The CMS Phase 1 Pixel Detector
The CMS detector is a multipurpose detector at the CERN LHC. The silicon pixel detector is closest to the proton-proton interaction point and provides high-precision tracking information. The original pixel detector has been replaced with an upgraded system (Phase 1) during winter 2016/17 to maintain the excellent track reconstruction performance of CMS at higher luminosities (up to 2.5×10^{34} cm^{-2}s^{-1} during LHC Run 2+3).

Main Improvements
Robustness
- Additional barrel layer and endcap disk
Vertex resolution
- Innermost layer and disks closer to beam
Efficiency
- Faster readout electronics
Material budget
- CO₂ cooling and lightweight CFK mechanics

Performance during first year of data-taking
Threshold and Noise
- Mean threshold of 1800e⁻ with noise of ~150e for outer barrel layers and endcap disks
- Mean threshold of 2600e⁻ for innermost barrel layer (different readout chip)

Operation and procedures
- Detector calibration after installation and during technical stops
- Fraction of active channels of 95.7%
- Periodic power-cycling/resets/programming to mitigate SEU effects

Performance
- Resolution of about 10(30)um in the transverse(longitudinal) direction
- Dynamic inefficiency at high inst. luminosity significantly reduced

DCDC converter issue
- 1184 DCDC converters used for powering
- Components started failing during last two months of operation (67 converters)
- Detector extracted for repair at the end of 2017
- Failure traced to FEAST2 chip, cause still under investigation

Conclusion
The CMS Phase 1 pixel detector delivered high-quality data during its first year of operation. An issue with the DCDC converter chips, required an unforeseen intervention in winter 2017/18. Despite the limited time available before the start of the next LHC run, all repair work was completed and the detector is again taking data. Detailed investigations of the DCDC converter issue are ongoing and are crucial in view of many future LHC detector upgrade projects.