LIGHT CHARGED HIGGS @ ATLAS

Graduiertenkolleg - Masse, Spektrum, Symmertrie
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OUTLINE

- why MSSM
- why light
- Production and Decay Channels
- Problems
- Outlook

MSSM

- Charged Higgs also appear in the Higgs triplet, the Little-Higgs, the left-right symmetric model and NMSSM, but lets consider MSSM here only
  ⇒ 5 Higgs bosons: h, H, A and $H^{\pm}$

- MSSM is a Two Higgs-Doublet Model (2HDM) Type II, meaning, the up-type fermion mass is provided by the first and the down-type fermion mass is provided by the second Higgs doubelt

- However MSSM is more constrained than the SM extended with a second Higgs-doublet

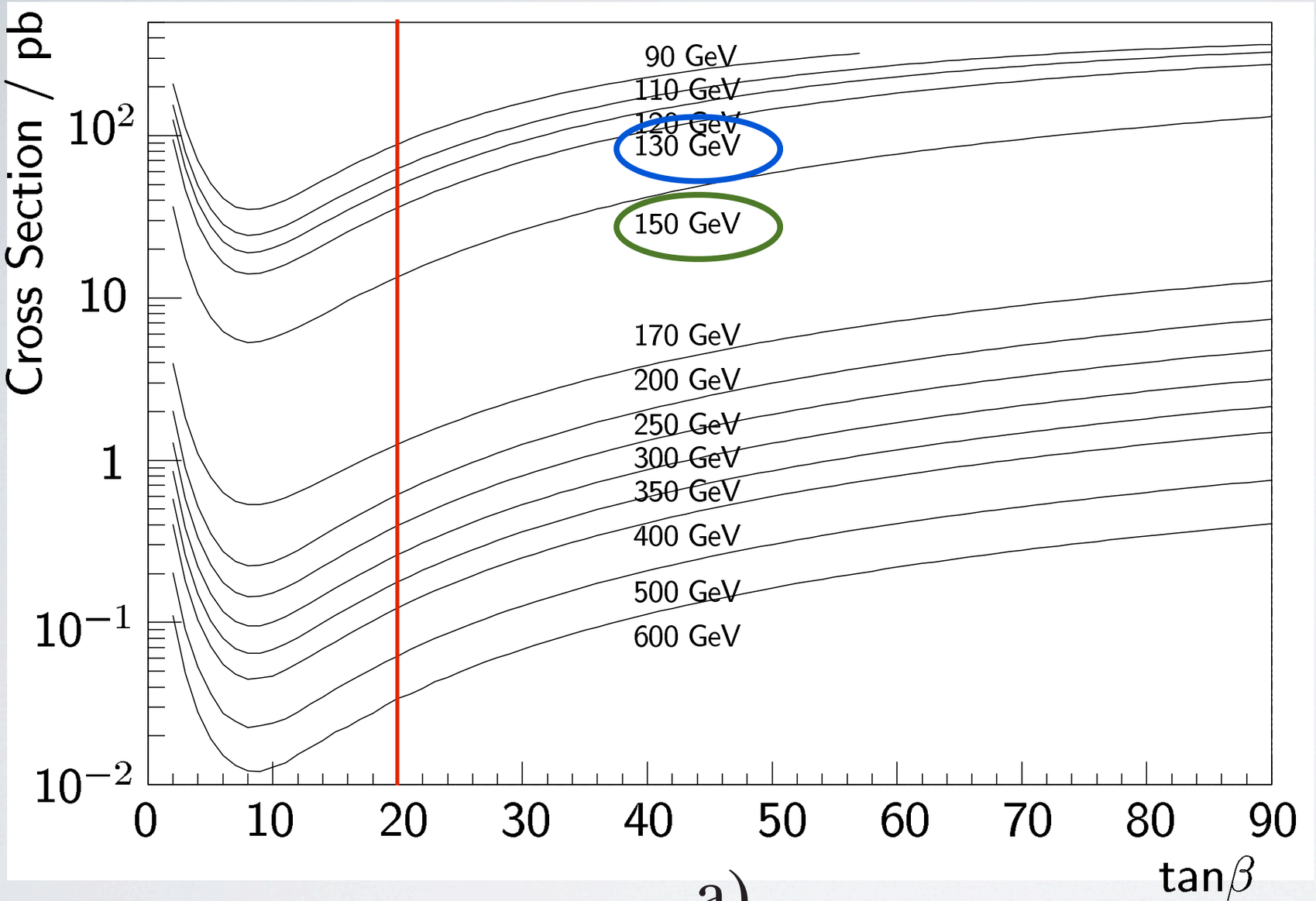
WHY LIGHT?

