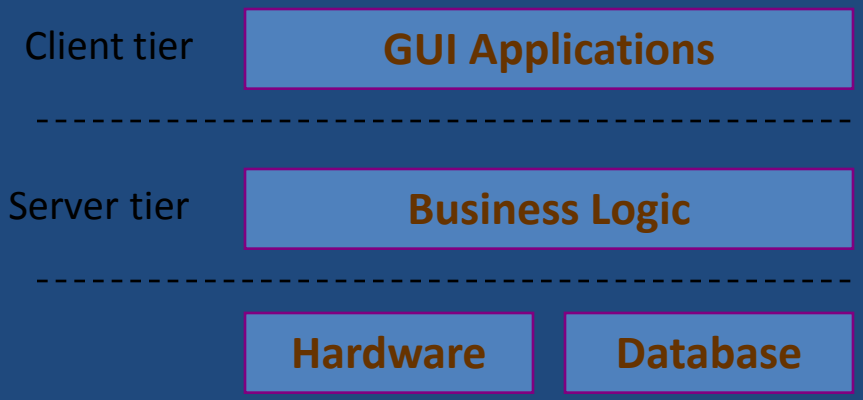
LSA Issues

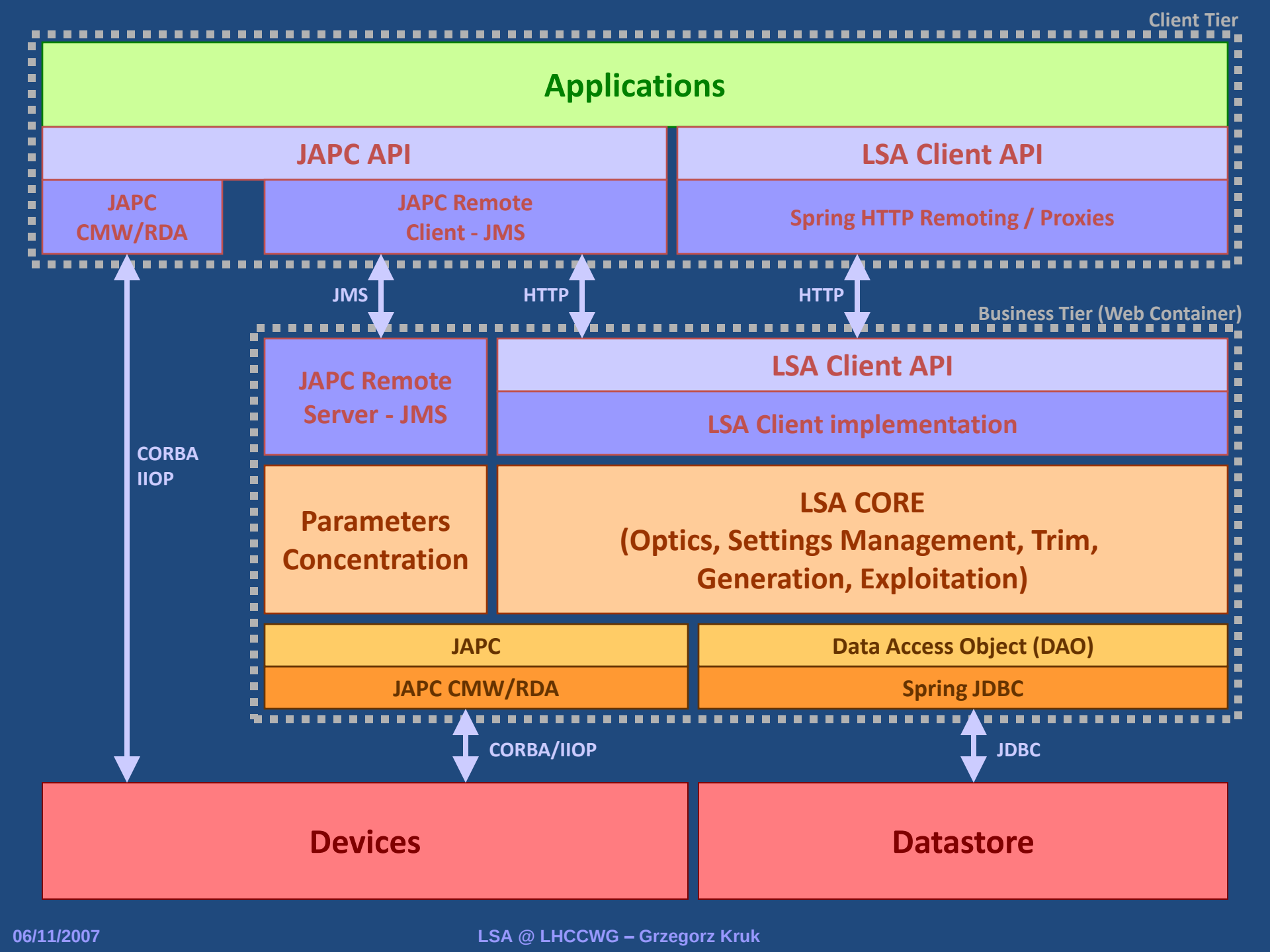
Mike Lamont

Architecture - 3-tier approach

- We wanted to deploy the system in 3 physical layers due to:
  - Central access to the database and to the hardware
  - Central security
  - Caching
  - Reduced network traffic
  - Reduced load on client consoles
  - Scalability

