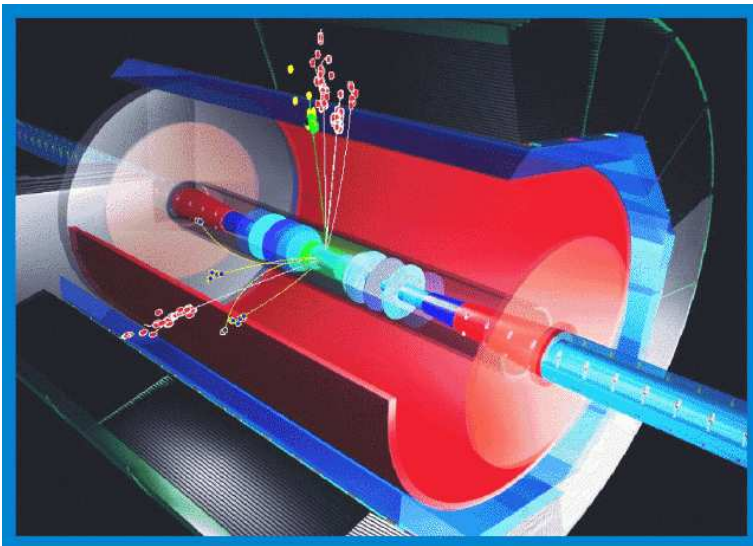


Study of VXD geometry for flavour tagging

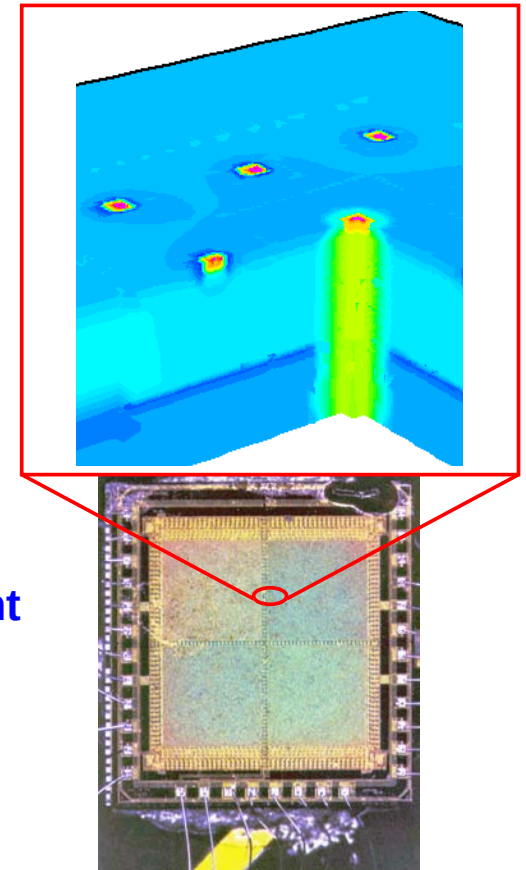
presented ^{*)} by
Jacek Ciborowski
Warsaw University
and
Lodz University



- $e^+e^- \rightarrow Zh, h \rightarrow \text{jets}$
- Flavour tagging in presence of SM background

Results:

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



^{*)} P. Łużniak (Lodz University), M. Adamus (Inst. Nucl. Studies, Warsaw)

Simulation

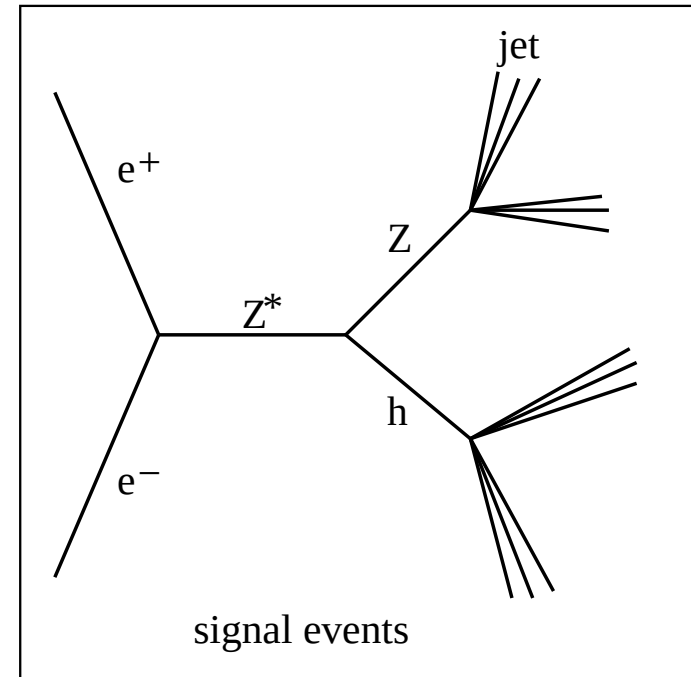
- **Event generator - PYTHIA :**

Signal: $e^+e^- \rightarrow Zh$ ($h \rightarrow c\bar{c}$, $h \rightarrow b\bar{b}$)

