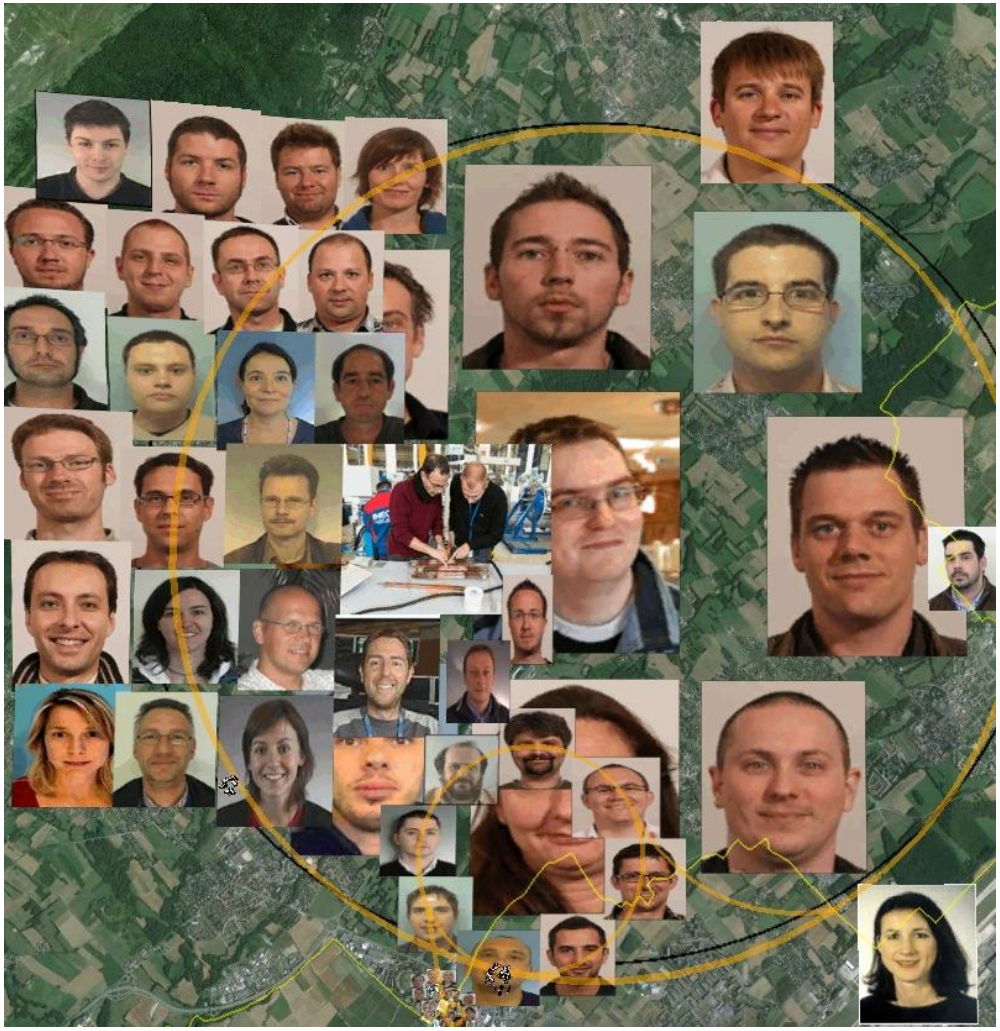

HARDCORE

We have the most wonderful Operations team in the world…



But…

HANDBAGS

- Commons problems and needs can be identified for OP, CO, ABP and equipment groups