- **light** means: $\mathbf{m_{H^\pm} < m_t + m_b}$
  ⇒ production via t-decays

- **heavy** means: $\mathbf{m_{H^\pm} \geq m_t + m_b}$
  ⇒ production via gluon-gluon or gluon-quark fusion

- these two scenarios have to be distinguished, as also decay channels change at the m_t-threshold

$H^{\pm}$ X-SECS @ LHC @ 14 TEV

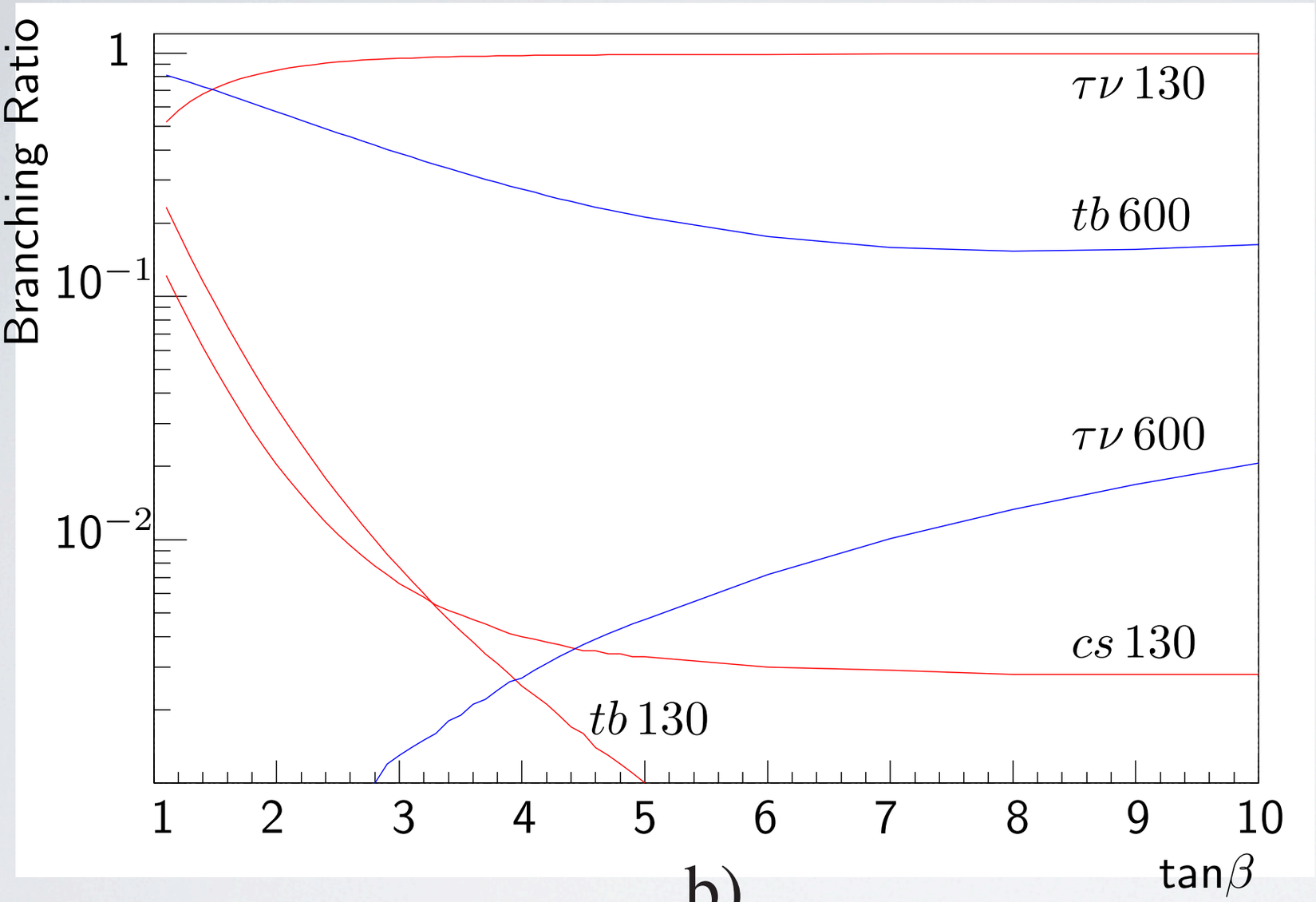


a)

Production cross section of charged Higgs at the LHC in the m_{hmax}-scenario

after 14 TeV Analysis:
(@ tanß=20)
7 Events(150 GeV)
20 Events(130 GeV)
78 BkgEvents(ttbar)
left per 1 fb^{-1}

LIGHT $H^{\pm}$ DECAY



b)

- the **τ-lepton** decays ~65% hadronically, else leptonically

Branching Ratios of the charged Higgs in the MSSM, in the so called m_{hmax}-scenario

