
CERN

MKB changes: impact on dilution pattern

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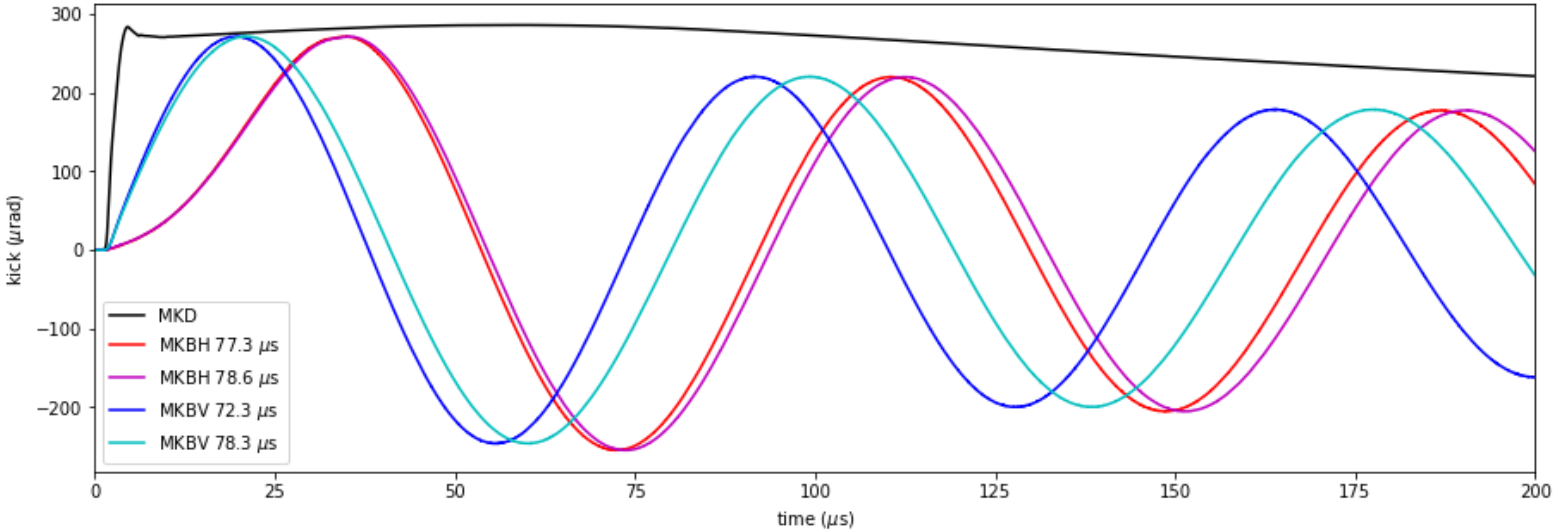
Machine Protection Panel meeting, April 3rd 2020

MKBs pulse changes

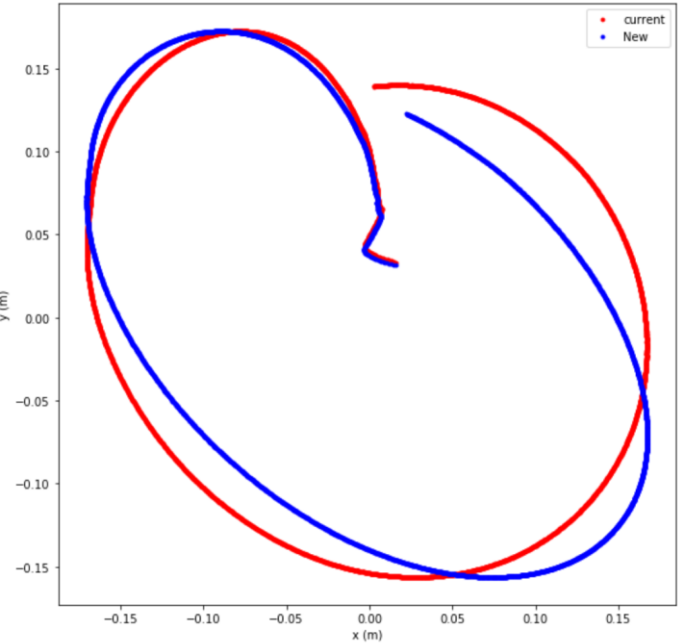
- MKBH change period 77.3 → 78.6 μs (+ 1.7 %)
- MKBV change period 72.3 → 78.3 μs (+ 8.3 %)

