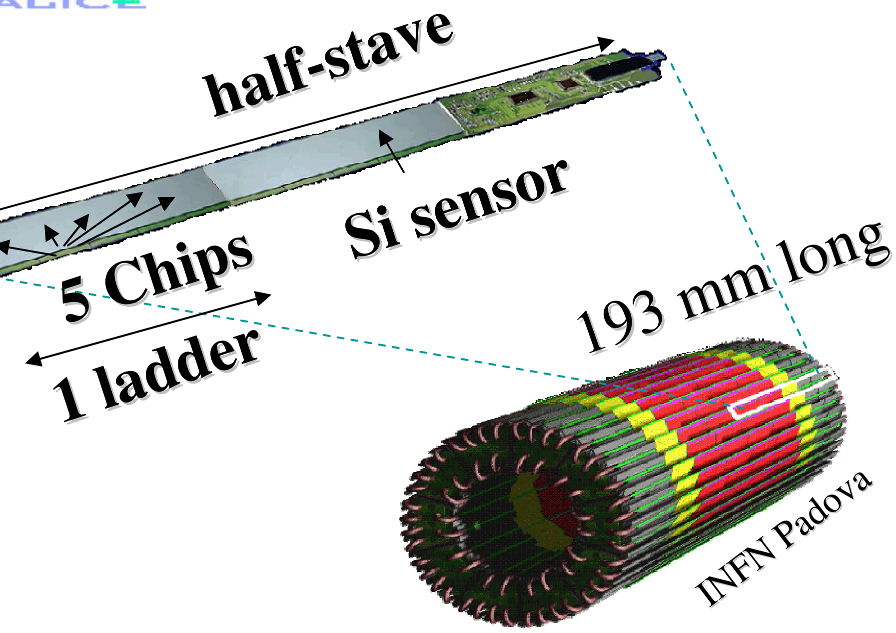
Pixel Fast-OR, Part 1: "Simulation"[1)]

Jan Conrad (CERN)

1) It would be more proper to call it a "(re-)construction"

Fast-OR (FO) for the simple minded



- Basic idea:
  - every pixel read-out chip produces a signal
    if >= 1 pixels fire
  - 1200 chips (400 inner layer, 800 in the outer layer)
    → 1200 (FO) signals
  - 1200 FO signals can be combined to form
    a Pixel FO Trigger Input

Input to CTP

The Pixel Fast-OR: possible applications & their status

Roughly Decreasing Urgency

- Low multiplicity minimum bias trigger in pp
  - **Simulation-study is done (I will concentrate on this study in the present talk)**
- High multiplicity trigger in central region (in pp)
  - simulation-study needs to be done
- "Centrality" trigger in Heavy Ions collisions
  - If possible, then for low multiplicity – simulation-study needs to be done
- Trigger for ultra-peripheral Heavy Ion collisions
  - simulation study needs to be done

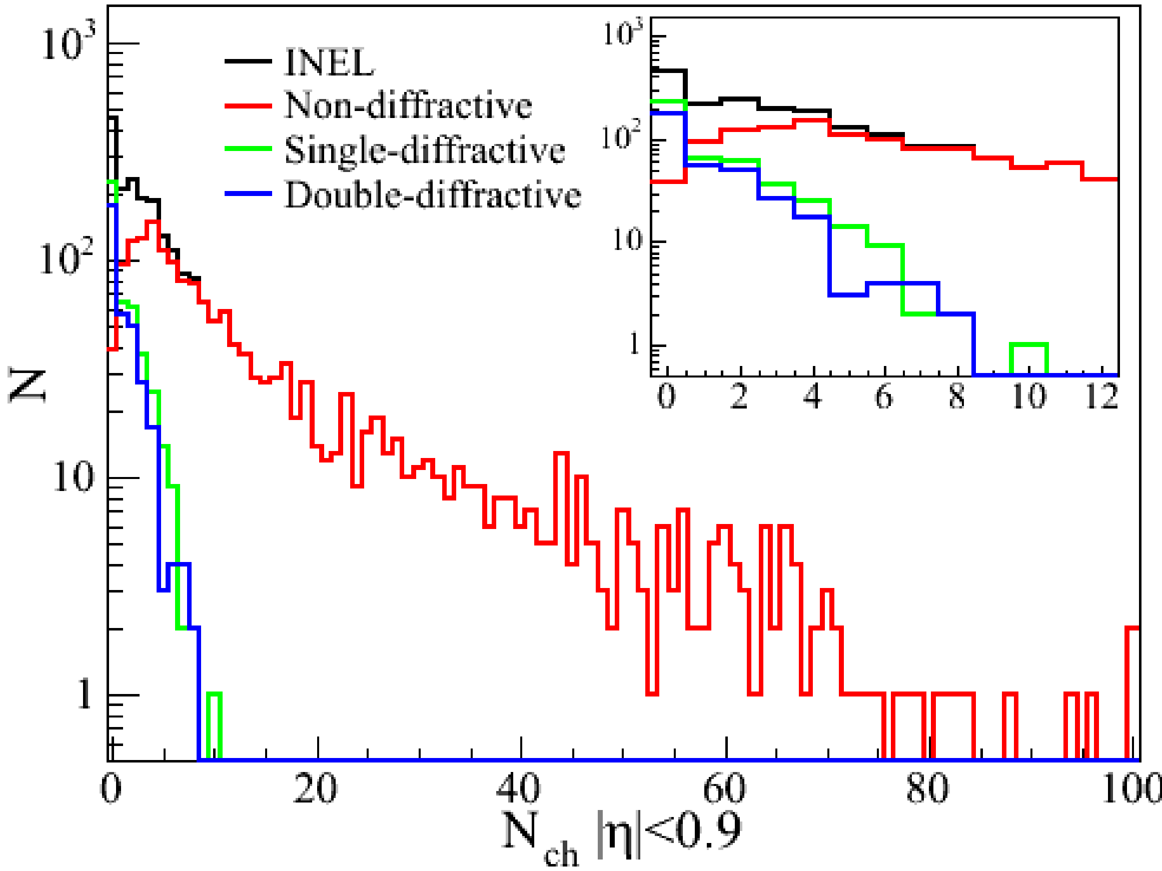
Let me just mention that we have a large amount of data with Fast-OR trigger from the combined ITS beam test in November, 2004

Pixel FO as MB trigger in pp

- <u>The question is:</u>
  - how to combine the 1200 FO signals best to
    - pick up as large fraction as possible of (low multiplicity) proton-proton events (signal)
    - get rid of as large fraction of beam- residual gas/halo events (background) as possible

