

# MC studies at Aachen IIIb



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- **CMS Top physics**
- **CMS Tau physics (lepton flavour violation)**

Further activities of Aachen IIIb:

- CMS Tracker (Installation/Quality tests/DQM)
- Computing (Aachen Grid)

# Top Topics

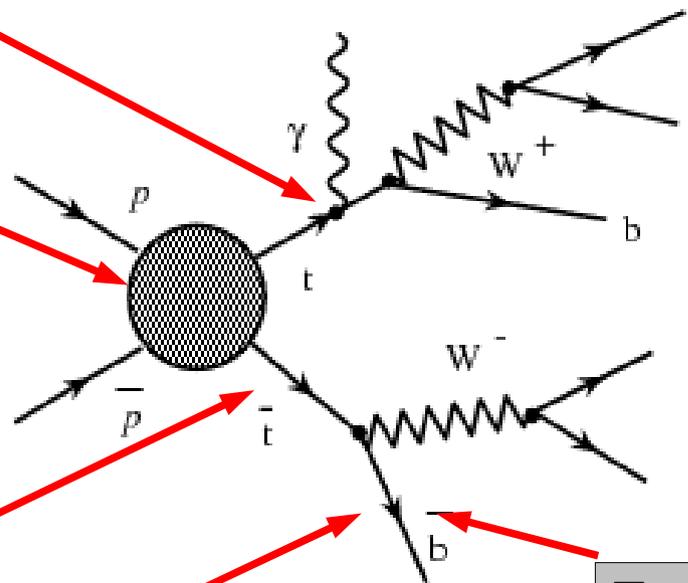
A. Stahl, M. Davids, M. Duda, F. Farshbaf, H. Geenen, W. Haj Ahmad, Th. Hermanns, S. Kalinin, Y. Küssel, D. Tornier, O. Pooth, M. Zöller

