Study of VXD geometry for flavour tagging

presented *) by
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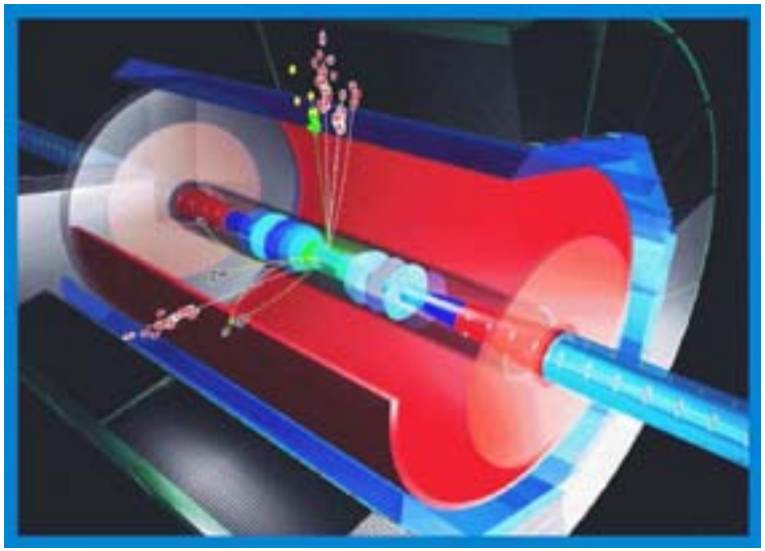
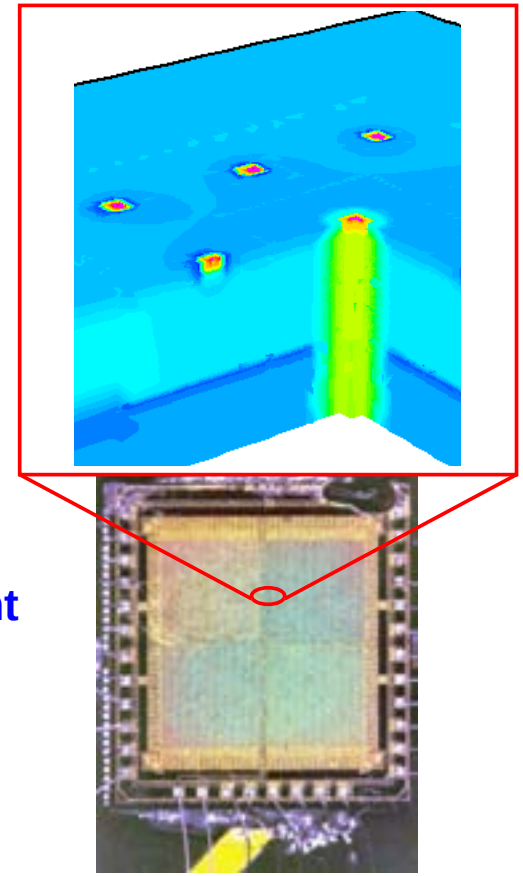


- $e^+e^- \to Zh$, $h \to$ jets
- Flavour tagging in presence of SM background



Results:

- Precision of b.r. measurement $\Gamma(h \to c\bar{c})$, $\Gamma(h \to b\bar{b})$ for different sets of VXD parameters

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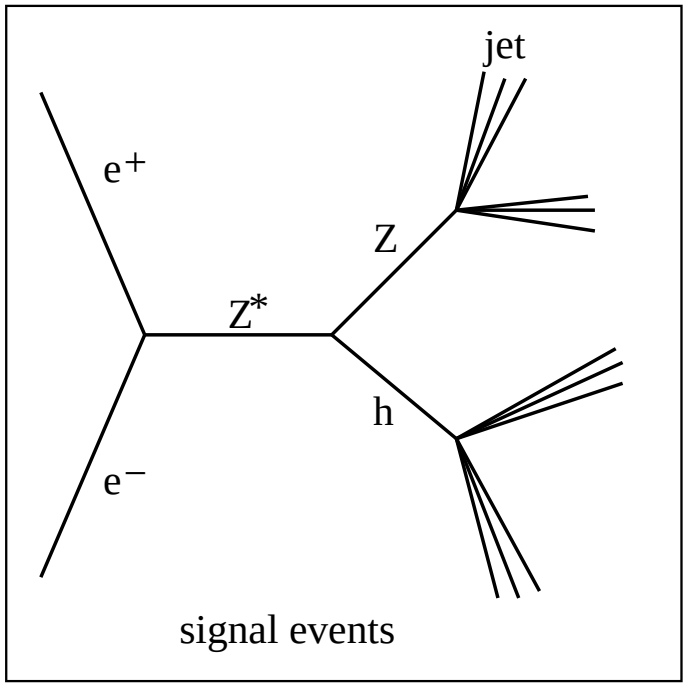
Simulation

- **Event generator - PYTHIA :**
  Signal: $e^+e^- \to Zh \quad (h \to c\bar{c},\ h \to b\bar{b})$

  - **SM:** M_h = **127 GeV**
  - **MSSM:** M_A = **350 GeV,**
    M_2 = **200 GeV,**
    $A_{\tilde{f}}$ = **2450 GeV,**
    M_h , Γ_h, **b. r. from HDECAY**
    M_h **= 127 GeV**

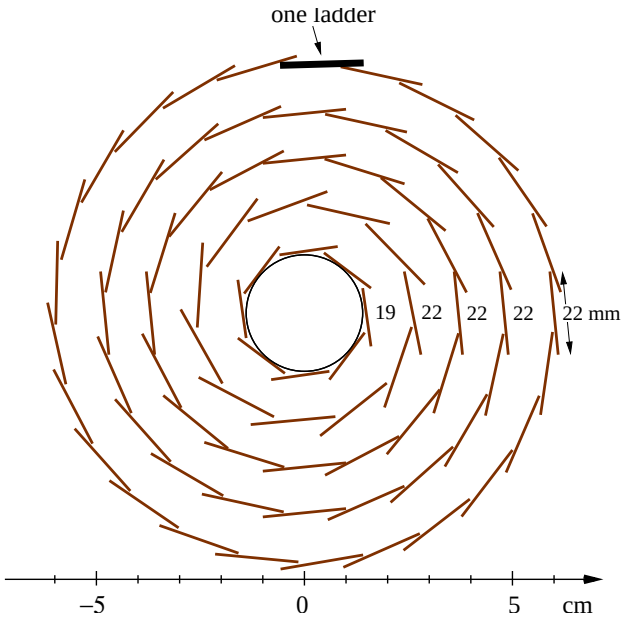
  Background: $e^+e^- \to W^+W^-$,
  $e^+e^- \to q\bar{q},\ e^+e^- \to ZZ$, **other higgs decays**

