LHC計画アトラス検出器
$gg \rightarrow H \rightarrow ZZ^{*}$ チャンネルにおける
ヒッグス粒子探索

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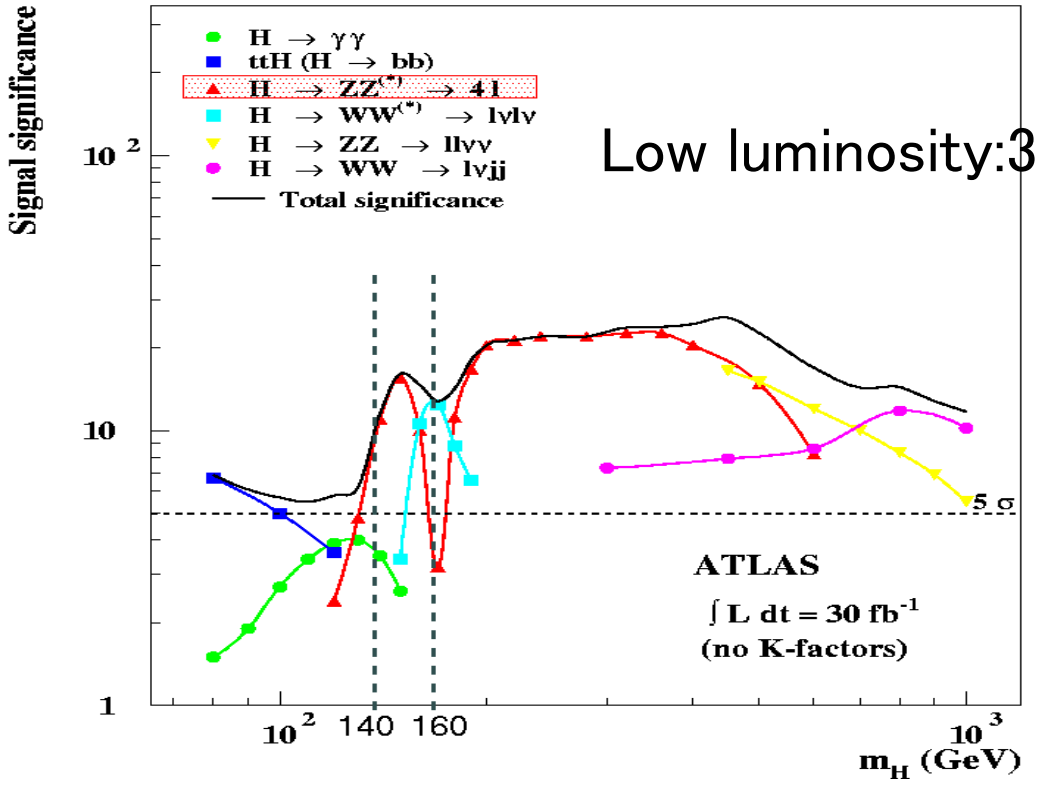
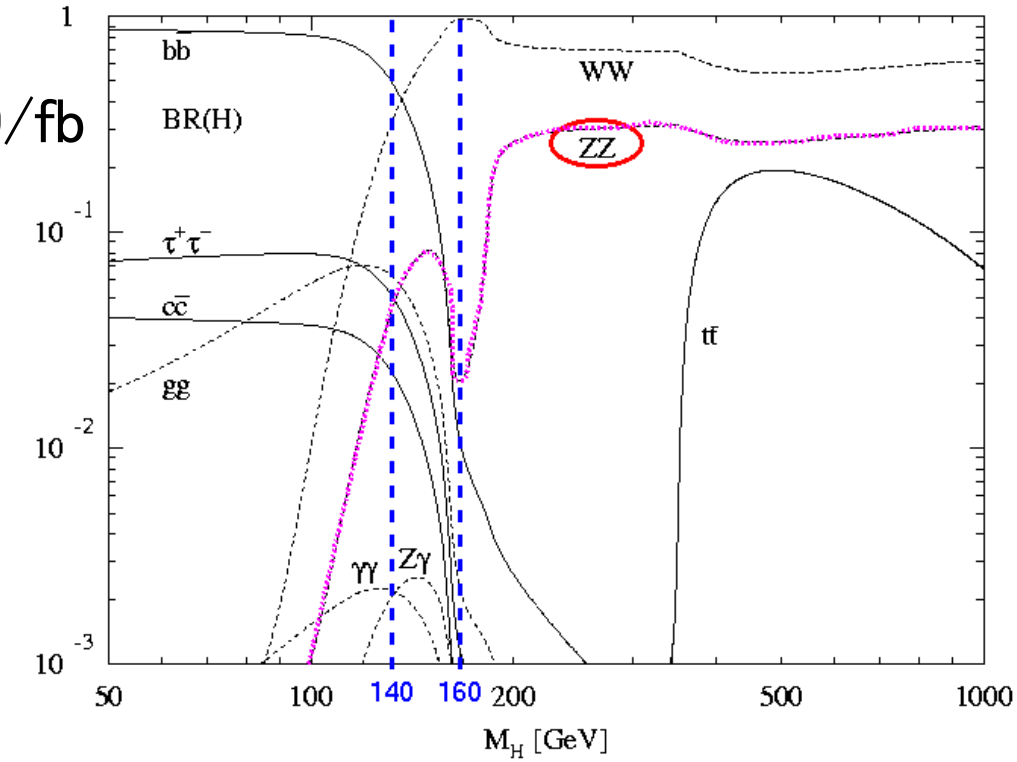
Introduction





