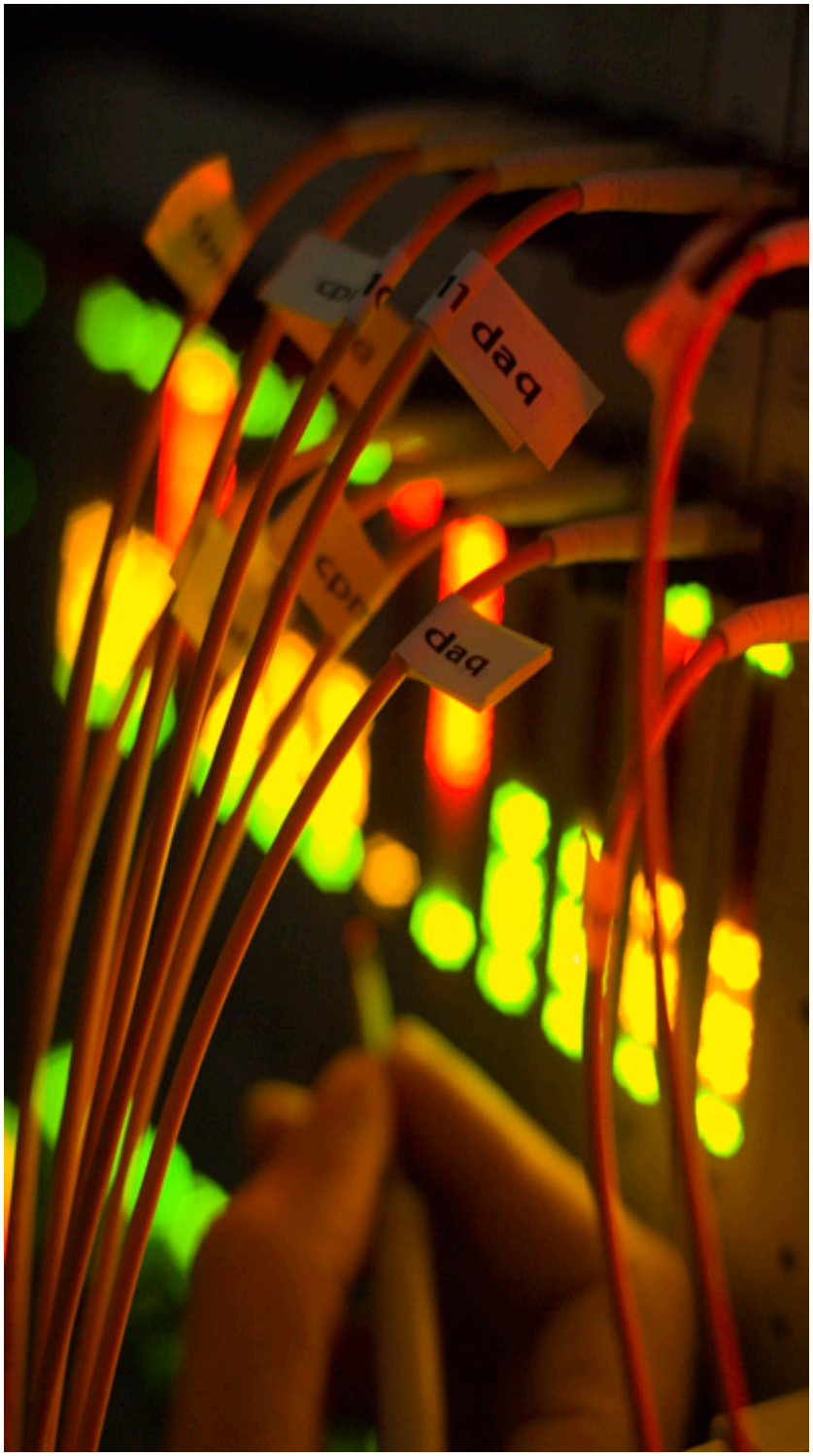
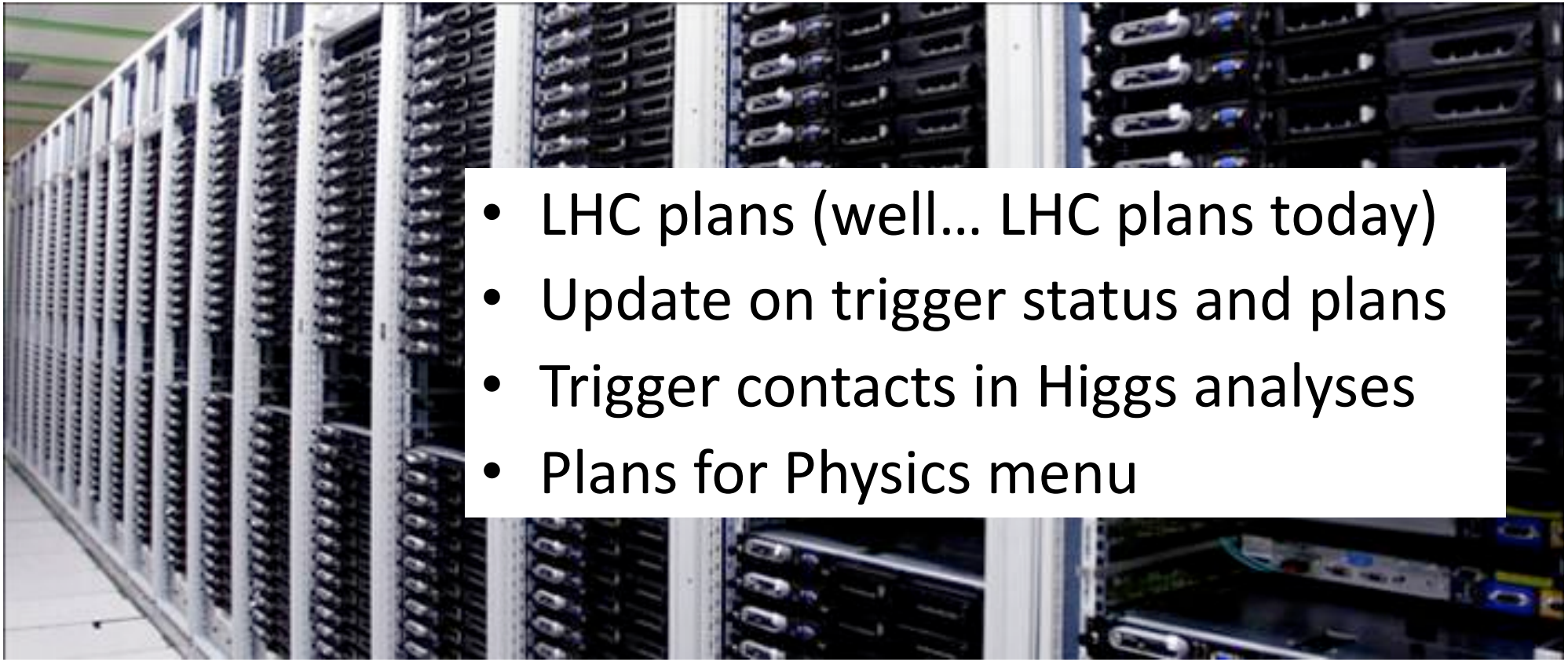


