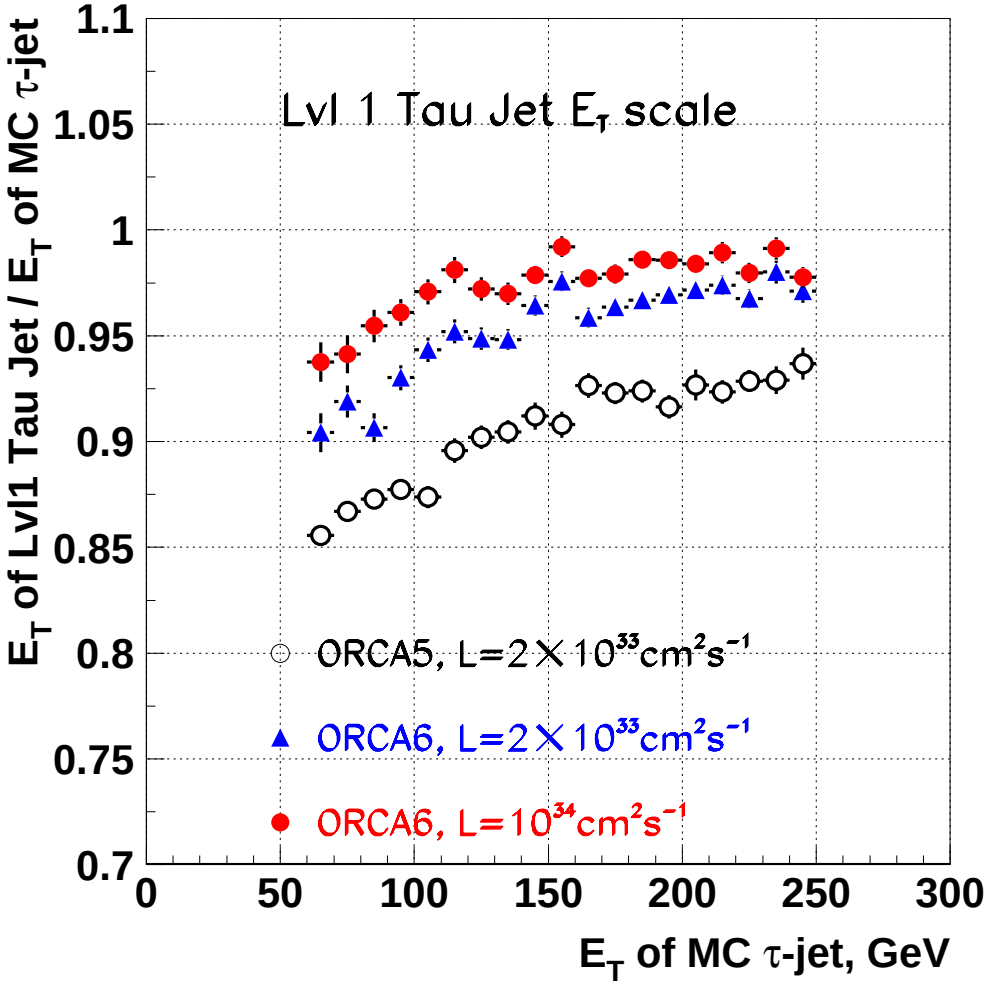
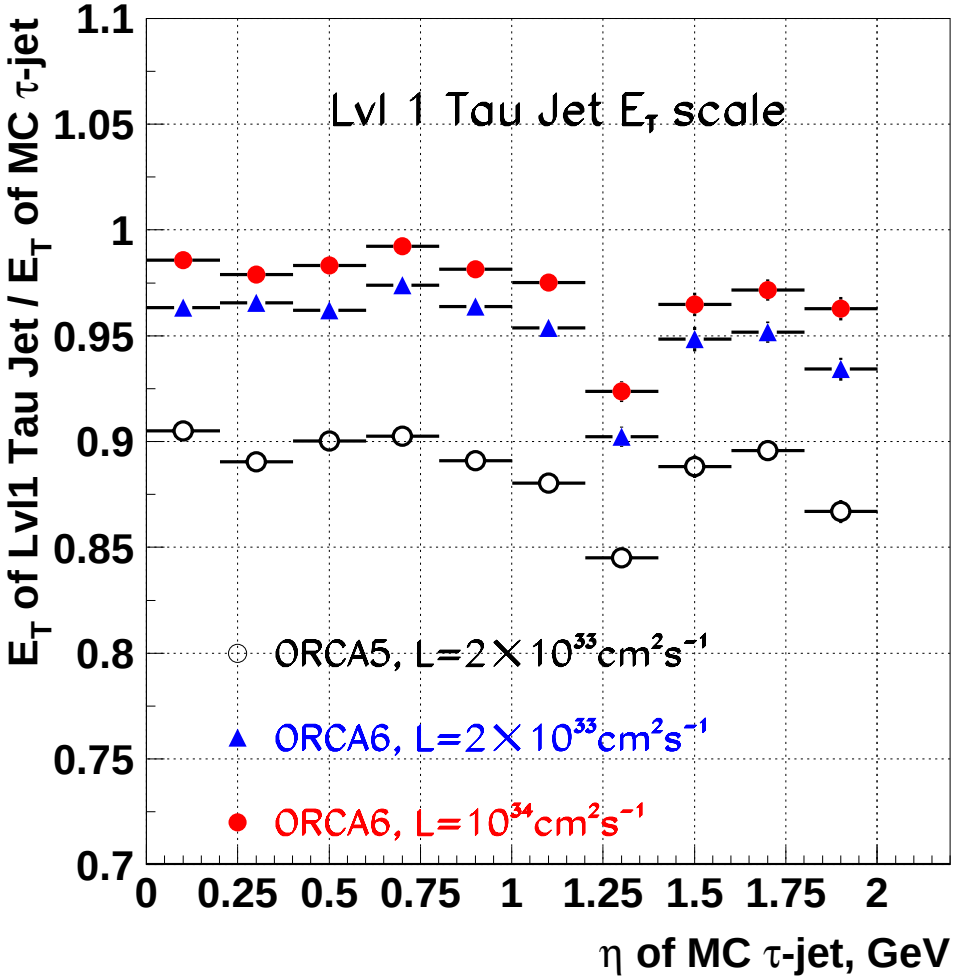
A. Nikitenko Imperial College, UK / ITEP Moscow

Update on Calo Taus with orca6 and progress on physics objects

- **Lvl-1 Taus**
  - **energy scale**
  - **search for Lvl-2 taus**
- **Lvl-2 Calo Taus**
  - **signal eff. vs. rate reduction**
  - **Lvl-2 Calo vs Pxl Taus**
- **CPU**
- **H->2tau-jet mass reco with / without EE**
- **other progress in physics objects**

L1 Tau Jet scale vs $E_T^{\tau\text{-jet}}$ and $\eta^{\tau\text{-jet}}$

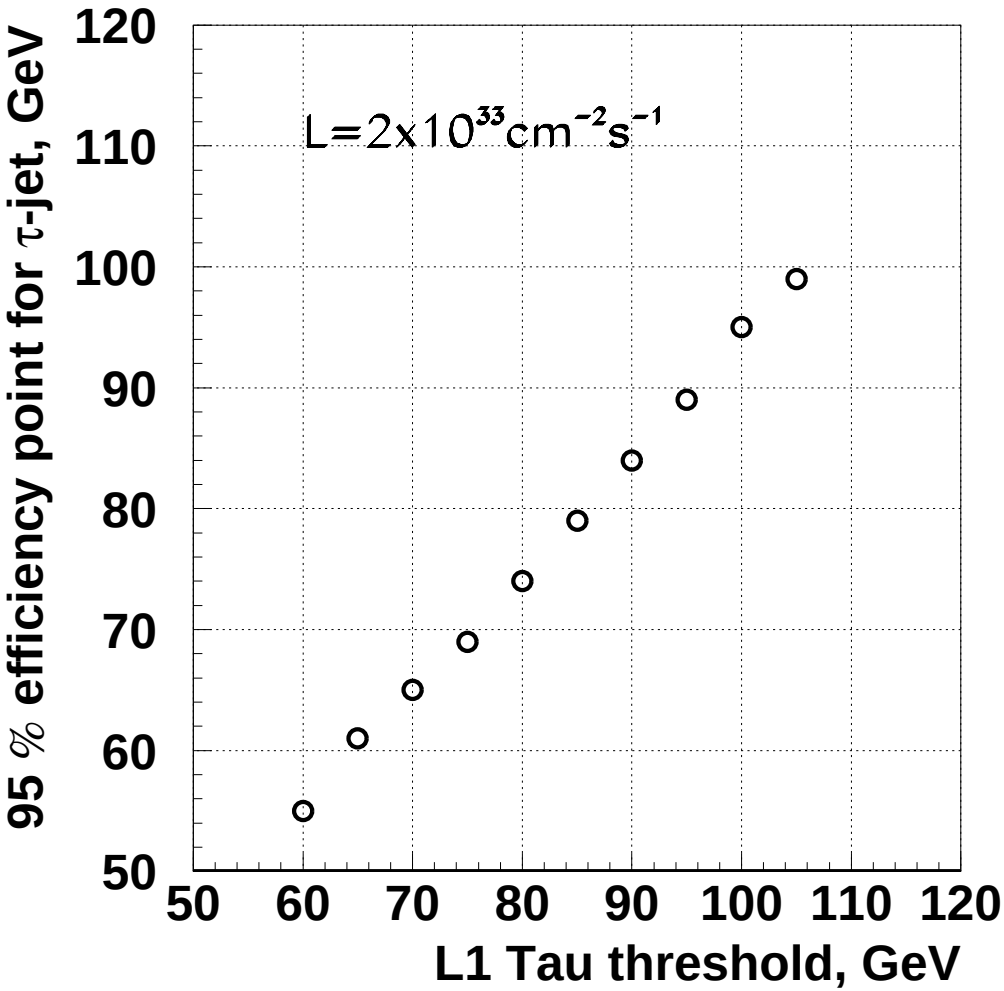




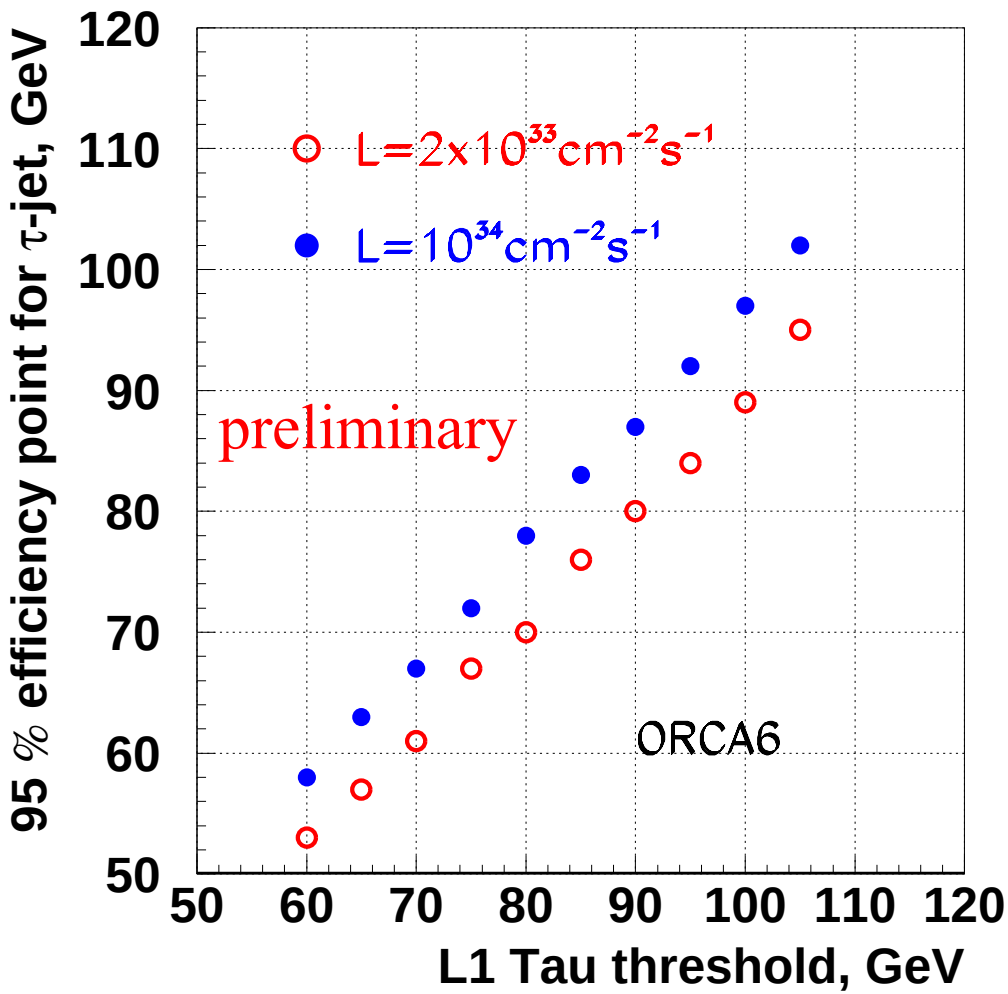
Scale is changed by 5-10 % . L1 uses qcd jet scale

