SLT status and Trigger rates

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- SLT commisioning status:
  - General overview
  - Electron channel
  - Muon channel
  - FLT & SLT mode
  - Running conditions
- J/Ψ rates:
  - Observed J/Ψ rate
  - Comparison to expectation
- Next steps

SLT commisioning status

- Trigger scenarios exerciced:

Double pretrigger requirement
+
SLT seeded with pretrigger messages
(electron and muon channels)

Double FLT track requirement
+
SLT seeded with pretrigger messages
(electron channel)

- General problems found and solved:

⇒ Bug in SHARC code: shift (2 bytes) in the 33% of the replies from SHARC to the SLT hit requests

⇒ Problem in OTR FED map: wrong identification between FED and SLB address in TC1

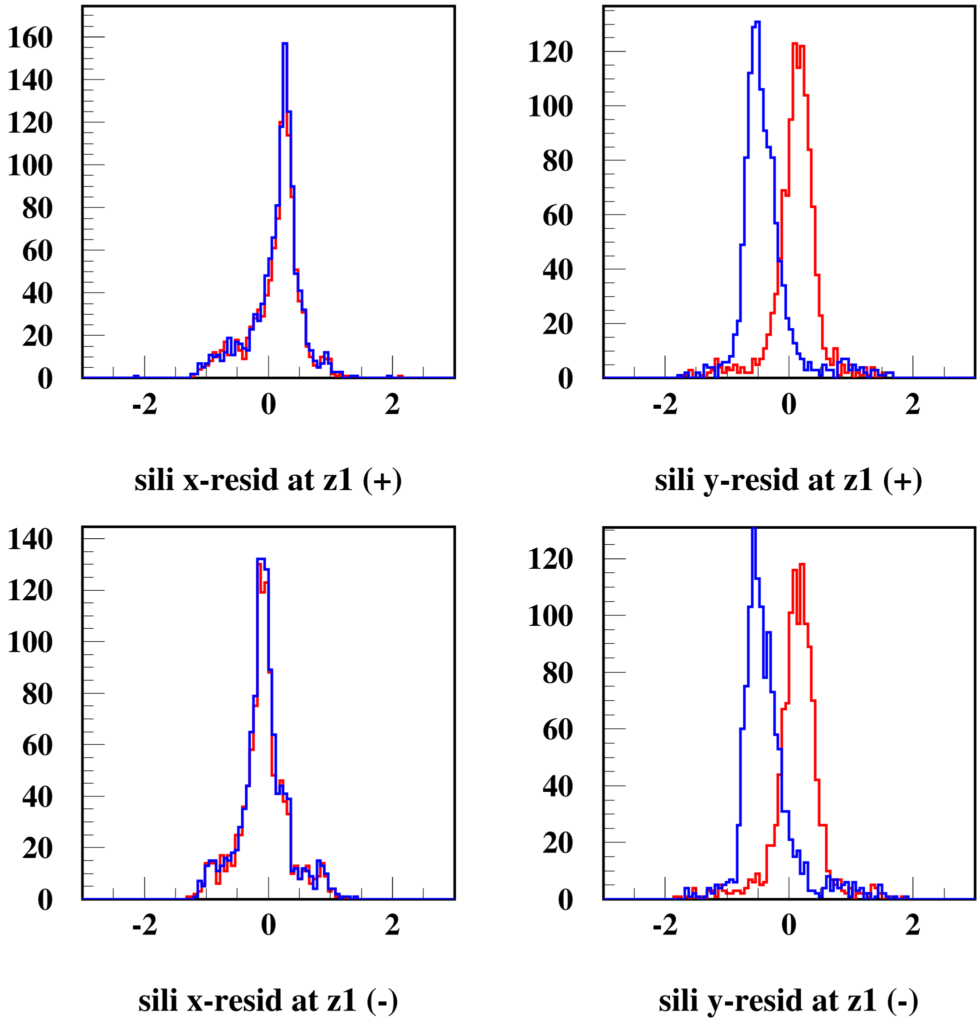
⇒ Alignment problems:
Wrong transformation from raw to Hera-B target coordinates
Alignment corrections (target related)

Estimated effect on J/Ψ rate: factor 4

SLT commisioning status

- Still some problems ... missing alignment for beam position monitors.