Trigger News

Higgs Working Group Meeting – 29 April 2010

Ricardo Gonçalo, RHUL

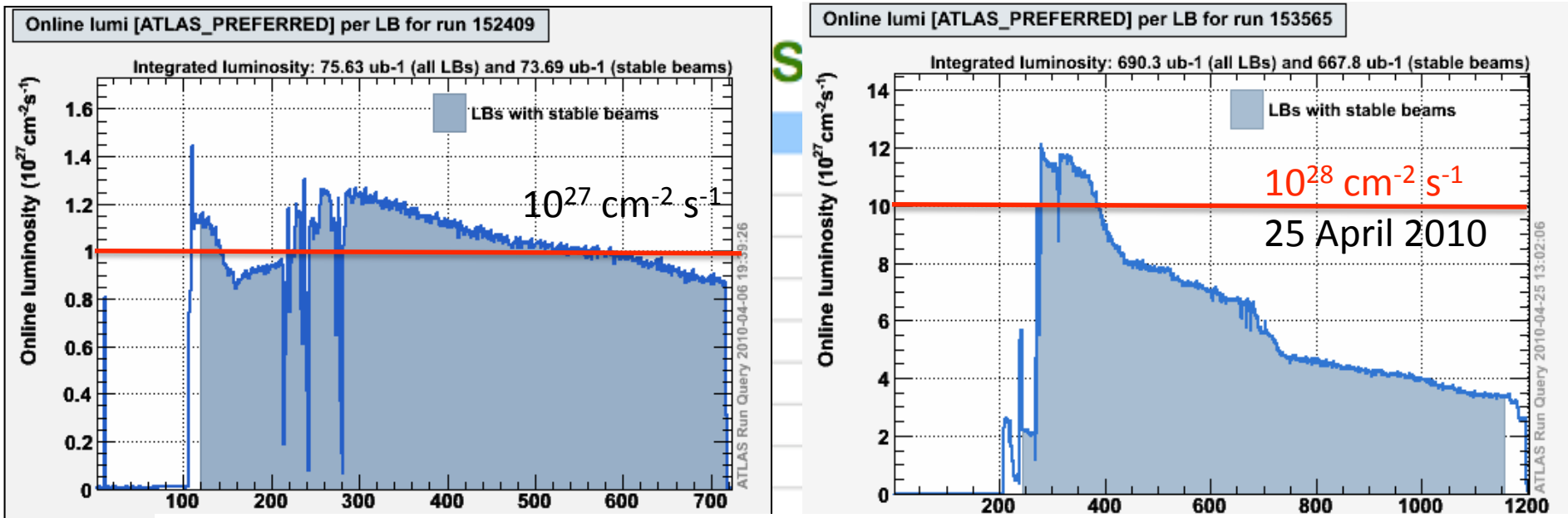
OUTLOOK



- LHC plans (well… LHC plans today)
- Update on trigger status and plans
- Trigger contacts in Higgs analyses
- Plans for Physics menu

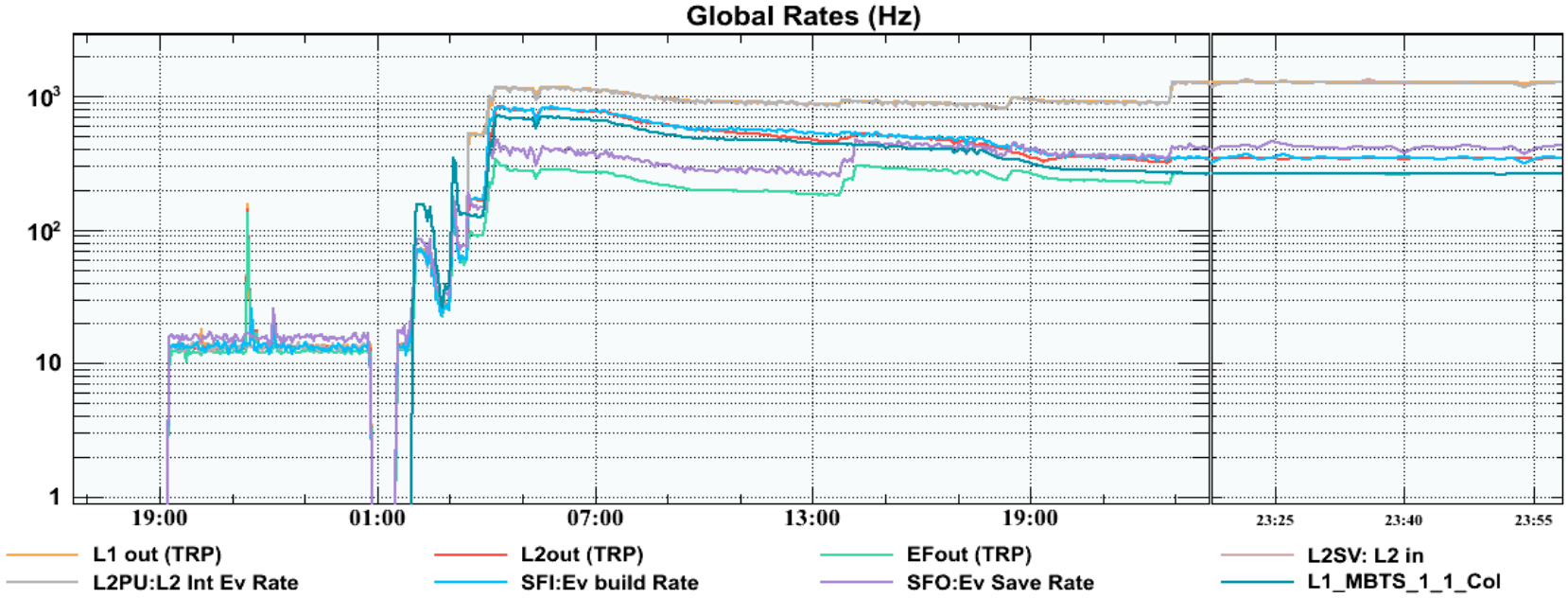
LHC is only just learning to walk, but soon it will be running!

- First LHC high-energy run on March 30th
- Last week running routinely at **10^{27} cm^{-2} s^{-1}** with **stable-beams** flag
- Crossed the **10^{28} cm^{-2} s^{-1}** line with squeezed, stable beams this weekend
- Might achieve 10^{30} cm^{-2}s^{-1} as early as June
- Should take about 3 months to go from 10^{30} to a few times 10^{31} or 10^{32}
- Luminosity will double every ~2 weeks!!!
- Collected just over **1 nb^{-1}** with stable beams so far
  - Expect 1000,000 times more until the end of the 2010 – 2011 run…