Top Charge measurement  
**(Th. Hermanns)**

Search for KK top-pair resonances  
**(W. Haj Ahmad)**

Spin-spin correlations  
**(M. Davids)**

Top mass via topology of b-jet  
**(F. Farshbaf)**



Top rediscovery semileptonic channel  
**(Y. Küssel)**

Top mass full hadronic channel  
**(M. Duda)**

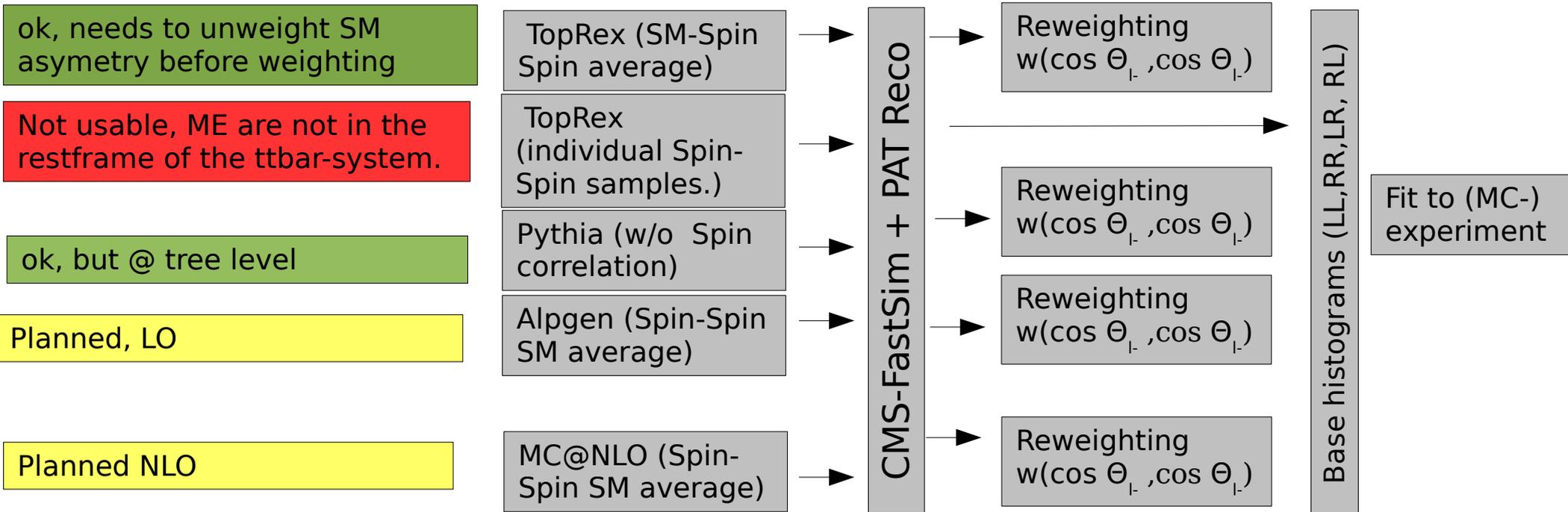
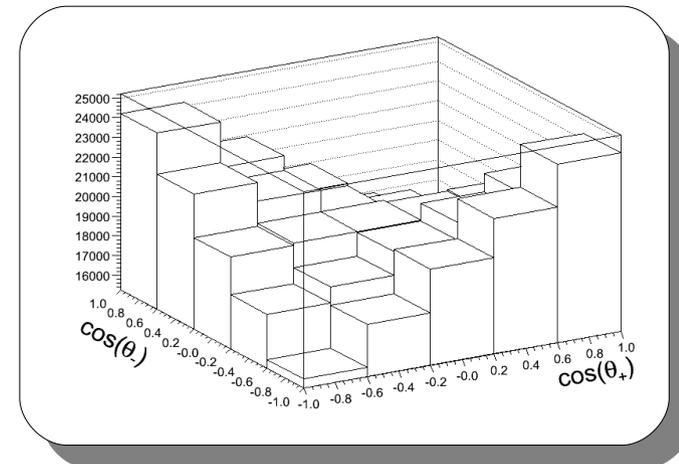
Top rediscovery dileptonic channel  
**(D. Tornier)**