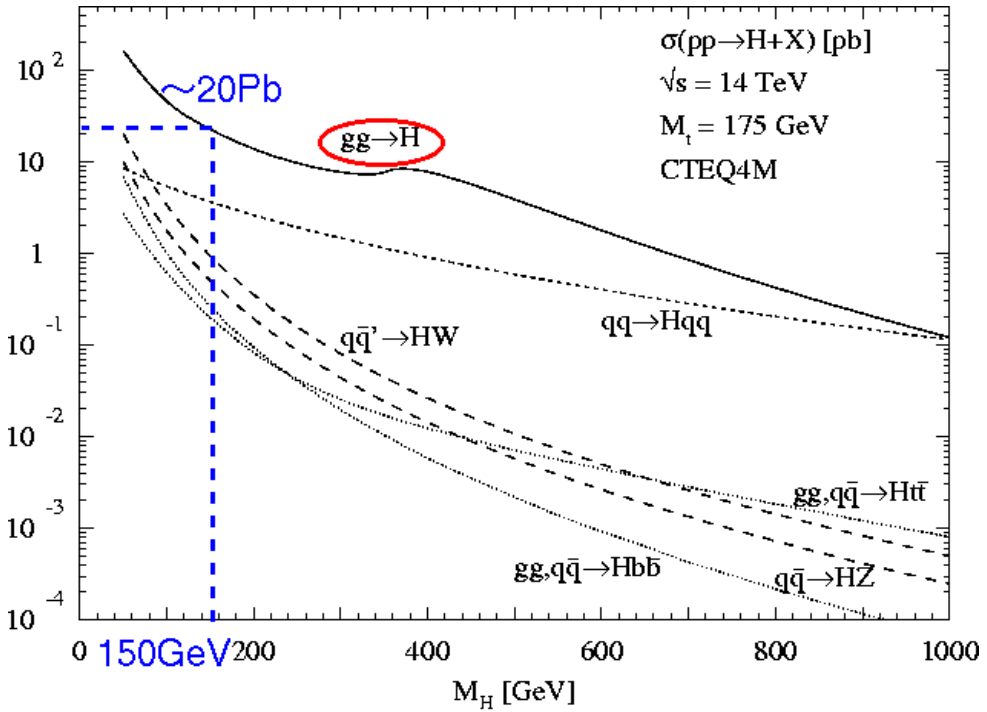
- H→ZZ*→4l channelは 140GeV<m_H< 160 GeV でも非常に有望

  →早期にHiggs粒子発見!

- 140GeV以下で Significanceが急落

  →H→ZZの崩壊分岐比が急落

Motivation

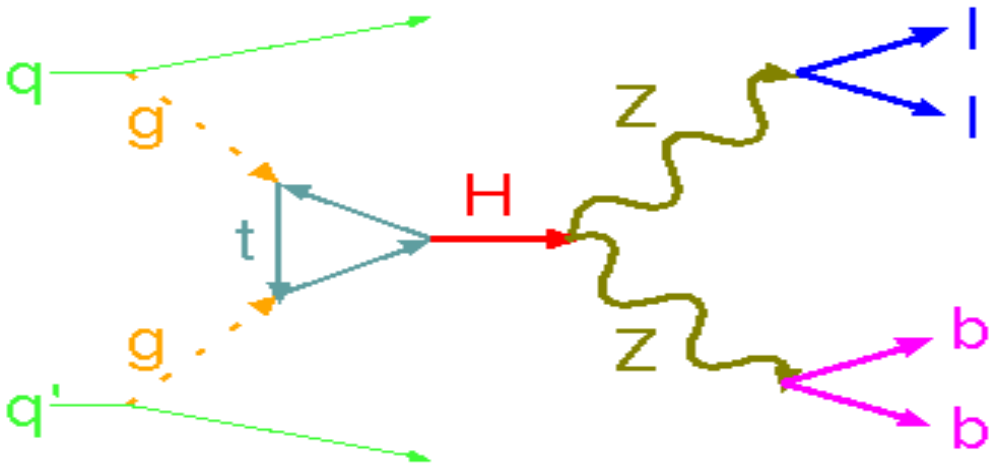


	BR
Z→ee	3%
Z→μ μ	3%
Z→bb	16%

- 生成過程：M_H<160GeVにおいてもっとも大きい生成断面積をもつgg-fusion
- 崩壊過程：b-quarkはleptonに比べて、Zボソンからの高い分岐比

