TPAC papers

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Plan for five papers?

1. Simulation study of generic DECAL performance
   - Response of full-size DECAL to photon showers
2. TPAC1.0 performance, collection of all results
   - Sensor functionality, deep P-well vs non deep P-well
3. Basic performance of TPAC1.2
   - Comparison of hi-res, deep P-well
4. MIP efficiency from CERN and DESY beam tests
   - Hi-res, deep P-well, epitaxial layer dependence
5. Electron shower properties at ultra-fine granularity
   - Core density measurement

1. DECAL performance

- One of the two papers stalled for a year
  - Mainly done by Anne-Marie but based on wrong noise performance
  - Targeted at NIM
- Motivation for DECAL
  - Resolution of full-sized DECAL to photons
  - Ideal resolutions and addition of realistic effects
  - Dependence on pixel size, noise, deep P-well, charge diffusion, dead areas, etc.
  - Seems hard to do PFA performance; drop
- Probably needs to be effectively redone
  - Difficult to be consistent with Anne-Marie's work
  - Should be a lot quicker now we know what to do
  - Could be done with Mokka, TPAC simulation, stand-alone GEANT4 or even one of SiD/ILD simulations
  - Which gives best information for particle counting?

2. TPAC1.0 performance

- The other of the two papers stalled for a year
  - ^{55}Fe calibration misinterpretation; now understood
  - Targeted at IEEE. Reconsider; J. Inst? Sensors?
- Basic performance of design(s)
  - Pedestal, noise, uniformity, trimming, calibration with ^{55}Fe, diffusion time, etc.
  - Comparison of deep P-well vs non-deep P-well, also 5 vs 12μm epi
  - Use test pixels (including TPAC1.1 "old" design) and bulk
  - Compare with Sentaurus and diffusion simulations
  - Drop all beam test results (from DESY Dec 2007)
  - Include anything on sensor-to-sensor uniformity?
- Most work done; needs collection of results
  - Need to ensure consistency as taken over a long period
  - Some measurements may need to be redone

3. TPAC1.2 performance

- New paper
  - Target at same journal as TPAC1.0 performance?
- Basic performance of design
  - Similar material as for TPAC1.0 paper
  - Have more variations; deep P-well vs non-deep P-well, hi-res vs standard, 5 vs 12μm for deep P-well, 12 vs 18μm for hi-res
  - No beam test results as those appear in following papers
- Many measurements have been done
  - Again, spread over a long period so consistency is an issue
  - May need to (re)do quite a lot to cover everything
  - E.g. no bulk pixel laser results for TPAC1.2 been taken?

4. MIP efficiency

- New paper
  - Journal?
- Response of sensor to MIPS
  - Deep P-well vs non-deep P-well
  - Hi-res vs standard sensors
  - Hi-res 12 vs 18μm epitaxial layer sensors
  - Need to compare with simulation; verify response can be modelled
- CERN Aug 2009 data not sufficient and not ready
  - Data efficiency has discrepancies; needs to be understood
  - Simulation very different; needs to be understood
  - Not enough hi-res 18μm epitaxial layer data taken
  - No non-deep P-well sensor data taken
  - Need DESY Mar 2010 data; electrons so need to crosscheck against CERN pion data as well

5. Electron showers

- New paper
  - Shower physics measurement, not sensor response
- Comparison of shower densities in data and simulation
  - Electron response and core shower density
  - Results vs particle energy and vs material depth
  - The most critical result for DECAL
- Need Mar 2010 beam test at DESY
  - No tracking for electron data from CERN Aug 2009
  - Will only go up to 6GeV ☹
  - More data would need CERN beam test; do we have the people to do this?
  - Needs good simulation agreement with MIP results

Order

- First two papers support each other
  - Realistic DECAL depends on TPAC results (noise, charge diffusion, etc)
  - Motivation for TPAC depends on DECAL results
  - Try to get them out roughly in parallel so each can reference the other
- TPAC1.2 paper needs to come out before beam test papers
  - Beam test papers need to reference the sensor design from this paper
- MIP paper needs to come out before shower density paper
  - Density measurement requires simulation to be verified