SLT Status & Commissionning plans

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Hera-B Technical Review

1) Trigger schemes/goals 2002

2) SLT upgrade status
   - SLT-MUON tracking
   - FLT-SLT interface / SLT steering
   - Background rejection and latencies

3) SLT commissioning plans
   - Commissioning steps
   - SLT Efficiency determination
   - Manpower situation

Trigger schemes/goals 2002

Baselines for Spring 2002:

- Upgrade/commission SLT in single-FLT/double-SLT mode, with improved efficiency ($\times 3 - 4$) compared to 2000 run.
- Tune/commission SLT in existing pair trigger mode in order to achieve sufficient background rejection ($>= 200$).
- Together with PRE/FLT/DET upgrades, aim for J/Ψ production rate of O(10^3) at 5MHz IR.

Requirements on SLT

- Will depend on Seeding Mode:

  a) Single FLT + 2nd-TDU-PRE Seeding:

  $\rightarrow$ better MUON-TUBE tracking ($\times$ 2.3)

  $\rightarrow$ new MUON-PIXEL tracking (same eff as TUBE)

  $\rightarrow$ CnA and MAP/PAM for SLT-MUON

  $\rightarrow$ new FLT-SLT interface and SLT steering

  $\rightarrow$ new RoI-based ITR(VDS?) sparsification (W.Gradl)

  $\rightarrow$ code optimization (MAP) for handling $\sim$ 20KHz input

  b) FLT pair Seeding:

  $\rightarrow$ not much to be gained from current efficiencies $\Rightarrow$

  $\rightarrow$ optimize Cuts/RoI's for sufficient rate reduction

SLT efficiencies on FLT seeding

Algorithm	MC-2000 (mask)		MC-2000 (ideal)	
	e^+e^-	$\mu^+\mu^-$	e^+e^-	$\mu^+\mu^-$
SLICER	0.99	0.99	1.00	1.00
REFIT-X	0.92	0.91	0.94	0.96
REFIT-Y	0.93	0.97	0.97	0.99
L2MAGNET	1.00	1.00	1.00	1.00
L2SILI	0.93	0.93	0.92	0.94
L2VERTEX	0.98	0.98	0.97	0.98
TOTAL	0.77	0.80	0.81	0.88

Requirements on PRE/FLT/Detector

compared to 2000 performance:

$\rightarrow$ MUON PRE ($\times$ 2)
$\rightarrow$ ECAL PRE ($\times$ 1.8)
$\rightarrow$ FLT/MUON/OTR efficiencies
(FLT$_{MUON}$ $\times$ 2.7, FLT$_{ELEC}$ $\times$ 1.5, SLT$_{PAIR}$ $\times$ 1.6)
$\rightarrow$ PIXEL+ITR in Trigger ($\times$ 1.7) $\Rightarrow$

- Gain factor $\sim$60 in $\mathrm{FLT_{single}/SLT_{double}}$ mode compared to $\mathrm{J}/\psi \rightarrow \mu\mu$ rate 2000

- Pair trigger has (10%) smaller overall efficiency due to FLT

- Partial Inner Detector compensated by running at higher IR in pair trigger mode ?

Expected J/ψ rates in various trigger modes

Trigger Mode	$\mathrm{FLT}_{\mathrm{sinlge}}/\mathrm{SLT}_{\mathrm{double}}$		Pair Trigger	
	e^+e^-	$\mu^+\mu^-$	e^+e^-	$\mu^+\mu^-$
SLT $\times$ RECO	0.63	0.43	0.67	0.79
J/Psi rate	840 /hour	1400 /hour	2600 /hour (*)	1300 /hour

