

Pixel Devices on the common RD50 n-in-p Strip Detector Mask Set (200mm)

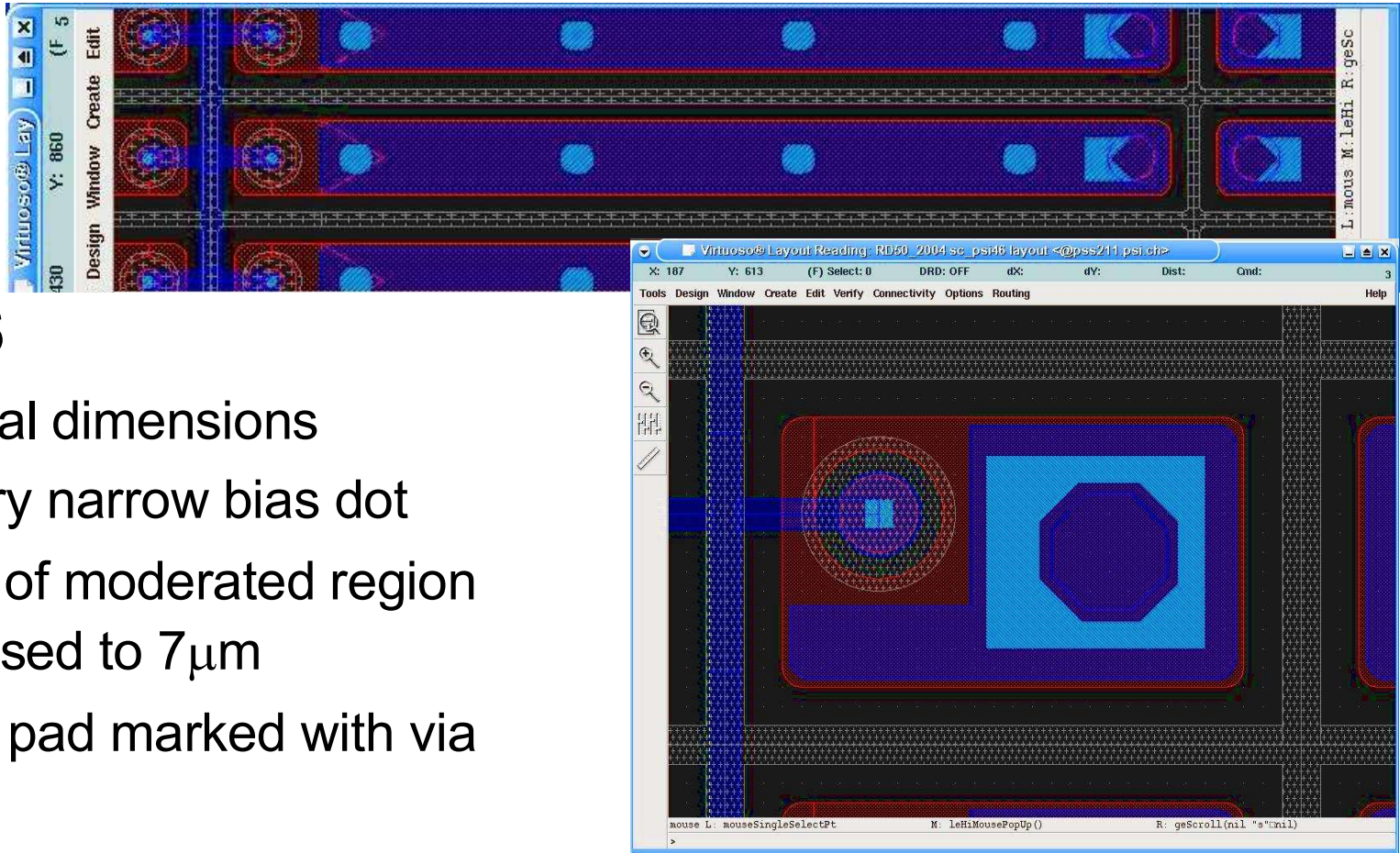
T. Rohe, PSI

7th RD50 workshop, Nov 14-16, 2005, CERN

- “n-in-p” pixel sensors very attractive
 - Single sided process (**cheap**)
 - Potentially the same radiation hardness as “n-in-n”
- 200mm mask set dedicated to strip detectors
 - See next talk by Hartmut
- Pixel devices are “**parasitic**”
 - Cover only a small fraction of the wafer
 - Only “single-chip”-devices are included
 - They contain (almost) all features of full size detectors
 - **Should not make additional demands on the technology** (which cost money)

- Process contains a poly layer
 - not necessary for DC-coupled pixels
 - some “experimental” structures use it as field plates in the pixel
- **No passivation**
 - problematic for bump bonding ?!!!
 - reconsider passivation ??
- Probably no bump deposition on wafer level
 - Limits possible bump vendors
 - Expensive
 - Small number of devices (costs not so important?)