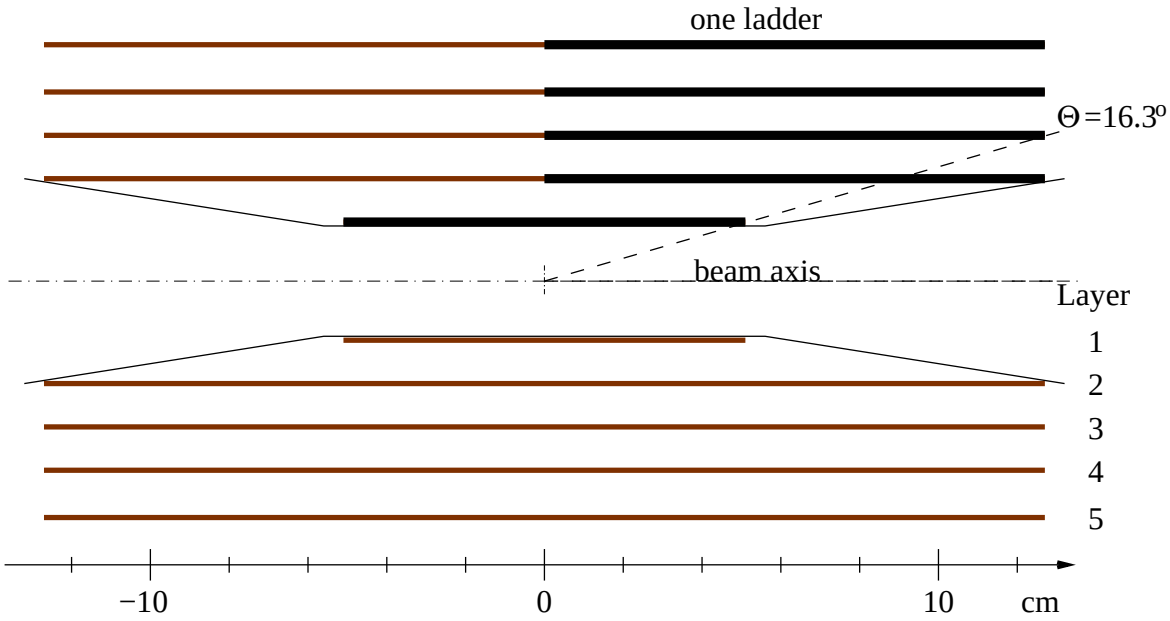
- **Centre of mass energy 500 GeV**
- **Corresponding luminosity 500 fb^{-1}**
- **Detector:**
  - **Simulation à Grande Vitesse 2.30**
  - **The entire ILC detector as in TESLA TDR**
  - **Varying VXD parameters (long barrel)**



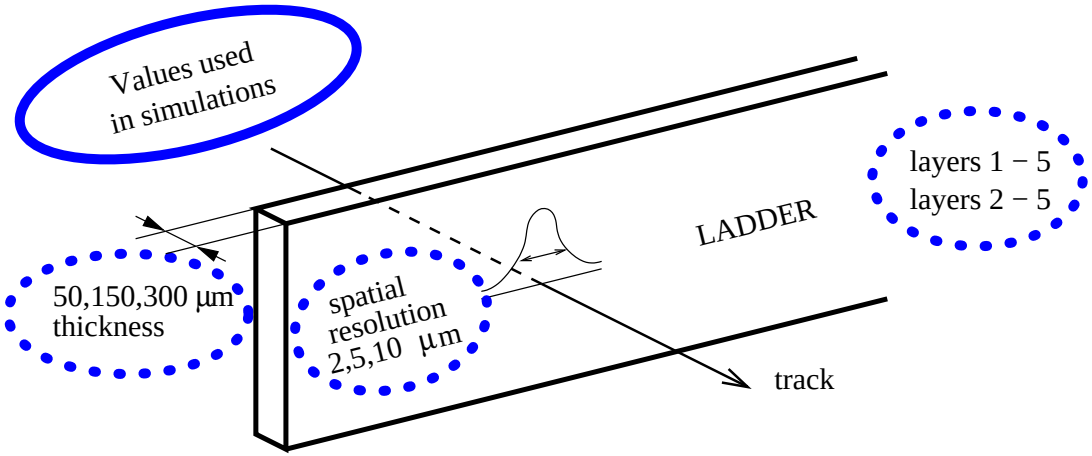
signal events

Description of the VXD geometry



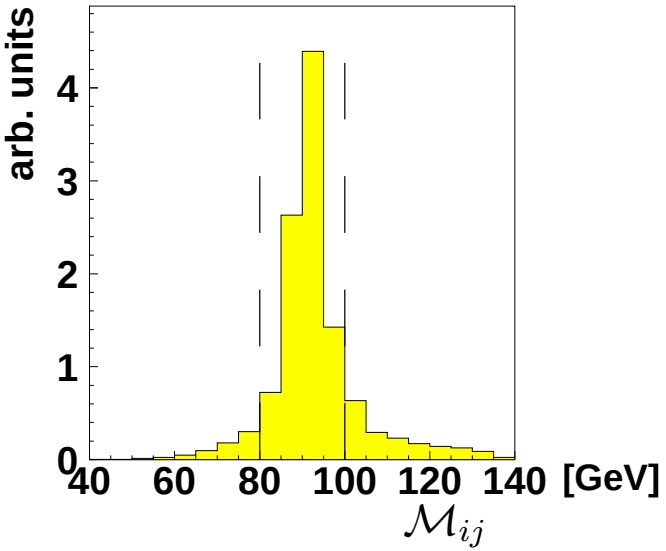


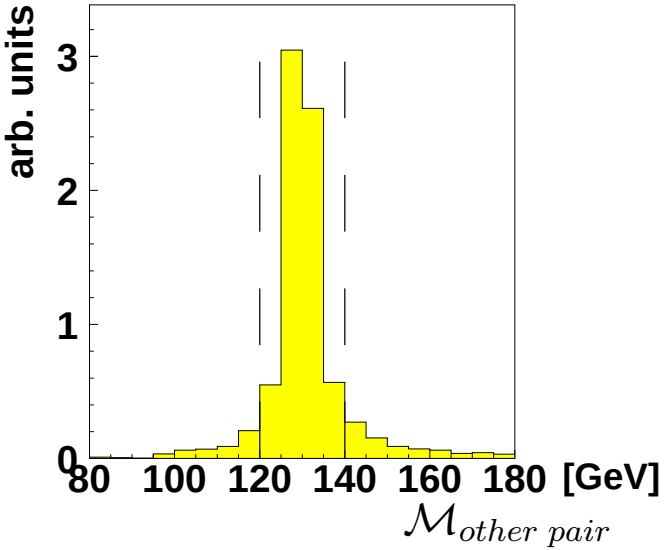
Layer	Radius	# ladders
1	15 mm	8
2	26 mm	22
3	37 mm	32
4	48 mm	40
5	60 mm	50