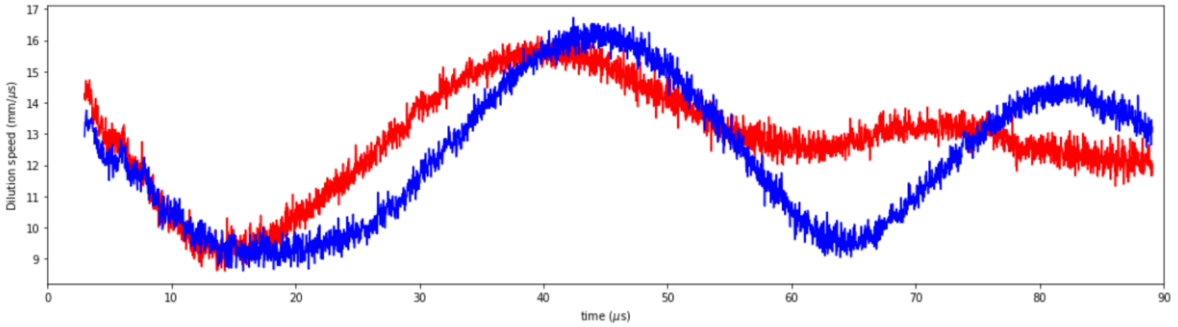


Waveform generated from logged data on 2016-07-22_17h_01 and rescaled to match the modified periods
Exact waveform and precise period will have to be measured

Nominal pattern comparison

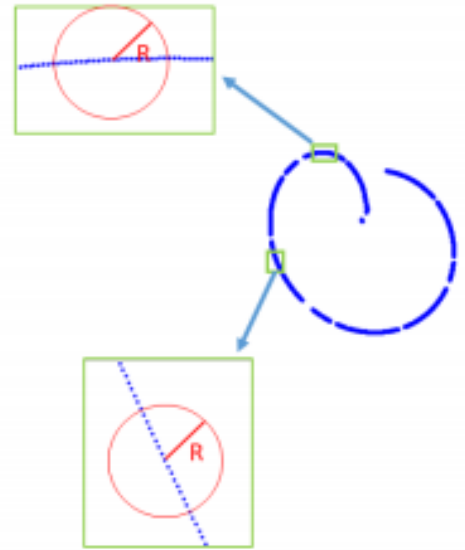
Every bucket outside the abort gap is filled full





Relative pattern effect calculations

- Work carried in 2018 by L. Richtmann & C. Wiesner
  - L. Richtmann, “Study of failure cases for the LHC dilution system” http://cds.cern.ch/record/2652574?ln=en
  - Showed that the evolution of the maximum density of energy deposited (heating) can be approximated by the number of bunch centres contained in a radius (referred as characteristic radius) of
    - 1.8 mm for the upstream (US) window
    - 14.6 mm for the dump core
    - 19.9 mm for the downstream (DS) window
  - Provided also the tools (python code and notebooks) to produce the results
  - Establish a simple formula to compute the dilution pattern using the total kicks to MKDs, MKBVs and MKBHs and associated maximum error