Reminder : L1 Taus use qcd jet energy corrections

orca5, $L=2x10^{33}cm^{-2}s^{-1}$



orca6, $L=2x10^{33}$ / 10^{34} $cm^{-2}s^{-1}$



L1 Tau id

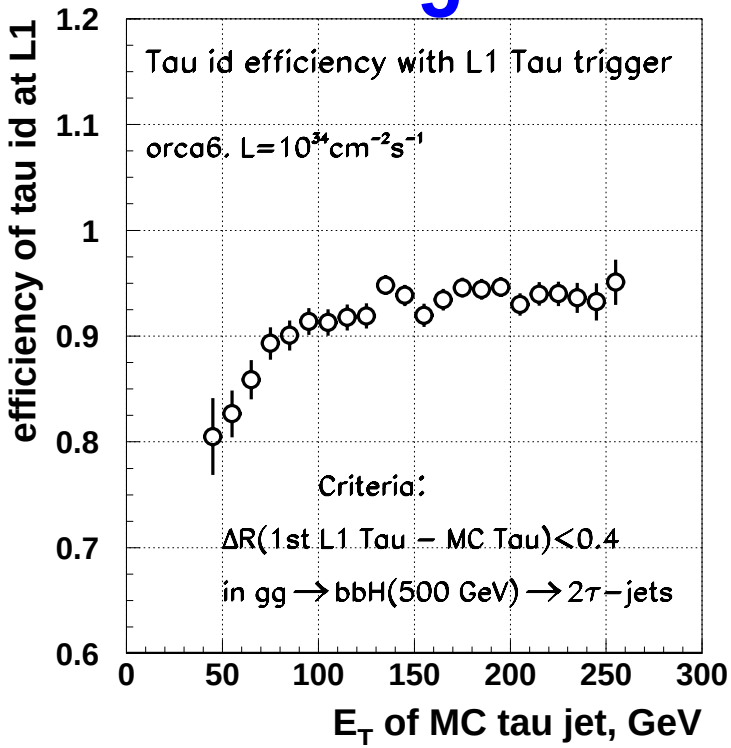
vs

$E_T^{\tau\text{-jet}}$

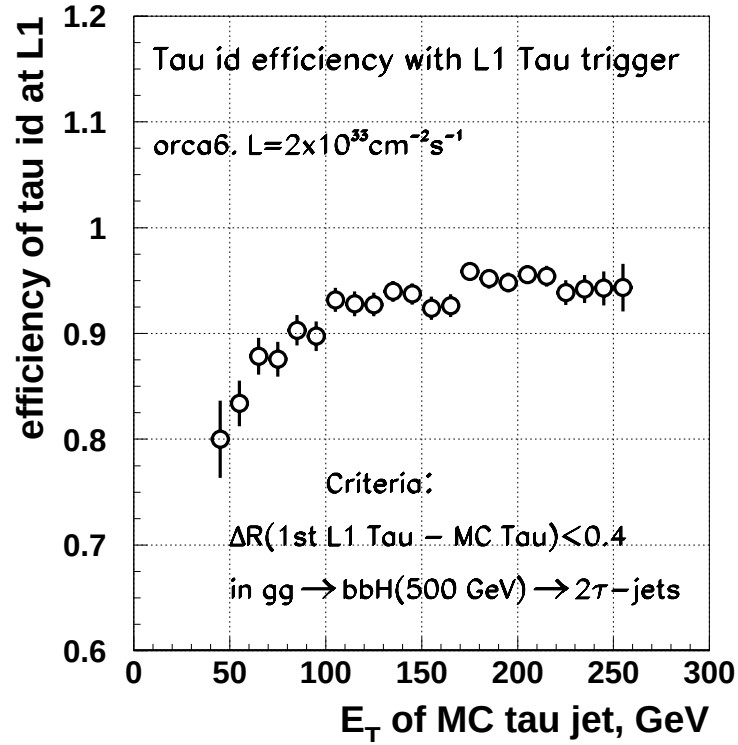
$\eta^{\tau\text{-jet}}$

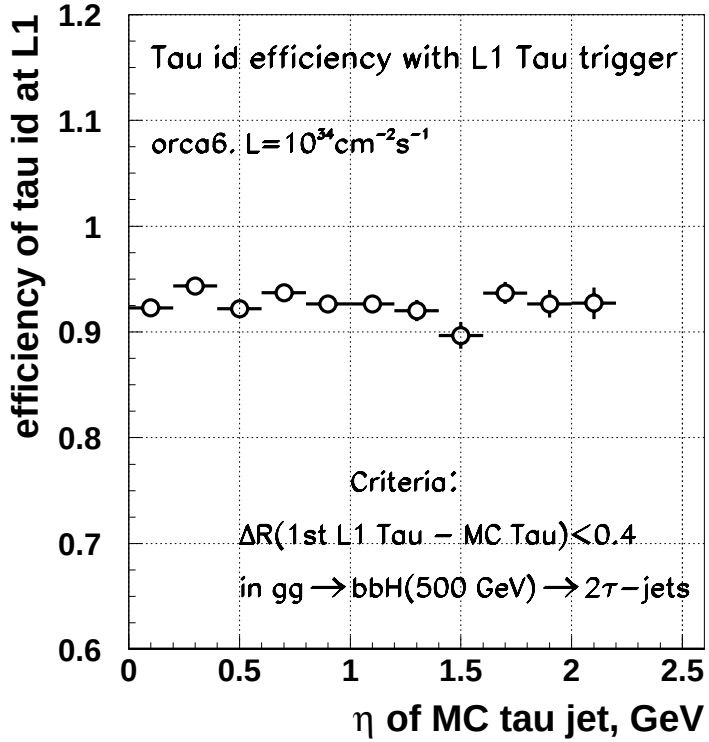
similar to orca5. ok

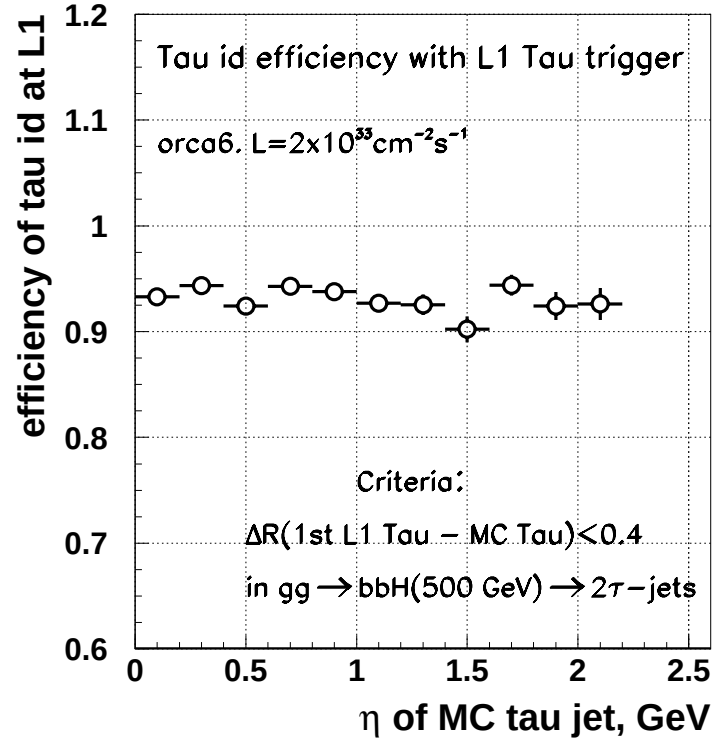
orca6. high lumi



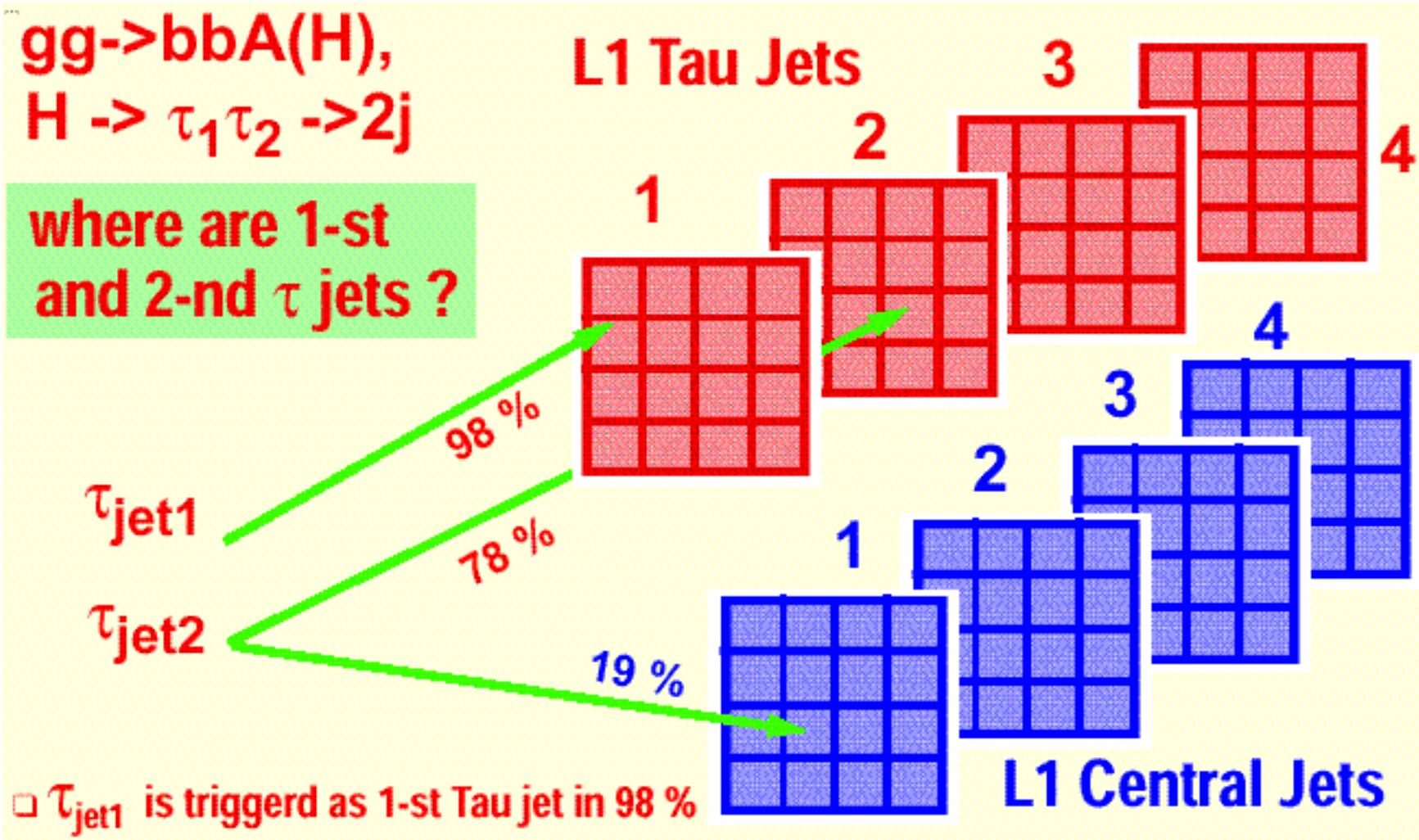
orca6. low lumi





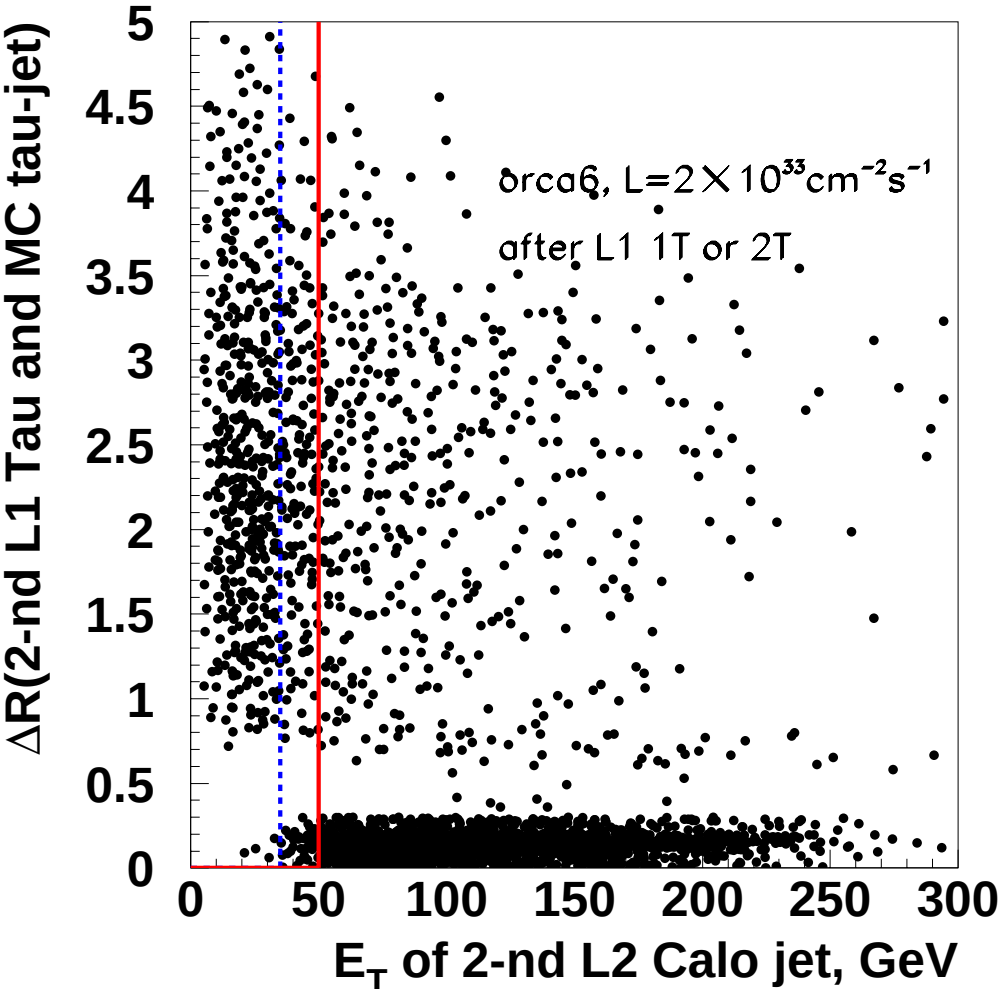


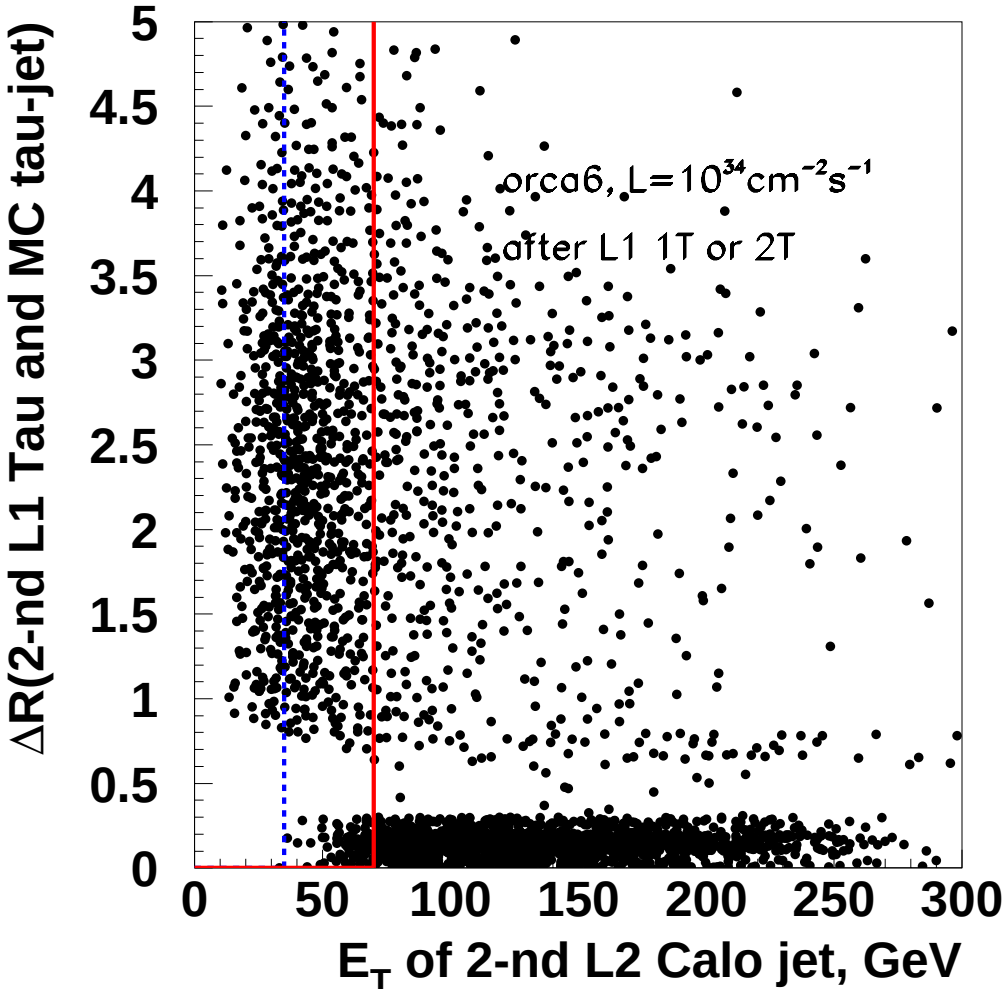
Purity of Lvl-1 Tau jets for $A^o/H^o \to 2\tau \to 2jets$



- τ_{jet1} is triggerd as 1-st Tau jet in 98 %
- 2-nd L1 Tau exists in 85 %, τ_{jet2} is triggerd as 1-st L1 Tau Jet in 78 %
  τ_{jet2} is triggerd as 1-st L1 Central Jet in 19 %
- 2-nd L1 Tau doesn't exist in 15 %, τ_{jet2} is triggerd as 1-st Central Jet in 94 %

