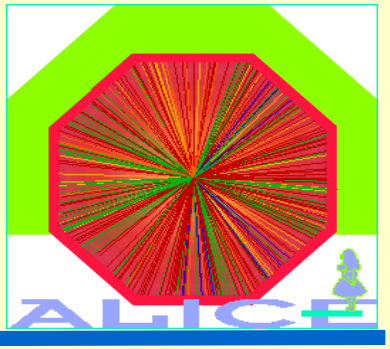
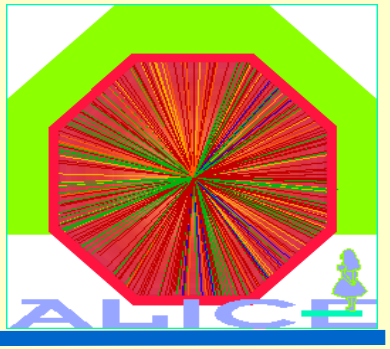
ALICE: Physics with electrons



- Quarkonia dielectron decays
- The ALICE Transition Radiation Detector
- The electron trigger
- Pion rejection power
- Quarkonia invariant mass resolution
- Conclusions

Quarkonia dielectron decays I



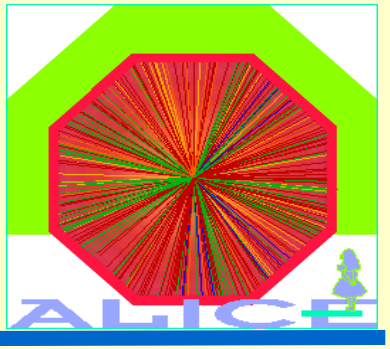
- Quarkonia states probe dynamics of nuclear collisions
- Quarkonia dissociation one of the most important observables of deconfined state
- Quarkonia suppressed if potential shielded by color screening
- Lattice QCD predicts sequential dissociation of quarkonia states

State	J/Ψ	Ψ'	χc	Υ	Υ'
Tdiss/Tc	1.17	1.0	1.0	2.62	1.12 *

- Changes in gluon momentum distribution near Tc also contribute

* ***F.Karsch and H.Satz, Z.Phys. C51 (1991) 209***

Quarkonia dielectron decays II

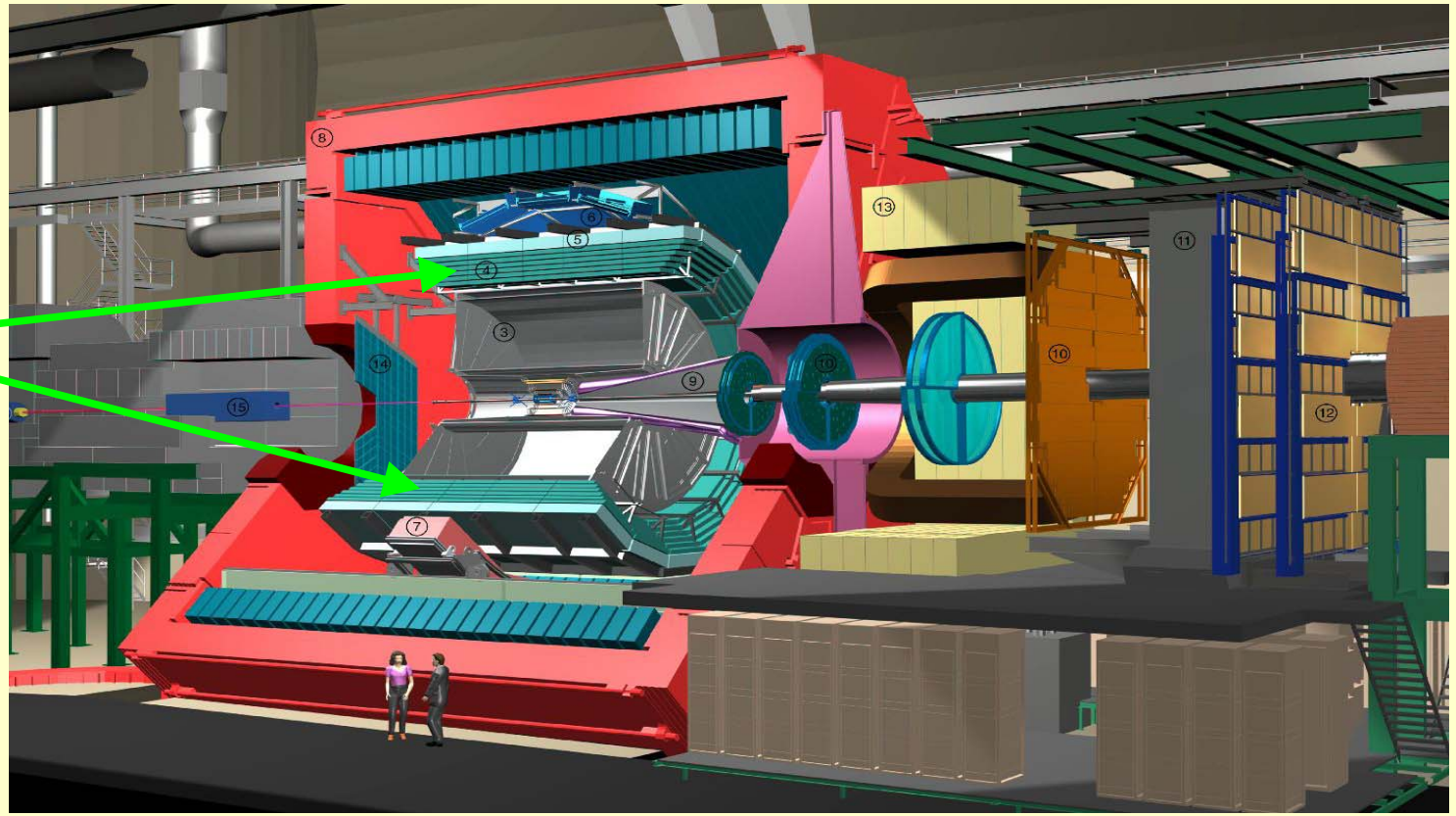


- Quarkonia rates sensitive to
  - Nuclear absorption and secondary scattering
  - Parton distribution functions, nuclear gluon shadowing
- Expect quarkonia in AA collisions reduced relative to pp or pA
- BUT copiously produced uncorrelated Q-Qbar pairs may form final state quarkonium --> *Is there quarkonia enhancement at LHC* ?
- Comprehensive Quarkonia measurements pp, pA, AA
- Reference: total charm/beauty cross section