Residuals Silicon RoIs – hits



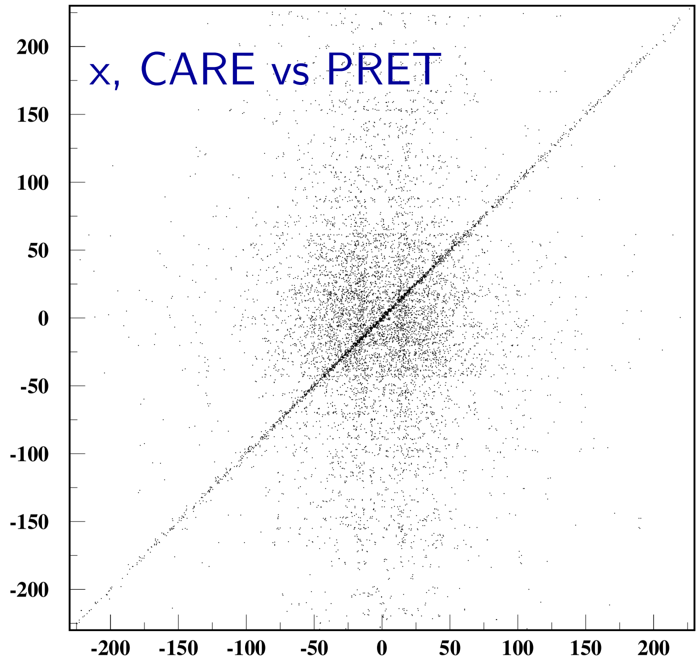
Beam position from monitors

Monitor beam position shifted .2575 cm in Y

Electron pretrigger & SLT

- Main differences with respect to 2000 run:
  - ⇒ No CARE used to find the seeding clusters but pretrigger informatin from the 2^{nd} TDU (reducing CPU time in the SLT and load through the switch)
  - ⇒ No cuts before SLT chain: p_T and mass cuts removed (effect on timing and rejection from SLT point of view)
  - ⇒ No outbending requirement

- Check on new features:
  - ⇒ Correlations between CARE and pretrigger messages showed $\approx 69\%$ pretrigger efficiency



⇒ Enough suppression from SLT ($\approx$ 1000) without mass cut

Electron pretrigger & SLT

- SLT processing time[1]:

  IA: 4MHz

Step	2002		2000	
	ms/call	*ms/evt*	*ms/call*	*ms/evt*
FLT building	.23	.23	-	-
ECAL readout	-	-	4.6	4.6
Cluster reco.	-	-	12	12
SLT algorithm	1.3	1.3	4.7	2.3
Event building	132.	.51	220	0.1
Total	-	2.2	-	17

No limit in SLT input rate due to processing time
(13.2kHz in 2000 due to ECAL online reconstruction)

(1) Also affected by the upgrade of the SLT farm (CPU from 390 to 1300 MHz in average).

Muon pretrigger & SLT

- Main differences with respect to 2000 run:
  - ⇒ No loading of the full tube and pad chambers but hit request in tube chambers FED based
  - ⇒ Muon geometry and masking transmitted via CnA
  - ⇒ New muon hit preparation
  - ⇒ New muon tracking algorithm (looser cuts)

- Performance of the new features already checked:
  - ⇒ Comparison of SHARC reply (FED info) to FED record after event building
  - ⇒ Check of the hit preparation and masking
  - ⇒ Check of muon tracking algorithm:
    rejection factor ≈ 4 (11 in 2002)
    0.41 ms/invocation

- SLT processing time[1]:

Step	2002		2000	
	ms/call	*ms/evt*	*ms/call*	*ms/evt*
FLT building	.22	.22	-	-
MUON readout	-	-	1.2	0.6
MUON tracking	0.41	0.41	3.0	1.5
SLT algorithm	4.1	0.41	17	2.3
Event building	121.	0.07	220	0.02
Total	-	1.2	-	2.9

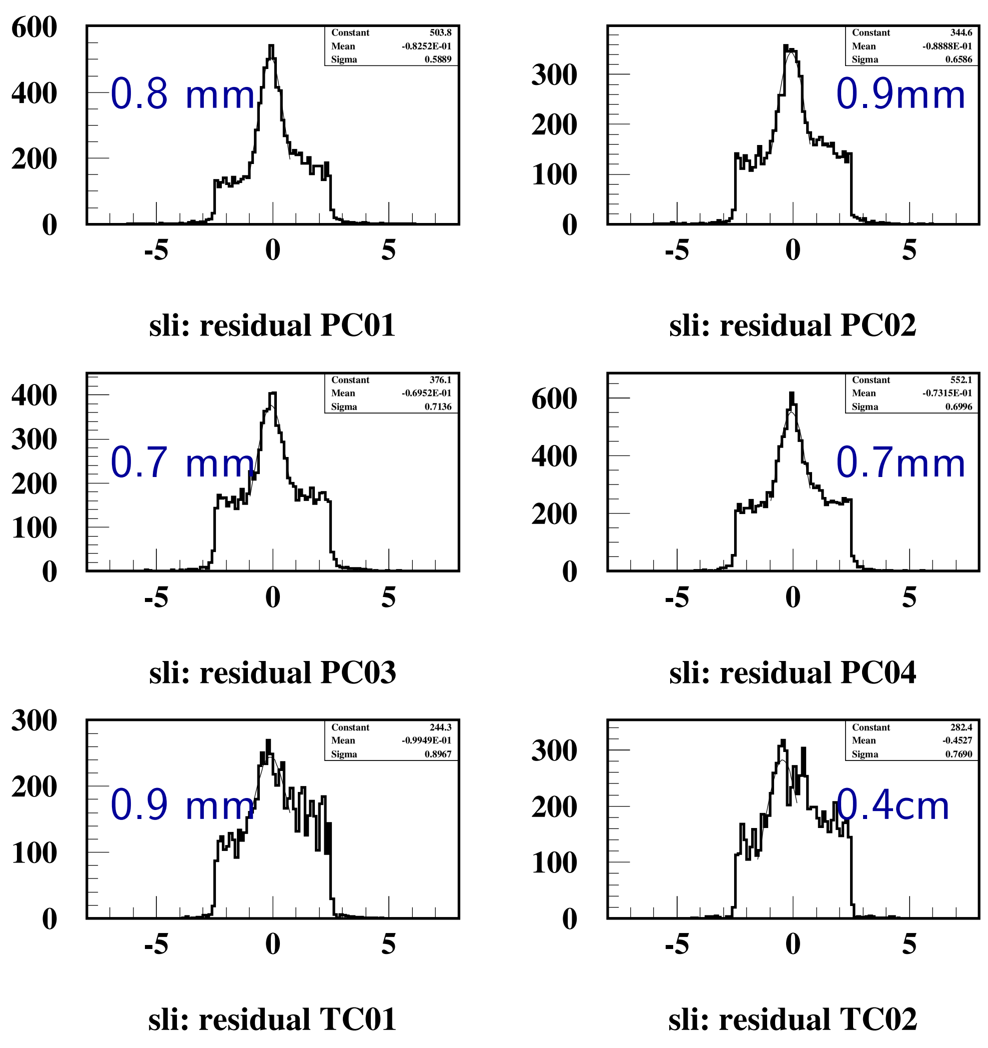
(1) Also affected by the upgrade of the SLT farm (CPU from 390 to 1300 MHz in average).