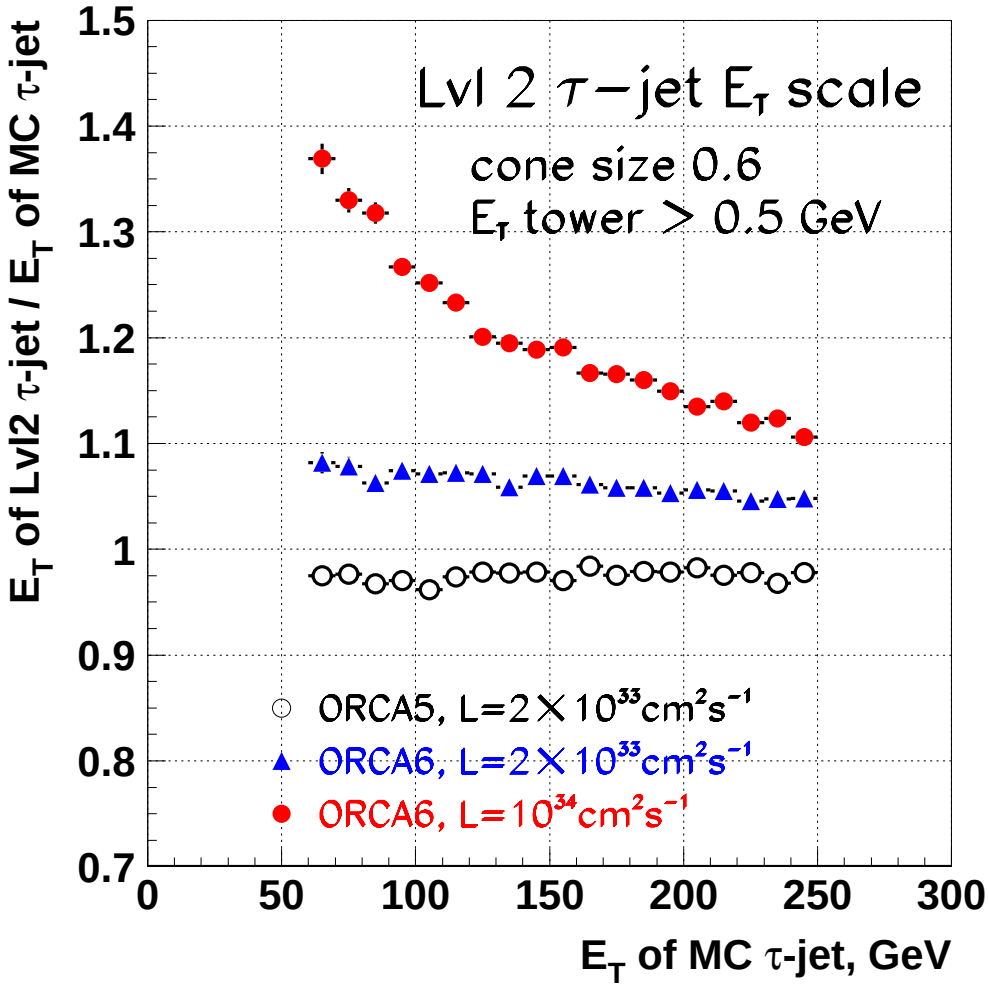
How to search for second τ jet at Lvl-2 for A^o/H^o->2τ->2jets

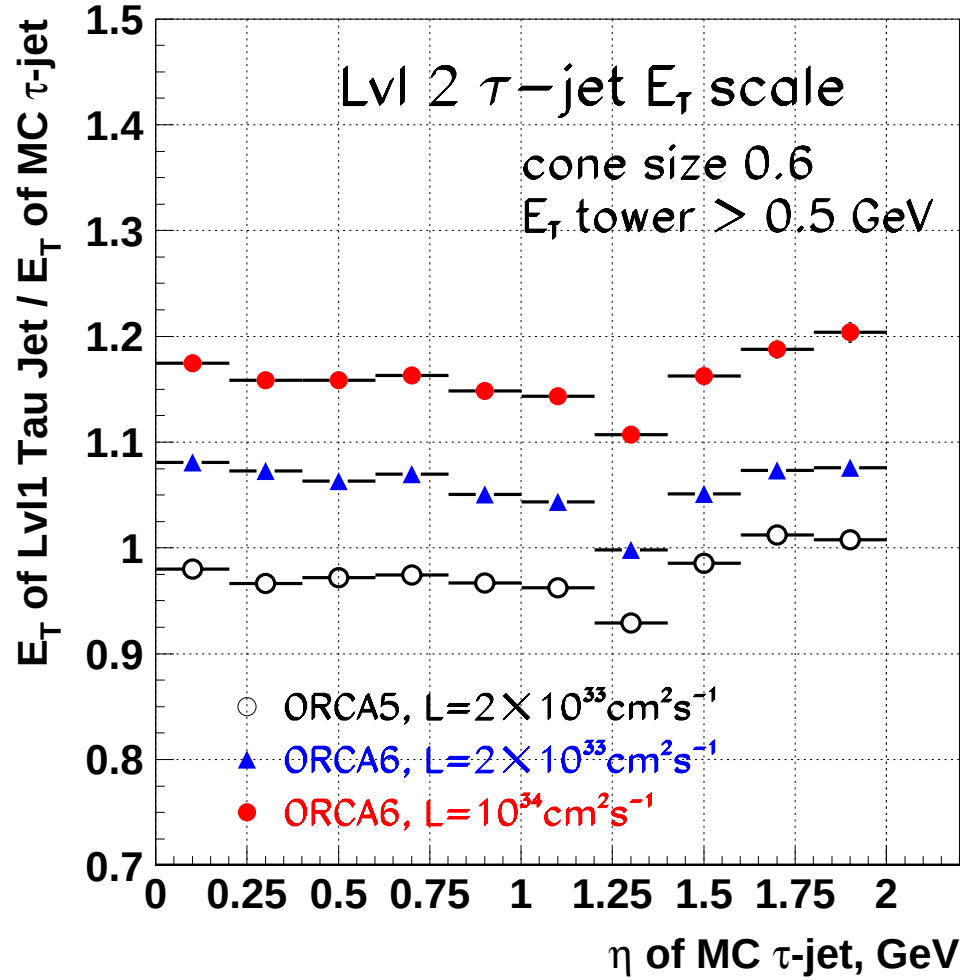




if $E_T^{2\text{-nd L2 Calo}} < E_T^{thr}$ take jet mathed with 1-st L1 Central Jet

L2 Tau Jet scale vs $E_T^{\tau\text{-jet}}$ and $\eta^{\tau\text{-jet}}$





Lvl-2 Tau jet energy is not used for Tau id at Lvl-2, however it is used to search for 2-nd Lvl-2 τ jet in A^o/H^o->2τ->2jet as :

if $E_T^{2\text{-nd L2 Calo}} < E_T^{thr}$ take jet mathed with 1-st L1 Central Jet

Search for two Lvl-2 Tau Jet candidates with L1 output in gg->bbH, H->2τ-jet events passed Lvl-1 T or 2T trigger

search for Lvl-2 Tau jets with Lvl-1 output	ORCA5 $L=2x10^{33}cm^{-2}s^{-1}$	ORCA6 $L=2x10^{33}cm^{-2}s^{-1}$	ORCA6 $L=10^{34}cm^{-2}s^{-1}$
matching with 1-st Lvl-1 Tau Jet	0.98	0.98	0.98
no 2-nd Tau Jet in the Lvl-1 Tau jet list	0.15	0.16	0.07
matching with 2-nd Lvl-1 Tau Jet	0.78	0.74	0.65
matching with 2-nd Lvl-1 Tau Candidate	0.90	0.88 (0.89)*	0.75 (0.87)*

How to find Lvl-2 Tau jet candidates :

1-st L2 Tau Jet Candidate - L2 jet matched with 1-st L1 Tau Jet

2-nd L2 Tau jet candidate -

a) if E_T of 2-nd L2 Calo Jet > E_T^{cut} - take this jet

b) if E_T of 2-nd L2 Calo Jet < E_T^{cut} - take L2 jet matched with 1-st L1 Central Jet

E_T^{cut} = 35 GeV used for orca5 and for orca6

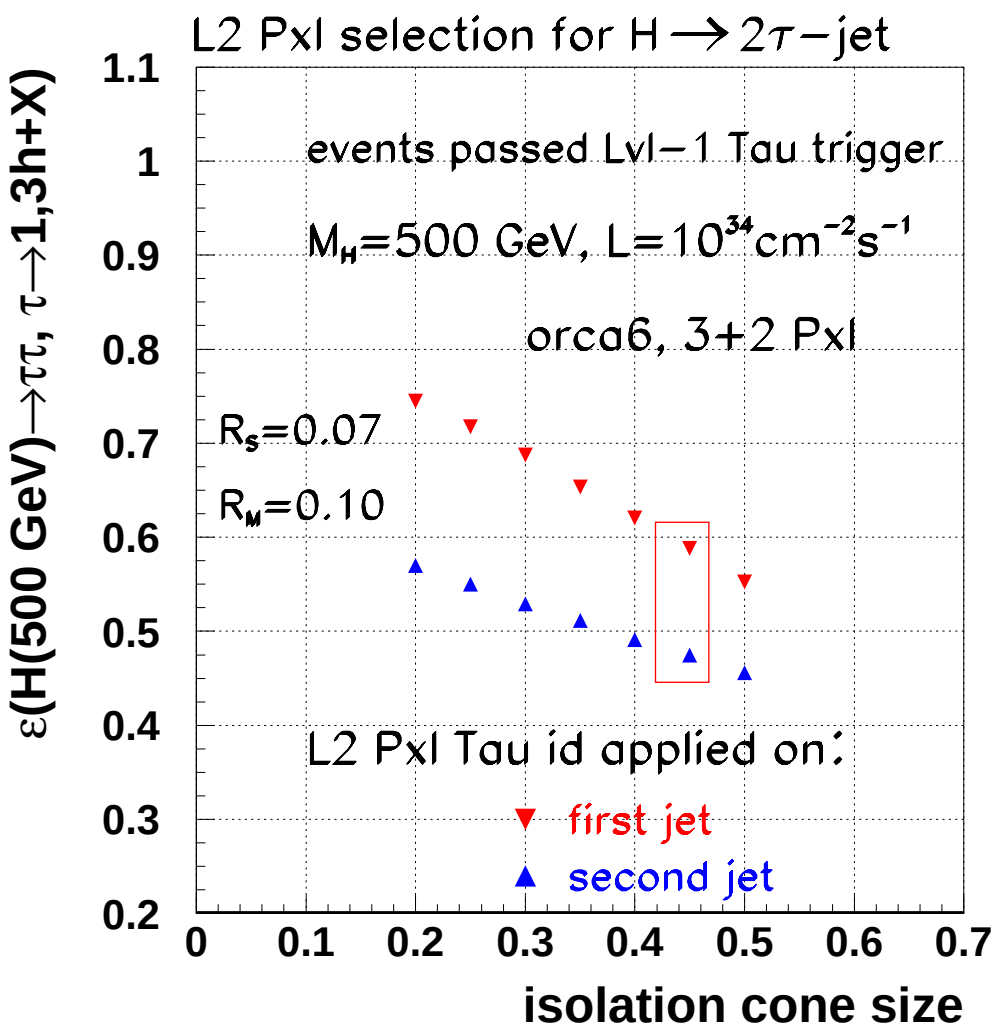
definition of L2 Calo Jet : 1-st / 2-nd L2 Calo Jet is L2 jet matched with 1-st / 2-nd L1 Tau Jet

* E_T^{cut} = 50 GeV for ORCA6 low lumi, 70 GeV for ORCA6 high lumi.

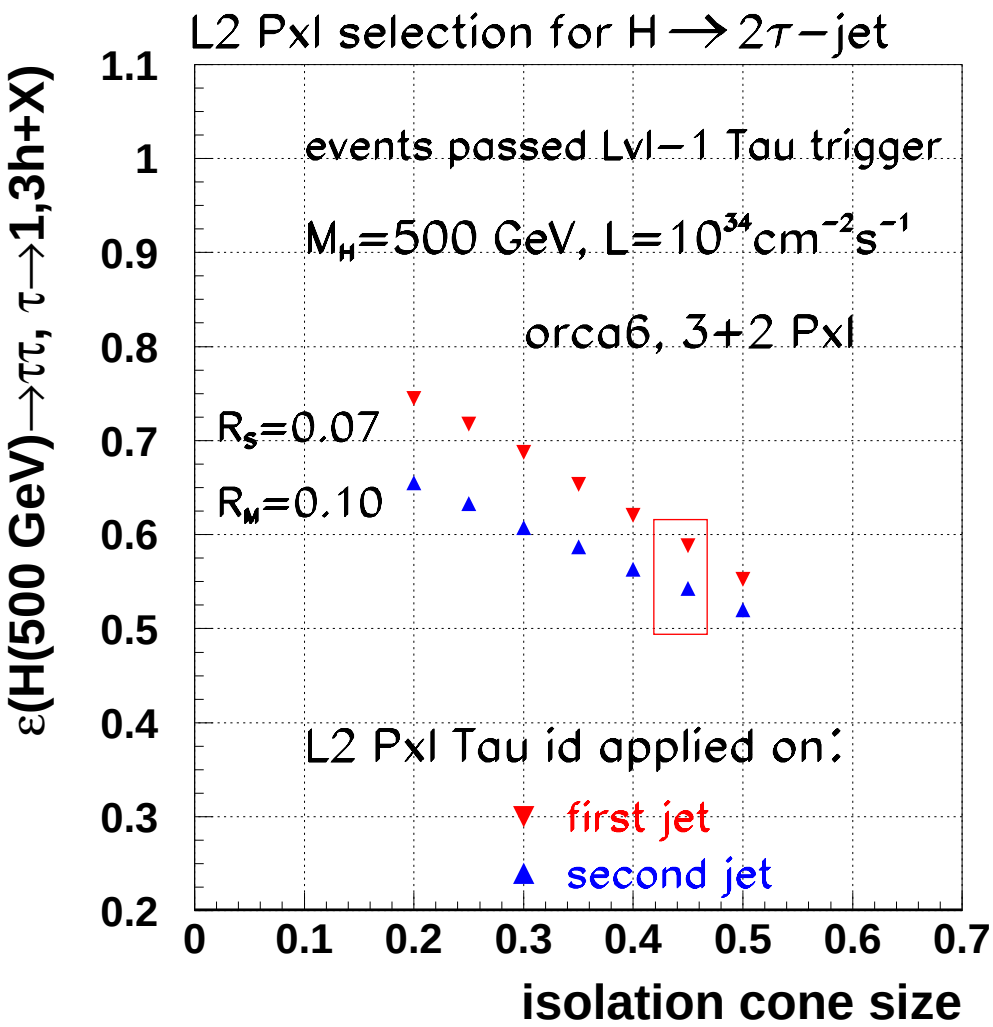
Optimization of search for second tau at Lvl-2 in A^o/H^o -> 2tau-jets . $L=10^{34}cm^{-2}s^{-1}$