Top mass via decay length of b-hadrons  
**(S. Kalinin)**

## Investigation of spin correlations in top pairs:

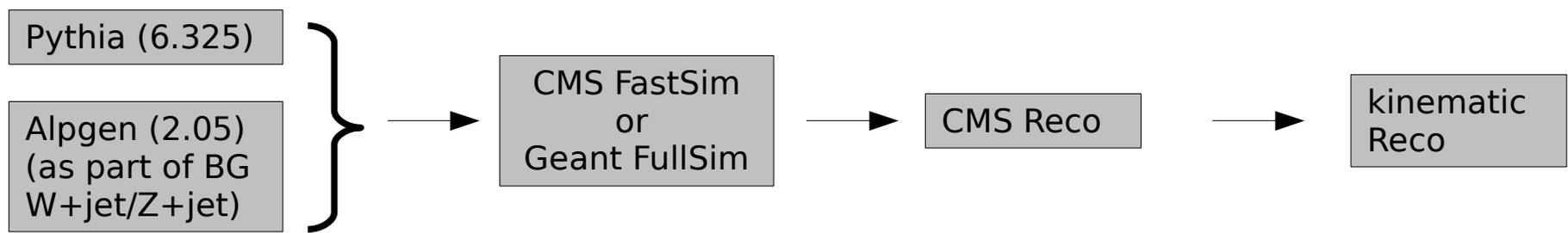
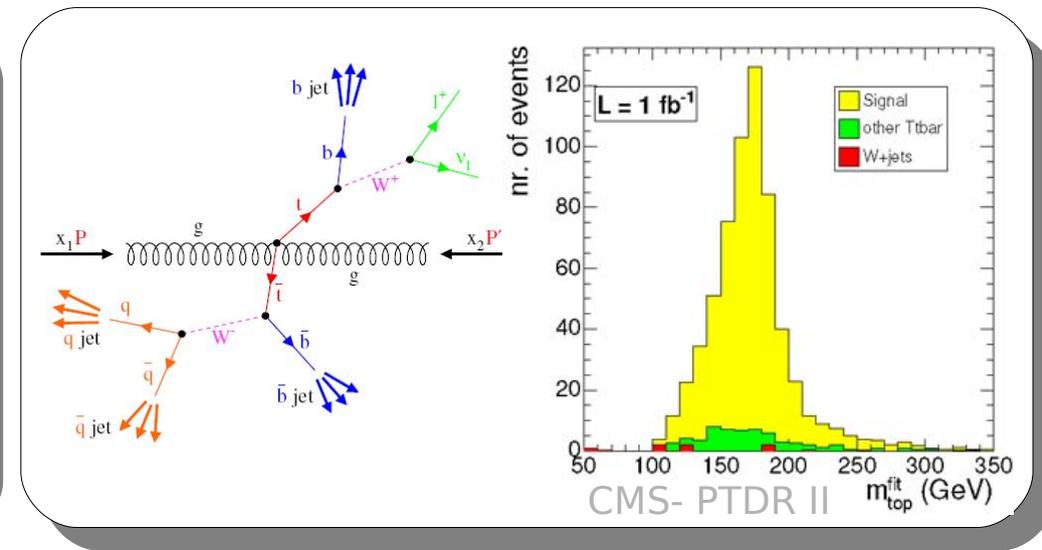
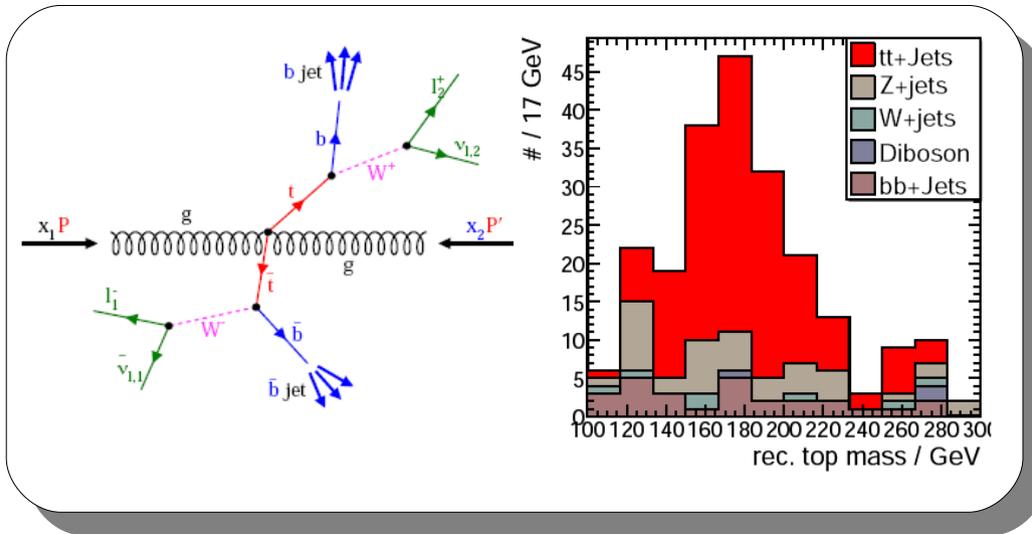
$$\frac{1}{N} \frac{d^2 N}{d \cos \theta_{l^+}^* d \cos \theta_{l^-}^*} = \frac{1}{4} (1 - \mathcal{A} \kappa_1 \kappa_2 \cos \theta_{l^+}^* \cos \theta_{l^-}^* + p_+ \cos \theta_{l^+}^* + p_- \cos \theta_{l^-}^*)$$

$$\mathcal{A} = \frac{N(t_{\uparrow} \bar{t}_{\uparrow} + t_{\downarrow} \bar{t}_{\downarrow}) - N(t_{\uparrow} \bar{t}_{\downarrow} + t_{\downarrow} \bar{t}_{\uparrow})}{N(t_{\uparrow} \bar{t}_{\uparrow} + t_{\downarrow} \bar{t}_{\downarrow}) + N(t_{\uparrow} \bar{t}_{\downarrow} + t_{\downarrow} \bar{t}_{\uparrow})}$$

