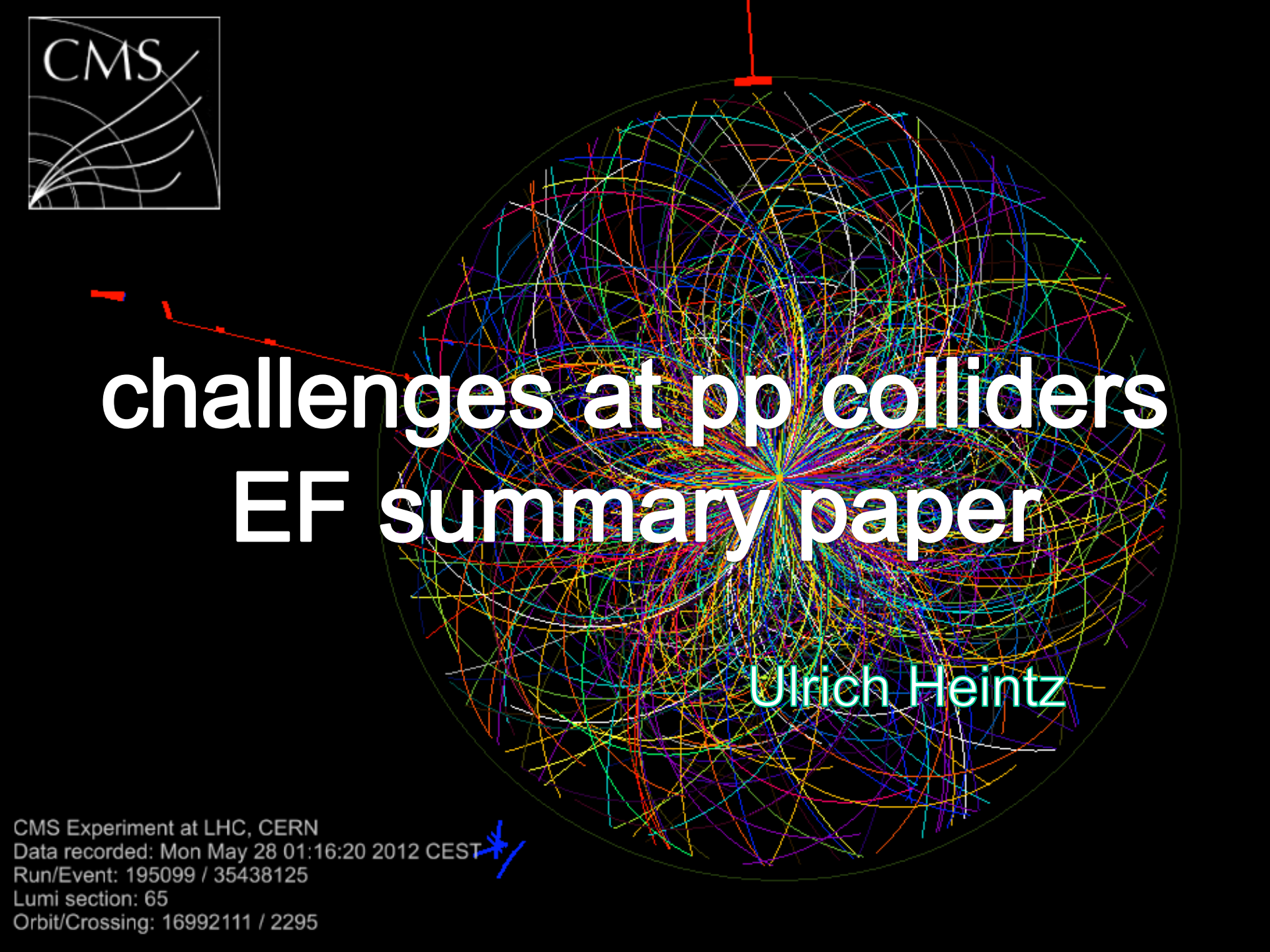
challenges at pp colliders
EF summary paper

