How To Make LVL1 Electron Trigger with RICH and EMCal

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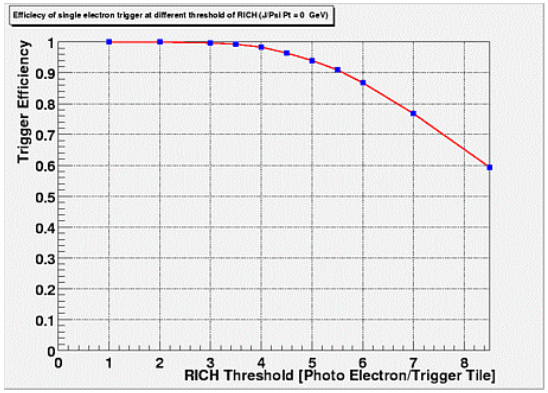
RICH LVL1 Trigger Module Specs

- RICH LVL1 module outputs 256 bits from 4×5 PMT tiles
  - 16 bits per LVL1 board
  - 8 GLINK outputs per arm
  - final prototype (w/o GLINK) made and tested at CNS
    - see *http://phenix.cns.s.u-tokyo.ac.jp/~matumoto/pub/test.html*
- number of bits can be reduced before look-up if needed
  - do we know impact of number of bits on cost / hardware design ?
    - if it is easy enough to handle 128 bits (RICH) + 72 / 100 bits (EMCal) on each arm, why compromise ?
    - trigger performance versus number of bits will be compiled soon

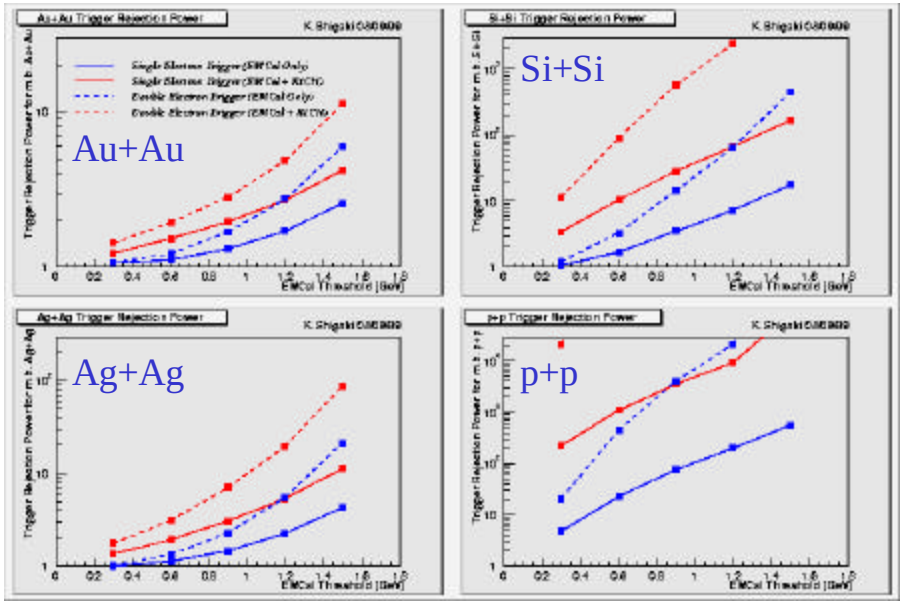
Do We Need RICH Adjacency Check ?

- not really
  - our trigger study has been using non-overlapping tile only
- RICH+EMCal look-up performs well enough without adjacency check
  - ~ 100 % trigger efficiency
    - n_{pe} threshold at ~ 3.5 while $<n_{pe}>$ ~ 10 with CO_2 radiator
  - high rejection power to keep trigger rate within DAQ capability



