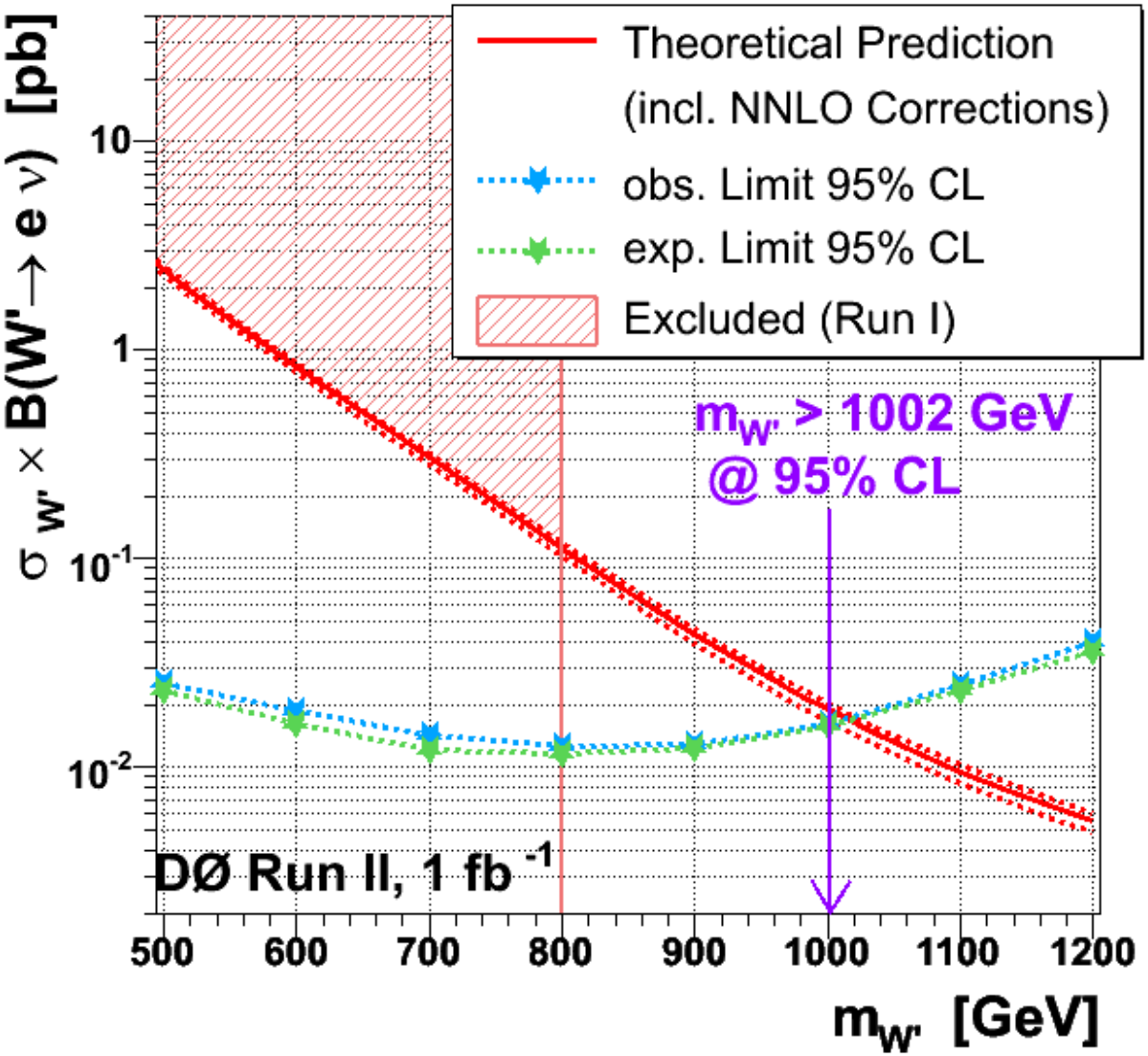
D0:

Nothing

Sensitivity:

$\tan\beta \sim 50$

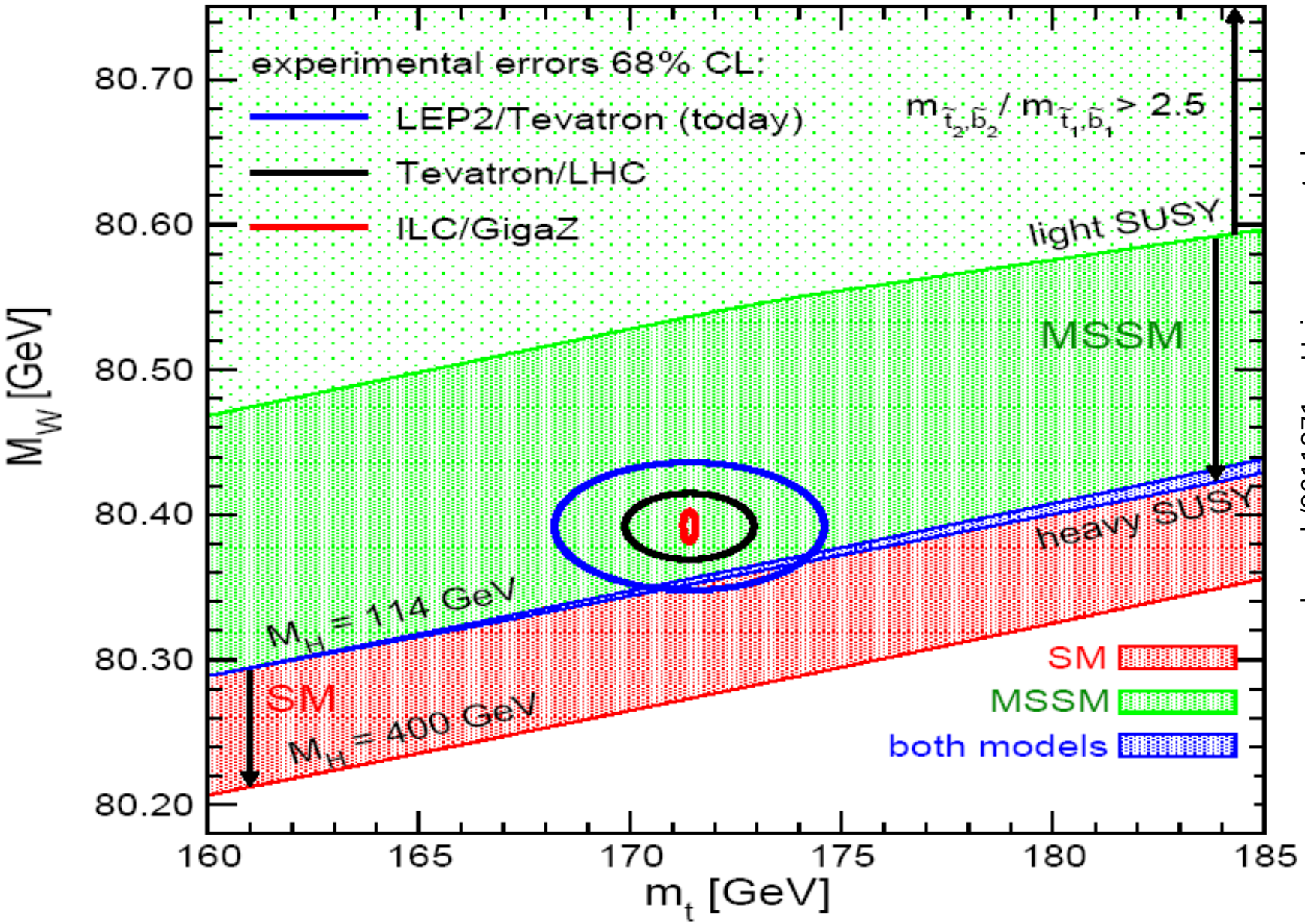
world Tevatron search new vector bosons



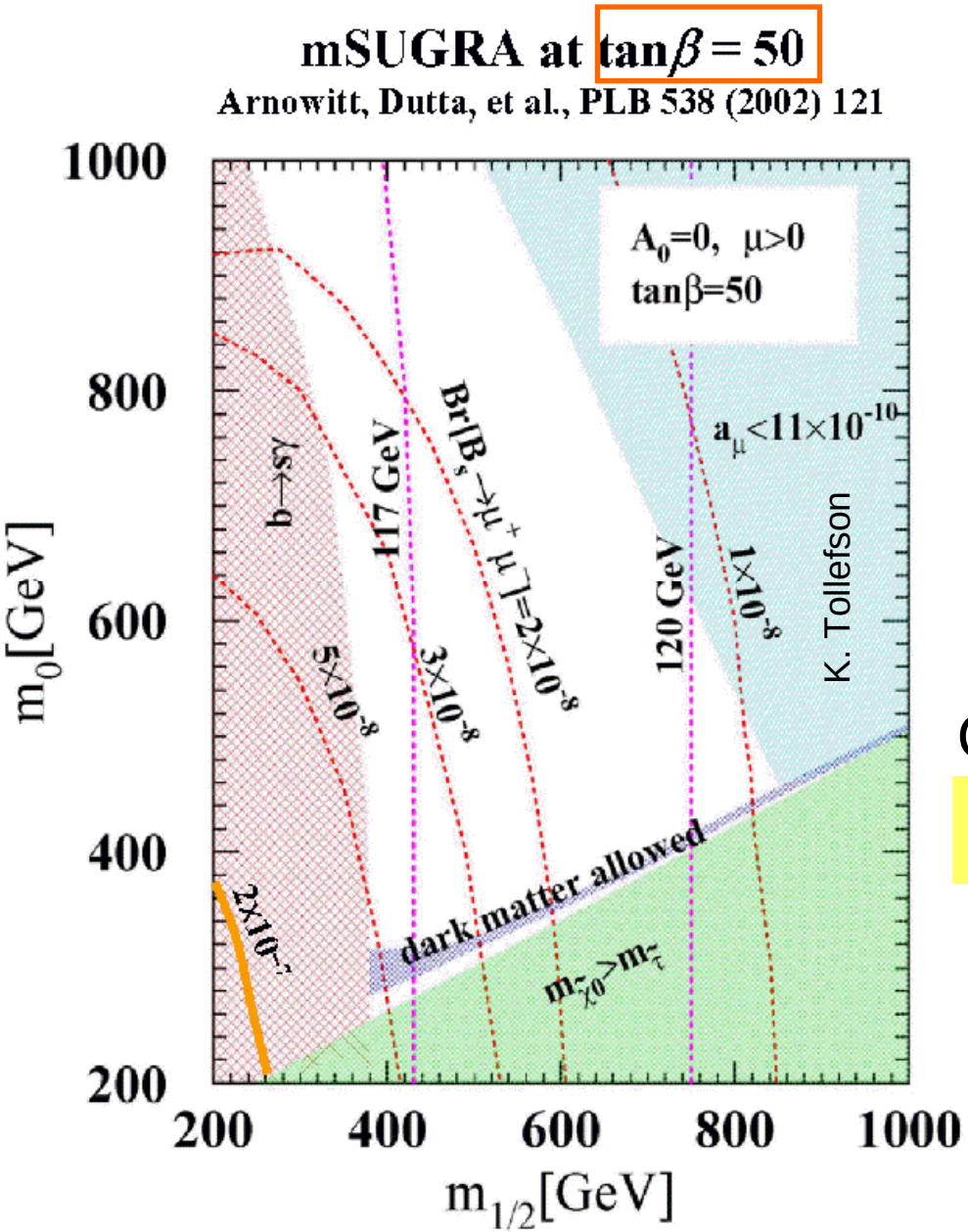
first direct search limit > 1 TeV

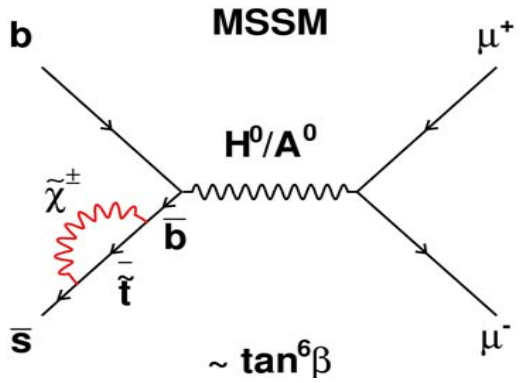
D0: $W' \to e\nu$, $L = 1$ fb^{-1} $m_{W'} > 1002$ GeV @ 95% CL

world electroweak and MSSM



hep-ph/0611371 Heinemeyer et al

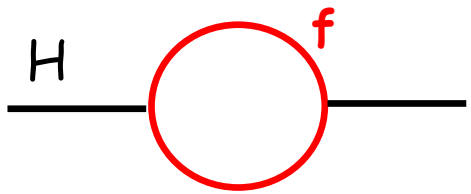




CDF (prel.):

$BR(B_s \rightarrow \mu\mu) < 5.8 \times 10^{-8}$

„hierarchy problem“



$$\Delta m_H^2 = \frac{|\lambda_f|^2}{16\pi^2}[-2\Lambda_{UV}^2 + 6m_f^2 \ln(\Lambda_{UV}/m_f) + \ldots] \longrightarrow \textbf{HUGE}$$

possible solutions:

a) Add SUSY partner loops: same coupling, negative sign !

b) „little higgs“ theories (Arkani-Hamed et al, 2001)