First look to FLT&SLT

Offline **FLT&SLT pair mode**

on 2FLT tracks + 2SLT pret. online run

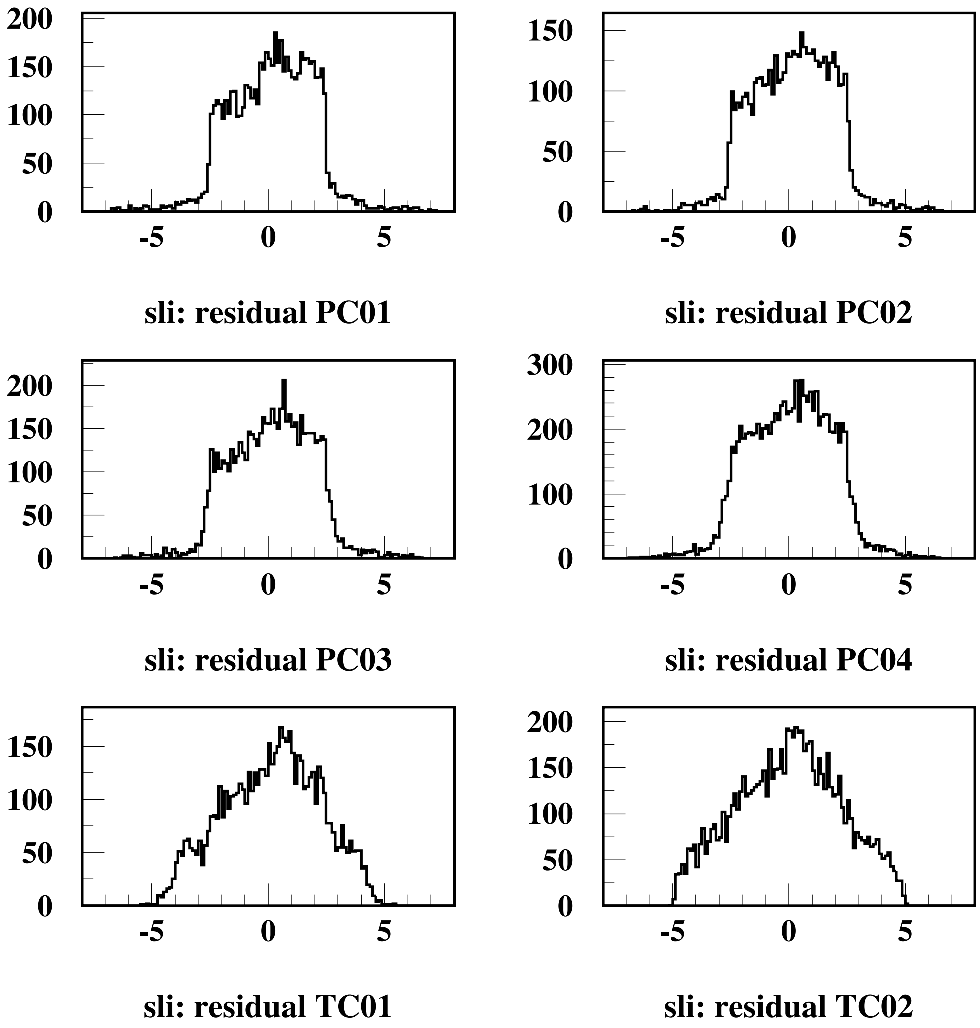
- Residuals FLT tracks–RoI hits (OTR x view)



FLT tracks are found by the FLT and aligned with the hits

First look to FLT&SLT

... and if you compare to the pretrigger seeded residuals ...