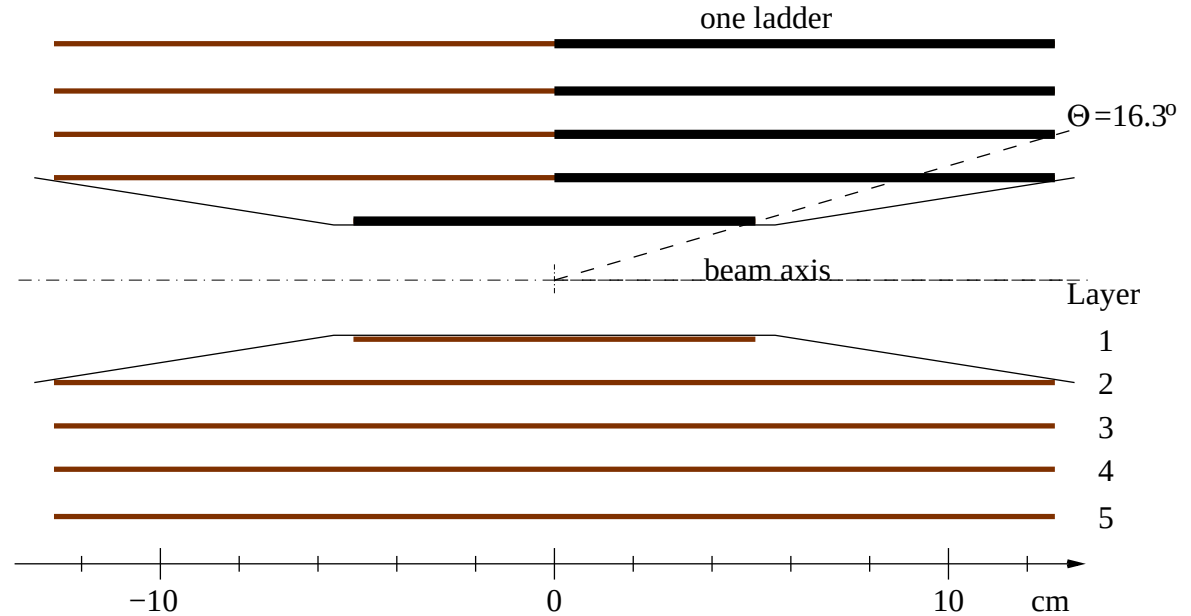
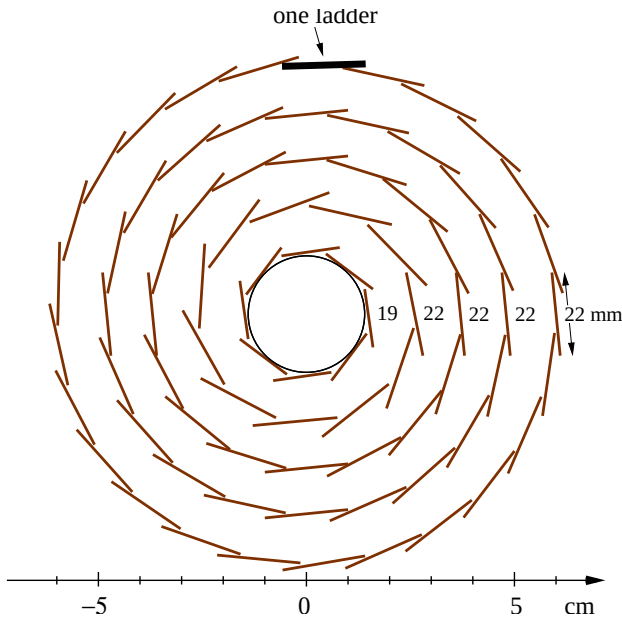
- **SM:** $M_h = 127 \text{ GeV}$
- **MSSM:** $M_A = 350 \text{ GeV}$,
 $M_2 = 200 \text{ GeV}$,
 $A_{\tilde{f}} = 2450 \text{ GeV}$,
 M_h, Γ_h , b. r. from HDECAY
 $M_h = 127 \text{ GeV}$

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

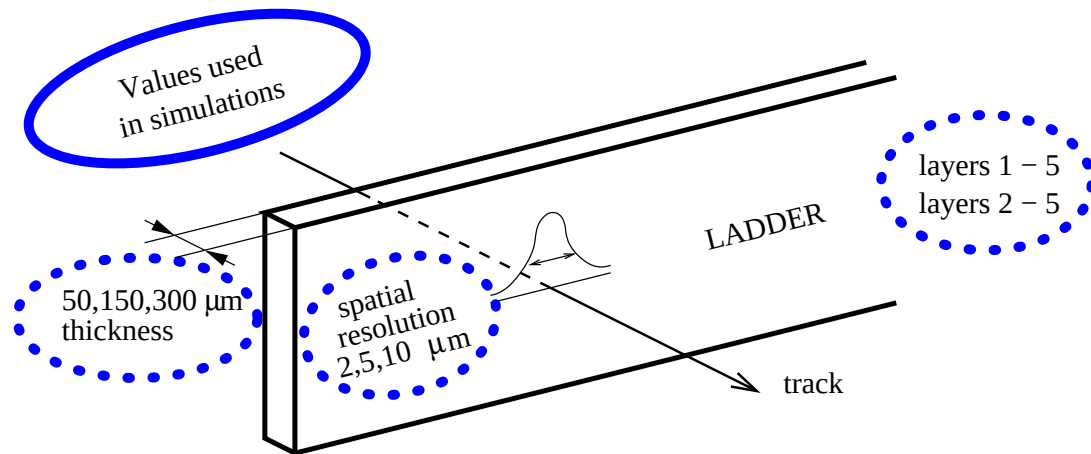
- Centre of mass energy 500 GeV
- Corresponding luminosity 500 fb^{-1}
- **Detector:**
 - Simulation à **Grande Vitesse** 2.30
 - The entire ILC detector as in TESLA TDR
 - Varying VXD parameters (long barrel)



Description of the VXD geometry

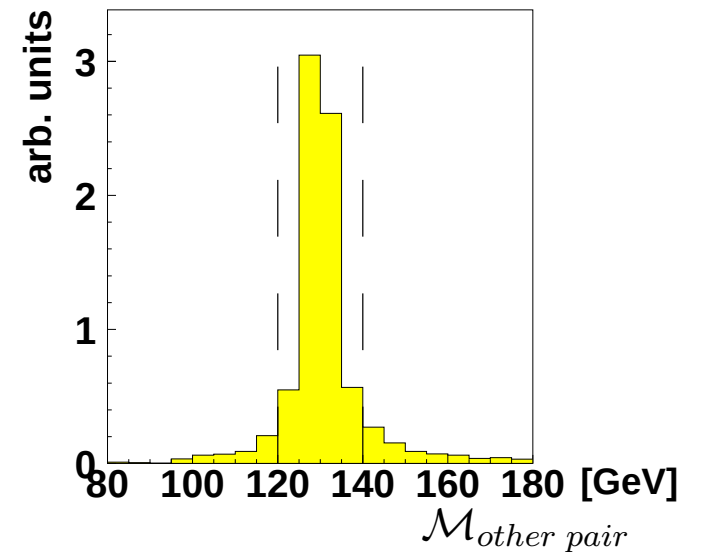
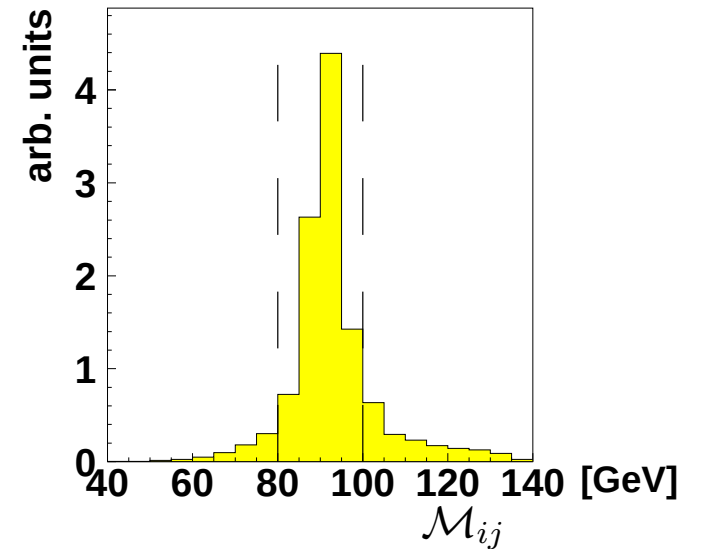


