Dear authors,

congrats to this very nice paper with beautiful results from the early phase of the pixel R&D.
The language is fine for the most part, but some improvements are needed.
Please find my comments below.

Next time, please add line numbers to a draft!

Content:

Fig 5/6 upper:
I have not understood why both the data points have uncertainties (colored bands), as well as the horizontal lines of the expected signal!

Fig 6 (lower plot) in general and
discussion of Fig. 6 in last paragraph of page 3:
To me it looks like “charge collection efficiency” and “particle detection efficiency” are confused/ mixed up here! At least it is unclear what you plot, how it is defined, etc.
Please explain how the plotted efficiency is defined!
Is this now the charge collection efficiency (as you say on p 3), or the particle detection efficiency (as you say on page 4)? These are two very different things!

Fig 8:
Do you understand the rather large inefficiency at 0 fluence, 150 V (middle plot) at the lower and upper right corner of the pixel? You say it’s due to the bias grid, but don’t say why it is so large at higher V.

Grammar/clarity
Abstract:

fluencies-→fluences

remove “To this extent”

the sentence …which allows for planar thickness 100 and 130 and 3D of 130 ….sounds funny. Almost sounds like a restriction of Si-Si: Why is 3D in 100 mum not possible? →rephrase

Intro:
collected data→delivered lumi

ten times such a fluence → ten times this fluence

remove “in fact”

saturated velocity →saturation velocity (2 times)

footnote 1: remove “indeed”

page 2:

underlying p-type layer → underlying p+ layer

fig 2 caption: between couples of →between two

“In addition, p spray implants can be Low, Medium and High, while p-stop rings can be Open or Close.”
→what does this mean? Explain!
I assume Low refers to low p-spray concentration. Then also mention the concentration if you can. Explain what Open or Close*d* means!

It is worth noting…→remove

number of junction/ Ohmic →numbers of junction/ Ohmic

page 3:
Figure 5 shows the trend of the MIP-MPV as a function of bias voltage
→remove “the trend of” (and also in other places)

Remove “By contrast”
Sentence starting with “the MIP-MPV trends” rephrase to sth like →The MPV for MIPs is shown in Fig 6. (top) as a function of bias voltage for three different fluences.

P4 first paragraph: the thick sensor →a thicker sensor

You say, that at high fluence for a thicker sensor a much higher Vbias is needed to get the same signal. While this statement is eventually correct, your plot does not really support this: The signal for 130 mum is always above the one for 100 mum. The problem is that you don’t compare the two thicknesses for the same fluence….
→Rephrase

Maybe rephrase:

This underlines the fact that at high fluences as expected at the HL-LHC thinner sensors can be operated at lower bias voltages.

, and, namely →remove ", and"

Fig 7: put a label on each plot with the thickness

P4, left column:
For what follows →For the following discussion, it is important to keep in mind that the sensors have punch through…

P5 before the irradiation →before irradiation

The observed loss of efficiency is practically independent from either the active layer thickness, or the p-spray and p-stop isolation structure.

→The observed loss in efficiency is practically independent of the active layer thickness and the p-spray and p-stop isolation.

I would remove "structure" since there is no p-spray structure

Later:
The complete uniformity of the efficiency can be recovered->Complete uniformity of the efficiency can be obtained by tilting…

Fig 8 caption:
Rephrase last sentence: "The efficiency clearly results affected by the bias structure…"

Conclusion:
The last part of the conclusion is unclear:

First you make rather general statements about the sensors studies for this paper up to 5E15. It looks like your statements ("performance is excellent") apply to planar and 3D.
→try to make a more specific/ quantitative statement about the efficiencies than just saying they are excellent(?)

The last part of the conclusion is unclear:
In the outlook, you make a statement that full detection efficiency should be possible for 25x100 and 50x50 *3D* sensors at the target fluence for voltages below 300 V.
→what is the target fluence? I assume 50% layer 1, I.e. 1E16? Or something else? Where does the 300 V come from??? Is 100 % efficiency realistic?

And: I think you need a similar outlook statement for planar sensors to complete the picture.