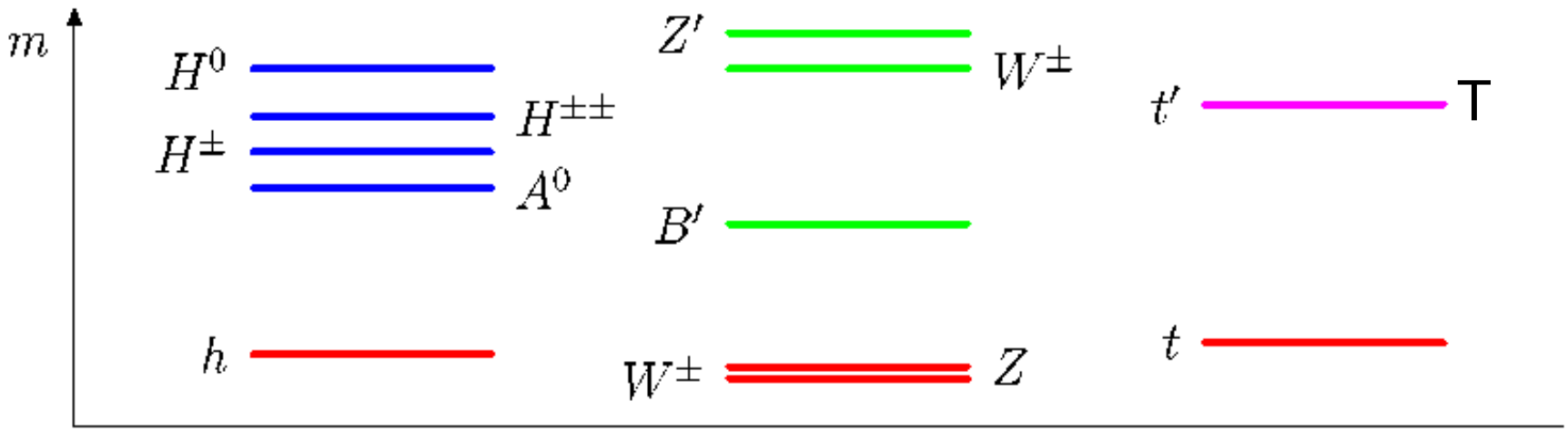
higgs = (pseudo) goldstone boson (new global symmetry)

new fermions (bosons) to cancel fermion (boson) loops !!!

➡ one light higgs, heavy new particles, no SUSY !

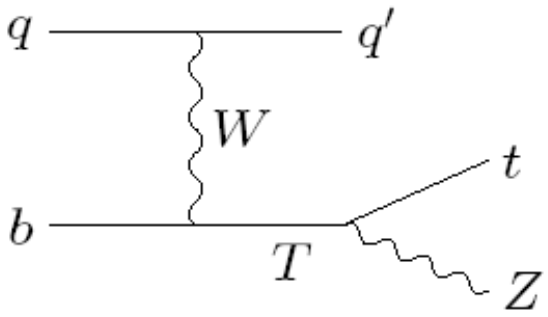
new heavy (> TeV) particles:

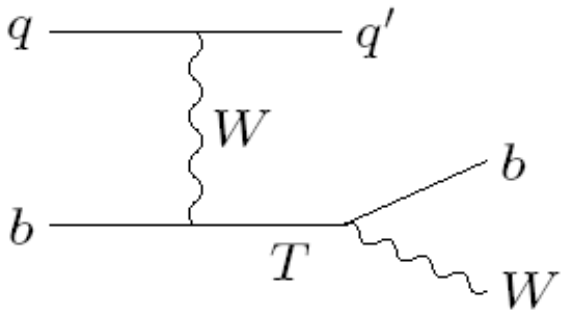
- vector bosons
- fermions, in particular top partner t‘ = T
- higgs scalars



