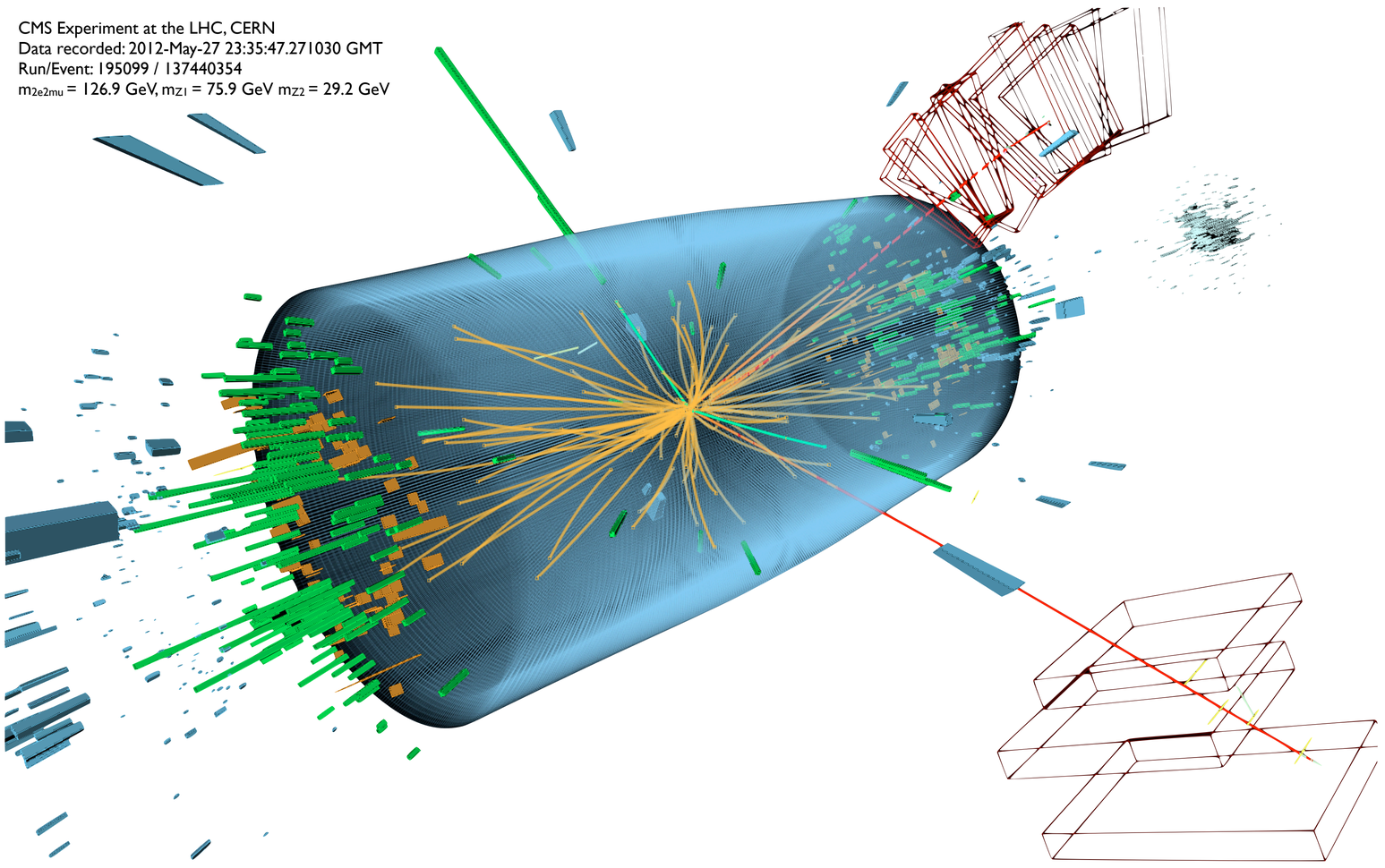
Search for Standard Model Higgs boson decaying into 4 leptons with CMS detector

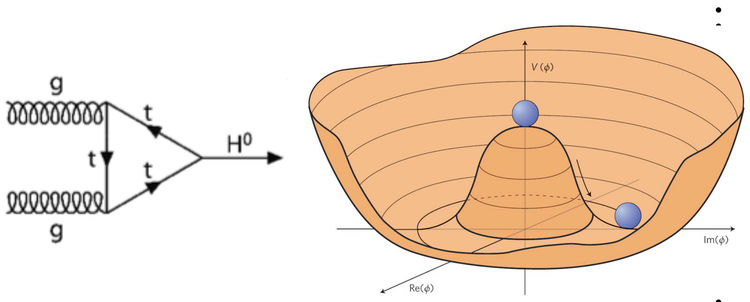
M. Dalchenko[1], M. Kovač[1,2], R. Pleština[1,2]