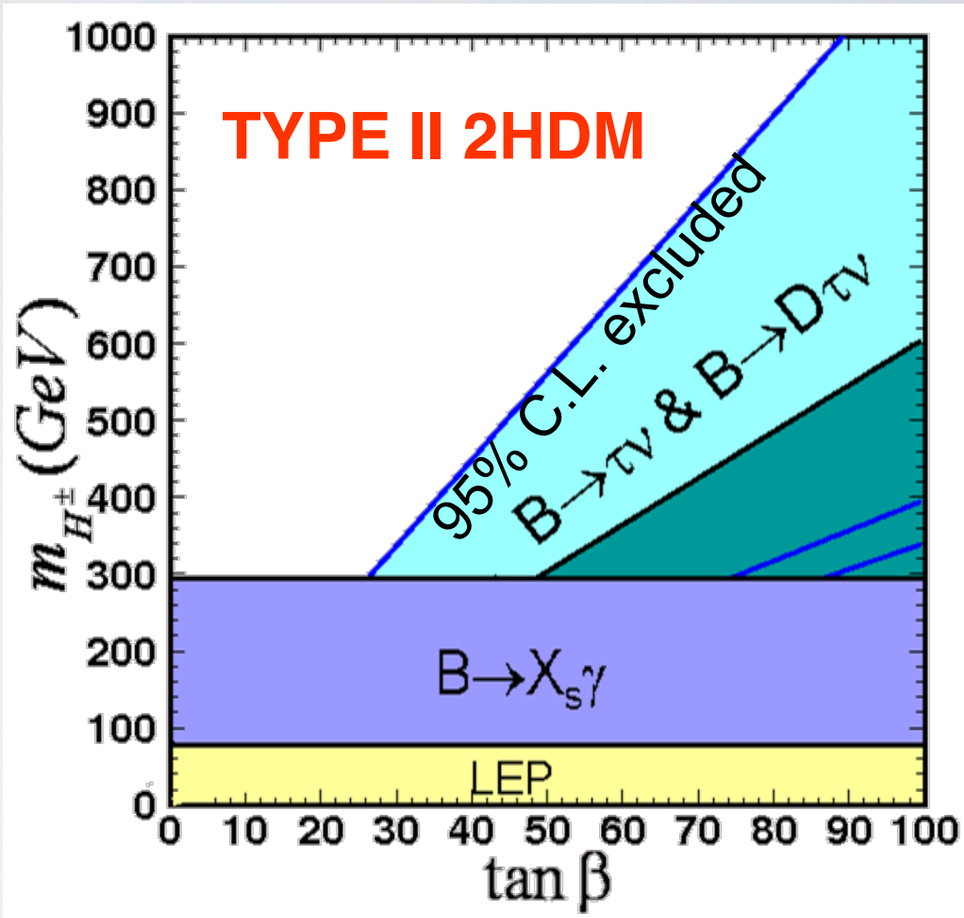
PROBLEMS

- B-Factory (flavour physics) measurements already give strong constraints on the charged Higgs mass ($m_{H\pm} < 295$ GeV)

- Light charged Higgs seems excluded for Type II 2HDM

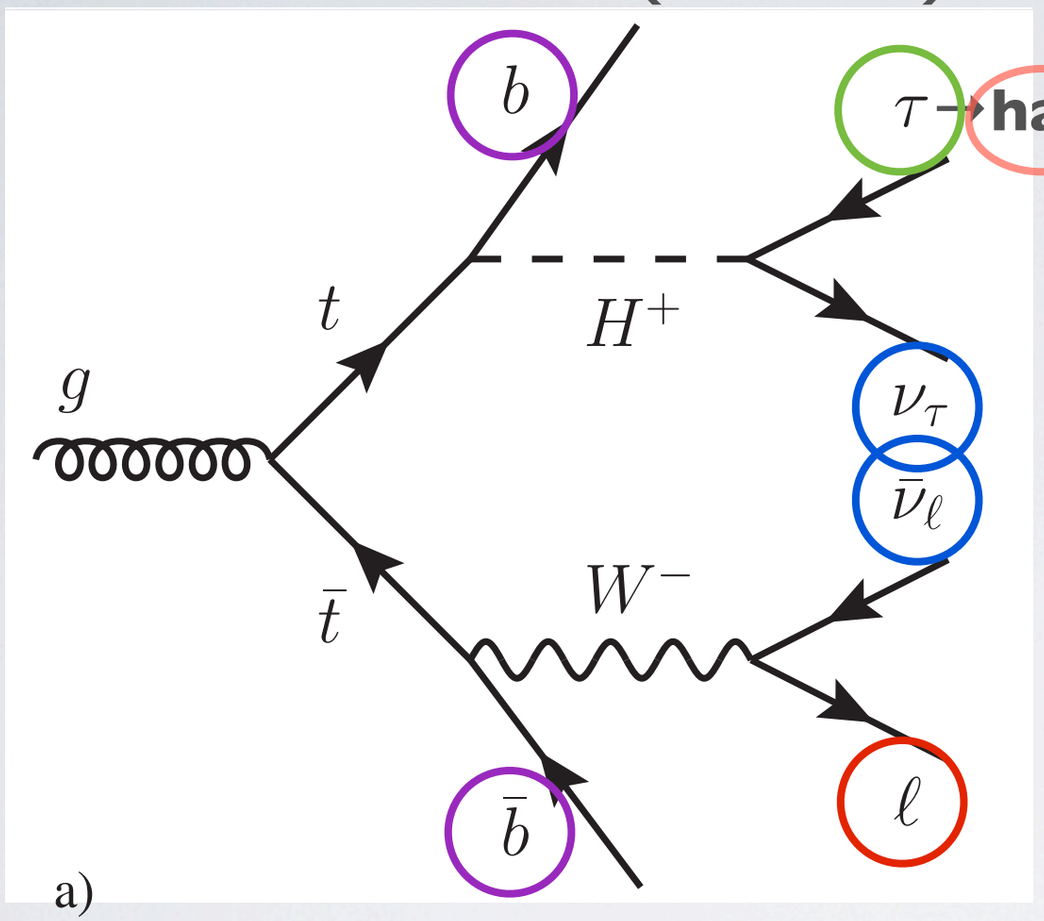
- ⇒ if $H^{\pm}$ realized in nature:

  heavy is favoured

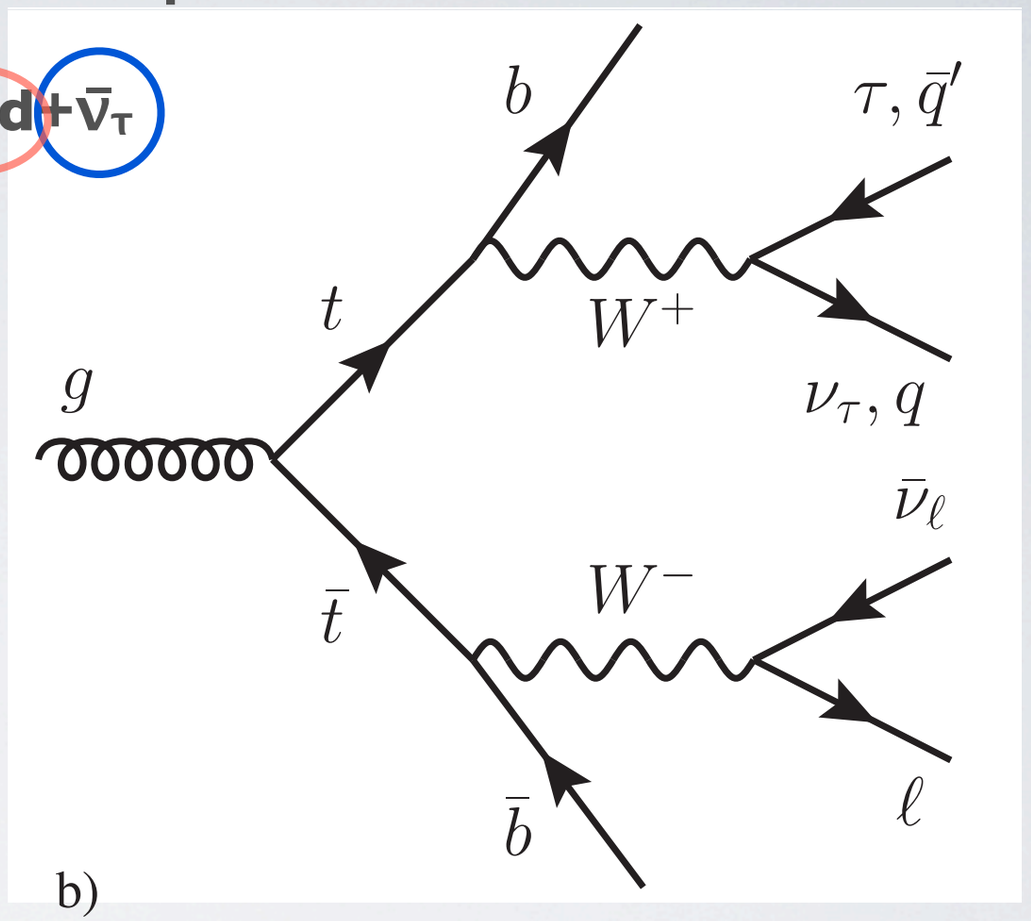


Indirect measurements: charged Higgs mass constraints

The τ(had)+lep Channel



what we are looking for



irreducible SM - background

- Irreducible background: means that it is kinematically not distinguishable from the signal signature
- Use: Trigger , Missing-E_T, b-tagging, Tau-Identification

