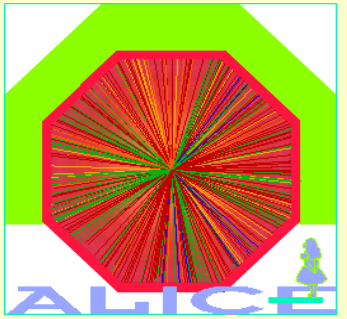
Central Diffraction in ALICE



- ALICE detector
- Selection of central diffractive single/double gap events
- Compare single/double gap events to non-diffractive events
- Analysis of multiplicity, P_T, η-distribution
- Analysis of $f_0(980)$ and $f_2(1270)$ production
- Prospects of dedicated double gap trigger
- Conclusions, outlook

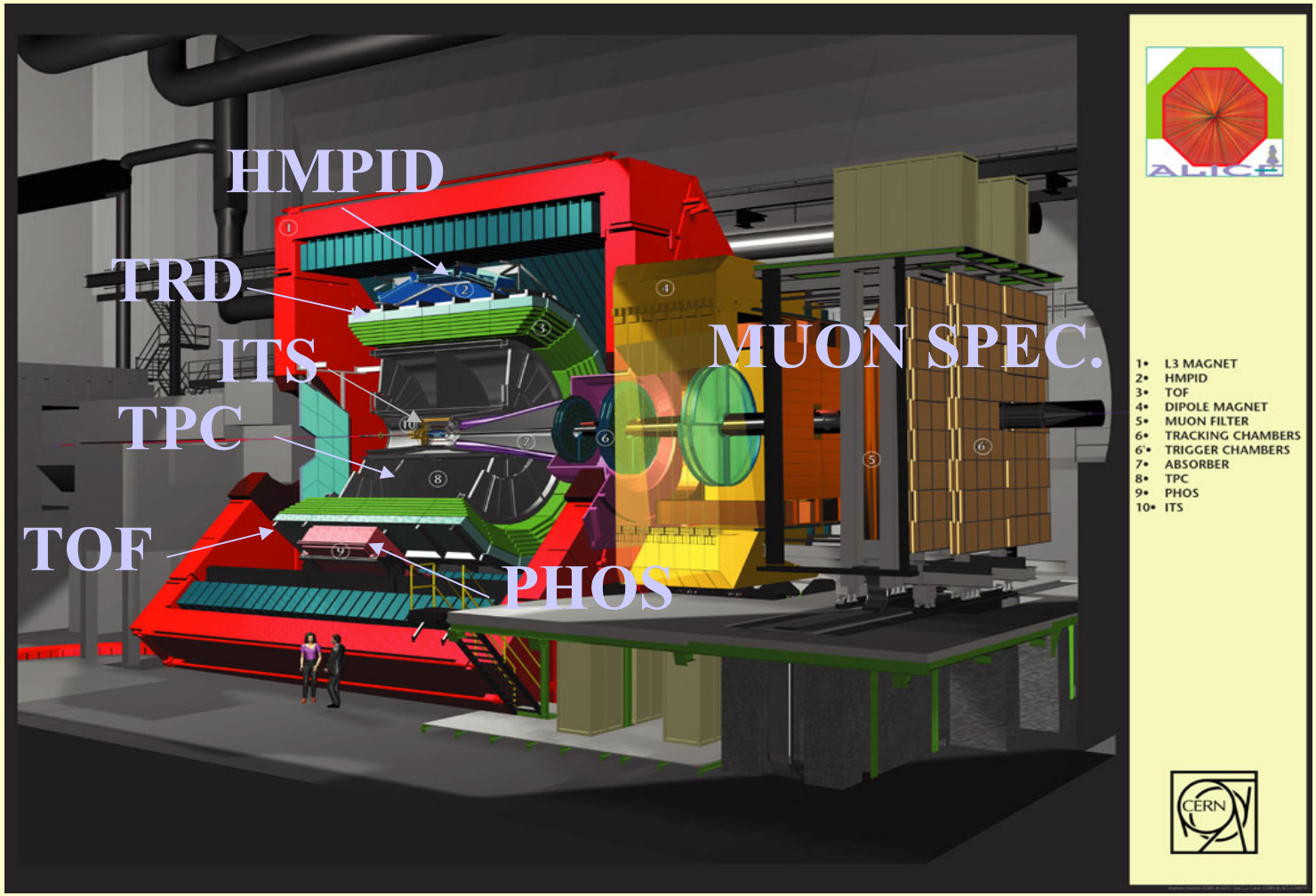
The ALICE experiment

Acceptance central barrel

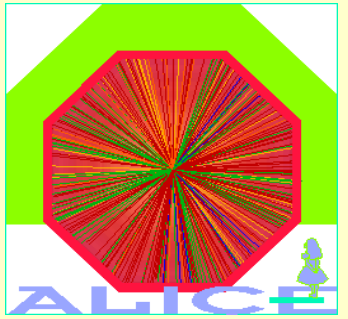
$-0.9 < \eta < 0.9$

Acceptance muon spectr.