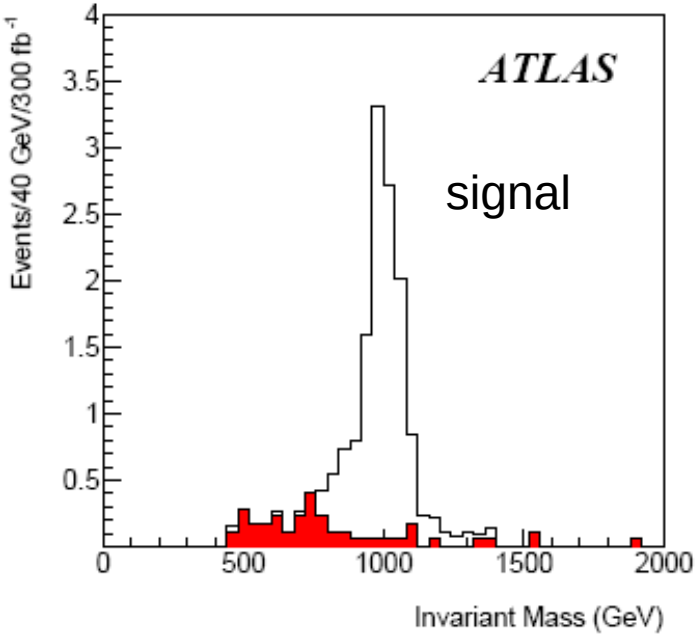
W. Kilian

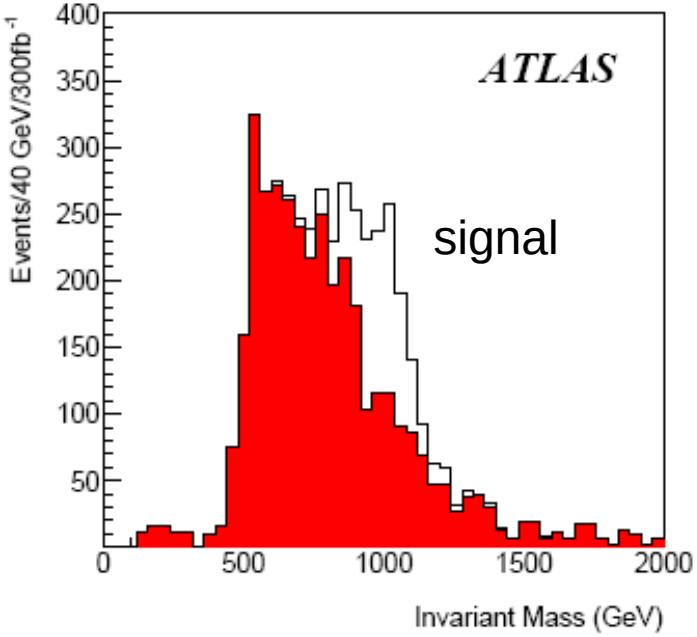
- Top partner T:





⇨ leptons + (b-) jets





LHC reach ~ 2 TeV

world unparticles

H. Georgi, Phys. Rev. Lett. 98, 221601 (2007):

Unparticle stuff with scale dimension $d_{\mathcal{U}}$ looks like a non-integral number $d_{\mathcal{U}}$ of invisible particles.

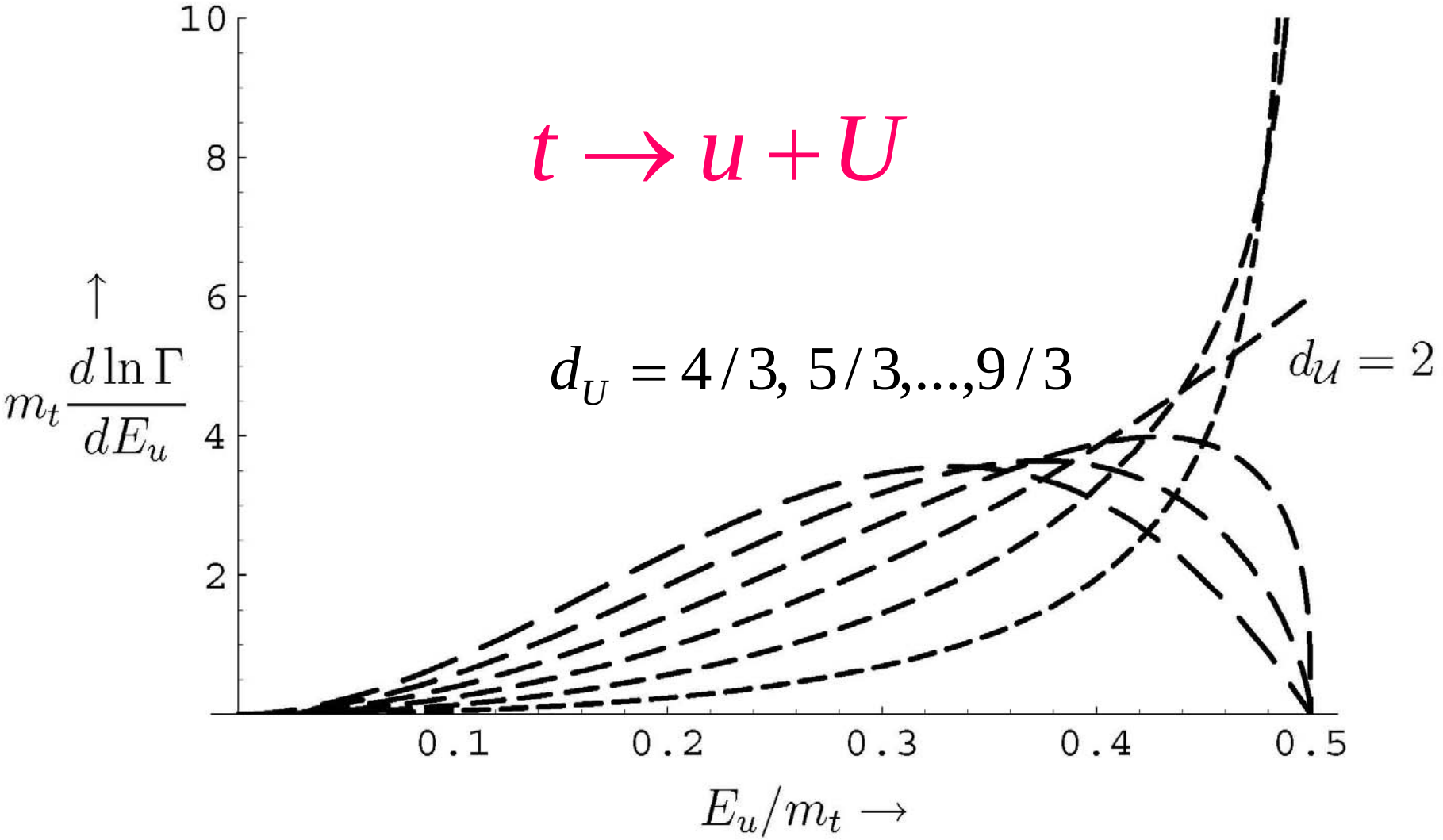
…sector interacting weakly with SM ….