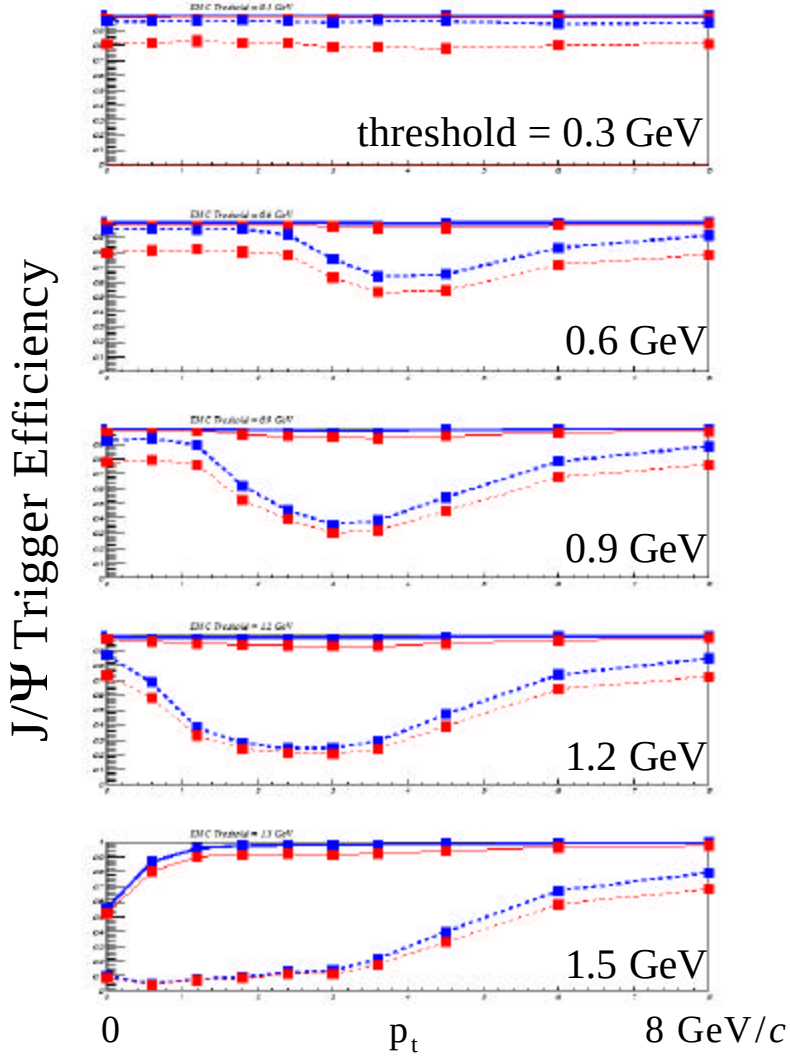
RICH J/Ψ trigger efficiency as a function of threshold on number of photo-electrons per tile

rejection against min.-bias events



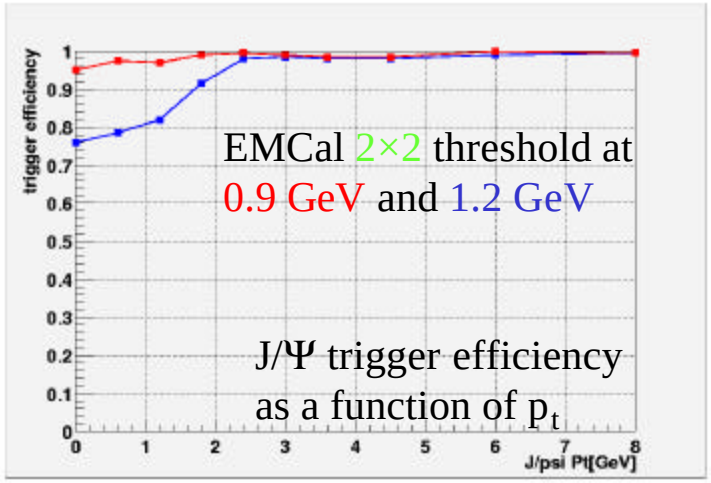
Is EMCal 4×4 Sum Usable ?