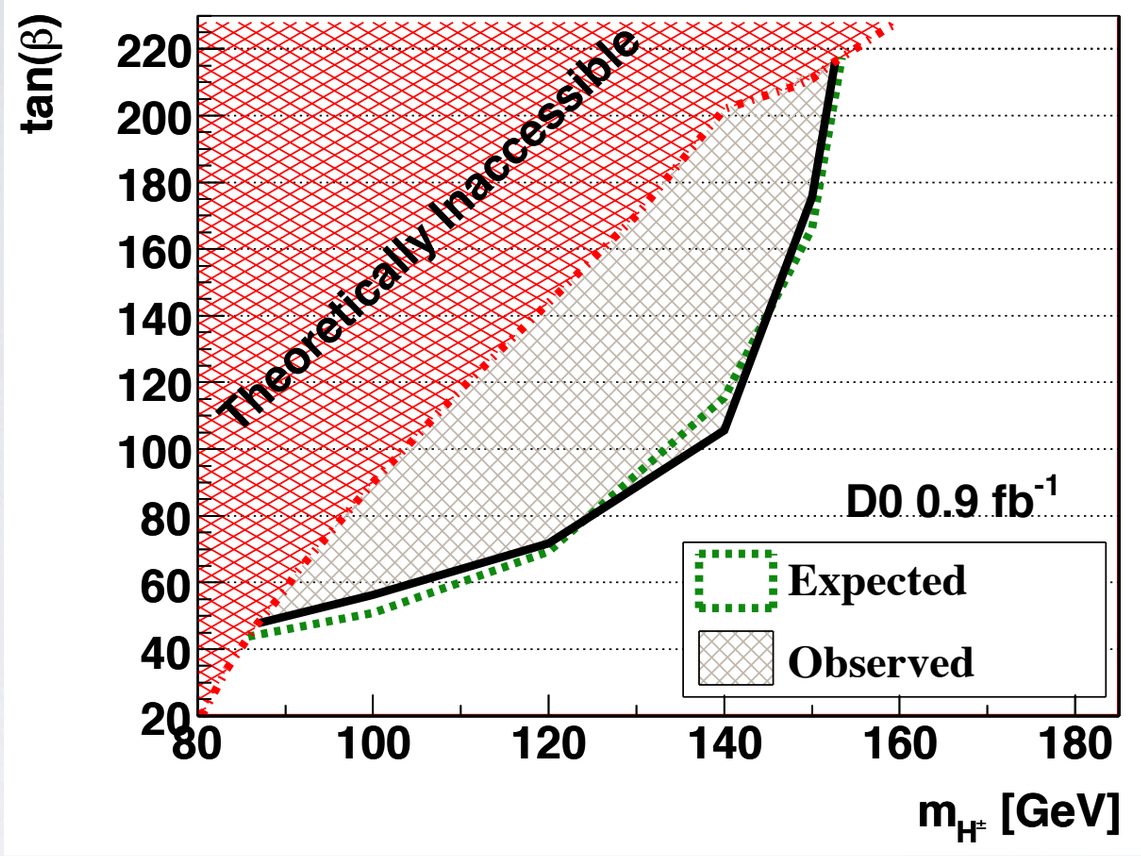
WHAT ARE WE DOING RIGHT NOW

- Find suited Triggers for this channel (Trigger Studies)
- To Do: Cut so hard, that only the signatures shown on the last slide are left (optimized Baseline Cuts)
- Cross check analysis on data
- Soon: Use **T**oolkit for **M**ulti**V**ariateData**A**nalysis (TMVA) for further signal-background distinction
- Estimate the remaining SM-Background from data (Embedding - technique?)

