Do We Need the Magnet Chambers (ITR & OTR)?

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Summary of the studies of many people during the last month.
Because of the limited time only a restricted set of questions asked:

¥What is the gain for ECAL reconstruction and efficiency
for J/ψ –> ee and χ_c

¥ Is there a ghost problem for J/ψ –> $\mu\mu$?

Additional information:

¥J/ψ mass resolution with improved magnet chamber alignment

¥Studies of ghost rates and their origine for all tracks in J/ψ events

Disclaimer

The analyses could only be done with available software,
such as tracking, clone removal and matching,
it was not possible to optimize routines.

No attempt could be made to search for an optimized scenario,
only full and reduced geometry were compared.

Not all questions could be answered

Definitions

Full geometry: all chambers MC1 - MC8 included

Reduced geometry: all magnet chambers removed except MC1/MS01

The Gain of the ECAL Analysis

Improvement factor without magnet chambers

$J/\psi \to ee$:	trigger eff.	1.5
	mass width	1.3
	E/P	1.2
$\chi_{c2} \to \gamma\, ee$:	reco. eff.	1.25
	mass width	1.45
	S/N	improved
$\chi_{c2} \to \gamma\, \mu\mu$:	reco. eff.	1.15- 1.4
	mass width	
	S/N	improved

MC Study for J/ψ –> μμ + 2 inel.

Full and reduced geometry, standard matching and clone removal

- Ghost rate about 2 %, with μ-likelihood about 0.4% (!)

- The efficiency of J/ψ with that low ghost rate is only about 72%.
  Losses come from pattern reco (7% VDS/OTR/ITR), matching (5%), clone removal (8%) and μ-likelihood (8%).

  It is not unlikely that the efficiency can be improved by a clever analysis, however, the ghost rate may then increase again (need purity vs. efficiency).

- Ghost reduction is not primarily related to muons but can be also achieved for pions with similar requirements. Important is a good definition of a track behind the magnet (e.g. requiring that a track is from K_S may also do it).

ªAll Tracks in $J/\psi \to \mu\mu$ Events

- ghost rate about 16% at low momenta, remains at about 8% even at high momenta.

- This ghost rate can be reduced below 1% if magnet tracking and a χ^2 cut on matching is applied.

Here is a clear case for keeping the magnet chambers!

- The all-track ghost rate has a relatively large fraction of electrons and protons: ghosts are often related to secondary interactions.

Data: Magnet Chamber Alignment and Mass Width for $J/\psi \rightarrow \mu\mu$

- AL+NK: Magnet tracking can be improved: For the decision we should assume that the magnet tracking and matching with magnet tracking can be made fully functioning.

  We know that in case we decide for the magnet chambers (and also if only one chamber stays) we have to do a lot of systematic work on the corresponding software.

[a]Momentum and Mass Resolution

- Momentum improved by Magnet Tracking below 20-30 GeV/c (Lanyov 19.3.01)

- $J/\psi \rightarrow \mu\mu$ mass resolution about 10 to 20 % better with magnet (Wouters analysis)

Open Questions

- Is MC/MS needed for improvement of J/ψ efficiency?

- can "all track" ghost rate be improved without the MC/MS? Is the requirement to see e.g. a resonance sufficient to remove ghosts?

- Do we know anything about K_s resolution with/without magnet?

- What about analyses of particle multiplicities? Are they hampered by the ghosts?

- Is detector development and performance study an argument for keeping the chambers (HC and MSGC) in the magnet?

- Should we keep at least one chamber (in the middle of the magnet)?

Possible Gains from Magnet Chambers

- Reduction of all track ghost rate
- Improvement of J/ψ efficiency?
- improved momentum resolution
- gain for exclusive decays?

  e.g., ψ'--> $J/\psi\ \pi\pi$, D* --> π D --> $\pi K \pi$, . . .
- Analysis of the accompanying event
- Gain for the reconstruction of primary vertices?
- Reconstruction of converted photons (important for χ_c)
- Efficency for K_s (see note by R.Mankel and P.Weyers).
- cross checks for magnetic field (and alignment).
- detector performance studies in magnetic field
- ....

Tentative Conclusion

Remove?