Pxl Tau id for 1-st and 2-nd jet

before optimization



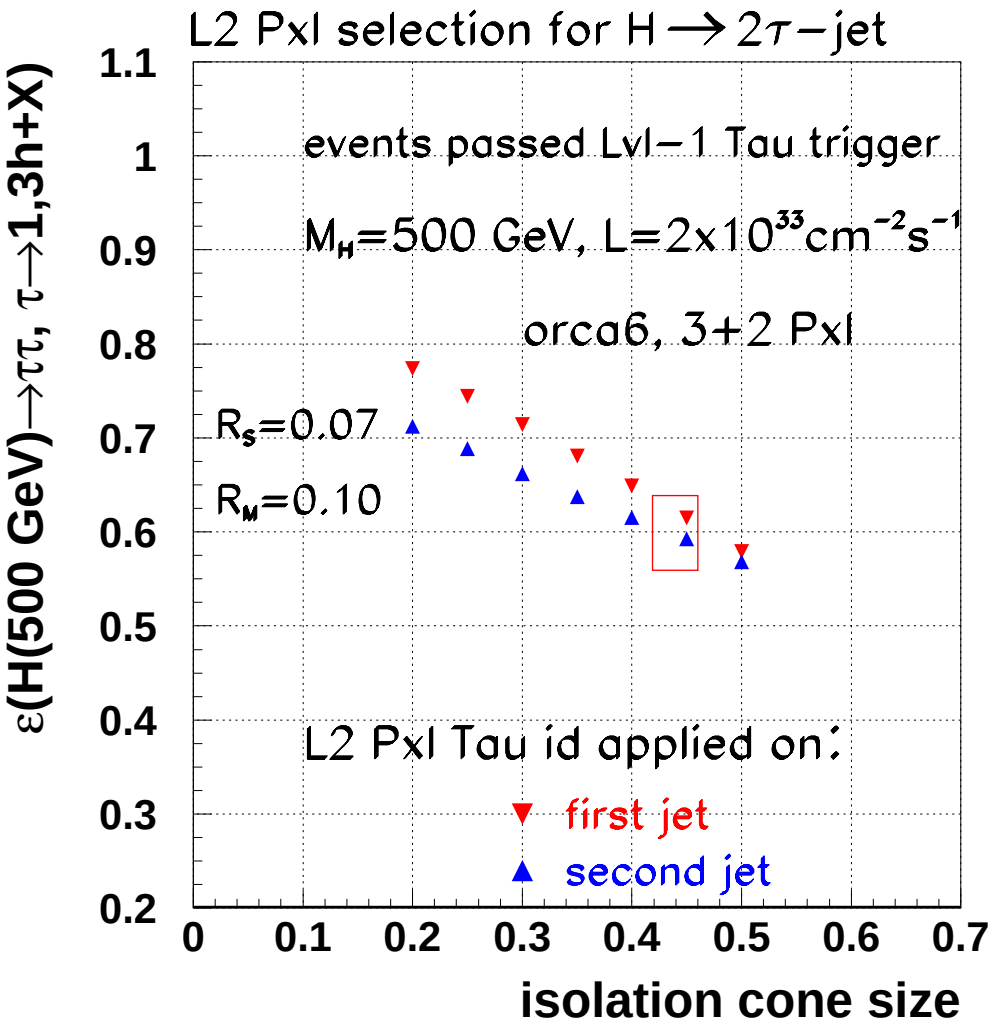
after optimization



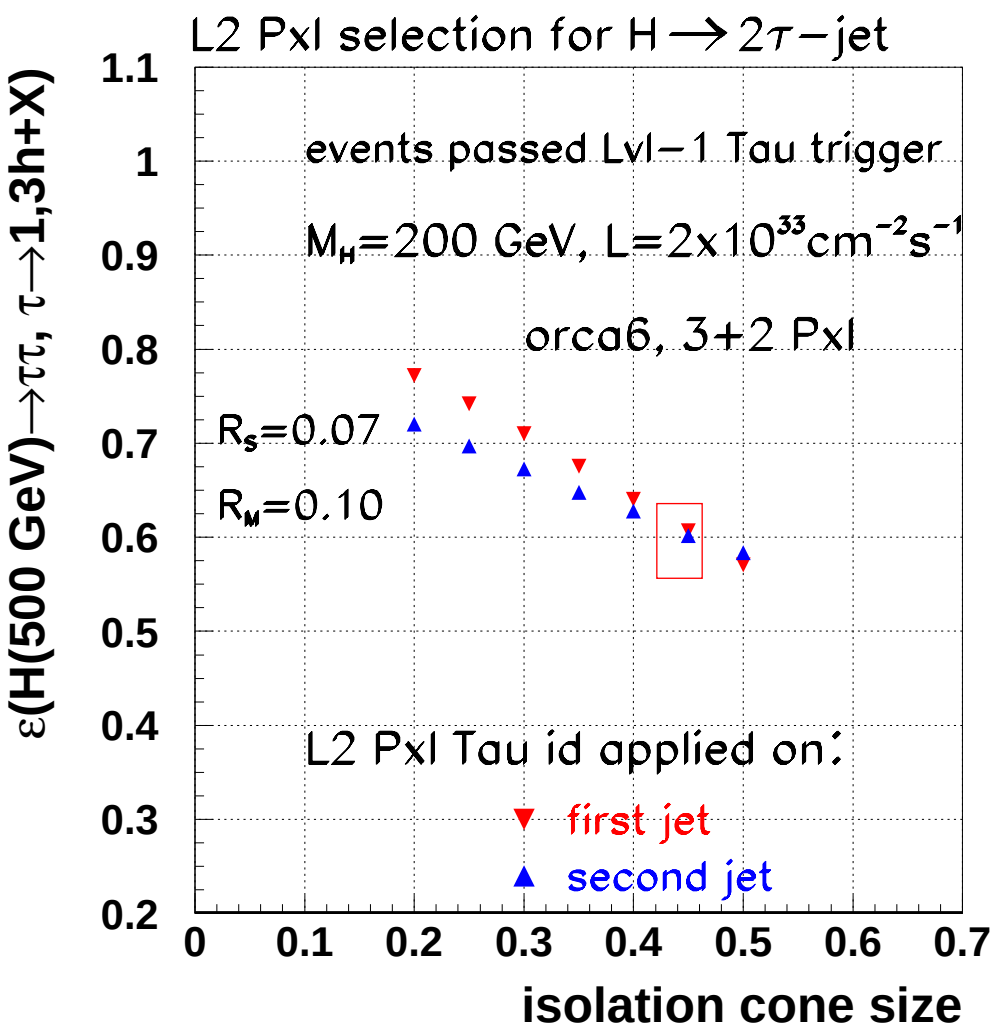
Optimization of search for second tau at Lvl-2 in A^o/H^o -> 2tau-jets . $L=2x10^{33}cm^{-2}s^{-1}$

Pxl Tau id for 1-st and 2-nd jet after optimization

M_H=500 GeV



M_H=200 GeV



gg->bbA(H), H -> $\tau_1\tau_2$ -> e + j

Olivier van der Aa

where is τ jet in events passed e&T trigger ?

a) 43 % collinear events: 1-st L1 e/γ = 1-st L1 Tau

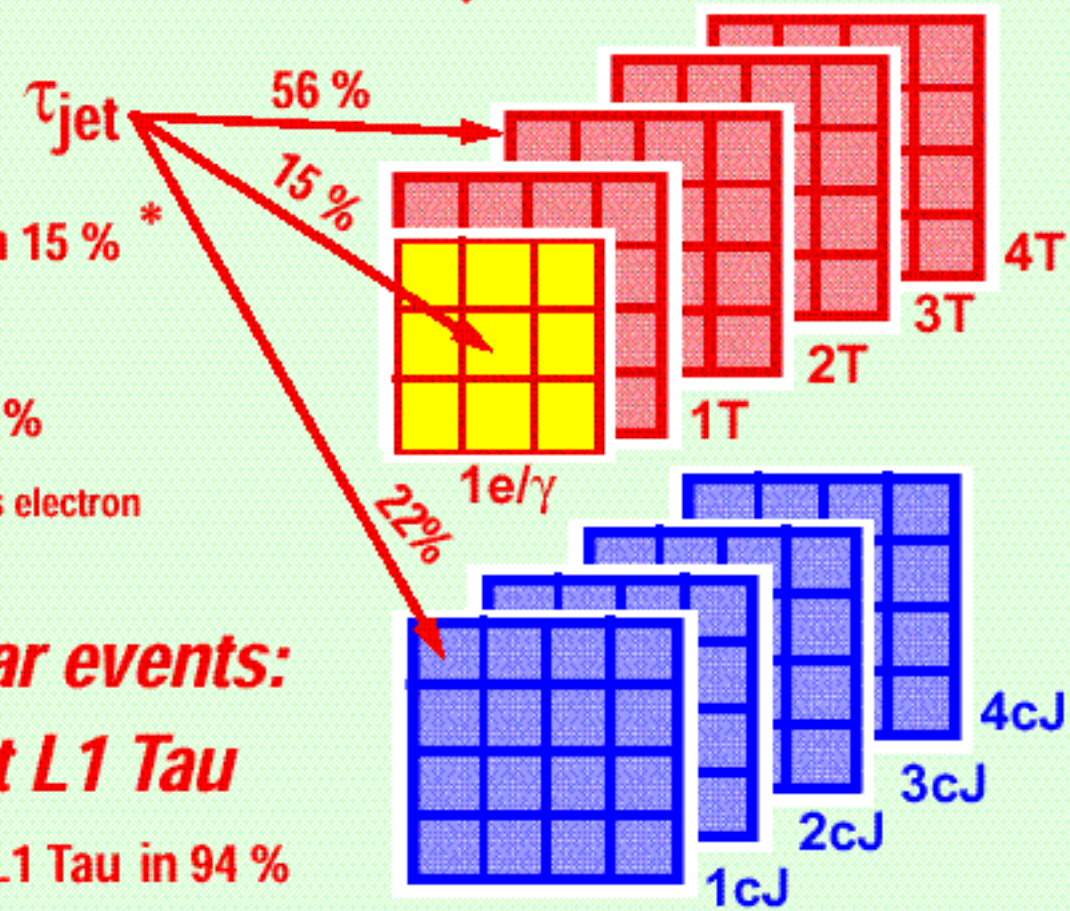
τ_{jet} is triggered by :

1-st L1 isolated e / γ in 15 % *

2-nd L1 Tau in 56 %

1-st L1 centr. Jet in 22 %

* in 83 % 1-st L1 isol. e/γ takes electron



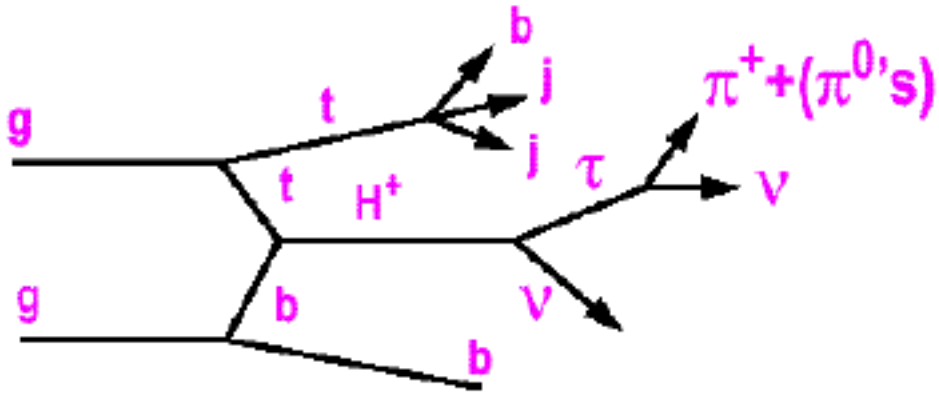
b) 56 % not collinear events: 1-st L1 e/γ != 1-st L1 Tau

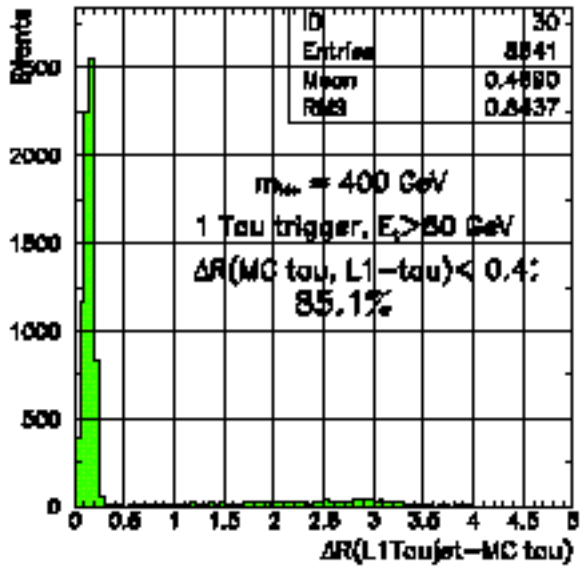
τ_{jet} is triggered by 1-st L1 Tau in 94 %