➢ gg→H→ZZ*→llbb Channelの解析

gg→H→ZZ*→llbb Channel



$$\int Ldt = 30fb^{-1}$$

- b-tagged jet の Energy resolution が悪い
- σ×BR(H→ZZ) : ∽1pb(M_H=150GeV)

✗ Final stateにllbbを含む主なEvent
✗ tt　　491pb
✗ Zbb　　76.9pb
✗ ZZ　　10.6pb

Monte-Calro Sample

Signal	0.998pb	PYTHIA6.2
tt	491pb	PYTHIA6.2
Zbb	76.9pb	PYTHIA6.2+CompHEP4.1
ZZ	10.6pb	PYTHIA6.2

- PDF CTEQ5L
- Fast Simulator ATLFAST

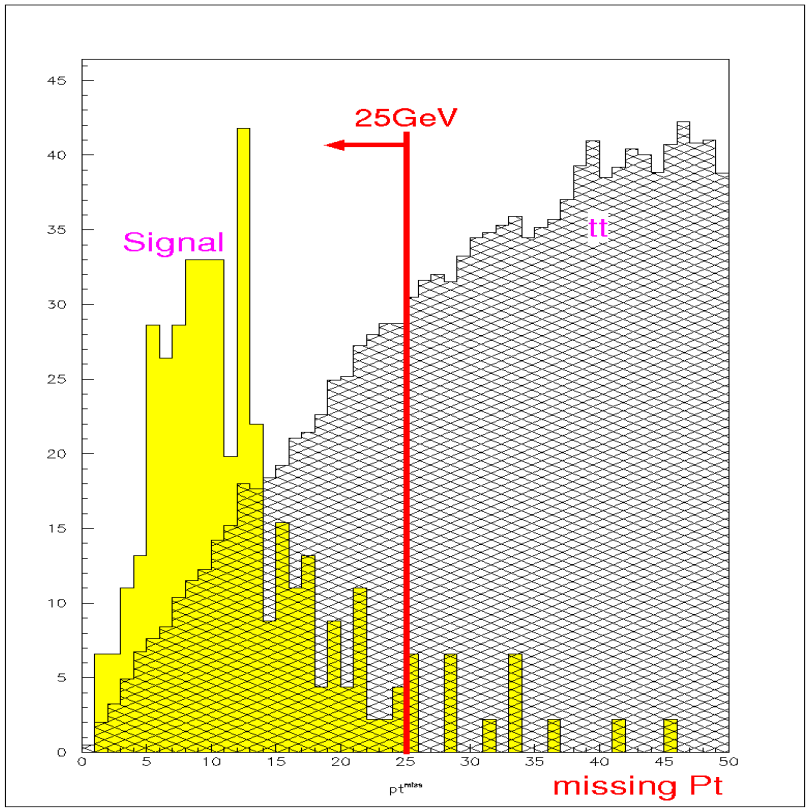
Event Selection1

- lepton
  - leptons : Pt > 20GeV, $|\eta| < 2.5$
  - Same flavor,opposite charge isolated leptons で1^{st} ,2^{nd} Ptを持つもの
- b-tagged jet
  - Pt > 20GeV
  - 2 b-tagged jets