¥ ECAL physics gains without magnet ch. **Y**

¥ J/ψ–> μμ (priority program) does not suffer - **~ 0**
or only slightly (resolution, efficiency)

¥ All tracks gain from magnet tracking appreciably. **N**

¥ There are indications that signals (K_s, identified particles, resonances) have in general no ghost problem. **~ 0**

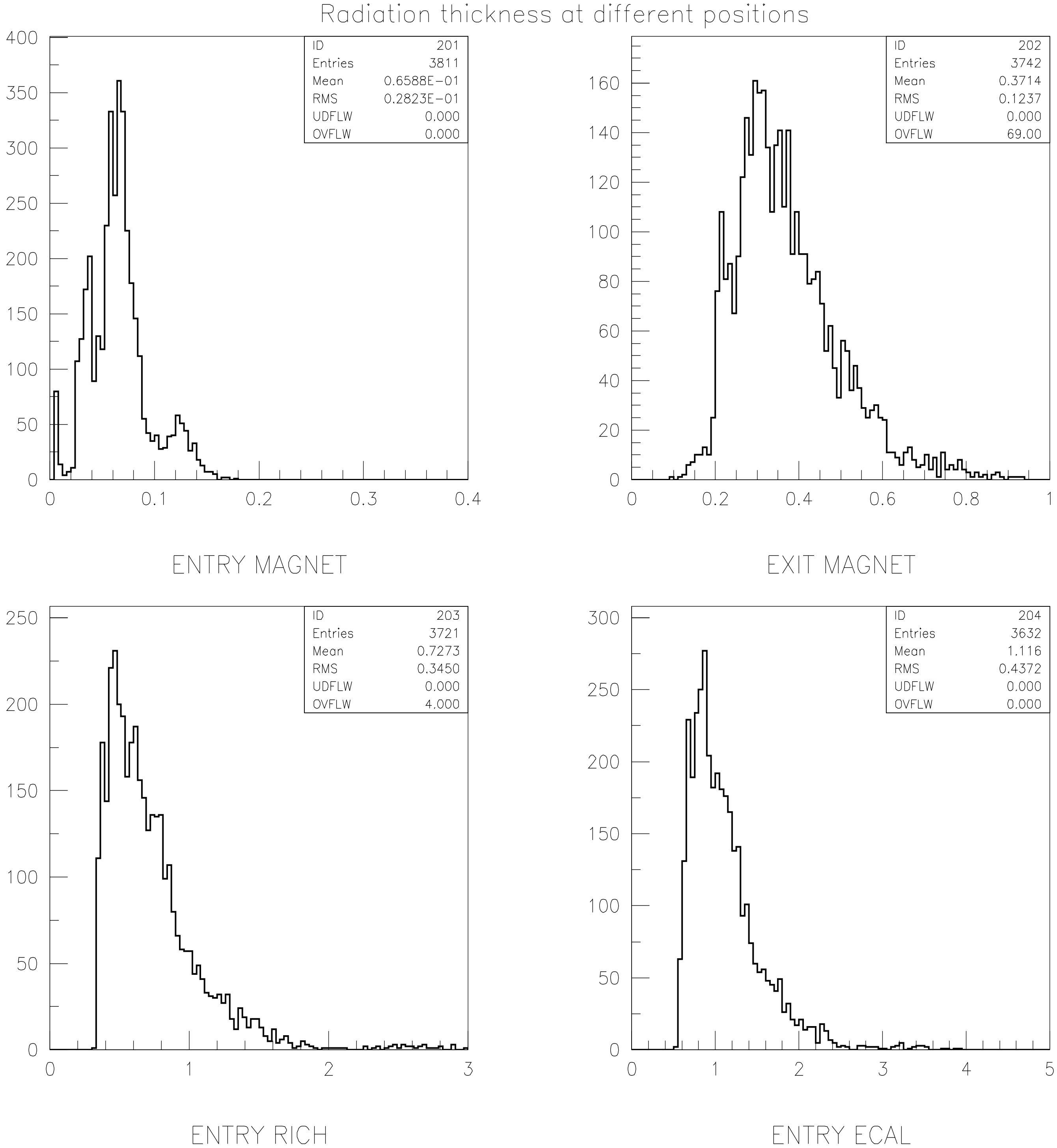
It seems as if we have no desastrous ghost problem!

¥ Do we loose possibilities to study alignment, detector issues, performance? **?**