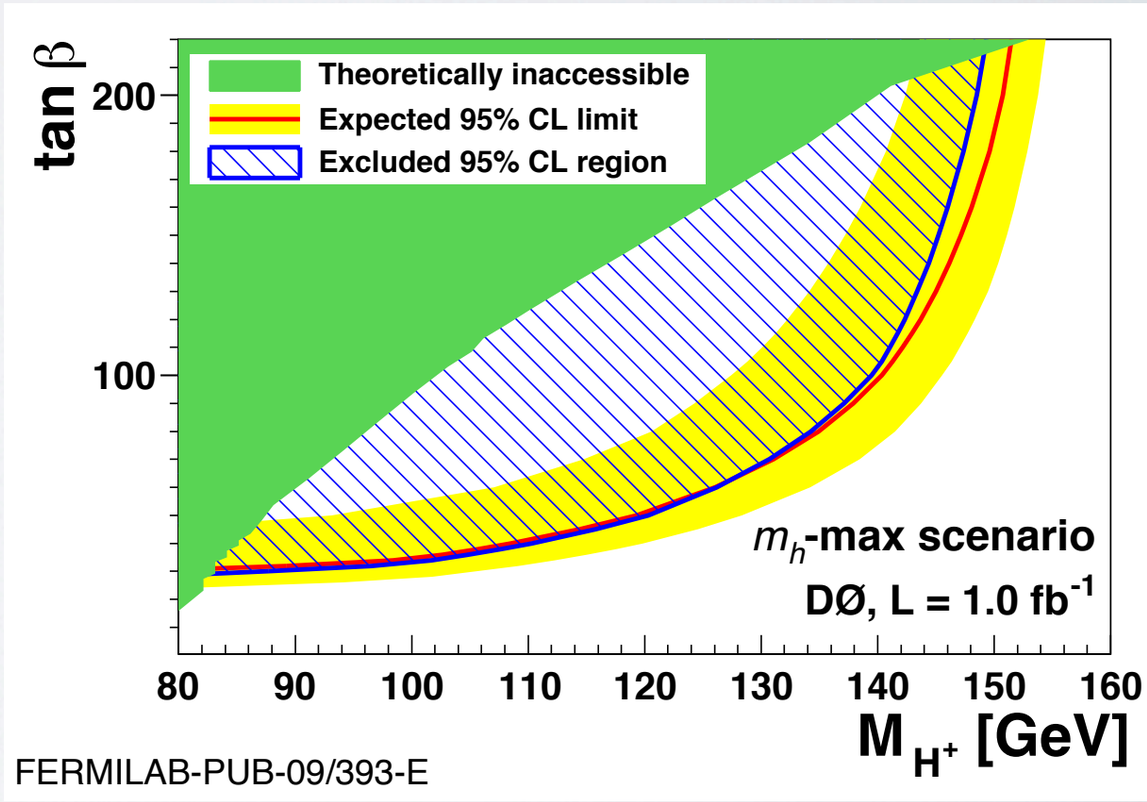
OUR GOAL

- Combine different light charged Higgs channels and improve existing exclusion limits for MSSM parameter space with first ATLAS - Data (End of 2011 ~ 1 fb^{-1}@ 7 TeV)

- Sensitivity suggests exclusion improvement, if systematics are under control and small