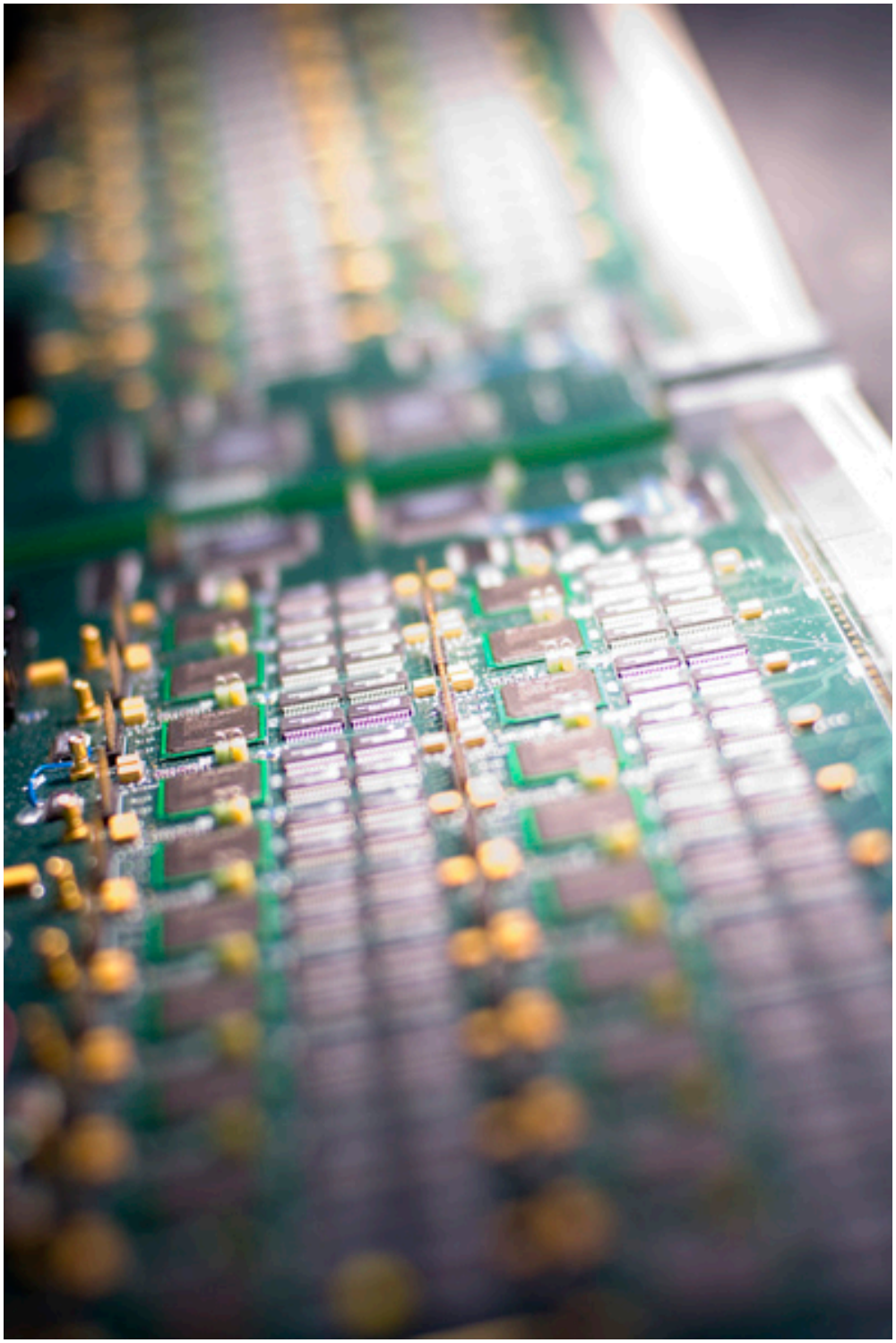


http://lhc-commissioning.web.cern.ch/lhc-commissioning/luminosity/2010-lumi-estimate.htm

- First time we had stable-beams flag on after LHC beam squeeze
  - Stable-beams flag means inner detector high voltage can be fully up
  - β^* squeezed from 11m to 2m
  - **Higher luminosity**: L proportional to $1/\sigma^2_{IP} = 1/(\varepsilon \times \beta^*)$
- Higher trigger rejection achieved **with higher pre-scales** to suppress biggest sources of rate
  - Rates dominated by minimum-bias triggers
- HLT running mostly in transparent mode so far: **Initial Beam** menu
  - One exception L2 MB trigger measuring activity in Inner Detector
  - More rejection at HLT will be needed soon



https://atlas-trigconf.cern.ch/wtrp_archive/2010-04-24/WTRP_wmi/



TRIGGER PLANS

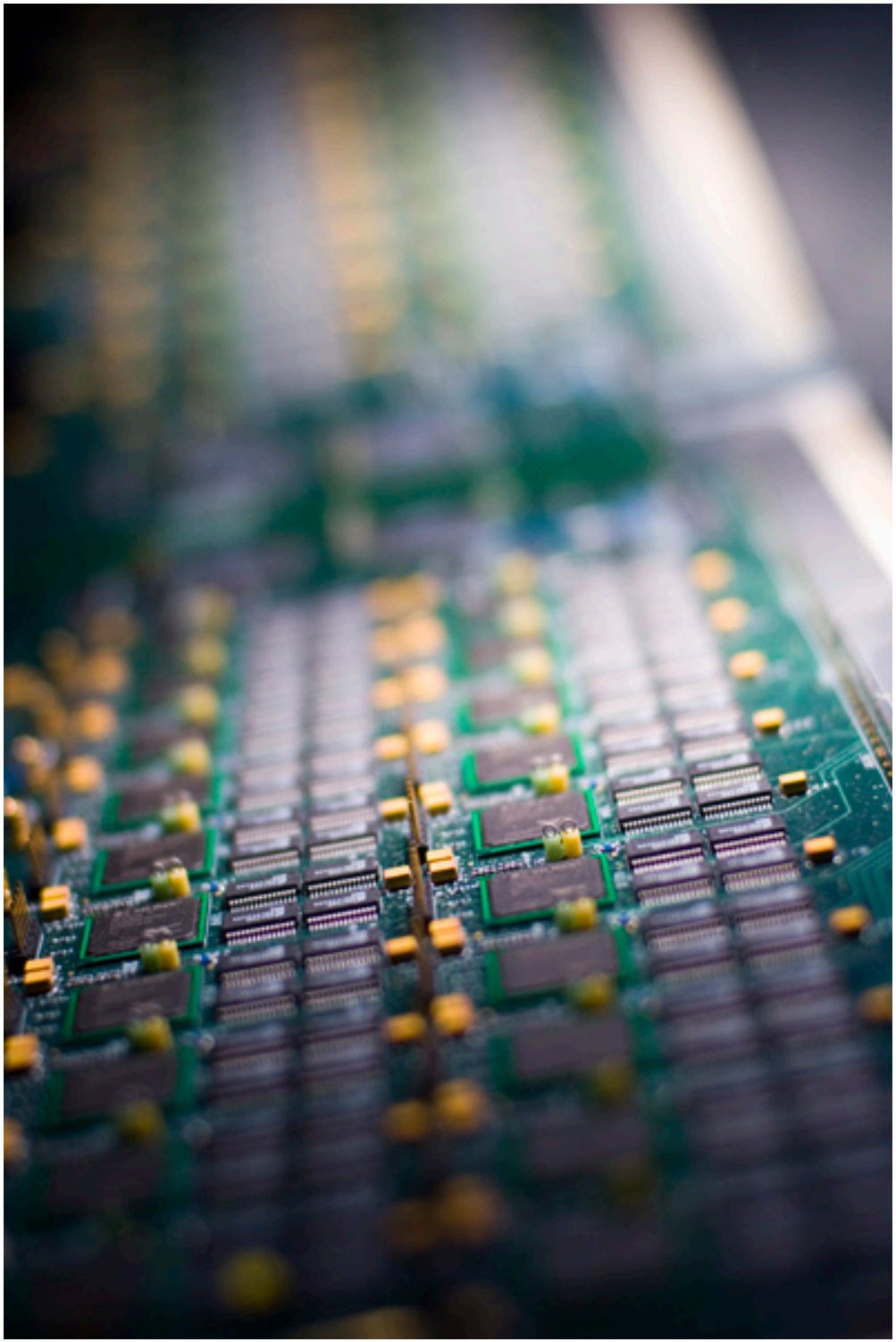
- Currently using the InitialBeam_v3 **commissioning** menu

- Plan to move to **Physics** menu when we reach around 10^{30} $cm^{-2}s^{-1}$
  - Physics menu on the drawing board right now
  - To be based on current estimates for 10^{31} menu https://twiki.cern.ch/twiki/bin/view/Atlas/L31TriggerMenu
  - L1 menu similar to current one and will not change in 2010
  - Plan is to contain most of what will be needed throughout the year, to be activated/deactivated through prescale changes

- From 10^{28} $cm^{-2}s^{-1}$ up to 10^{30} $cm^{-2}s^{-1}$
  - At low luminosities, **MinBias** triggers take up most of the rate
  - With increasing luminosities, MinBias triggers are more prescaled
  - As L1Calo and L1Muon rates grow, HLT starts to be deployed in active rejection (around 10^{29})
    - This can be done one for small groups of chains at a time
    - HLT chains being validated every day in every run
    - In case HLT chains not yet validated, L1 prescales will be used instead.