$-2.5 < \eta < -4.$



ALICE pseudorapidity acceptance

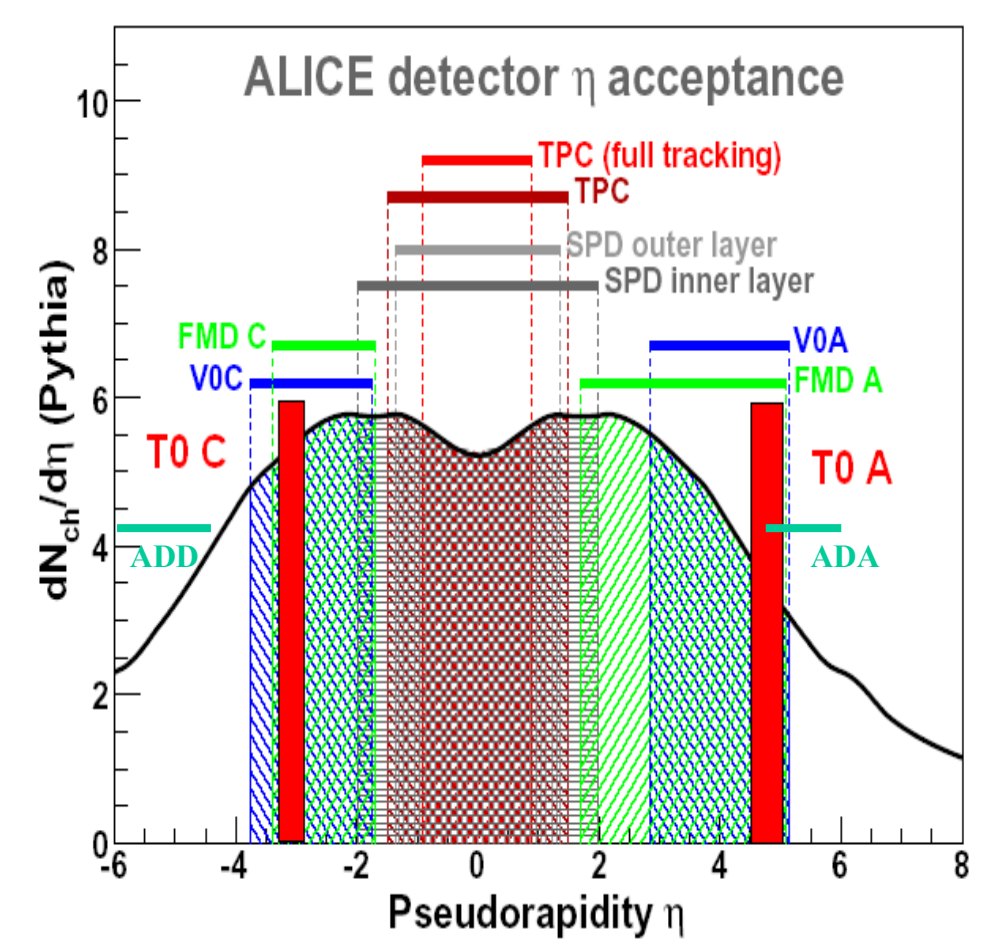


→ *additional forward detectors*
(no particle identification)
$1 < \eta < 5$
$-4 < \eta < -1$
→ *definition of gaps* η_+, η_-

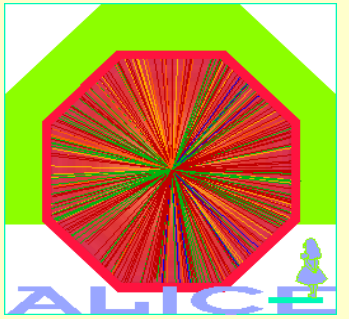
p-p luminosity L = $5 \times 10^{30} cm^{-2} s^{-1}$:
→ reduced prob. overlapping events

diffractive L0 trigger (hardware):
Pixel or TOF mult (central barrel)
gap η_+*:* $3 < \eta < 5 \rightarrow \Delta\eta \sim 0.5$
gap η_-*:* $-2 < \eta < -4 \rightarrow \Delta\eta \sim 0.5$

high level trigger (software):
$-3.7 < \eta < 5$
→ *improved including ADA, ADD*
→ *see talk by Daniel Tapia Takaki*



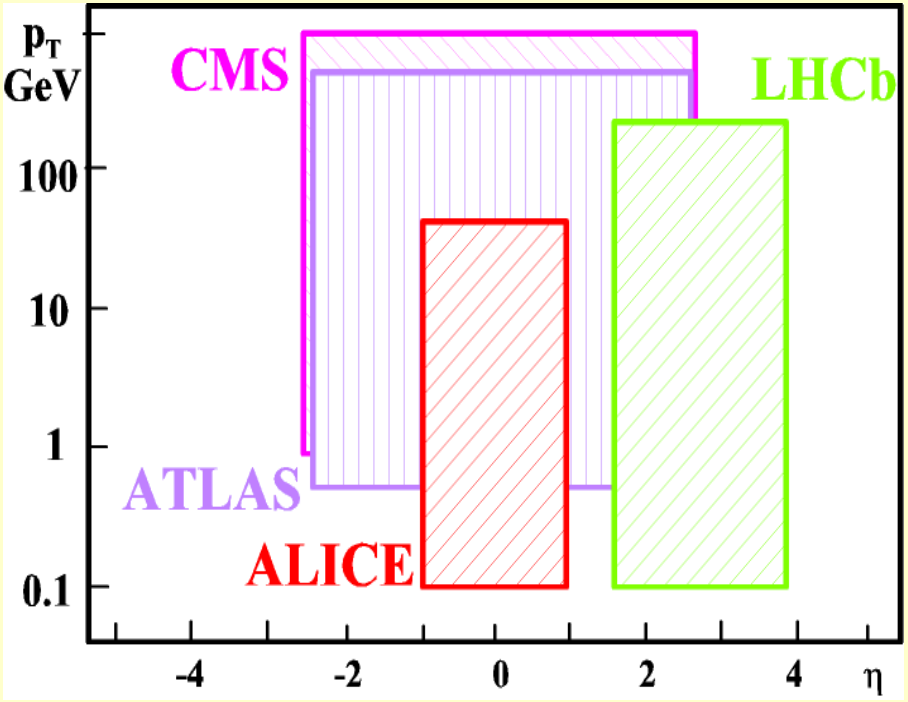
ALICE central barrel comparison to other LHC detectors



low magnetic field

	Magn. field (T)	P_T cutoff GeV/c	Material x/x0 (%)
ALICE	**0.2-0.5**	**0.1-0.25**	**7**
ATLAS	**2.0**	**0.5 (0.08)**	**20**
CMS	**4.0**	**0.75 (0.2)**	**30**
LHCb	**4Tm**	**0.1**	**3.2**