を要求

Event Selection2

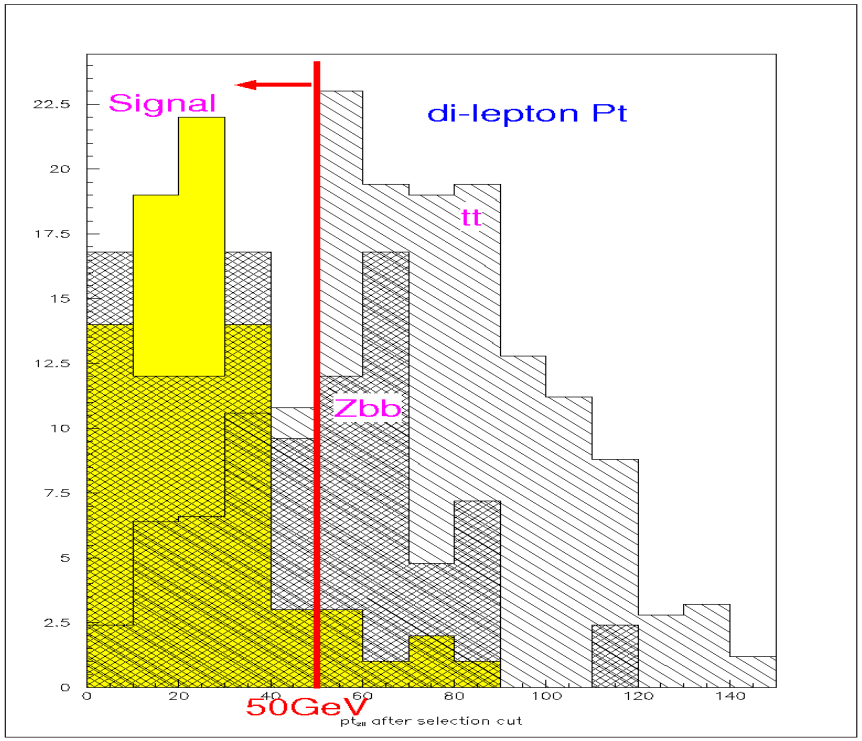
Pt cut



missing Pt < 25 GeV

tt 89%減

signal 7.7%減



dilepton system Pt < 50GeV

zbb 61%減

tt 87%減

signal 3.8%減

bb system も Pt < 50GeV

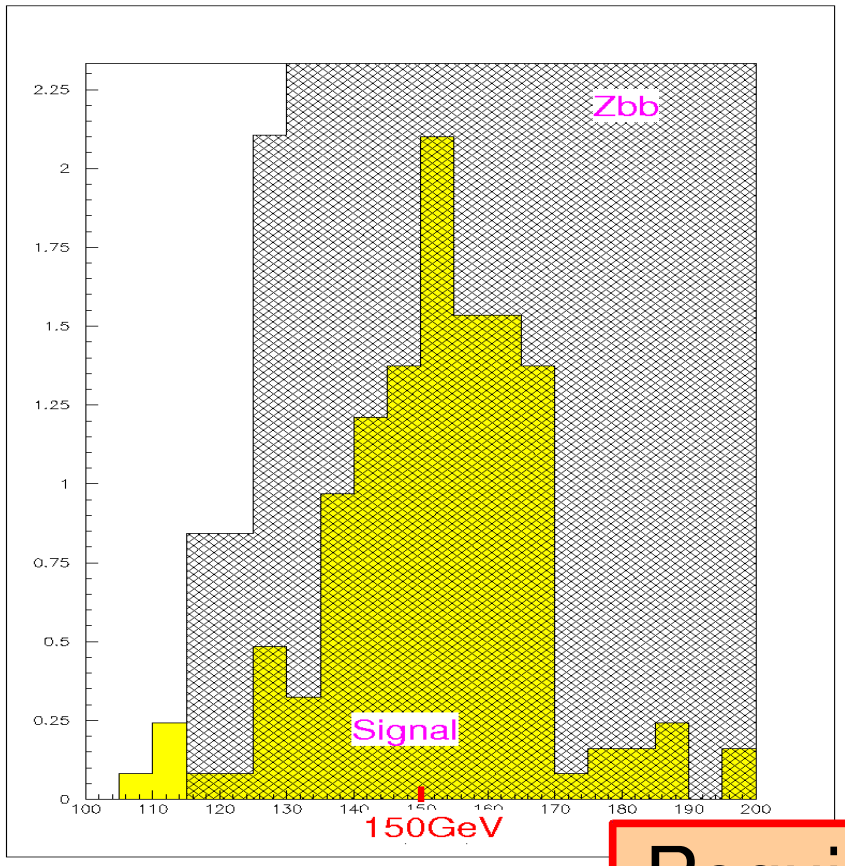
Event Selection3

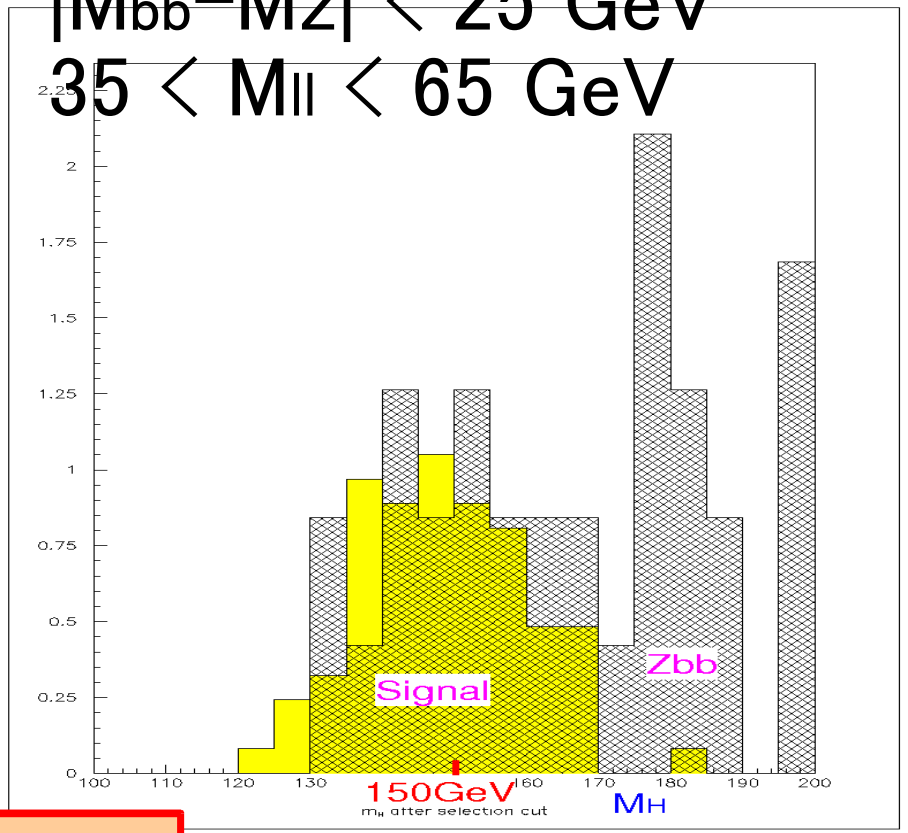
on-shell Z→bb

Z*→bb Z→ll	Resolution ◎ Background ×