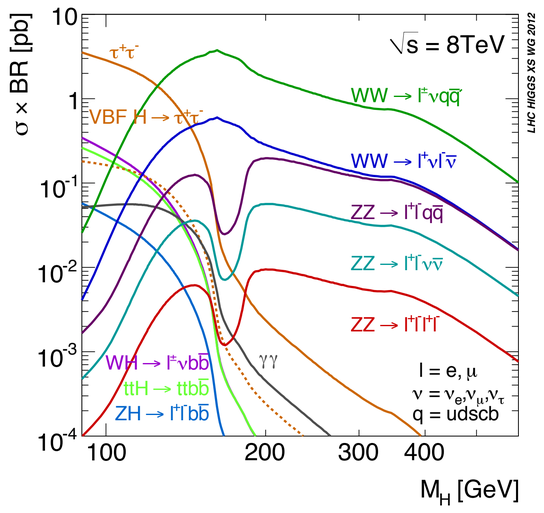
1 - LLR - École Polytechnique, Palaiseau, France, 2 - University of Split, FESB, Split, Croatia



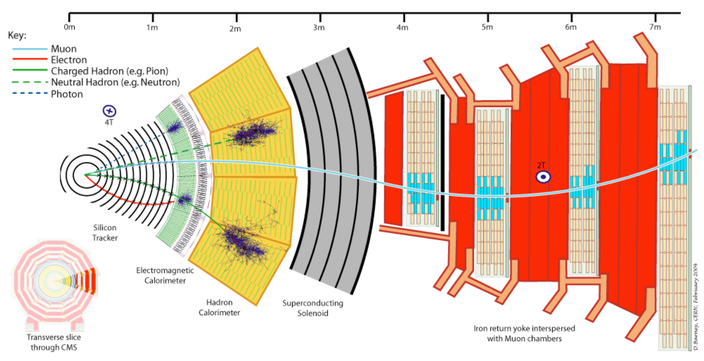
SM Higgs boson

$$\mathcal{L} = (\mathcal{D}^\mu\phi)^* D_\mu\phi - \mathcal{V}(\phi) - \tfrac{1}{4} F^{\mu\nu} F_{\mu\nu}$$





Detector and objects



Objects

e: combine tracker - ECAL info, MVA for eID, particle isolation

μ: combine tracker - muon chambers info, particle isolation

Validation: Tag-and-probe on Z & J/Ψ candles

Compact Muon Solenoid detector

- height 15 m, length 21.6 m, mass 12500 t
- approximately 100M electronic channels

Event selection

Lepton selection

Identification, particle isolation and impact parameter

Suppresses Z+jet, $Z\bar{b}\bar{b}$ and $t\bar{t}$ (reducible)

pT > 20, 10, 5, 5 (7, 7) and $|\eta|$<2.5 for muons(electrons)

Building Z candidates

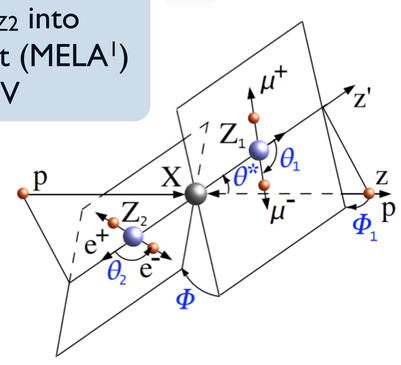
Same flavor, opposite charge lepton pairs

"Z_1": closest to nominal Z, 40 < m_{Z1} < 120 GeV

"Z_2": remaining pair with highest leptons p_T and 12 < m_{Z2} < 120 GeV

Higgs kinematics

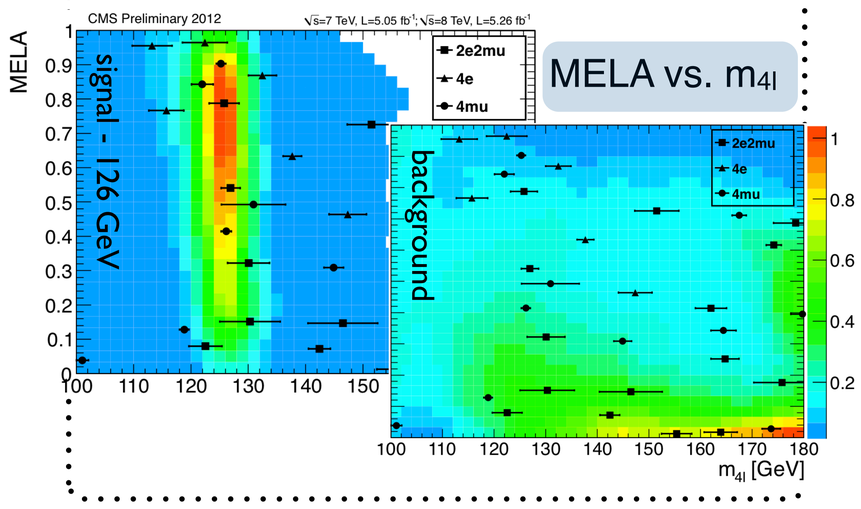
Combine 5 production/decay angles, m_{Z1} and m_{Z2} into kinematic discriminant (MELA[1]) m_{4l} > 100 GeV



