Report from the Tracking and Vertexing Group:

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Structure of parallel session

- **Silicon Sensor Fabrication on 8" wafers** (Ron Lipton)
- **3D Silicon Sensors** (Martin Hoeferkamp)
- **Diamond Tracking Sensors** (Joshua Moss)
- **ATLAS CMOS Development** (Herve Grabas)
- **Ultrafast Silicon Sensors** (Abe Seiden)
- **FCP130, IFCP65, and Incorporation into RD53A** (Farah Fahim)
- **A SEU-immune Self-tuned Pixel Chip Architecture** (Timon Heim)
- **Ultralight Structures for Tracking Detectors** (Bill Miller)
- **CMS Phase 2 Tracker Upgrade** (Yuri Gershtein)
- **ATLAS Phase 2 Upgrade Pixel Layouts** (Swagato Banerjee)
- **Mu2e Tracker** (Bob Bernstein)
- **DUNE Tracking Reconstruction Challenges** (Xin Qian)
- **Pixel Readout for DUNE** (Jonathan Asaadi)

Findings

- A new generation of silicon 3D sensor designs geared toward HL-LHC requirements is underway with reduced thickness, thinner columns, smaller pitch, increasing breakdown voltage
- A domestic producer of 8” silicon sensor wafers is coming online.
- The ATLAS Diamond Beam Monitor is now being commissioned for the 13 TeV run; good collision-to-background discrimination is evident in test beams; first results on a 3D polycrystalline diamond device show success in scale up and cell size reduction.
- A full reticle demonstrator strip sensor, CHESS2, in HV CMOS technology has been shown which improves the resolution of current baseline sensors by a factor of 2 in r-Φ and z.

Findings, continued

- Ultra-fast silicon detectors based on low gain avalanche diode technology are demonstrating stable operation with gain around 20, good gain uniformity, and high rate capability.
- A preliminary architectural investigation of a test CMS pixels chip in 130 nm was described, and qualitative analysis of it has been successful: preamplifier response can be monitored, and all comparator response times are changing with change in threshold voltage; adaptation to 65nm is underway with mini-ASIC submission followed by tests started recently.
- A self-adjusting threshold mechanism referenced to noise hit rate is being sought to negate effects of SEUs and changes in transistor characteristics – inspired by ATLAS Phase 2 Pixel Upgrade needs.

Findings, continued

- Ultra-light composite material has been prototyped with foam core and cooling tube for ATLAS Pixel upgrade, including application of techniques to maintain thermal conductivity.
- CMS HL-LHC tracker design was introduced; it provides much lower mass, increased granularity and resolution, and track reconstruction at Level-1 (40 MHz).
- 2 layouts are under consideration for the ATLAS Phase 2 Pixel tracker: comparing an extended geometry with well-tested support structure to an inclined one requiring less material in the active volume.
- Mu2e straw tube annular tracker is being actively prototyped for minimum mass and best possible resolution on Decay-in-Orbit spectrum, and its upgrade path is already on the horizon.

Findings, continued

- A full-chain automatic reconstruction is now available for DUNE after much dedicated effort; great progress in pattern recognition has been achieved
- The pixel-based LArTPC for DUNE is showing potential to overcome challenges that conventional wire readout would pose for neutrino detection