Signal: the PDC 04 pp data

- Sqrt(s) = 14 TeV
- B = 0.5 T
- ~ 10k events



Background: beam – gas/halo

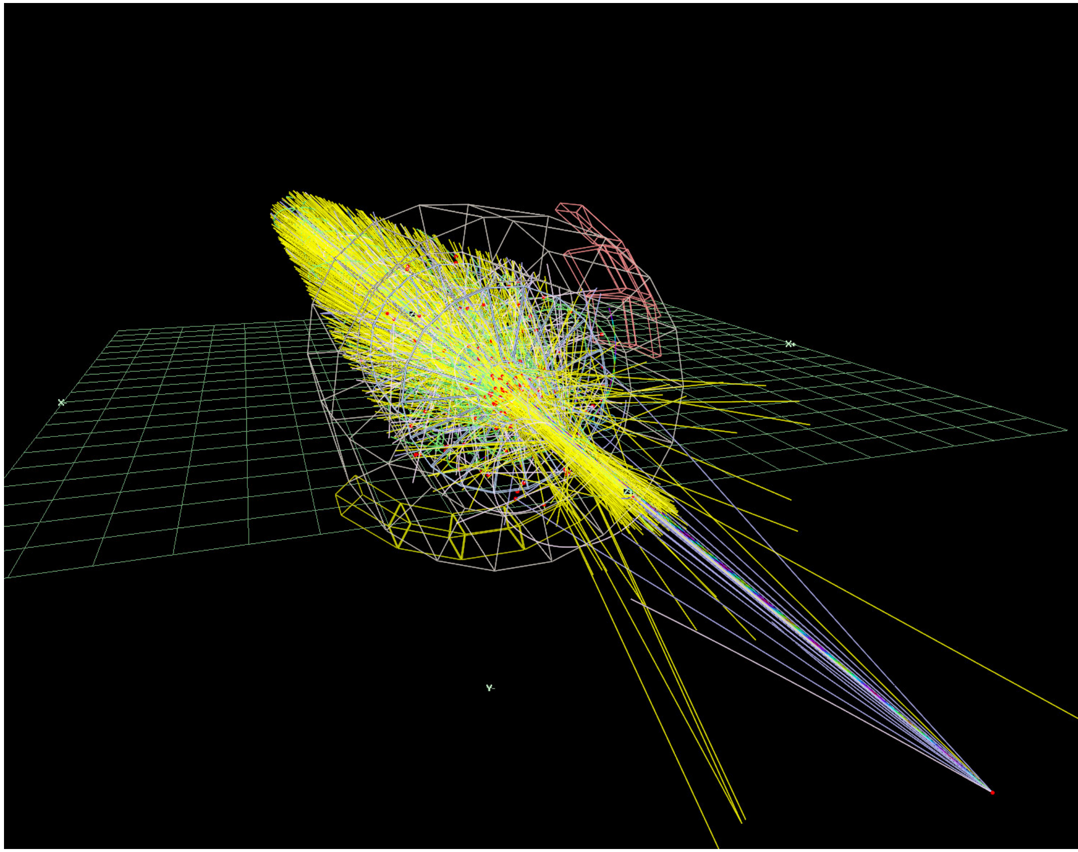
- Simulation: HIJING generates random pz
  beam-gas:

  $-20\ m < z_{vertex} < 20\ m$

  beam-halo:
  $abs(z_{vertex}) > 20\ m$
  (A. Morsch)

- p-O,p-H,p-He, p-C generated
- Results presented are for p-O
- no significant difference found for for the other gases
- ~ 5k events