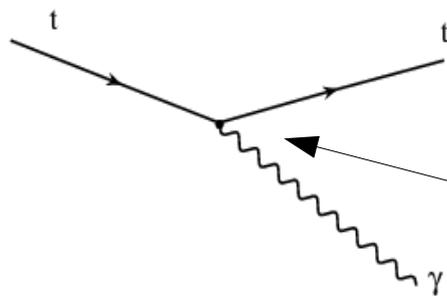
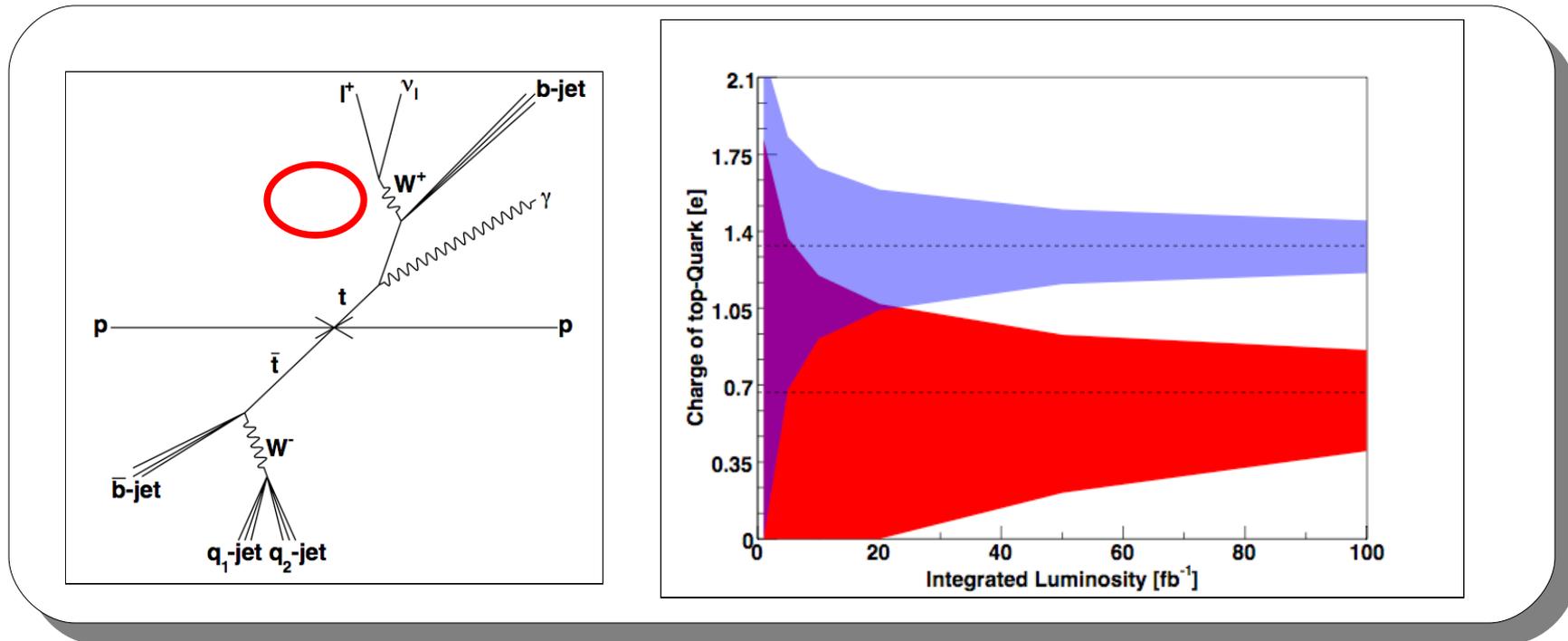