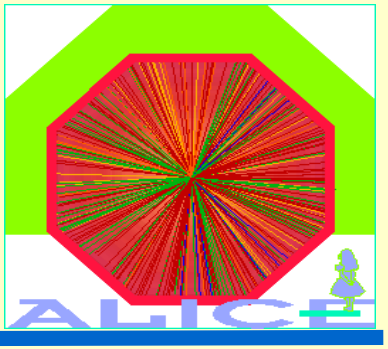
ALICE

- Transition radiation detector TRD

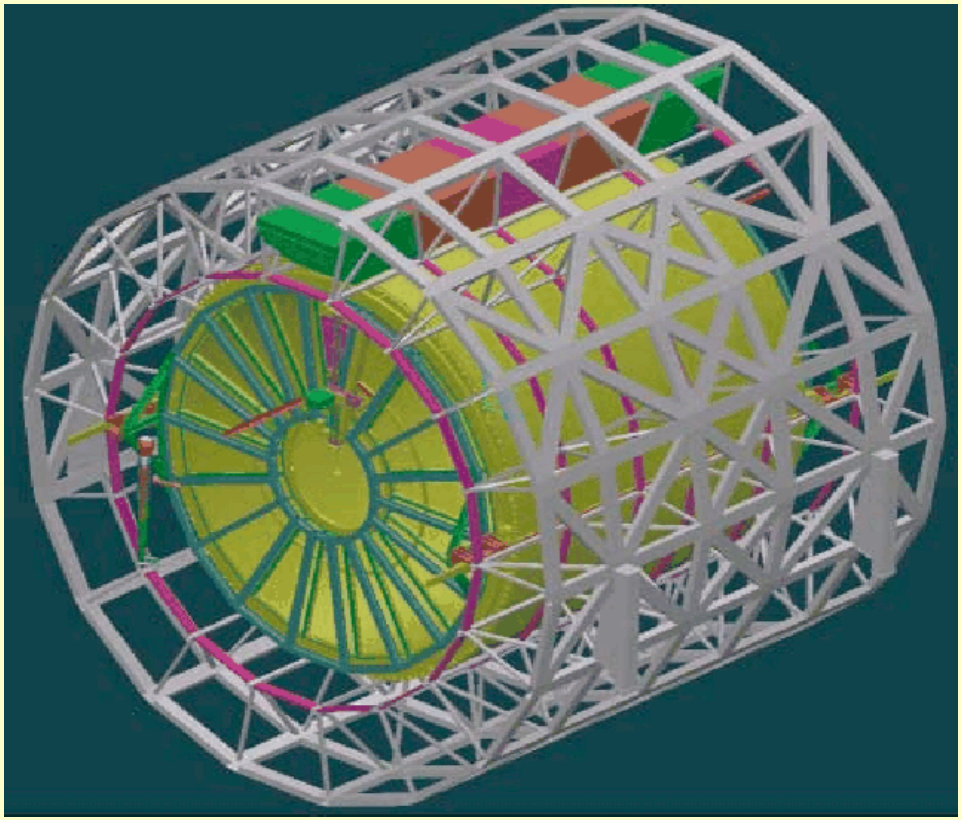
TRD



Transition radiation detector



- TRD: radiator + driftspace + MWPC
- R > 300 cm
- $|\eta| < 0.9$
- 18 ϕ–sectors
- 5 Z – modules
- 6 R – layers
- Total 540 chambers

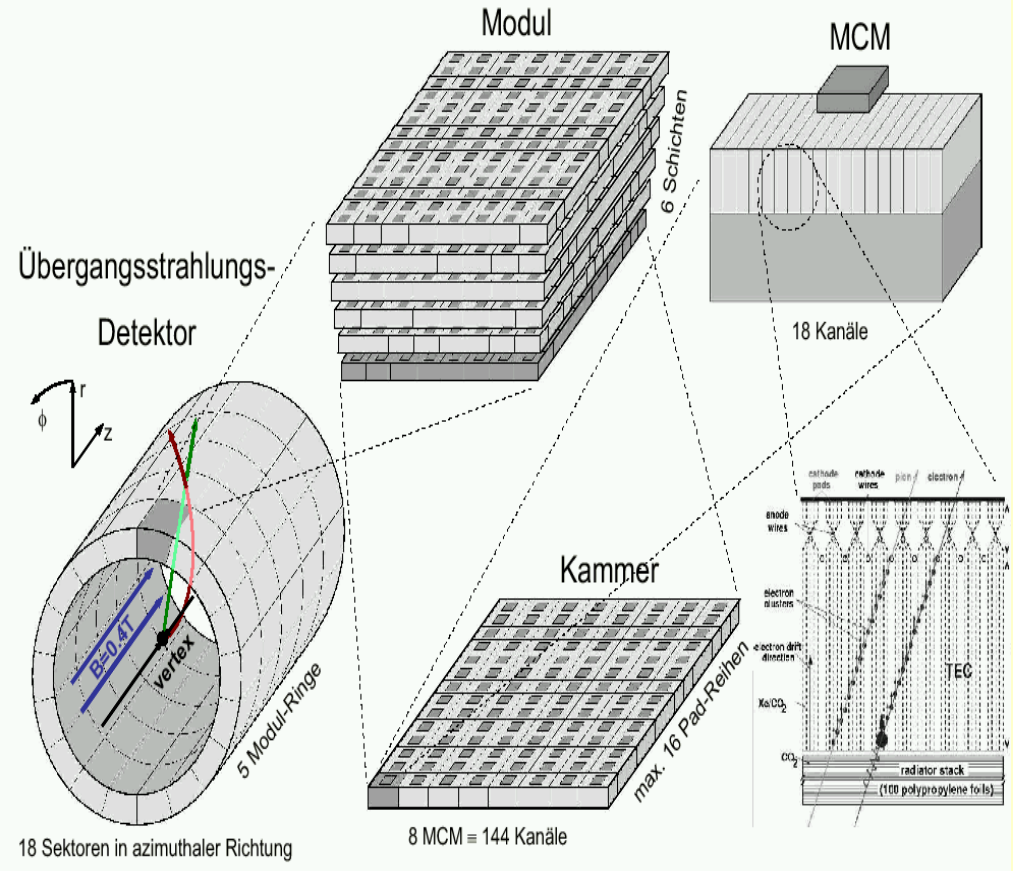


TRD read out

- TRD tracking capability
- electron identification
- pion suppression

- online electron trigger
  for pt > 2 GeV/c
(B.Vulpescu, Heidelberg)