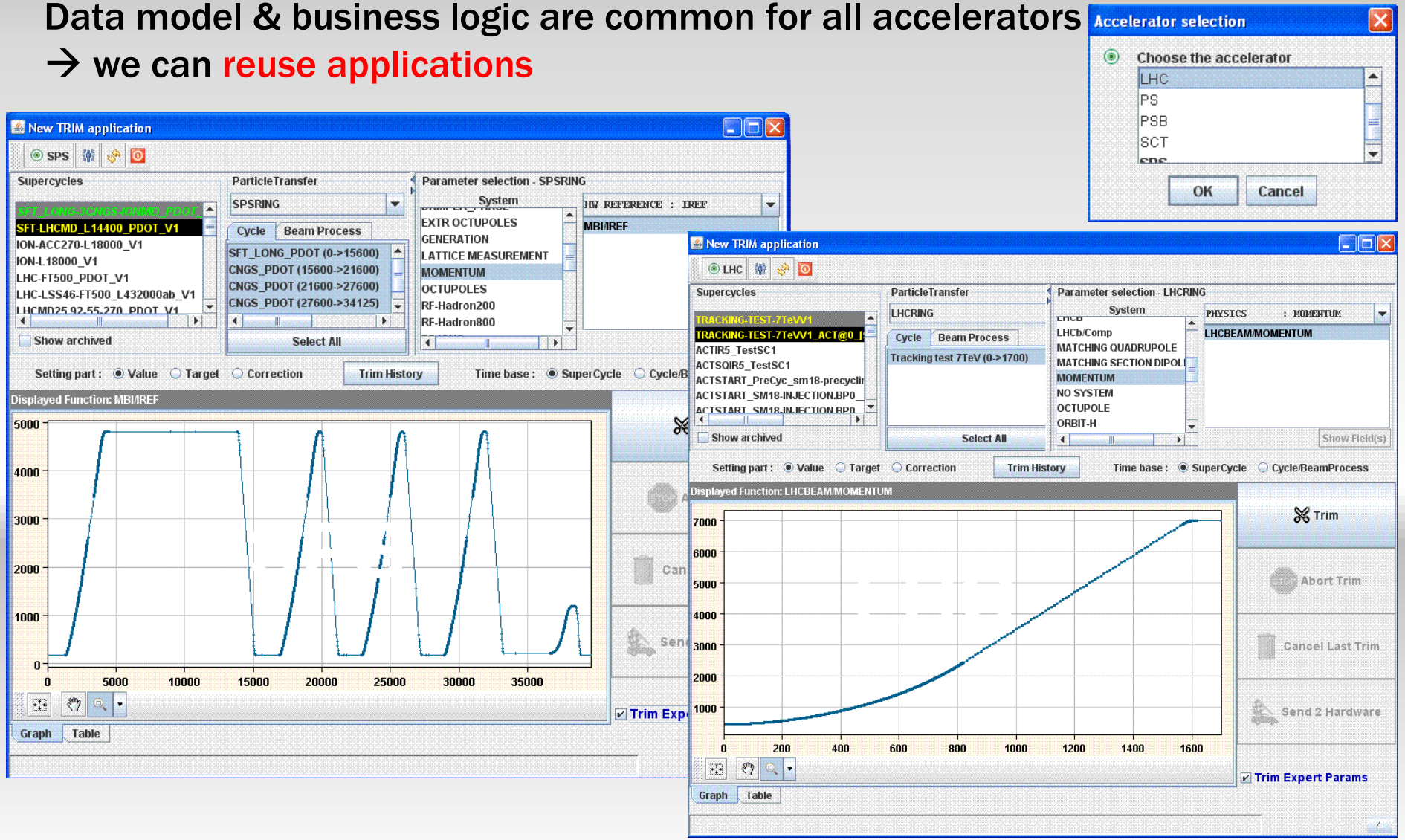


- With a minimal cost of 3-tier architectures
  - Complexity of programming
  - Testing & debugging
  - Deployment

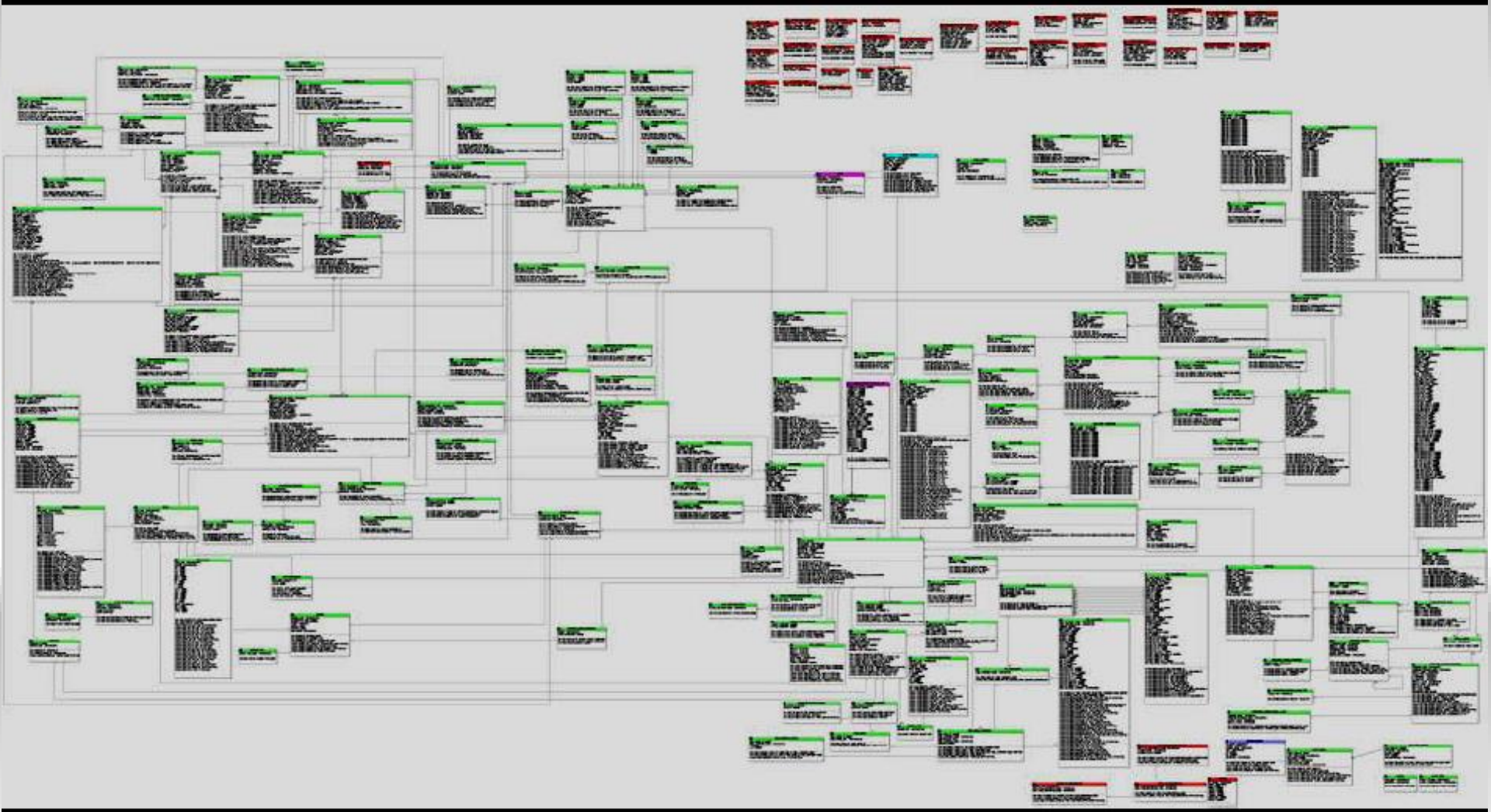

Client Tier
Applications
JAPC API
LSA Client API
JAPC CMW/RDA
JAPC Remote Client - JMS
Spring HTTP Remoting / Proxies
JMS
HTTP
HTTP
Business Tier (Web Container)
JAPC Remote Server - JMS
LSA Client API
LSA Client implementation
CORBA IIOP
Parameters Concentration
LSA CORE (Optics, Settings Management, Trim, Generation, Exploitation)
JAPC
Data Access Object (DAO)
JAPC CMW/RDA
Spring JDBC
CORBA/IIOP
JDBC
Devices
Datastore

Generic Applications

Data model & business logic are common for all accelerators
→ we can reuse applications



complicated data model



Chris Roderick circa 2007

representing a complicated domain


Logging
Measurements
LSA

production database												
	3-tier					2-tier						
Application	SPS	LHC	LEIR	PS	PSB	SPS	LHC	LEIR	PS	PSB	DEBUG (SPS)
EquipState	run	run	run	run	run	run	run	run	run	run	run
EquipMonitor	run	run	run	run	run	run	run	run	run	run	run
Trim	run	run	run	run	run	run	run	run	run	run	run
Trim History Browser	run	run	run	run	run	run	run	run	run	run	run
Steering	run	run	run	run	run	run	run	run	run	run	run
Drive	run	run	run	run	run	run	run	run	run	run	run
Resident Sequence Management	run	run	run	run	run	run	run	run	run	run	run
Global Generation	run	run	run	run	run	run	run	run	run	run	run
Settings Manager	run	run	run	run	run	run	run	run	run	run	run
Settings Viewer	run	run	run	run	run	run	run	run	run	run	run
Parameter Viewer	run	run	run	run	run	run	run	run	run	run	run
Optics Viewer	run	run	run	run	run	run	run	run	run	run	run
Knob creator	run	run	run	run	run	run	run	run	run	run	run
Auto trim	run	run	run	run	run	run	run	run	run	run	run
PC Measurement	run	run	run	run	run	run	run	run	run	run	run
Acquire Settings	run	run	run	run	run	run	run	run	run	run	run
Calibration Curves Generation	run	run	run	run	run	run	run	run	run	run	run
Parameters Configuration	run	run	run	run	run	run	run	run	run	run	run
AcceleratorMode/BeamMode	run	run	run	run	run	run	run	run	run	run	run
LSA App Suite	run	run	run	run	run	run	run	run	run	run	run

LSA/InCA changes during LS1

Among other things….