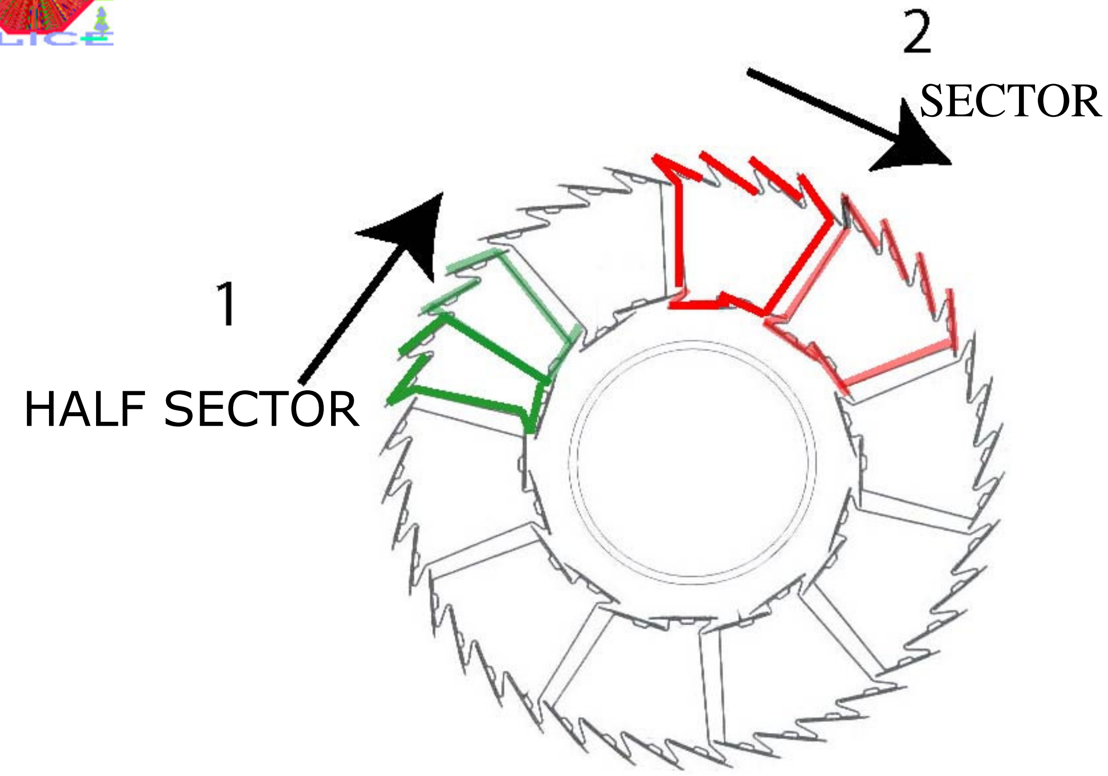
Matevz Tadel

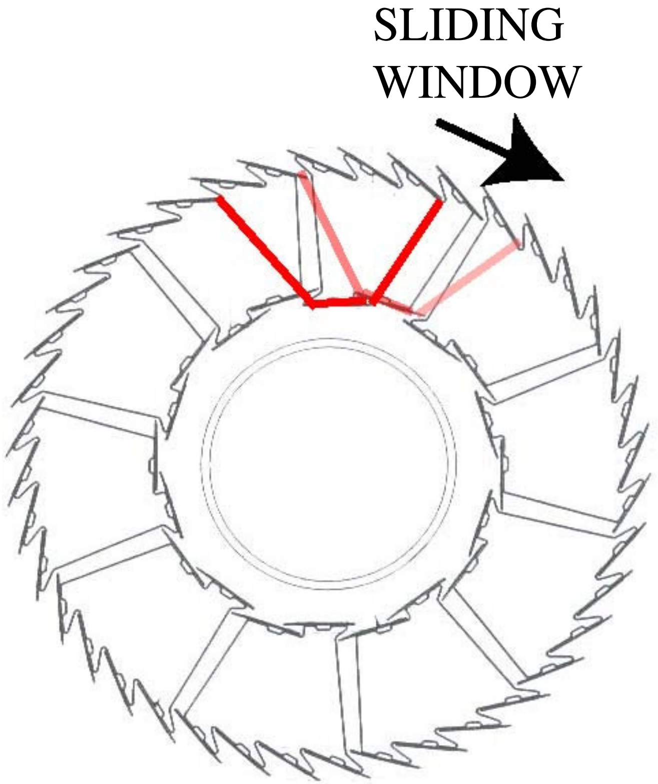


FO: considered algorithms

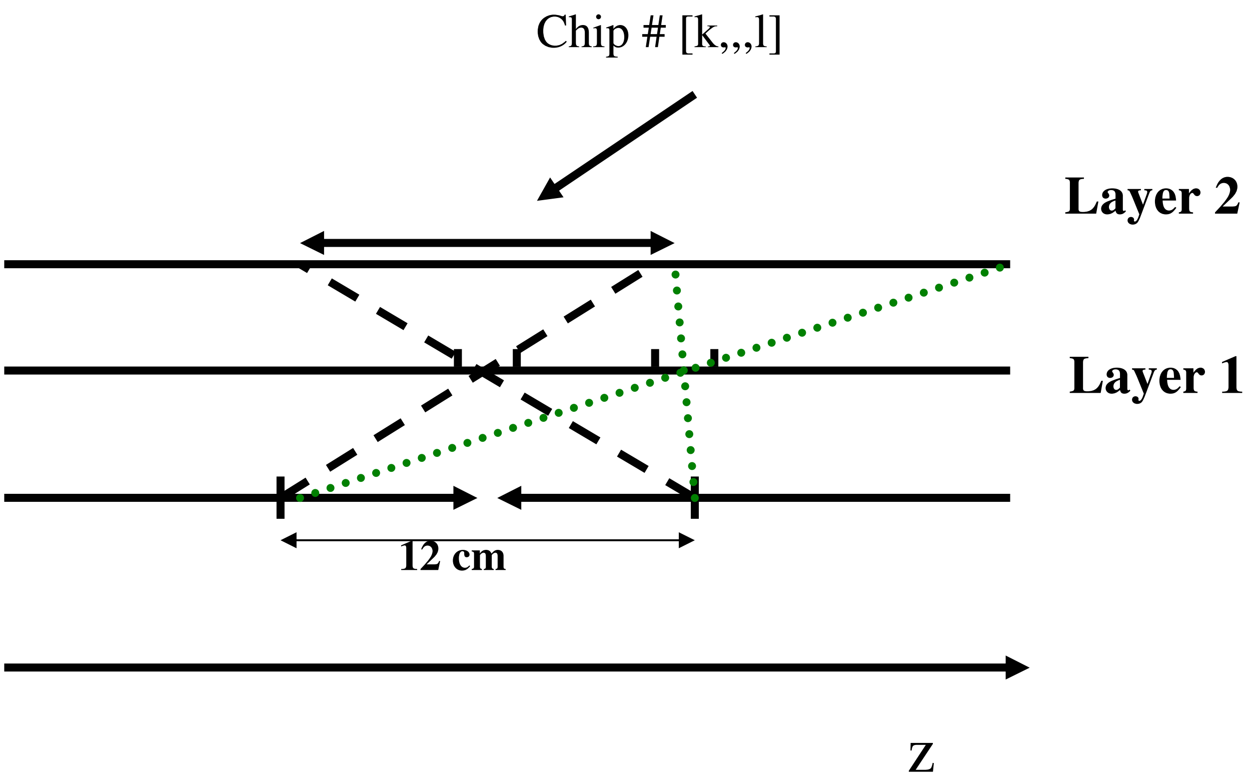
- OR of all incoming FO signals (simplest, see TDR)
  → **GLOBAL OR**
- Require one FO signal in each layer of the SPD
  → **LAYER COINC**
- Require correlation in φ (see next slides)
  → **SECTOR COINC.**
  → **HALF SECTOR COINC.**
  → **SLIDING WINDOW (2 different)**
- Require correlation in z (see next slides)
  → **VERTEX (3 different)**

φ-correlation triggers





z- correlation trigger



z-correlation then typically combined with φ-correlation

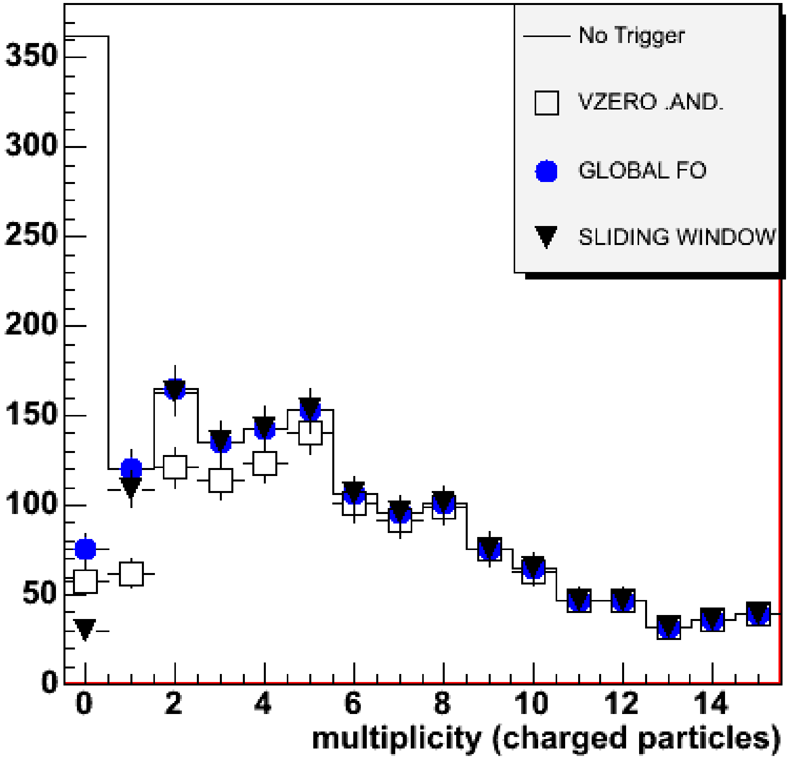
Results: efficiencies p-p

TRIGGER	Inelastic	Single Diffractive	Double Diffractive	Non Diffractive
GLOBAL FAST OR	**0.88**	**0.60**	**0.70**	**0.99**
LAYER COINC.	**0.86**	0.57	0.62	**0.99**
SECTOR	**0.86**	0.56	0.60	**0.98**
HALF SECTOR	**0.85**	0.55	0.59	**0.98**
SLIDING WINDOW	**0.86**	0.56	0.61	**0.98**
VERTEX (SW)	**0.85**	0.55	0.58	**0.98**

High efficiency for inelastic events, close to 100 % for non-diffractive part.

Low multiplicities

$|\eta| < 1.5$



TRIGGER	Efficiency $1 <= n < = 3$
VZERO.AND	0.71
VZERO.OR	0.99
GLOBAL FO	**1.**
LAYER COINC.	**0.98**
SECTOR	**0.96**
HALFSECTOR	**0.95**
SLIDING WINDOW	**0.97**
VERTEX	**0.94**

