

Ben

General :

Table 1 caption : change "radii" to "average radii" since in Section 4.1, you point out at L654 that the radius ranges from 27.5 to 32.6 mm. (Its actually not so obvious how you get the average of 29 mm from these three values. ) → ok

L65-69 : We are already replacing layer-one, so is this statement really true ? Perhaps, instead :

"It is expected to deliver high-quality data, modulo some planned replacement of components, until the end of ..." → yes, we consider the replacement as part of the "Phase-1 upgrade"

L88 : "2.3 mm" -> "2.3 cm" (right ?) →yes!

Figure 1: I have seen a more thorough version of this figure that labels the layer radii in cm. It could also quantify the beam pipe radius change. Otherwise, it would be good to include somewhere in the text what the old beam-pipe radius was. → added radii of detector layers to Fig. 1 and beam pipe radius to text.

Figure 3 and L132-134 : You should say that this is from a GEANT-based simulation and reference GEANT. → ok, added.

Figure 7 : Why does it appear that the best efficiency at around 400 MHz is with the old PROC600 ? The old one looks a few percent better than the new one. → It is probably just a fluctuation. These are different modules tested at a different time.

L679 : Maybe you add the step about baking the Airex foam into cylindrical shapes ? → ok

L758 : It says that there were quality requirements on the FPIX disk structures. Can we say what the efficiency was of this requirement ? It would be important to know for planning future detectors. → Changed to:

A disk structure was accepted if all surface temperatures were within 10 C of the coolant temperature, except for temperatures measured on the clamp-on heaters themselves and on reflective pads co-cured to the surface of the blades. No production disk structures were rejected due to thermal considerations.

Section 7.5 : Figure 31 shows the module temperatures, but the text does not discuss this. Can be fixed with a brief addition to L1131 :

"The temperature distribution of the modules along the cooling loops for nominal power load is shown in Fig. 31." → ok

L1172 : This line is the first mention of the strip tracker detector. I think it makes sense to give a few sentences about the outer tracker in the introduction. We should at least understand the overlap of the two systems in pseudorapidity, and the radii of the outer tracker layers. But maybe it would also be good to mention the performance of the outer tracker in order to understand what the benefit of the inner tracker is. → removed this reference to the strip tracker. Since it does not fit well in the introduction, prefer to leave

as is. The only mention of the strip tracker is now in Fig. 40, where we added a reference to the CMS detector paper.

L1189 : How was the decision of module placement based on module quality done ? Maybe add what the optimization was based on ? → Deleted this sentence.

References :

[4] Would it be better to use the pixel phase-one upgrade reference posted at CERN, rather than the U.S. DOE's / Fermilab page ?

So :

<https://cds.cern.ch/record/1481838?ln=en>

<http://inspirehep.net/record/1193236?ln=en#>

instead of :

<http://dx.doi.org/10.2172/1151650>.

→ yes, changed

Text improvements :

----- abstract -----

"The design of the upgraded CMS pixel detector allows to cope"

->

"The upgraded CMS pixel detector is designed to cope"

→ ok

"instantaneous" (check spelling) → ok

"after the first long shutdown of the accelerator" ->

"after the upgrades to accelerator during the first long shutdown." → ok

"has higher" -> "has a higher" → ok

"up to absolute pseudorapidities of 2.5."

-> "up to an absolute value of pseudorapidity of 2.5." → ok

----- section 1 -----

L51 : "as innermost" -> "as the innermost" → ok

L52 : "high-precision, charged-particle tracking" → ok

L64 : "shutdown 2016/2017" -> "shutdown during 2016/2017." → ok

L69 : "high-quality data" → ok

L79 : "system, as well" → ok

----- section 2 -----

L96 : "endcap disks" -> "forward disks" (since \*F\*pix) → ok

L106 : "This scheme allowed for installing the CMS Phase-1 pixel detector within the limited period"  
->  
"This scheme allowed the CMS Phase-1 pixel detector to be installed within the limited period" → ok

L107 : "in winter" -> "during winter" → ok

L116 : "has to fit" -> "is required to fit" → ok

L118 : "is needed" -> "are needed" → ok

L129 : "carbon-fiber materials" → ok

L130 : "and adopting the use of a lower mass, two-phase CO2 cooling system." → ok