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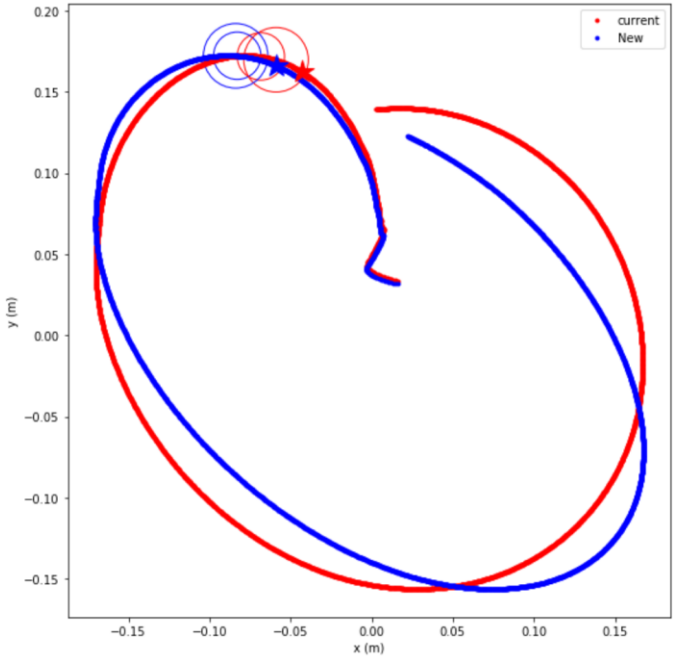
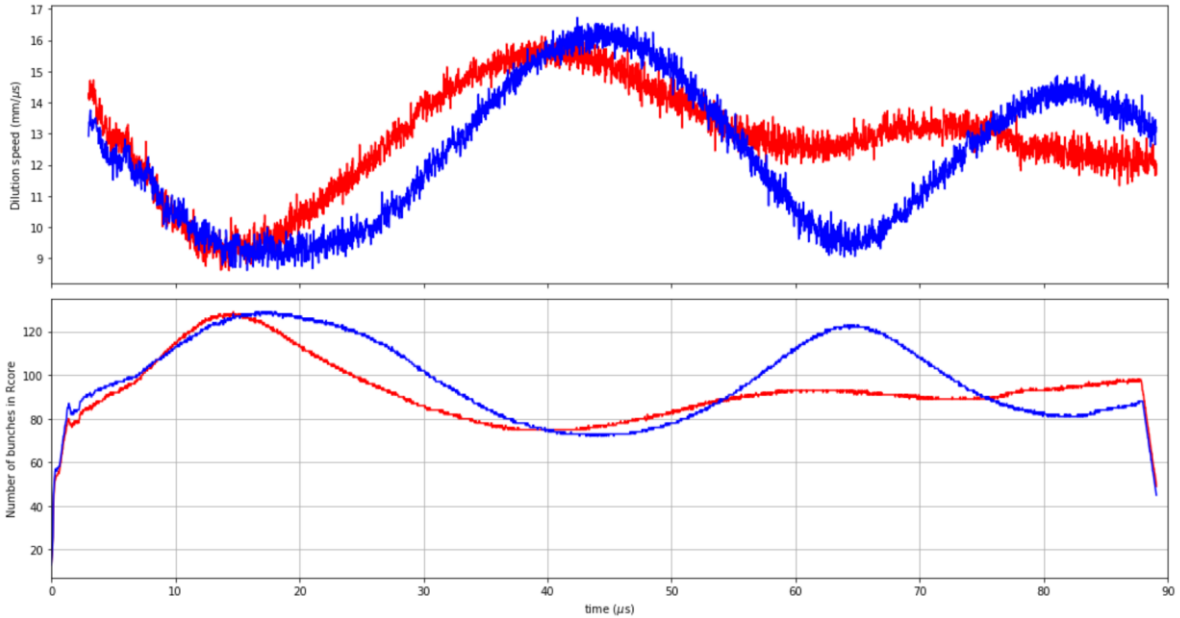
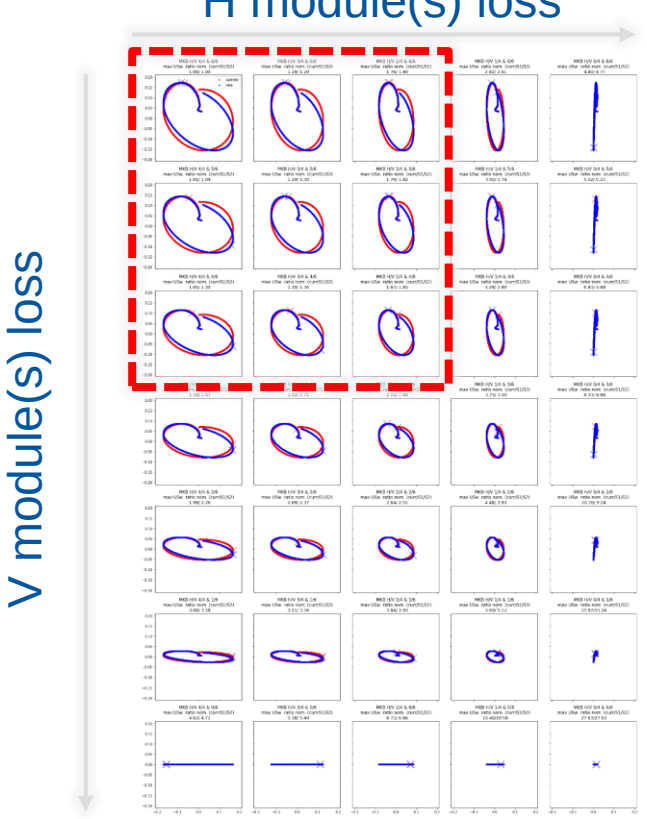