R. Kinnunen

in $H^+ \to \tau\nu$ τ-jet is triggered by 1-st L1 Tau in 85 %

$gg \to H^+tb$, $H^+ \to \tau\nu$, $t \to bqq$





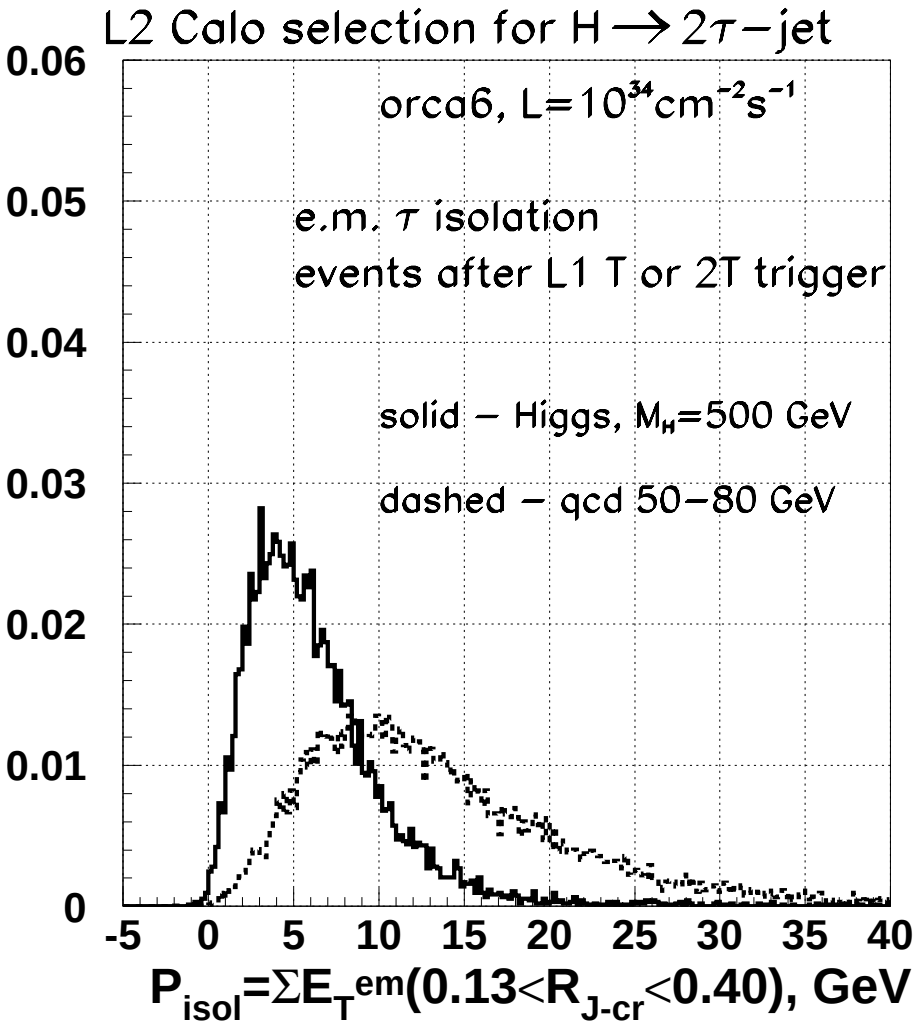
M. Konecki

in $H \to \tau\tau \to \mu + j$, τ-jet is triggered by 1-st L1 Tau in 93 %

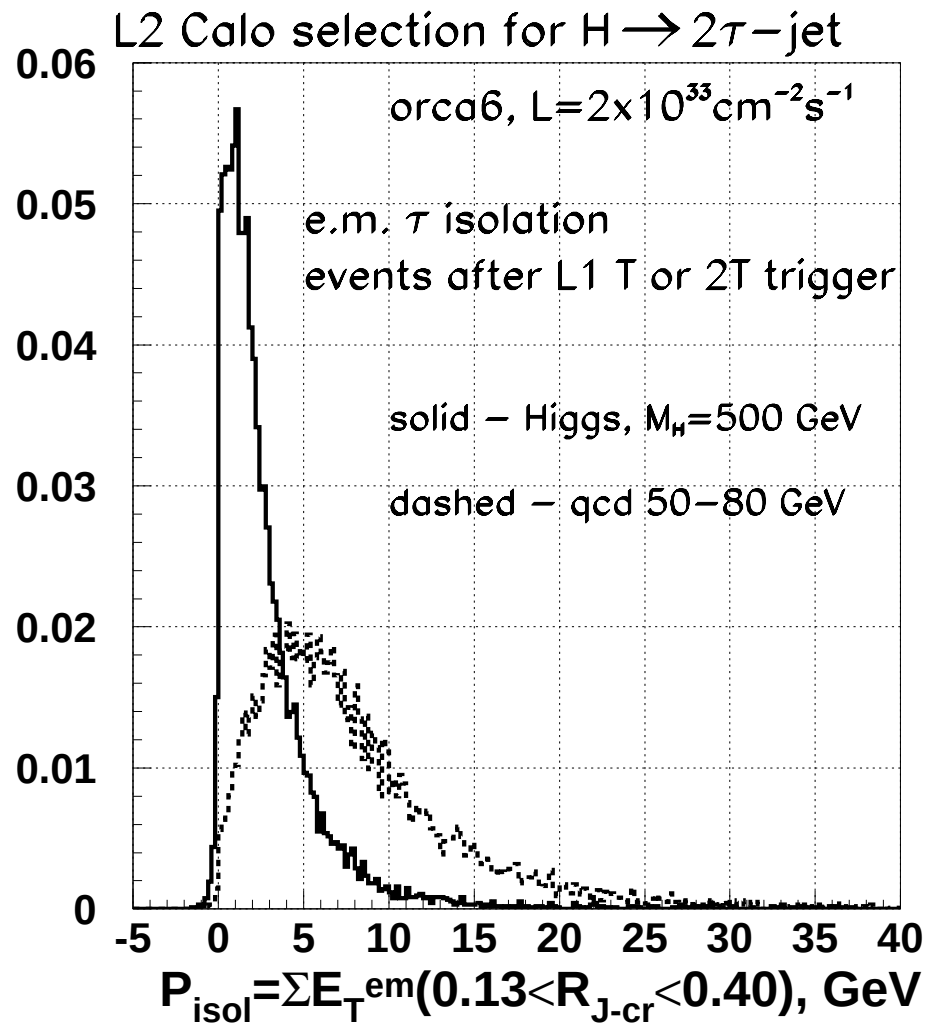
....

L2 Calo Tau id with e.m. isolation (I)

orca6. high lumi



orca6. low lumi



negative values of P_{isol} appeared due to ECAL sel. readout

L2 CaloTau id

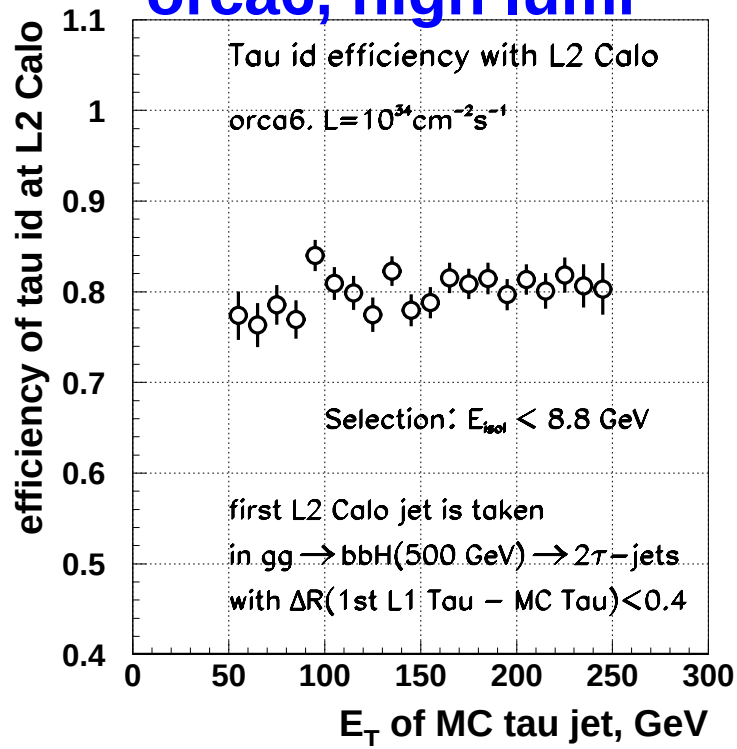
vs

$E_T^{\tau\text{-jet}}$

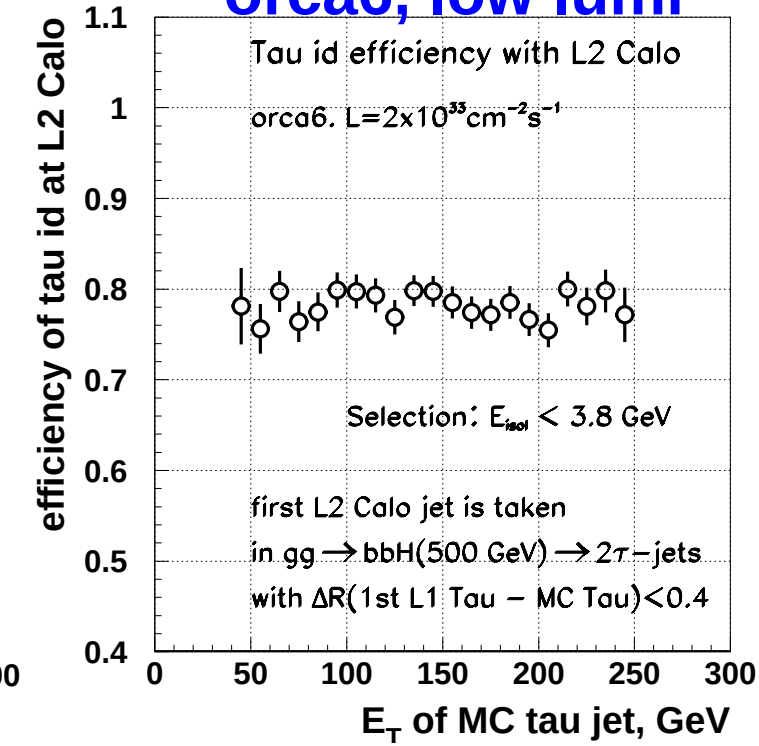
$\eta^{\tau\text{-jet}}$

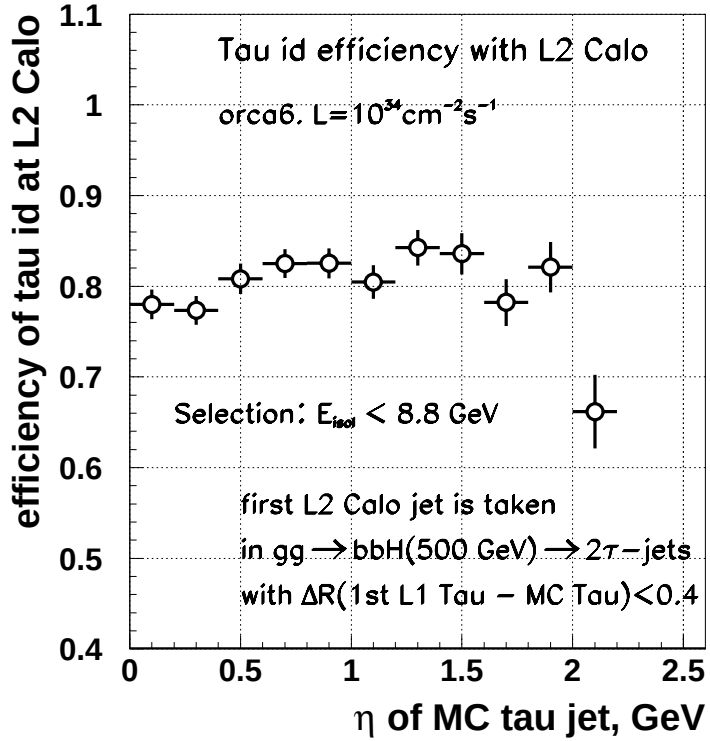
Similar to ORCA5 OK !

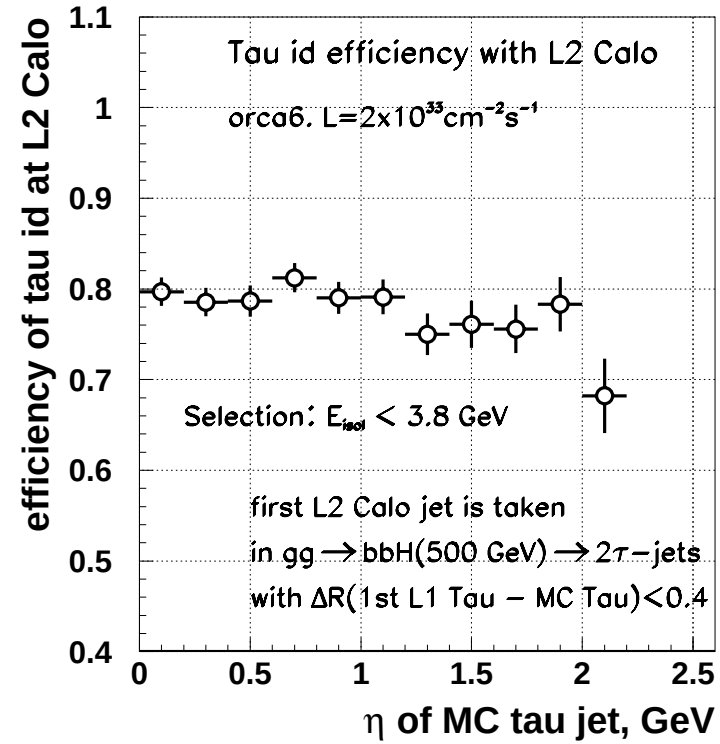
orca6, high lumi



orca6, low lumi

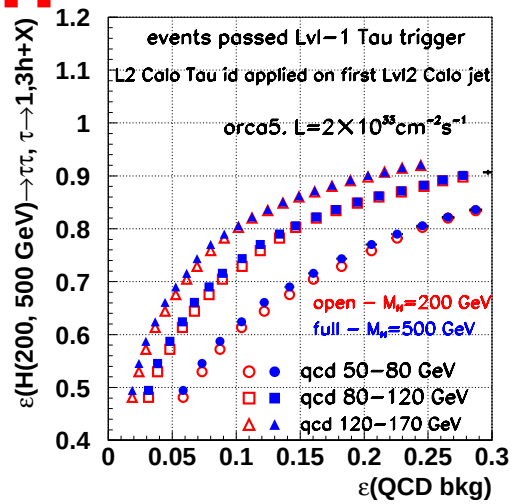




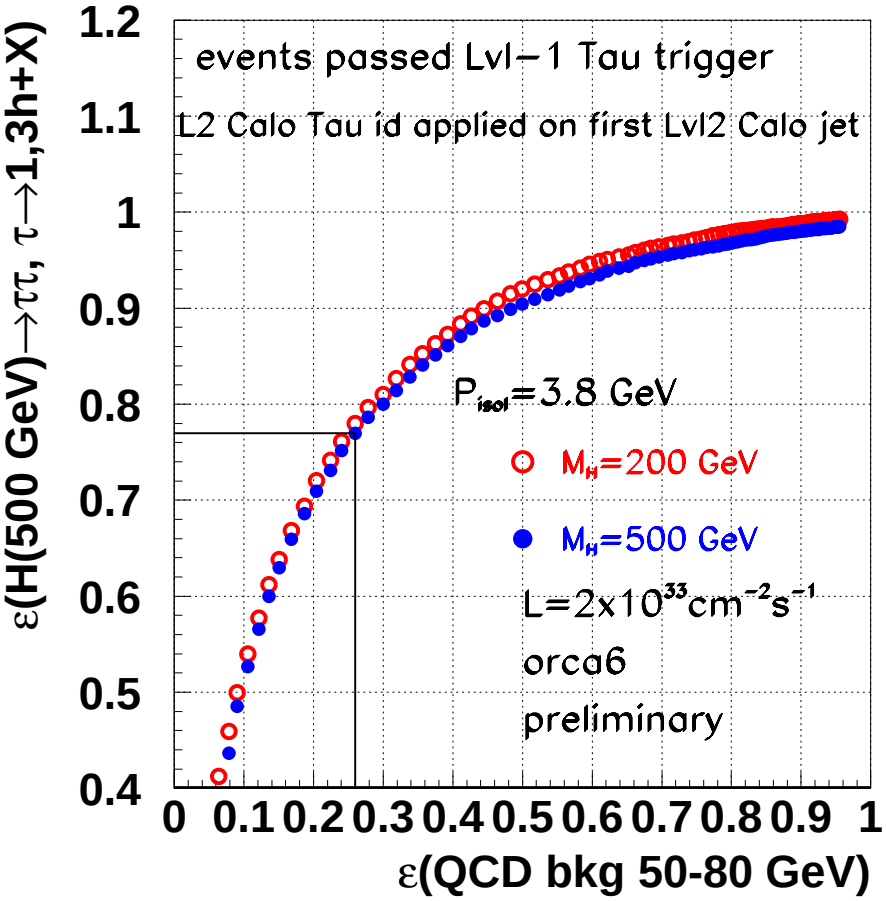


L2 Calo Tau id with e.m. isolation Signal vs bkg.