L135 : "beam line, the" → ok

L139 : "system [4], therefore a replacement ..." → ok

L144 : "FPIX and up to ..." -> "FPIX that are up to almost 600 MHz/cm<sup>2</sup> for BPIX L1" → ok

----- section 3 -----

L171 : "had been continued" -> "have been continued" → ok

L186 : "as it allows to operate the sensors under-depleted." ->  
"as it allows the sensors to be operated under-depleted." → ok

L190 : "as large area implant" -> "as a large area implant" → ok

L191 : "at the back" -> "on the back" → ok

L192 : "is implemented" -> "are implemented" → ok

L193 : "guard-ring scheme" → ok

L194 : "allows all sensor edges to be at ground potential" → ok

L201 : "In the case of" → ok

L202 : "a punch-through biasing grid."  
Also, L206 needs same hyphen → okx2

L220 : "are using open" -> "use open" → ok

L224 : "which has the same functionality" -> "providing the same functionality" → ok

L225 : "p-stops, the" → ok

L225 : "charge-collecting pixel electrodes" → ok

L243 : "possibility to increase the" -> "possibility of increasing the" → ok

L247 : "has to" -> "must" → ok

L247 : "which is" -> "that is" → ok

L255 : "well-tested" → ok

L266 : "Modifications are mainly made in the chip periphery to overcome the limitations of the PSI46 at high rate."

->

"The main modifications made in the chip periphery are to overcome the limitations of the PSI46 at high rate." → ok

L268 : "They feed" -> "These supply" → ok

L271 : "is first passed" -> "is passed" → ok

L331 : "is a higher-than-expected noise" → ok

L332 : "is a lower-than-expected efficiency" → ok

L334 : "avoiding a compromise of the data quality" → ok

L341 : "column does no longer acquire new hits" ->  
"column no longer acquires new hits" → ok

L342 : "of going back to" -> "of a return to" → ok

L347 : "time-stamp buffer-full signal." → ok

L377 : "The TBM08" -> "The TBM08 version" → ok

L378 : "TBM09 and TBM10 versions have" → ok

L381 : "in TBM09 and TBM10" → ok

L399 : "and avoid losing them" → ok

L407 : "revealed a vulnerability" → ok

L407 : "single-event upsets" → ok

L408 : Since "event" often means "pp collision" in HEP papers, it may be better to be more clear here. I recommend :

"SEUs are events in which" -> "SEUs are interactions in which" → ok

L411 : "in the pixel detector readout chain" ->  
"in the readout chain of the pixel detector"  
(otherwise, you would need hyphens) → ok

L422 : "The new chips will be used in new modules after replacement during the consolidation work in LS2."

(this statement is a bit ambiguous since it implies that they won't be used during the replacement, but only after the replacement)

--> "The new chips will be used in new modules that will be incorporated during the consolidation work in LS2." → ok

L427 : "TBM08, with" → ok

L428 : "feature also" -> "also feature" → ok

L428 : "PSI46dig ROC but a TBM09 chip with two readout links"

->

"PSI46dig ROC but with a TBM09 chip that has two readout links" → ok

L429 : "L1 required" -> "L1 requires" → ok

L441 : "The KIT/RWTH Aachen production has developed" -> "The KIT/RWTH Aachen consortium developed"

(or "has previously developed" if it was done before CMS phase-one) → changed to developed.

L455 : "84 and 96%." → ok

L478 : "ROCs and a TBM08" → ok

L528 : Is it obvious what "global threshold" means, or can you explain this with half a sentence ? Perhaps something like :

"Then, the global threshold to which signal amplitudes are compared (VthrComp)"

→ indeed this is not obvious. The terms refers to the threshold setting that can be set for the whole ROC. (Compare L272ff: The comparator threshold is set by a DAC for the whole ROC, but can be adjusted via a 4-bit DAC (trim bits) for each pixel individually.)

Changed to: "the setting of the comparator threshold (\vthrcomp) was adjusted.."