Z→bb Z*→ll	Resolution × Background ◎

$|M_{bb}-M_Z| < 25$ GeV

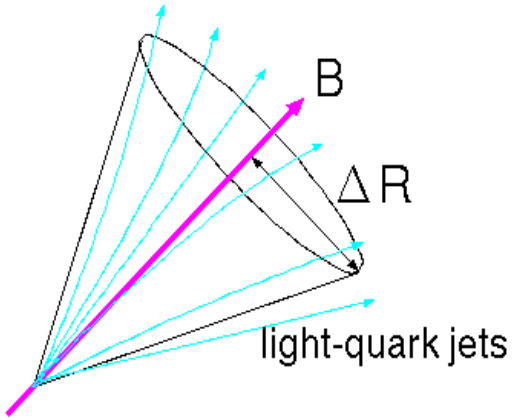
$35 < M_{ll} < 65$ GeV



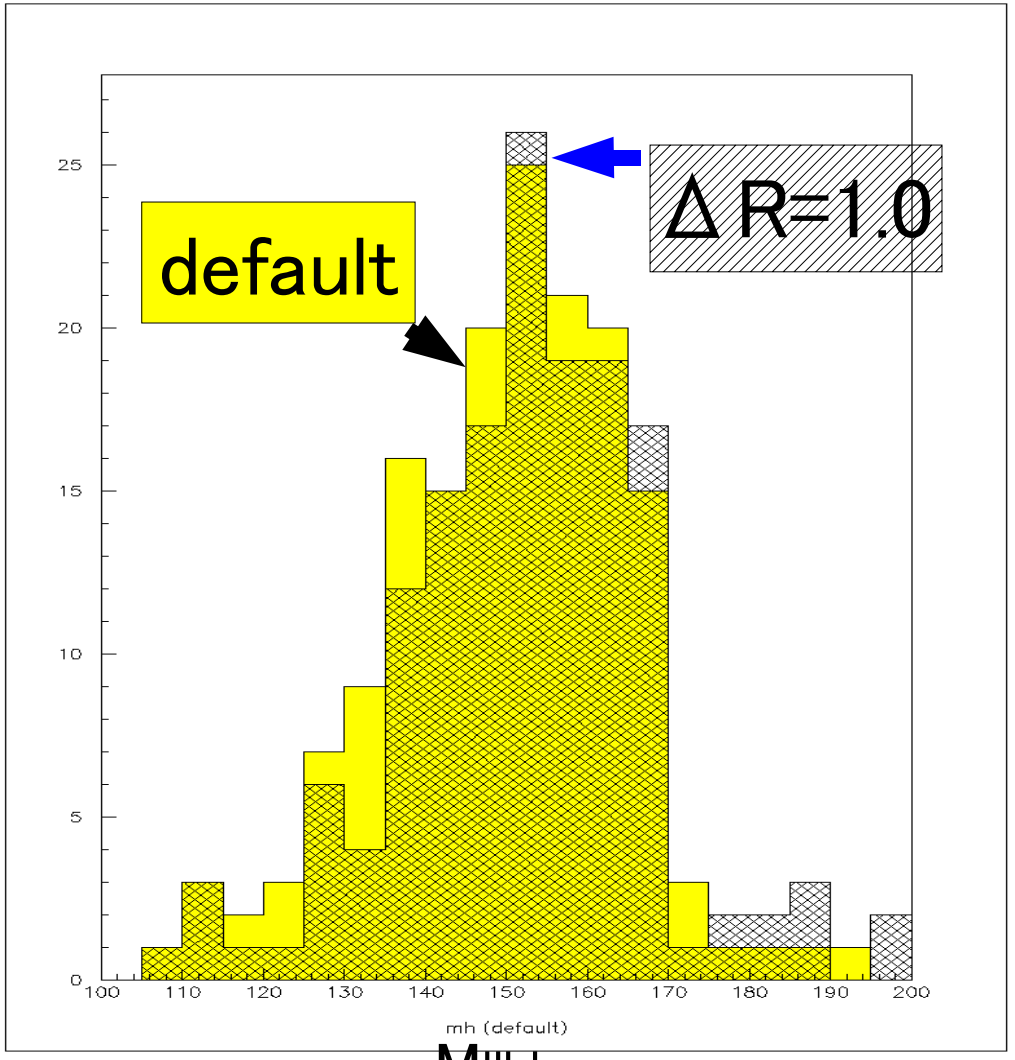


Required Z→bb

Improve the resolution
b-jet energy collection



$$R = \sqrt{\quad^2 + \quad^2}$$



Mllbb

- b-jetはenergy resolutinが悪い
- ΔRを大きくして、energy collectionを行う