Greg Kruk

- LSA DB schema change
  - No need to change the code
  - Some attributes will be added to certain domain objects
- Repackaging of LSA modules
  - Impact - all apps depending on LSA
  - Re-release to use the new products
- LSA Client APIs cleanup
  - The existing functionality won't be removed but you might need to update your code

Will make the non-backward compatible changes this year. **This means that ALL the applications that use LSA APIs will have to be adapted to follow these changes**.

Settings Generation

- Existing tools
  - Optics import
  - Knob upload
  - Aperture model
  - Beam process scan and anticipatory feed-forward

- From Greg:
  - Basically the three things will change:
  - Delphine is implementing the API to save new optics/twiss in LSA DB. This is to use an application rather than Perl script to do the optics upload
  - Last year Pablo implemented storage of measured Twiss parameters but I think it wasn't used yet operationally
  - We'll change slightly the lsa-client APIs and domain objects that are used to access the optic/twiss information

Including: collimations, RF, transverse feedback, BI etc. etc.

Pre-cycle and ramp-down combo

- Cycle generation data driven
  - Update relevant tables and go
  - Some tinkering required
- It will, of course, take longer
  - Ramp-down from 6.5 TeV
    - Triplets, Q4 limit circumvention? Some PC options to explore.
- Full pre-cycle
  - Dipoles to 6.5 TeV – relatively fast
  - Triplets and selected IPQs to 4 TeV, say, to avoid the wait.

Injection

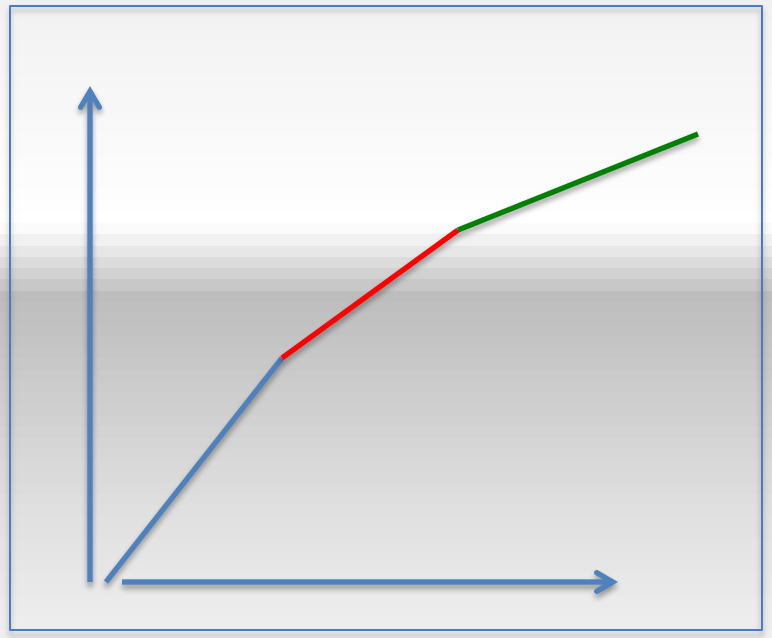
- b2,b3 decay at injection
  - Re-measure without correction
  - Update model coefficients
- Corrections applied by server (recently adopted orphan)
  - Might think about making this a little more robust
    - E.g. ability to switch hypercycles and keep book keeping straight

Ramp

- Snapback (b2,b3,b4,b5)
  - Leave start ramp as is (pretty fast already).
    - Note suggestion by Serge Claudet to slow it down – to reduce step function like change seen by cryogenics. Easily done.
  - flat-top current in on-line FIDEL, re-generate of course
  - Re-measure bare ramp, adjust model etc.

Optics change in the ramp (2 & 8)

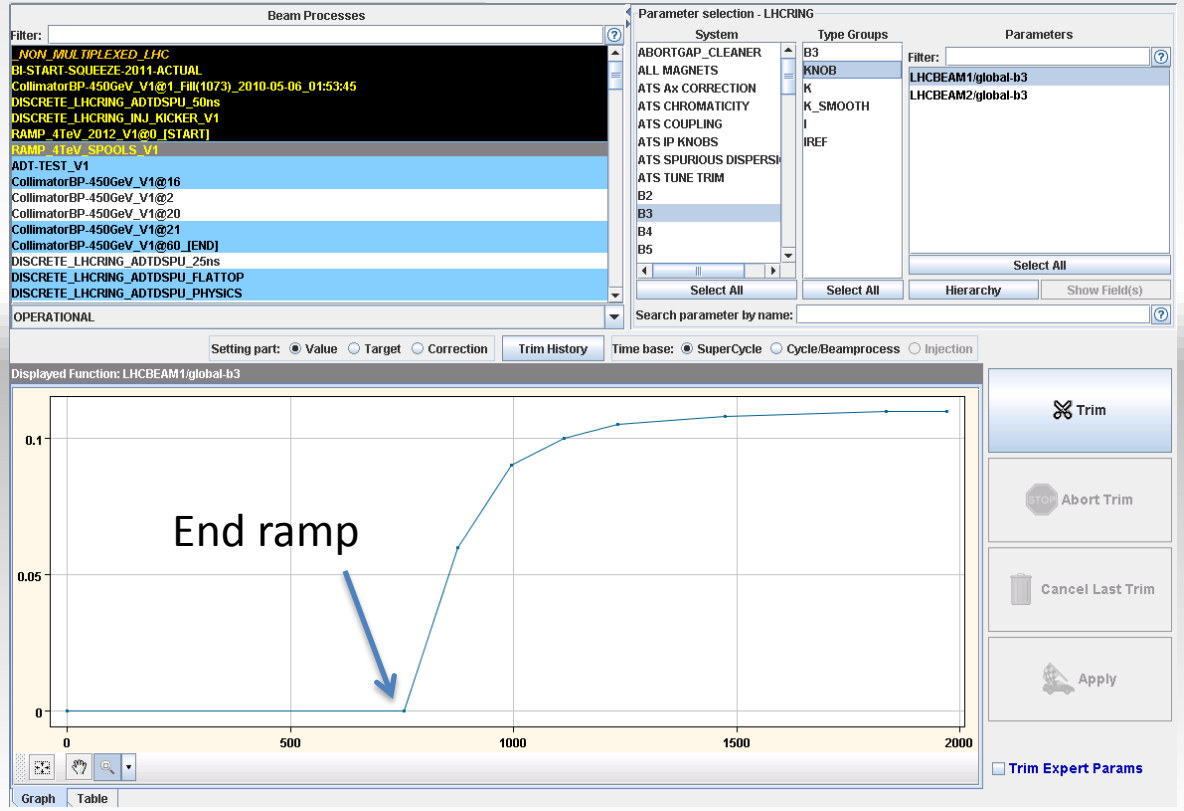
450 GeV	O1
1000 GeV	O1
3000 GeV	O2
6500 GeV	O2



Suitably spaced to avoid a significant discontinuity in the first derivative of the I(t)