L529 : "its timing by" -> "and its time delay by" → ok

L539 : "that there is" -> "that there was" (to be consistent) → ok

L544 : All the settings are defined in terms of V, but here you use charge as a unit. Perhaps you can just reword slightly to :

"A target threshold corresponding to 2000 e- was chosen" → ok

L568 : "which is" -> "that is" → ok

L571 : "that allows to send a calibration signal to a top metal pad in the ROC"

->

"that allows a calibration signal to be sent to a top metal pad in the ROC" → ok

L573 : "The generated signal was read out by the ROC, and in this way the pixel capacitance was measured." → ok

L576 : "heights, which" → ok

L581 : "whether handling damaged the module and"

-> "whether the module was damaged by handling and" → ok

L583 : "hit-detection efficiency" → ok

L586 : "from 20 up to 160 MHz/cm<sup>2</sup>" → ok

L606 : "In order to be qualified for" -> "In order to qualify for" → ok

L608 : "less than 4\$ of pixels defective" → ok

L620 : "low-yield phases" → ok

L621 : "were too high sensor leakage current" ->  
"were unacceptably high sensor leakage current" → ok

L625 : "permitted starting the module construction almost"  
->  
"permitted the start of of module construction to be almost" → ok

L631 : "of the ROC wafer" -> "of the ROC wafers" → ok

L638 : "In both the BPIX and FPIX detectors the" → ok

L641 : "The BPIX and FPIX detectors are connected to four service half-cylinders each,  
which"  
->  
"The BPIX and FPIX detectors are each connected to four service half-cylinders,  
which" → ok

L643 : "act as pre-heaters for the CO2 cooling."  
-> "act as pre-heaters that stimulate the gas phase of the CO2 cooling." → ok

L656 : "carbon-fiber reinforced polymer" → ok

Figure 16 : "in the r\$/phi\$ view" → ok

L697 : "at highest" -> "at the highest" → ok

L697 : "highest instantaneous luminosities" ( perhaps ? ) → ok

L698 : "The detector cooling line segments are joined with the cooling line segments on  
the service half-cylinder"  
->  
"The cooling line segments of the detector are joined with those of the service  
half-cylinder" → ok

L712 : "5 cm" -> "5 mm" see [1] below → yes!

L726 : "has been tested" -> "was tested"  
(Its not still going otherwise it would be several years) → ok

L729 : "carbon-fiber composite" → ok

L744 : "skins glued to"  
(ambiguous, do you mean this : )  
-> "skins that are glued to" → ok

L762 : "double-walled rear section that is 1500 mm long, and" → ok

L778 : "single-shell front section" → ok

L801 : "gold-plated contact pads" → ok

L814 : "requires" -> "required" → ok

L828-832 : suggest also using semi-colons for clarity :

"The DAQ system to control and read out the full pixel detector consists of 108 front-end driver modules (FEDs), which receive and decode the pixel hit information; three front-end controller modules (TkFECs), which serve the detector slow control; 16 pixel front-end controller modules (PxFECs) used for module programming, and clock and trigger distribution; and 12 AMC13 cards [50] providing the clock and trigger signals." → ok

L875 : "have been set up" -> "were set up" → ok

L878 : "testing and measurement" → ok

L878 : "has been carried out" -> "was carried out" → ok

L898 : "The powering of the CMS Phase-1 pixel detector"  
(this reduces the number of adjectives that are piled on) → ok

L914 : "as energy" -> "as an energy" → ok

L915 : "pulse-width modulation" → ok

L918 : "stopped from remote" -> "stopped remotely" → ok

L931 : "electromagnetic shielding" → ok

L935 : "in a several year-long R&D" → ok

Figure 27 : Perhaps add that :

"Thirteen pairs of DC-DC converters are shown mounted on the motherboard." → ok

L961 : "power-filter boards" → ok

L971 : make "power good line" consistent with L919 : "Power-Good bit"  
( I recommend not using capital letters and using a hyphen)  
--> "power-good line" and "power-good bit". → ok

L982 : part of this sentence is present tense and part is past tense.  
Suggest : "This affected only" → ok

L989 : "maximal current" -> "maximum current" → ok

L990 : "as not to" -> "so as not to" → ok

L991 : "The sense wires, however, are used" → ok

L999 : "pixel detector modules" -> "detector modules" (perhaps "pixel" is obvious by now ) → ok

L1005 : "from beginning" -> "from the beginning"