η –pt acceptance

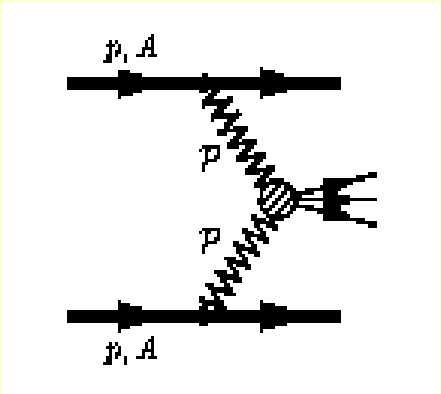


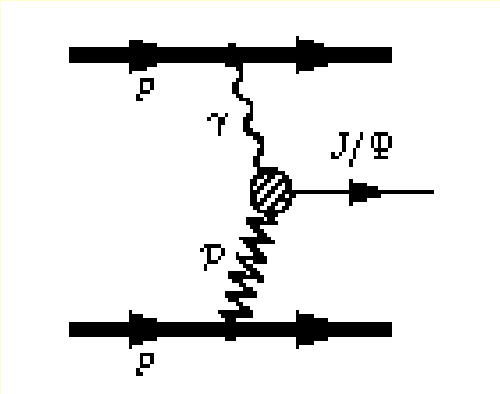
→ *low p_T trigger ?*

ALICE acceptance

- ALICE acceptance matched to diffractive central production:

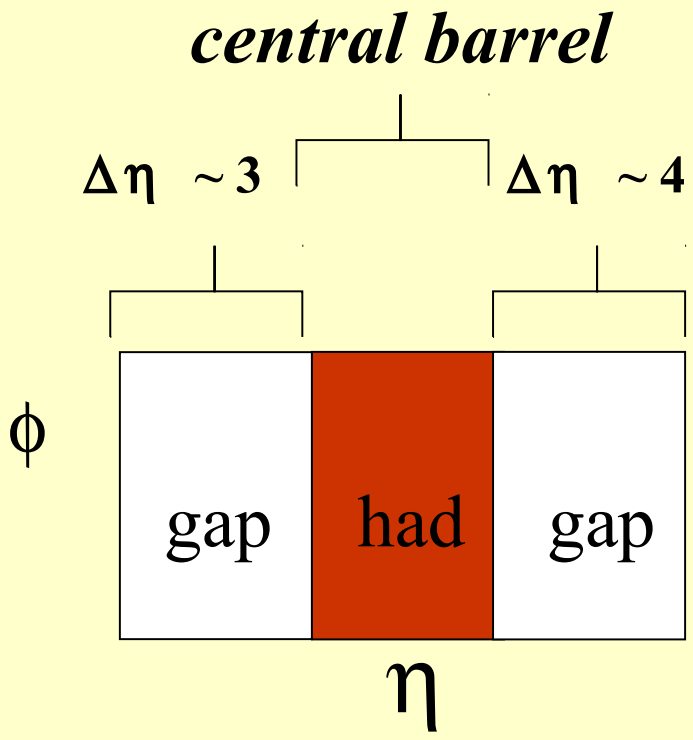
  double pomeron, (γ–pomeron, odderon-pomeron)





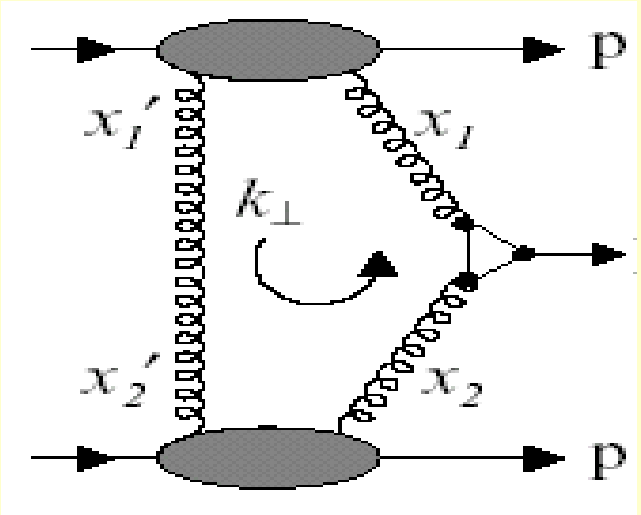
Data taking:
pp @ L = 5×10^{30} $cm^{-2}s^{-1}$
pPb @ L = 10^{29} $cm^{-2}s^{-1}$
PbPb @ L = 10^{27} $cm^{-2}s^{-1}$

$$(\rightarrow \left.\frac{d\sigma}{dy}\right|_{y=0} \sim nb)$$



Central exclusive diffraction in QCD

Formalism of central exclusive production predicts cross sections for $\gamma\,\gamma$, dijets, $\chi c, \chi b$



Ingredients

- *unintegrated gluon distribution*
- *cross section $gg \rightarrow X$*
- *Sudakov factor, no additional hard gluon*
- *soft rescattering, suppression factor S^2*