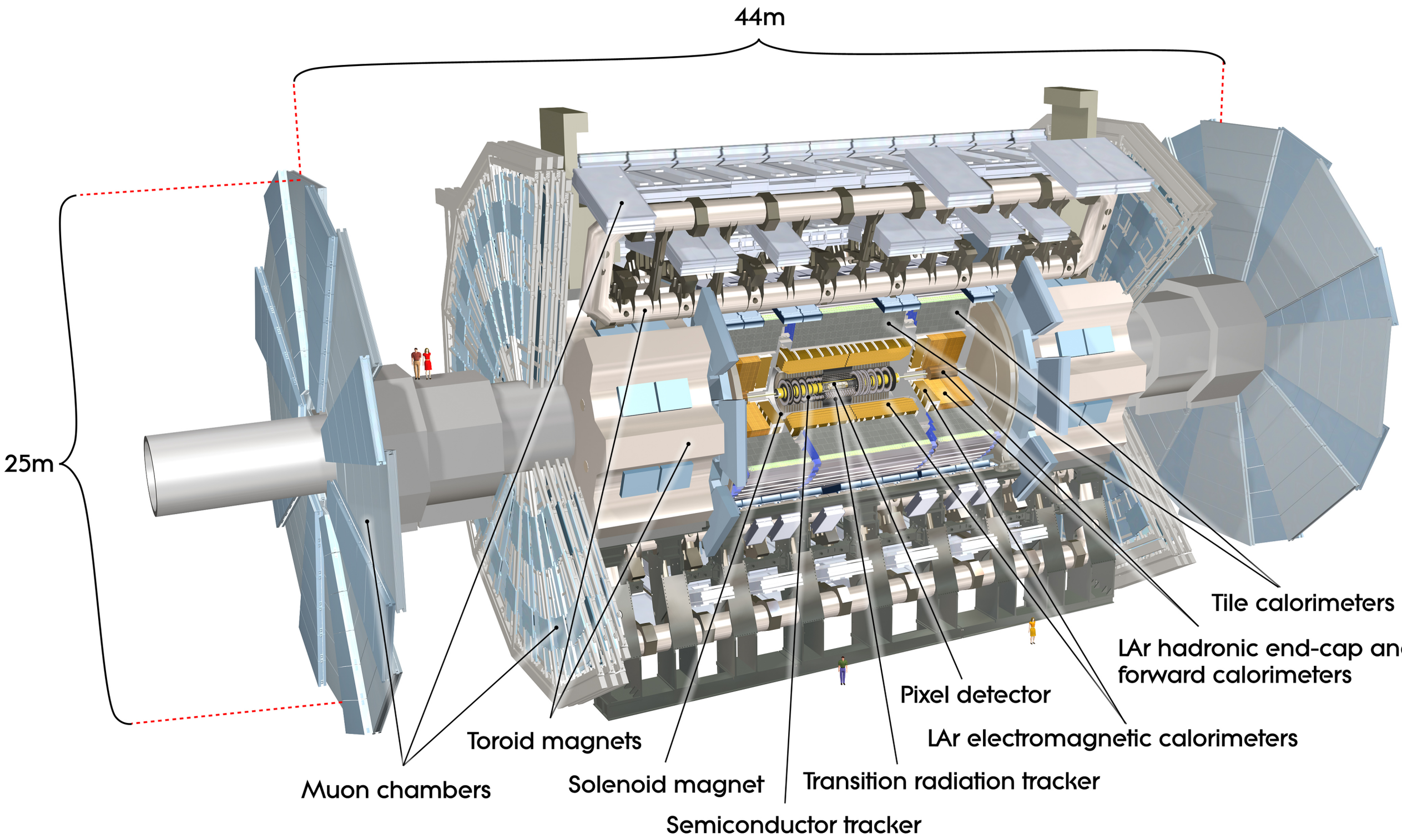


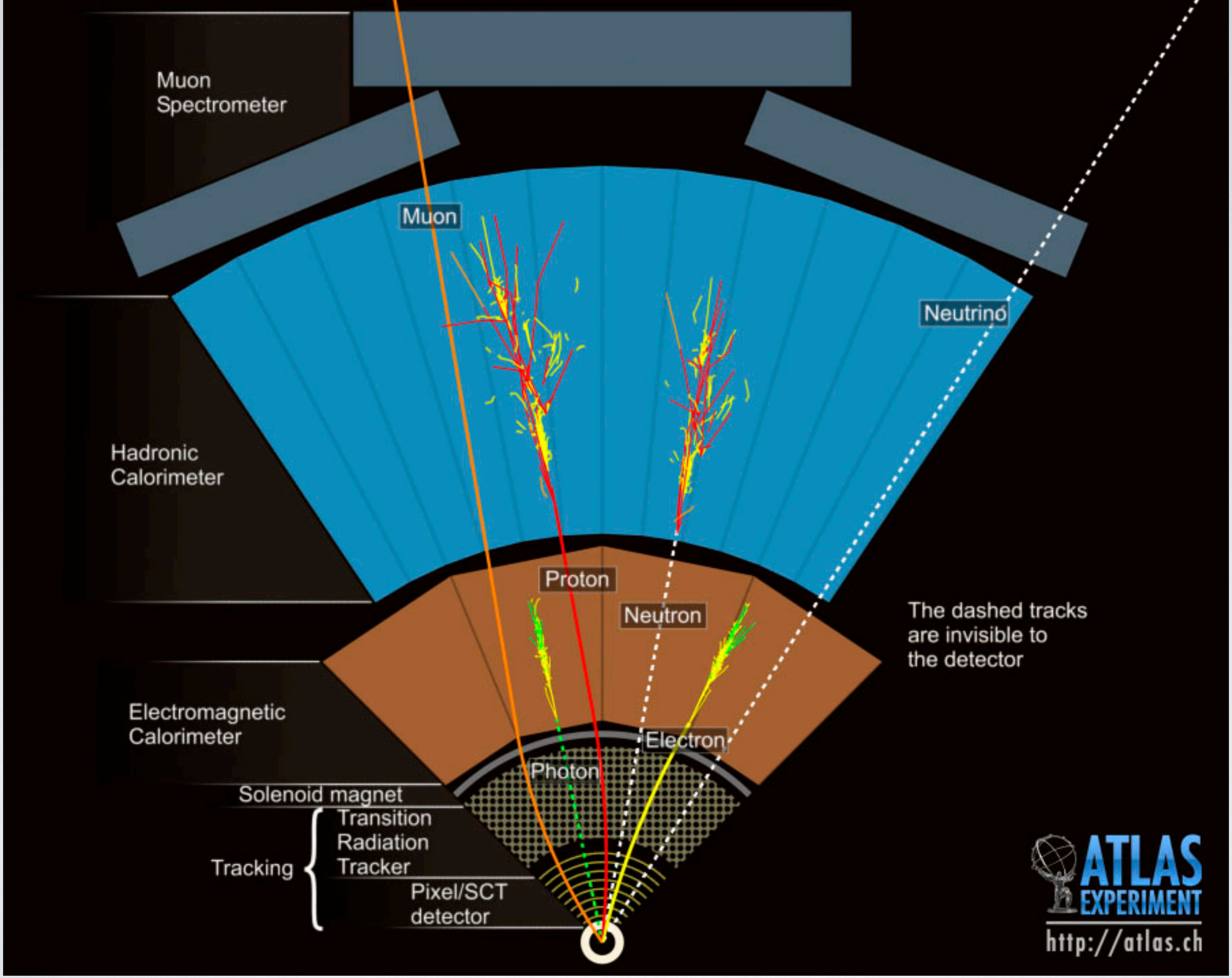
current exclusions by DØ



THANK YOU FOR YOUR ATTENTION !