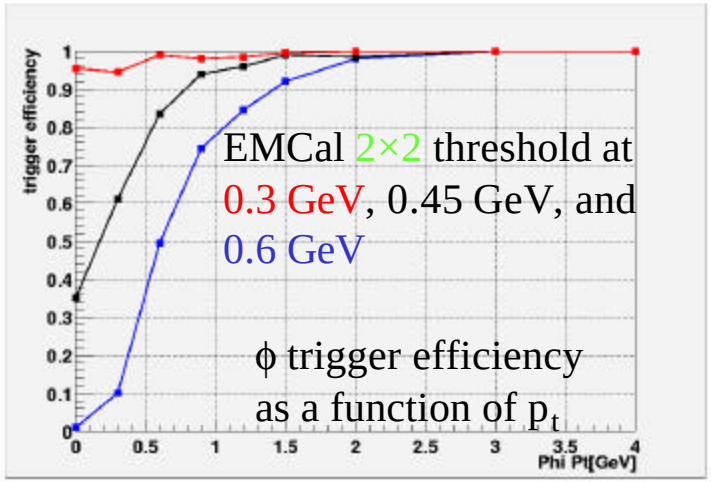
- problem with 4×4 sum
  - threshold needs to be < 1.2 GeV to trigger on J/Ψ
  - hardware lower limit is ~ 5 % of full scale (*ref.* P.Stankus)
    - as high as ~ 1 GeV in A+A and 200 GeV p+p run
- perhaps okay for J/Ψ, but marginal at best
  - will not work in 500 GeV run
- forget about ϕ
  - threshold needs to be < 0.6 GeV



How About Using EMCal 2×2 Sum ?

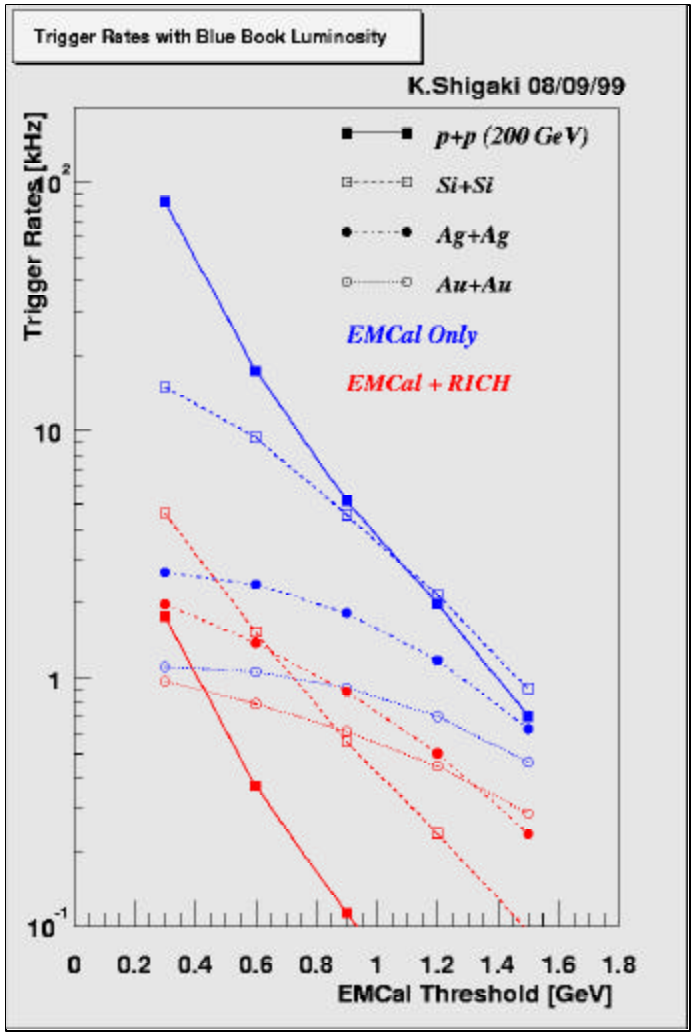
- possibility to use 2×2 sum
  - lower hardware limit by a factor of > 20
  - lower threshold requirement, too, but not by much
    - ~ 0.9 GeV to trigger on J/Ψ
    - ~ 0.3 GeV to trigger on ϕ
  - a promising option
    - trigger rate still within LVL1 DAQ capability





RICH + EMCal 2×2 Sum Trigger Rate

- trigger rate still within LVL1 DAQ capability even with lower threshold than with 4×4 sum
  - 2×2 trigger rate cannot exceed 4×4 trigger rate at same energy threshold
- can we have both options ?
  - preferable if selectable on RICH-EMCal look-up board



electron trigger rate as a function of EMCal cluster energy threshold