Need to generate single Spin-Spin events (individual samples or flag events)  
 TopRex: fix ME/maintainance issues, Pythia: no Spin-Spin correlations,  
 MadGraph/Alpgen: only Spin-Spin average

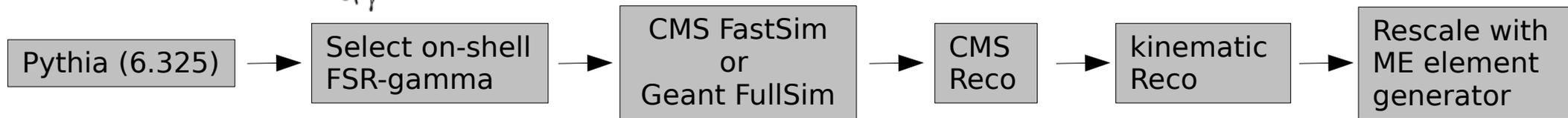
## top rediscovery (dileptonic, semileptonic, full hadronic channel)



## top charge

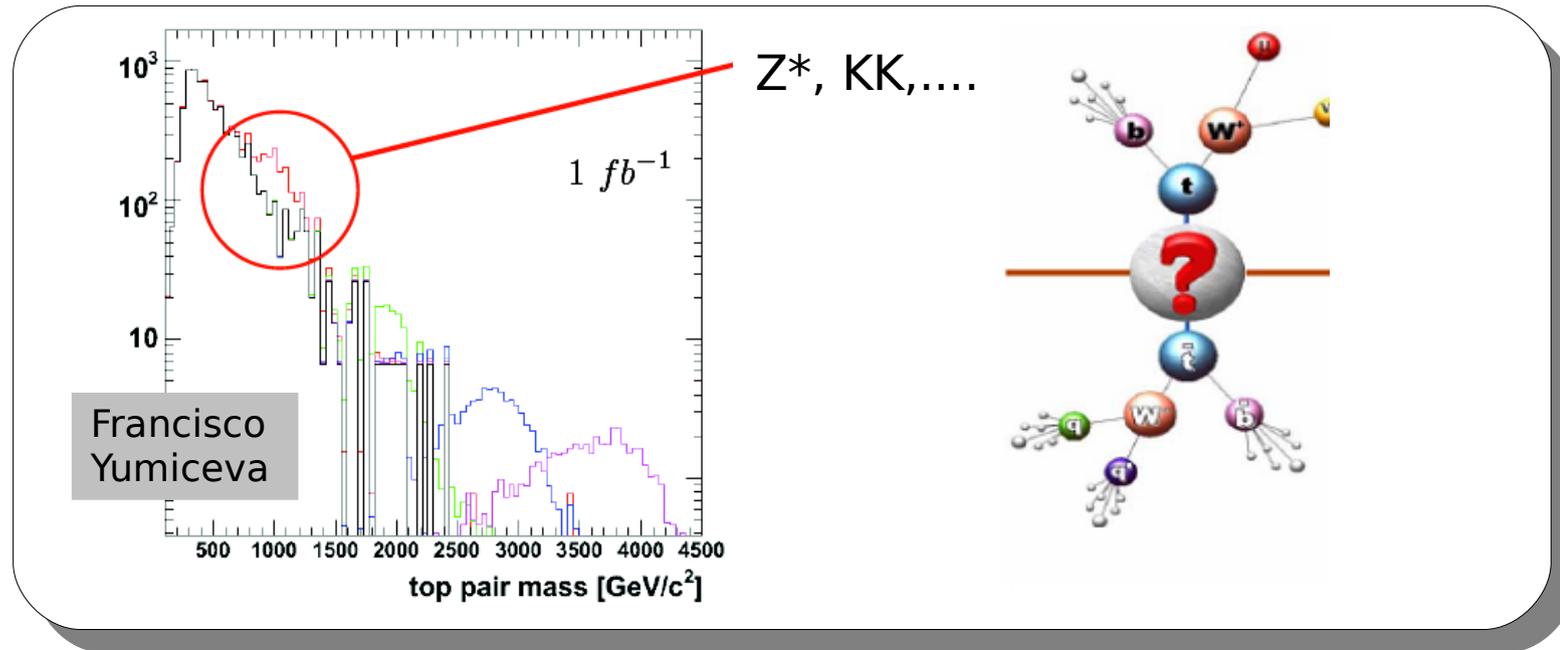