Coming together is a
BEGINNING

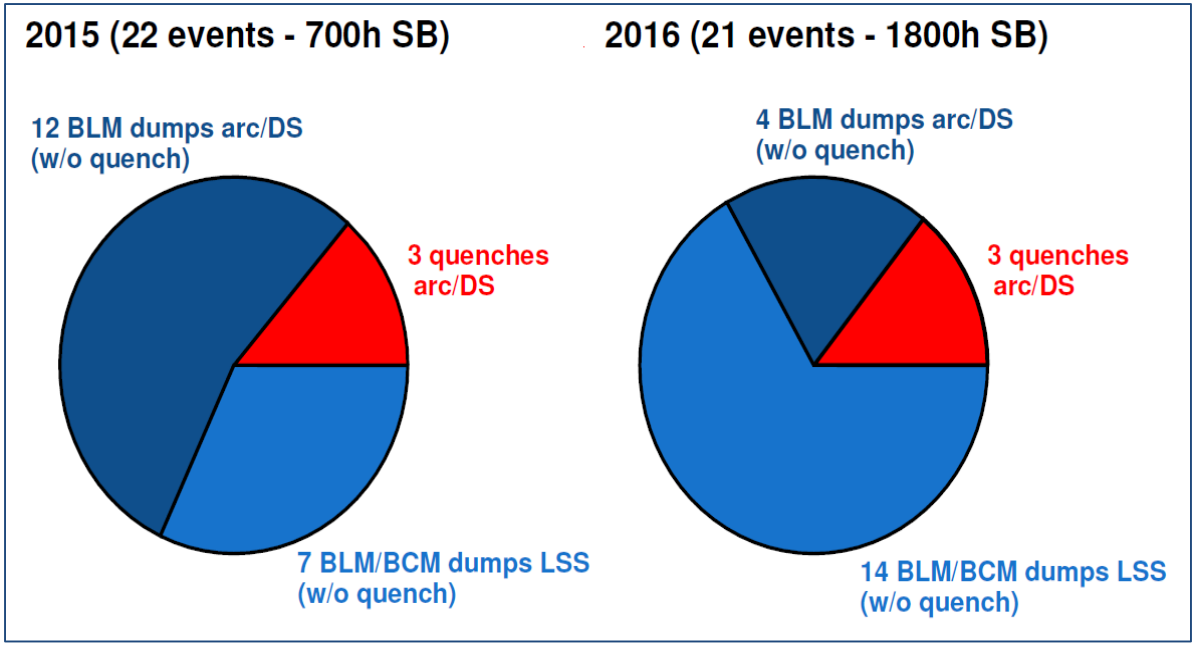
Keeping together is
PROGRESS

Working together is
SUCCESS

Availability has been very tasty

Premature dumps slashed

Painstaking adjustment of BLM thresholds



R2E

Equipment	Dump 2012	Dump 2015	Dump 2016
Total	3 /fb^{-1}	3 /fb^{-1} 1.2 /fb^{-1}	0.15/fb^{-1} (proton run)