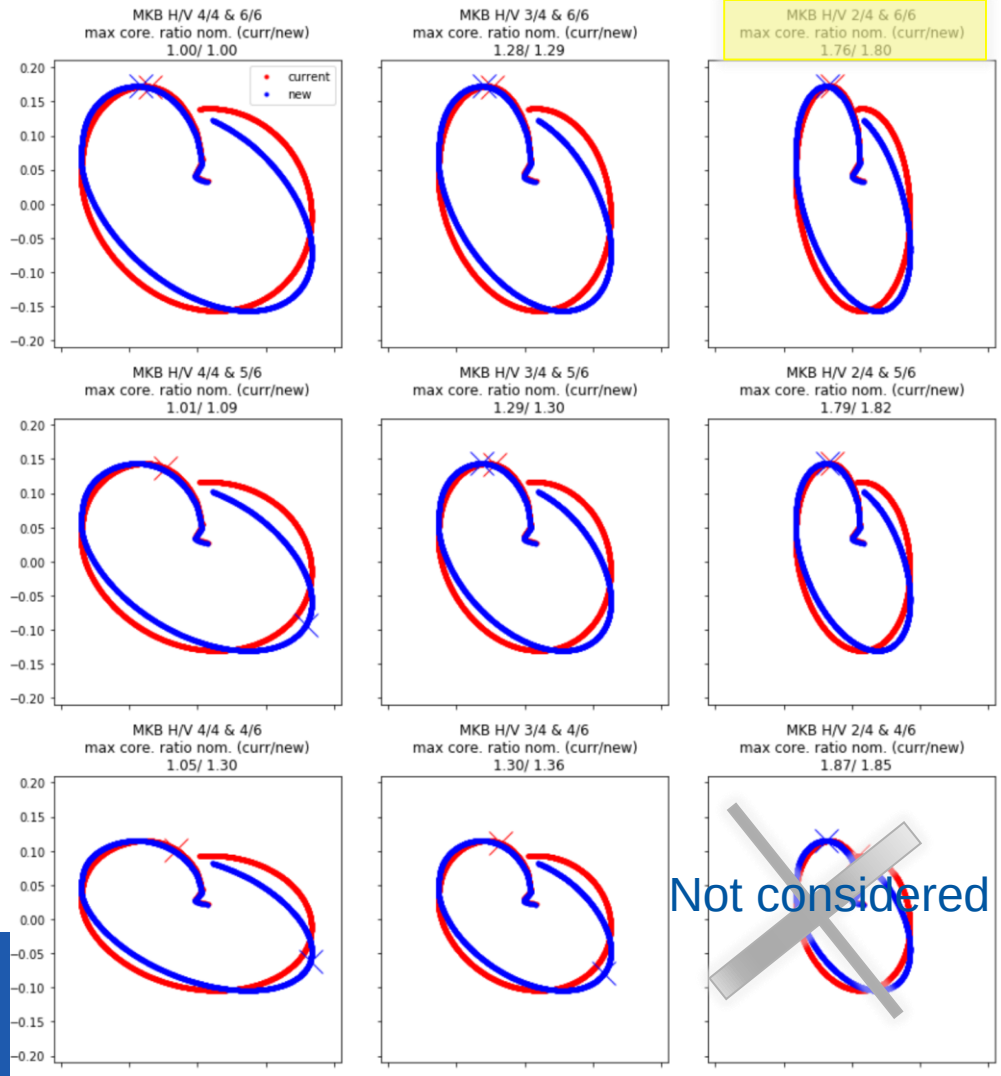
Failure cases, module(s) loss

- Patterns for every cases
  - 4 H & 6 V modules
- Focus on the changes in case of the loss of up to 2H and/or 2V