$$\Gamma_{\mu}(p, q, k) = -ie\{\gamma_{\mu} [F_{1V}(k^2) + \gamma_5 F_{1A}(k^2)] + \frac{\sigma_{\mu\nu}}{2m_t} (p + q)^{\nu} [iF_{2V}(k^2) + \gamma_5 F_{2A}(k^2)]\}$$

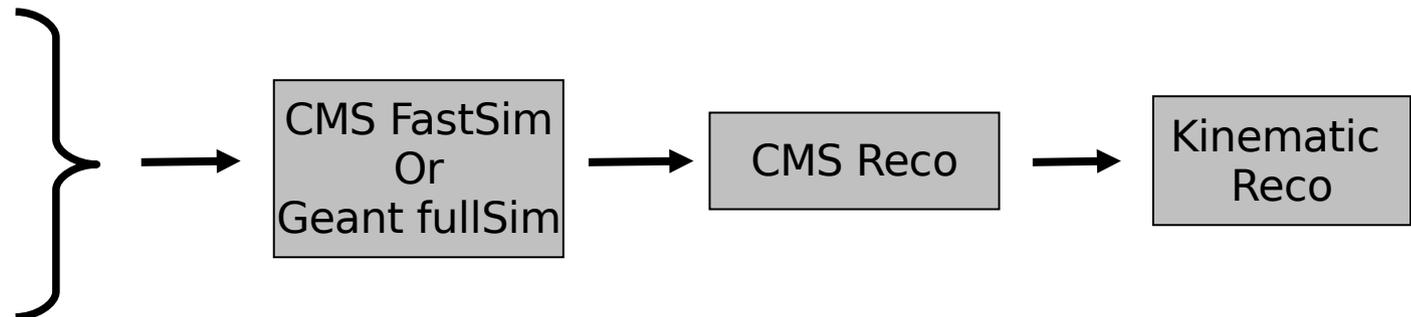


Could we get a Pythia interface for this ME-Generator (Baur-Generator)  
 Baur: allow to model the tt-γ vertex (charge+Vector/Axial component form-factors)