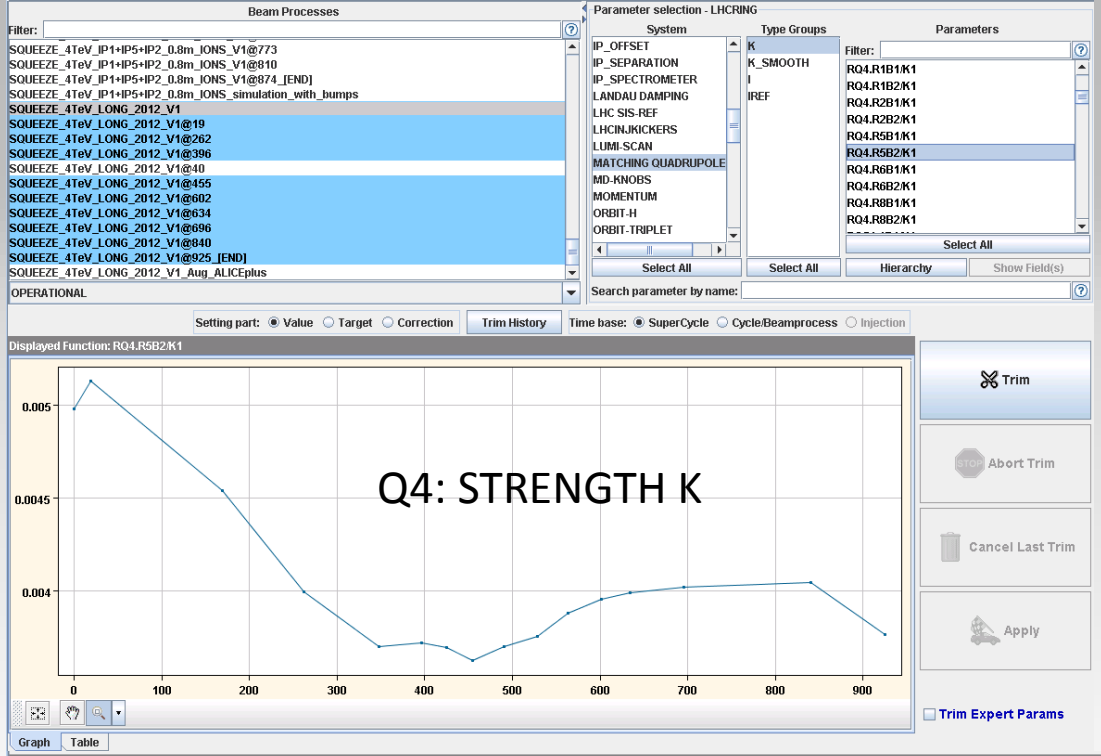
Flat-top

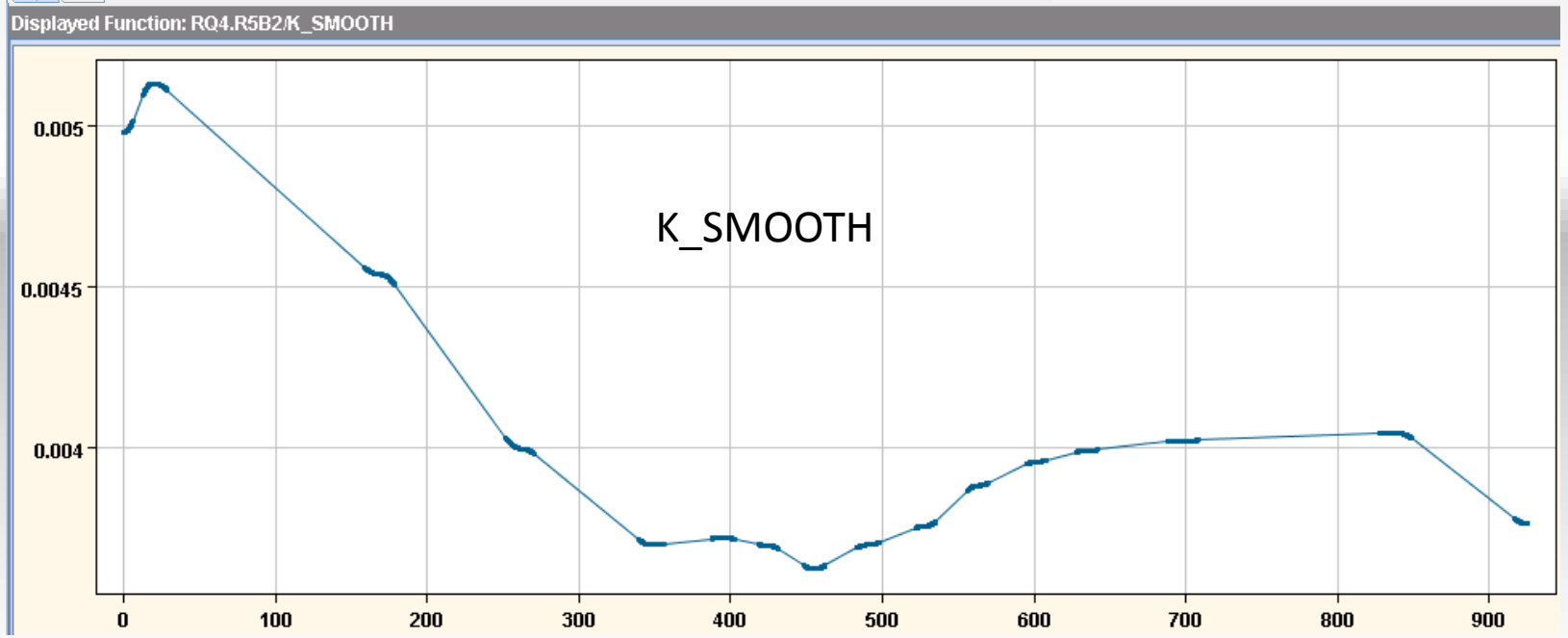
- Here we have a separate beam process for the spools, allowing function driven compensation of decay on flat top
  - Will be less significant but still worth correcting