…scale invariant, therefore no fixed particle mass …

…fields scale with dimension d_U …

See also J.J. Van der Bij and S. Dilcher, hep-ph/0707.1817 and references therein

unparticle signature : missing energy



H. Georgi, Phys. Rev. Lett. 98, 221601 (2007)

unparticle signature at LHC: virtual contribution to Drell Yan

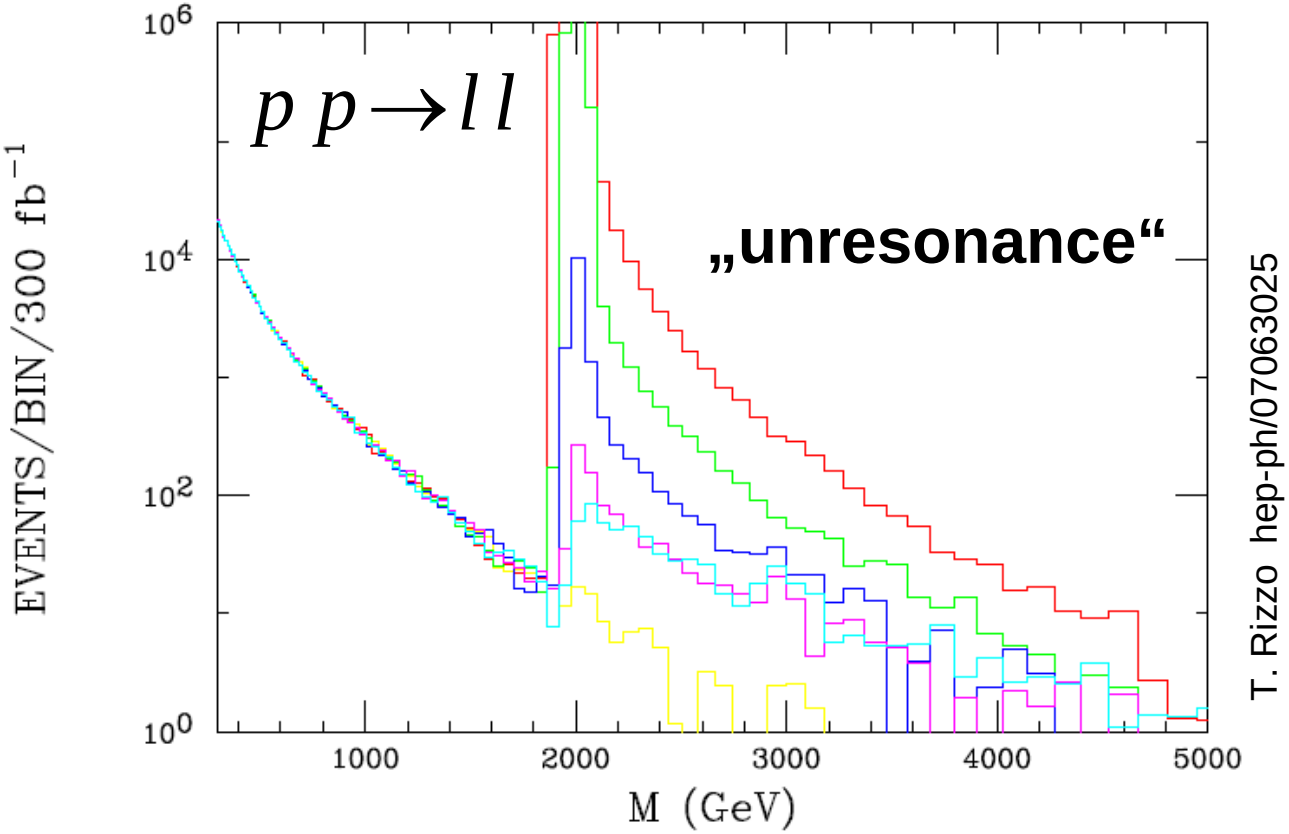


Figure 6: Drell-Yan dilepton mass distribution at the LHC with high luminosity assuming $\mu = 2$ TeV with $\Lambda = 1(2)$ TeV in the top(bottom) panel. The yellow histogram is the SM prediction while the red(green,blue,magenta,cyan) histograms corresponds to d=1.1(1.3,1.5,1.7,1.9), respectively.

germany LHC-D workshops SUSY/BSM

- Aachen, March 2006
- Bonn, February 2007
- Hamburg, Dec. 2007 (HGF)

working groups:

- **SUSY/BSM parameter determination and benchmarks**
  (conveners K. Desch and W. Porod)
- **SUSY/BSM tools** (conveners W. de Boer and F. Krauss)
- **Model independent searches**
  (conveners P. Biallass and S. Caron)

http://web.physik.rwth-aachen.de/~mkraemer/BSM/

convenors: Maria Spiropulu , Sarah Eno

working groups:

- WG1: Leptonic searches (SUSY) $e, \mu + X$
- WG2: Hadronic searches (SUSY) $jets + MET$
- WG3: HSCP and photonic searches (GMSB) *heavy stable charged particle*
- WG4: High Energy Pair Searches (U(1)-prime/ED/other)

http://cmsdoc.cern.ch/cms/PRS/susybsm/

convenors: Maria Spiropulu , Sarah Eno

working groups:

- WG1: Leptonic searches (SUSY) $e, \mu + X$

  $\tilde{\chi}_2 \to ee\,\tilde{\chi}_1$

- WG2: Hadronic searches (SUSY) $jets + MET$

  $\tilde{q} \to q\,\tilde{\chi}$

- WG3: HSCP and photonic searches (GMSB) *heavy stable charged particle*

  $\tilde{\tau}$ $\tilde{\chi} \to \tilde{G}\,\gamma$

- WG4: High Energy Pair Searches (U(1)-prime/ED/other)

  $Z' \to \mu\mu$

http://cmsdoc.cern.ch/cms/PRS/susybsm/

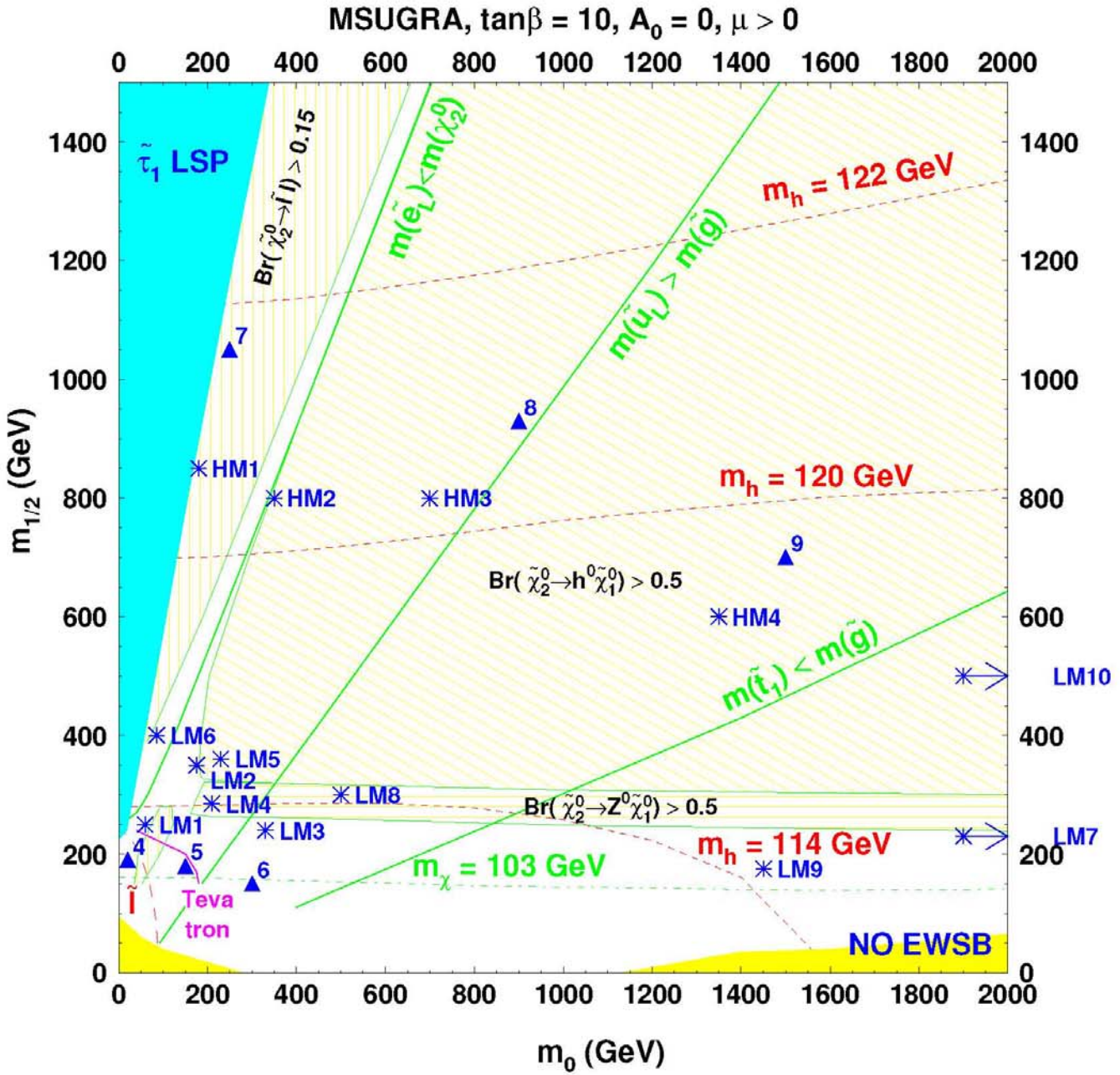
cms msugra benchmark points

HM =

High Mass

LM =

Low Mass



current global activities:

- „data“:

  (pre-) CSA07: 150 million MC events

  SUSY/BSM: ~ 70 samples (LM1, LM2, ….)

  100k events each, simulated and reconstructed

  ⇨ skimming

- tools:

  susy analyzer

  „prototype of code to perform a physics analysis, mainly in view of SUSY searches“

  susy tools

  „SusyTools is an attempt to refactor SusyAnalyzer in a more "CMSSW framework"-like“

working groups:

- WG1: Leptonic searches (SUSY)

  AC IB, AC IIIA, KA

- WG2: Hadronic searches (SUSY)

  HH

- WG3: HSCP and photonic searches (GMSB)

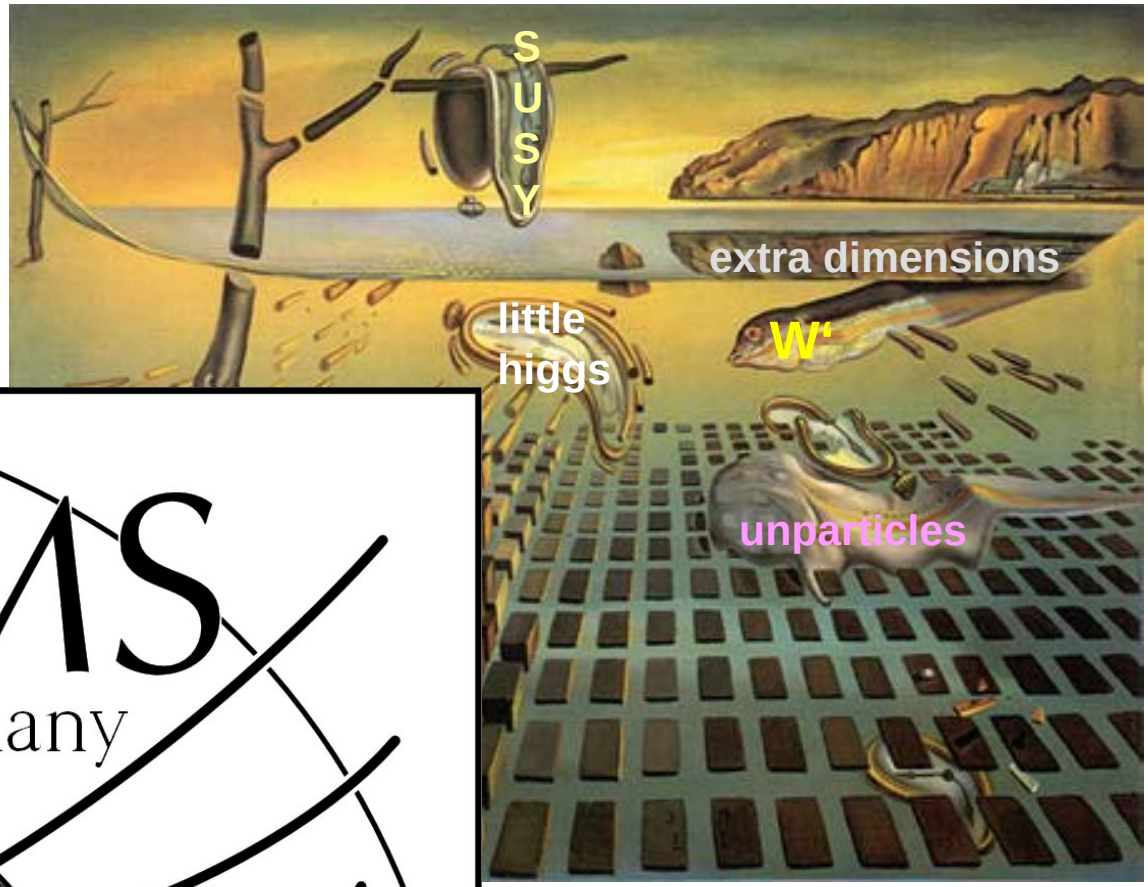
  HH ?

- WG4: High Energy Pair Searches (U(1)-prime/ED/other)

- Model independent searches

  AC IIIA

SUMMARY



CMS Germany

BMBF FSP-CMS

… hopefully some overlap …