... an important reduction of the RoI can be applied.

Running conditions

Some inestabilites due to rate limitations

Not completely understood

Main deadtime sources:

- Throtle:
  a. L4 reconstruction:
     posibility of downscaling the online reconstruction already implemented.
     (L4 nodes busy)
  b. Transfer of data through the switch:
     optimization of map/pam code ?.
     (SLT and L4 free nodes)
  c. SLT processing time:
     not observed.
     (SLT nodes busy)
- FIFO depth:
  Only one event stored in the FIFO between FEDs and SLBs:
  up to 8 events forseen but still producing FED errors

Running conditions

Example of trigger rates:

- Electron channel:

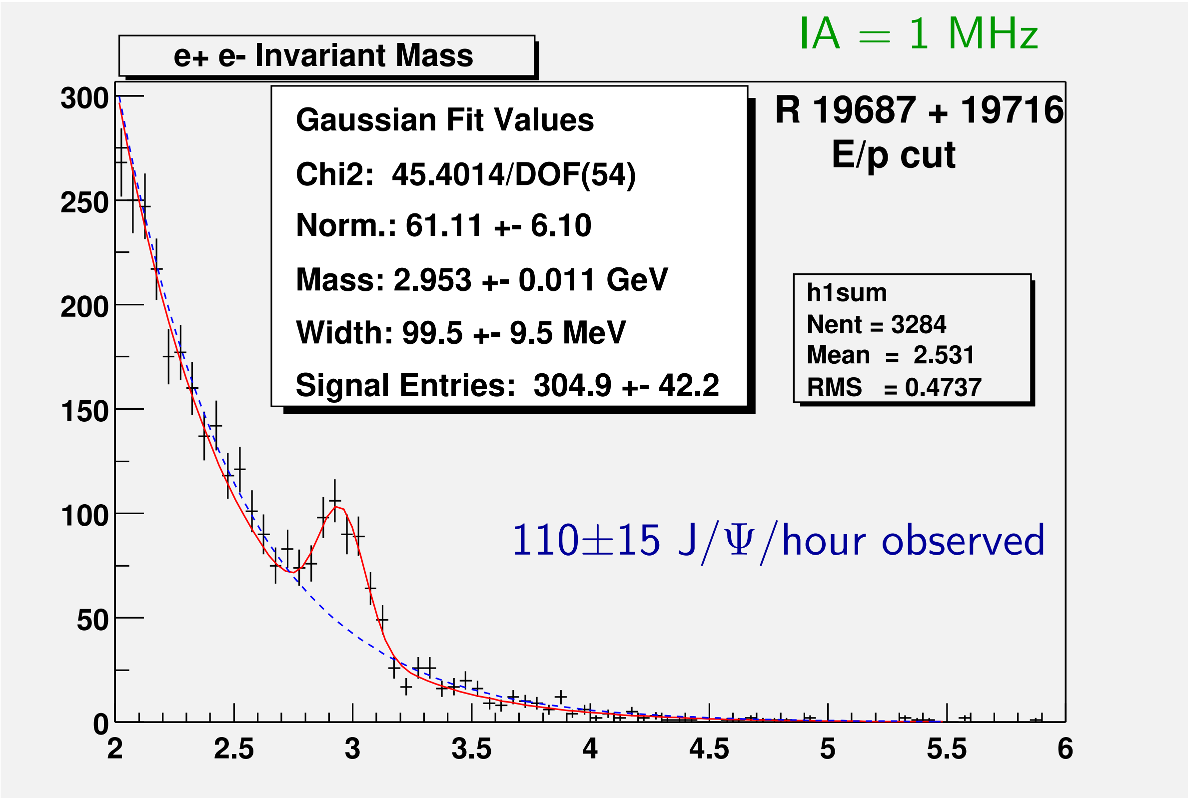
IA	*Pret.*	*SLT in.*	*SLT out.*	*Deadtime*
2MHz	11kHz	8kHz	5Hz	30%
4MHz	33kHz	18kHz	18Hz	46%

- Muon channel:

IA	*Pret.*	*SLT in.*	*SLT out.*	*Deadtime*
1MHz	5.8kHz	5kHz	1Hz	14.5%
5MHz	33kHz	14kHz	8Hz	58%

J/Ψ rates (electron channel)

$E_T > 1$GeV at pretrigger level
Double pretrigger requirement at FCS
Full SLT (no p_T or mass cut, no vertex)
No ITR included



Analysis cuts:

- OTR multiplicity: nhits < 7000
- E/p: $M - 1\sigma < E/p < M + 1\sigma$
- vertex $\chi^2 < 3$

Deadtime: 10%

175 ± 24 J/Ψ/hour corrected

J/Ψ rates (electron channel)

Estimated J/Ψ rate:

- $J/\Psi \rightarrow e^+e^-$ production rate: 3400 J/Ψ/hour/MHz
- 1.5 MHz interaction rate (observed*1.5)
- .187 (full trigger chain efficiency, E_T>0.7GeV, incl. ITR – B. Petersen)
- .6 (increase E_T cut to 1.0 GeV – M. Bruschi)
- .6 (remove ITR acceptance – May report, Tab. 4)
- .9 (livetime- FCS counters)
- .69 (pretrigger efficiency)
- .71 (E/p cut efficiency)
- .93 (TGT: coasting beam, rate stability – M. Funcke)

140 J/Ψ/hour predicted
vs
110$\pm$ 15 J/Ψ/hour observed

Observed = .8*Estimated

J/Ψ rates (electron channel)

Effect of the solved problems on the J/Ψ rate:

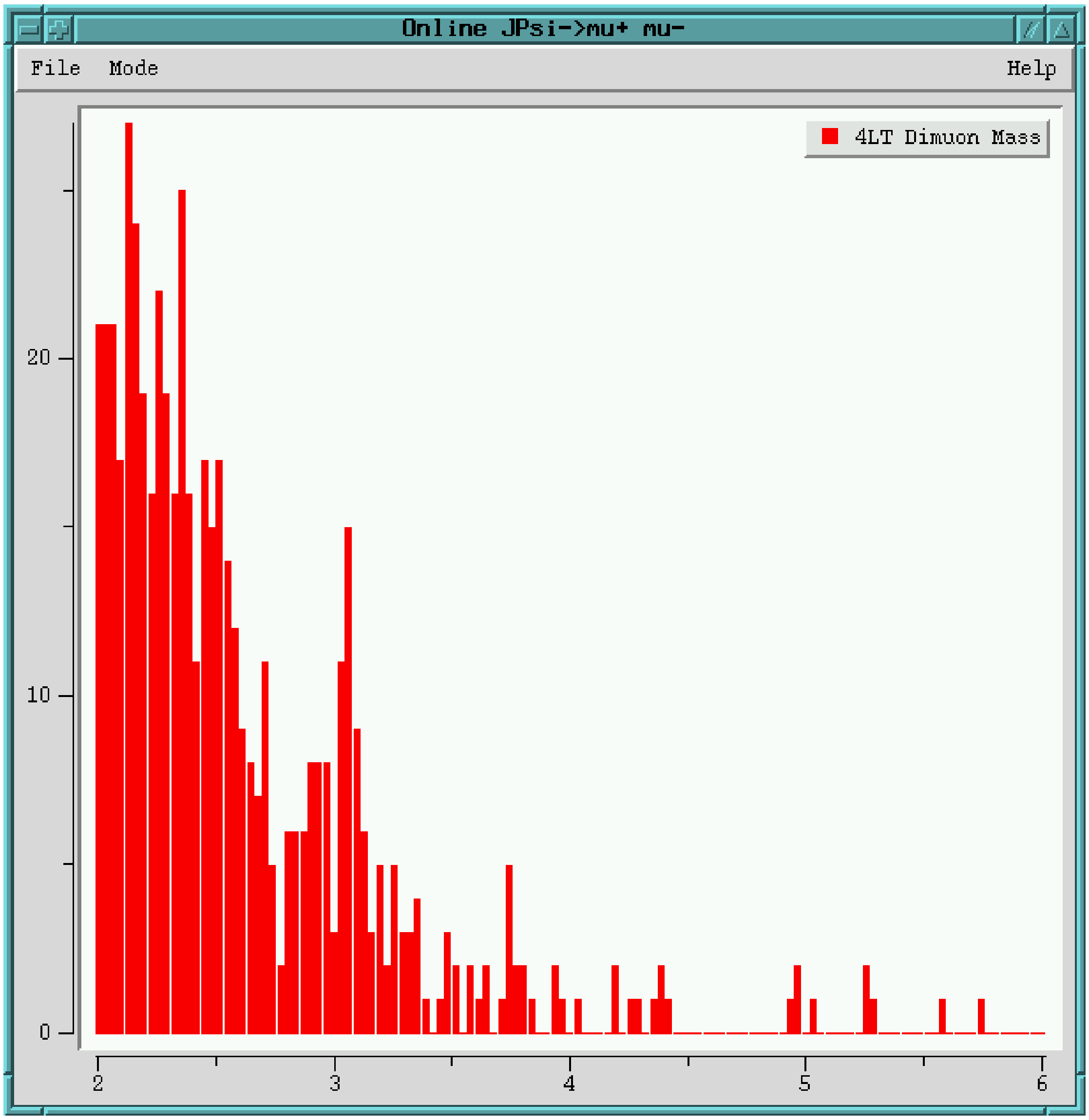
Run	*Triggered $J//Psi$ rate/MHz IA* [1]	*Cumulative changes w.r.t. run 19393*
19393	43	-
19598	108	– OTR FED map fixed – Target alignment
19597	156	– SLB bug fixed
Predicted	156	–

(1) Live J/Ψ rate corrected for efficiency of analysis cuts and dead time

J/Ψ rate normalized to 1MHz and live time

J/Ψ rates (muon channel)