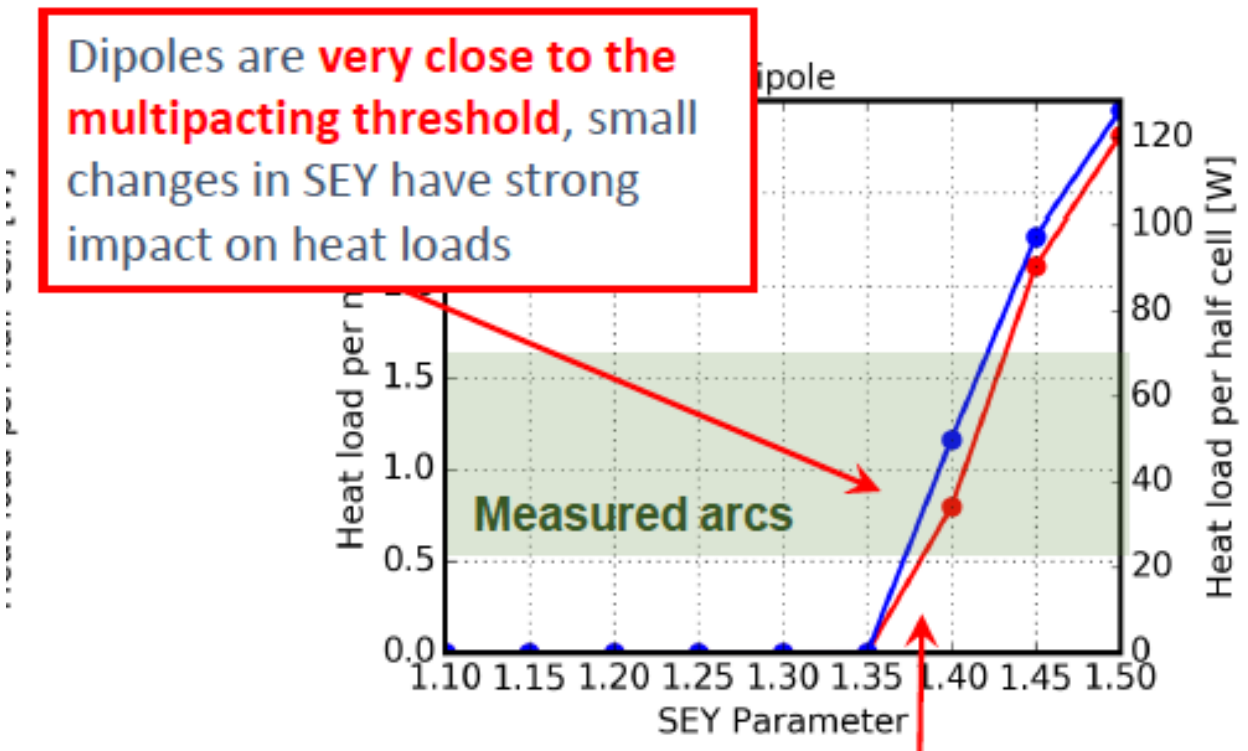
The beam is beautiful

Machine is phenomenally stable (at 6.5 TeV except for the triple movements)

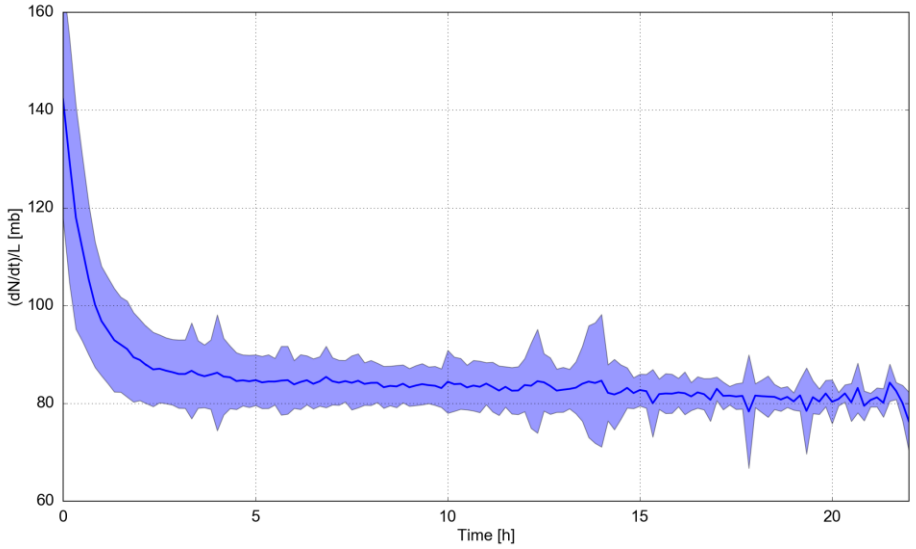
- **Clearly, beam lifetime is very good in Run II!**
  - *Big improvement compared to 2012.*
  - *Somehow unexpected (for me at least).*
- **Handling of ~250MJ beams at the LHC is excellent**
  - *Now running with nominal TCP gaps, 25ns, 30% smaller-than-design β^*.*
  - *Reduced crossing angle in 2016: seen an effect, but still good.*
  - *Big step up compared to 2012. Somehow unexpected for me.*
  - *Still not pushed bunch intensity.*