Higgs selection

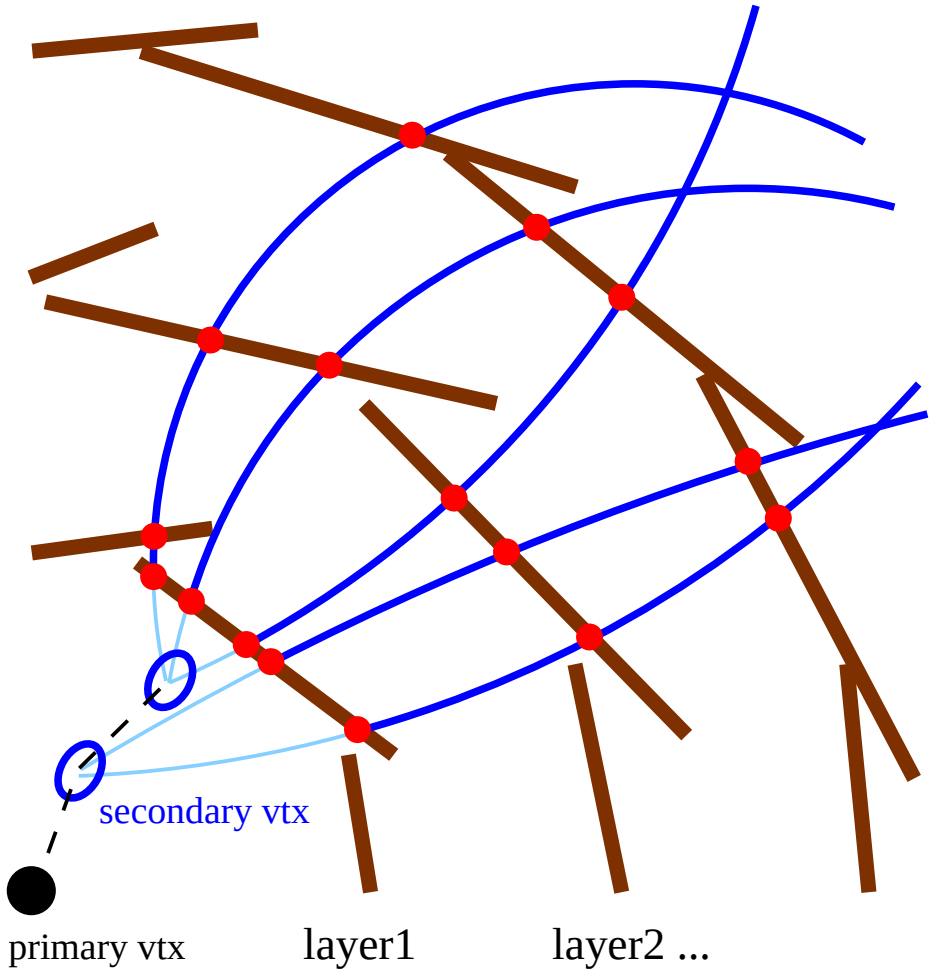
- $E_{vis} > 0.8\ E_{cms}$
- P_t **of event** < 20 GeV
- $|P_z|$ **of event** < 30 GeV
- $|\cos(\theta_{thrust})| < 0.7$
- **4 jets (JADE algorithm)**
- **Rescale jet energies to satisfy energy and momentum conservation (jet velocities fixed)**
- **Find pair** (i, j) **with invariant mass** $\mathcal{M}_{ij}$ **closest do** M_Z
- **Event assumed** $e^+e^- \to Zh$ **if:**
  - $|\mathcal{M}_{ij} - M_Z| < 10$ GeV
  - $|\mathcal{M}_{other\ pair} - M_h| < 10$ GeV