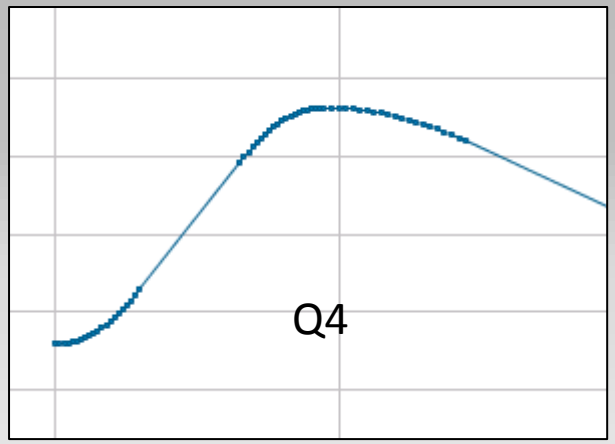


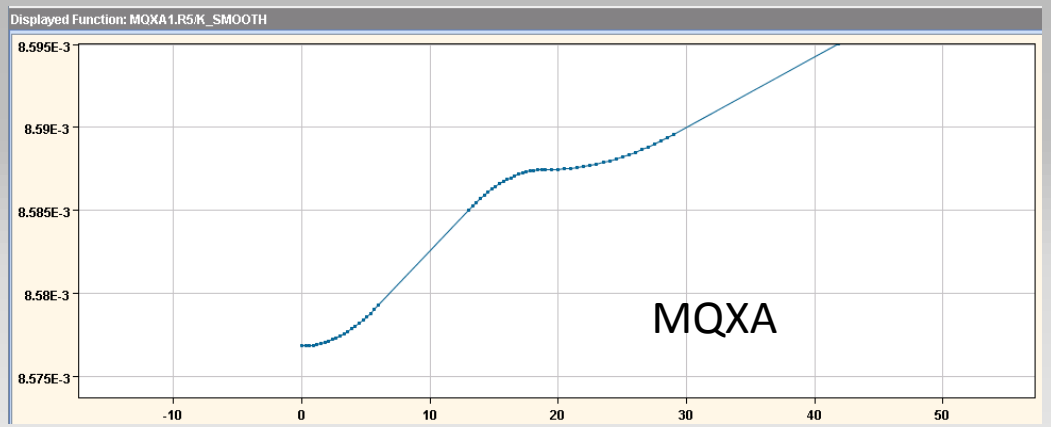
Squeeze

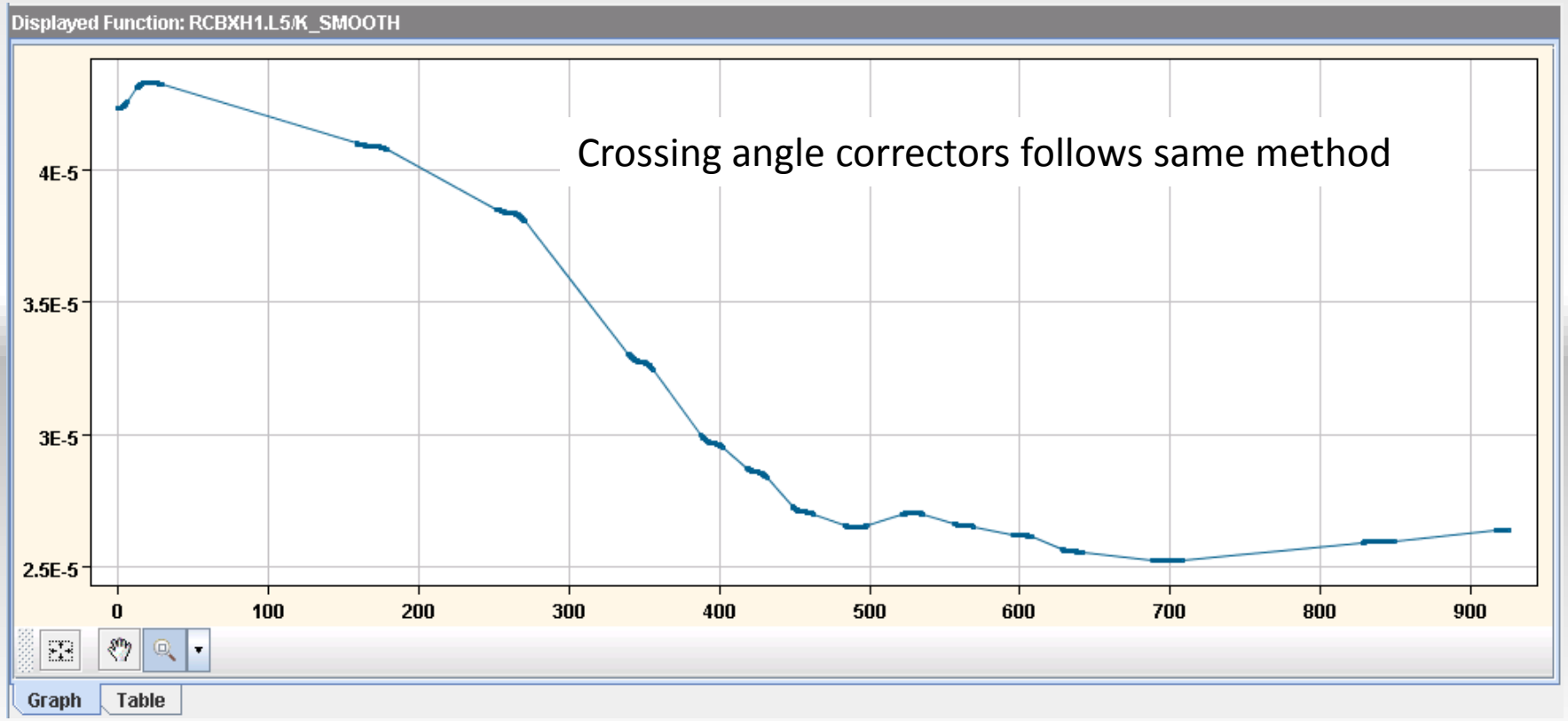
- Interesting problem
  - Adopted three strategies for consistent optics transitions and smooth behaviour of current functions
    1. Strict parabolic – linear – parabolic (IPQs, triplets..) between matched optics points
    2. Bespoke PLP for trims between matched points
    3. Nothing
  - Orbit correctors used for separation and crossing bumps follow (1)