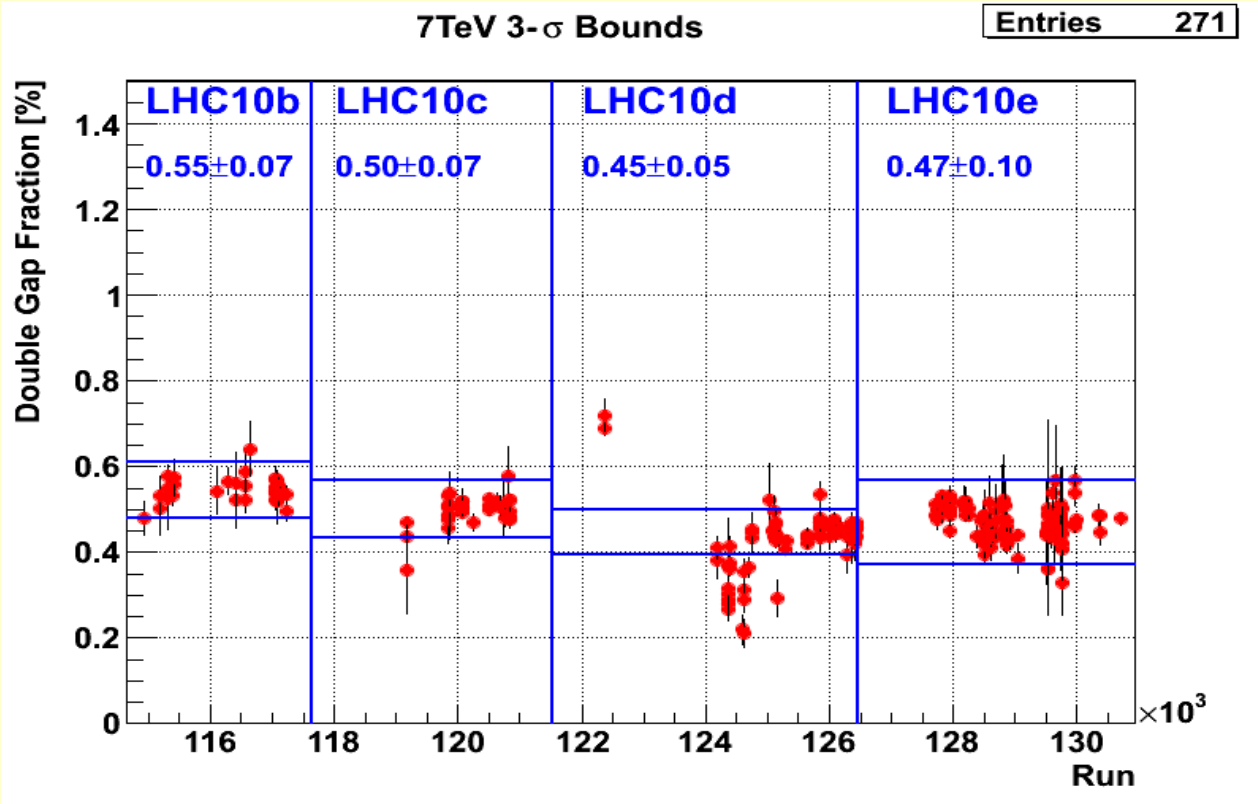
ALICE: measure central state with rapidity gap on either side

→ expect enhanced production of $J^{PC} = J^{++}$ states

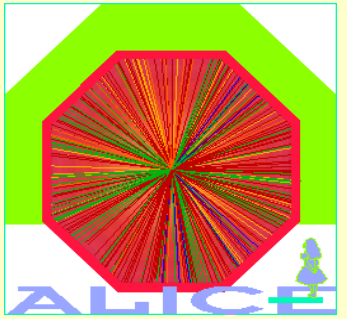
→ $f_0(980)$: $J^{PC} = 0^{++}$, $f_2(1270)$: $J^{PC} = 2^{++}$

First analysis min bias data

3 σ cut on single gap, double gap fraction on a run basis



Data sample pp collisions at 7 TeV

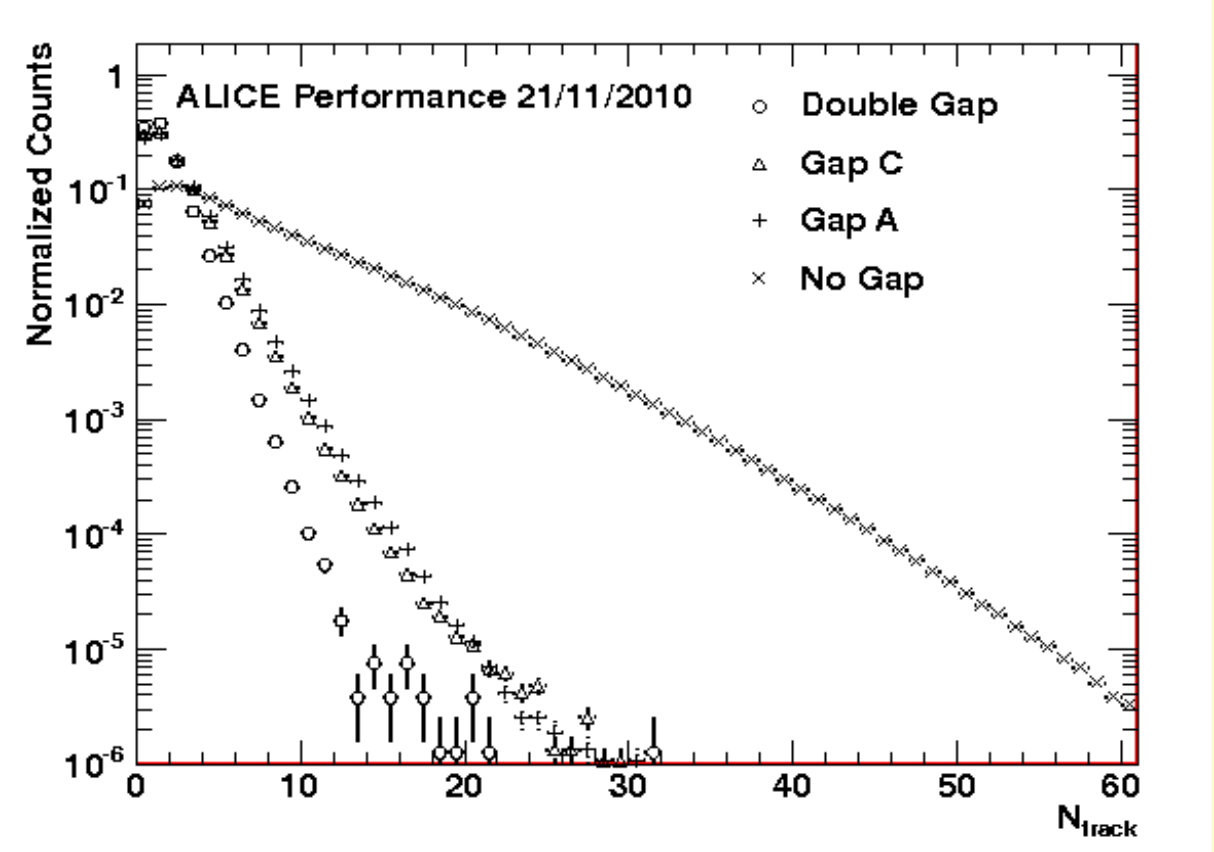


- Physics selection 325×10^6
- SPD fired 303×10^6
- Primary vertex 270×10^6
- Events with two tracks in central barrel total 30.3×10^6
  - Gap A event: no activity in V0A (trigger analysis) 1.35×10^6
  - Gap C event: no activity in V0C 1.33×10^6
  - No gap event: activity in V0A and V0C 27.5×10^6
  - Double gap event: no act. in V0A, no act. in V0C 1.38×10^5
- Events with 3-tracks in central barrel total 26.8×10^6
  - No gap event: 25.2×10^6
  - Gap A event: 0.79×10^6
  - Gap C event: 0.74×10^6
  - Double gap event: 5.08×10^4