- “**ATLAS**”-type (1 flavour)
 - **Size $9.8 \times 10.4 \text{ mm}^2$**
 - Array $18 \times 160(+4)$ pixels
 - Pitch $400 \times 50 \text{ }\mu\text{m}^2$ (edge: $600\mu\text{m}$)
- “**CMS**”-type (2 flavours, w and w/o poly)
 - **Size $9.9 \times 10.2 \text{ mm}^2$**
 - Array 52×80 pixels
 - Pitch $150 \times 100 \text{ }\mu\text{m}^2$ (edge: double)
- “**PSI**” type (2 flavours, w and w/o poly)
 - **Size $5.4 \times 6.2 \text{ mm}^2$**
 - Array 22×40 pixels
 - Pitch $150 \times 100 \text{ }\mu\text{m}^2$ (edge: double)



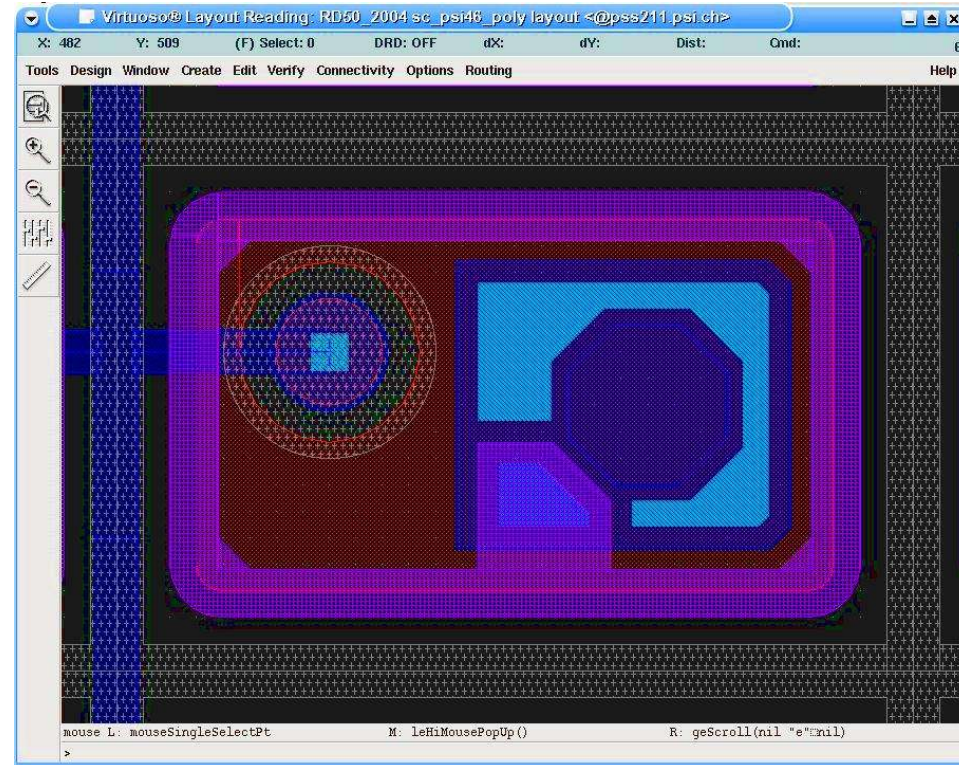
- **ATLAS**

- Original dimensions
 - very narrow bias dot
- Width of moderated region increased to $7\mu\text{m}$
- Bump pad marked with via