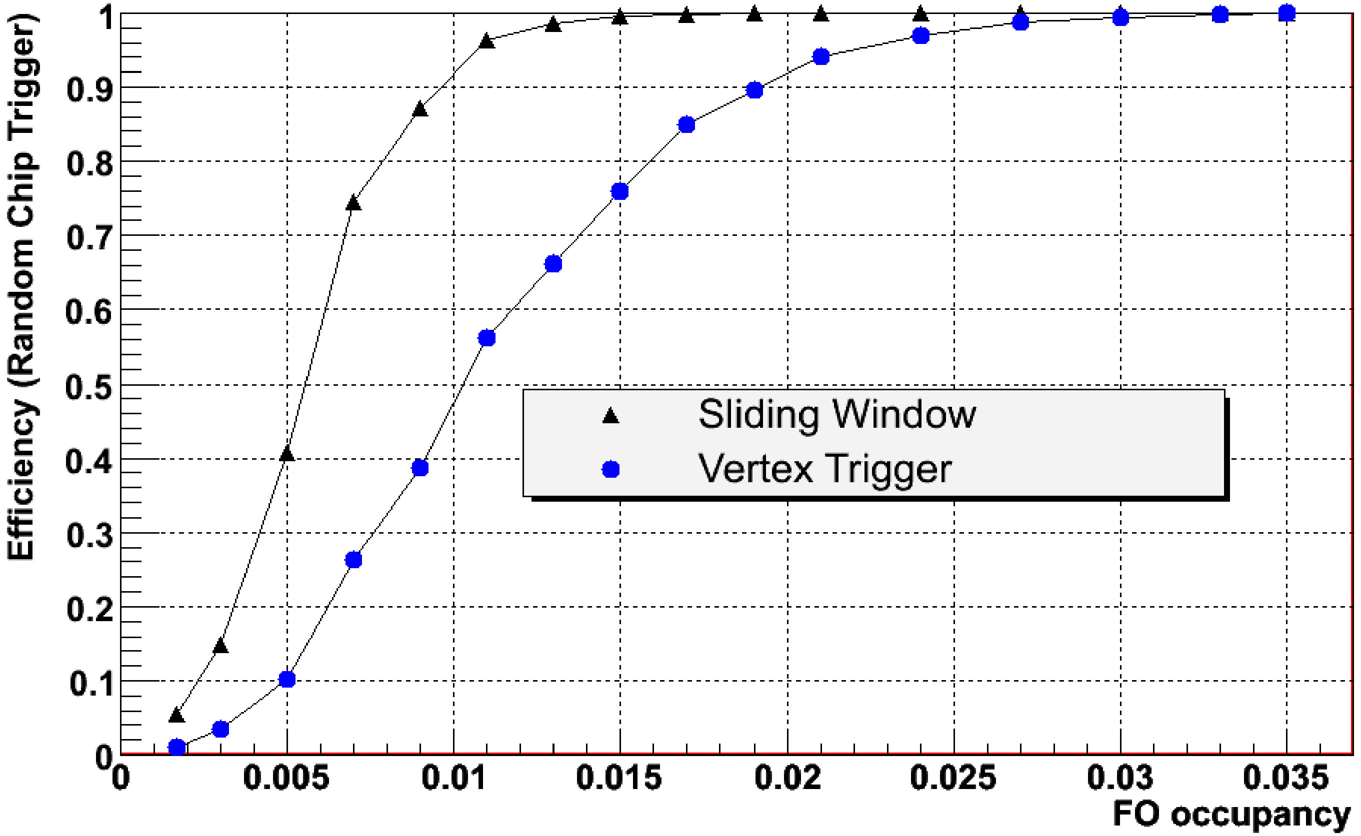
Very efficient for low multiplicity events

Efficiencies: background

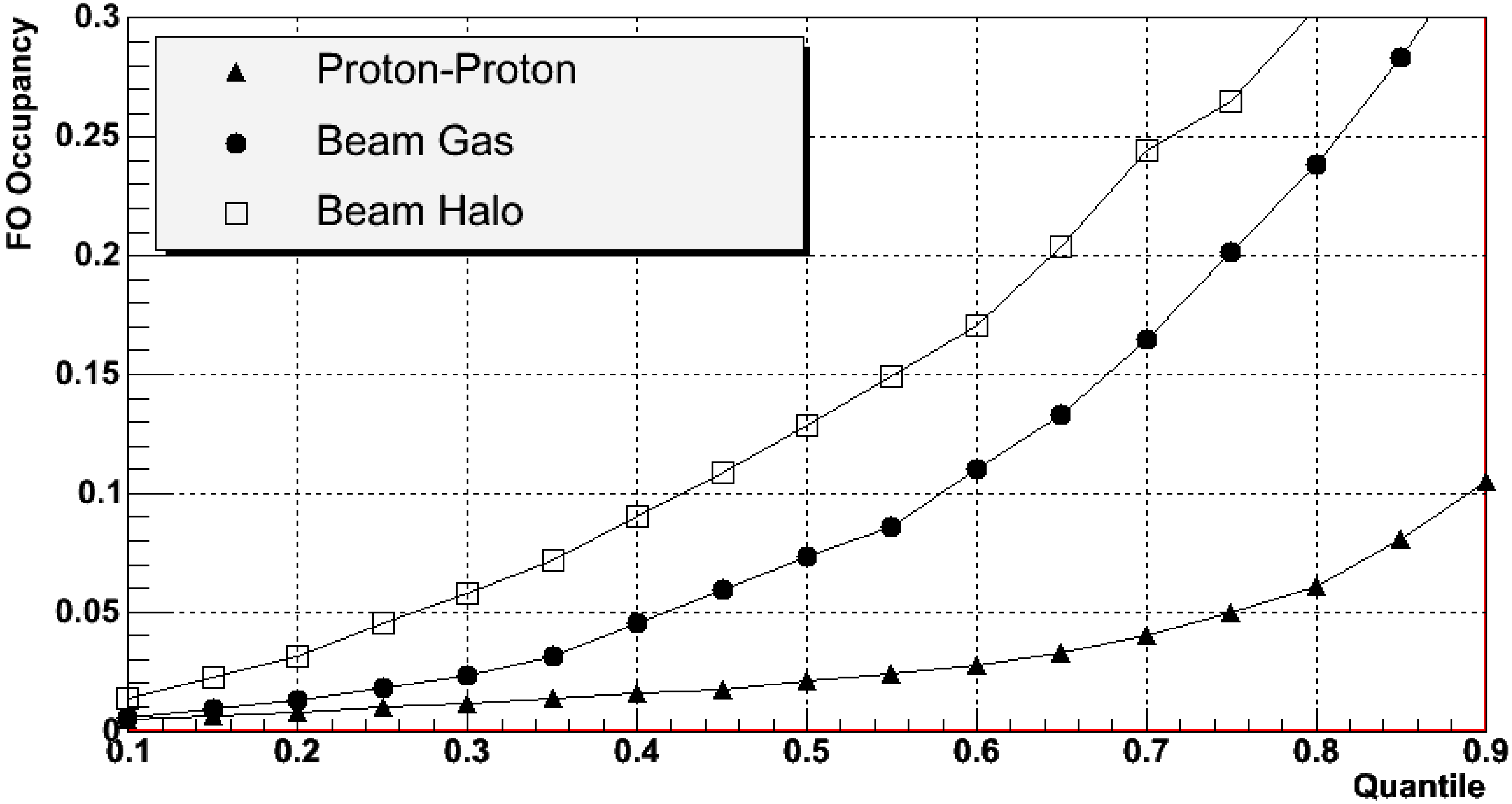
TRIGGER	Efficiency beam gas	Efficiency beam halo
GLOBAL FO	**0.46**	**0.41**
LAYER COINC	0.42	0.39
SECTOR	0.40	0.38
HALFSECTOR	0.39	0.38
SLIDING WINDOW	0.41	0.39
VERTEX	**0.40**	**0.38**

…… efficient to pick up beam-gas background ….