Layer	Radius	# ladders
1	15 mm	8
2	26 mm	22
3	37 mm	32
4	48 mm	40
5	60 mm	50



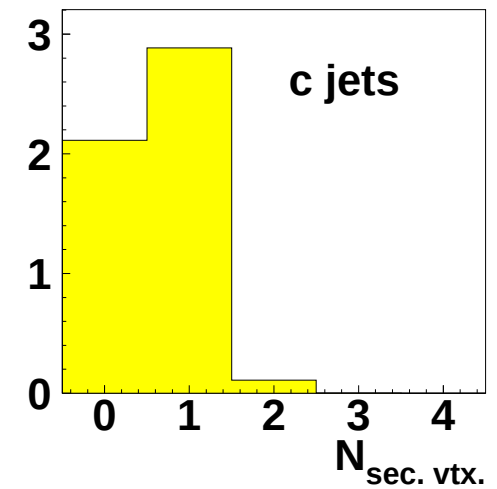
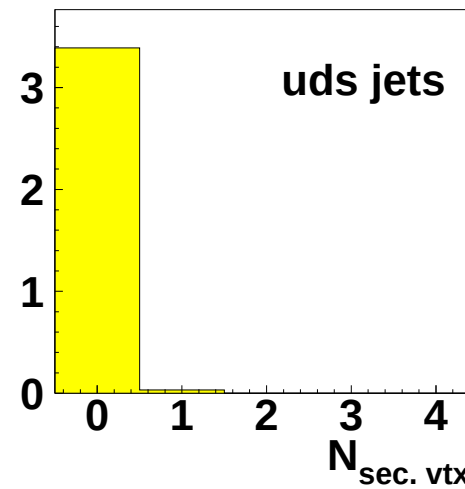
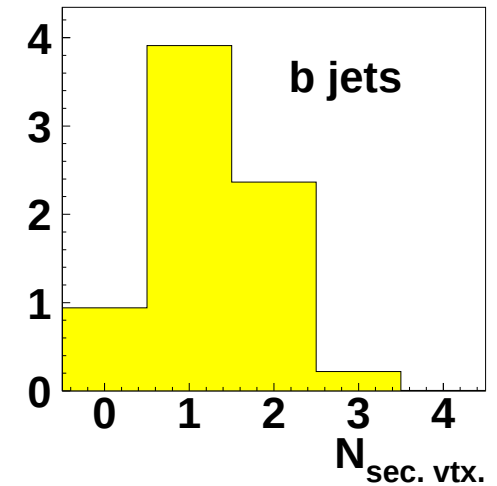
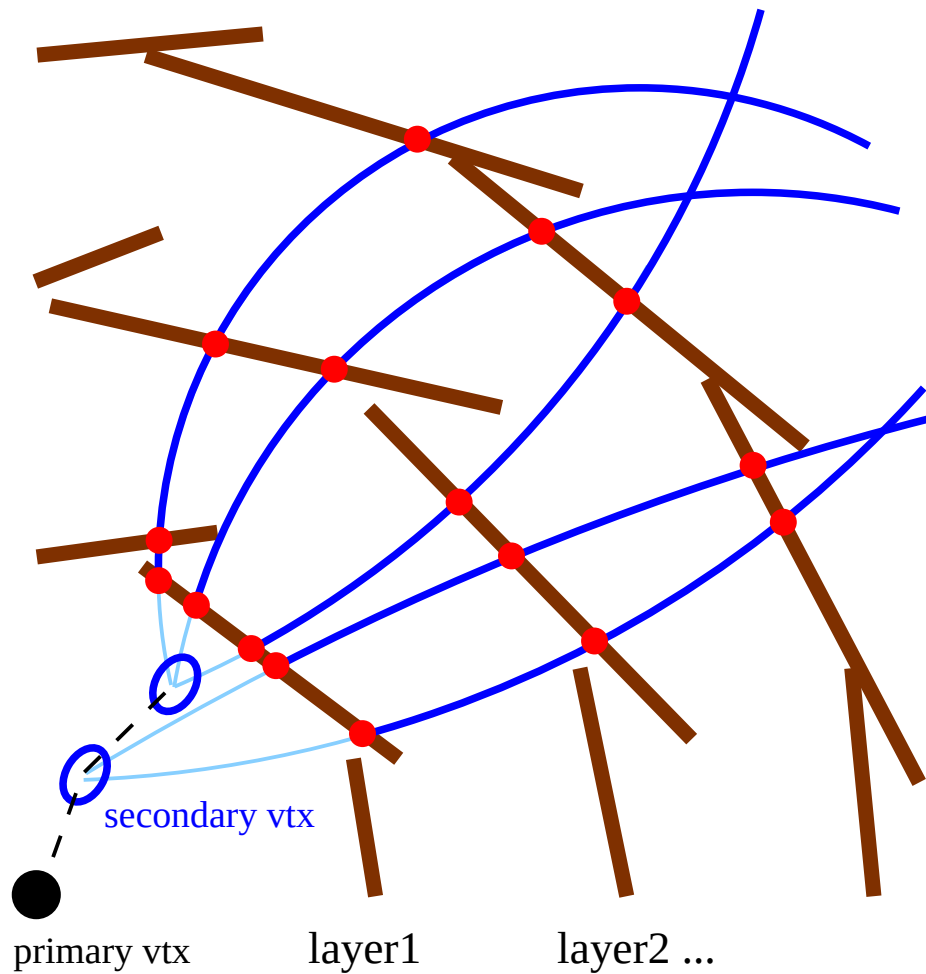
Higgs selection