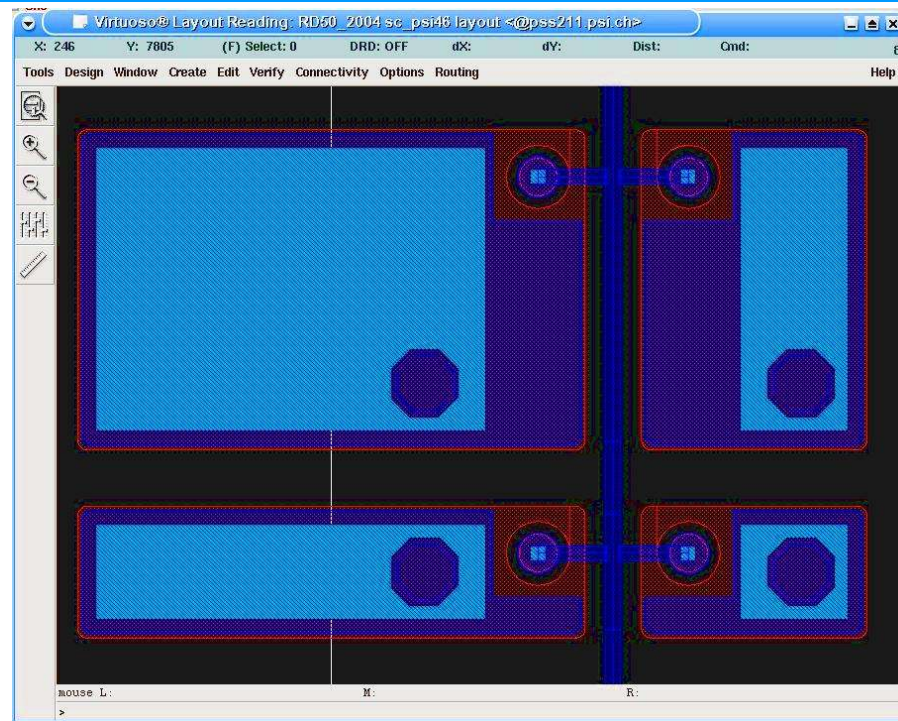
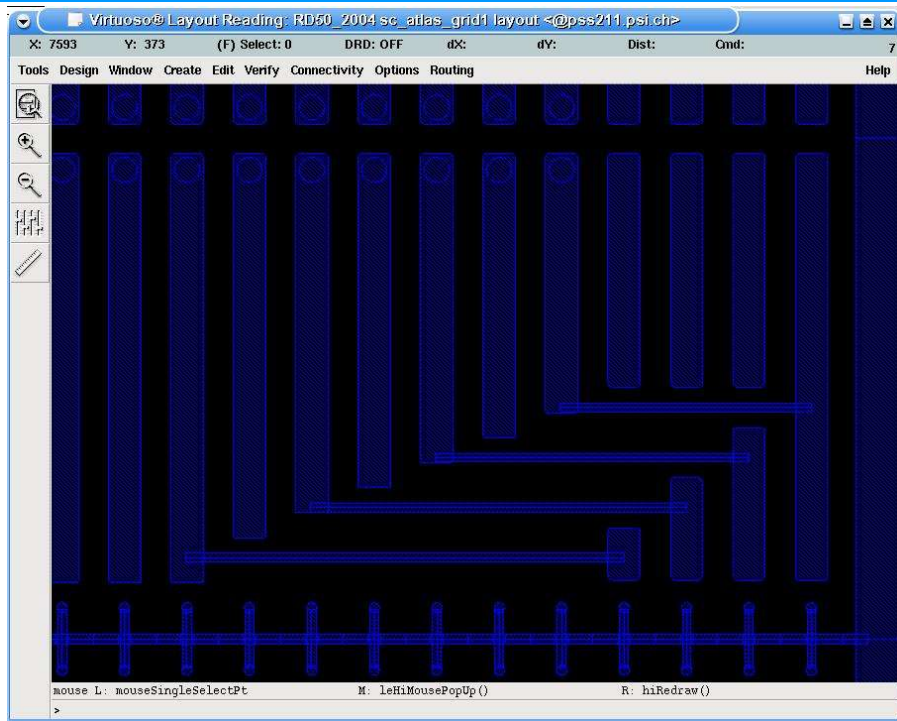
- **CMS**

- Gap slightly increased $20 \rightarrow 30\mu\text{m}$
- Width of moderated region increased to $10\mu\text{m}$
- Bias dot much larger than original

- Poly provided by strip technology
- Use it as field plate
 - higher breakdown voltage ?
 - problems at the point crossing the metal
- Not (easily) possible in ALTAS geometry because of small pitch