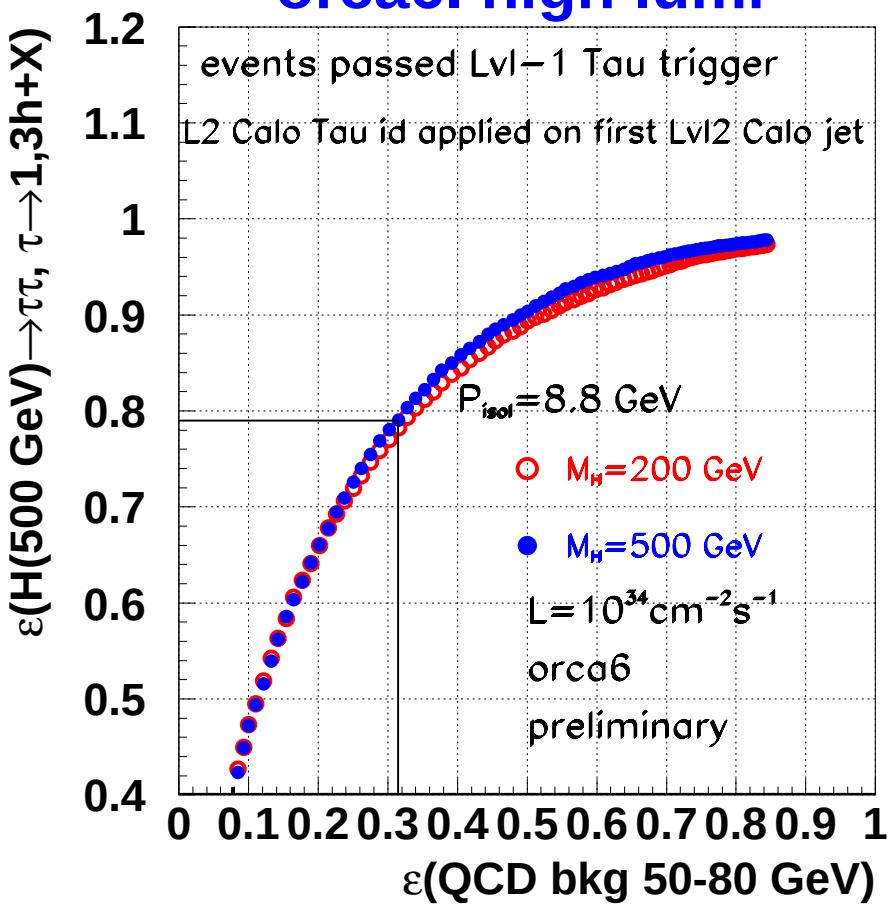
orca5. low lumi



orca6. low lumi



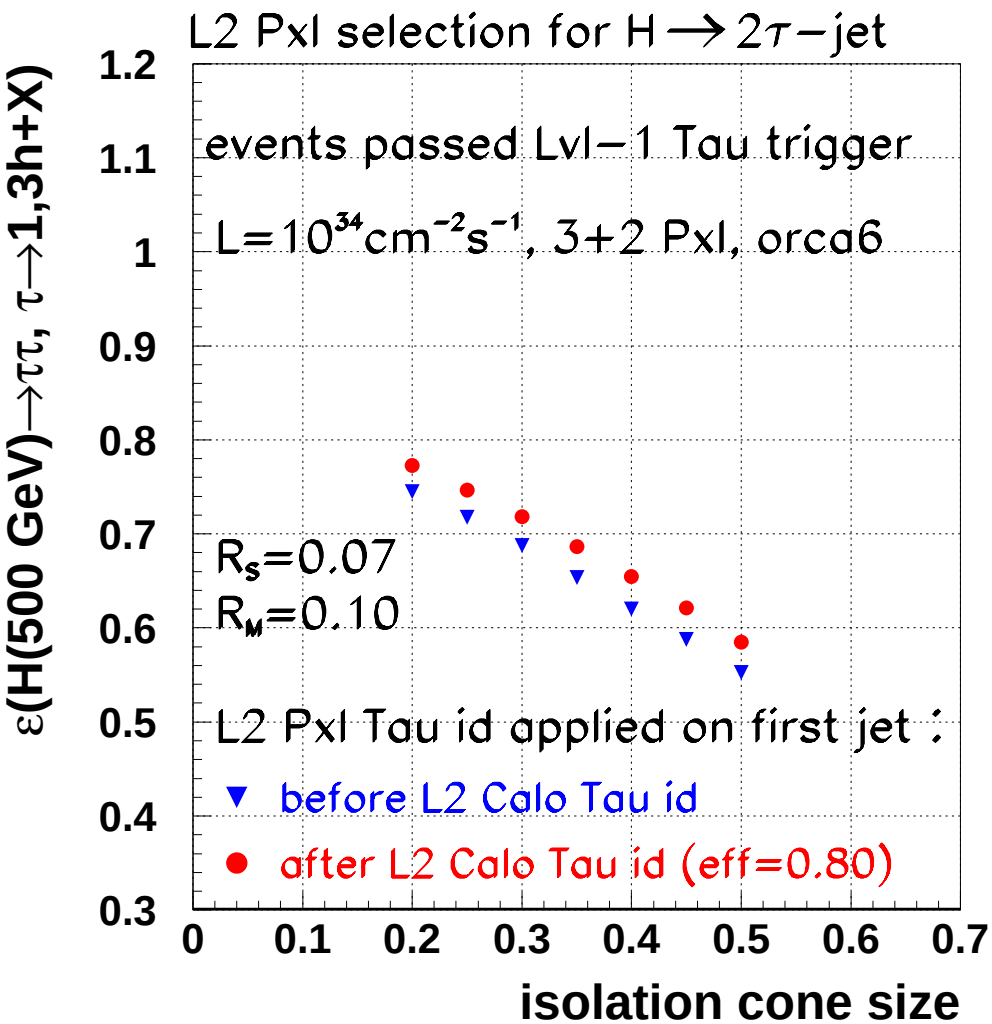
orca6. high lumi

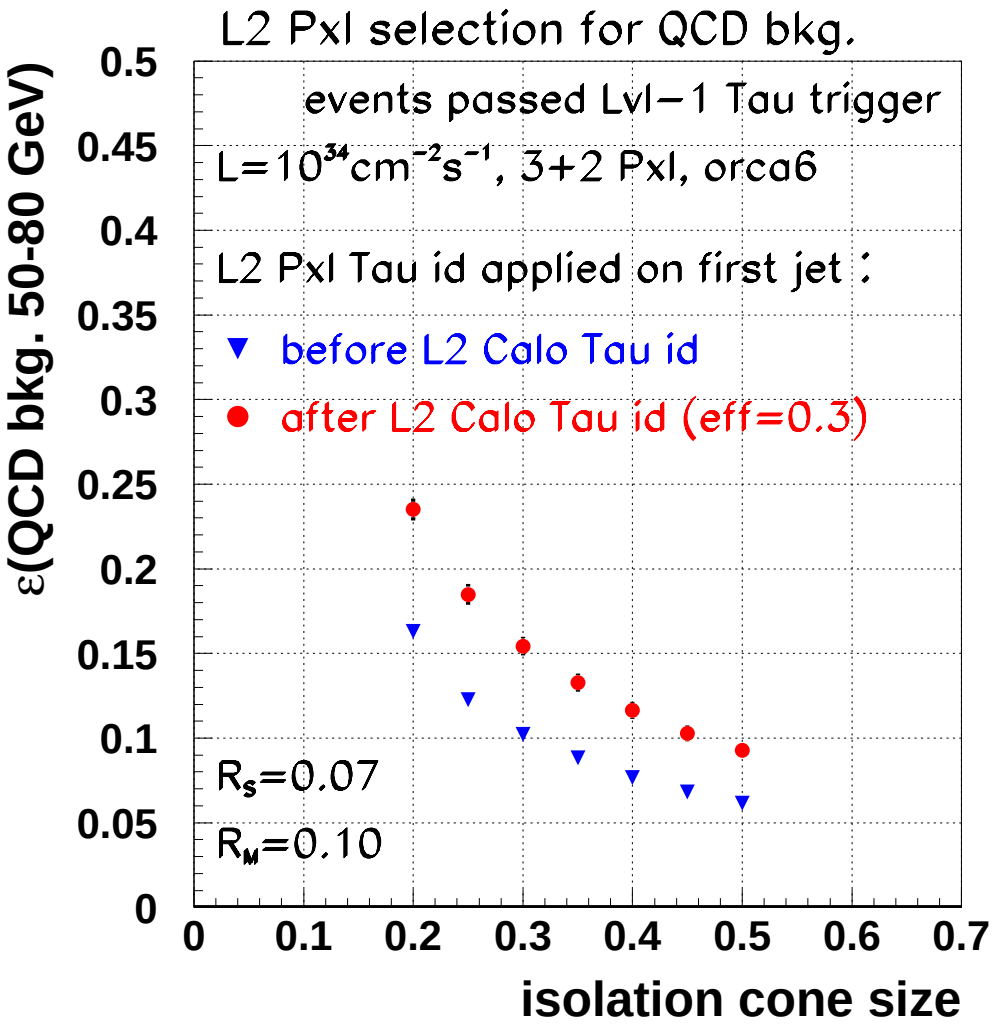


Looks similar to orca5 results.

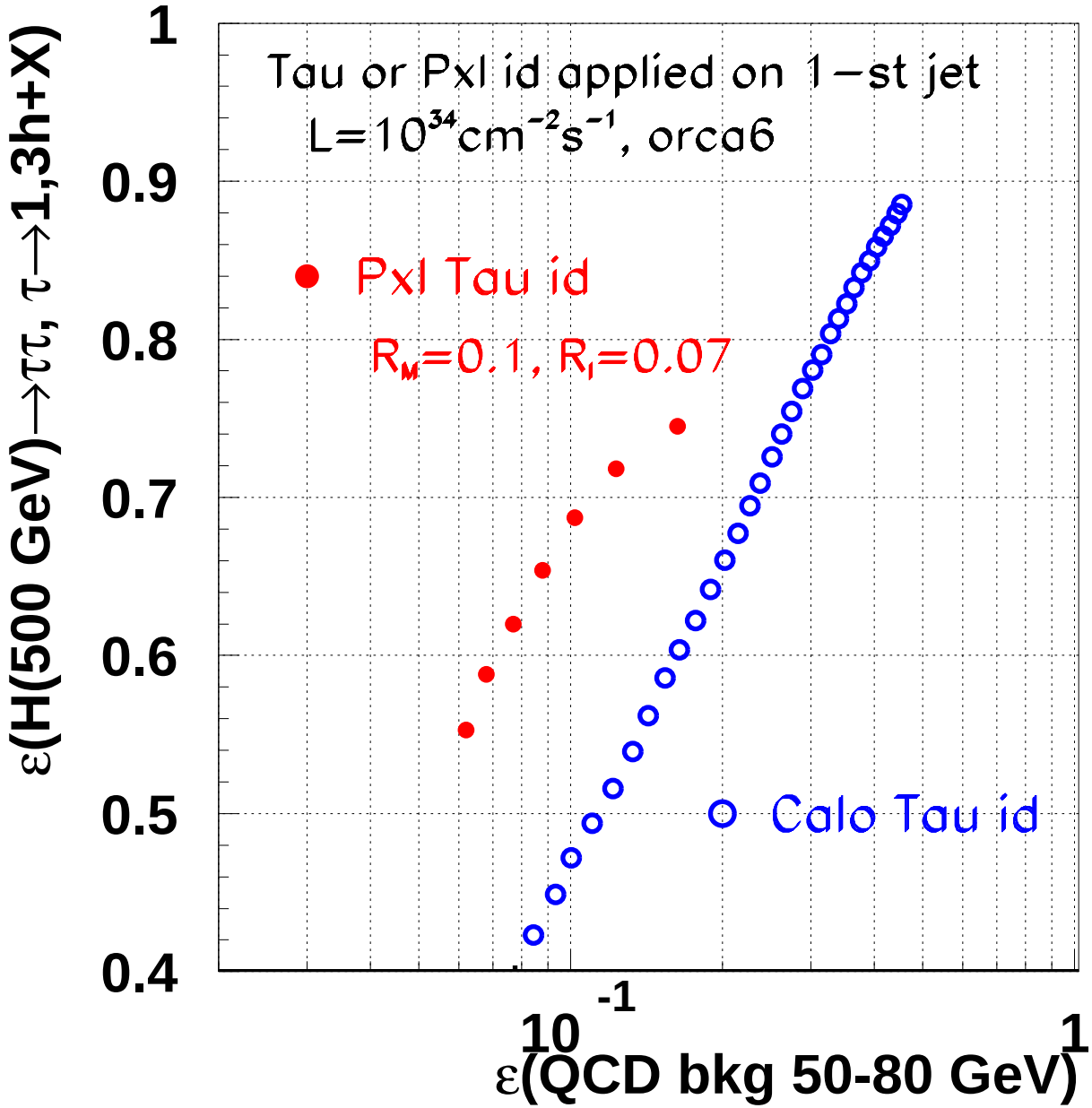
More tuning may be done on E_T threshold of towers to build Lvl-2 tau jet

Effect of L2 Calo Tau preselection on efficiency of pixel isolation at HLT for QCD and A^o/H^o->2tau-jet