- default→ΔR=0.4

20%の改善がみられた

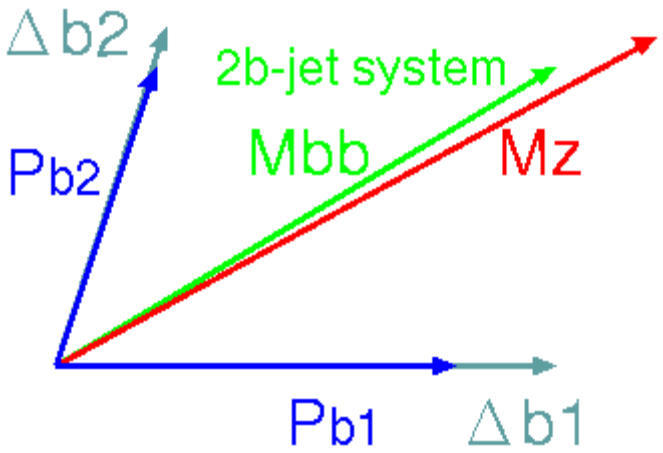
Improve the resolution

fixed m_Z

- Z→bbのinvariant mass M_{bb}をM_Zに固定する

↓

SignalのMass resolutionの向上

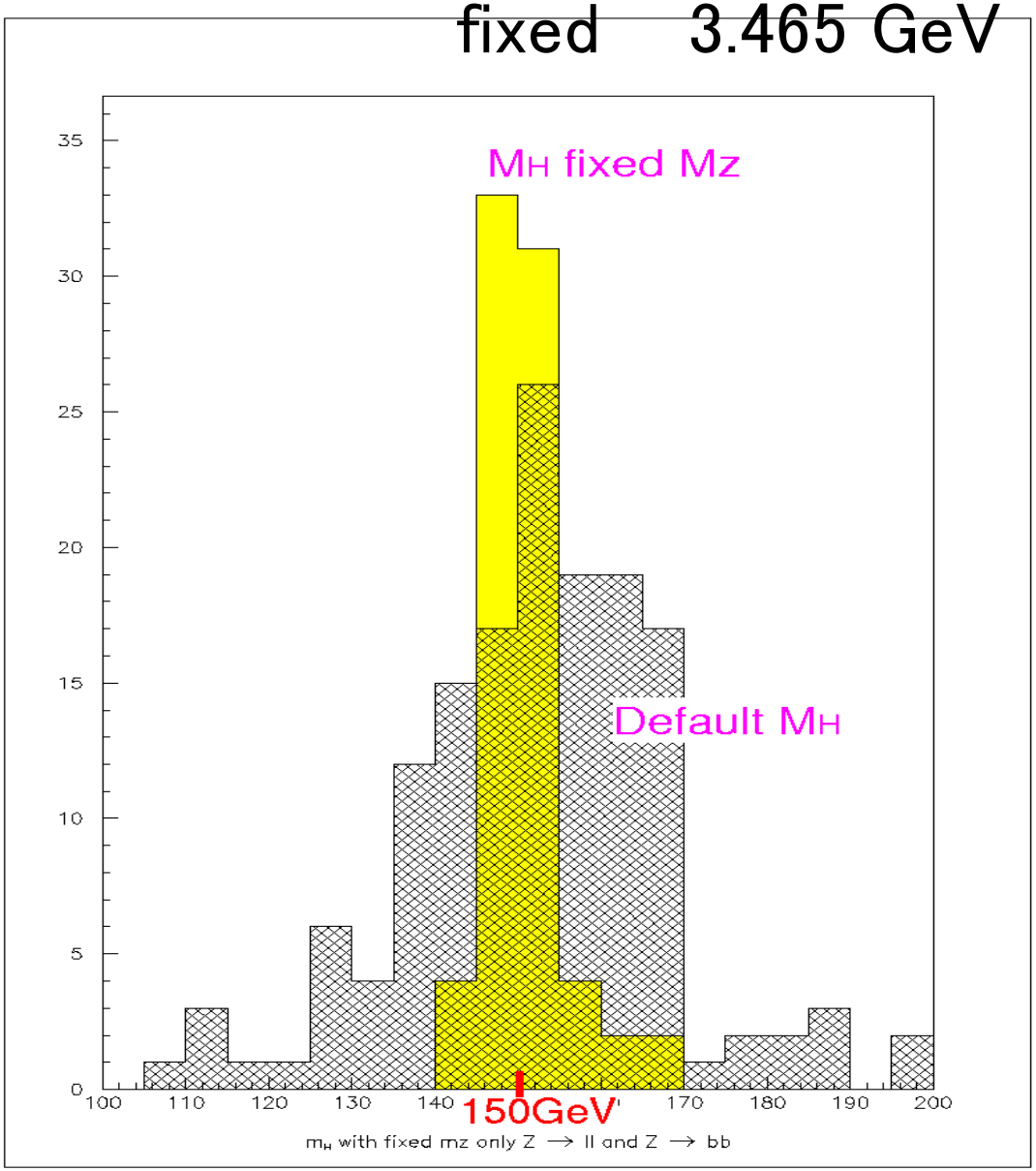


$$b1 \propto \sqrt{E1}/E1$$

σ

default 9.902 GeV

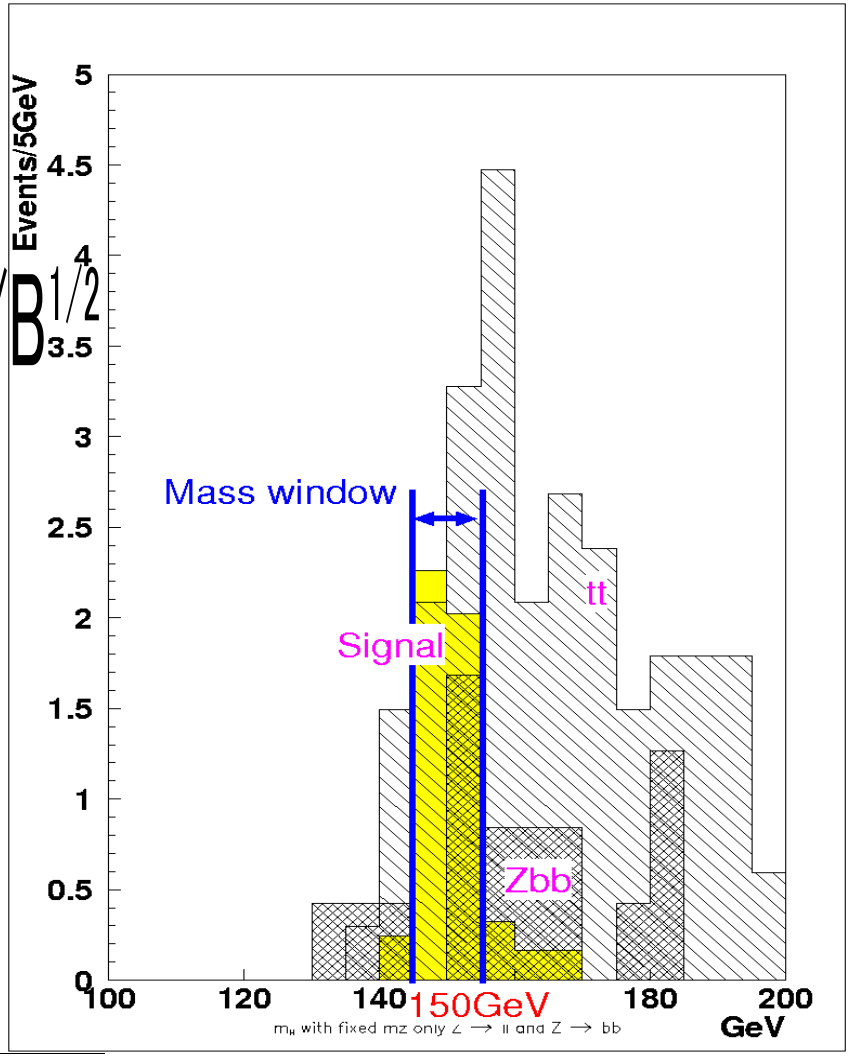
fixed 3.465 GeV



Result

$\int Ldt = 30fb^{-1}$
M_H=150GeV

	Signal	tt	Zbb	ZZ	$S/B^{1/2}$	
Trigger	15.5	38900	12400	366		
$Pt^{missing} < 25GeV$	14.3	4320	11100	335		
$Z \rightarrow bb$	6.38	190	19.4	3.81		
$Pt_{ll}, Pt_{bb} < 50GeV$	6.14	25.3	7.58	1.42		
mass window	4.12	6.69	4.21	0.67	1.21	±15GeV
mass window(fixed)	4.28	4.31	1.69	0.18	1.72	± 5GeV