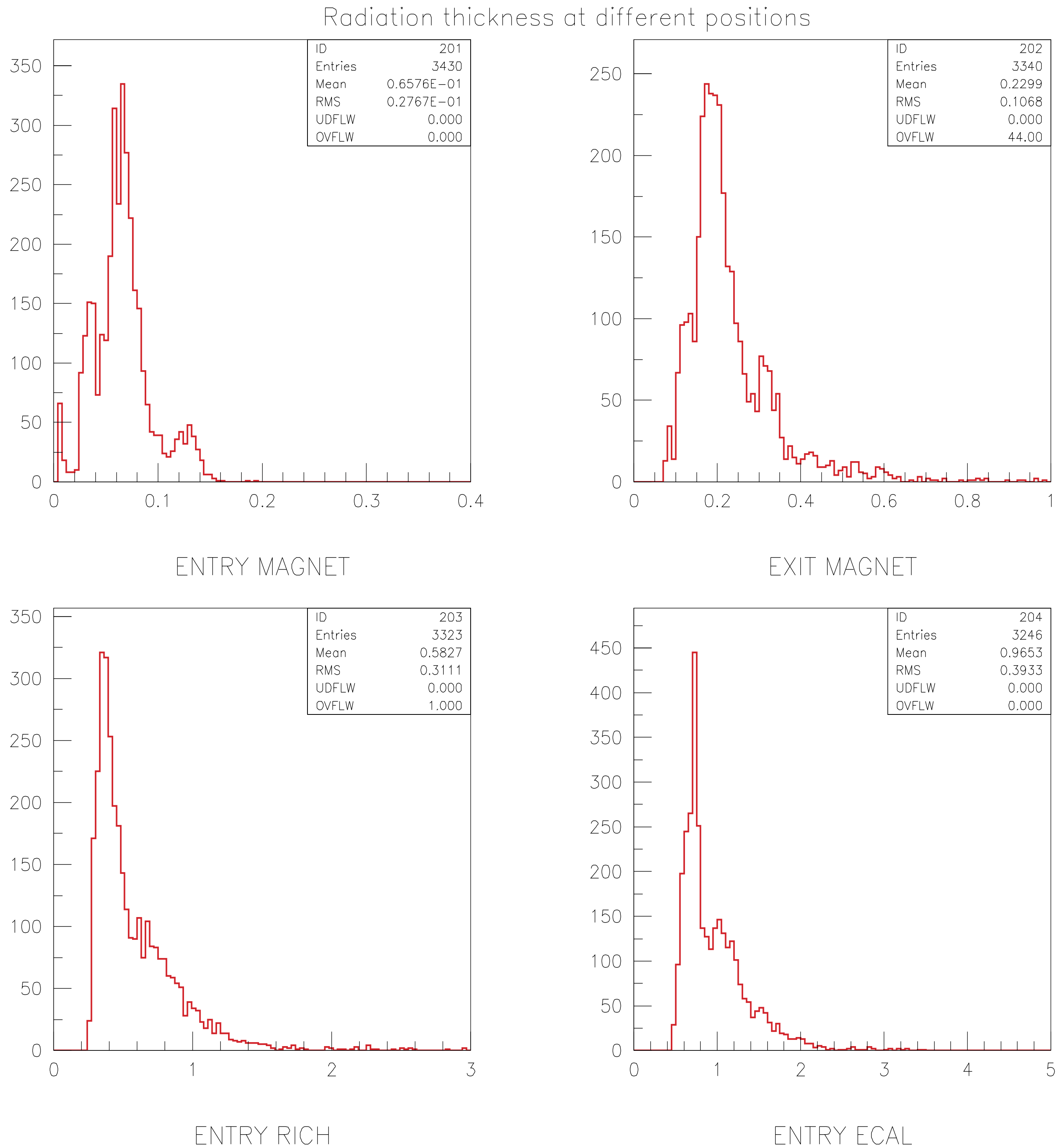
The decision-makers have to weigh the arguments!