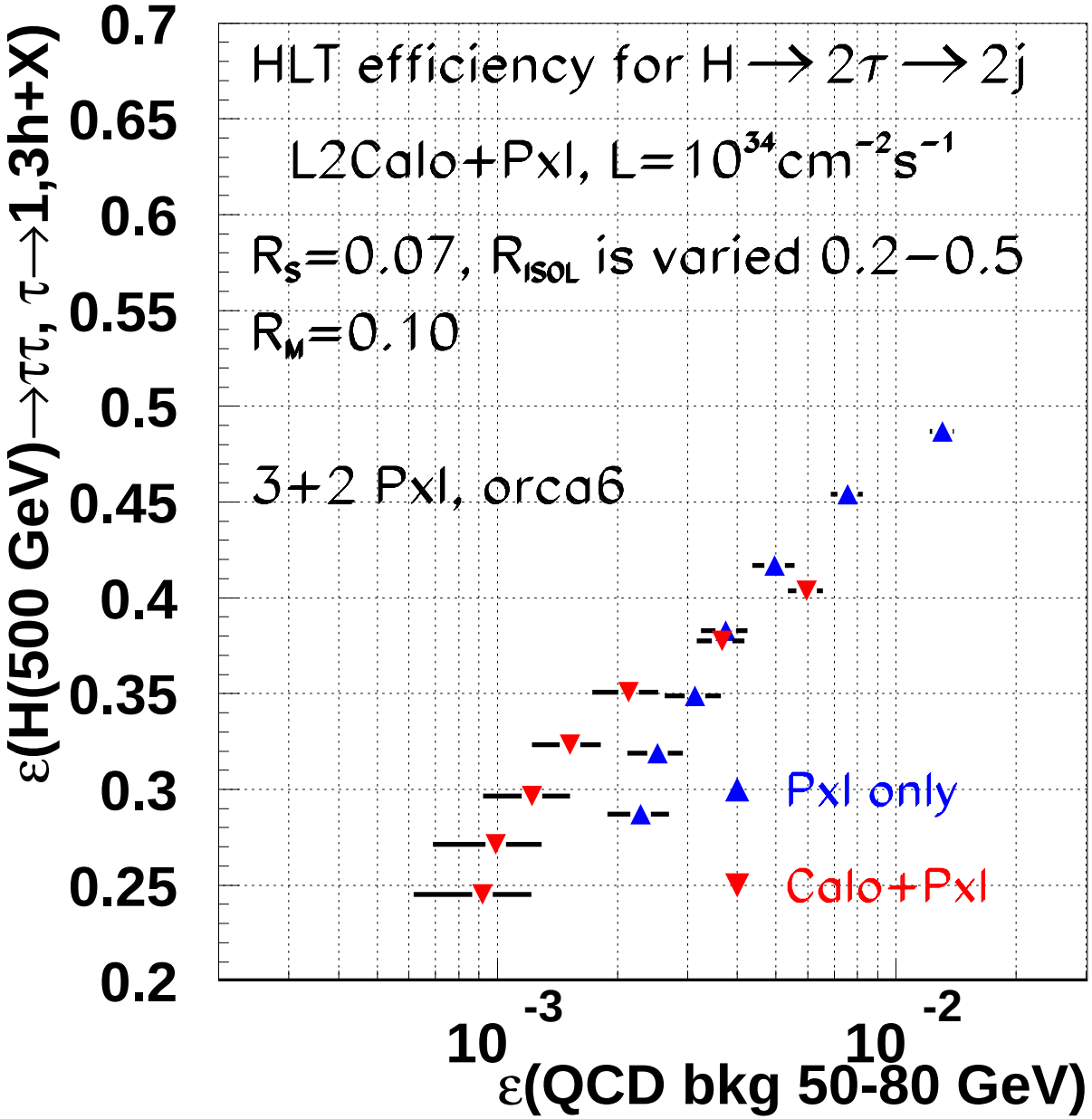




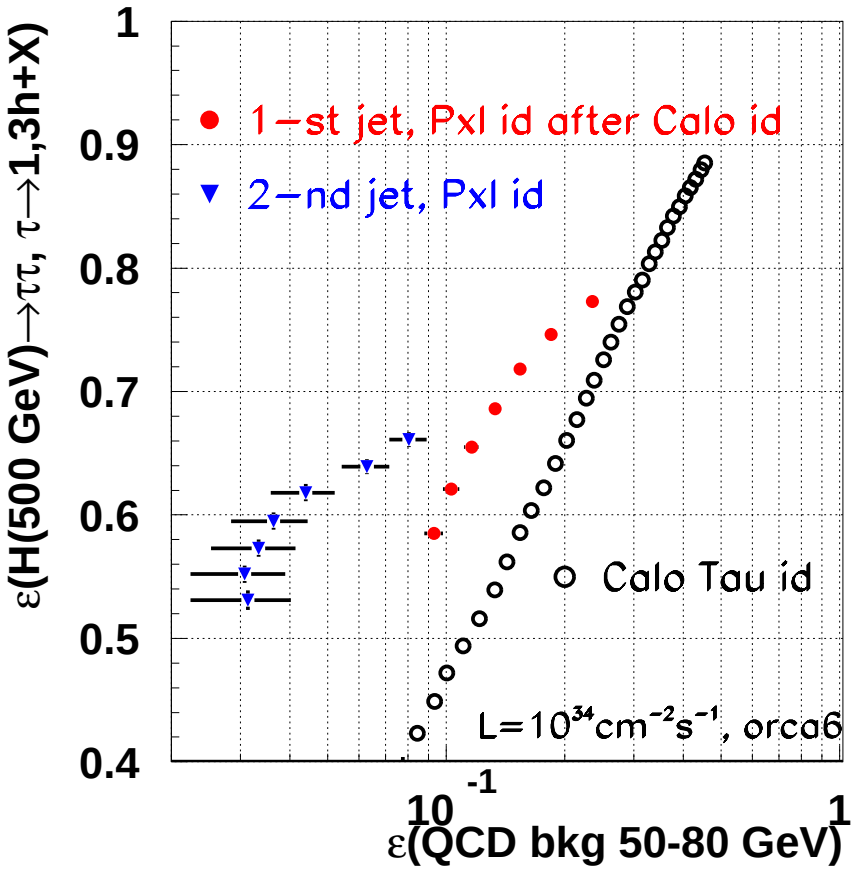
Pxl Tau id is more efficient then Calo Tau id

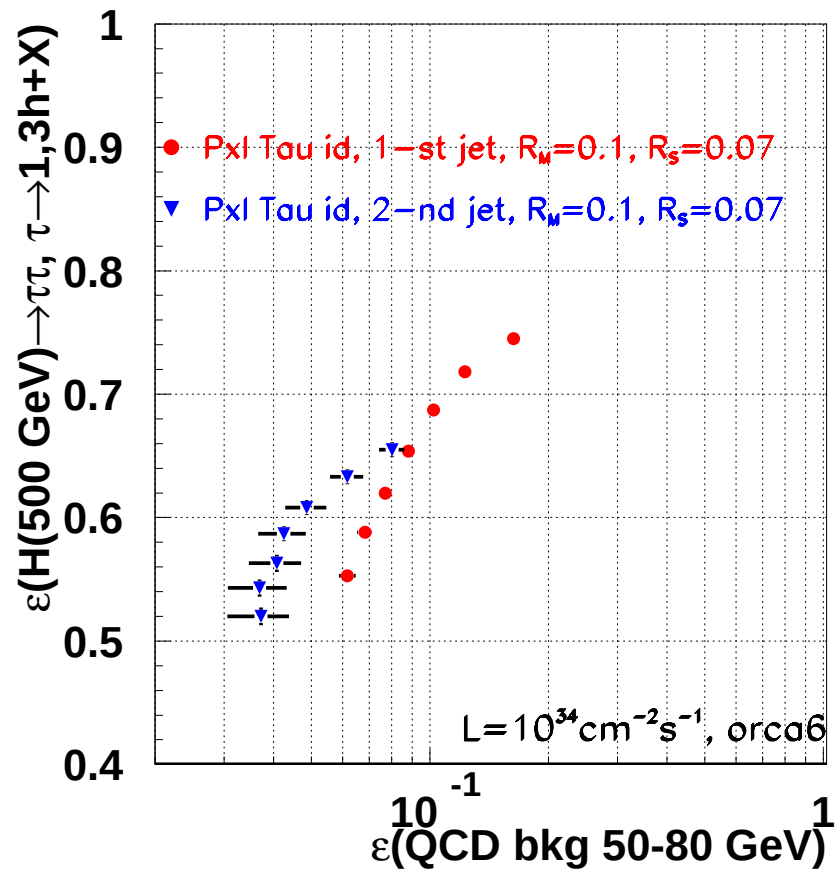


Calo + Pxl path for H->2tau-jet is more efficient than Pxl only. Why ?



Why Calo + Pxl path for H->2tau-jet is more efficient than Pxl only.





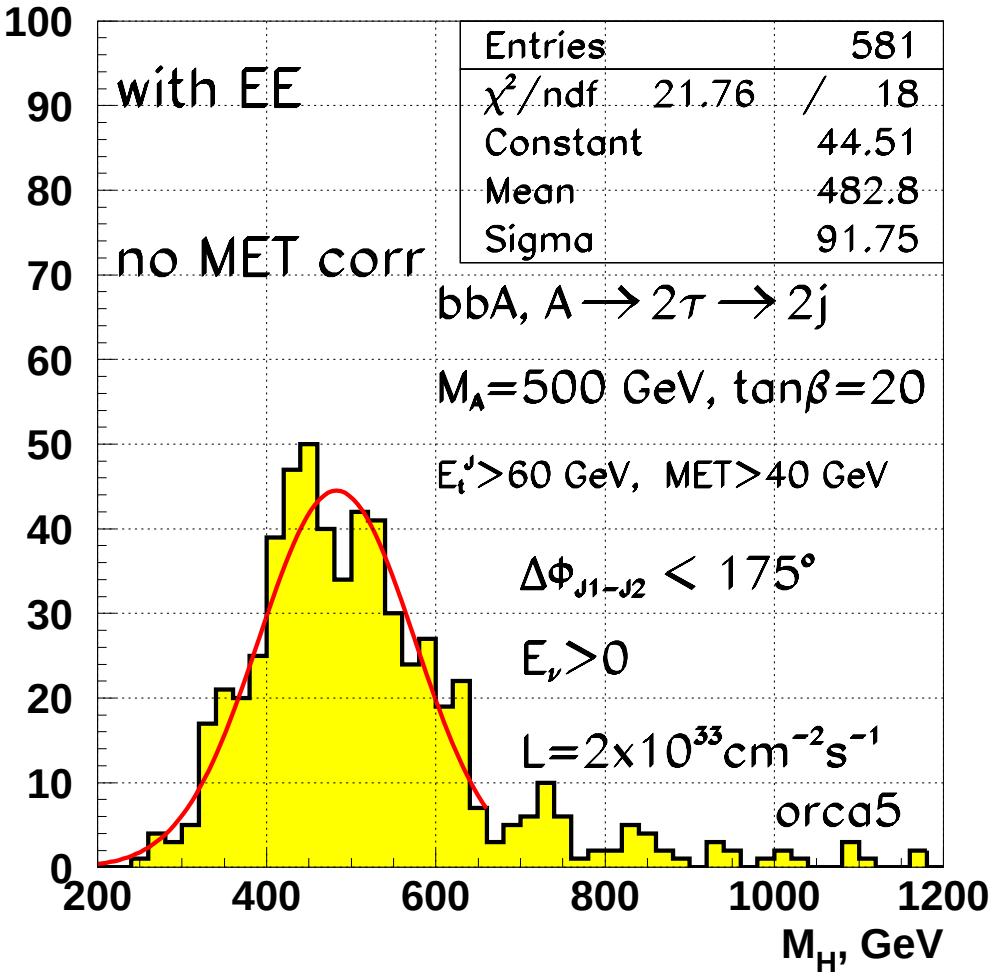
Calo+Pxl R_I=0.4	1-st jet Calo ID	1-nd jet Pxl ID	2-nd jet Pxl ID	total eff	Pxl only R_I=0.5	1-st jet Pxl ID	2-nd Jet Pxl ID	total eff
Higgs	0.790	0.655	0.573	0.30	Higgs	0.553	0.520	0.29
qcd bkg	0.315	0.116	0.033	0.0012	qcd bkg	0.0616	0.0372	0.0023

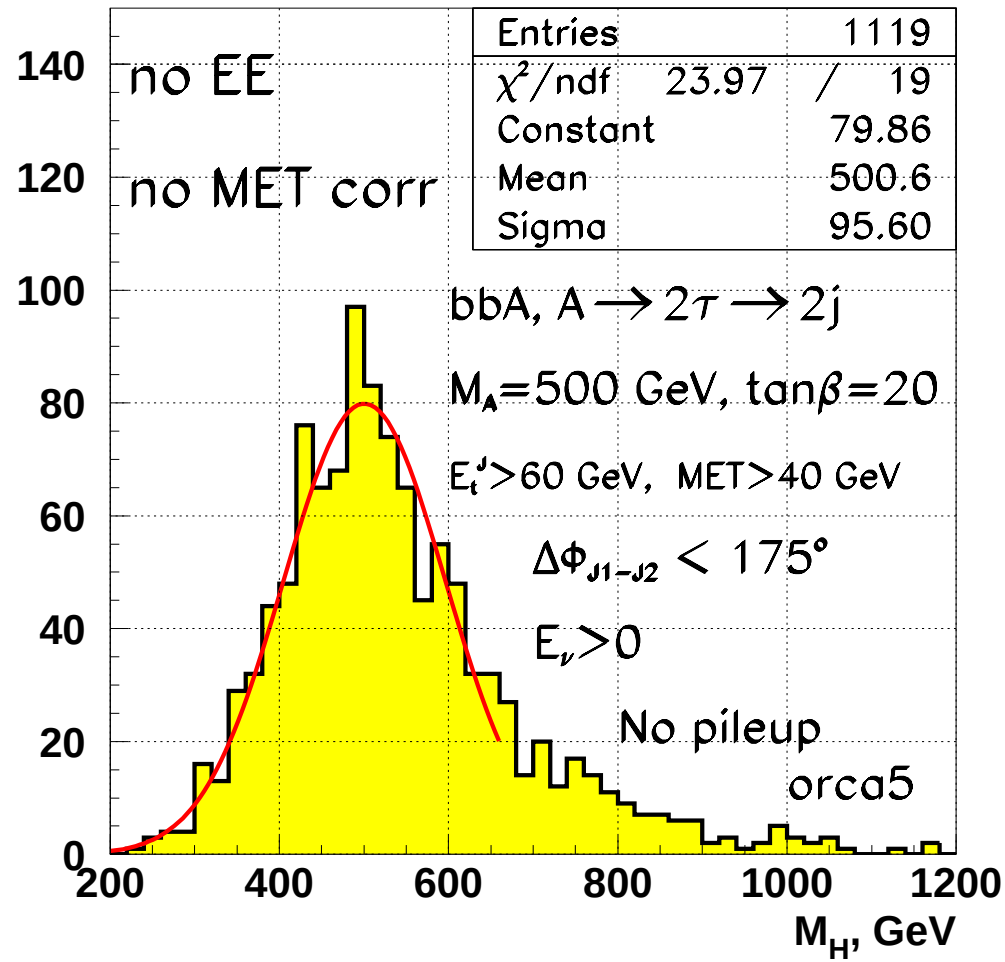
HLT CPU estimates for SUSY, Taus with Calo and Pixels

Pentium III, 800 MHz CPU. Time in ms.

	H->2tau-jet , M_H=500 GeV			QCD, p_T = 50-80 GeV		
	L= $2x10^{33}cm^{-2}s^{-1}$		L=$10^{34}cm^{-2}s^{-1}$	L=$2x10^{33}cm^{-2}s^{-1}$		L=$10^{34}cm^{-2}s^{-1}$
Calo tower building	**32**		**47**	**30**		**48**
	SUSY, global jet finding					
All jet reco: cone size 0.5, seed > 1 GeV, tower > 0.5 GeV	11		43	11		45
Lvl-2 MET from calo towers	6		9	6		9
Total time for SUSY triggers	**17**		**52**	**17**		**54**
	Lvl-2 Calo Taus					
Regional Jet reco of 2-3 Jets + jet shape analysis - e.m. isolation	**13**		**21**	**11**		**19**
	Pixel Tau trigger					
	2+1 Pxl	**3+2 Pxl**	**3+2 Pxl**	**2+1 Pxl**	**3+2 Pxl**	**3+2 Pxl**
Pixel RHits reco (get Data)	34	48	115	39	55	126
Reco Pxl lines and vrtx (doIt)	23	34	276	30	42	327
Pixel isolation for two jets	negligible					
Total Time for Pixel trigger	**57**	**82**	**391**	**69**	**97**	**453**
Total Time for Lvl-2 Calo + Pxl Trigger	**70**	**95**	**412**	**80**	**108**	**472**

Higgs mass reco in gg->bbA^o/H^o->2τ->2jet with and without EE





cms120 and orca5 data no METcorrections	<M>, GeV	σ, GeV	σ / M, %	eff. of mass reco E_ν>0, $\Delta\phi_{jj}$<175°
with EE, L=2x10^{33}cm^{-2}s^{-1}	483.0	92.0	19.0 %	0.19
No EE, no pile up	500.0	95.0	19.1 %	0.20

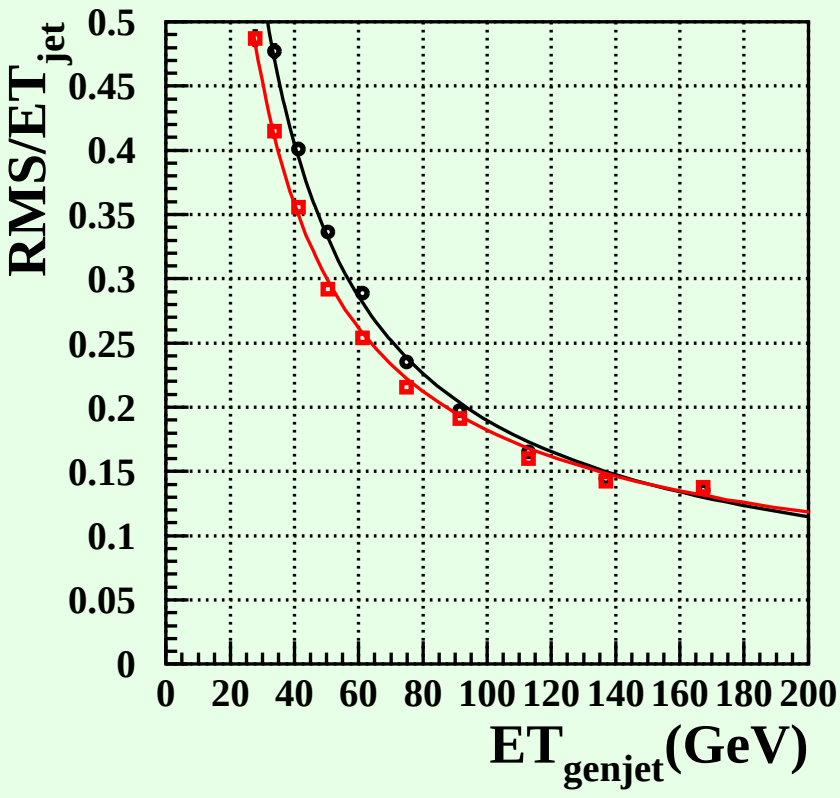
....