Excellent performance w.r.t collective effects this year. **Reached ~1.4*HL-LHC brightness!**

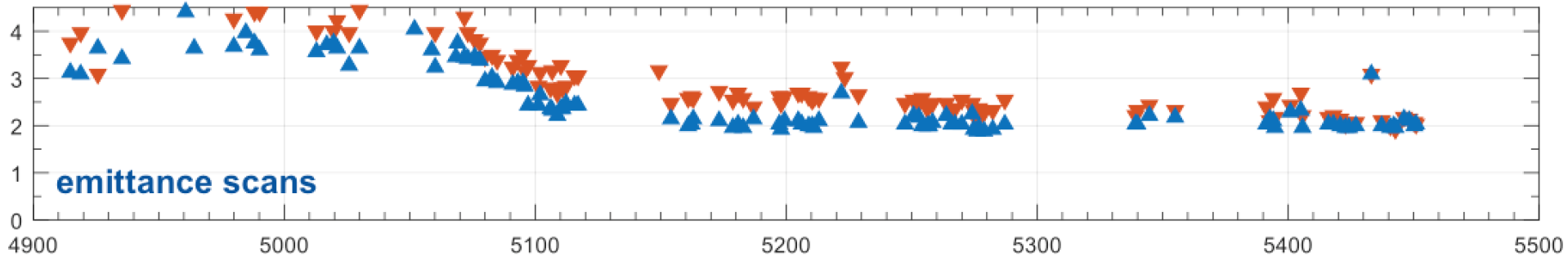
Even though it's cloudy in places



Luminosity is great



"Something in the bush"



Interesting developments in the world of luminosity, luminosity imbalance, emittance growth, beam loss, LHCb polarity, crossing angles…

HAPPY OPTICS OWLS !!!

- The new approach using k-mod as input for corrections resulted in:
  - **Smallest β-beat ever achieved in LHC**
  - **1% RMS β-beat at the IP1 and IP5 (without crossing angles)**
- Coupling corrected to ≈ $2*10^{-4}$ in MD

2 shifts required for commissioning of nonlinear optics

System performance is excellent

Cryo maintain: 98.6%

QPS: MTBF per element : ~4Mh
Average availability for proton run: 99.49%

System performance is excellent

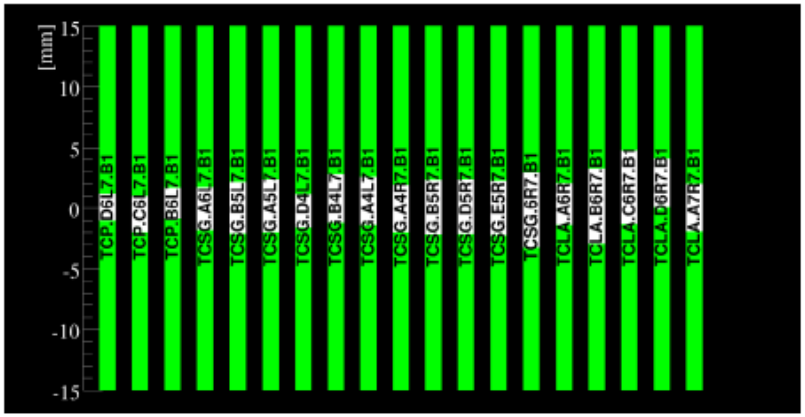
MKI 1.2 million pulses since 2014 – 3 erratics