Module



MWPC

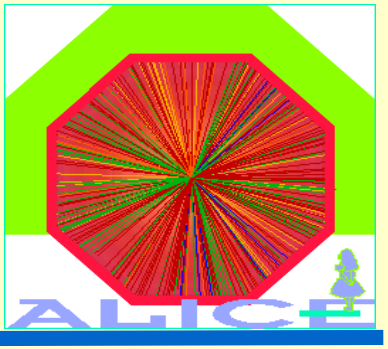
Drift space

Radiator

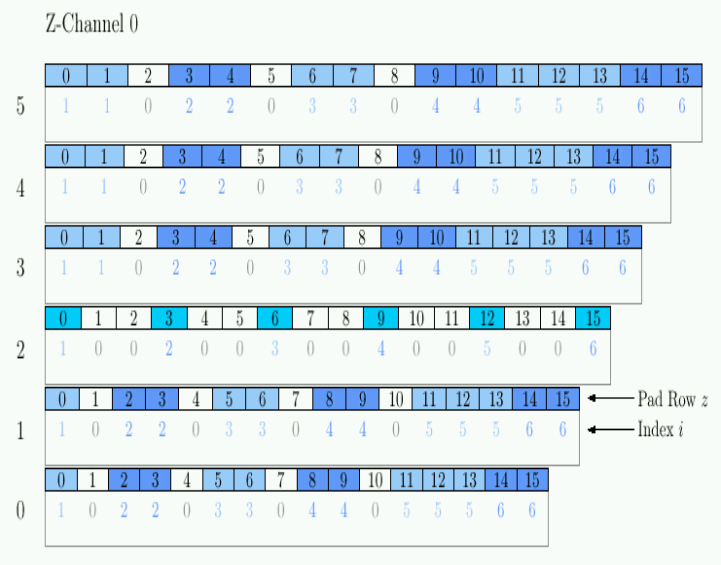
TRD barrel

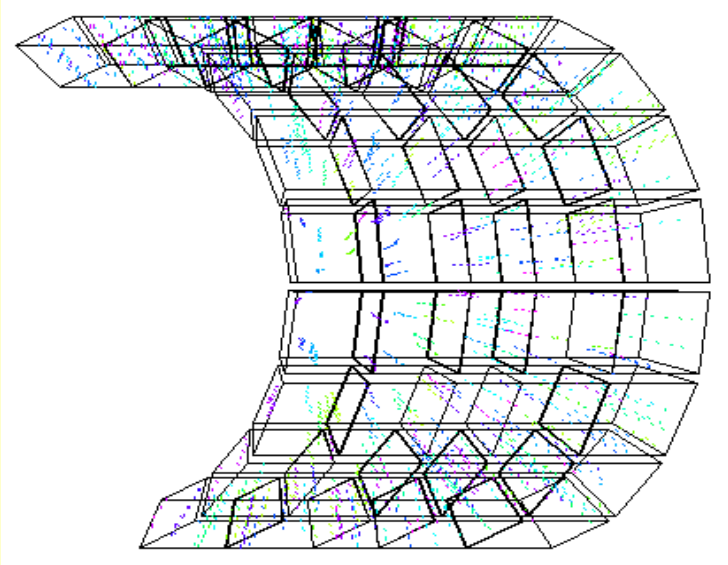
Chamber

Tracks in module

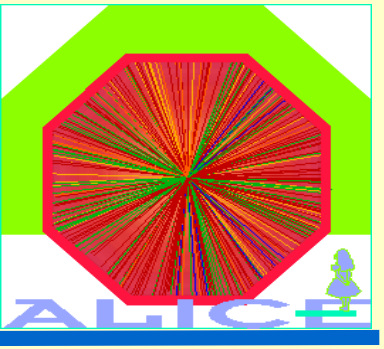


- Track resolution in one chamber:
  - $\sigma(y) \sim 0.4$ mm, $\sigma(\alpha) = 0.6$ deg, $\sigma(z) = 3$ cm
- Track reconstruction within a module (6 layers)