Other News

- Meaning of **pass-through** factor:
  - Used to be fraction of events seen by trigger that will be forced through the system
  - Will soon be expressed wrt prescaled events – as fraction of non-prescaled-out events that are forced through the system
    - Avoids need to change passthrough factors for every change of prescales
- **Zero-Bias** trigger: L1_ZB
  - Collects unbiased events according to the luminosity profile.
  - Seeded by MBTS_4_4 and triggering on the same bunch after one full revolution around LHC
- **Menu Tools**: looking into tools to monitor the evolution of subsets of the menu (e.g. chains of interest to Phys & CP groups)
- **Releases:**
  - Trigger using 15.5.X caches online – very stable and bug free after a lot of work
  - Under discussion whether to move to 15.6.9.Y caches in next technical stop
  - Many new offline developments could be picked up, but involves very serious validation work
- **Streams**:
  - L1CaloEM stream **dropped**, since it became large fraction of L1Calo
  - RNDM stream now contains both simple random trigger and ZeroBias



TRIGGER AND HIGGS

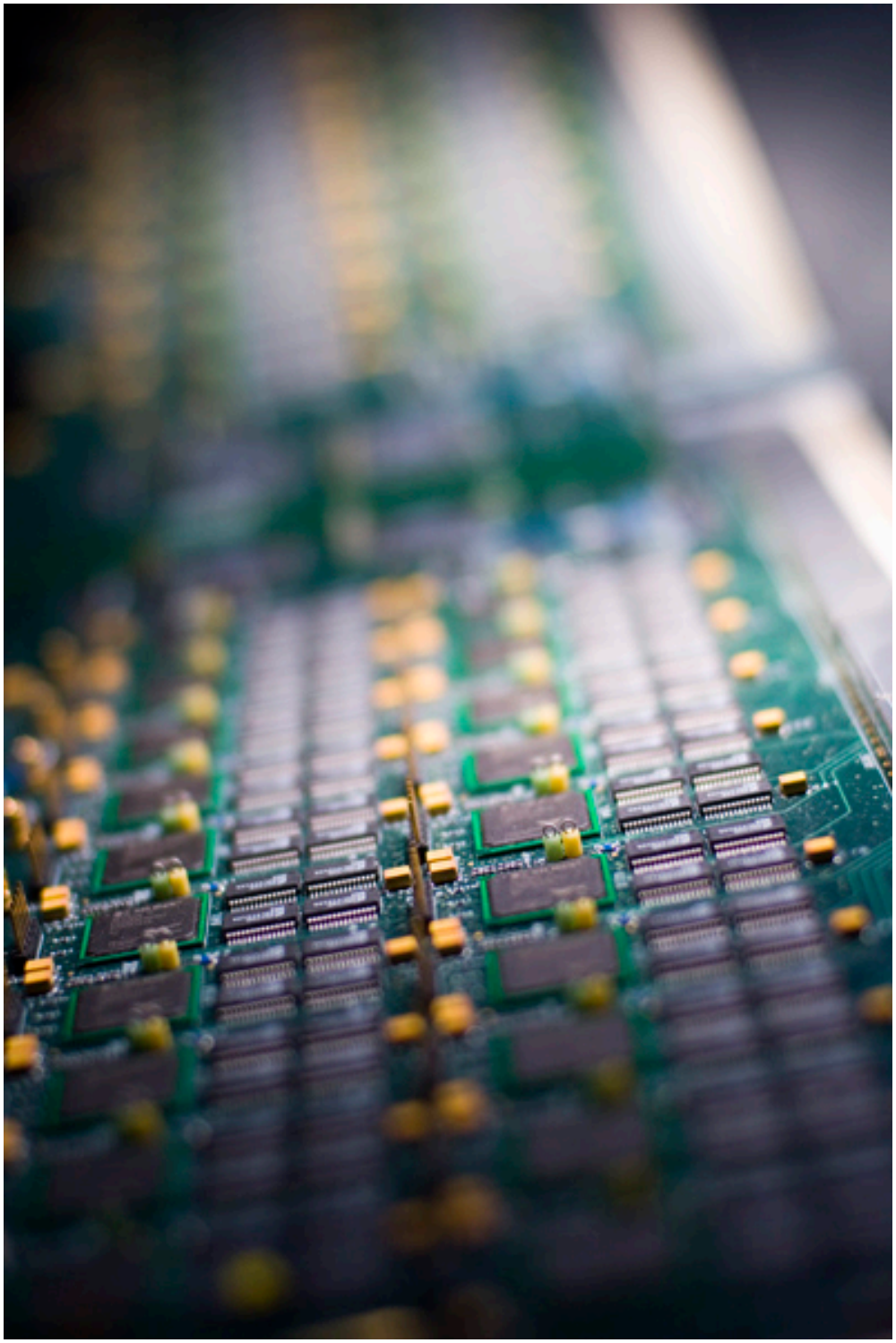
- Trigger **Menus Coordination** is forum for discussing and approving trigger menus
  - Includes detector, comb.perf., and physics groups, plus phys.coord., data prep. etc
  - Higgs Group represented by me

- "Menu representatives encouraged to discuss trigger strategy and collect feedback from respective groups"

- For rapid and efficient feedback, essential to have good contact with all ongoing analyses
  - Set up **network** of people involved in **each analysis**
  - Not expected to do all (or almost any) trigger studies
  - Mostly to know "who to ask"
  - **Many thanks** to all who volunteered for this!

Trigger Contacts in Analyses

Higgs Group	Channel	Contact Person
HSG1	H->γγ	Li Yuan
HSG2	H->4l	Diego Rodriguez
	H->2l2tau, H->2l2nu and H->2l2b	Paul Thompson
	HZ (H->invisible)	Sylvie Brunet
HSG3	H->WW (gg, VBF, WH, ttH, inv.)	Gemma Wooden
HSG4	H->ττ leptonic and lep-had final states	Matthew Beckingham and Henrik Nilssen
	H->ττ hadronic final states	Stefania Xella
HSG5	ttH (H->bb) semileptonic	Catrin Bernius
	ttH (H->bb) hadronic	Michael Nash
	H+ (light, hadronic tau)	Martin Flechl
	H+ (light, leptonic tau)	Arnaud Ferrari
	H+ (heavy)	Martin zur Nedden



Under Discussion: the Physics Menu

Menu Coordination Meeting Today

http://indico.cern.ch/conferenceDisplay.py?confId=93130

Thursday 29 April 2010

14:00 - 14:01 Minutes/Action Items from Previous Meeting (15/4) *01'*

Material: Slides 

14:01 - 14:46 Discussion *45'*

1) Impact of high intensity, bunch trains on trigger

2) Streaming: CosmicCaloEM, Random/ZeroBias,
streaming of empty events of interest to physics

3) Muon trigger commissioning: Need for high MBTS rate into EF.