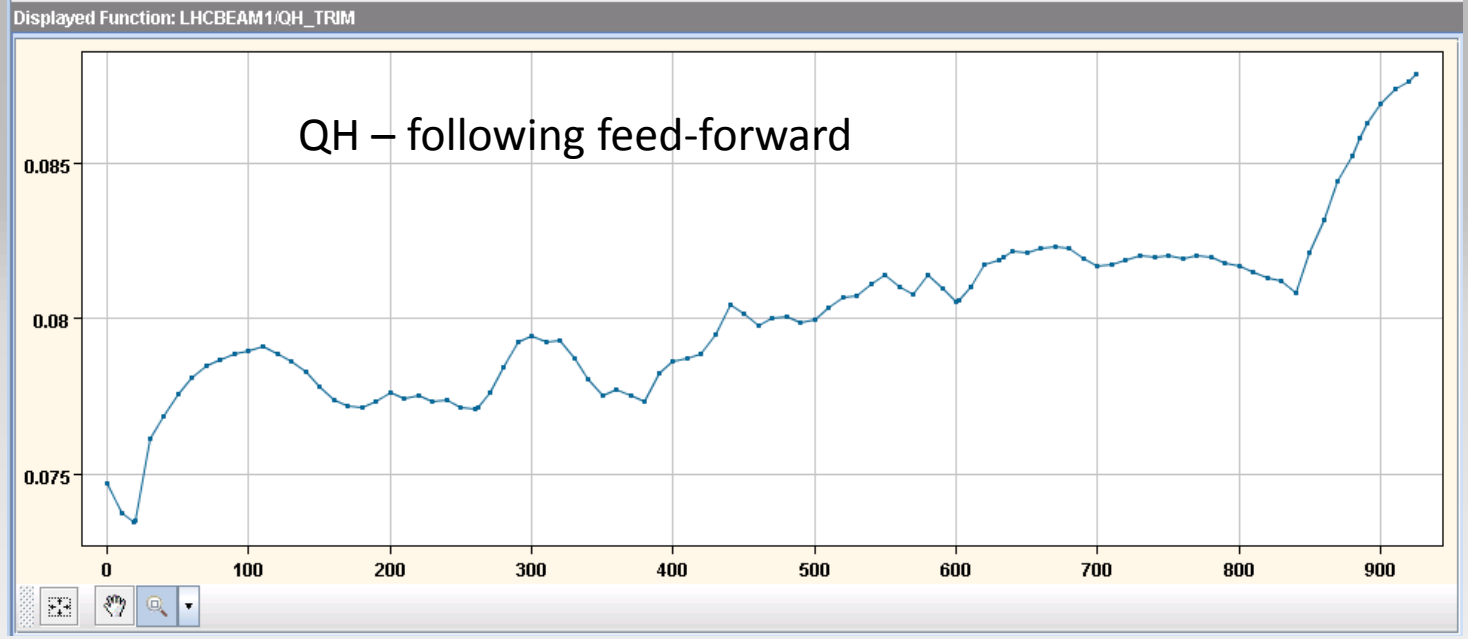

Beam Processes
Filter:
SQUEEZE_4TeV_IP1+IP5+IP2_0.8m_IONS_V1@773
SQUEEZE_4TeV_IP1+IP5+IP2_0.8m_IONS_V1@810
SQUEEZE_4TeV_IP1+IP5+IP2_0.8m_IONS_V1@874_[END]
SQUEEZE_4TeV_IP1+IP5+IP2_0.8m_IONS_simulation_with_bumps
SQUEEZE_4TeV_LONG_2012_V1
SQUEEZE_4TeV_LONG_2012_V1@19
SQUEEZE_4TeV_LONG_2012_V1@262
SQUEEZE_4TeV_LONG_2012_V1@396
SQUEEZE_4TeV_LONG_2012_V1@40
SQUEEZE_4TeV_LONG_2012_V1@455
SQUEEZE_4TeV_LONG_2012_V1@602
SQUEEZE_4TeV_LONG_2012_V1@634
SQUEEZE_4TeV_LONG_2012_V1@696
SQUEEZE_4TeV_LONG_2012_V1@840
SQUEEZE_4TeV_LONG_2012_V1@925_[END]
SQUEEZE_4TeV_LONG_2012_V1_Aug_ALICEplus
OPERATIONAL
Parameter selection - LHCRING
System
IP_OFFSET
IP_SEPARATION
IP_SPECTROMETER
LANDAU DAMPING
LHC SIS-REF
LHCINJKICKERS
LUMI-SCAN
MATCHING QUADRUPOLE
MD-KNOBS
MOMENTUM
ORBIT-H
ORBIT-TRIPLET
Select All
Type Groups
K
K_SMOOTH
I
IREF
Select All
Parameters
Filter:
RQ4.R1B1/K1
RQ4.R1B2/K1
RQ4.R2B1/K1
RQ4.R2B2/K1
RQ4.R5B1/K1
RQ4.R5B2/K1
RQ4.R6B1/K1
RQ4.R6B2/K1
RQ4.R8B1/K1
RQ4.R8B2/K1
Select All
Hierarchy
Show Field(s)
Search parameter by name:
Setting part: Value Target Correction
Trim History
Time base: SuperCycle Cycle/Beamprocess Injection
Displayed Function: RQ4.R5B2/K1
0.005
0.0045
0.004
0
100
200
300
400
500
600
700
800
900
Q4: STRENGTH K
Trim
Abort Trim
Cancel Last Trim
Apply
Trim Expert Params
Graph
Table


Displayed Function: RQ4.R5B2/K_SMOOTH
0.005
0.0045
0.004
0
100
200
300
400
500
600
700
800
900
K_SMOOTH

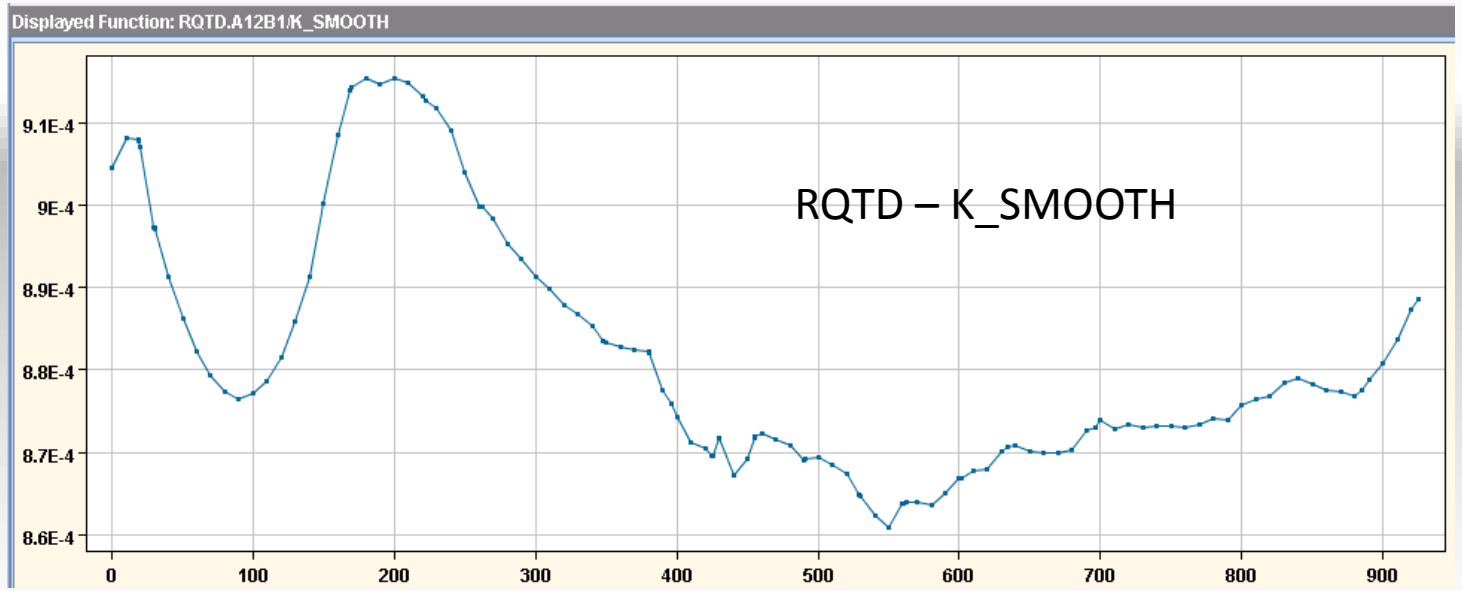

Q4

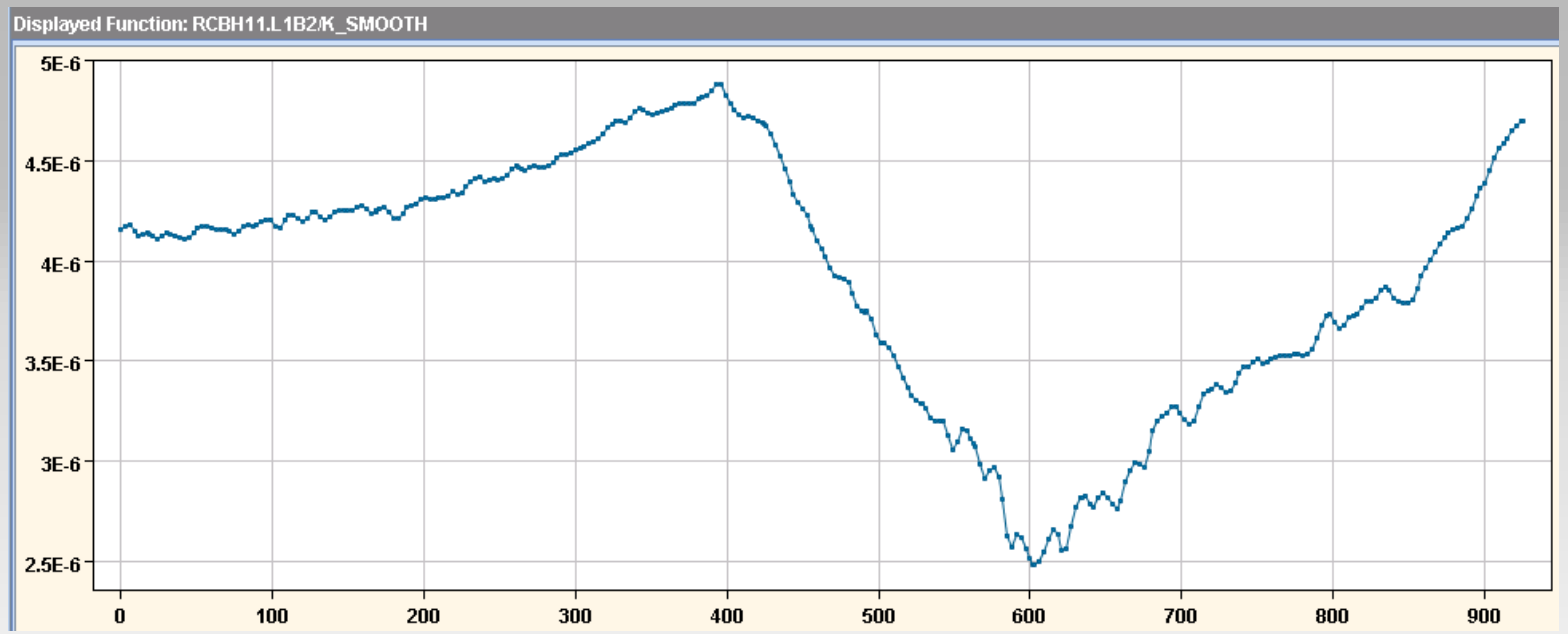

Displayed Function: MQXA1.R5/K_SMOOTH
8.595E-3
8.59E-3
8.585E-3
8.58E-3
8.575E-3
-10
0
10
20
30
40
50
MQXA