Failure cases, module(s) loss

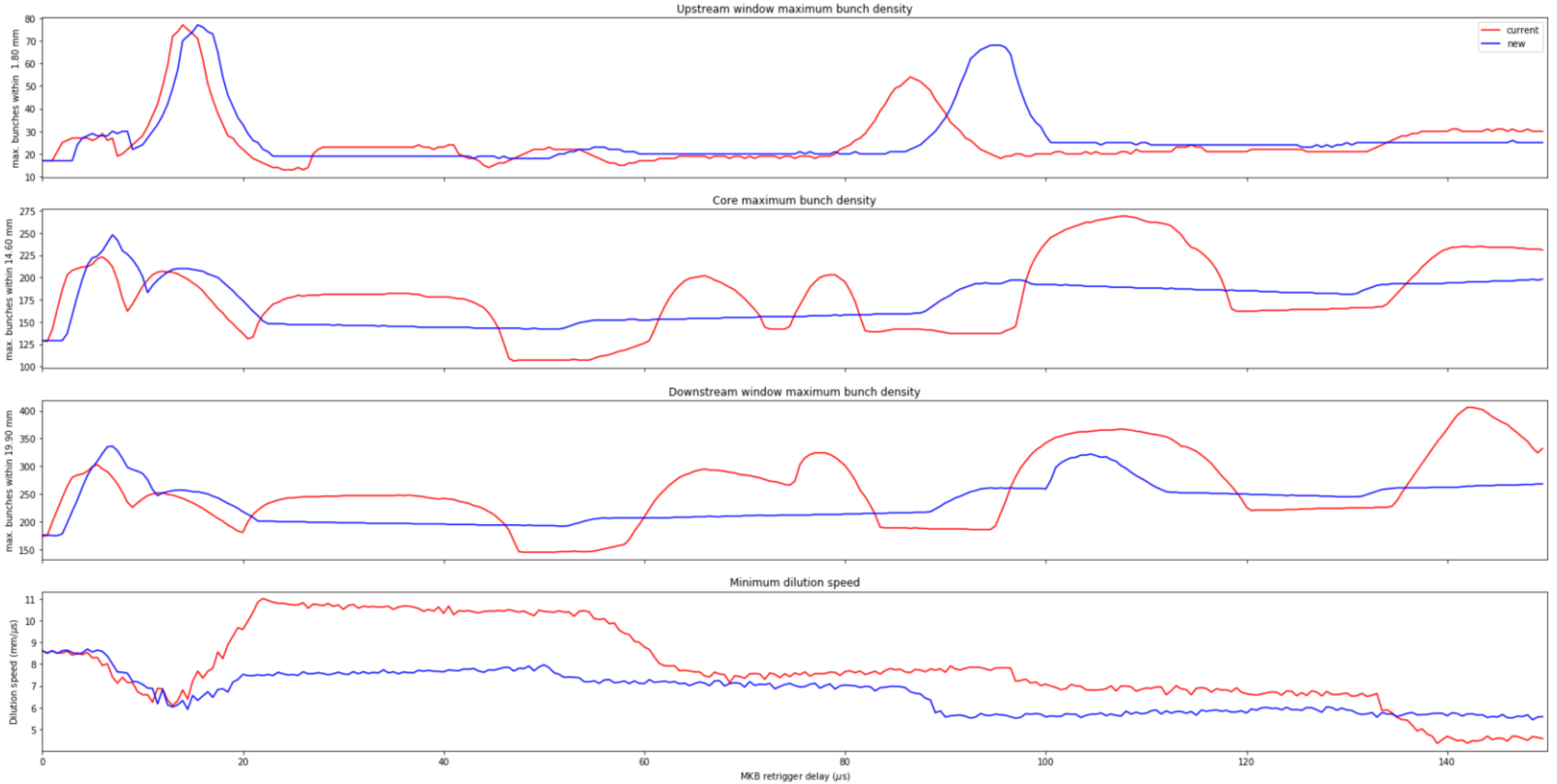
- Cross shows location of highest bunch number within core characteristic radius
- Ratio showed above the pattern, example of 1 missing H
  - Shows ratio of maximum number of bunches within the characteristic core radius compared to the current pattern without loss of modules
  - 1.28/1.29 means
    - 28% higher max. density for the current with 1H loss than nominal current
    - 28% higher max. density for the new with 1H loss than nominal current
- Worst case is with loss of 2H
  - Going to the new pattern would increase the maximum density on the core from +76% to +80%



Not considered

Re-trigger delay study

Maximum number of bunches within each characteristic radius as a function of the MKD re-trigger delay to MKB



Conclusion

- Characteristic radii provide a fast but relative evaluation of dump pattern effects
- The changes considered to MKB H and V period
  - small to negligible effect in the horizontal pattern
- Effects on the dump pattern
  - In the nominal case : maximum density reached changes are negligible
  - In the case of loss of modules : very small to negligible increase in the maximum estimated bunch density for the worst-case scenario when 2H modules are lost
  - In the case of MKD retriggering from MKB spurious trigger : overall maximum bunch densities and evolution as a function of re-trigger delay are similar
- Effects on dump patterns, nominal are abnormal, of the MKB period change are acceptable

Thank you