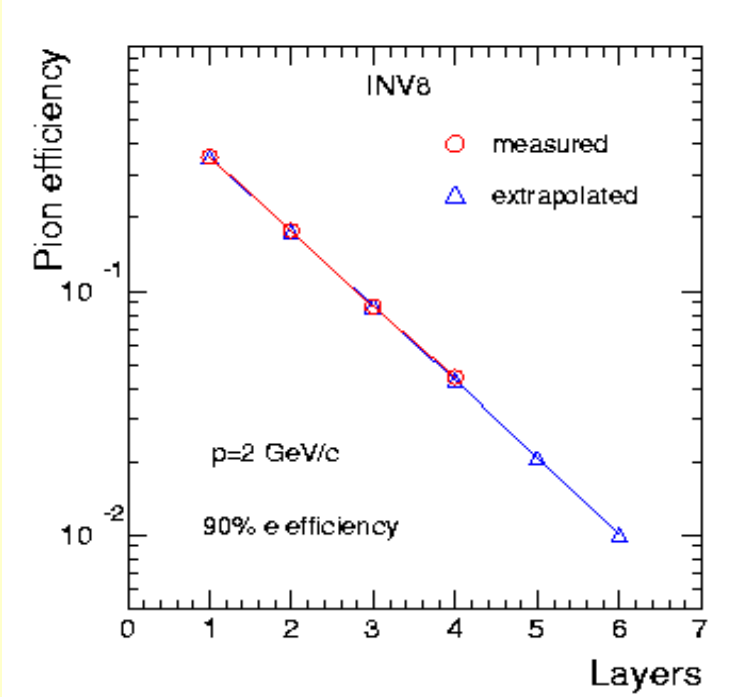




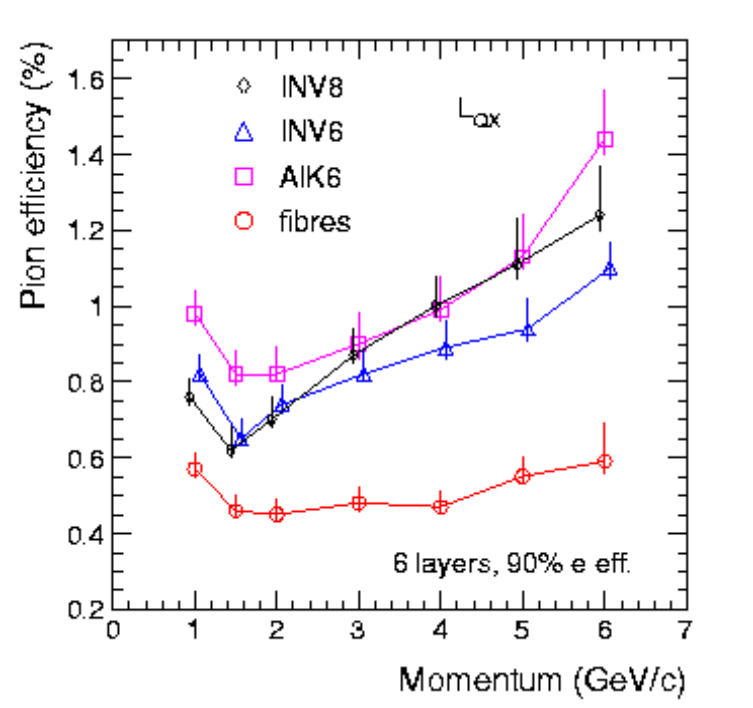
Pion rejection by TRD



- data from test beam experiment

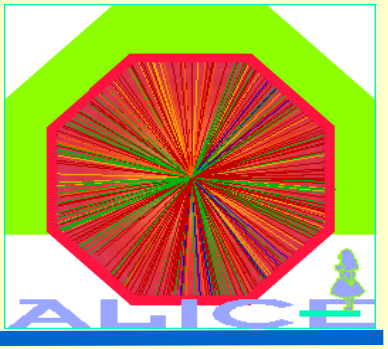


- pion rejection as function of number of layers

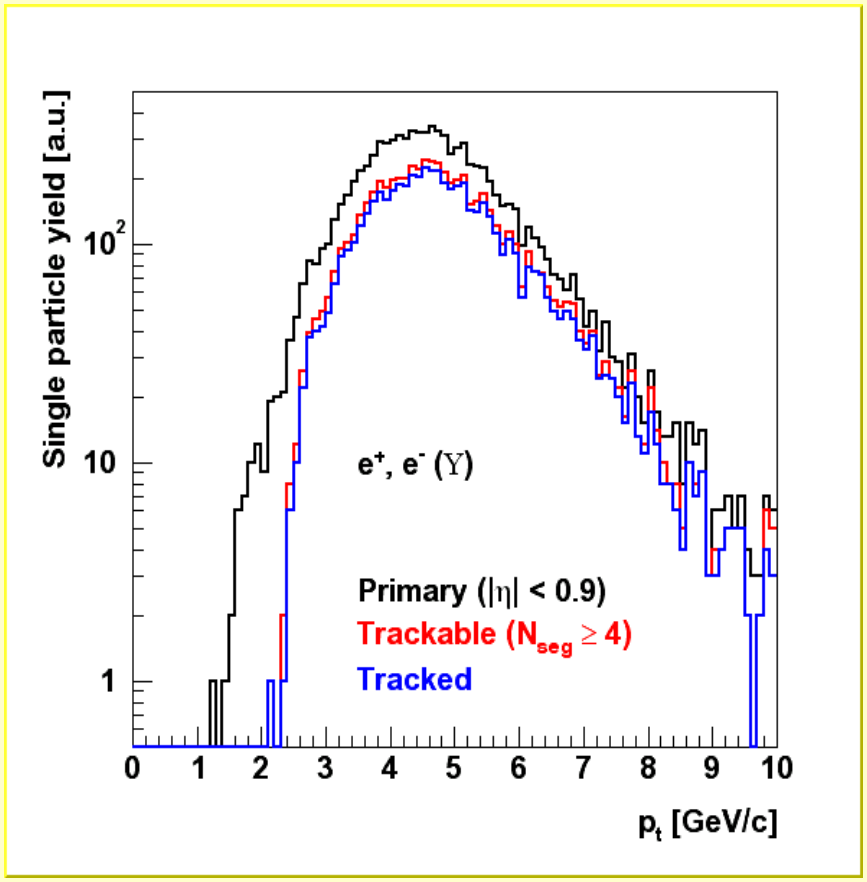


- pion rejection as function of momentum