Random FO signals



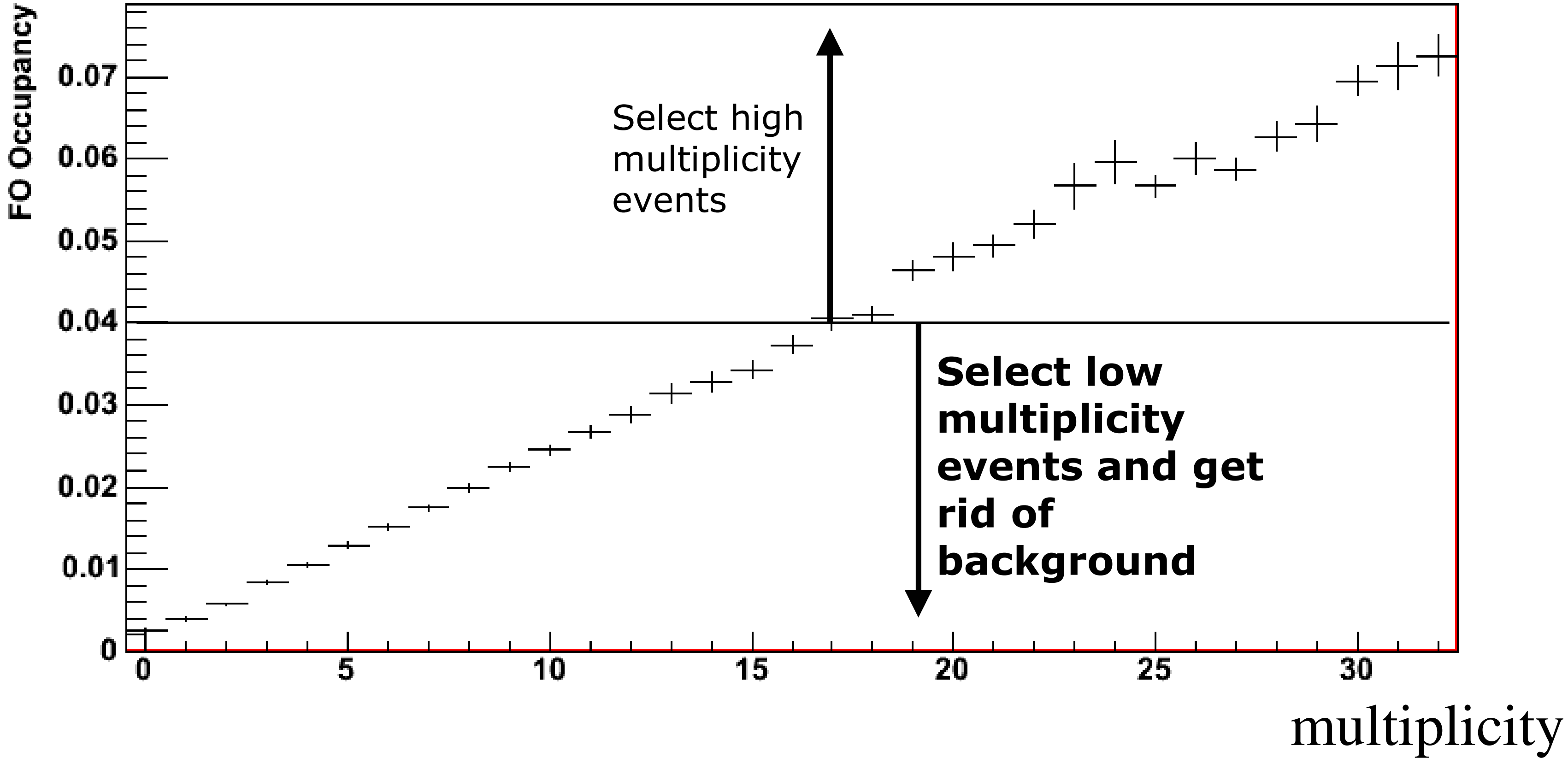
Upper cut on FO occupancy ?



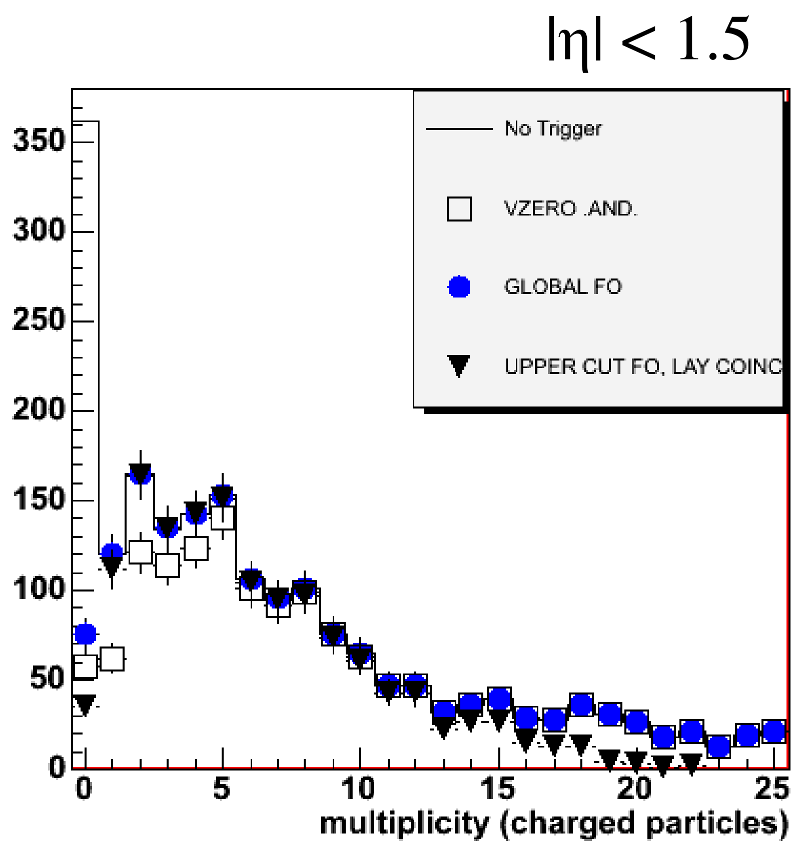
Median FO occupancy

Beam gas (Beam Halo) : 0.075 (0.12)

Multiplicity vs. FO occupancy in pp



$n_{FO} < 50$



TRIGGER	Efficiency BeamGas	Efficiency Beam Halo
GLOBAL FAST OR	0.46	0.41
Layer COINC	0.42	0.39
LAYER COINC UPPER CUT	**0.07**	**0.03**

TRIGGER	Efficiency $1 <= n <= 3$
LAY/UPPER CUT	**0.98**

ok if in or with VZERO.AND !!!!

But we have better ways to get rid of the beam background

FO in combination with VZERO

- The Pixel FO was part of a more general study to evaluate possible MB triggers for proton-proton running, in particular combinations with the VZERO trigger

- **J.C, G. Contreras, C. Jørgensen,**
  ALICE-INT-2005-025 and PPR VII, ch. 6.1
  - … you will find all I presented today and more …

http://agenda.cern.ch/fullAgenda.php?ida=a053593 (pp meeting Juli)

http://agenda.cern.ch/fullAgenda.php?ida=a056134 (pp meeting Oct)