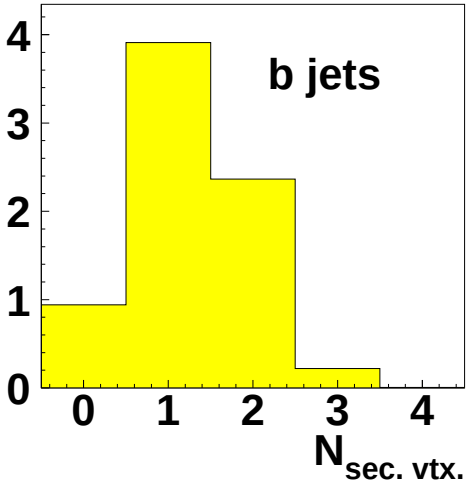


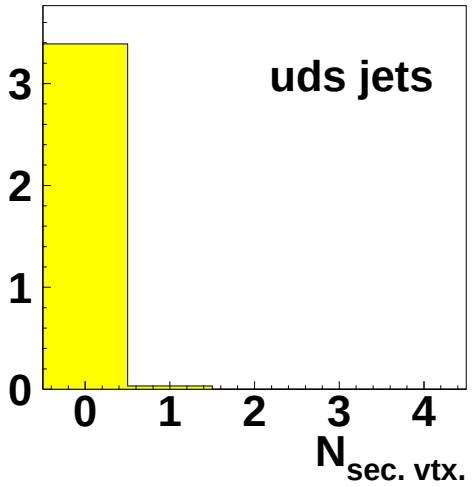


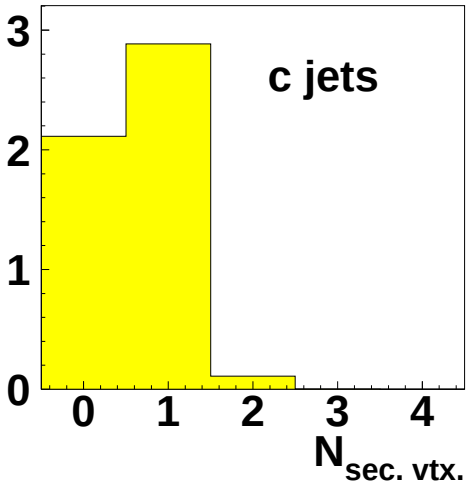
Jet flavour tagging - 1

- **Search for secondary vertices in each jet (with ZVTOP)**

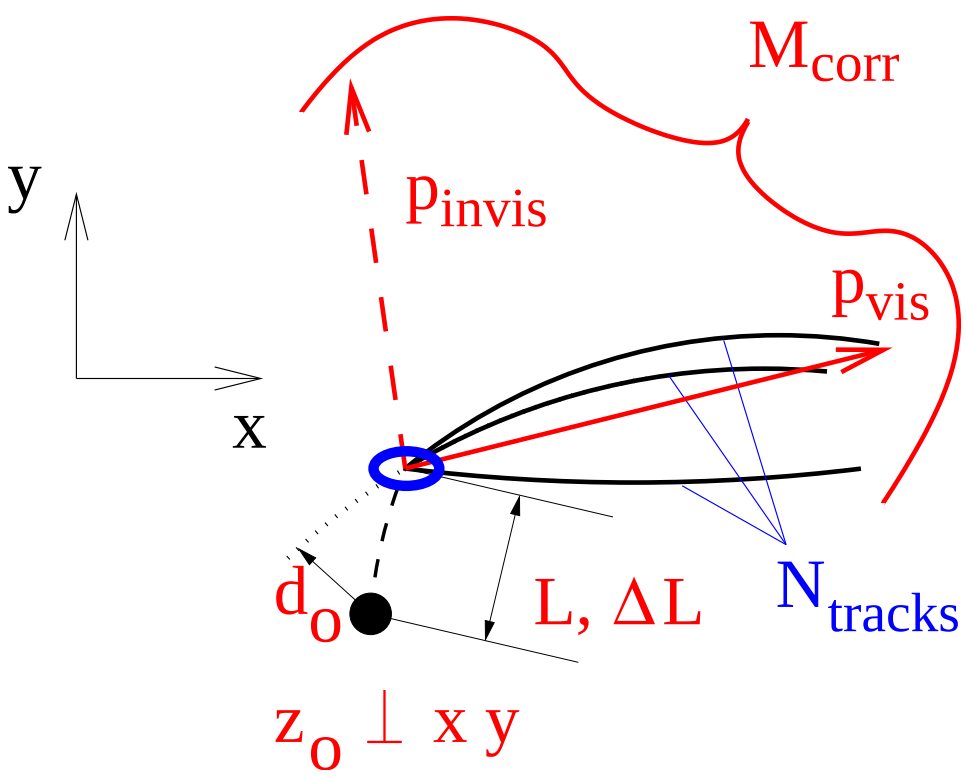


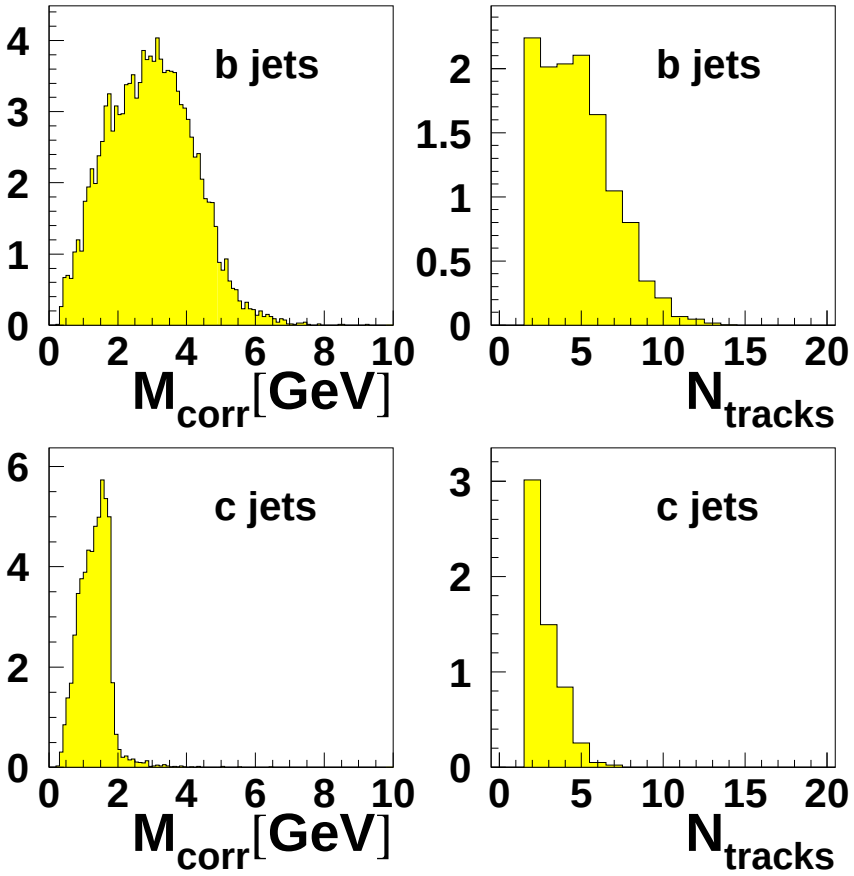