Multiplicity distribution

- Multiplicity of reconstructed tracks in central barrel

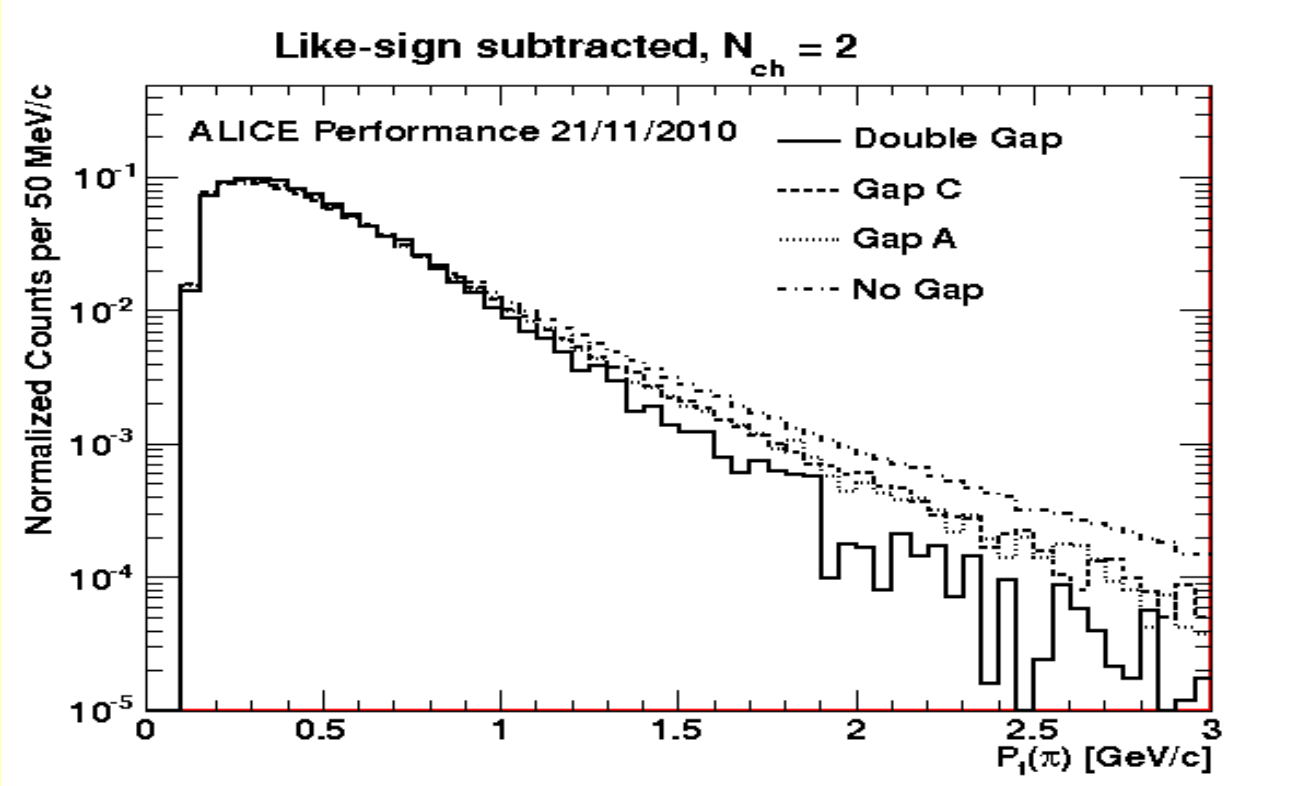
Raw uncorrected distribution



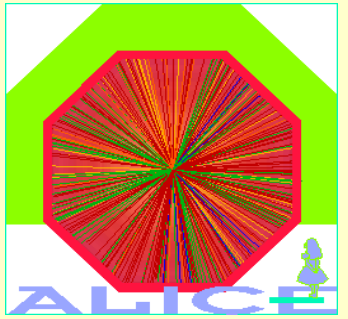
Transverse momentum distribution

- Single track transverse momentum distribution for gap and no gap two-track events