4) Physics Menu
-- TimeScale
-- Testing of Menus

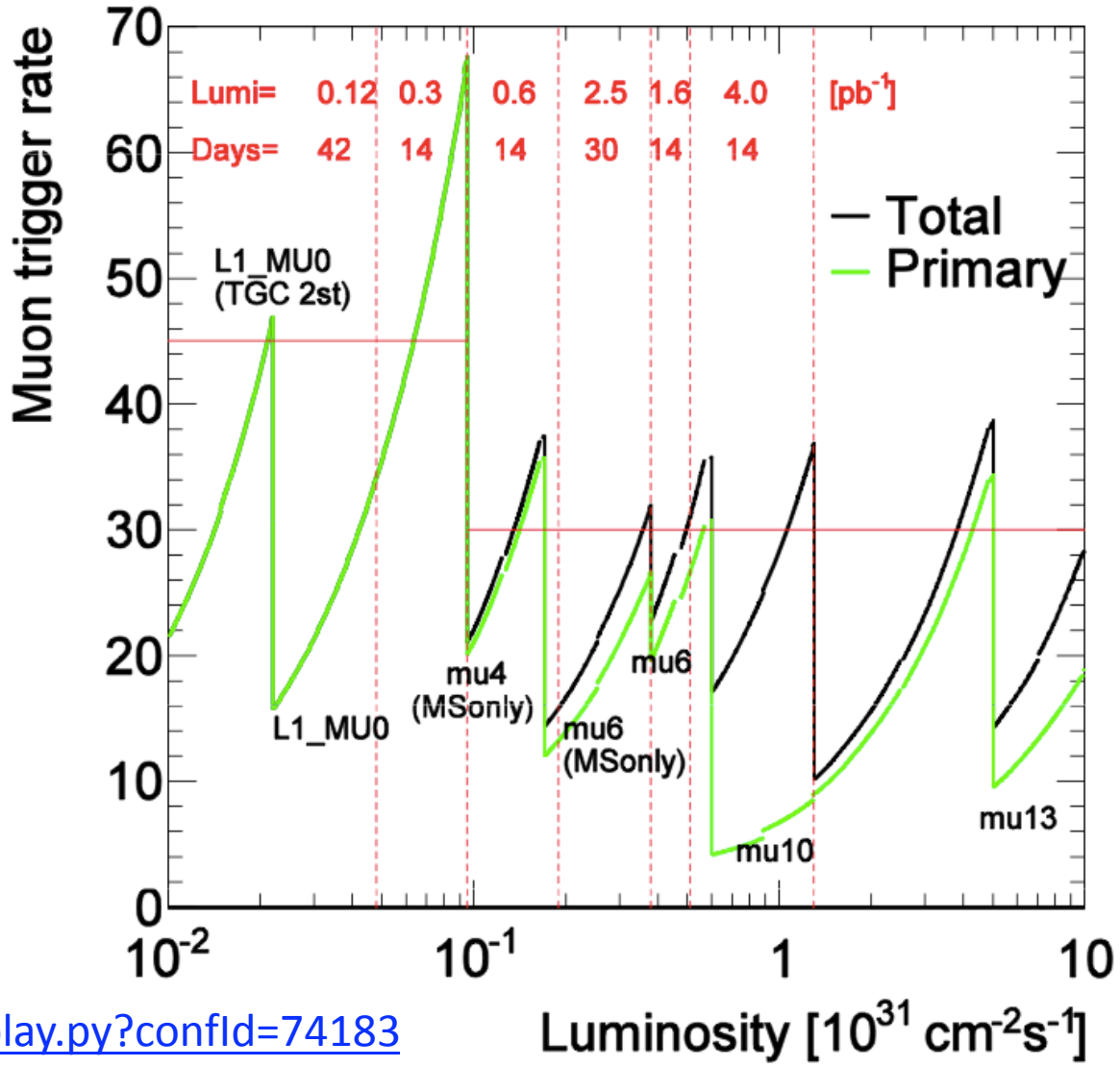
5) Running Missing ET and Jets at EM scale

14:46 - 15:01 Handling short bursts in trigger rates *15'*

15:01 - 15:21 MinBias trigger requests *20'*

Muons

- Primary Physics Triggers as a function of luminosity
- Primary trigger **mu10** up to $4x10^{31}$
- Then move to **mu13** up to 10^{32}



Details in
http://indico.cern.ch/conferenceDisplay.py?confId=74183

Lumi=$10^{31}cm^{-2}s^{-1}$

Note: zero pileup assumed

- Not yet enough stat from data plus not all triggers in initial beam menu, use rates from 15.5.5 and divide by 2.5 (safe estimate comparing data/MC)

2e3_loose	4 Hz (est.)
2e3_medium	2 Hz
2e5_medium	0.6 Hz
2g10_loose	few Hz (est.)
e3_loose (presc)	few Hz
g10_loose (presc)	1 Hz
e10_loose	20 Hz (est.)
e10_medium	11.4 Hz
e20_loose	1.5 Hz
g20_loose	6.2 Hz
em105_passHLT	<1 Hz

- Plus ~5Hz of monitoring triggers
- Total: ~45Hz
- Comments
  - As rates lower than expected run with EM2 in physics menu and use 2e3_loose instead of 2e5_medium
  - Use e10_loose instead of e10_medium
  - Add 2g10 trigger (recent request)
  - As not all rates are yet known, so add some backup, e.g. 2e3 seeded from EM3

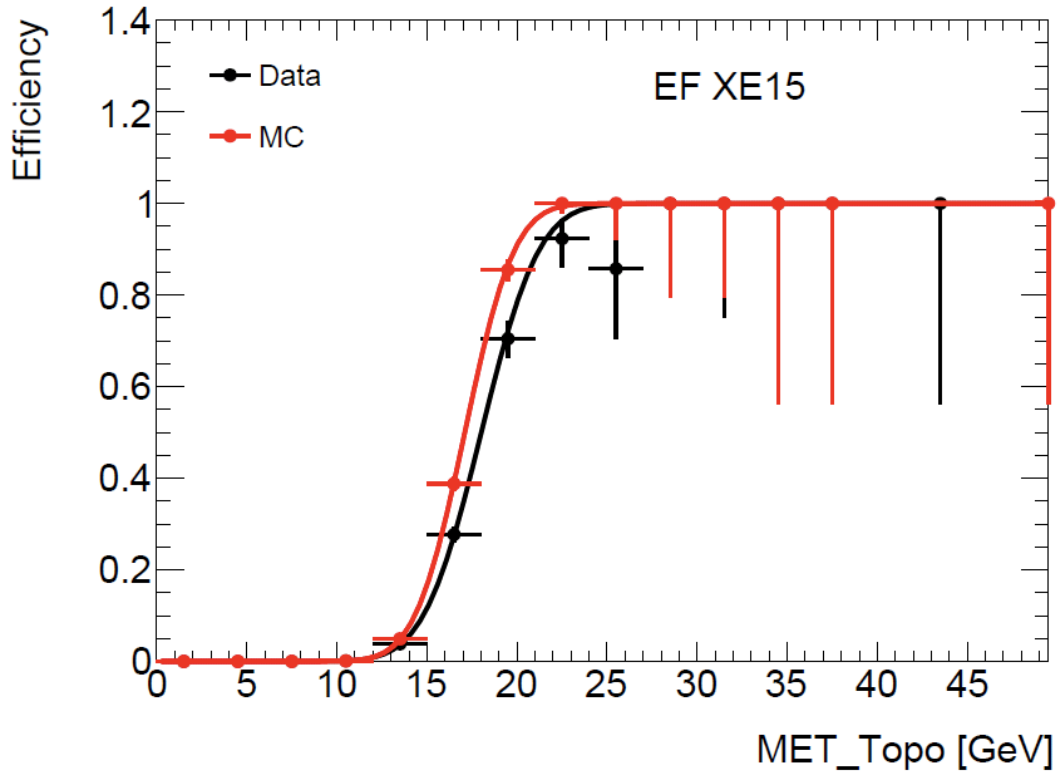
Up to Lumi= few times $10^{31}cm^{-2}s^{-1}$

- Note: by this time we will upload new optimisations which should bring the rates down a bit
- However, now we also have to consider pile-up which increases rates
- Evolution:
  - e10_loose (~$1 \cdot 10^{31}$) → e10_medium, e15_loose (~$2 \cdot 10^{31}$) → e10_tight, e15_medium (~$4 \cdot 10^{31}$) → e15_tight
  - 2e3_loose (~$1 \cdot 10^{31}$) → 2e3_medium (~$3 \cdot 10^{31}$) → 2e3_tight, 2e5_medium or 2e3_medium prescaled
  - g20_loose (~$2 \cdot 10^{31}$) → g20_tight
  - Above depends as well on how fast we ramp up. We don't want to change menu every 2 weeks…