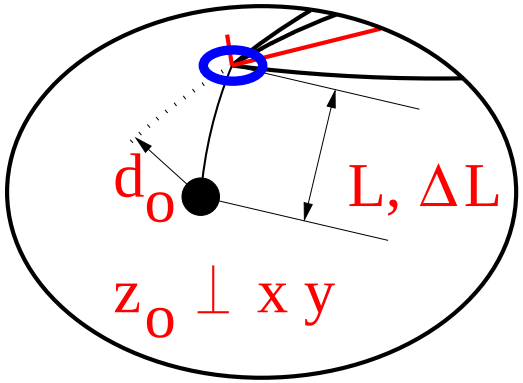
Jet flavour tagging - 2

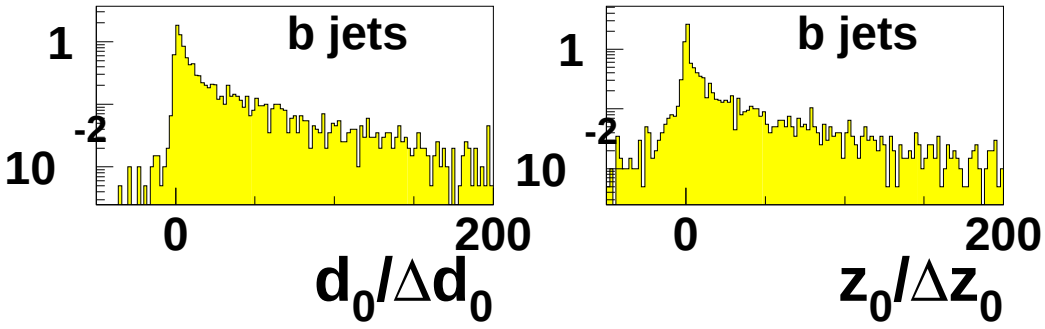


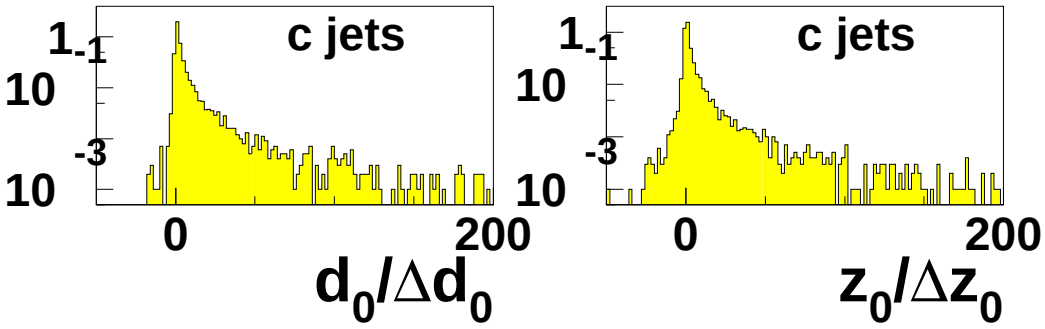


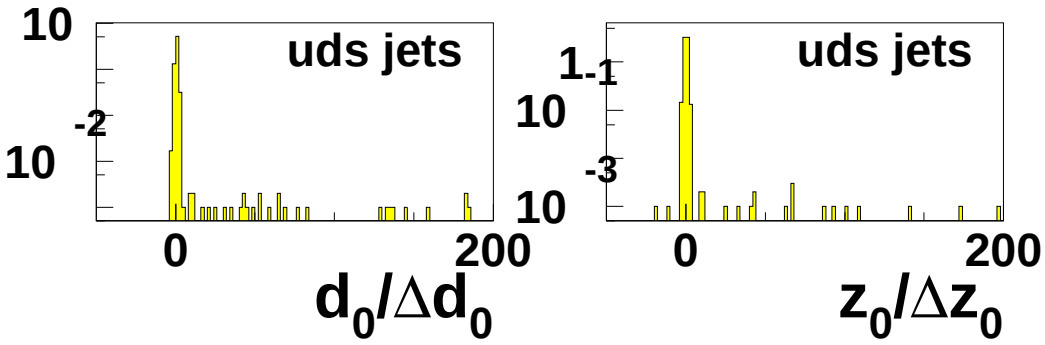
- **Neural Network** returns **c-tag** and **b-tag** $\in (0,1)$ of each jet using above quantities