(*) without Bremsstrahlung

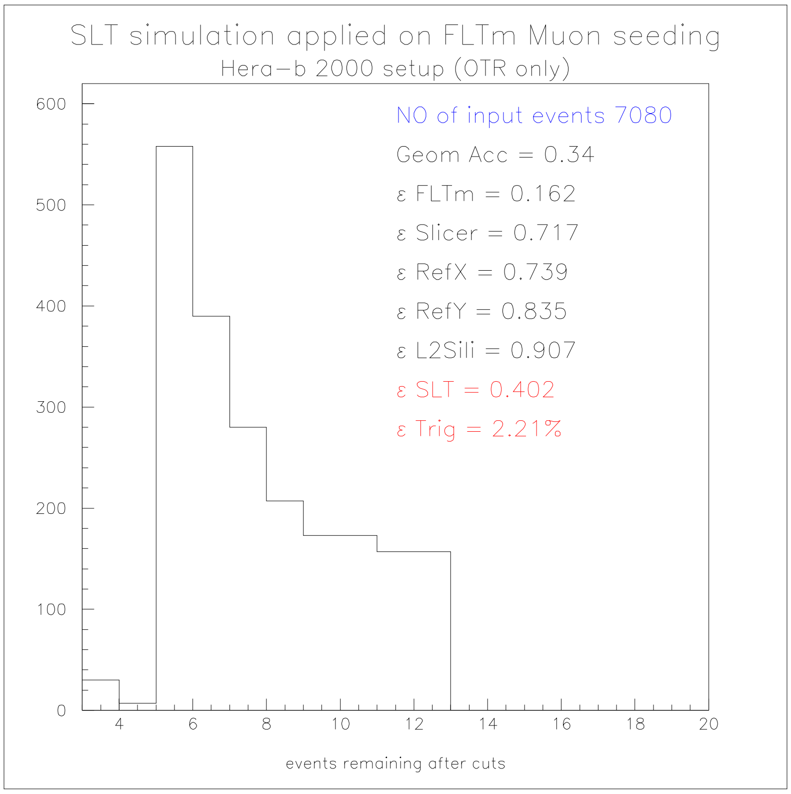
a) SLT-MUON tracking

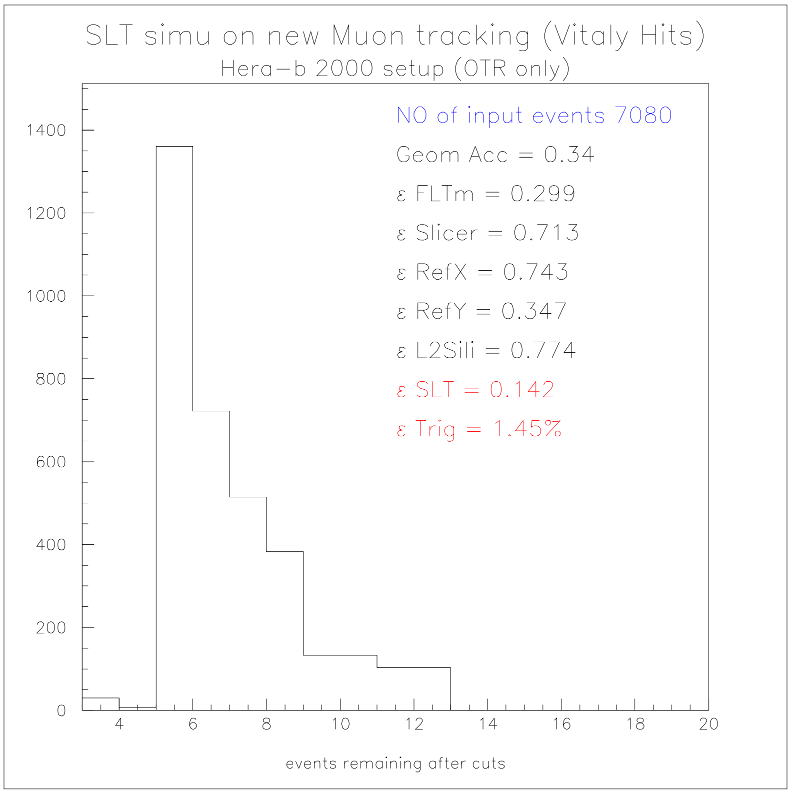
Goals:

- Substitute Second-FLT tracking
- Increase 2000 SLT-MUON efficiency
- Base MUON Hit-Prep and GEO on CnA
- Introduce MAP/PAM for MUON RoI's
- Include PIXEL's

Status:

- PAD-TUBE algorithm running on MC
- Using Hit-Prep from Boris F.
- Hit-Reco/Tracking study (MU1/2)
  - ⇒ Tracking improvement (×1.35)
  - ⇒ Hit-Reco improvement (×1.37)
  - ⇒ But net SLT efficiency decrease !
  - ⇒ Try to include MU3/4 in tracking !
  - ⇒ Need tuning of SLT Seeding !