Displayed Function: RCBXH1.L5/K_SMOOTH
Crossing angle correctors follows same method
4E-5
3.5E-5
3E-5
2.5E-5
0
100
200
300
400
500
600
700
800
900
Graph
Table

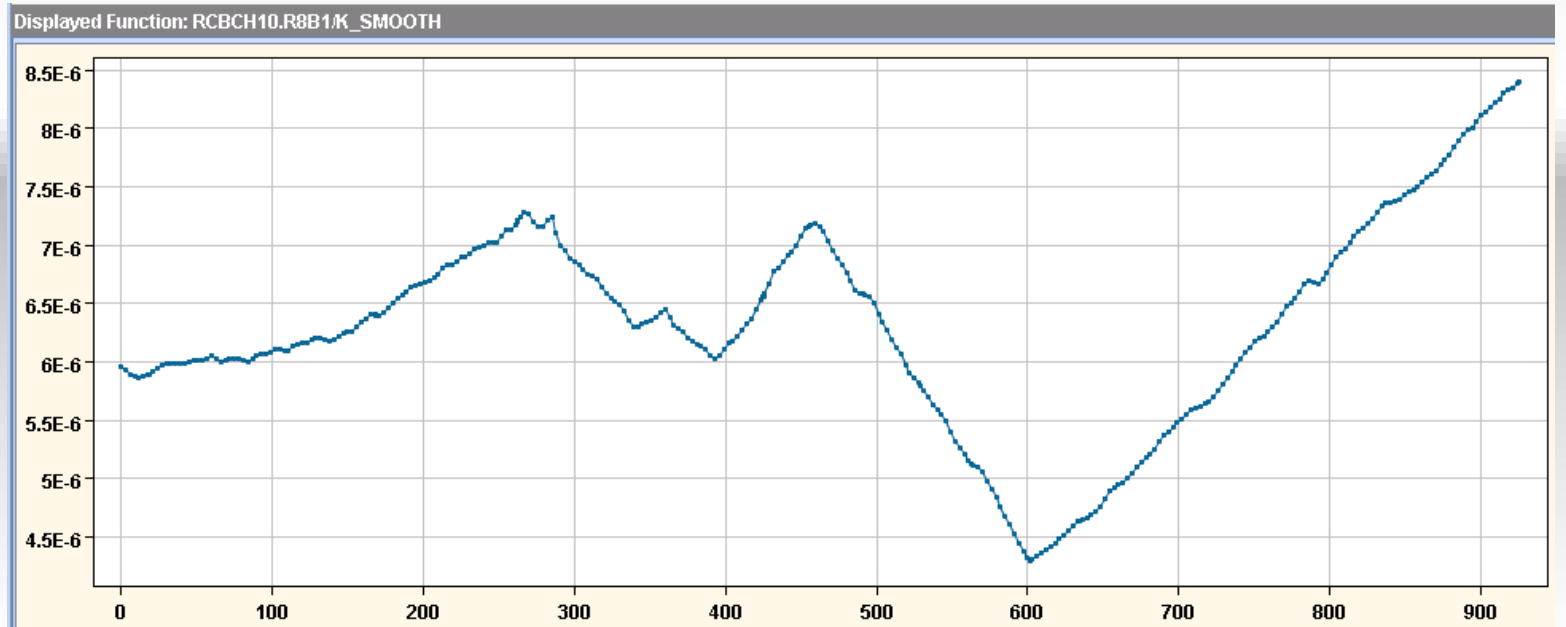


Tune correction in squeeze – corrections anywhere in time – bespoke smoothing



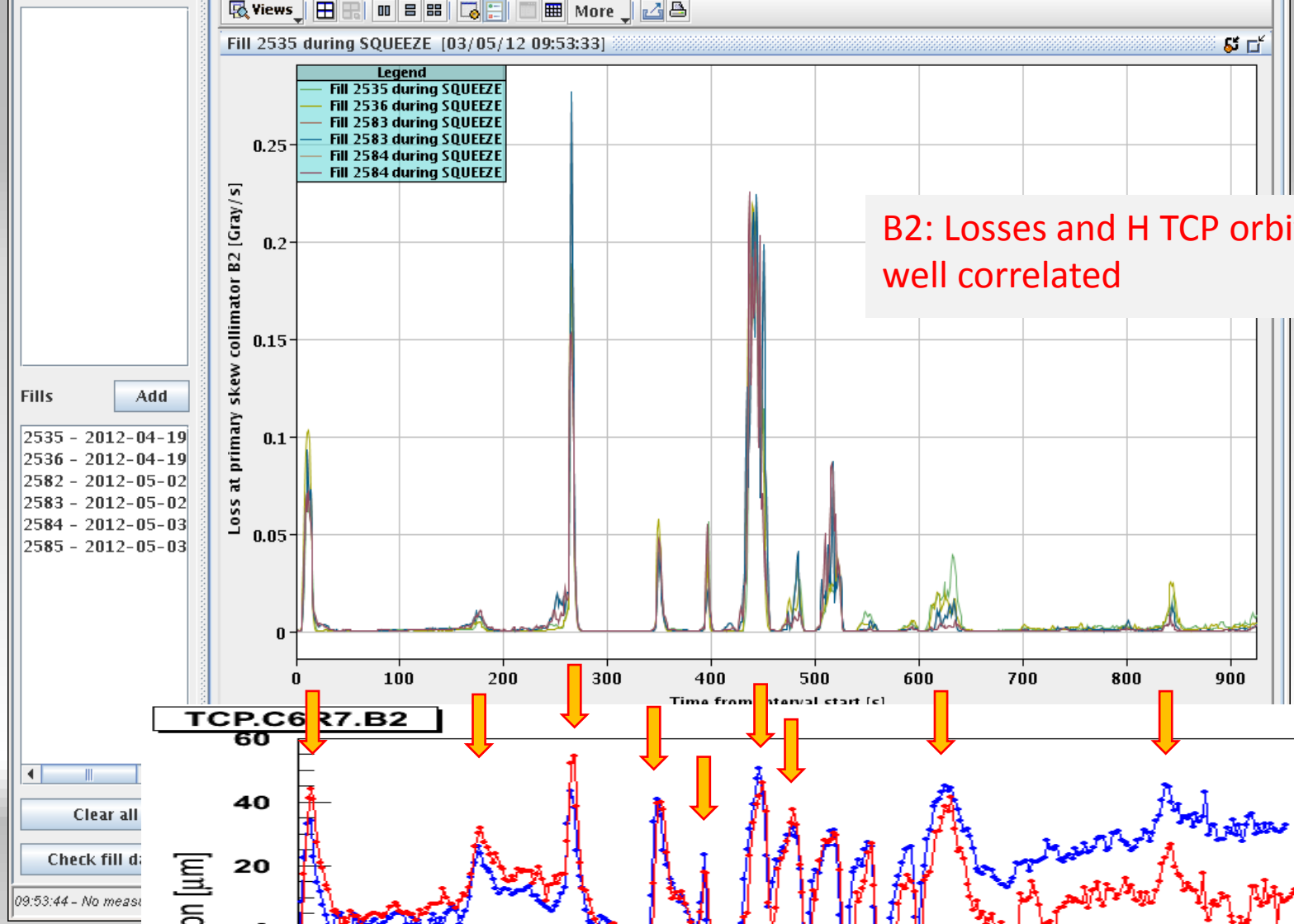


Non-bump orbit correctors in squeeze following feed-forward

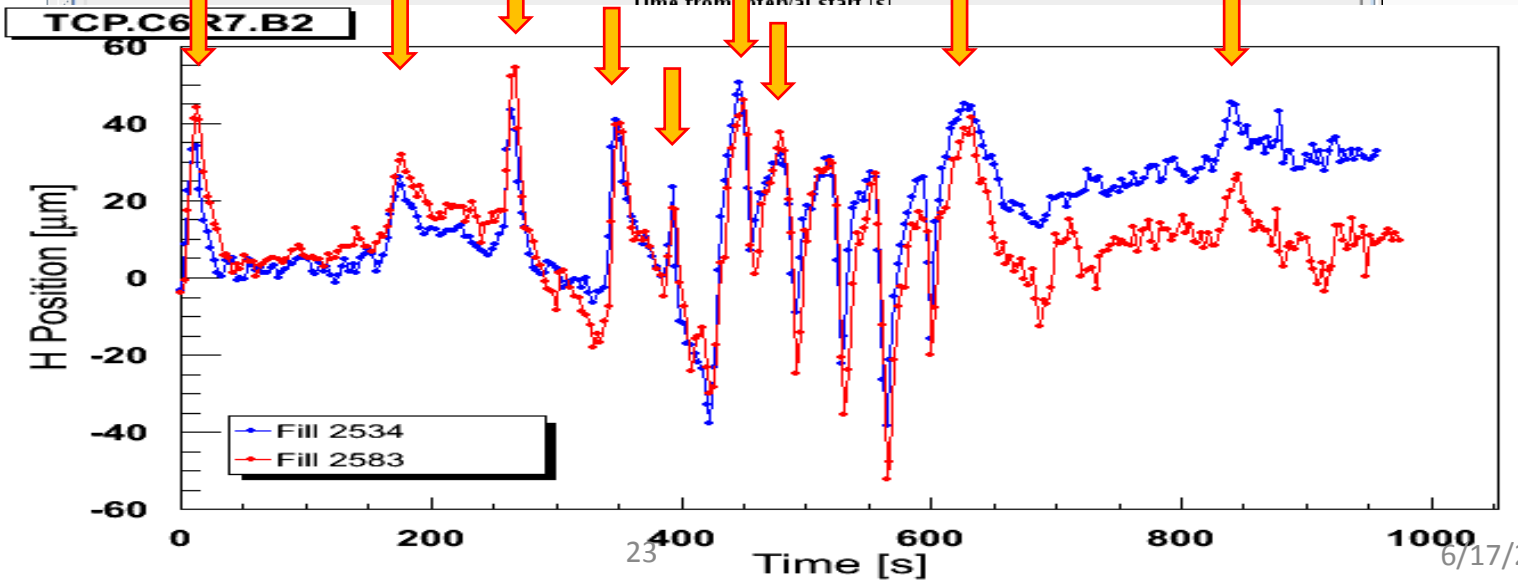


Squeeze spikes

- Know we're not handling this perfectly yet
  - Spikey losses in squeeze with tight collimator settings – orbit shifts at TCPs – particularly B2
  - Something provoking orbit perturbation combined with low OFB bandwidth
    - With higher bandwidth (x10) OFB could get in there.
- Feed-forward in squeeze was useful in reducing 10-12 micron peak to 2 micron peak – valid for a few weeks (ground motion perhaps…). **Problem reproducible.**



B2: Losses and H TCP orbit well correlated



Jorg Wenninger

Orbit feedback in squeeze

- **Optics changes** were never fully commissioned and never used.
  - Injection optics used throughout
  - Fixing is a must for post LS1 (solution used in run 1 was a compromise and not ideal).
- **Linear interpolation between overlays** in squeeze
  - this should be adapted to following the parabolic-linear-parabolic scheme used by LSA.
- **Model overlays** used…

Collision

- Combined IP1, IP5, IP2, and tilting the crossing angle in 8 was not a good idea!
- Keep it simple
- Speed – stuck with it
- Staggered collisions – if really necessary