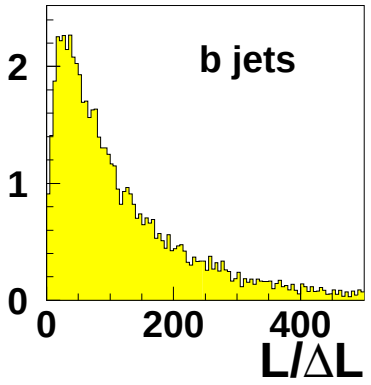
Jet flavour tagging - 3

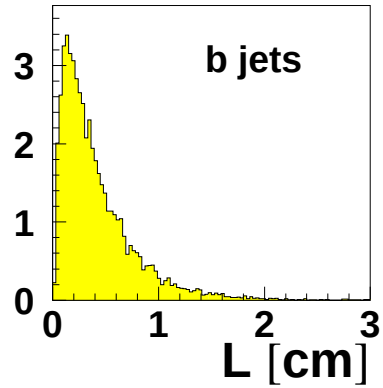


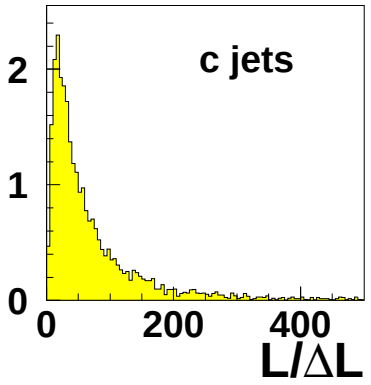


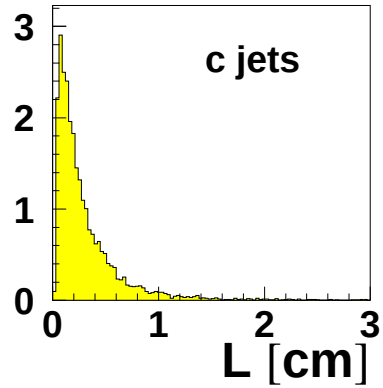




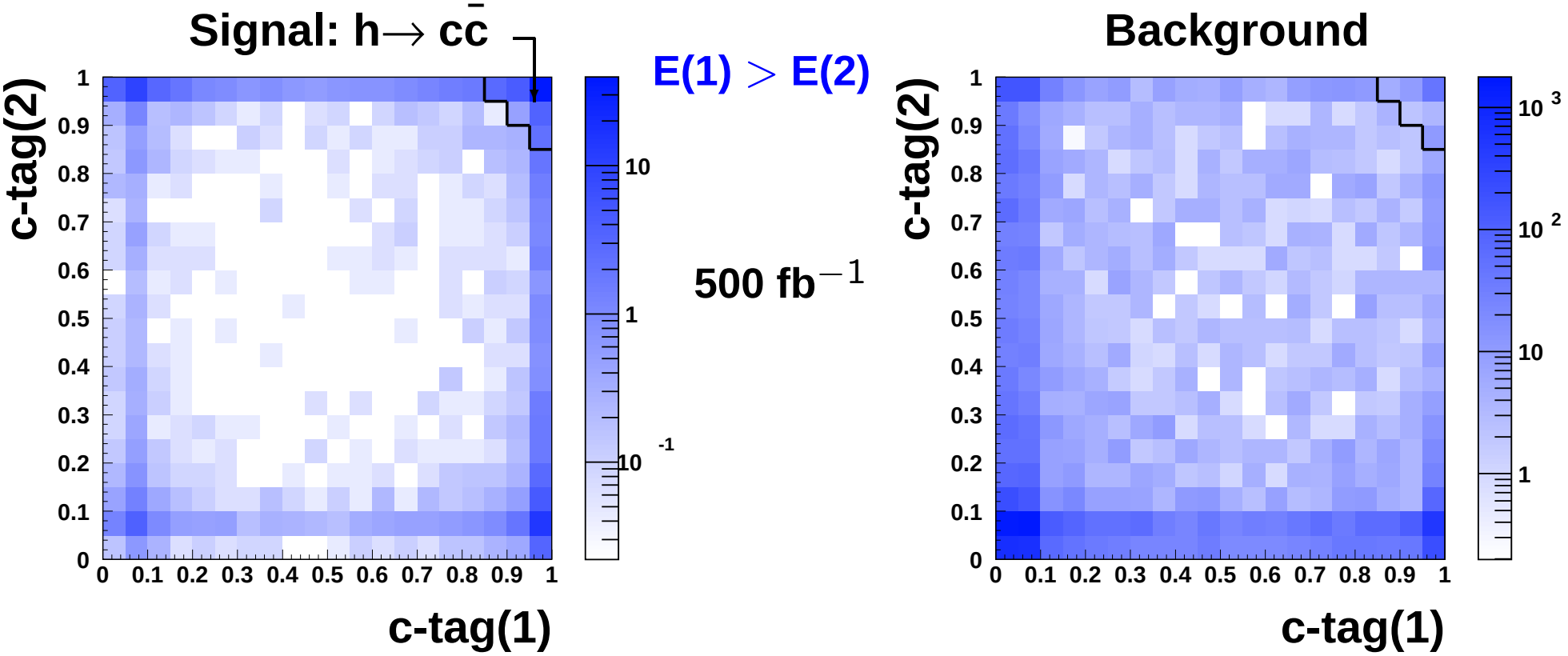








c-tag in h → jet(1) jet(2)



Cuts chosen to minimise $\Delta\Gamma/\Gamma$

Signal	**42 events**
Background	**79 events**

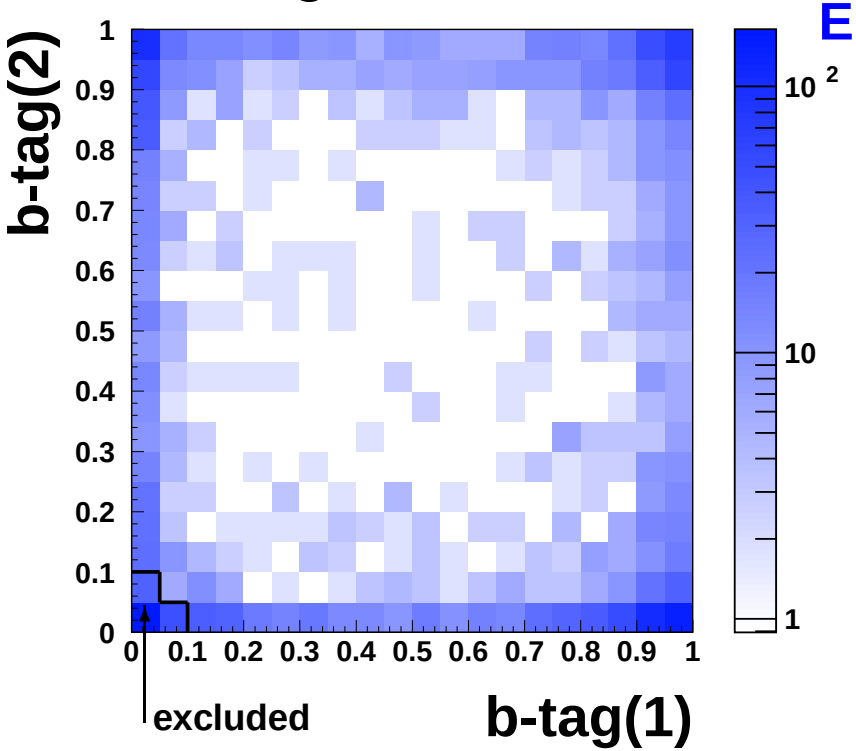
Precision of b.r. measurement:

$$\frac{\Delta\Gamma(h \to c\bar{c})}{\Gamma(h \to c\bar{c})} = 26\%$$

Example for:
layers 1 - 5
ladder thickness $50\mu m$
spatial resolution $2\mu m$

b-tag in h → jet(1) jet(2)

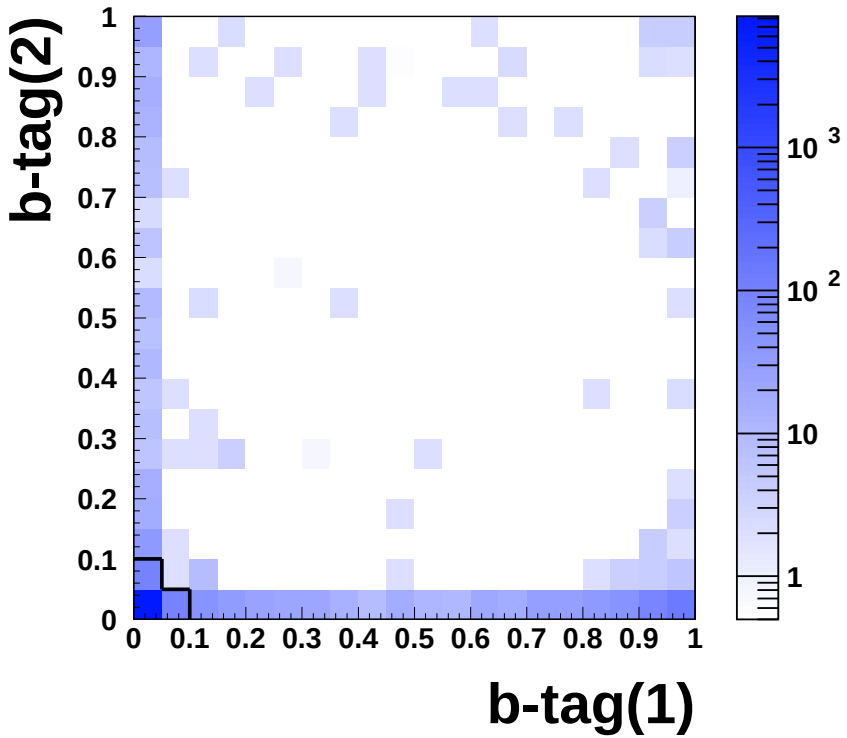
Signal: h→ b$\bar{b}$



E(1) > E(2)