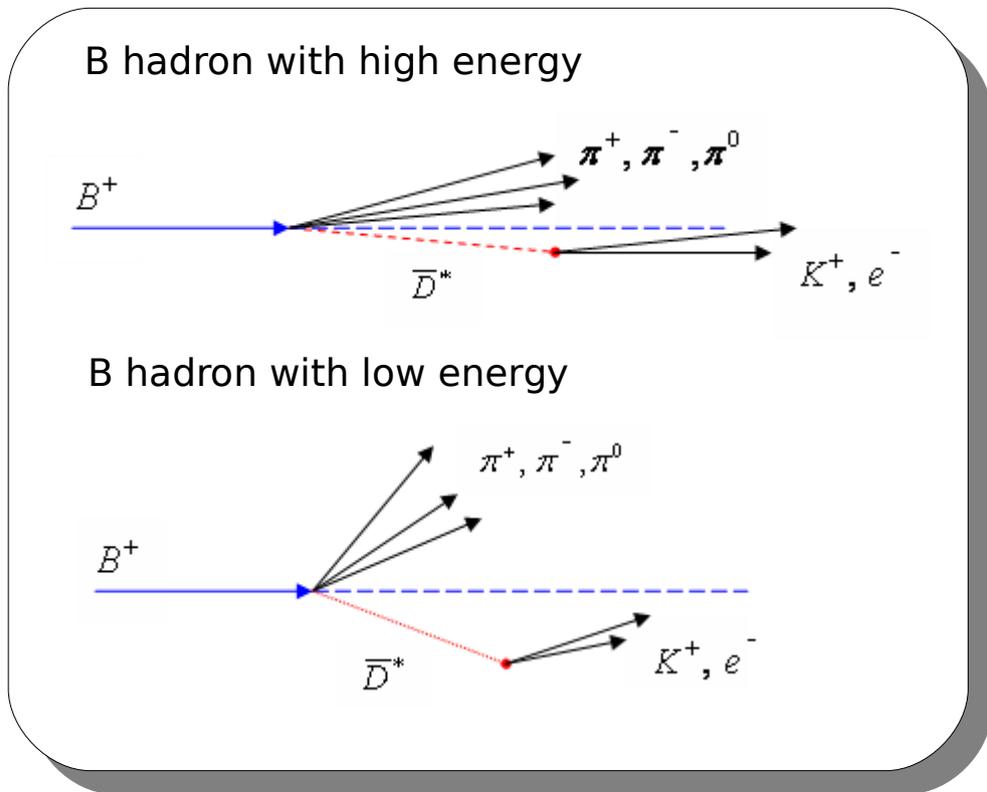
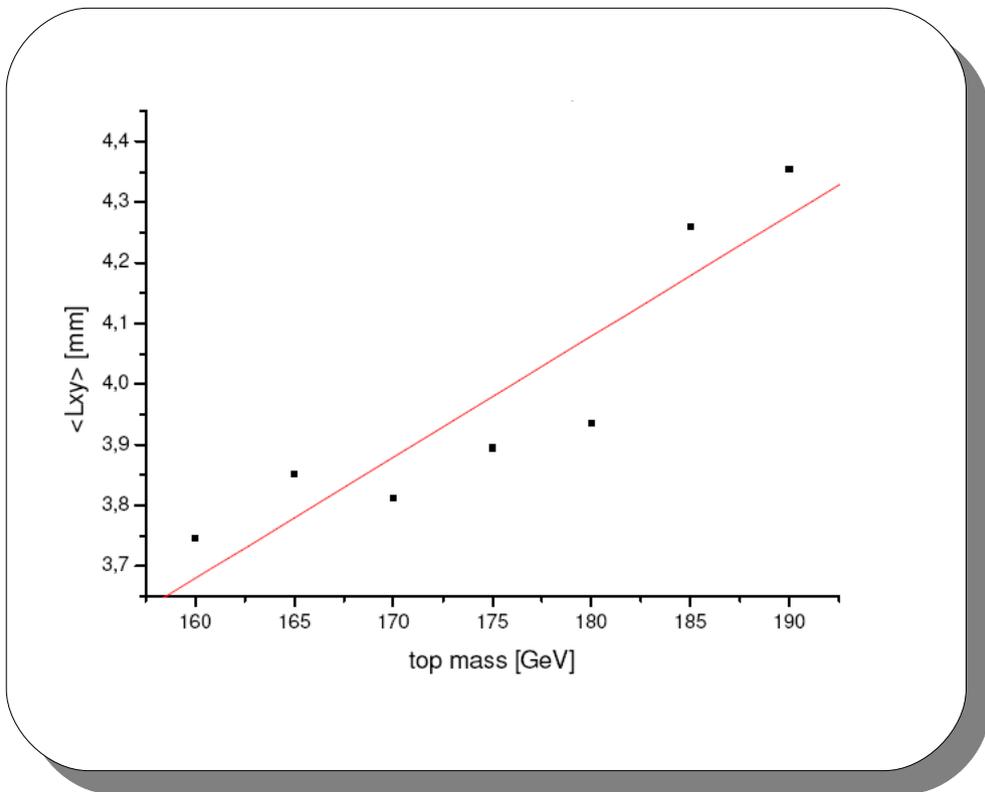
## ttbar Resonances



- Pythia  
(standart ttbar)
- MadGraph (Z\*,...)  
(topBSM model)
- ...any other ideas  
are welcome...