Monika Wielers

Missing ET

- The hope is to have xe30 unprescaled up to a luminosity of 10^{31}
- An inclusive bandwidth of 20Hz was requested so that xe30 can remain unprescaled up to 10^{32}
- Current bandwidth allows running XE15 unprescaled up to 10^{30} (around 15Hz)



D.Casadei

tau50_loose + higher	6.3 Hz
2tau20_loose	2 Hz
tauNoCut_trk9_xe25	5.1 Hz
tau12_loose_xe20	5.1 Hz
tau16_loose_e10_loose	3.8 Hz
tau16_loose_mu10	1.4 Hz
tau16_loose_3j40	1 Hz
Monitoring various	2 Hz

MC

1.3 10^31

Large overlap of
2 tau+met items and
Large overlap with MET
and egamma
=> It is <~ 15 Hz

When looking at rates in data for run 153565 (see rustem online rates)

tau50_loose + higher	3 Hz
2tau20_loose	<1 Hz
tauNoCut_hasTrk9_xe25	<1 Hz
tau12_loose_xe20	1 Hz
tau16_loose_e10_loose	1 Hz
tau16_loose_mu10	< 1 Hz
tau16_loose_3j40	0 Hz
Monitoring various	2 /hz

DATA
(extrapolated)

Monitoring : tau12_loose/ tau12_loose_PT and maybe some L1 (HLT in PT) chain for high pT

Stefania Xella

Work in progress

1 10^32 **no pileup**

(*)
All missing in 10^31 menu

tau84_medium	6 Hz
tau125_loose	<1 Hz
2tau29_medium	3 Hz
tau16i_medium_xe25	10 Hz
tau16i_medium_e15i	7 Hz
tau16i_medium_mu15	7 Hz
tau16_medium_3j40	3 Hz
Monitor. various	2 Hz

MC

Use of medium and isolated for tau triggers in view of scenario with only short time at 10^31 and long at 10^32

+ additionally tau16i_medium -> tau29_loose combinations for tau+X as support (possibly e15i -> e15, request from tau WG). Rate for these is largely overlapping with above.

When looking at rates in data for run 153565 (see rustem online rates)

tau84_loose + higher	6 Hz
2tau29_loose	3 Hz
Tau16_loose_xe25	10 Hz
Tau16_loose_e15	7 Hz
Tau16_loose_mu15	7 Hz
Tau16_loose_3j40	3 Hz
Monitor. various	2 Hz

DATA
(extrapolated)

b-jet input to physics menu

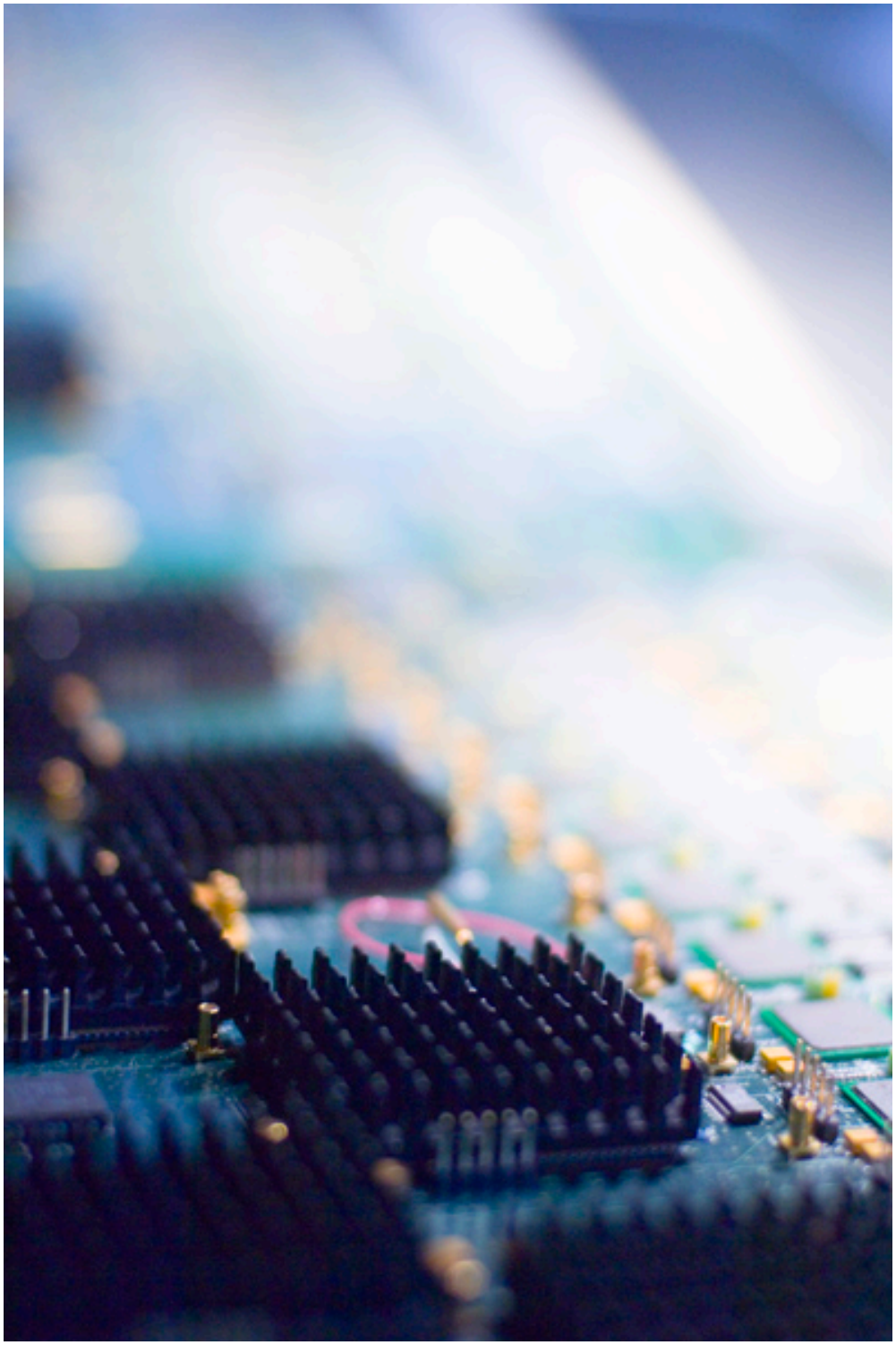
Input is not, unfortunately, based on data experience.
Joint beamspot+*b*-jet CAF reprocessing is going to start and will allow us to evaluate performance of the *b*-jet slice taking into account the beam spot parameters evaluated online (so far online beam spot parameters are not uploaded in the condition folder).

- `-- What are the primary physics triggers for the Luminosity range of 1030 to 1032 for each lumi step (if prescaled then to which rate)`

  2b20_3L1J20, 3b20_4L1J20, 1b40_2b20_3L1J10, 1b40_2b20_3L1J20, 2b40_3L1J20, 3b20_4L1J10.
  All unprescaled: at present they only account for 0.07 Hz at 10^{31} Hz.

  One can say that is a quite conservative approach..
  Indeed we would like to relax a bit the selection or decrease the thresholds but beforehand we need to understand out performance on data (beamspot dependence, performance of different taggers).

  - Proposal: add few, lower thresholds, signatures (ready to prescale them is the rate becomes too high).