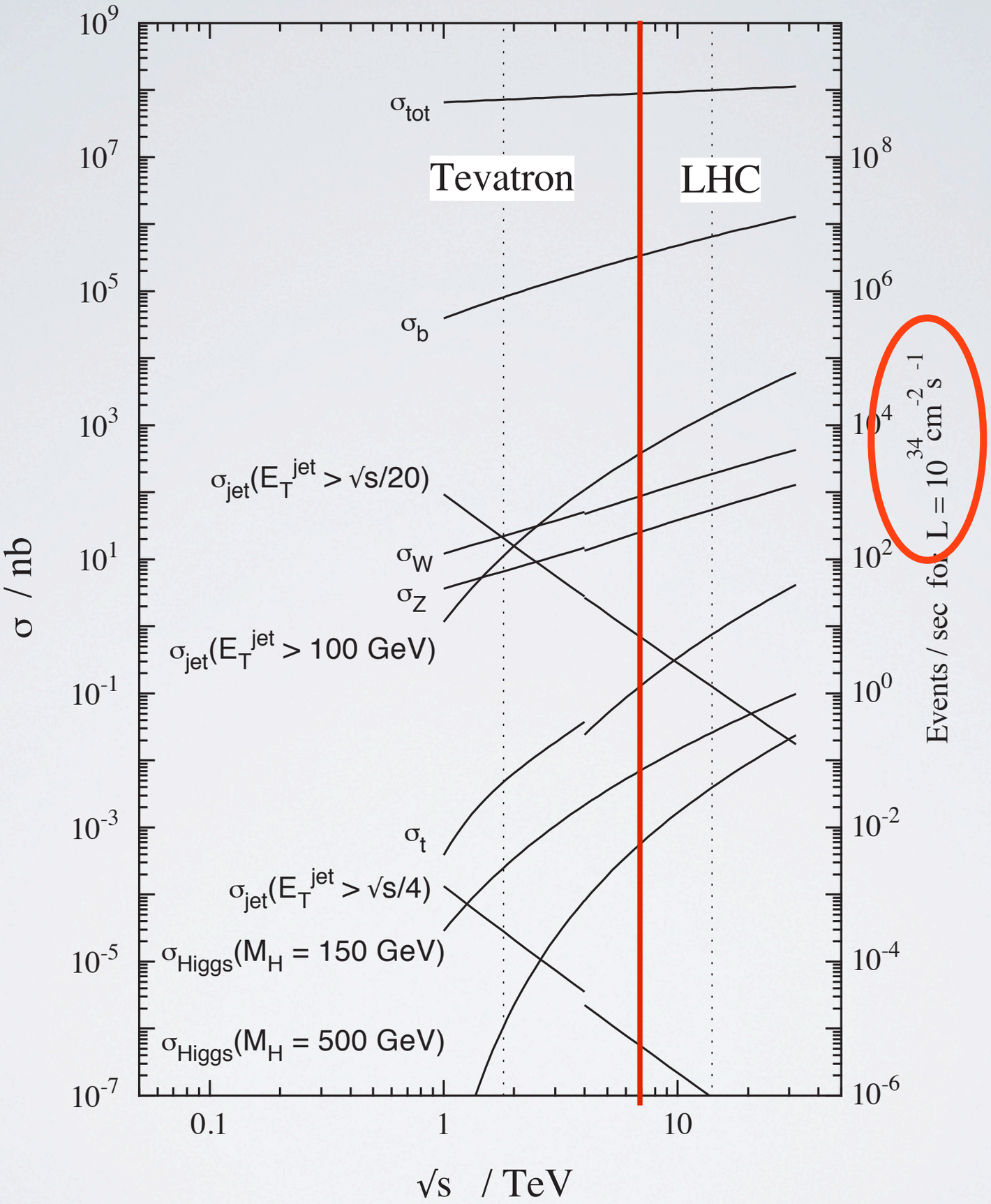
DO YOU KNOW ATLAS?




Muon
Spectrometer
Muon
Neutrino
Hadronic
Calorimeter
Proton
Neutron
The dashed tracks
are invisible to
the detector
Electromagnetic
Calorimeter
Electron
Photon
Solenoid magnet
Tracking
Transition
Radiation
Tracker
Pixel/SCT
detector
ATLAS
EXPERIMENT
http://atlas.ch

MHMAX - SCENARIO - PARAMETERS

Name	Parameter	Value / GeV
Sfermion masses	M_{SUSY}	1000
Stop mixing	X_{t}	2000
Higgs mass parameter	μ	200
Gaugino masses	M_2	200
Gluino mass	M_3	800


Tevatron
LHC
σ_tot
σ_b
σ_jet(E_T^jet > √s/20)
σ_W
σ_Z
σ_jet(E_T^jet > 100 GeV)
σ_t
σ_jet(E_T^jet > √s/4)
σ_Higgs(M_H = 150 GeV)
σ_Higgs(M_H = 500 GeV)
σ / nb
Events / sec for L = 10^34 cm^-2 s^-1
√s / TeV
10^9
10^7
10^5
10^3
10^1
10^-1
10^-3
10^-5
10^-7
10^8
10^6
10^4
10^2
10^0
10^-2
10^-4
10^-6
0.1
1
10