Raw uncorrected distribution

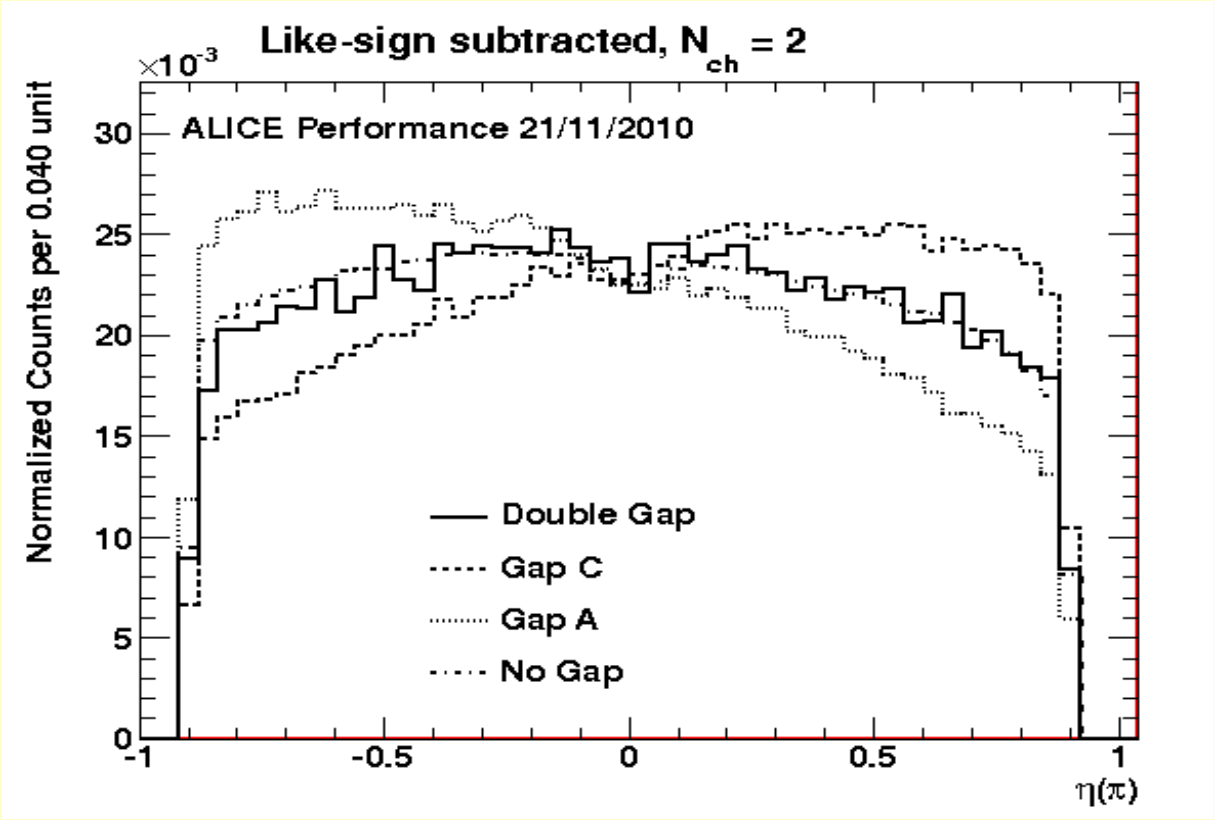


Pseudorapidity distribution



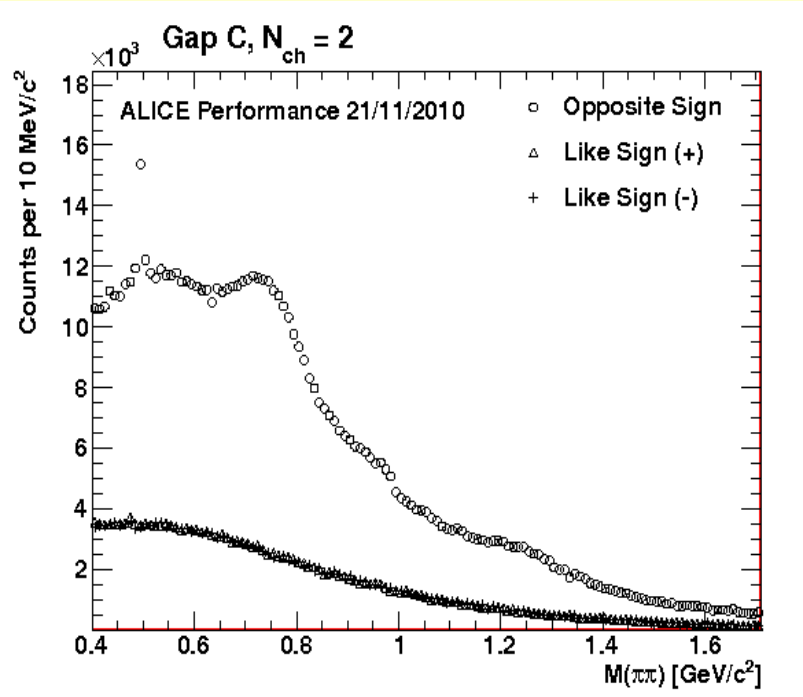
- Pseudorapidity distribution for gap and no gap two track events

Raw uncorrected distribution

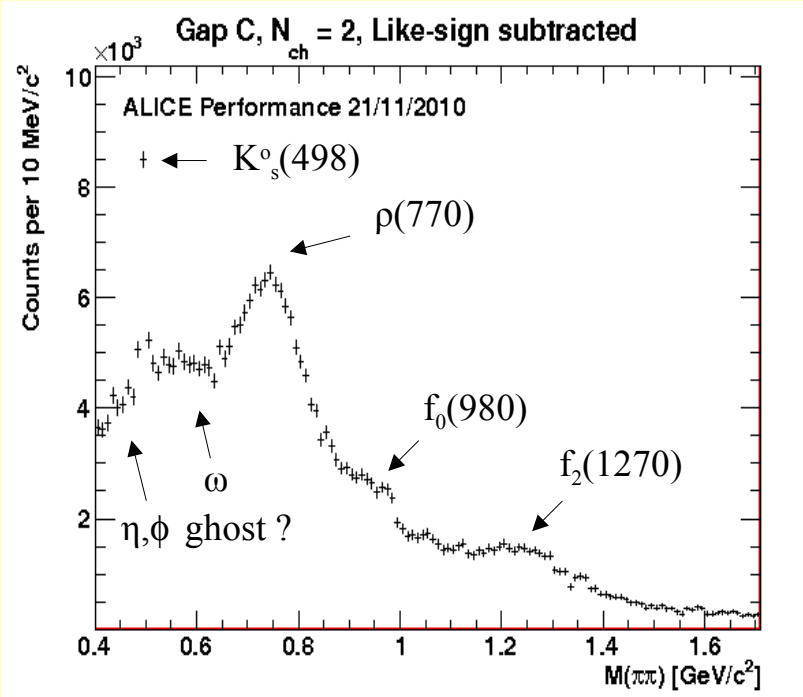


Invariant mass distribution single gap events

- Two track invariant mass distribution for gap C events

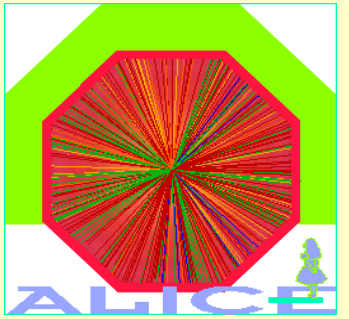


Invariant mass distribution for like and unlike sign pairs



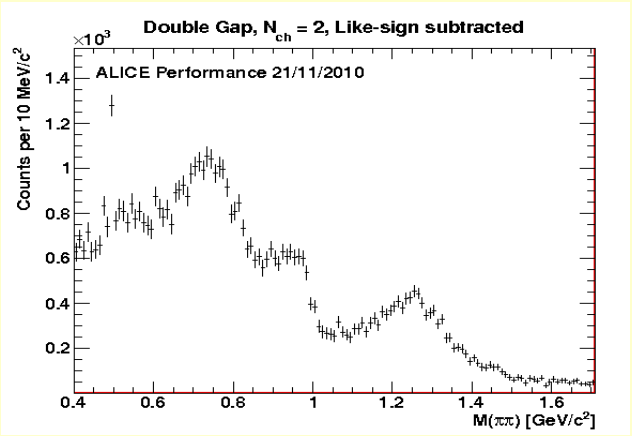
Invariant mass distribution corrected for like sign pairs