CONCLUSIONS

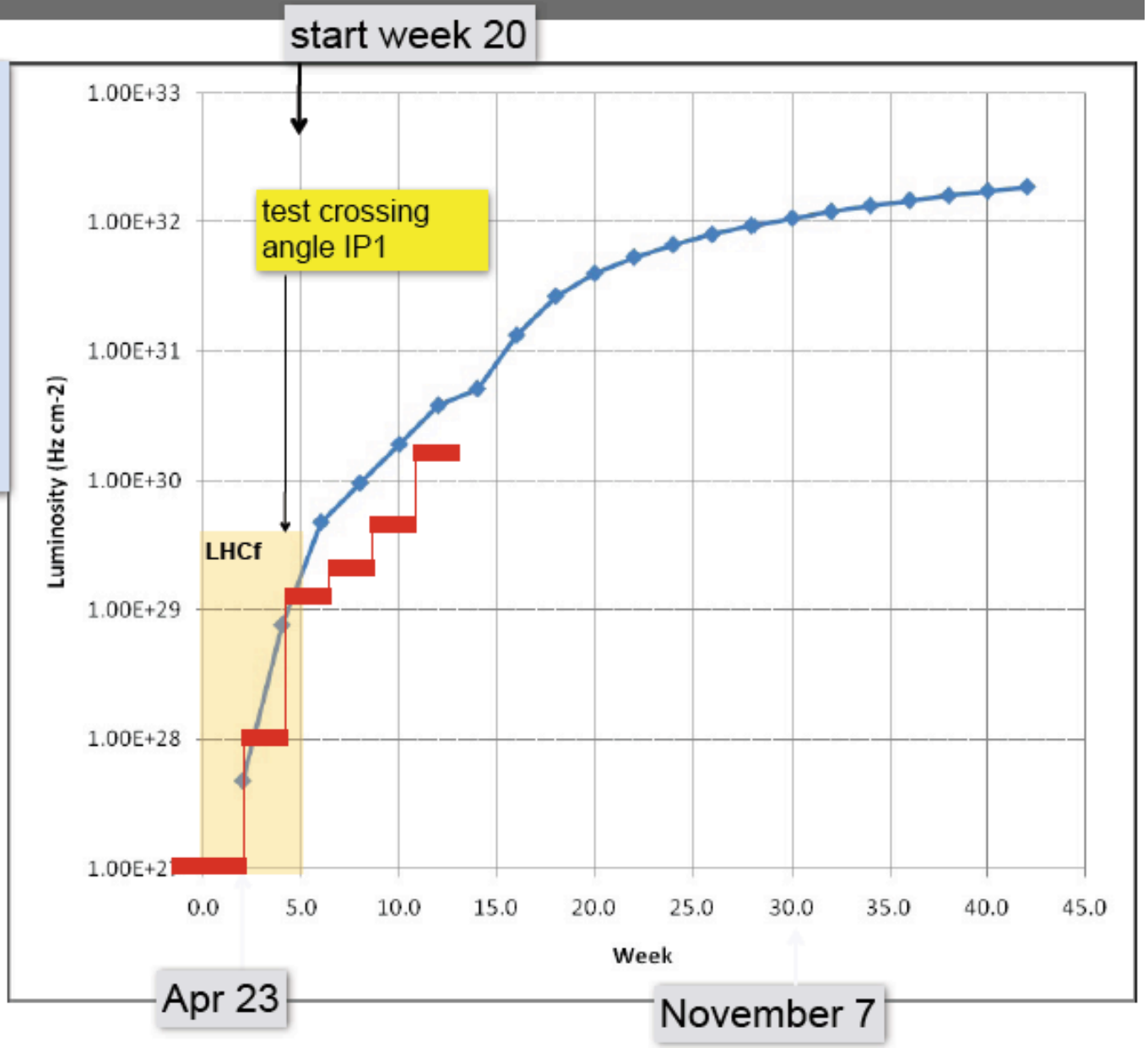
- The increasing LHC luminosity means the HLT will soon need to actively reject events
- Moving from commissioning menu to physics menu
- Relying on trigger contact people in analyses to spread information on trigger strategy
- Input welcome!

BACKUP SLIDES

Lumi evolution (Initial thinking from LPC coordinator)

Initial thinking
Details cannot be shown publicly yet

Highlights
- going to ~10^{11} p/bunch by week 26
- going to 50ns bunch train as early as week 28