500 fb^{-1}

Background



Cuts chosen to minimise $\Delta\Gamma/\Gamma$

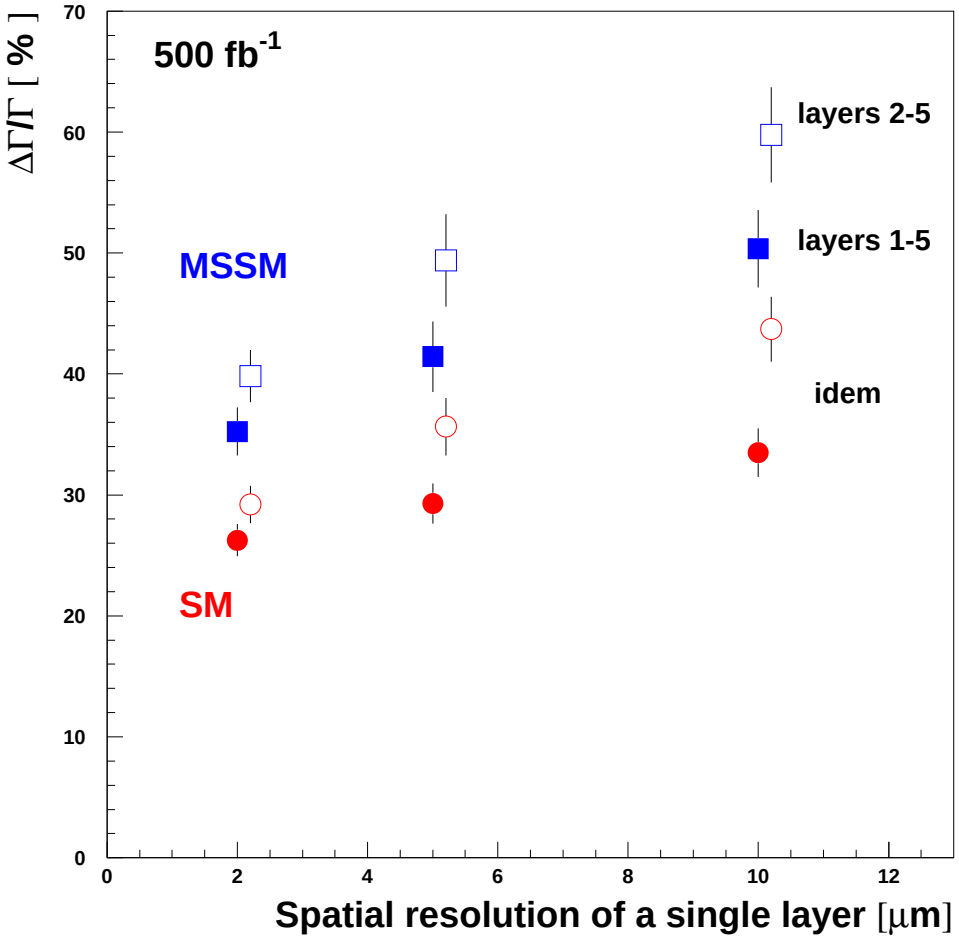
Signal	**2414 events**
Background	**785 events**

Precision of b.r. measurement:

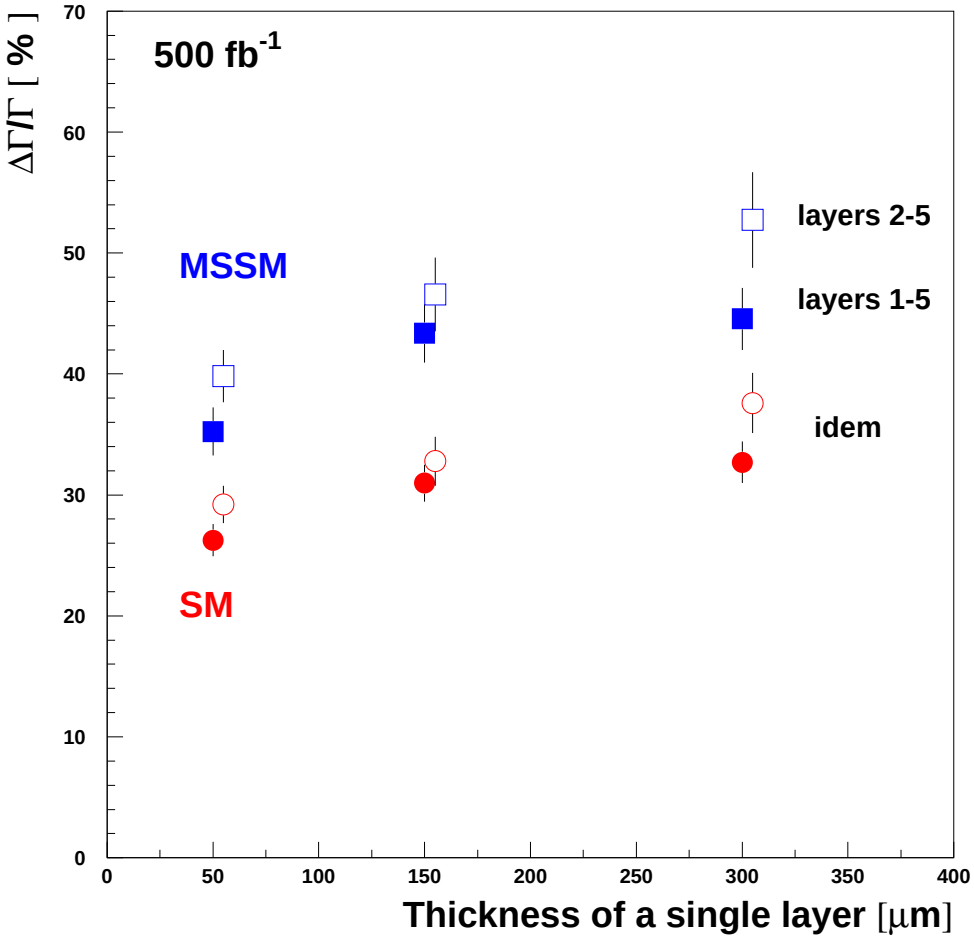
$$\frac{\Delta\Gamma(h \to b\bar{b})}{\Gamma(h \to b\bar{b})} = 2.3\%$$