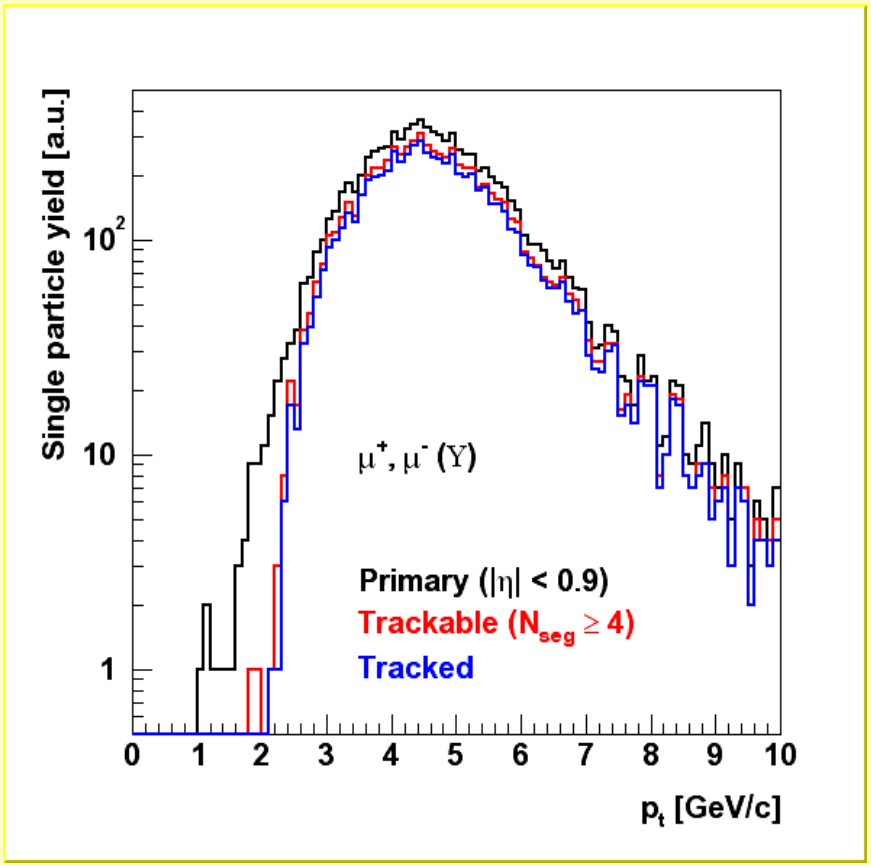
Y decay tracks



- electrons

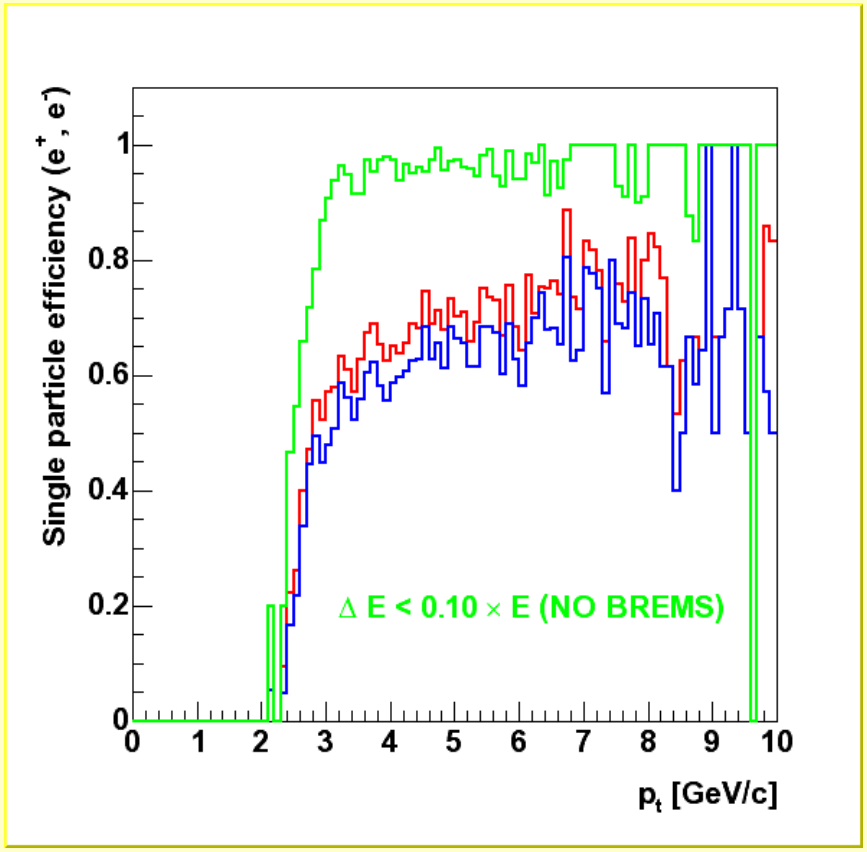


- muons (case study)



Y decay tracks efficiency

- electrons



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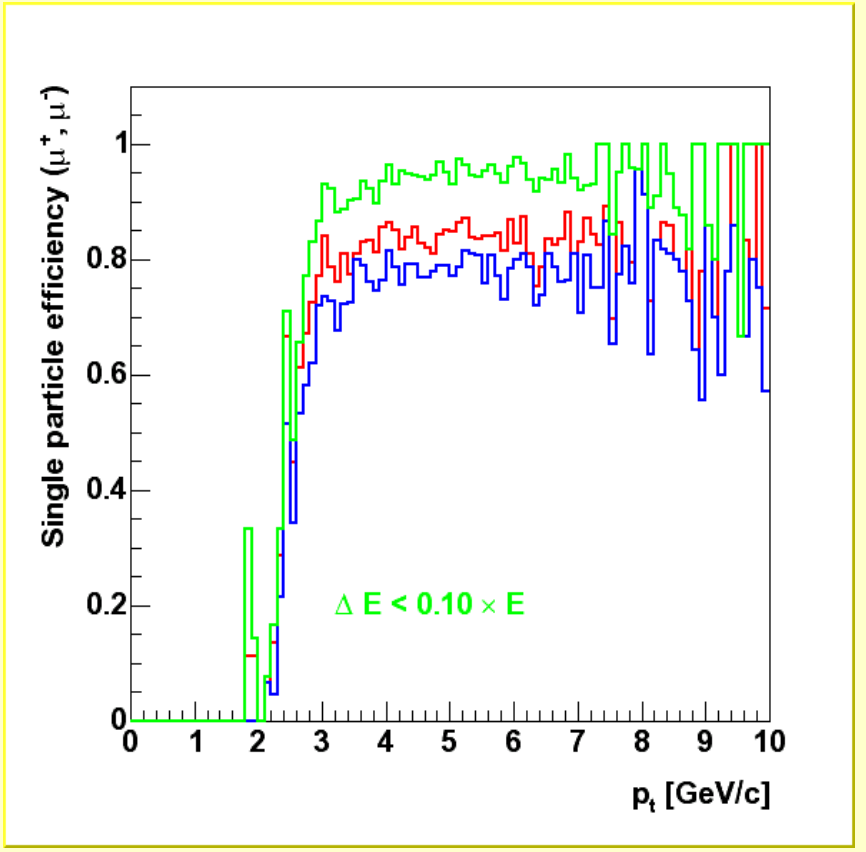
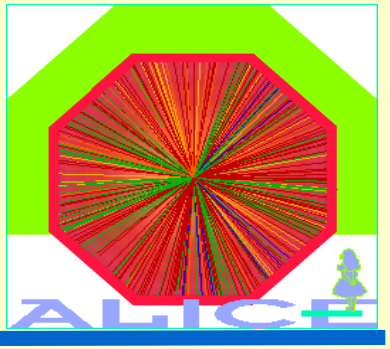
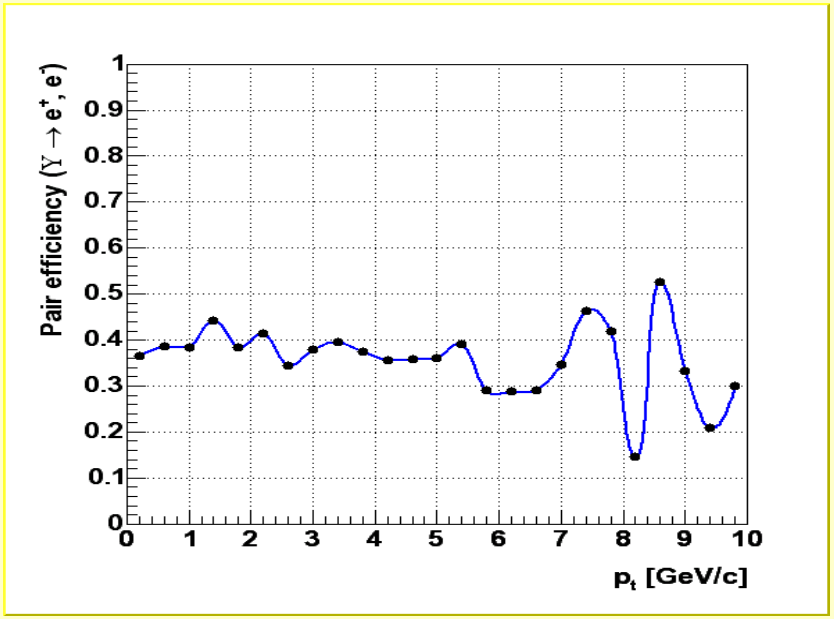