Summary

H→ZZ*(→llbb) channelの現在の$S/B^{1/2}$は1.7

↓

$S/B^{1/2}$を改善する必要がある

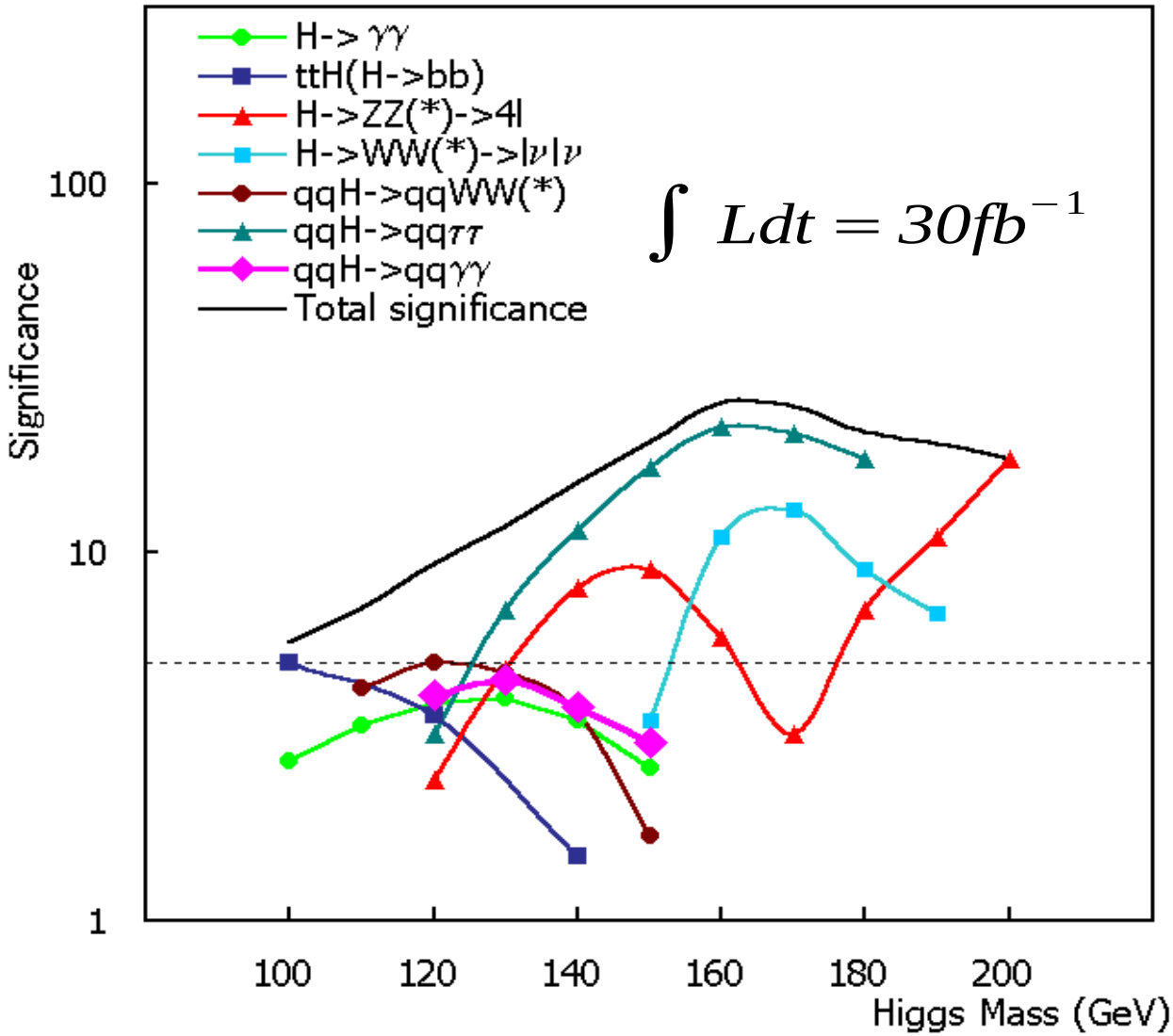
- 今後の課題
  - tt BGをより減らす

ZZ(*)→4l channelの低質量領域をカバーが可能

→Higgsの早期発見に寄与

ATLASにおける SM Higgsのまとめ

- ZZ*→4l の low tailが 延び、significanceの改善が期待できる
  可能性がある



- VBFを中心に1year Runで5σ discovery可能
- 180GeV以下のHiggsでYtが10〜20%の精度で決めることができる