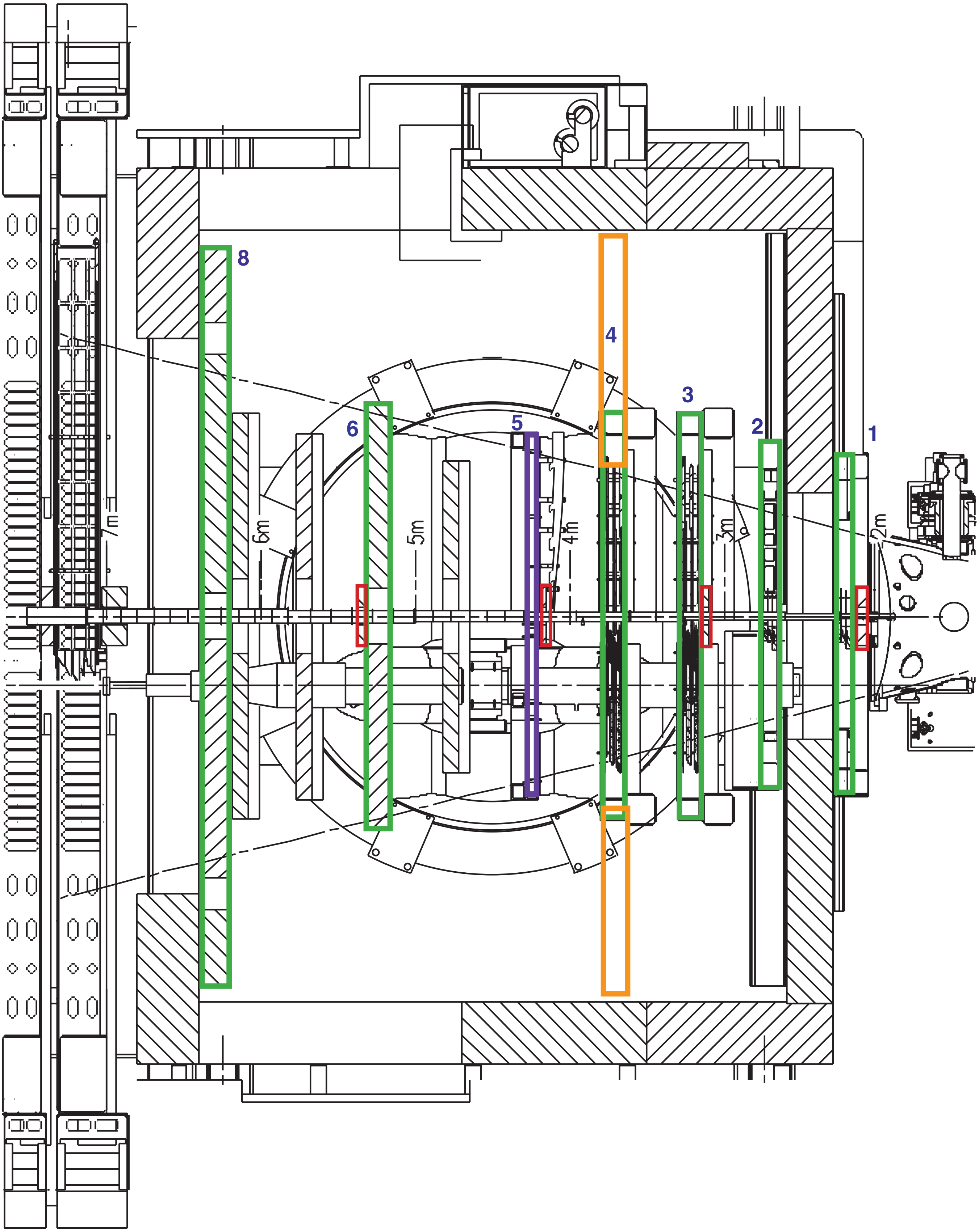
MC simulation done by S. Nowak, new geometry:

Standard geometry (without MC5)



Reduced geometry without MC2, MC3, MS03, MC4, MS05, MC6, MS06, MC8





16.11.01 Magnet decision

Option A: no magnet chambers

1. Open MC2 and MC3
2. Uncable and open MC4
3. Remove rails of MC5
4. Dismount MC6 and C8+

Option B: one magnet chamber

Use chamber with ITR $\Rightarrow$ MC3 or MC6

- MC6 disturbs all work inside magnet, especially high-pt
- MC6 close to centre of magnet

Check whether MS03 can be mounted on MC4

Magnet Tracker: Recommendation

M Medinnis
16 Nov, 2001
DESY

The Trade-off

- ECAL performance is significantly improved by removing material in magnet.
- The magnet tracker reduces ghosts and significantly improves momentum resolution at low momentum.

Priority Physics program

Charmonium (J/ψ, ψ', χ_c) production
B cross section.

- J/ψ, ψ' ($\mu^+\mu^-$) have not been shown to be significantly influenced by magnet tracker
- J/ψ, ψ' (e^+e^-) would benefit from less material (but S/B worse than for $\mu^+\mu^-$)
- χ_c would benefit significantly (e.g. better resolution, almost 2x better S/B.)
- B cross section can be done without magnet tracker

Other physics

- Any studies involving charged tracks in addition to trigger tracks would benefit from presence of tracker (ghost reduction by 15 - 20%).
- Any studies involving π^0 or γ would benefit from less material.

Recommendation

Because of

- the clear benefit of removing material in the magnet to χ_c studies,
- the modest impact of removal to the rest of the priority program,
- the feeling that we can learn to cope with a maximum 8 - 20% ghost content,

I recommend to:

Remove the magnet tracker, keeping only the first super-layer (MC01, MS01, SI08).

But…

There has been discussion recently on keeping a super-layer in addition to the 1st.

This would be an acceptable compromise, if the tracking community is interested in this option and it is made clear that this would greatly benefit the tracking by Nov. 28.

(…we would also need to know which one to keep in: MC/S03, MC/S04, MC/S06?)

Note: if there is interest to study the behavior of the chambers in a field, this could be done before the start of routine data taking