Y tracking efficiency in dielectron channel

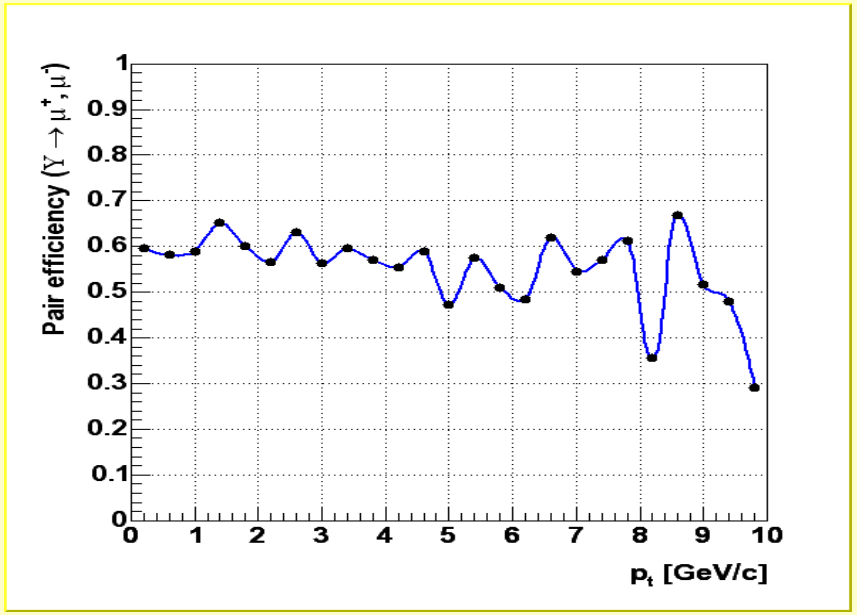


- low multiplicity events, defined for Y--> e+e- within TRD acceptance
- $\varepsilon(Y) = \varepsilon(e^+) \times \varepsilon(e^-)$
- conditions: 2 tracks of opposite charge, single track Pt > 2 GeV/c