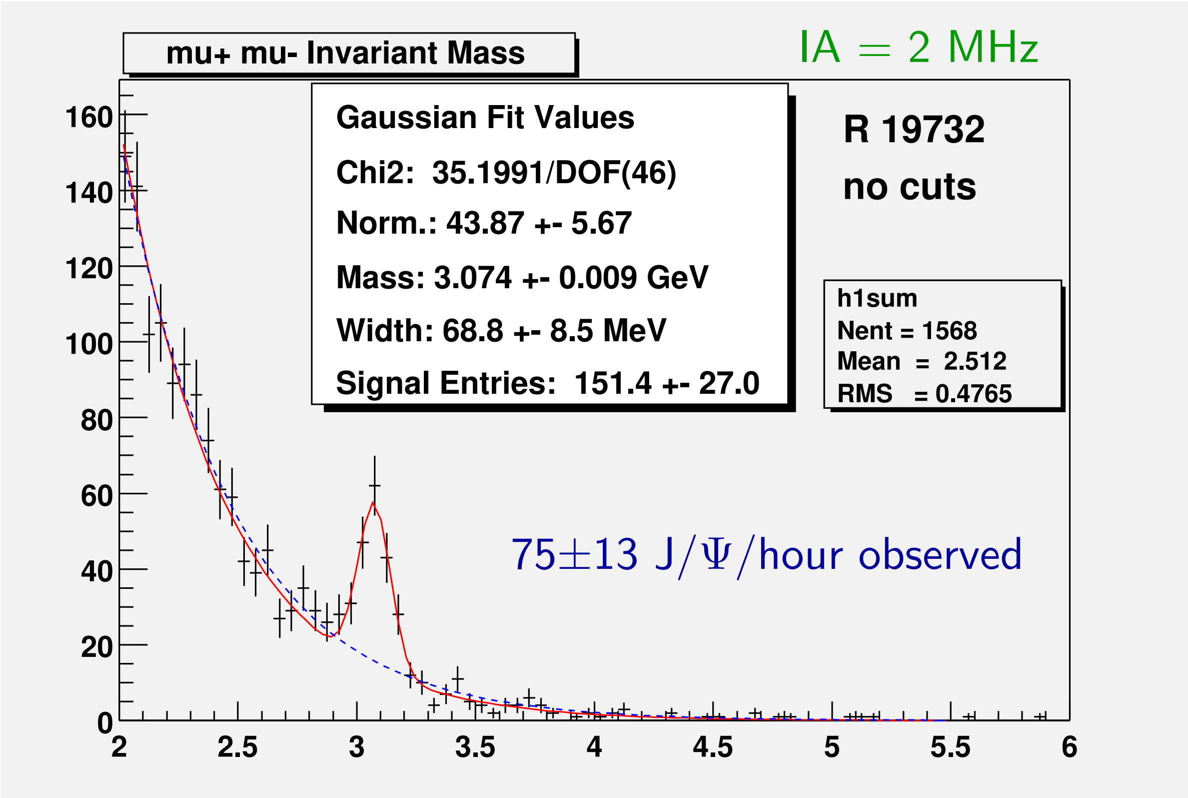
The first J/Ψ online peak of 2002 ...



... encouraging for the first try.

J/Ψ *rates (muon channel)*

Double pretrigger requirement at FCS
Full SLT (no p_T or mass cut, no vertex)
No ITR included



Deadtime: 16%

89 ± 15 J/Ψ/hour corrected

J/Ψ *rates (muon channel)*

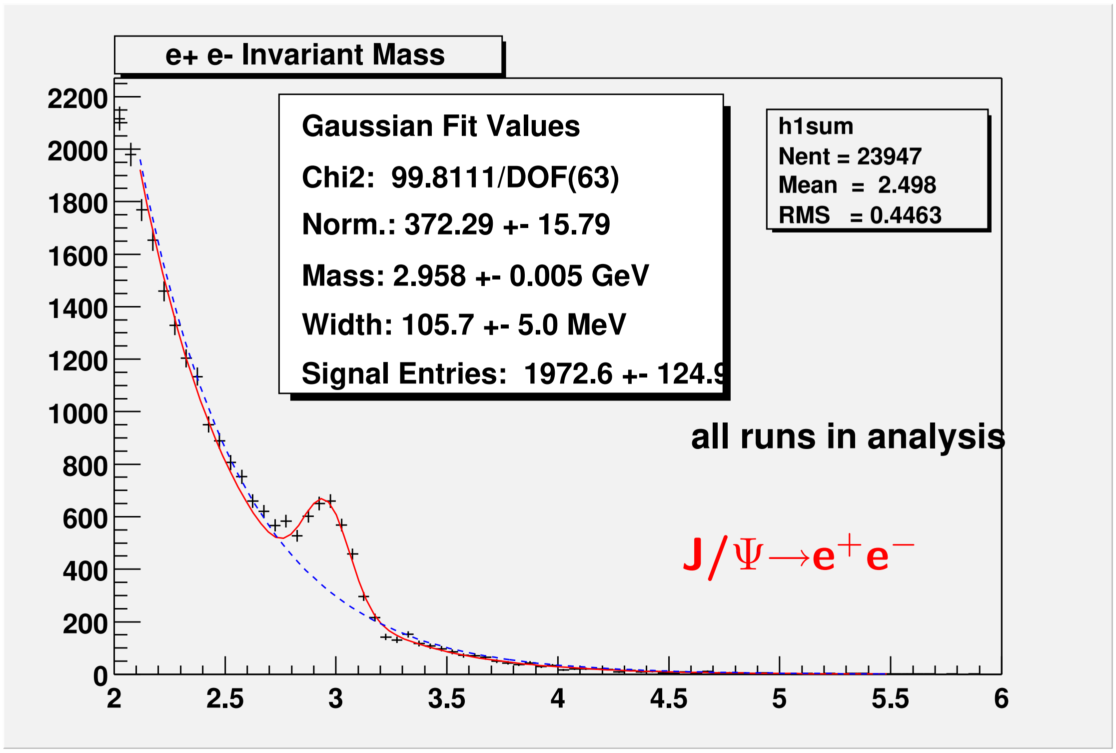
Estimated J/Ψ rate:

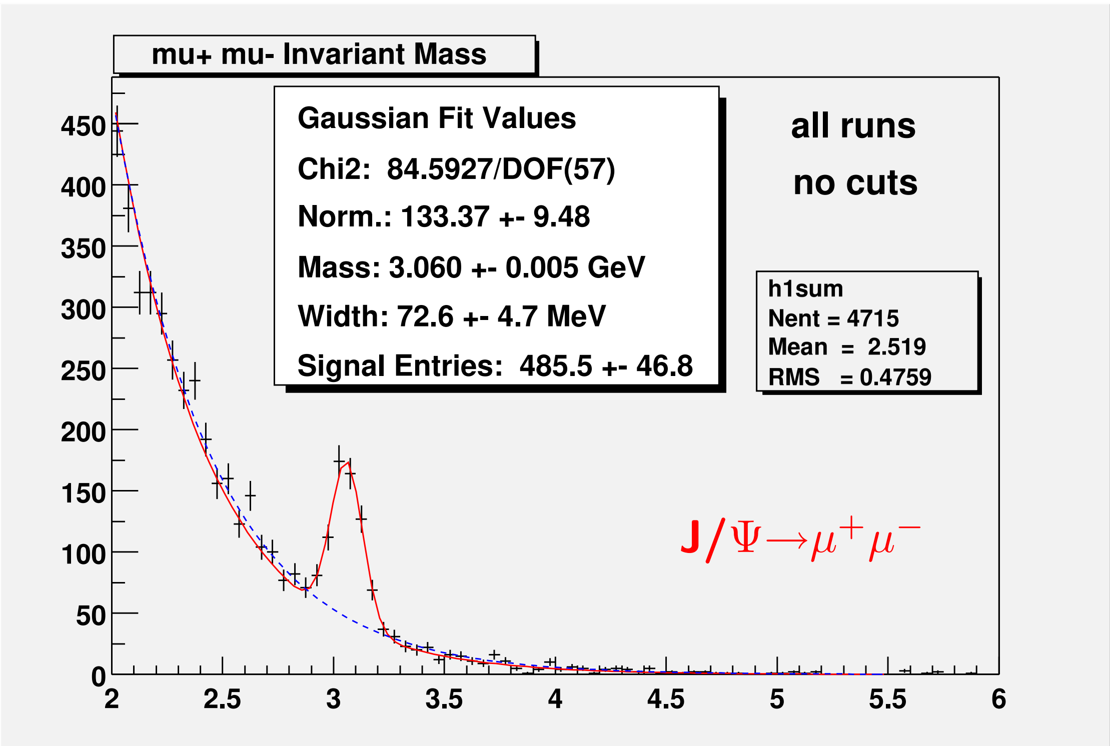
- J/$\Psi \rightarrow \mu^+\mu^-$ production rate: 3400 J/Ψ/hour/MHz
- 3MHz interaction rate (Obseved*1.5)
- .226 (full trigger chain efficiency, incl. ITR – B. Petersen)
- .52 (pad efficiency $(.85)^4$)
- .6 (remove muon pixels and ITR acceptance)
- .84 (livetime FCS counters)
- .5 pretrigger masking
- .5 hit preparation masking
- .93 (TGT: coasting beam, rate stability – M. Funcke)