- Here only some examples from PPR ……

MB triggers as discussed in PPR

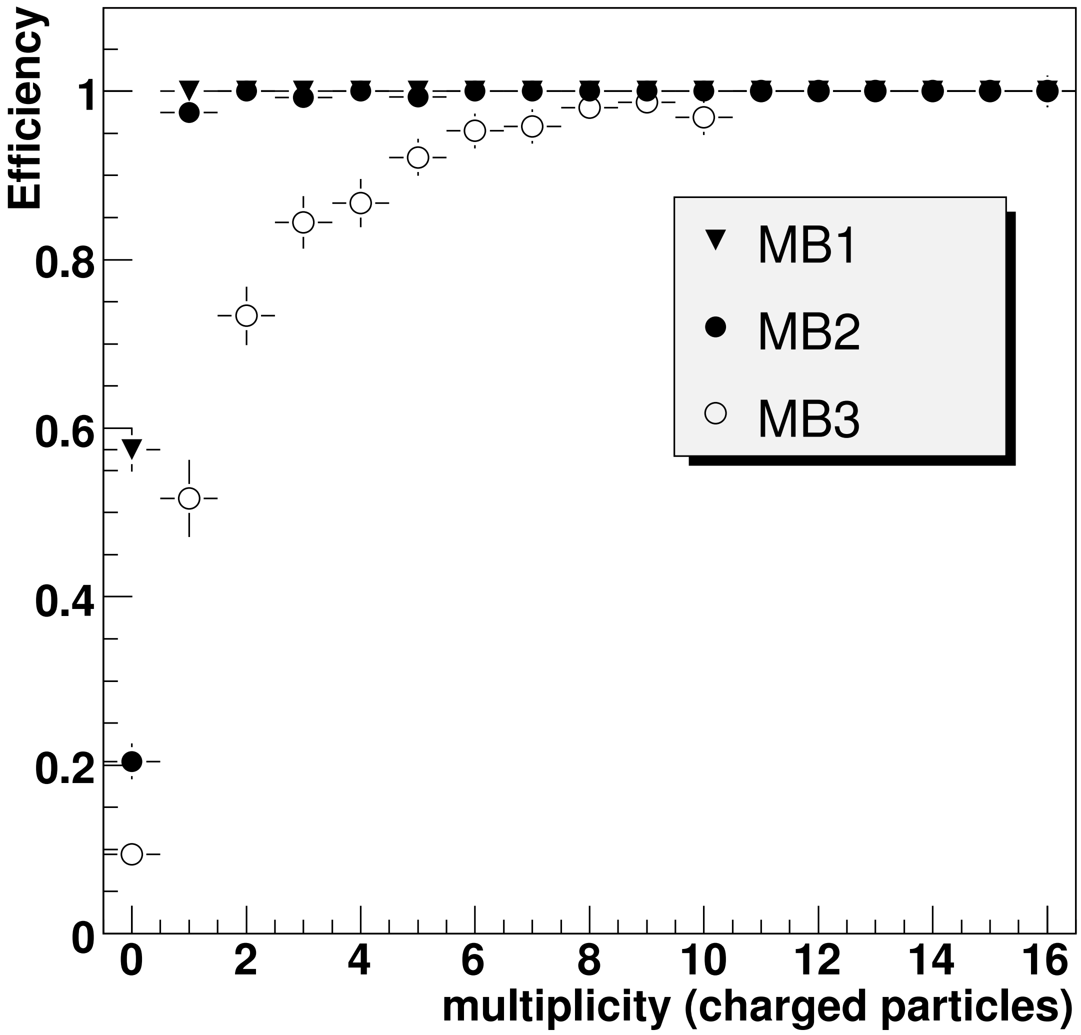
- **MB1: (GLOB.FO) or (VZERO.OR) and (notBG)**
  - •preferred, but careful with 4 bunch crossing integration of GLOB.FO
  - •(worst for background rejection)
- **MB2: (GLOB.FO) and (VZERO.OR) and (notBG)**
  - •no problem anymore regarding the 4
  - •bunch crossing integration
- **MB3: (GLOB.FO) and (VZERO.AND) and (notBG)**
  - •The most stringent, best for background
  - •rejection

Process	MB1	MB2	MB3
Non diffractive	1	0.99	0.97
Single diffractive	0.74	0.60	0.38
Double diffractive	0.88	0.69	0.46
All inelastic	0.94	0.88	0.79
Beam Gas	0.01	0.02	0.00*
Beam Halo	0.02	0.00 *	0.00*

Regarding bunch crossing id:

see Karels talk on October p-p meeting

Fast-OR as MB trigger in pp III



Short look at rates (including MB 1 trigger)

$L_0 = 3 \cdot 10^{30}$

Source	pp running (25 ns) Rate [kHz]	pp running (75 ns) Rate [kHz]	Pilot runs (156 bunch) Rate [kHz]
Proton-proton	200 **(188)**	200 **(188)**	10 **(9.4)**
beam gas	5 **(0.4)**	1 **(0.08)**	0.05 **(4e-3)**
beam halo	100 **(2.3)**	17 **(0.4)**	**1 (0.023)**

Assumptions (conservative, I think):

$I_{pilot}/I_{nominal} = 0.02$, $I_{75ns}/I_{nominal} = 0.3$, $R_{beamgas,nom} = 120$ Hz/m

$L_{pilot}/L_{nominal} = 0.05$, $L_{nominal} = L_{75ns}$ $R_{beam\ halo,nom}$ see figure slide 22,

$N_{pilot,75ns}/N_{nominal} = 1/2$

Conclusions part 1

- The Fast-OR as minimum bias trigger in proton proton collisions has been studied
- The Fast-OR has good efficiency for inelastic events especially at low multiplicity
- Correlation triggers in (z,φ) do not help to get rid of background → go for an OR of all Fast-OR channels and combine with triggers which can veto against background
- Simulation studies for the other possible applications need to be done

Ultra peripheral collisions

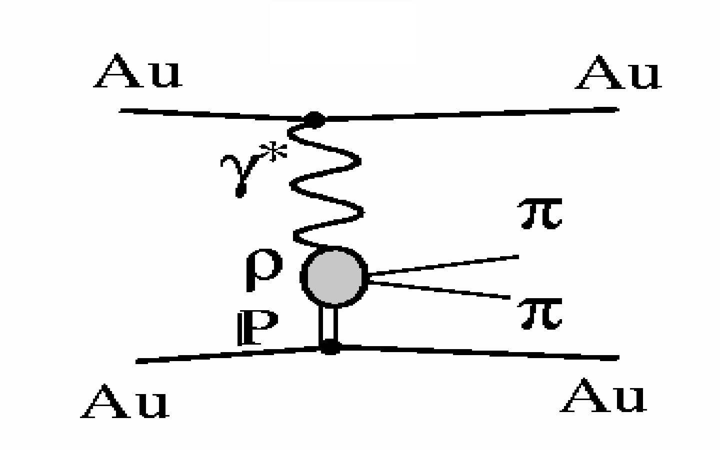
- <u>Signal:</u>
  - Light vector mesons
  - Heavy vector mesons (Quarkonia: J/Ψ,Upsilon)
  - γγ
  - Y-parton
  - → **need to be interfaced to AliROOT (NEW: γγ exists)**
- <u>Backgrounds:</u>
  - two photon interactions
  - peripheral A-A
  - Cosmic muons (negligible for SPD)
  - γA- incoherent interactions
- <u>Possible trigger, which could be examined:</u>
  - (2 < nFO < 8) and not.VZERO ?
  - Topological triggers (require back to back tracks in transverse plane)
  -

For more information on physics and generators: Joakim Nystrand (Bergen)

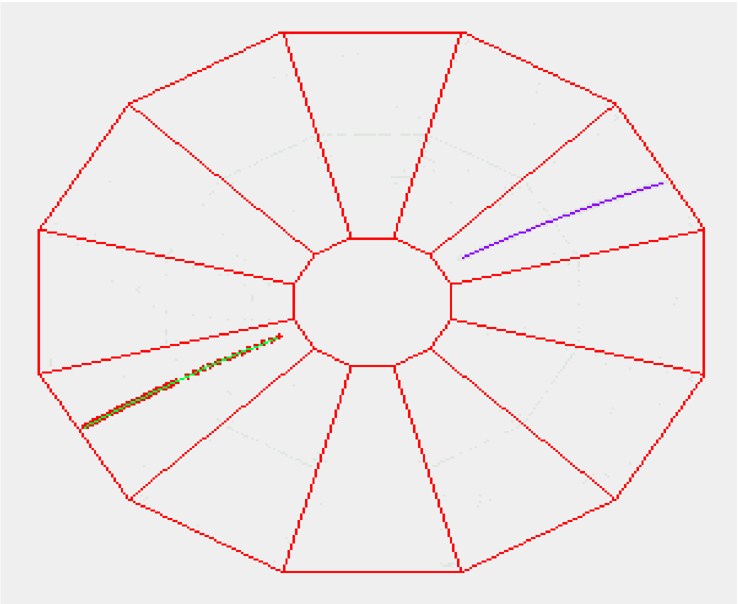
Trigger for ultraperipheral HI

STAR: Low multiplicity and zero energy
t Zero Degree Calorimeter (ZDC)