Ulrich Heintz



environment at hadron colliders

	2012	HL-LHC
beam energy	$4\ \mathrm{TeV}$	$7\ \mathrm{TeV}$
luminosity	$7.7 \times 10^{33}/\mathrm{cm}^2/\mathrm{s}$	$5 \times 10^{34}/\mathrm{cm}^2/\mathrm{s}$
integrated luminosity	$24/\mathrm{fb}$	$3000/\mathrm{fb}$
number interactions/crossing	≈ 20	140
bunch spacing	$50\ \mathrm{ns}$	$25\ \mathrm{ns}$
radiation dose (R≈5 cm)	$3 \times 10^4\ \mathrm{Gy}$	$5 \times 10^6\ \mathrm{Gy}$

challenges: interaction rate

pileup

radiation damage

challenges

- interaction rate
  - increase rejection power of trigger system
  - low power, high bandwidth links
- pileup
  - pixelization
  - precision timing
- radiation damage
  - radiation hard detector technologies
  - operate at low temperatures

EF instrumentation summary paper

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2 Physics at the energy frontier
3 Benchmark processes
4 Challenges for energy frontier
  4.1 Hadron colliders
  4.2 e+e- colliders
  4.3 μ+μ- colliders
5 Technology R&D themes
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  5.2 Next generation trackers
  5.3 High resolution hadron calorimeters
6 Facilities
7 Conclusion

some inputs from CLIC study group. this is where a summary of our discussion will go

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I just went over this

Marcel's talk

Anna's talk

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pixelization
timing
resolution
mechanics and power
data transmission
cost

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5.1 Advanced triggers and data acquisition

- "Emerging Optical Link Technologies for HEP“
- "High speed, massively parallel, ATCA based Data Acquisition Systems using modular components“
- W. Smith: "Triggers for hadron colliders at the energy frontier"
- G. Brooijmans, H. Evans, A. Seiden: "Atlas Upgrade Instrumentation”
- E. Grunendahl, M. Johnson, R. Lipton, T. Liu, A. Ryd, L. Spiegel: "Level 1 Track Triggers at HL-LHC“
- "Application Specific Integrated Circuits (ASICs) for HEP applications"

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5.2 Next generation trackers

- G. Bolla, M. Garcia-Sciveres: "Hybrid Pixel Detector Challenges for next Generation Frontier Experiments at the LHC“
- M. Battaglia: "Monolithic Pixel Sensors“
- R. Lipton, C. Kenney, S. Parker, L. Spiegel, J. Thom: "Combination of Active Edge and 3D Electronics Technologies“
- C. Da Via, C. Kenney: "3D Architecture Pixel Sensors"
- H. Sadrozinski: "Ultra-fast Silicon Detectors (4D-UFSD)“
- H. Kagan, W. Trischuk: "Diamond Sensors“
- W. Cooper, C. Haber, D. Lynn: "Low Mass Support and cooling“
- S. Dhawan, R. Sumner, R. Khanna: "Powering Future Particle Physics Detectors"

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5.3 High resolution hadron calorimeters

- RD52 Collaboration: "Hadronic dual-readout calorimetry for high energy colliders“
- "Development of Cost-effective Crystals For Homogenous Hadron Calorimetry“
- R. Rusack: "Solid State Photodetectors",
- "Imaging Calorimetry"
- J. Yu, M. Hohlmann, V. Polychronakos, and A. White: "Micro-Pattern Gas Detectors for Calorimetry"
- M. Hohlmann, V. Polychronakos, A. White, J. Yu, "Micro-Pattern Gas Detectors for Charged-Particle Tracking and Muon Detection“
- R. Ball, J. R. Beene, Y. Benhammou, E. H. Bentefour, J. W. Chapman, E. Etzion, C. Ferretti, P. S. Friedman, D. S. Levin, M. Ben Moshe, Y. Silver, R. L. Varner, C. Weaverdyck, and B. Zhou: "Plasma Panel Detectors for Ionizing Particles“
- B. Bilki, K. Francis, J. Repond, L. Xia: "Development of Resistive Plate Chambers",
- A. Ronzhin, H. Frisch: "Use of Flat Panel Microchannel Plates in Sampling Calorimeters with Timing"