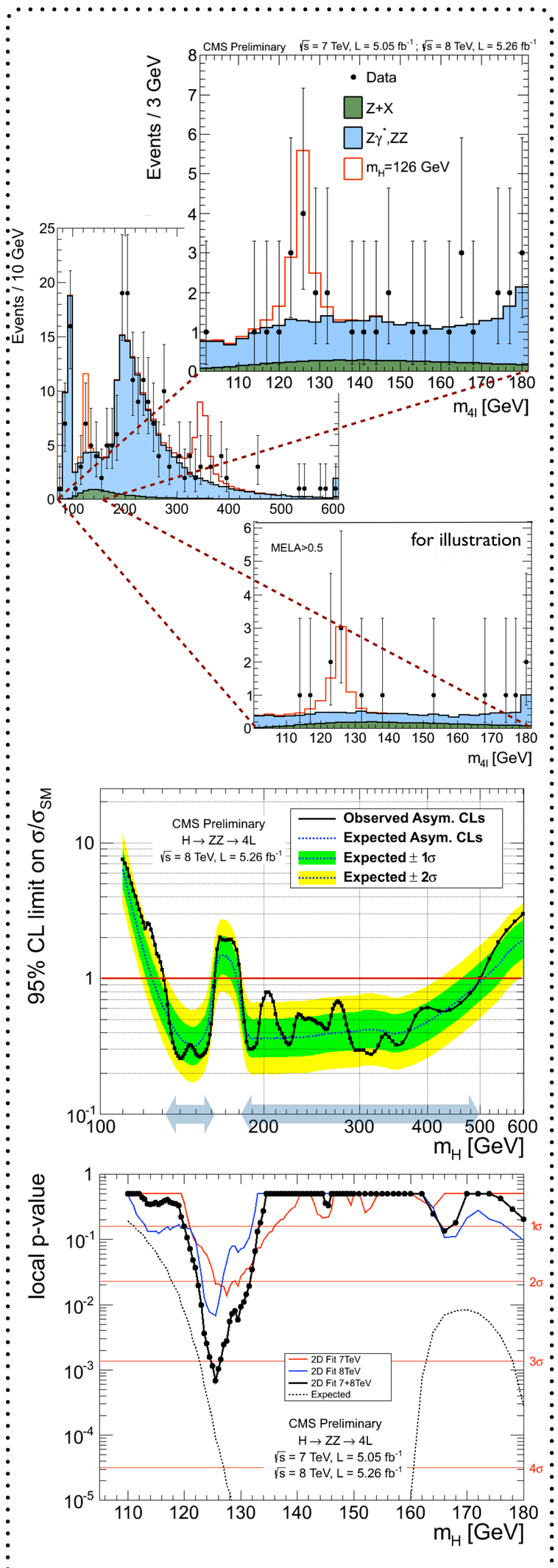
Background control

- irreducible (ZZ) - from simulation
- reducible - from data (fake rate method)

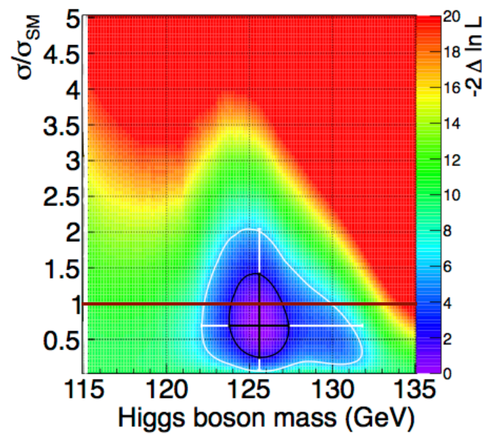
Results



MELA vs. m_{4l}



Conclusion



An excess of events is observed in the mass range 120 < m_{4l} < 130 GeV. These events cluster around a mass m_{4l} ≃ 125.5 GeV, giving rise to a local excess with respect to the background expectation with a significance of 3.2 σ.

[1] Matrix Element Likelihood Analysis

References: CMS - PAS - HIG-12-016