Pile up subtraction algorithm with new orca6 data. First results.

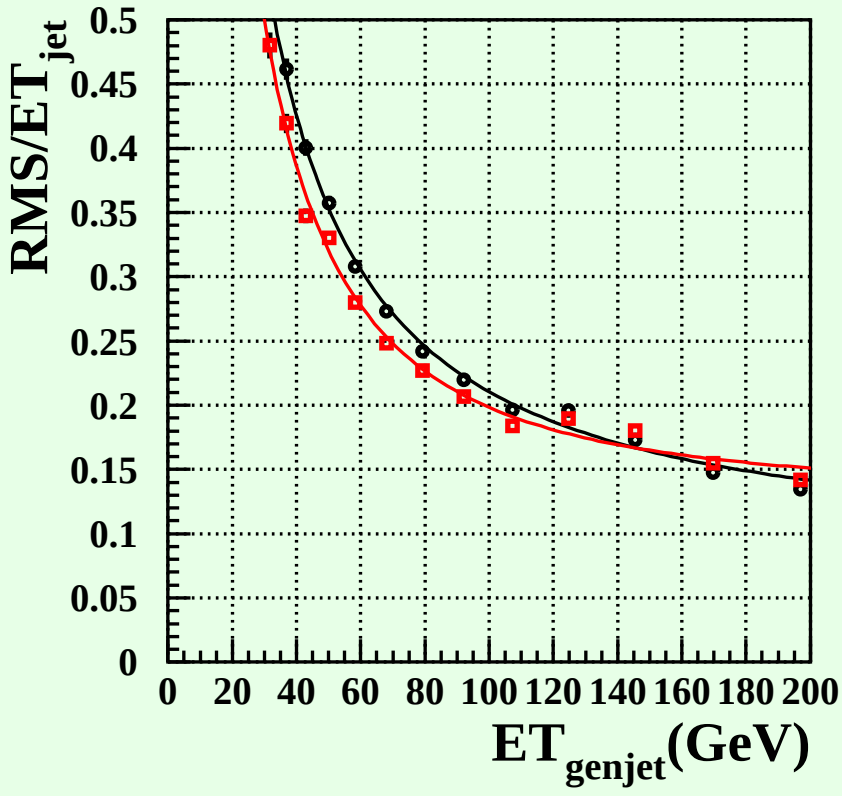
A. Oulianov

FNAL events at $L=10^{34}cm^{-2}s^{-1}$. analysis made on FNAL farm

qcd 2-jet sample



t t_bar sample - bb+4J



black - no pu subtraction, cone 0.7

red - with pu subtraction, cone 0.7

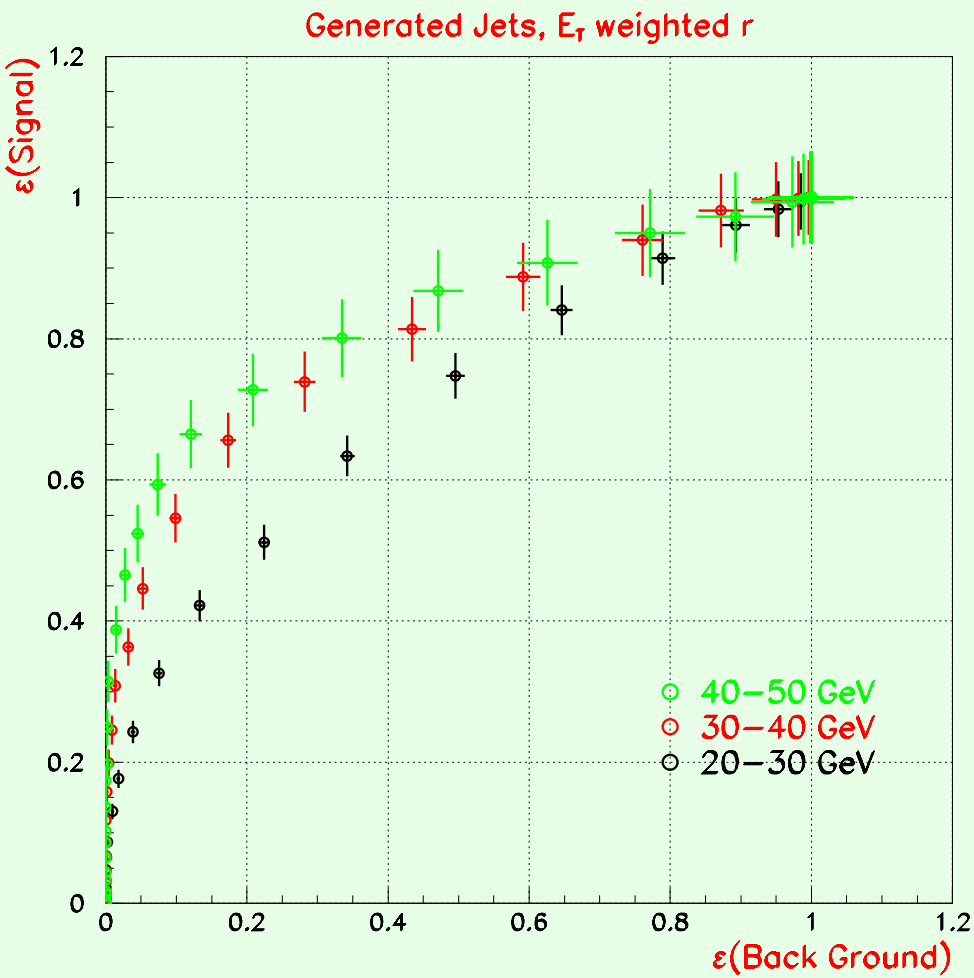
improve in resolution ~ 10 % for soft jets

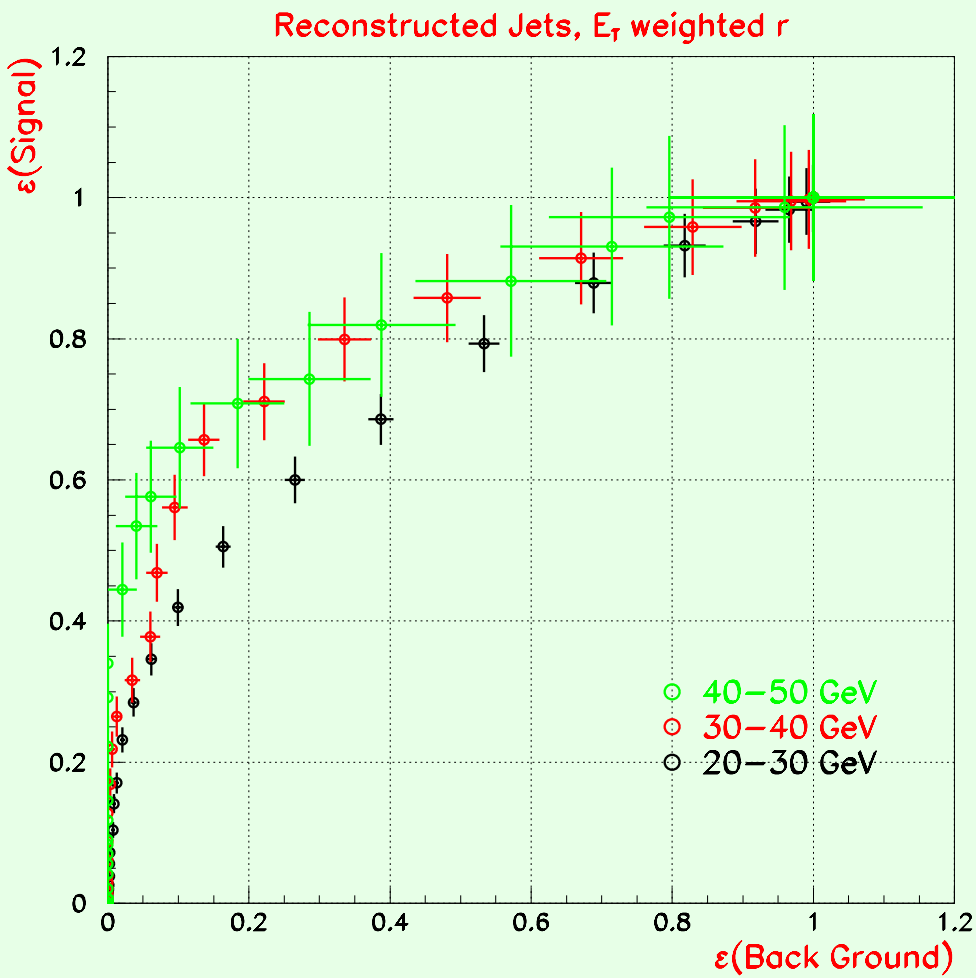
False jet subtraction with jet shape variables

Isa Dumanoglu

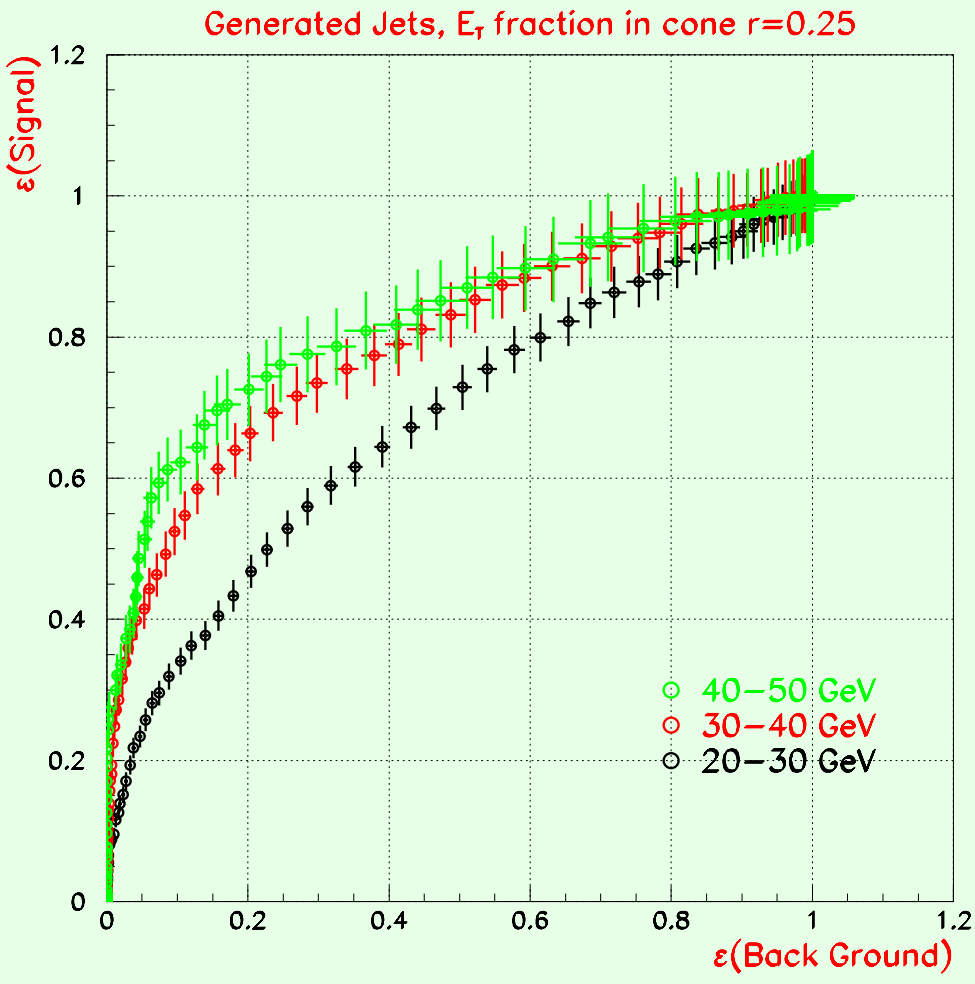
False calo jet is a jet associated (ΔR) with MC jet where > 50 % of E_T comes from non signal vertex particles. R_{reco}= 0.5. Variables to use are :

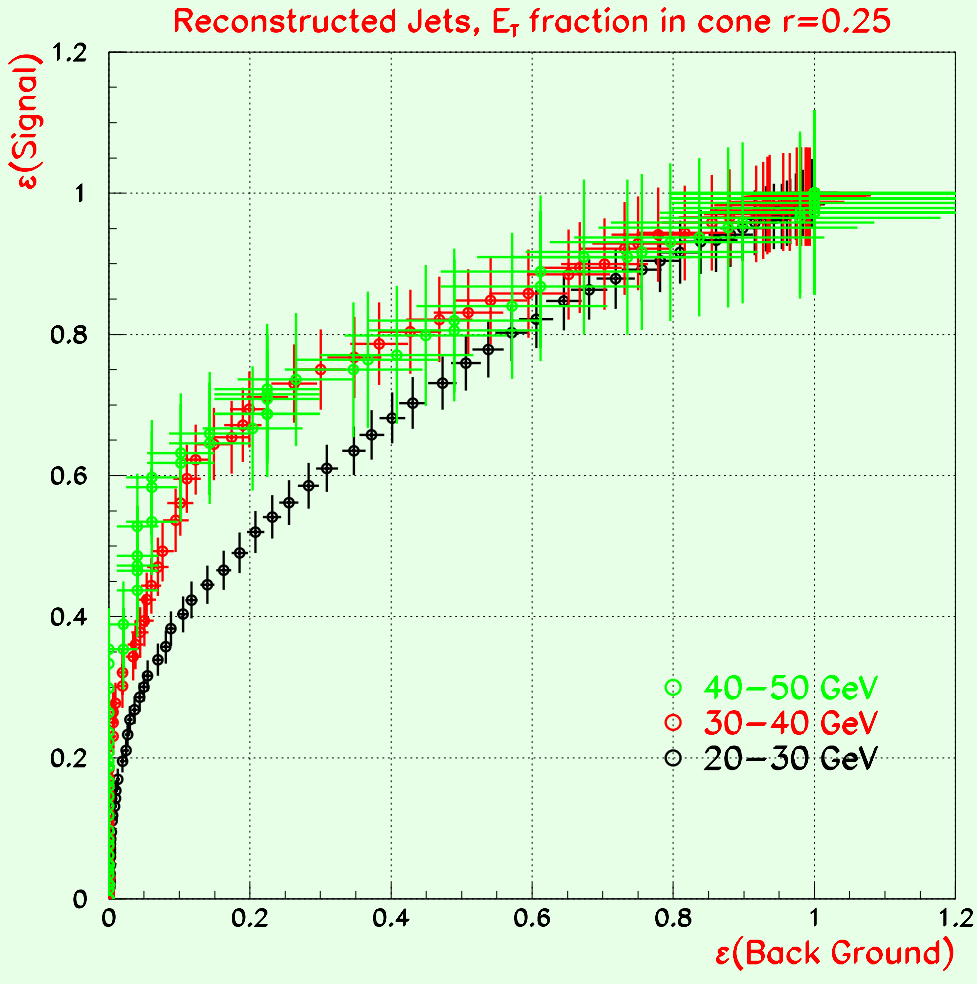
E_T weighted radius





E_T fraction in cone r < R





Similar performance of both variables

...

Software development

- **Fast calo tower building (factor ~ 5 faster than in orca5).**

  Bart van de Vyver

- **implementation of jet merging/splitting with/without MidPoint**

  H.P. Wellicsh

- **tracks are included in root ntpl maker**

  J. Damgov