Miscellaneous

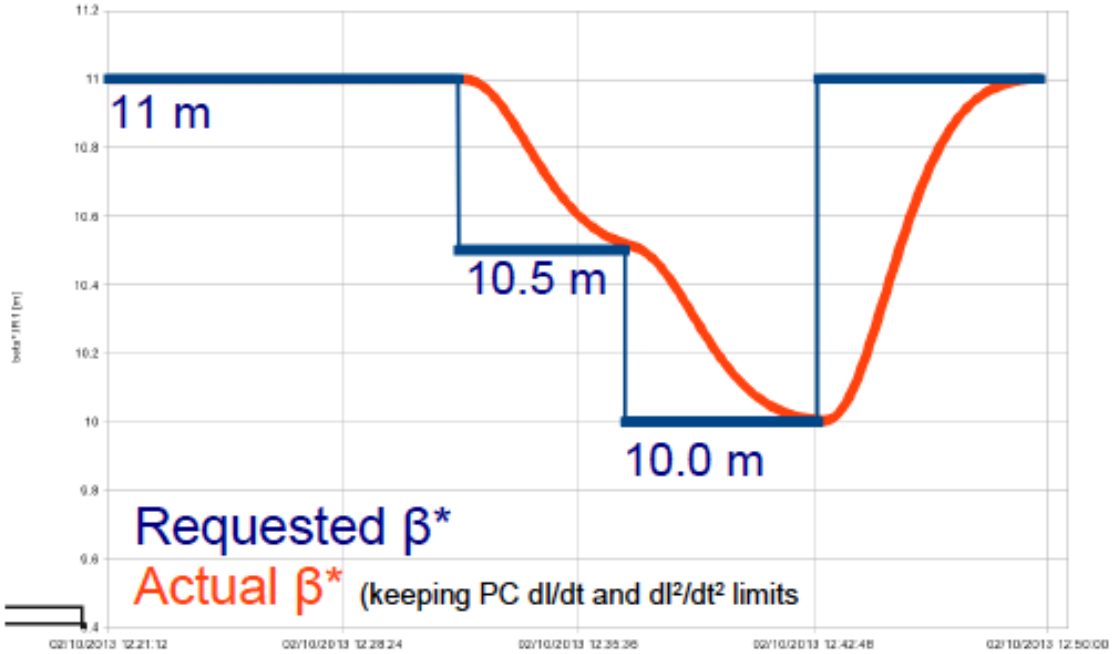
- IPQ hysteresis
  - Continue to ignore (following last attempt)
- Use of triplet multipole correctors
  - Implement in terms of b3, a3 etc. compensation trims – polarity issues!
- Current tracking in the squeeze
  - Decay of single quadrant power converter driven IPQs
  - Model still not quite right.
- Systematic b2 correction?
- LSA database slow – regeneration and incorporation

Out of the LSA box – RT squeeze

- Initial test successful earlier this year
  - Squeezed and un-squeezed (11 to 10 m) in IR1 with beam as proof of principle
- Offers flexibility and an “adiabatic” approach
  - De-couple IPs
  - Orthogonal to orbit feedback
  - Incremental approach allow re-optimization in the steady state as required

RT squeeze

- Allows arbitrary changes (test on 2013-02-10, RS & ML):



- N.B. naked squeeze in IR1 only with no prior orbit, Q/Q' corrections included. 2nd-order feed-down effects on tune and orbit clearly observed. Beam lifetime OK throughout test → to be further studied/explored for after LS-1

Conclusion

- LSA is in a pretty good state and its reach is growing
  - Many thanks to Greg Kruk, Chris Roderick and the small core team
    - Significant consolidation planned for LS1
  - Many thanks to developers (OP, COLL, ABP…) for some truly exceptional functionality
- With applied LSA there are some issues, development, and preparation required for 2015 but imagine things coming back in a familiar shape