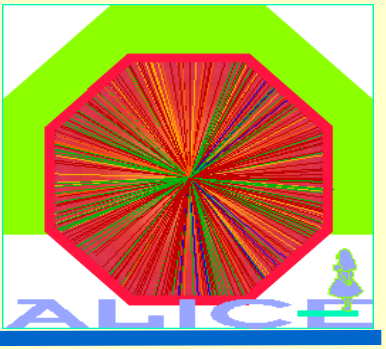
- electron channel e+e-



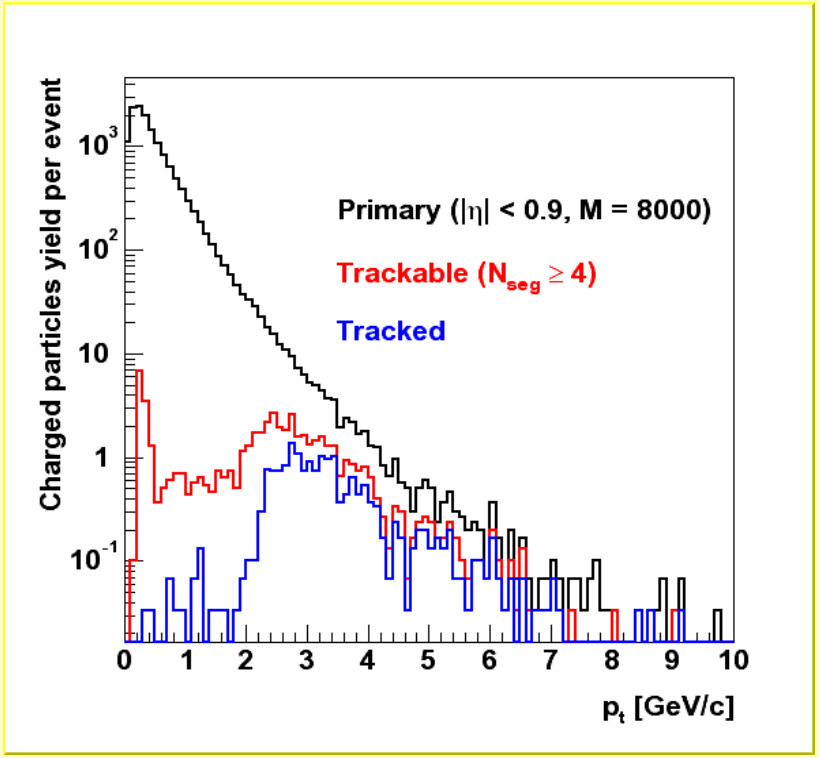
- muon channel μ+μ-

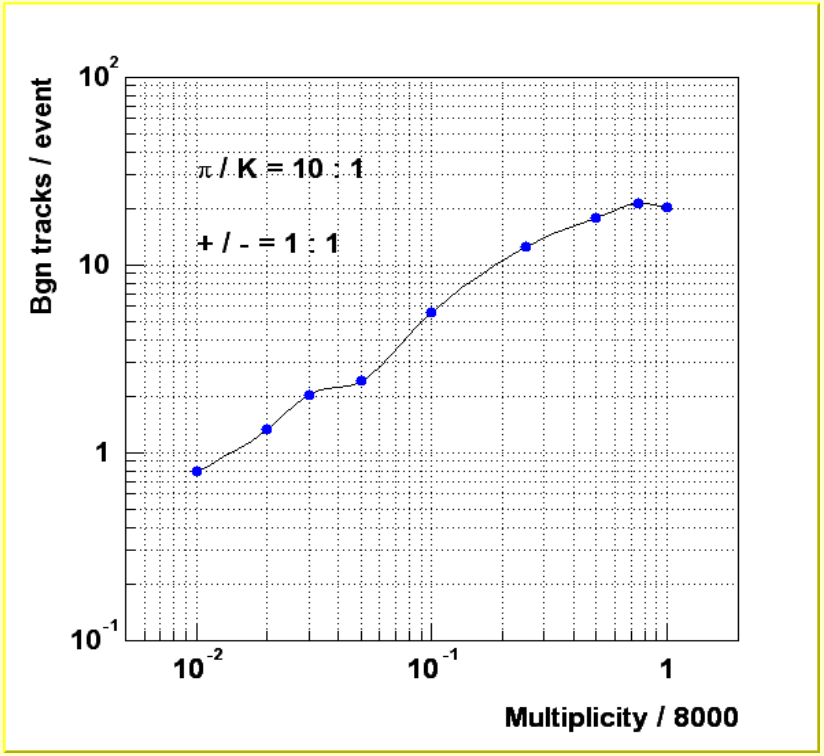


Trigger background



- TRD trigger central Pb-Pb, reconstructed tracks Pt > 2 GeV/c

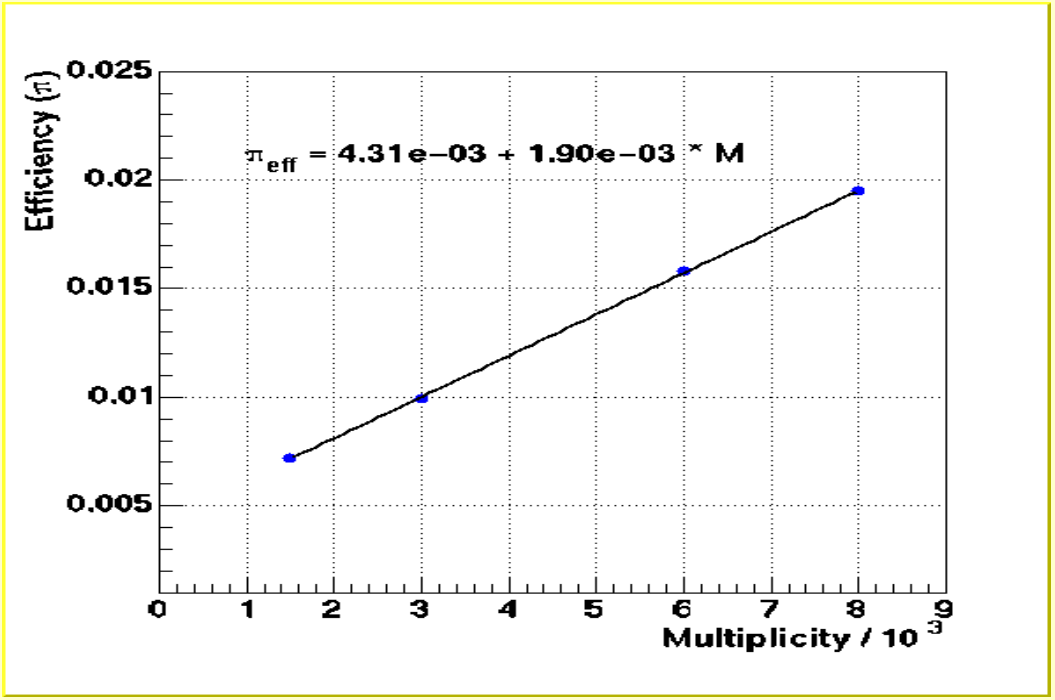




- background mainly pions --> needs pion suppression > 50

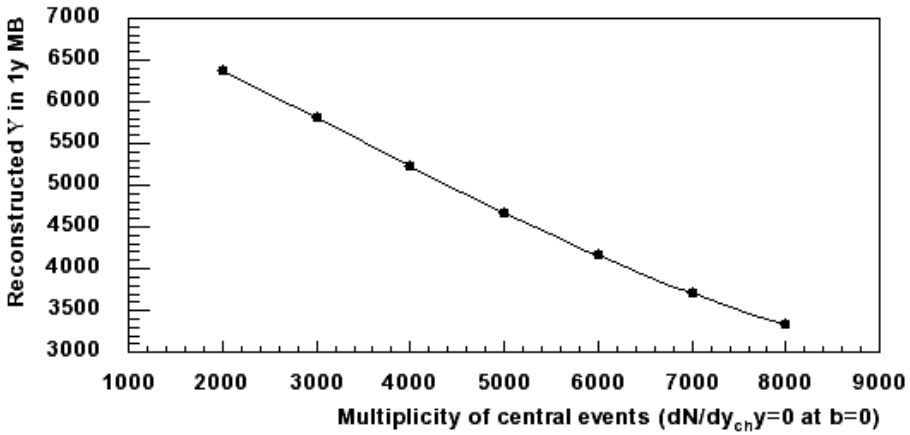
Pion reduction

- pion efficiency at 90 % electron efficiency

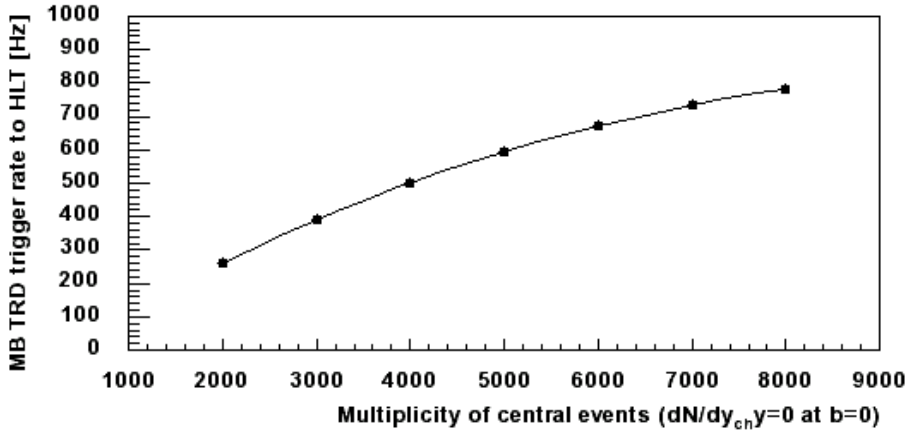


Trigger rate min. bias

- total number of Y collected in one year min. bias data



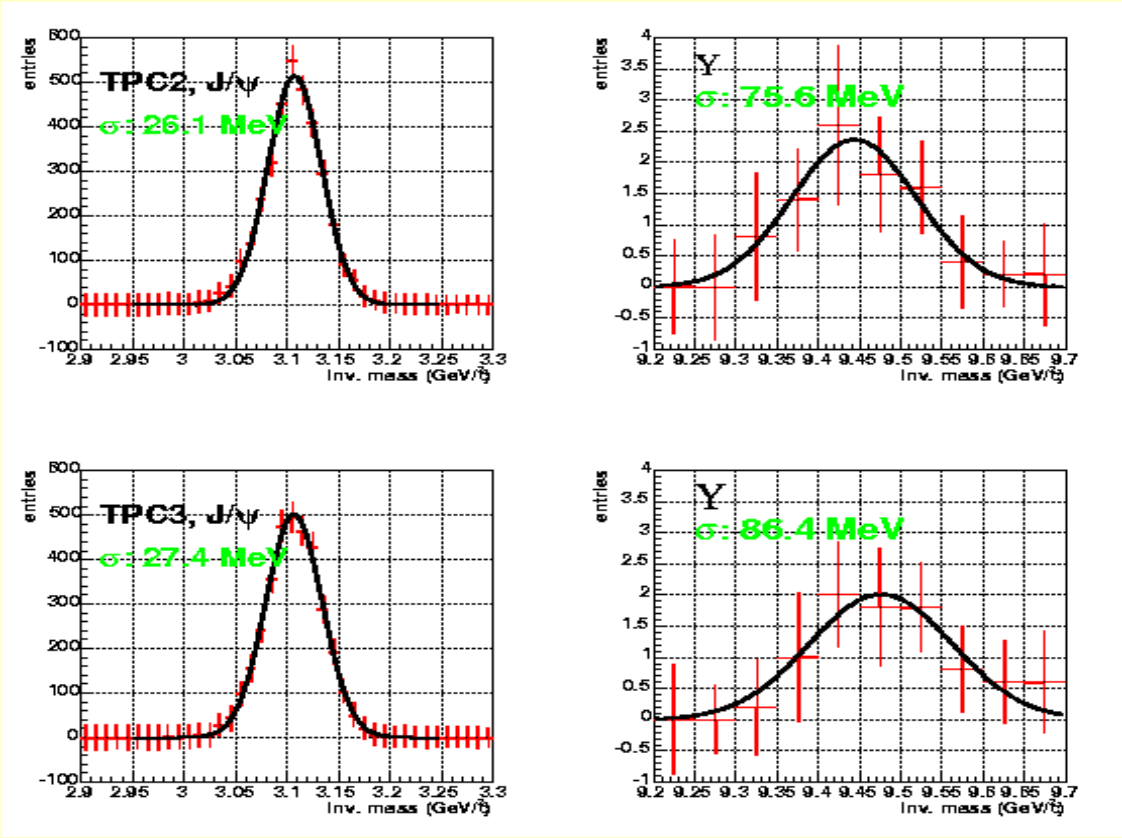
- Online dielectron pair trigger rate
- dominated by misidentified pions