Example for:
layers 1 - 5
ladder thickness $50\mu m$
spatial resolution $2\mu m$

Precision of the b.r. measurement $\Gamma(h \to c\bar{c})$

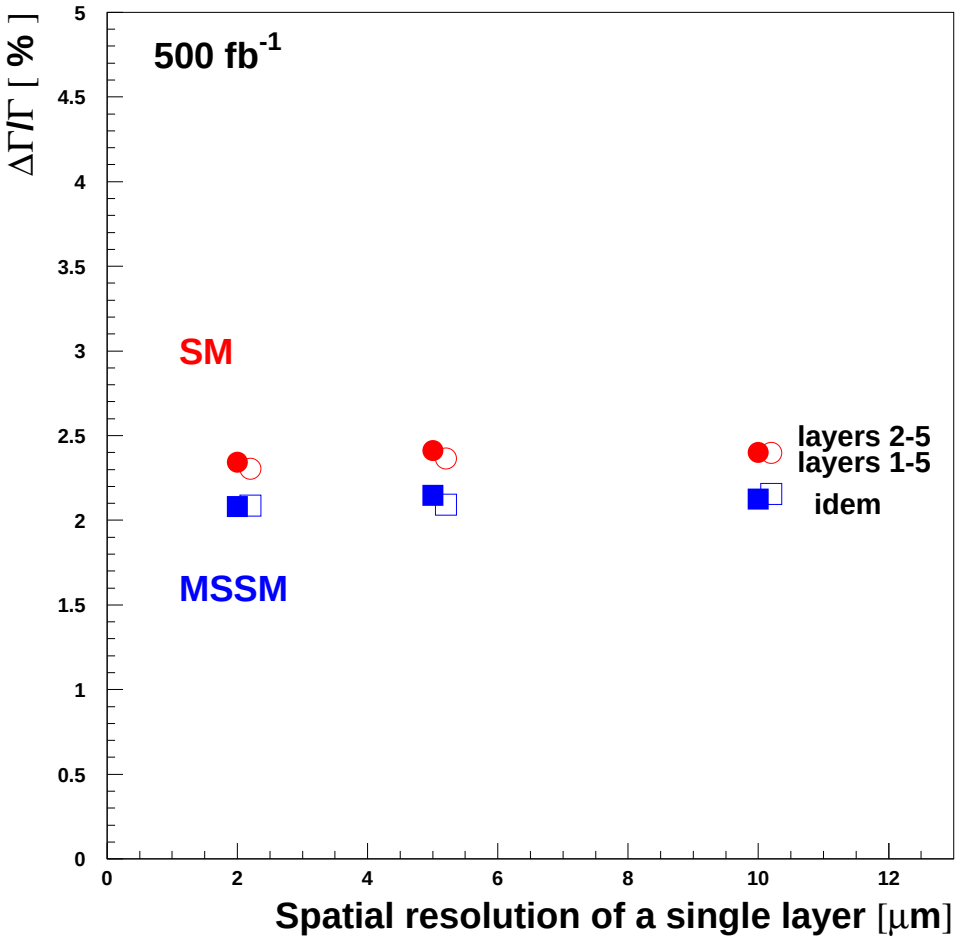


layer thickness $50\mu m$

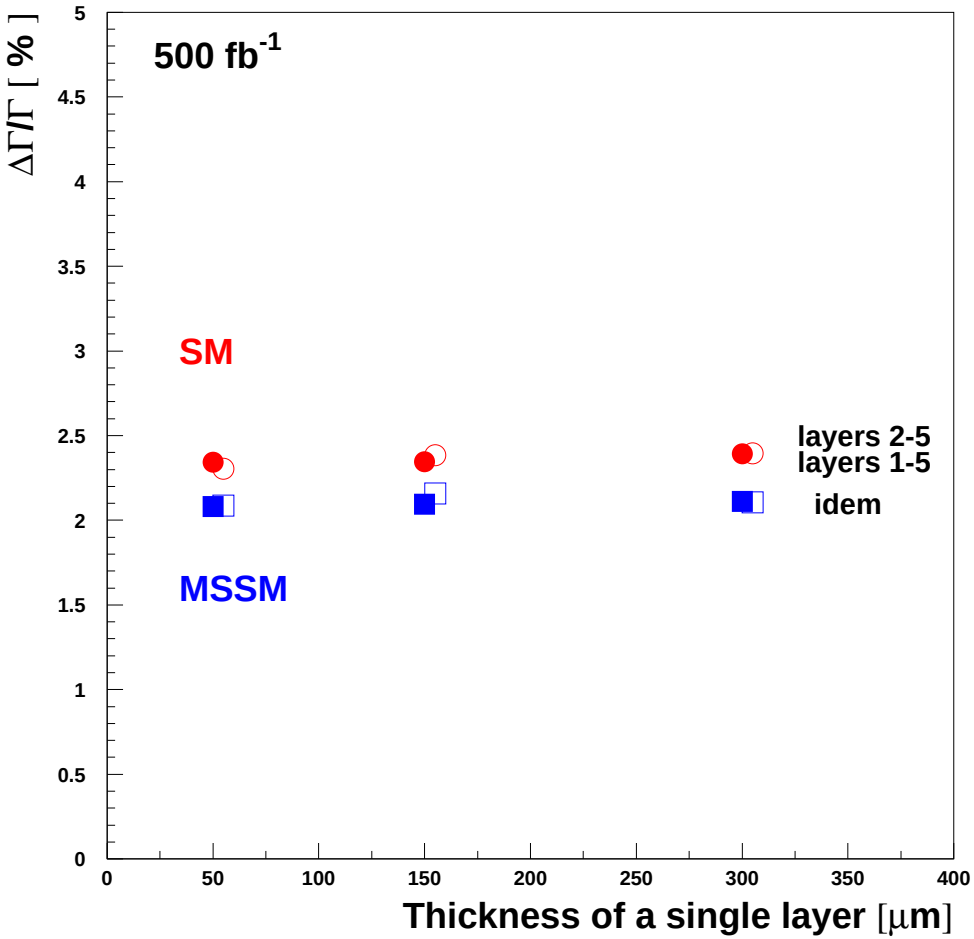


spatial resolution $2\mu m$

Precision of the b.r. measurement $\Gamma(h \to b\bar{b})$



layer thickness $50\mu m$



spatial resolution $2\mu m$

Conclusions

- **Little impact of studied VXD parameters on $\Gamma(h \to b\bar{b})$**
  Explanation:
  more signal than $h \to c\bar{c}$ (typical $\triangle\Gamma/\Gamma$ with b-tagging $\approx$ 2.3 %, without b-tagging $\approx$ 4 %), signal and background easier to separate (jets from background are less likely to mimic b - jets)

- **For $h \to c\bar{c}$ strong dependence on:**
  - **spatial resolution**
    $\approx 2\mu m$ has been achieved (e.g. MAPS)
  - **layer thickness**
    important to have as thin as possible
  - **presence of the innermost layer**