

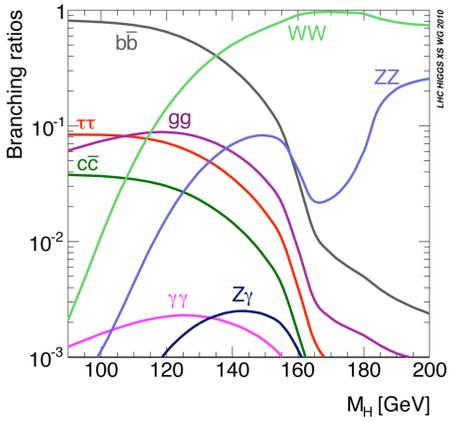


H → γγ search in CMS with the first 1.66fb⁻¹ of 2011 DATA

Hugues BRUN IPN Lyon (CNRS/IN2P3, Université Claude Bernard Lyon 1) on behalf of the CMS collaboration



1. Interest of the Channel

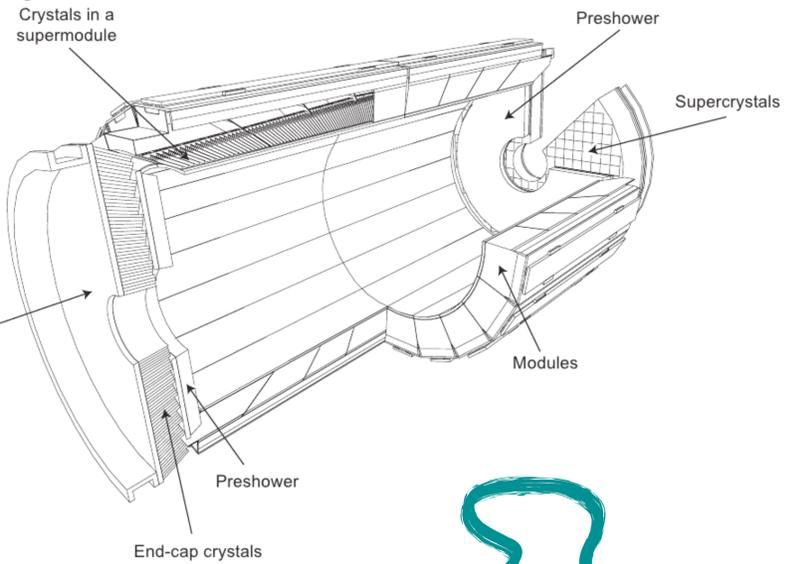


Most promising channel at low mass of the Higgs Boson :
 → clean final state
 → narrow mass peak

BUT very small branching ratio (≈0.002)

2. The CMS Electromagnetic Calorimeter (ECAL)

Discovery potential is strongly dependant of the resolution on the diphoton mass :
 → excellent resolution improves sensitivity (design ≈ 0.5% for γ with E>100 GeV)
 → monitoring of crystal transparency loss (du to radiation induced changes in crystals transparency) with a LASER system
 → calibration in situ with π⁰→γγ, E/p ratio for electrons and with Z → e⁺e⁻



3. Vertex Determination

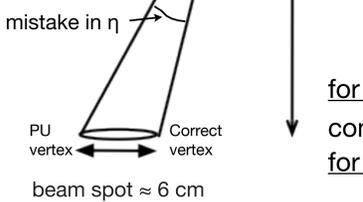


6.5 pp interactions in average with a longitudinal spread of 6cm
 error on vertex position larger than 10mm
 → error on M_{γγ} > error from ECAL resolution

Vertices are ranked using 3 variables :

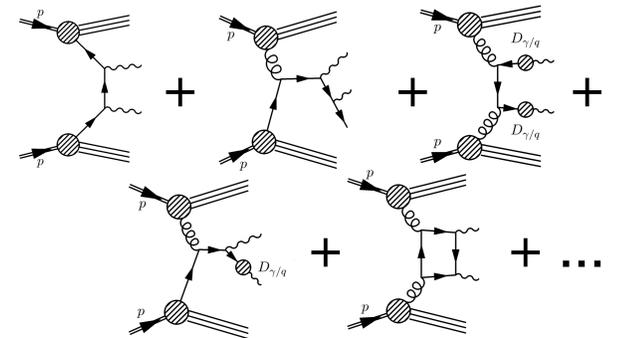
- one is the quadratic sum of the pT of the tracks from the vertex
- the 2 others measure the pT balance between the tracks and the diphoton system

for converted γ : extrapolated vertex (using cluster position in ECAL and conversion vertex) give a constraint to chose the good vertex
 for unconverted γ : the vertex with the best rank is chosen