"2017 onwards" -> "2017 and onwards" → ok

L1010 : "In the long shutdown during 2017/2018 the" → ok

L1010 : "aiming for replacement of defective" -> "in order to replace defective" → ok

L1011 : "and to allow for investigation of the failures" -> "and to investigate the failures" → ok

L1015 : "with a minimal dose of about 1 Mrad necessary for failure." → ok

L1024 : "switching off and on the power supply." → ok

L1025 : "which features" -> "that features" → ok

L1033 : "small-diameter, thin-walled pipes" → ok

L1070 : "10K" -> "10 \deg C" to be consistent with the rest of the paragraph. → ok

L1116 : "far away from the system limits" -> "with a safe margin from the system limits" → ok

L1141 : add the year that it was built, otherwise it sounds like it was built in the TS 2016/2017.

"A pilot system [62] was operated from 2015 to 2016 to be prepared" → ok

L1141 : "to be best prepared" -> "to be prepared" → ok

L1143 : "from the possibility of accessing the pixel detector" → ok

L1144 : "and a complete readout chain." → ok

L1148 : "The goal of installing the pilot system was"  
-> "The goal of the installed pilot system was" → ok

L1151 : "system for the Phase-1 upgrade"  
-> "system developed for the Phase-1 upgrade" → ok

L1157 : "has been resolved" -> "was resolved" → ok

L1170 : "for single event effects" -> "for SEU effects"  
(since it has already been explained) → not the same. Kept.

L1172 : I just realized that no where in this paper do we mention what the strip tracking detector is. This is the first mention of it.

Assuming you introduce it beforehand somewhere, here you could say "Furthermore, it was checked that the DC-DC converters did not cause any additional noise in the strip tracker detector, which is outside of the inner tracking volume." → removed this sentence.



L1225 : "connectors applying" -> "connectors while applying" → ok

L1226 : "The high voltage distribution" -> "The high-voltage power distribution" → ok

L1239 : "A custom-made" → ok

L1242 : "low-voltage and high-voltage power" → ok

L1252 : "drawing too high current" -> "drawing too much current" → ok

L1256 : "isolation" or "insulation" ? → insulation

L1279 : "port-card cooling structures" → ok

L1280 : "port-card power cables" → ok

L1299 : It is not so clear why the patterns were lost. Perhaps :  
"were lost in patterns at the corners of modules due to mechanical stresses." → added.

L1326 : "has to be installed" -> "was to be installed" → ok

L1421 : "However, if thresholds are too low pixel, pixel noise ..." → ok

L1428 : "cross-talk noise" → ok

L1518 : "small-amplitude signals" → ok

L1522 : "cannot be compensated for because" → ok

L1523 : "Despite the shift" → ok

L1535 : "A full module level alignment of the pixel detector" ->  
"A complete module-level alignment for the pixel detector" → ok

L1564 : "pixel varying" -> "pixel while varying" → ok

L1571 : "or beam" -> "and beam" → ok

L1571 : "beam-background events" → ok

L1574 : "but not for all" -> "but not all" → ok

L1581 : "and by annealing" -> "or by annealing" → ok

L1585 : "level, full" → ok

L1591 : "affected by radiation damage" → ok

L1598 : "The second method looks" → ok

L1608 : "High cluster hit-detection efficiency" → ok

L1608 : "maintain good track" → ok

L1610 : "is carefully monitored" → ok

L1612 : "as the "sensor efficiency" → ok

L1615 : "various effects, like : presence of delta-rays, ..."

->

"various effects, like the presence of delta-rays, ..." → ok

L1618 : "lead to a temporary" → ok

L1626 : "low-rate inefficiency" → ok

L1637 : "namely b-tagging, secondary vertex resolution and primary vertex identification [3,67]." → ok

L1640 : "the whole tracker detector"

(this is not currently well-defined since the outer tracker has not been mentioned in this paper yet) → changed to "reconstructed tracks"

L1649 & Figure 47 : The " $\phi$  direction" was never explained. → added definition of coordinate system in the introduction

L1661 : "improving pattern recognition" -> "improved pattern recognition" → ok

L1661 : "but also added redundancy" → ok

L1665 : ", delivered" -> ", has delivered" → ok