SLT simulation applied on FLTm Muon seeding
Hera−b 2000 setup (OTR only)
NO of input events 7080
Geom Acc = 0.34
ε FLTm = 0.162
ε Slicer = 0.717
ε RefX = 0.739
ε RefY = 0.835
ε L2Sili = 0.907
ε SLT = 0.402
ε Trig = 2.21%
events remaining after cuts


SLT simu on new Muon tracking (Vitaly Hits)
Hera−b 2000 setup (OTR only)
NO of input events 7080
Geom Acc = 0.34
ε FLTm = 0.299
ε Slicer = 0.713
ε RefX = 0.743
ε RefY = 0.347
ε L2Sili = 0.774
ε SLT = 0.142
ε Trig = 1.45%
events remaining after cuts

Time schedule:

- Optimize TUBE efficiency (1 month)
- Introduce CnA and adapt MUON hit-prep (1 month)
- Introduce MAP/PAM for MUONs
  $\Rightarrow$ complex project (1++ month)
- Pending tasks for including PIXELS:
  - MC-DAQif (digit.) code
  - PRE-TRIG simulation
  - PIXEL Hit-Prep
  - PIXEL tracking

  $\Rightarrow$ additional manpower needed in order to be ready before X-Mas

SLT upgrade status (ctnd)

b) FLT-SLT interface / SLT steering

Goals:

- Upgrade the FLT-SLT interface by decoding 2nd TDU message
- Upgrade SLT handling of different trigger modes (Double/Single track trigger, FLT/Pretrigger tracks, Real/emulated pretrigger)
- Fully steer SLT via CnA (including FLT mode)

Status:

- Code essentially written
- Needs testing on MC and new data

SLT upgrade status (ctnd)

c) Background Rejection and Latency

(from 2000 MUON data at 5MHz)

- In FLT-seeding mode: factor ∼9-10 rejection per track
- In SLT-stand-alone mode: factor ∼50 rejection per track
- Additional factor ∼2 from J/ψ vertex

⇒ FLT_{pair} mode, factor 200 achievable

⇒ $FLT_{single}/SLT_{double}$ factor 1000.

- CPU power due to SLT latency ≤10KHz in 2000 FLT_{pair} mode
- SLT code optimization ongoing (L2Sili,MAP,Refit)
- Need RoI-based ITR-Sparsification (1 month)
- CPU upgrade ? (300MHz → 900MHz)

⇒ in $FLT_{single}/SLT_{double}$ mode, we are aiming to run live at 20KHz

⇒ precise evaluation needed on first 2001 background data

Commissioning plans

- **Prerequisites**

  - PRE-Triggers / FLT-Triggers
  - Calibration (Energy, Dead/hot channel maps)
  - Geom. Alignment ("reasonable" with known resolutions)
  - Efficiency maps for comparing data with MC expectations

- **2001 steps**

  - SLT-2002 MC efficiency determination
  - Update SLT-CnA executable
  - Cycle "new" SLT code online in October dry run
  - ITR Sparsification tests
  - SLT offline analysis on new mbias data
  - First SLT_{Alone} running in December

Commissioning plans (ctnd)

- **Jan/Feb 2002 steps**
  - Exercise PRE/FLT - SLT machinery
  - Evaluate SLT efficiency on new data sample $\Rightarrow$
  - Tune background rejection on FLT input
  - Provide J/ψ sample for 4LT analysis tuning
- **SLT Efficiency Determination**
  - Reconstruct tracks from MUON-efficiency-Run and determine the relative SLT efficiency.
  - Acquire single track MUON/ELECTRON triggers, reconstruct J/ψ offline and measure relative SLT efficiency.
  - Use ECAL-PRE L2Sili-only data to reconstruct J/Ψ offline and measure absolute Slicer/Refit efficiencies.
- **SLT Manpower situation**

  2001: NBI 2 (1 in HH) + DESY 3

  2002: NBI 2 $\rightarrow$ 1 (0.25 in HH) + DESY 3

CONCLUSIONS

- SLT on heavy duty for $\mathrm{FLT}_{\mathrm{single}}/\mathrm{SLT}_{\mathrm{double}}$ trigger mode:
  - new SLT steering written
  - first improvements in TUBE tracking
  - PIXEL hit-prep and tracking delayed due to lack of manpower
- Amount of work for tuning/commissioning the pair trigger mode should not be underestimated, in order to reach the expected perf.:
  - RoI tuning with (drift-time in OTR, L2Magnet, L2Sili, L2Vertex)
  - Bgd rejection studies on new data
- We are still confident to reach the SLT-2002 expectations !