Edge Pixels



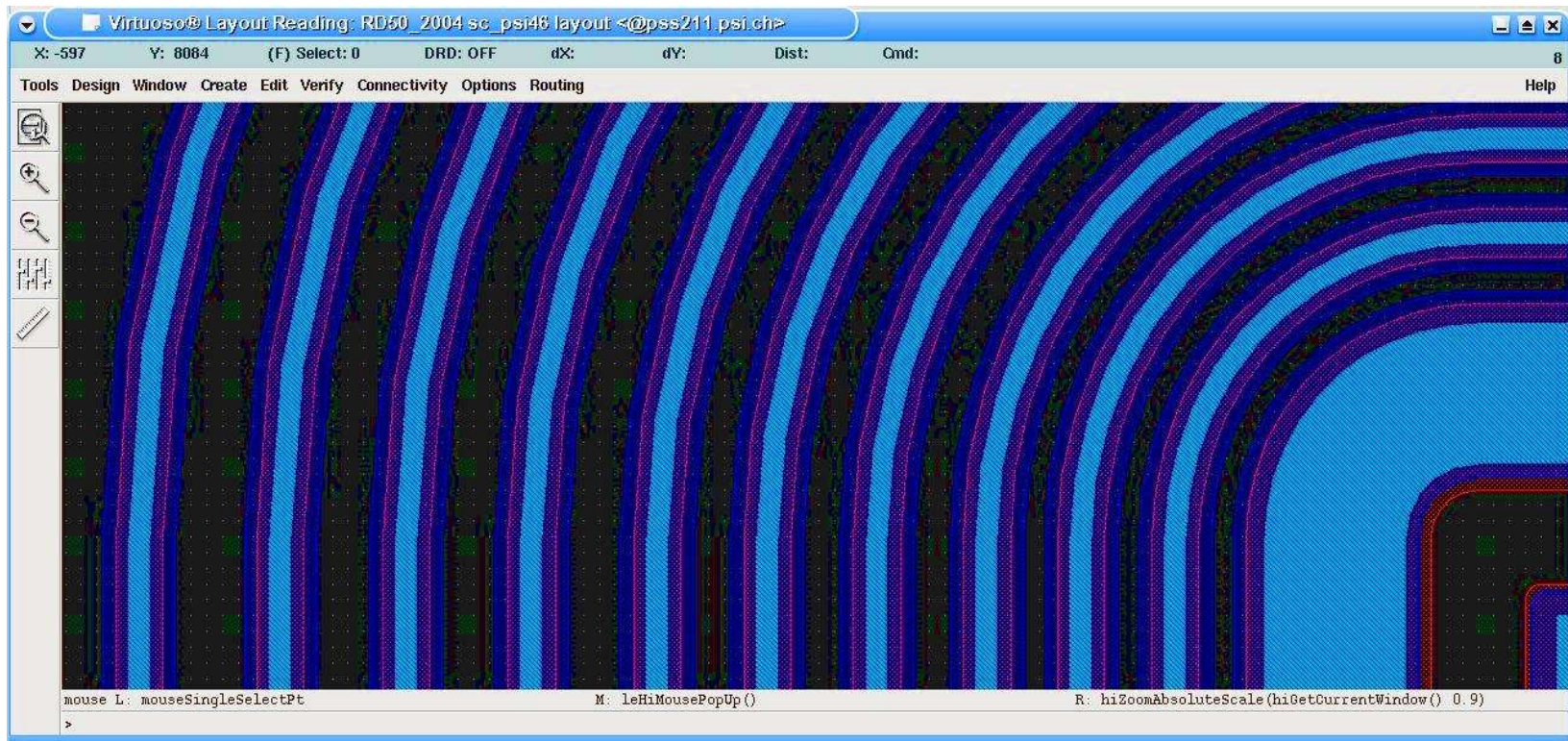
• ATLAS

- last $200\mu\text{m}$ not covered by ROC
- 4 pixels are connected to others
- pixel in other direction are elongated

• CMS

- last $100\mu\text{m}$ not covered by ROC
- Edge pixels are elongated in both directions

Guard Rings



- Bias ring $\sim 50\mu\text{m}$
- 10 guard rings with increasing pitch
 - not optimised for p-spray isolated n-side
 - gap filled with “low dose” p-spray
- High bias at device edge problematic?

Summary

- “n-in-p” pixel sensors for inclusion on the common RD50 200mm-wafer **drawn** (will be submitted to Gianluigi this week)
- Sensors are compatible with
 - **ATLAS ROC (FE-I)**
 - **CMS ROC (PSI 46)**
 - Generic pixel chip (PSI 49)
- Design **close** to such used in **LHC experiments**
- Additional design using **poly field plates**
 - Potentially higher breakdown voltage
 - Not standard for DC-coupled pixel
 - 2 extra mask layers (costs)

Open Questions

- Bump bonding
 - Single die bump bonding
 - **No passivation**
 - Possible vendors
 - PSI ? (Only limited resources available. Overview of all wishes by RD50 very helpful)
 - IZM ?? (ATLAS institutes and other non-RD50 members interested??)
 - Others???
 - Availability of readout chips?
 - Funding?
- Who will test the devices?
 - Complicated infrastructure necessary to run readout chips: Source (beta, gamma), laser?
 - Test beam as part of experiments (ATLAS/CMS/...)?
 - Irradiation: probably CERN-PS