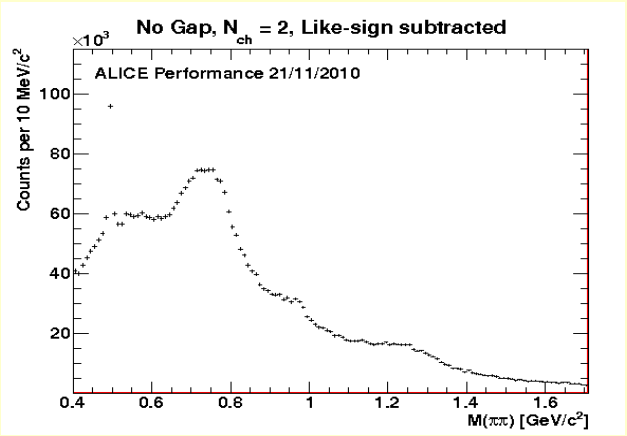
Invariant mass distribution for double gap and no gap events



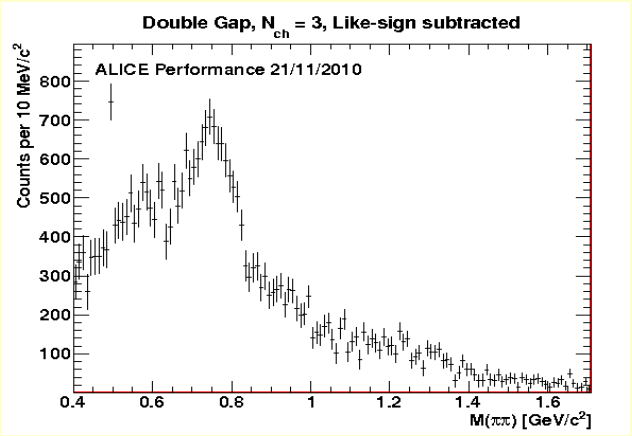
- Two track invariant mass distribution for double gap and no gap events

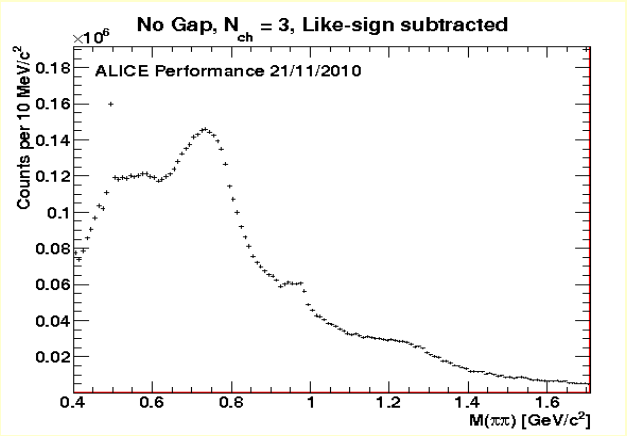
$N_{trk}=2$





$N_{trk}=3$





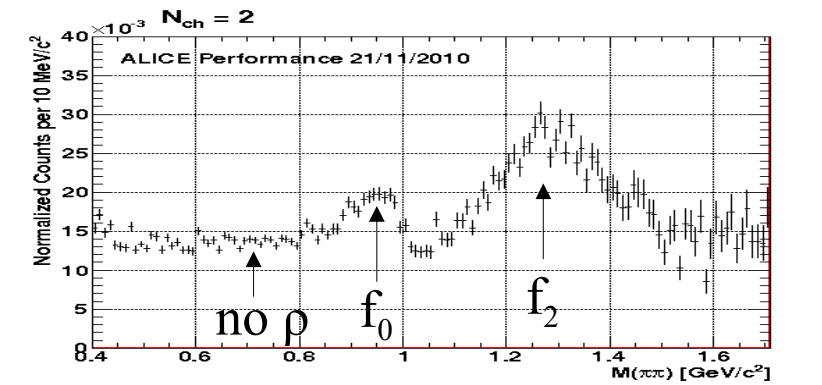
Invariant mass double gap events

Invariant mass no gap events

Normalized pair mass distribution

- Normalized pair mass distribution =
  pair invariant mass double gap events / pair invariant mass no gap events