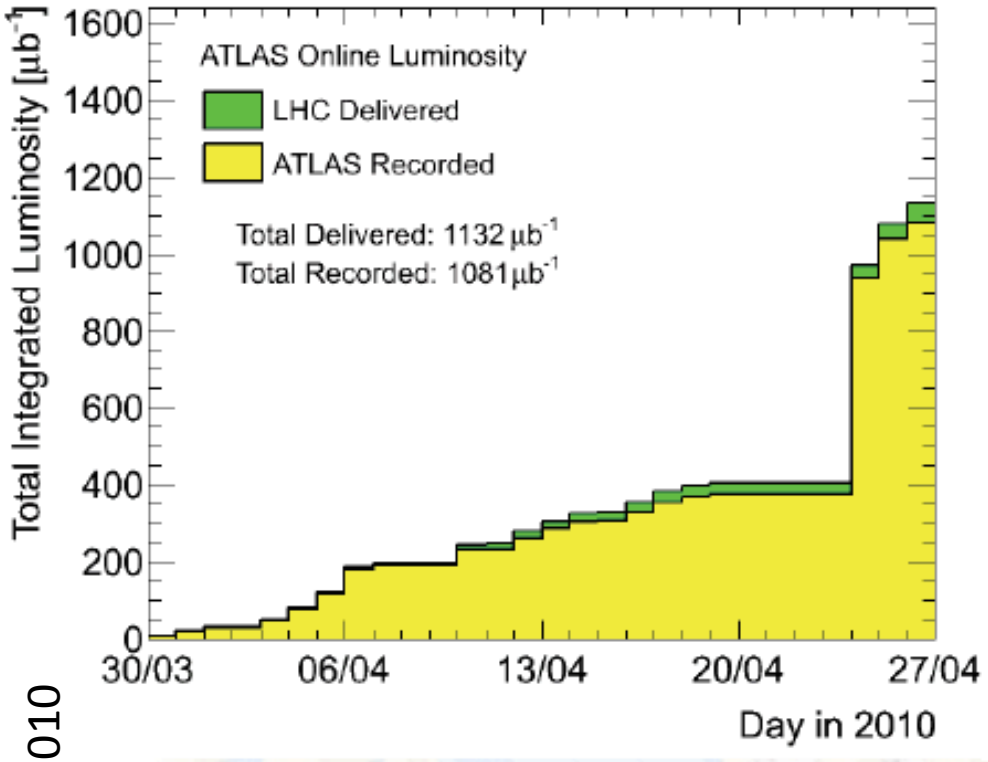


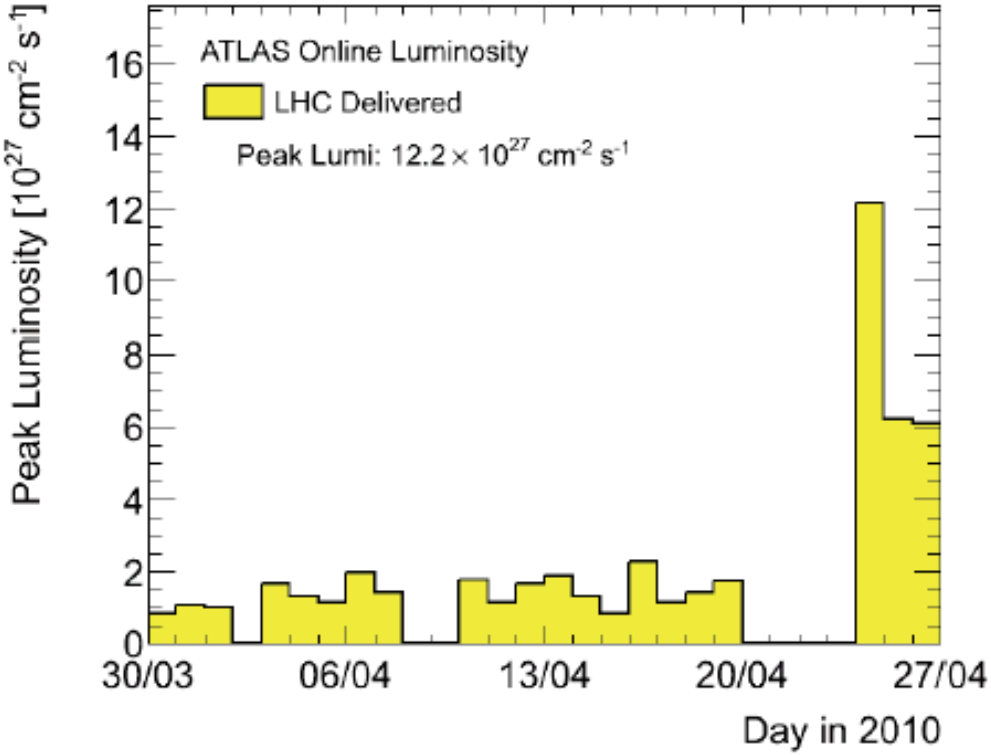
23.4 - ...
2m 3x3 1.1e10 p/bch

30.3 - 19.4
10m 2x2 1.1e10 p/bch

B.Gorini – ATLAS weekly 27/4.2010

Overview of luminosity





ATLAS weekly 27/4.2010

- Collected just over **1 nb^{-1}** so far with stable beams
- Peak luminosity **1.2E28 cm^{-2}s^{-1}**
- Data taking efficiency (ATLAS Ready fraction): **95.5%**

Moving from 15.5.X to 15.6.9.Y online

Summary:

– **many changes make commissioning the HLT w.r.t. offline much harder to understand the efficiency of the EF in particular**

• ID ~100 tag changes, Tracking ~50 tag changes

– most are multiple updates and most are used in the trigger.

– Performance tweaks, especially for low pt tracking., and EDM interface changes.

• Some minor changes to the persistent classes for the muon EDM, which may improve online

performance but definitely improve ESD/AOD/DPD i/o performance. Not especially needed online.

• Tau: the 'current safe tau offline optimization' due to change soon, not necessarily in Tier0

• Many calo and tau reco changes, hard to tell effect from ChangeLog, so request reprocessing.

• Jets: new offline jet software brings the data-based JES and anti-kT jet algorithm , move to EM energy scale. Some of this could be back-ported.

• MET: few things (robustness fixes for higher lumi) they would like to either back port or get by moving to 15.6.9.

• Muons: major changes in offline muon reco which affect EF & EDM, in particular would reduce EF timeouts. Would prefer to move to 15.6.9 but back port looks possible.

• **Conclusions from this:**

– **Strong cases to move to 15.6.9 from tracking, ID and muon.**

– **Requests to run tests with 15.6.9 to get more feedback from the**

signature groups.

Pro

– Useful/essential for HLT commissioning to have very similar EF & Reco

in HLT and Tier0

• June already too late though?

– Useful to have HLT online and MC with much closer release, for

analysis

– Validation of physics perf in 15.6.9 by signature groups has been very

thorough, for MC

Con

– 15.5.7 very well validated for online use w.r.t. technical issues, while

15.6.9 is not; would take some time and effort

– Would not be great time to switch release after HLT commissioning

has started. But still sooner is better than later.

– Unknown how reco will respond to higher lumi. If Tier0 doesn't

effectively freeze at 15.6.9 for the rest of the year we gradually lose

the "closer" advantages above.

Initial EF bandwidth allocation proposal

	Total 1E+30	Total 1E31	Total 1E+32
MinBias	20	10	10
Egamma	30	45	50
Muon	30	30	50
jets	25	25	20
tau	20	20	15
met	15	15	10
Bjet	10	15	10
Bphys	15*	15	10
ID calib	5	2	2
LAr calib	5	2	2
Tile calib	5	2	2
Muon	5	2	2
Other	10	5	5
Total	195	188	188

Average maximum over the fill is **200Hz**
Short spikes up to 300Hz are acceptable

+10 Hz for express stream

* at 1E+30 used by Muons

Waited by partial event size

The feedback should be sent to trigger menu coordination group

Muon trigger

```
primary=mu6_MSonly
  mu4_MSonly PS=10

primary=mu6
  mu4 PS=10

primary=mu10

 < 10*31
  mu4 PS=8
  mu6 PS=6

10**31
  mu4 PS=200
  mu6 PS=100

primary=mu13
  mu6 PS=100
  mu10 PS=10
```

	InitialBeam_v2/v3	Physics_1E31
PT1	mu4	mu4
	mu4_passHLT	
	mu4_MSonly	
	mu4_SiTrk	mu4_SiTrk
	mu4_tile	mu4_tile
	mu4_tile_SiTrk	
	mu4_trod	mu4_trod
	mu4_trod_SiTrk	
	mu4_MG	mu4_MG
	mu4_NoIDTrkCut	mu4_NoIDTrkCut
	mu4_L2MSonly_EFFS_passL2	
	mu4_MSonly_EFFS_passL2	
	mu4_MB2_noL2_EFFS	
PT2	mu6	mu6
	mu6_passHLT	
	mu6_MSonly	
	mu6_SiTrk	
	mu6_MG	mu6_MG
PT3	mu10	mu10
	mu10_passHLT	
	mu10_MSonly	
	mu10_SiTrk	mu10_SiTrk
	mu10i_loose	mu10i_loose
	mu10_MG	mu10_MG
	mu13	mu13
PT4		
PT5	mu15	mu15
PT6	mu20	mu20
	mu20_MSonly	mu20_MSonly
	mu20_passHLT	mu20_passHLT
2mu	2mu4	2mu4
	2MUL1_i40_HV	2MUL1_i40_HV
	2mu4_MSonly	
	2mu6	2mu6
	2mu10	2mu10
	mu4_mu6	mu4_mu6

Missing in this table
Primary:
MU4_MV
Supporting:
EF_mu4_MB2_noL2_EFFS

Primary
Supporting
Backup
Commissioning

Alex Oh

Additional Information

Trigger user info:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerUserPages
Tutorials:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerSoftwareTutorialPage
TDT Twiki:	https://twiki.cern.ch/twiki/bin/view/Atlas/TrigDecisionTool
TDT Doxygen:	http://atlas-computing.web.cern.ch/atlas-computing/links/nightlyDevDirectory/AtlasOffline/latest_doxygen/InstallArea/doc//TrigDecisionTool/html/index.html
Trigger obj matching:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerObjectsMatching
TrigAnalysisExample:	http://atlas-computing.web.cern.ch/atlas-computing/links/nightlyDevDirectory/AtlasOffline/latest_doxygen/InstallArea/doc/TrigAnalysisExamples/html/index.html
UserAnalysis example:	https://twiki.cern.ch/twiki/bin/view/AtlasProtected/UserAnalysis
Trigger Configuration:	http://trigconf.cern.ch
TriggerTool:	http://www.cern.ch/triggertool
Run query:	http://atlas-runquery.cern.ch/
Trigger EDM:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerEDM, http://alxr.usatlas.bnl.gov/lxr/source/atlas/Trigger/TrigEvent/TrigEventARA/TrigEventARA/selection.xml
TriggerMenu group:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerPhysicsMenu
TriggerSW group:	https://twiki.cern.ch/twiki/bin/view/Atlas/TAPMCoreSW
TriggerConfig group:	https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerConfiguration
Help on e-groups:	hn-atlas-TriggerHelp at cern.ch