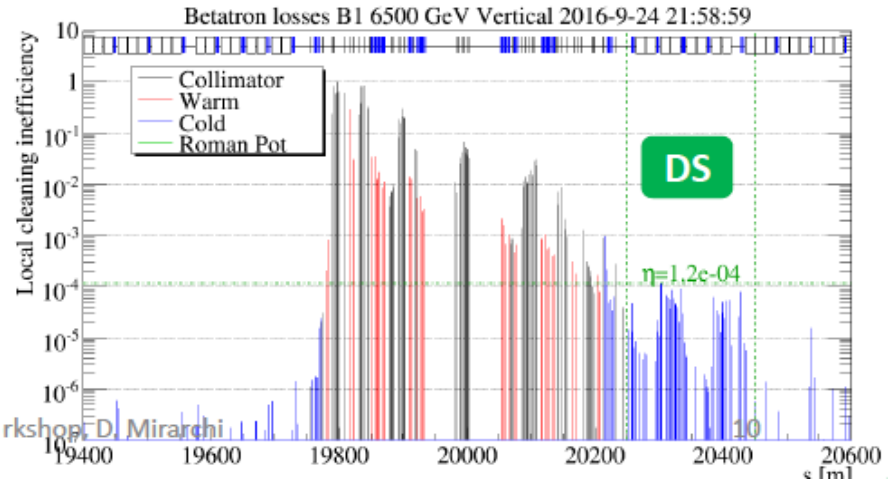
System performance is excellent

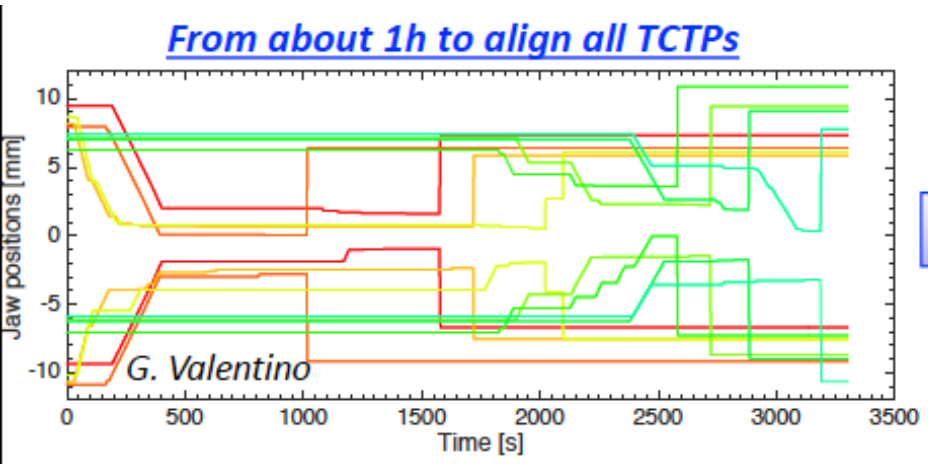
System performance is excellent

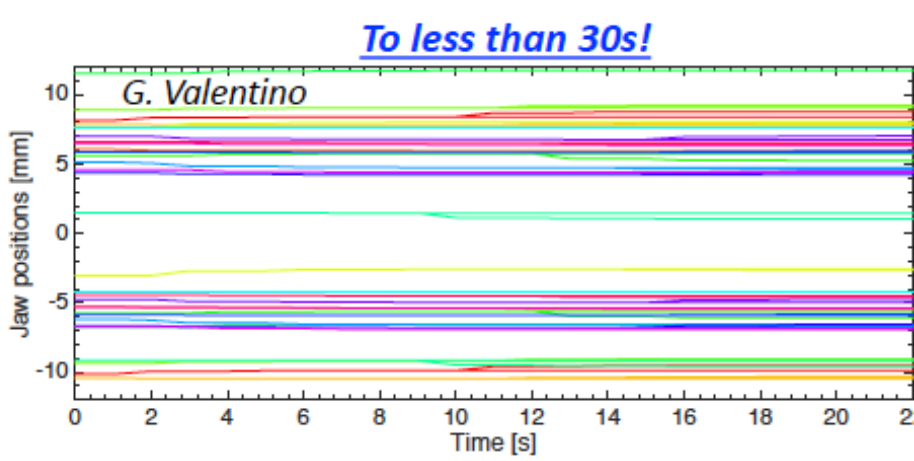
Physics

- Collimators gap in IR7









Joint collaboration ABP/BI/OP

dBLM

BPM

DOROS

BGV