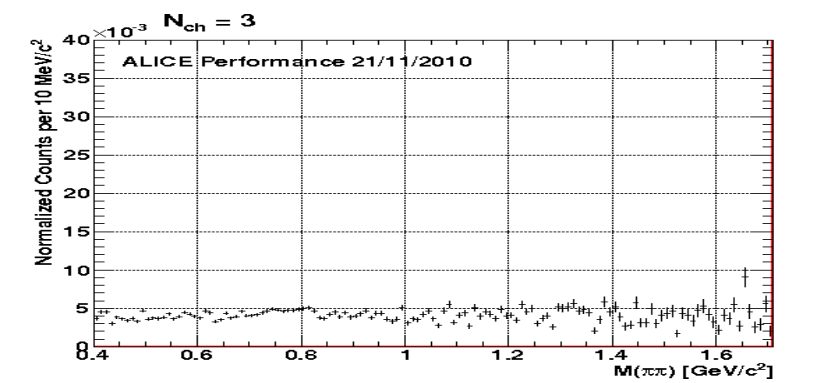
$N_{trk}=2$



→ *enhancement for $f_0(980)$, $f_2(1270)$*

→ *where is the $f_0(1500)$?*

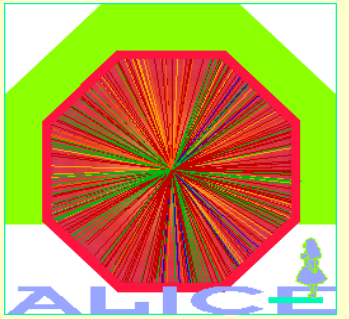
$N_{trk}=3$



→ *no enhancement for $N_{trk}=3$*

→ *exclusive production in $N_{trk}=2$*

Search for the $f_0(1500)$



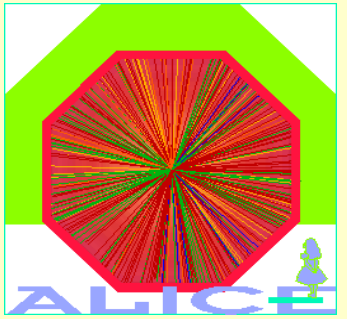
- PDG: $f_2(1270)$: Br($\pi\pi$)=85%, Br($K\underline{K}$)= 5%
  $f_0(1500)$: Br($\pi\pi$)=35%, Br($K\underline{K}$)= 8%
- *Identify $f_2(1270)$, $f_0(1500)$ in $\pi\pi$ and $K\underline{K}$ decay channel:*
  - $K\underline{K}$ channel:
    - bad news: statistics of $f_2(1270)$ reduced by factor 17, $f_0(1500)$ reduced by factor 4
    - good news: strength of $f_0(1500)$ relative to $f_2(1270)$ grows by factor 4

→ *$f_2(1270)$, $f_0(1500)$ analysis in $K\underline{K}$ needs a dedicated double gap trigger*

→ *proposal to physics board for implementing double gap trigger and data taking of 3 M double gap events (ALICE mini week oct 10)*

→ *if approved data taking expected in 2011*

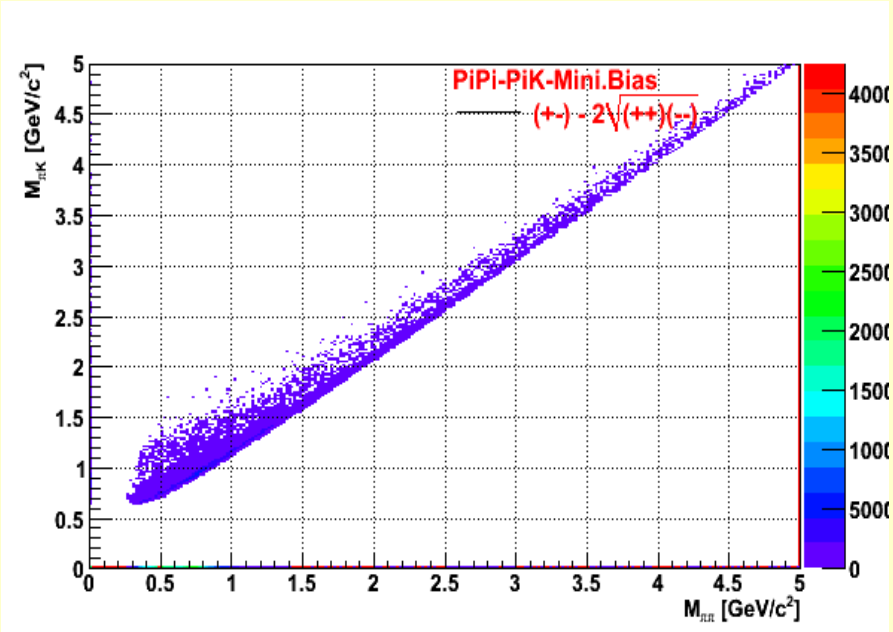
Conclusions, outlook



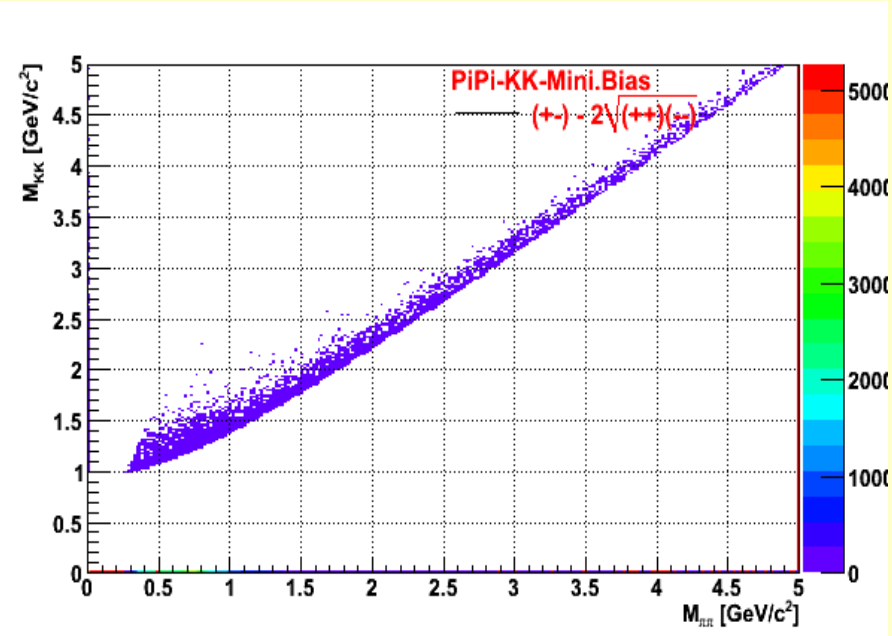
- ALICE has capability to identify single and double gap diffractive events
- Analysis of single and double gap events show different central barrel multiplicity and single track P_T and η-distribution
- Two track invariant mass distribution can be understood as continuum plus f_0, f_2 resonance contribution plus contribution from ρ-production of diffractive and non-diffractive events
- f_0, f_2 enhancement in double gap events established in normalized pair mass distribution
- Proposal for data taking of double gap events with dedicated trigger
- Purity of gap events will be improved by additional AD detector array

Backup: Two track mass ghosts

Resonance ghost due to π assumption



πK → ππ



KK → ππ