## B-decay length / b-jet topology



Pythia (6.325)

Alpgen (2.05)  
(as part of BG  
W+jet/Z+jet)



CMS FastSim  
or  
Geant FullSim



CMS Reco



kinematic  
Reco

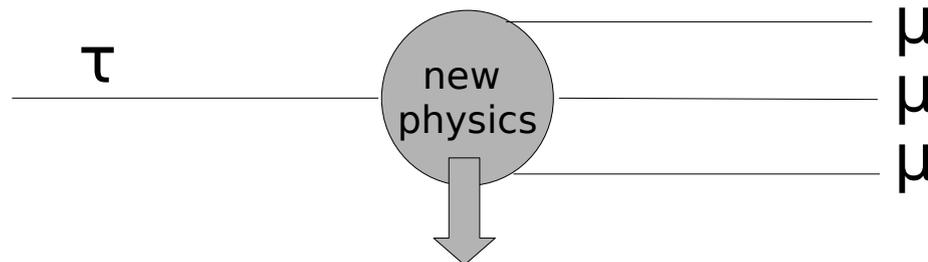
Search for lepton flavour violating  $\tau \rightarrow \mu\mu\mu$  decay:

- Optimized  $\tau$ -vertex reconstruction (L. Perchalla, P. Sauerland)
- LFV decay (M. Giffels)

- Generator: pythia+tauola
- Decay mode implemented into Pythia
- No special ME used
- Event generation according to phase space

### Current implementation:

- ME not yet implemented into a generator
- Event selection via hit-and-miss according to ME



almost model independent matrix element:

$$\begin{aligned} \mathcal{L} = G & \left( g_{LL}^S (\bar{\mu} P_{R\mu}) (\bar{\mu} P_{L\tau}) + g_{LR}^S (\bar{\mu} P_{R\mu}) (\bar{\mu} P_{R\tau}) + g_{RL}^S (\bar{\mu} P_{L\mu}) (\bar{\mu} P_{L\tau}) + g_{RR}^S (\bar{\mu} P_{L\mu}) (\bar{\mu} P_{R\tau}) \right. \\ & + g_{LL}^V (\bar{\mu} \gamma_\nu P_{R\mu}) (\bar{\mu} \gamma^\nu P_{L\tau}) + g_{LR}^V (\bar{\mu} \gamma_\nu P_{R\mu}) (\bar{\mu} \gamma^\nu P_{R\tau}) \\ & + g_{RL}^V (\bar{\mu} \gamma_\nu P_{L\mu}) (\bar{\mu} \gamma^\nu P_{L\tau}) + g_{RR}^V (\bar{\mu} \gamma_\nu P_{L\mu}) (\bar{\mu} \gamma^\nu P_{R\tau}) \\ & \left. + g_{LR}^T \left( \bar{\mu} \frac{\sigma_{\rho\nu}}{\sqrt{2}} P_{R\mu} \right) \left( \bar{\mu} \frac{\sigma^{\rho\nu}}{\sqrt{2}} P_{R\tau} \right) + g_{RL}^T \left( \bar{\mu} \frac{\sigma_{\rho\nu}}{\sqrt{2}} P_{L\mu} \right) \left( \bar{\mu} \frac{\sigma^{\rho\nu}}{\sqrt{2}} P_{L\tau} \right) \right) \end{aligned}$$

MC issues:

c++ stable pythia version...