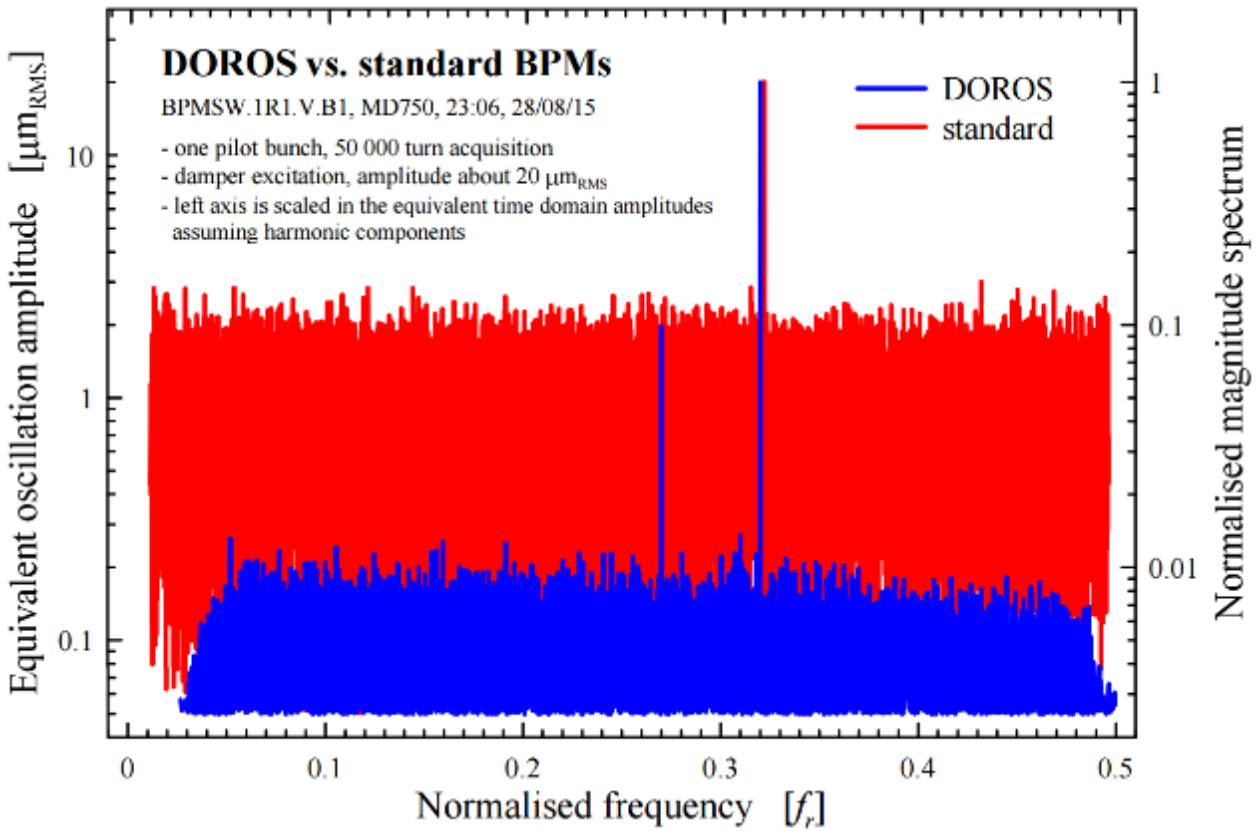
WS

BSRT

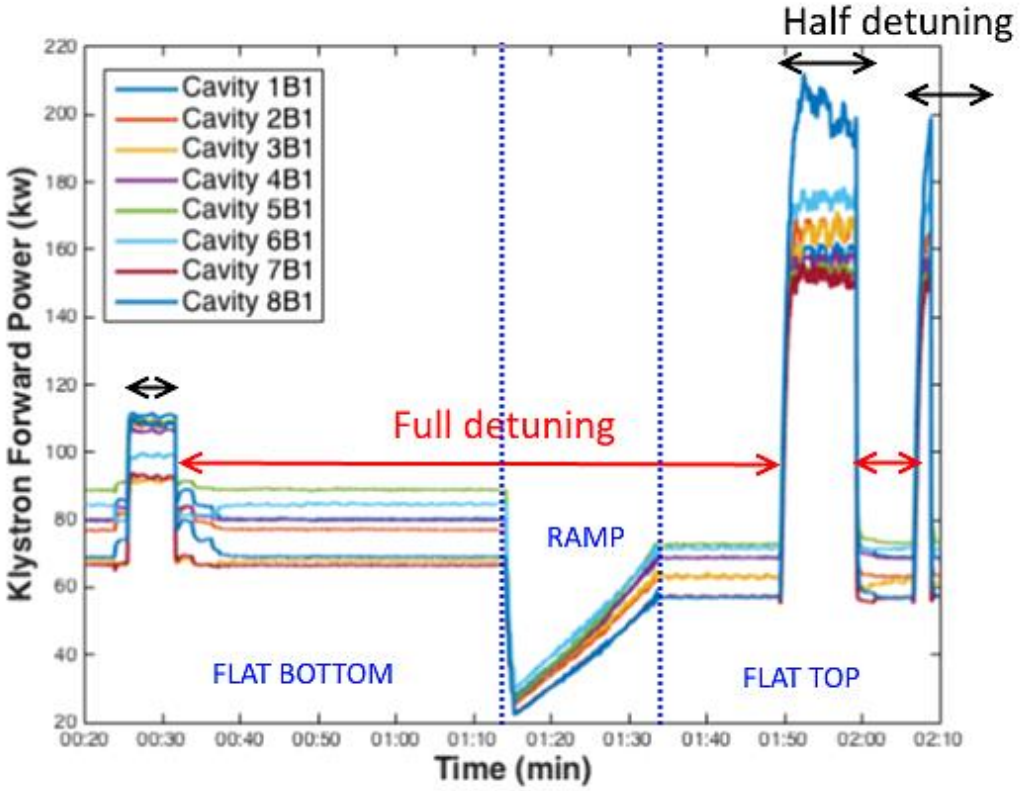
System performance is excellent

Pretty cool (and critical) beam instrumentation out there

Spectra comparison between WBTN and DOROS



RF: excellent system performance; interesting developments…



It is a safe machine

- Thanks to the (r)MPP for
  - Procedure, rules, documentation, enforcement: Operations and MD
  - Culture
  - Sometimes besides being safe you have to seen to be safe, set an example

No quench from circulating beam losses with more than 250 MJ beams!
Keep working for safe and "quench-free" runs