Mass resolution offline J/ψ, Υ

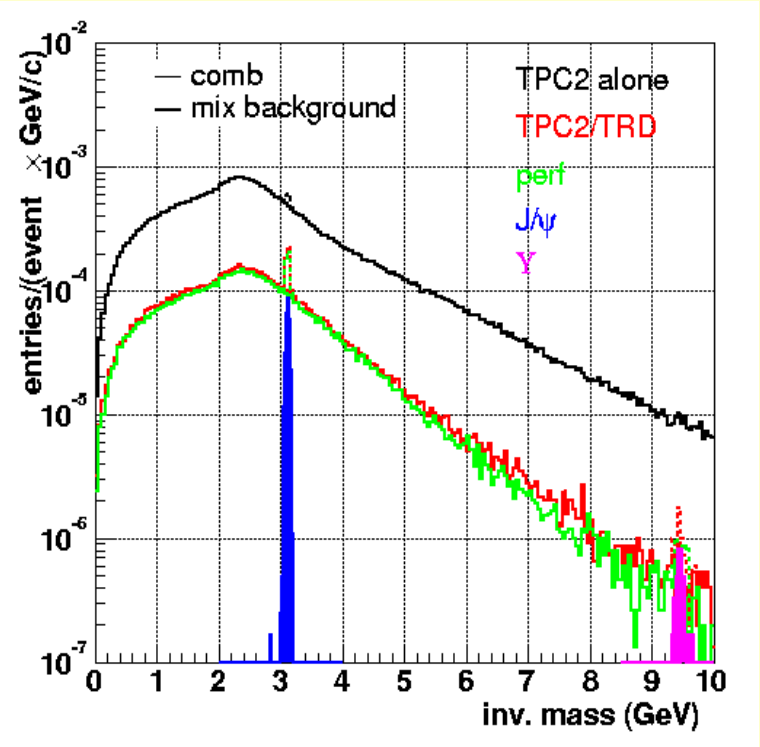
- mass resolution offline:
-TRD, TPC combined
(T.Mahmoud, Heidelberg)

- J/Ψ: σ ~ 27 MeV/c2
- Υ: σ ~ 80 MeV/c2

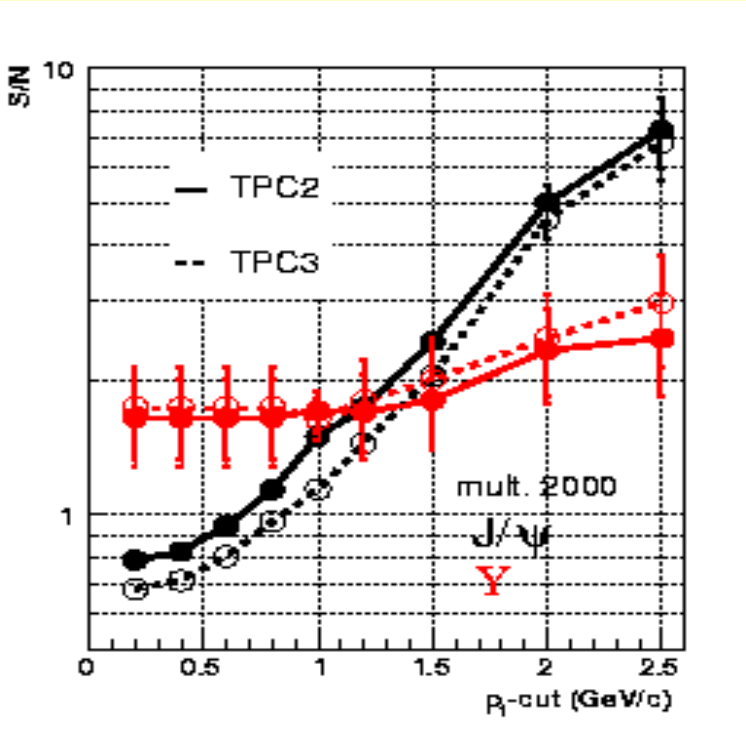


m(Υ)-m(Υ') ~ 563 MeV/c2
--> m(Υ)-m(Υ') ~ 7 σ
m(Υ')-m(Υ") ~ 332 MeV/c2
--> m(Υ')-m(Υ") ~ 4 σ

Mass spectrum

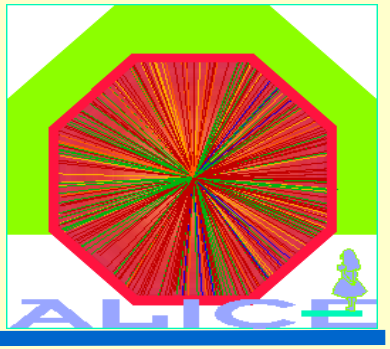


e+e- invariant mass



Signal/noise with pt-cut

Conclusions



- ALICE TRD detector delivers online trigger for electron pt > 2 GeV/c
- Measurement of Y dielectron decays feasible
- Comprehensive measurements in pp, pA and AA needed in order to disentangle the rich and complex issues in quarkonia physics

Υ efficiency multiplicity dependence