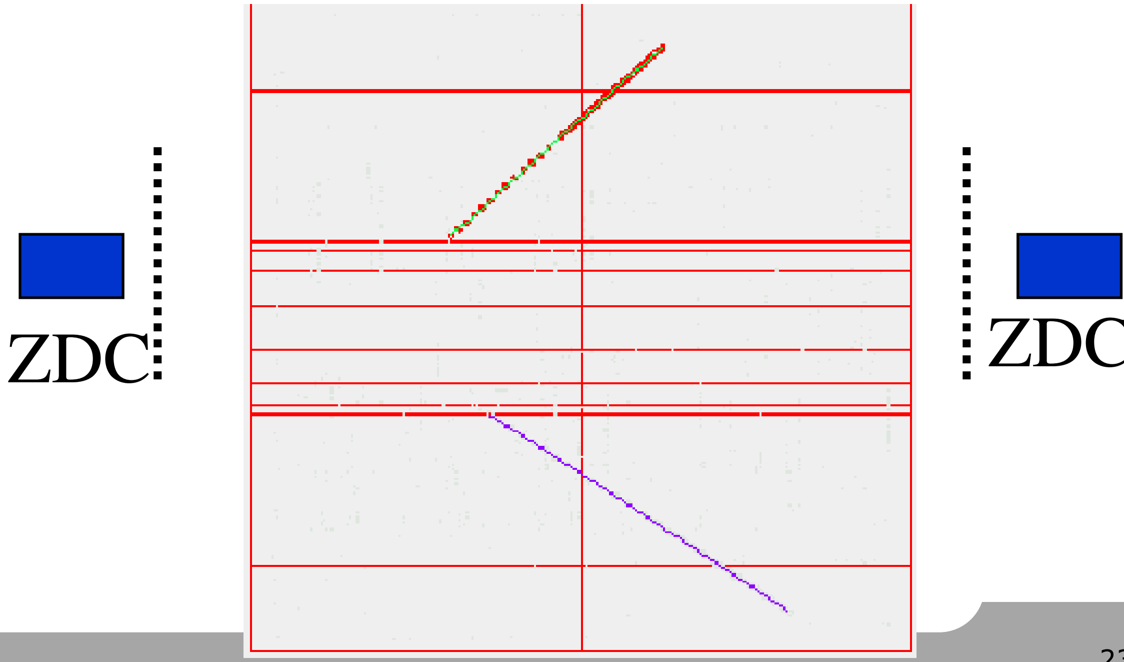
→ Light vector meson production



End view



Side view



Fast-OR: centrality trigger

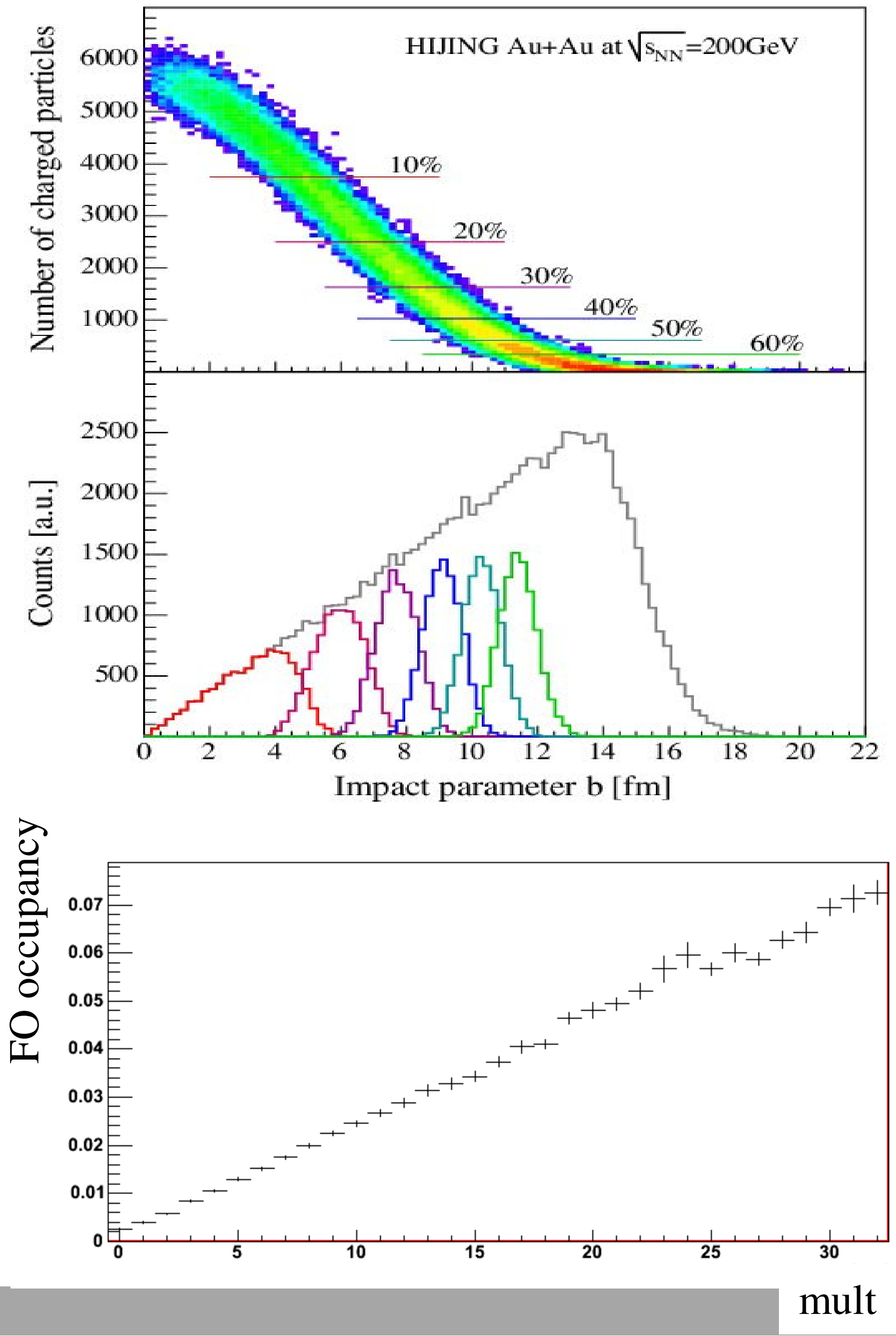
<u>High multiplicity trigger in central region</u>

•Make cut in FO, see if you can select different impact parameters

→ For high multiplicities would need
→ a "multiplicity trigger" ?