It is a safe machine

No asynchronous beam dumps in 2016

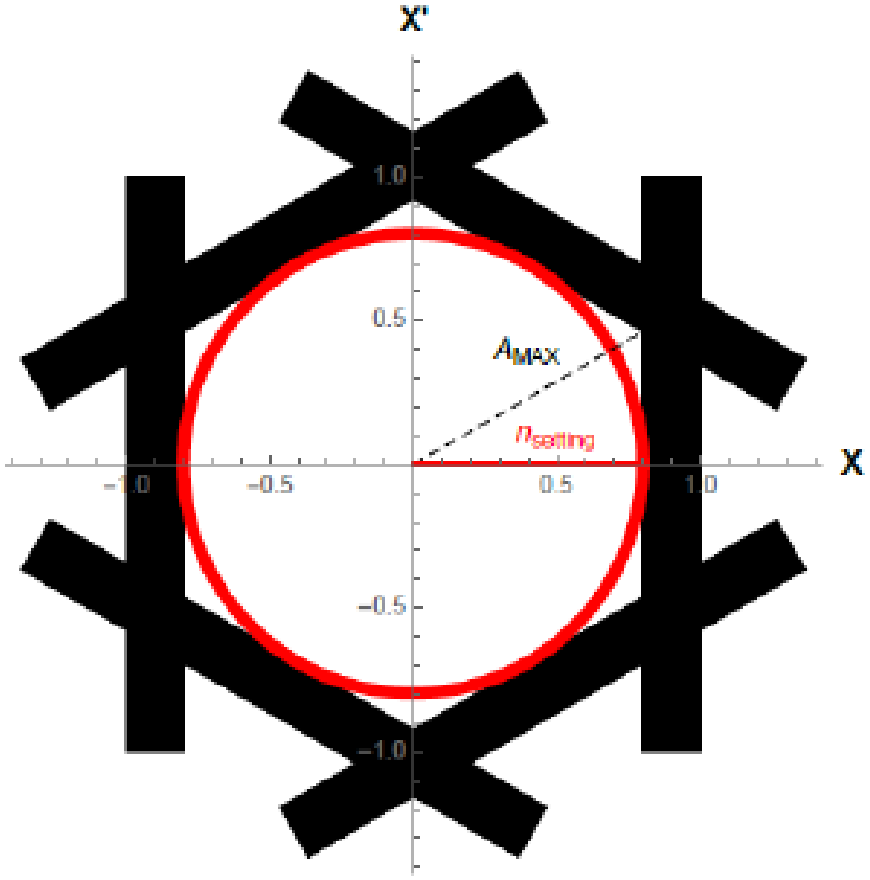
LBDS is a part of Machine Protection:

We do not run in degraded mode (we don’t mask faults / adjust thresholds…)

System returns in ‘As Good As New’ state after every fault / intervention

Even if it takes all night

You shall not pass



2017

- 800/200 ns for MKI/MKP look promising and are suggested for 2017
- Cryo triplet limitation ~1.75e34 guaranteed
- ATS or nominal optics will not impact the quality of the optics corrections in 2017
- 9.3 sigma with increase bunch intensity might be pushing it BUT start relaxed and then reduce
- Especially with BCMS beams, the heat load from e-cloud will not be a strong limitation for the LHC performance reach

2017

- TCDI limit BCMS to 144b
- 2556 bunches, 1.3e11 ppb at 450 GeV
- Full de-tuning ready to be deployed
- 10 sigma for 2.5 um
- TCP 5.5 sigma --- 35 cm???
- ATS?

WHAT ARE THE PRIORITIES FOR 2017?

Summary 1/2

- 6.5 TeV
  - Stable operation
  - Magnets/protection systems performing well
- Optics!
  - ATLAS and CMS at beta*= 40 cm,
  - ALICE and LHCb levelled as required
- Nominal 25 ns beam, 2040 bunches
  - Injection limited by SPS beam dump vacuum leak
- High electron cloud
  - Operating with high chromaticity, octupoles, ADT throughout the cycle to combat instabilities
- Good transmission through the cycle
- Excellent luminosity performance
- Acceptable emittance growth (and enjoying effects of synchrotron radiation damping)

Summary 2/2

- Availability sometimes excellent!
  - But recall serious timeouts
- Mature system performance
  - QPS, RF, Cryogenics, ADT, Power converters, Collimation, BI, Controls, LBDS, injection, TDI…
- Operational efficiency is good
  - Injection, decay and snapback, feedbacks, combined ramp & squeeze
- Machine protection
  - excellent as always, vigilance required
- Challenges
  - UFOs – have conditioned down
  - ULO – still there but stable
  - Beam induced heating and R2E have been addressed very effectively over the last years

Many, many thanks…

- Organization
  - Everything: Sylvia
  - Unflinching support: Malika & Brennan
  - Technical coordination: Hervé
  - Proceedings?: Brennan? and Sylvia
- Session chairs – brilliantly done
- Speakers – excellent, excellent
- Everyone for hanging in there