- $E_{vis} > 0.8 E_{cms}$
- 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 to M_Z
- Event assumed $e^+e^- \rightarrow Zh$ if:
 - $|\mathcal{M}_{ij} - M_Z| < 10$ GeV
 - $|\mathcal{M}_{other\ pair} - M_h| < 10$ GeV

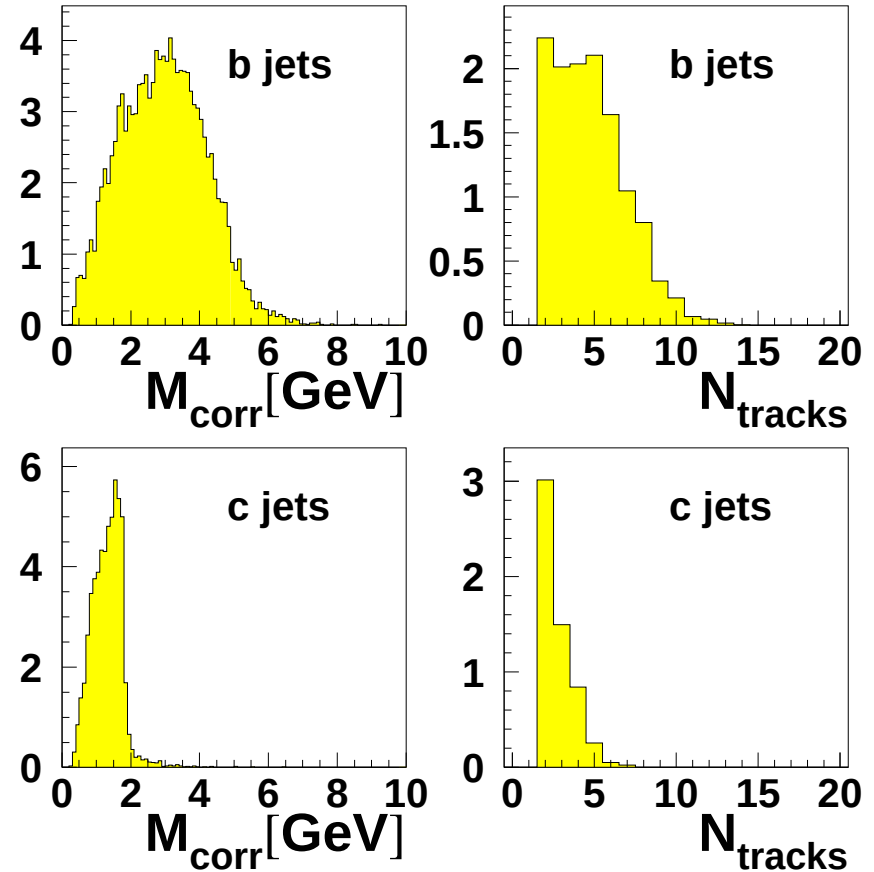
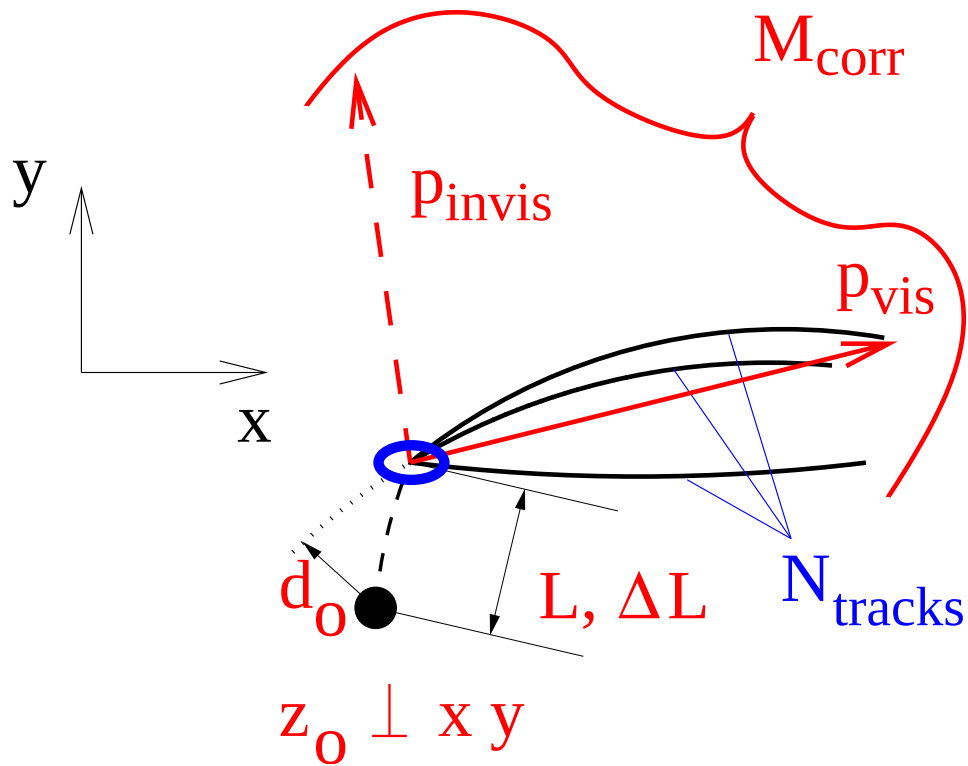