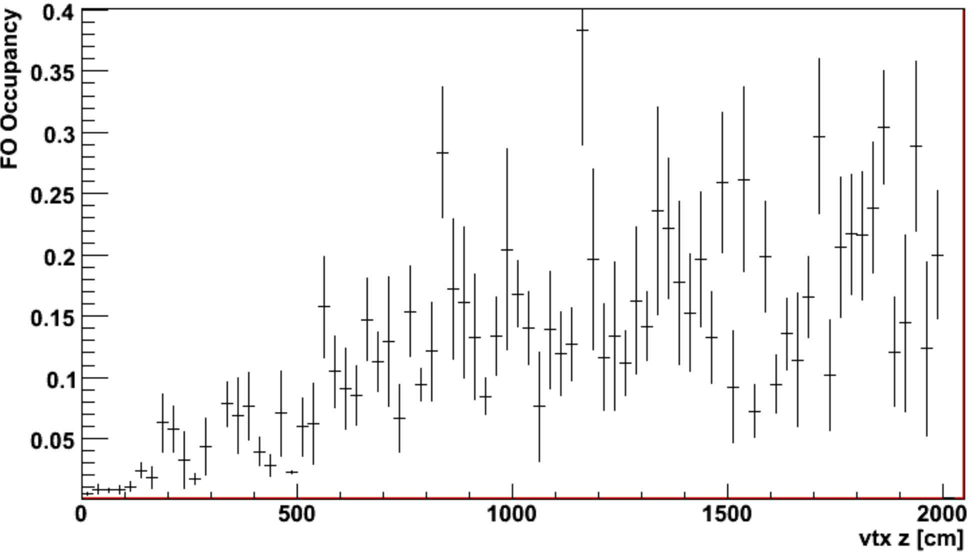
→ but can help at lower
→ multiplicities

→
→ Same type of optimisation as in pp,
→ but has to be redone:
→ - new backgrounds ?

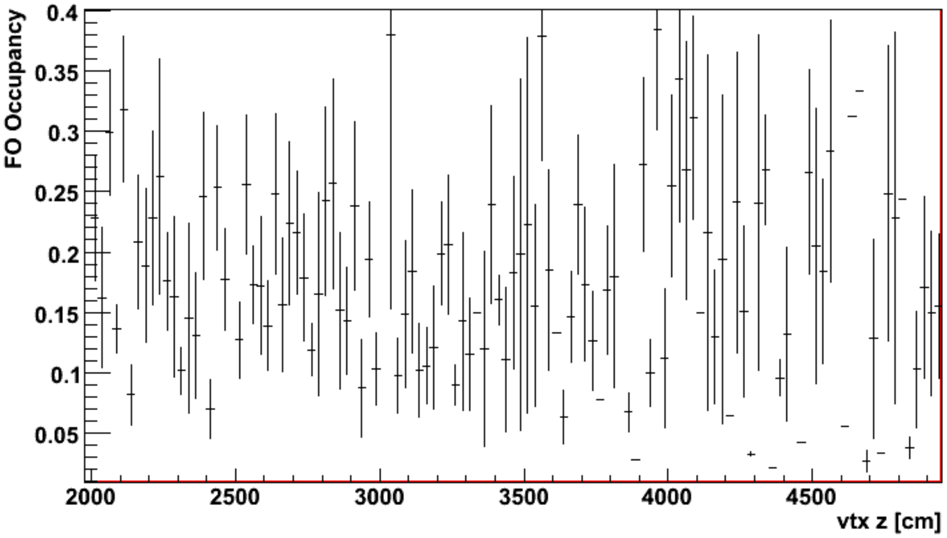


C. Jørgensen

Vertex dependence of FO occupancy

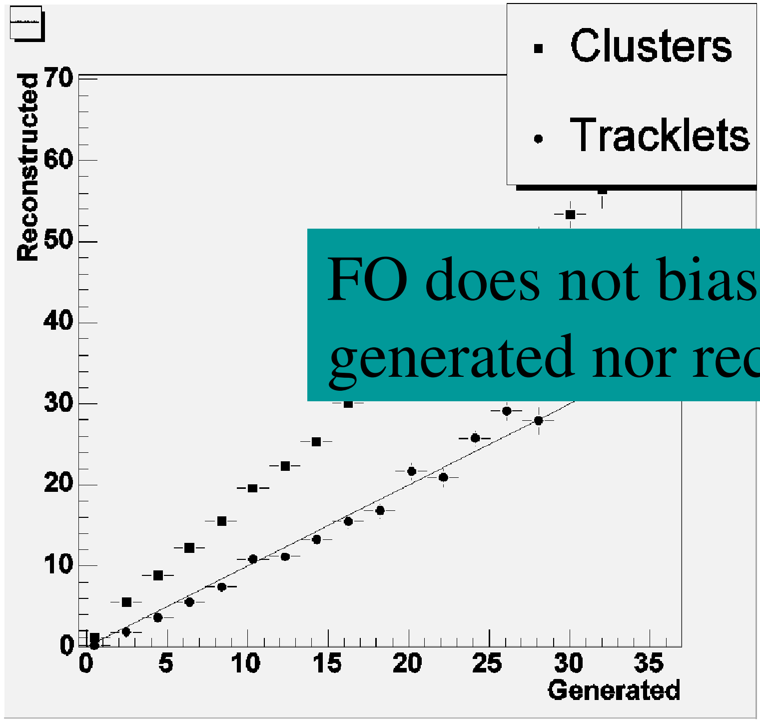


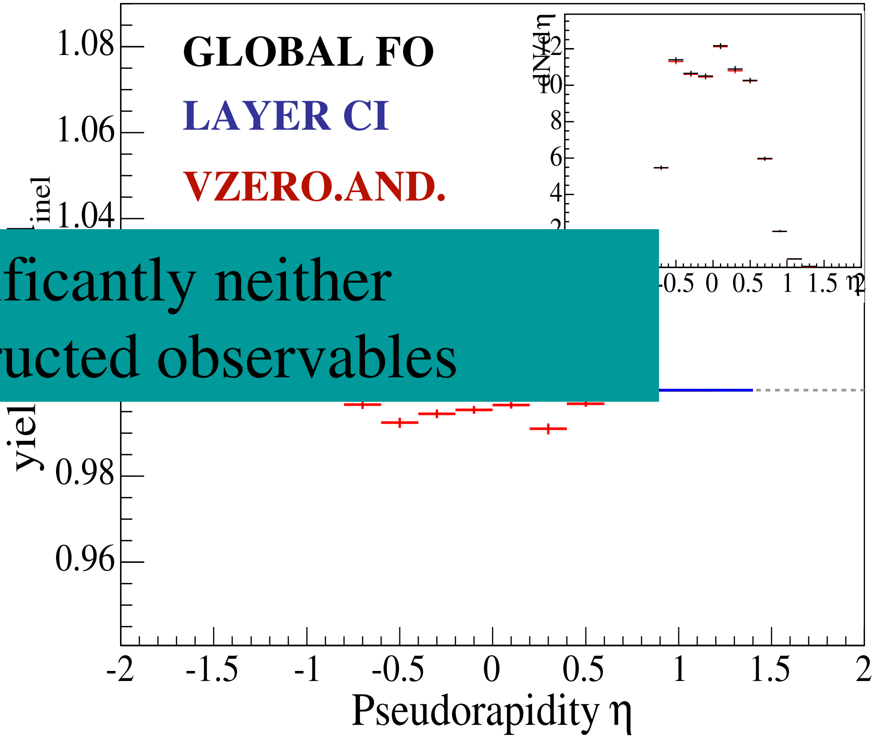
beam gas



beam halo

Interlude 1: trigger bias in multiplicity reconstruction ?





FO does not bias significantly neither generated nor reconstructed observables