4. Backgrounds

- large reducible background : γ+jets event or multijets events with one or more jets misidentified as a γ (jets containing π⁰→γγ)
- irreducible background with γγ from QCD



5. Selection

Cuts are applied to suppress the reducible background :
 ✓ **isolation** : based on Σp_T of tracks and energy deposit in the calorimeters, the isolation is corrected for pileup using fast-jet

✓ **cluster shape** : to reject π⁰→γγ

✓ **lepton veto** : reject γ which are also reconstructed as electron

Isolation and cluster shape cuts efficiency estimated with Z→ee Tag and Probe and with Z→μμγ for lepton veto

cut different for 4 categories of γ, depending of the γ position and the γ R₉

6. Events Categories

2 p_T categories
 p_T(γγ)>40 GeV
 p_T(γγ)<40 GeV

2 position categories
 • the 2γ in the barrel
 • at least 1 in the endcap

2 R₉ categories
 R₉ of the 2γ > 0.94
 at least 1γ with R₉

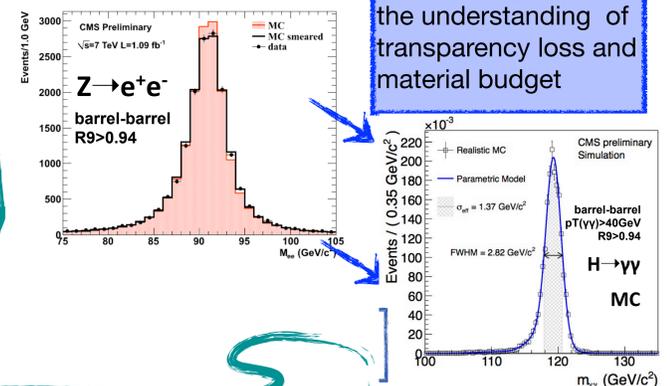
Categories with different resolution and signal to background ratio

7. Signal Modeling

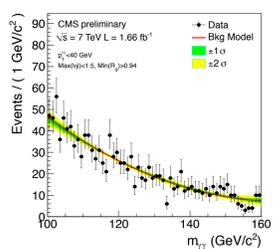
- Yield from DATA (trigger and selection efficiency from Tag and Probe)
- Shape from MC fit with a sum of gaussians after MC smearing

MC smearing : apply a smearing to MC in order that MC match DATA
 → the same smearing is applied to H→γγ MC

work in progress on the understanding of transparency loss and material budget

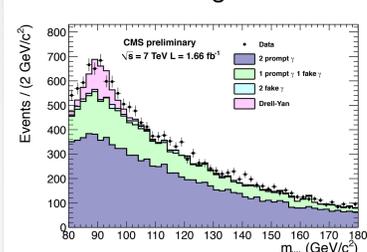


8. Background Modeling



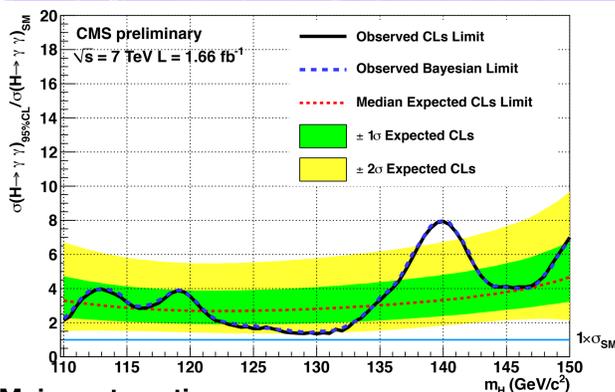
For each category, DATA are fitted with a 2nd order Bernstein polynomial

Good DATA/MC agreement :



9. Result

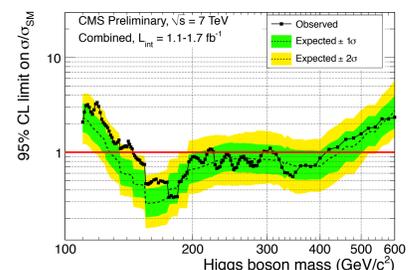
Statistical Method : both frequentist CLs using profile likelihood and



Main systematics are :

- Gluon-gluon cross section (12.5% on scale and 7.9% on PDF)
- Integrated luminosity (4.5%)
- class migration due of the cut p_Tγγ>40GeV (6.0%) and the R₉ cut (4.0% in barrel, 6.5% in endcap)

10. Perspectives



References :
 "Search for a Higgs boson decaying into two photons in the CMS detector" [CMS PAS HIG-11-21]
 "ECAL 2010 performance results" [CMS DPS 20011/008]