Jet flavour tagging - 1

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

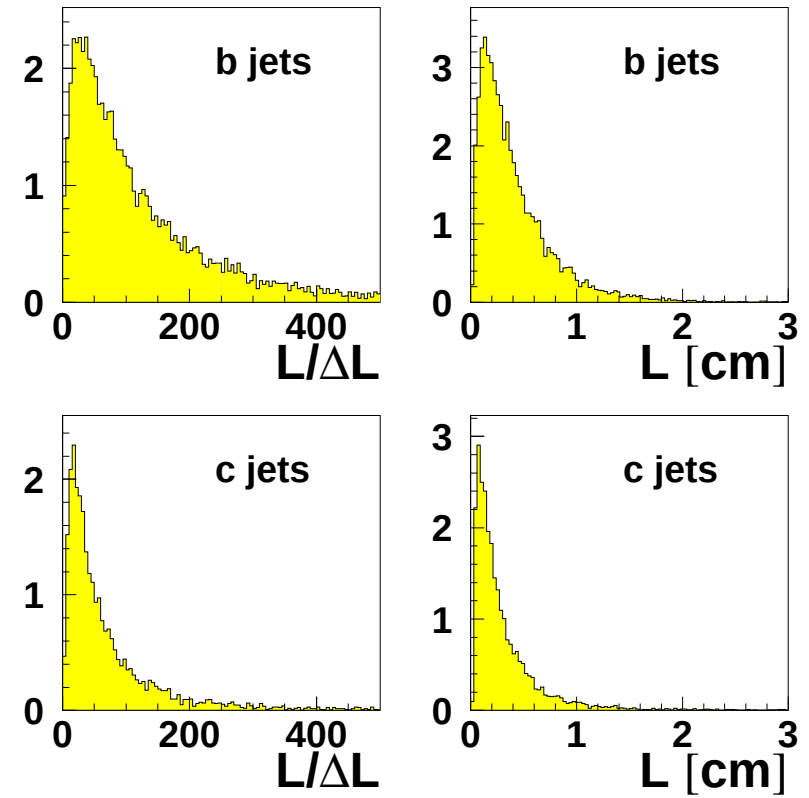
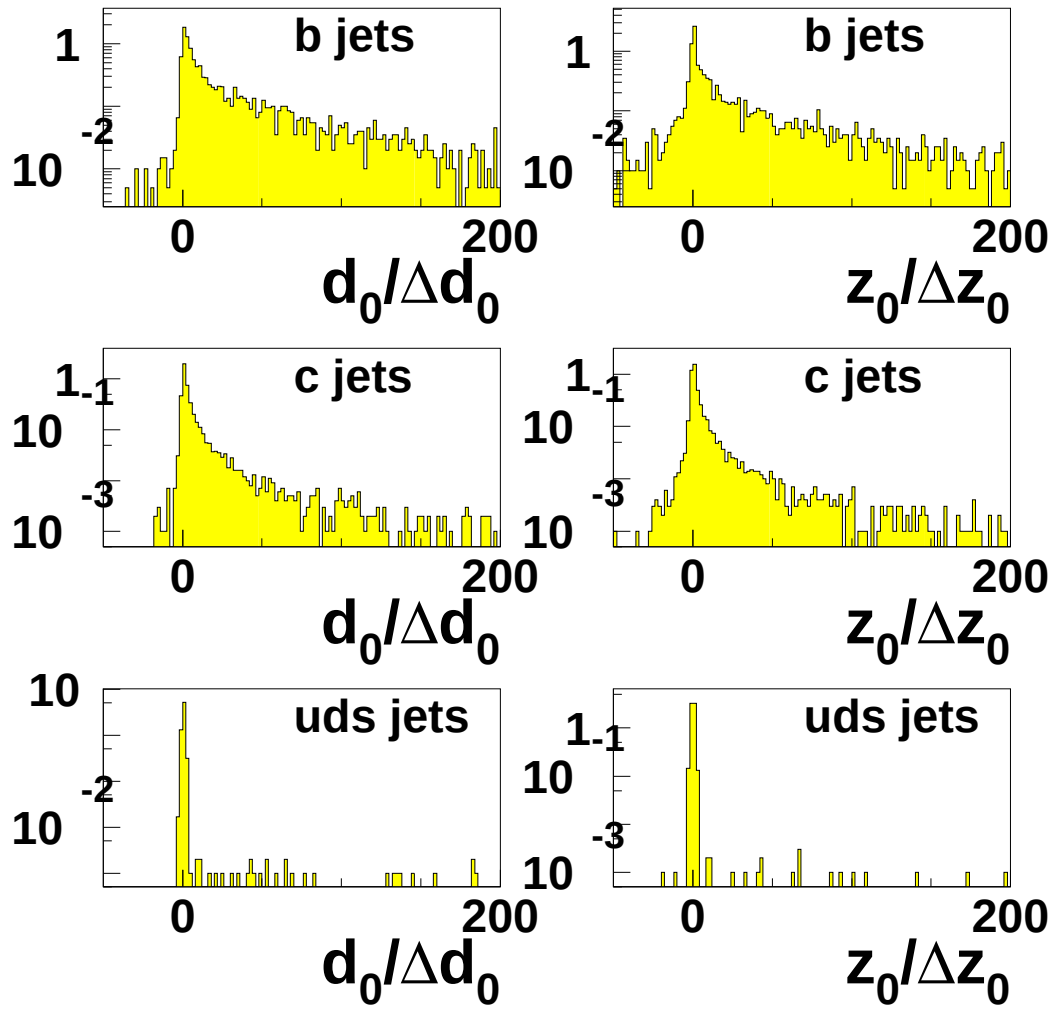
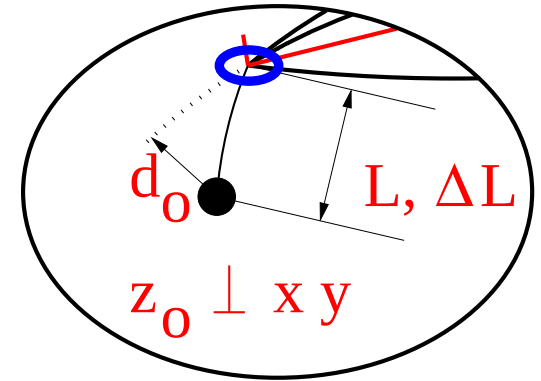