140 J/Ψ/hour predicted
vs
75$\pm$ 13 J/Ψ/hour observed

Observed = .5*Estimated

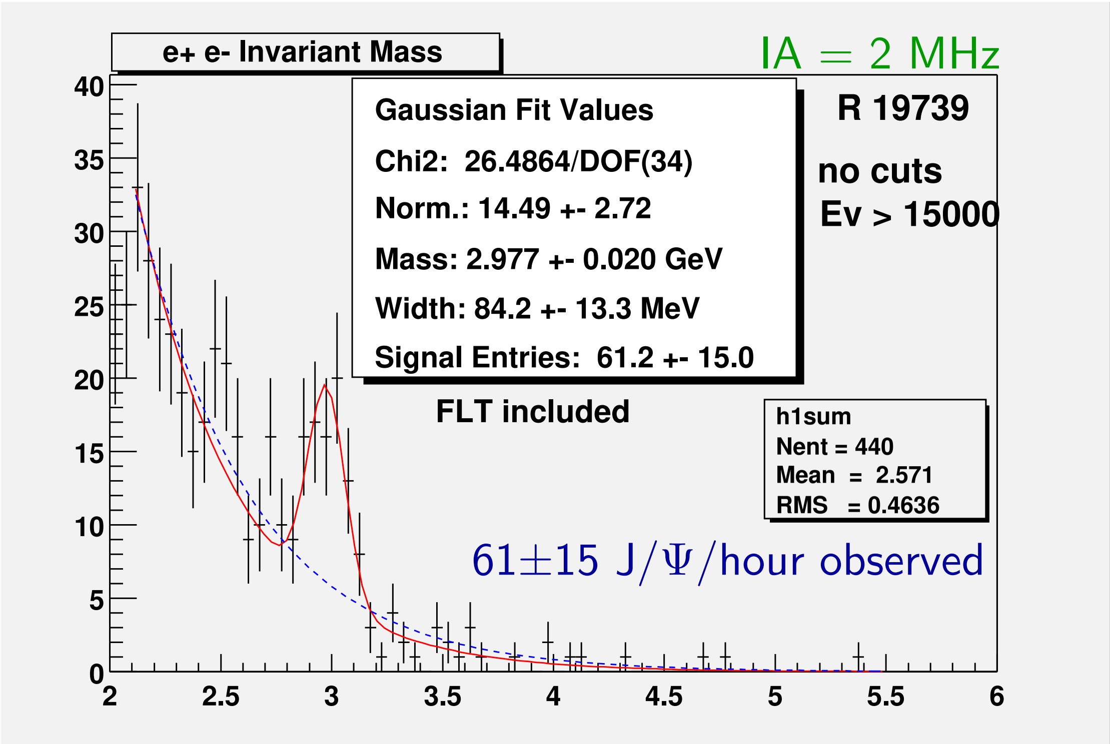
Full J/Ψ sample





J/Ψ rate with FLT

$E_T > 1$GeV at pretrigger level
Double FLT track requirement at FCS
Full SLT (no p_T or mass cut, no vertex)



Analysis cuts:

- OTR multiplicity: nhits < 7000
- E/p: $M - 1\sigma < E/p < M + 1\sigma$
- vertex $\chi^2 < 3$

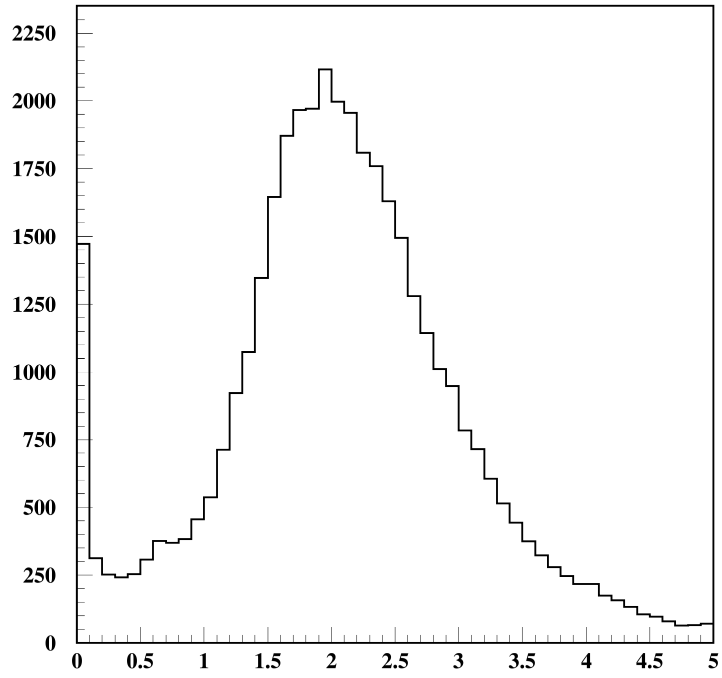
Deadtime: 13%

100 ± 25 J/Ψ/hour corrected
vs
350 ± 50 J/Ψ/hour in pret. + SLT mode

53% FLT track efficiency

High-pt photon signal

Online e^+e^- invariant mass



- High-p_t photon peak can be used for calibration.
- Applying E/p cut ω and ϕ can be observed ... it worths to try.

Next steps

Still quite to do in the commisioning phase ...

- Investigate and optimize the rate limitations
- Continue with the pretrigger+SLT modes but ...
- ... emphasize the commissioning of the FLT+SLT
- Test and implementation of possible trigger scenarios
- ... let's keep space for solving the unknown problems ...
- Optimize SLT algorithm:

  $\Rightarrow$ Size of RoIs
  $\Rightarrow$ Cuts in Slicer, Refit and Silicon algorithms

- Study of additional cuts:

  $\Rightarrow$ E/p cut after SLT chain in electron channel
  $\Rightarrow$ Vertex cut
  $\Rightarrow$ Mass cut after SLT chain