Jet flavour tagging - 2

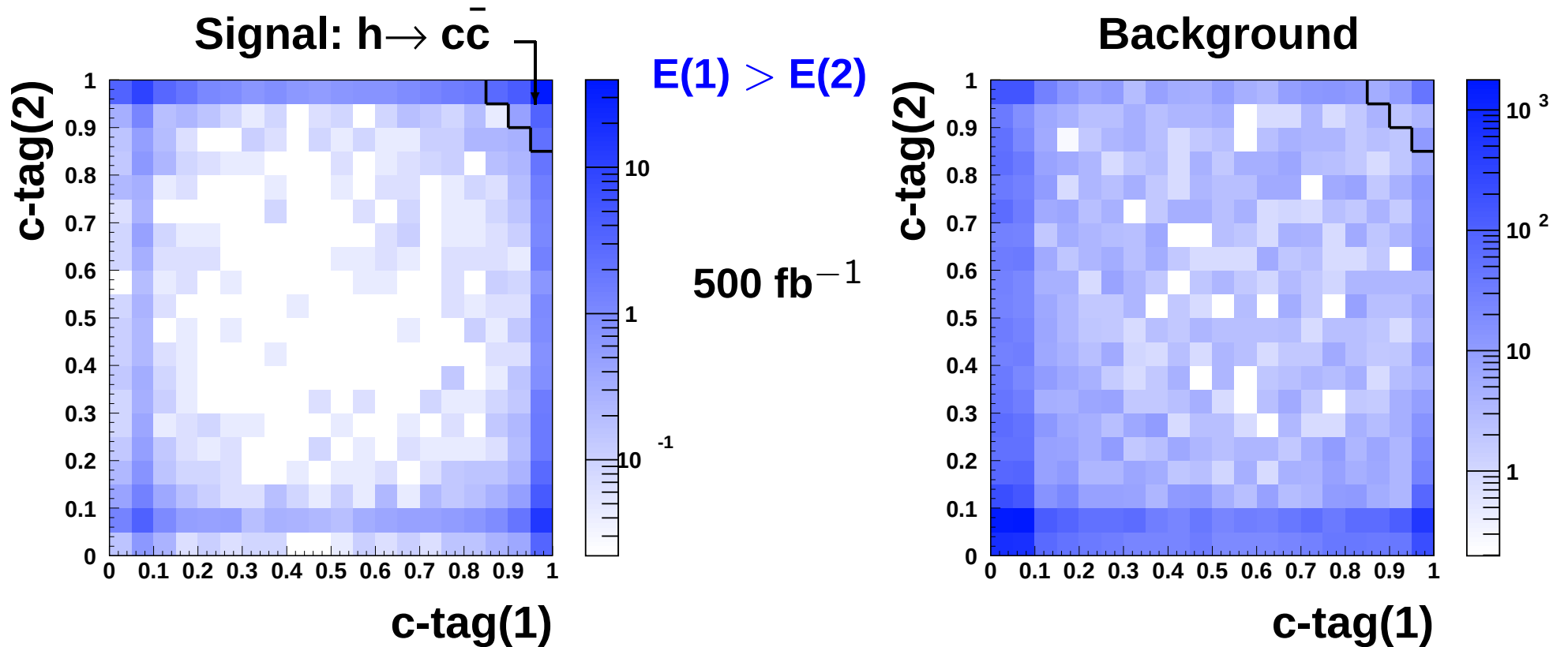


- **Neural Network** returns **c-tag** and **b-tag** $\in (0, 1)$ of each jet using above quantities

Jet flavour tagging - 3



c-tag in $h \rightarrow \text{jet}(1) \text{jet}(2)$



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

Signal 42 events

Background 79 events

Precision of b.r. measurement:

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

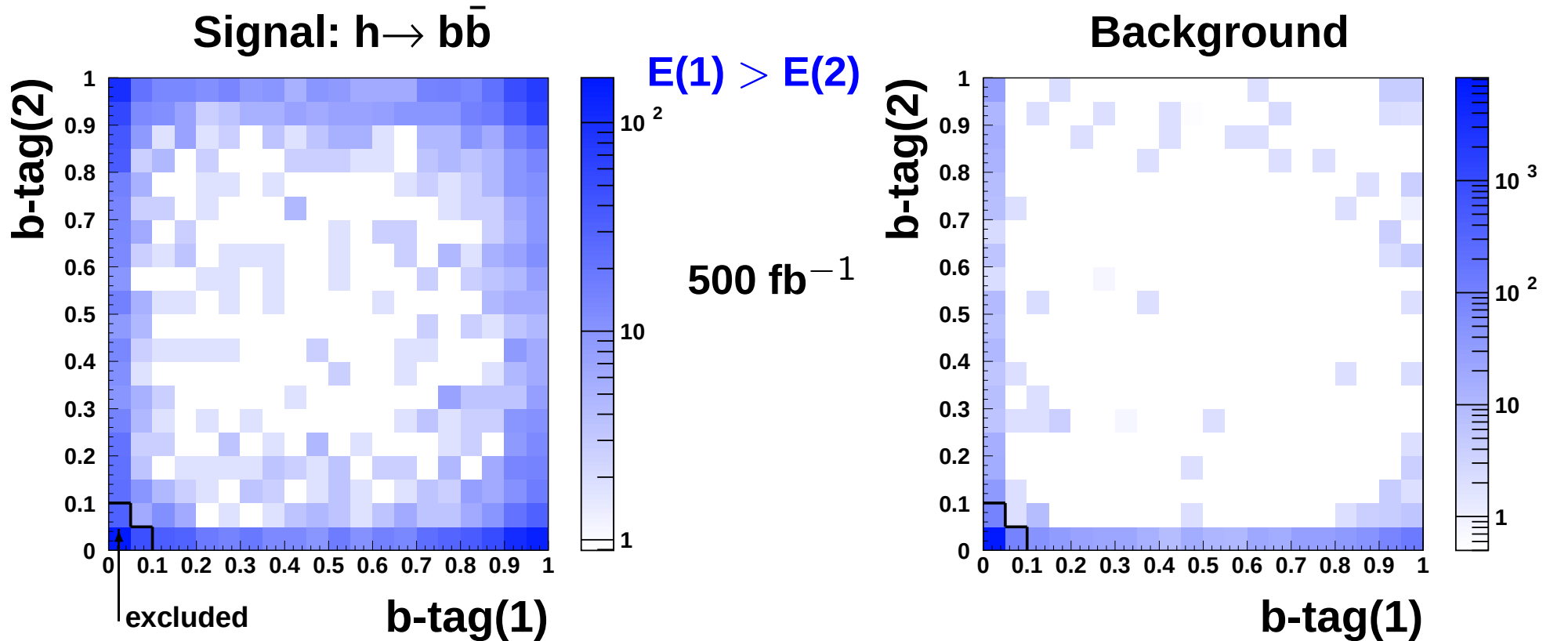
Example for:

layers 1 - 5

ladder thickness $50\mu\text{m}$

spatial resolution $2\mu\text{m}$

b-tag in $h \rightarrow \text{jet}(1) \text{jet}(2)$



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

Signal	2414 events
Background	785 events

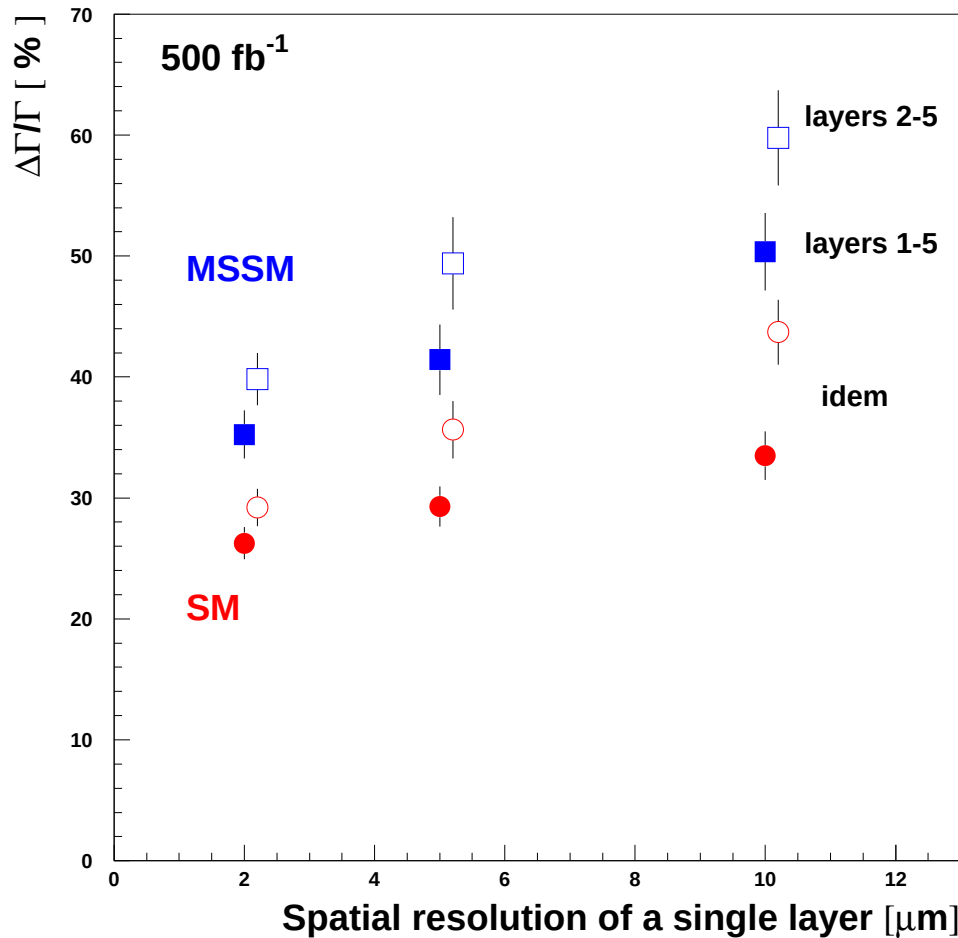
Precision of b.r. measurement:

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

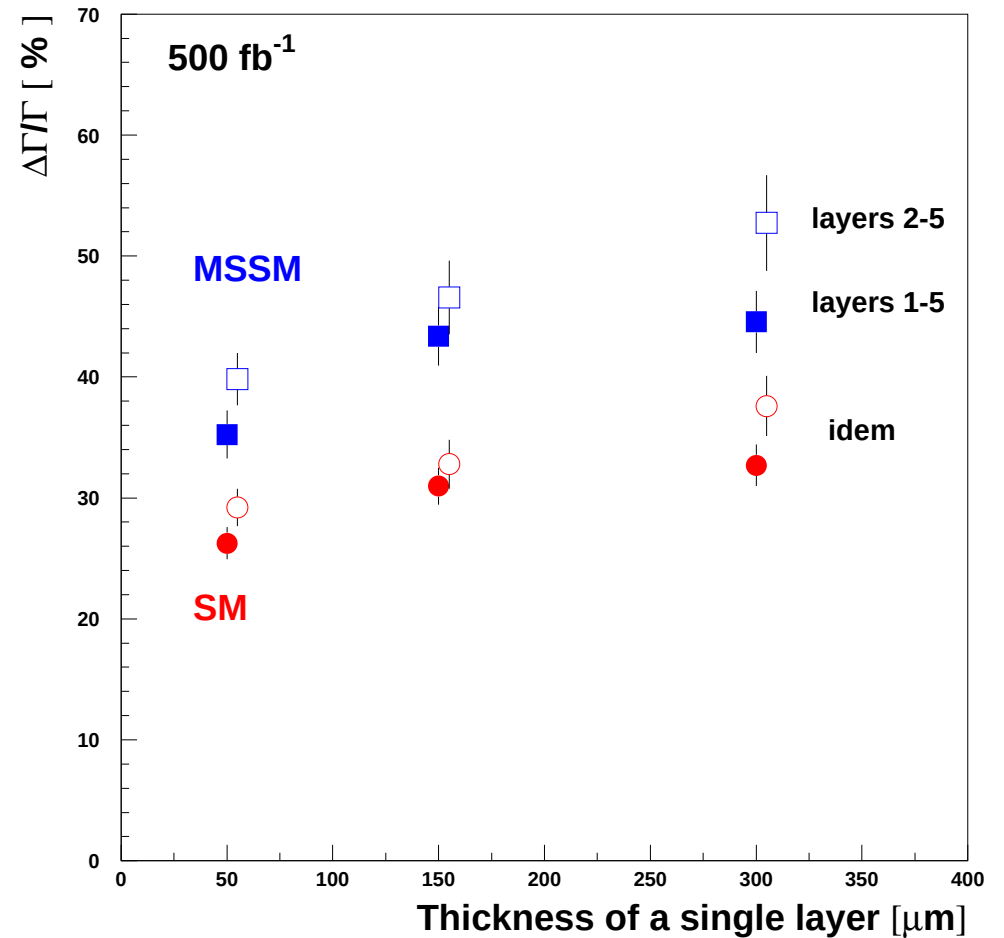
Example for:

layers 1 - 5
ladder thickness $50\mu\text{m}$
spatial resolution $2\mu\text{m}$

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

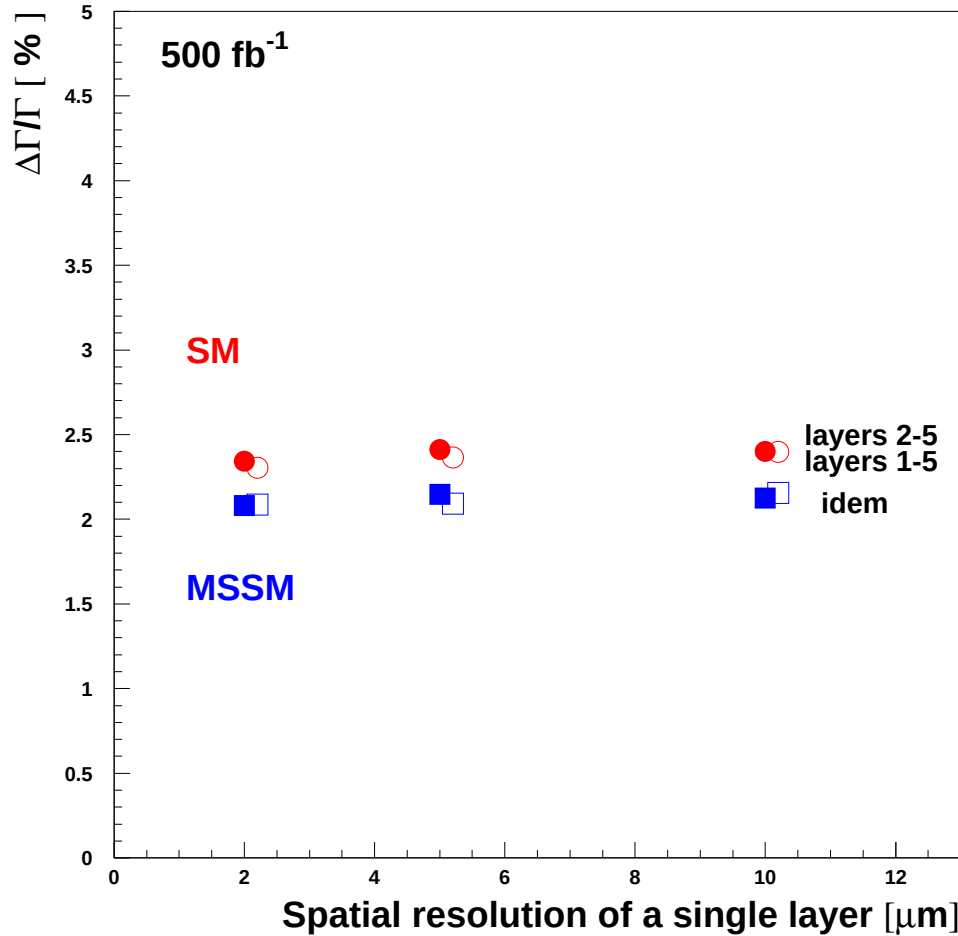


layer thickness 50 μm

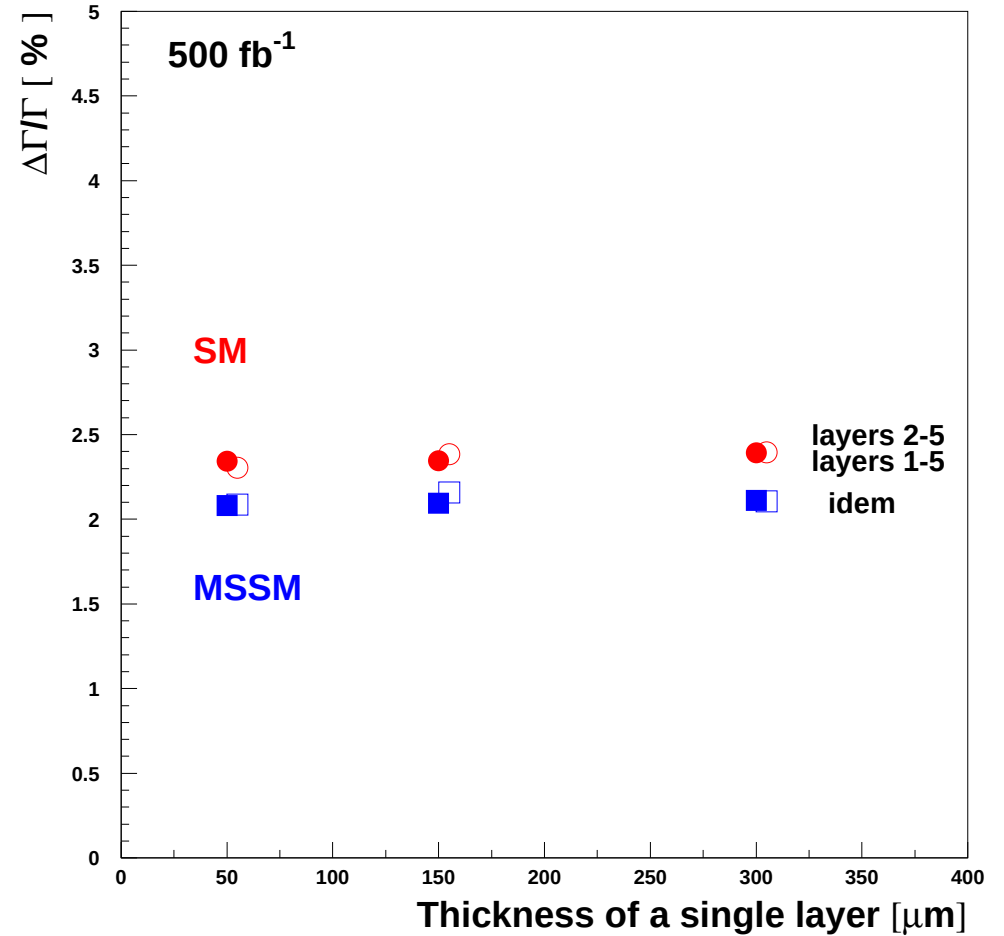


spatial resolution 2 μm

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



layer thickness 50 μm



spatial resolution 2 μm

Conclusions

- Little impact of studied VXD parameters on $\Gamma(h \rightarrow b\bar{b})$

Explanation:

more signal than $h \rightarrow c\bar{c}$ (typical $\Delta\Gamma/\Gamma$ 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 $h \rightarrow c\bar{c}$ 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