The ProtoDUNE detectors at CERN are prototypes for the far detector of DUNE, an upcoming neutrino experiment in the USA. They are meant to validate the technology behind large liquid argon time projection chambers at full scale and will receive SPS beam particles from August until November 2018. The FELIX (Front-End Link eXchange) data acquisition system is envisioned to read out one sixth of the single-phase ProtoDUNE detector (ProtoDUNE-SP). It is based on the concept that a thin interface between the detector front-end and commodity servers provides superior system flexibility and longevity.

**Hardware and Software**

- A 2x100 Gb/s network card transfers the data to the back end DAQ.
- Using a PCIe card as a front-end interface allows for the use of off-the-shelf and upgradable hardware. FELIX software in the host PC controls the complete FELIX system, including data transfer to the network.
- The FLX-711 board features a 16-lane Gen3 PCIe slot capable of outputting data at 128 Gb/s. The system performs continuous 75 Gb/s DMA transfer to its host PC’s memory.  
- Each APA consists of three wire planes: two induction planes and a collection plane. Due to the angle between the wires of different planes, the location of any collected charge can be reduced to a point.

**FELIX**

- FELIX is a system originally developed within the ATLAS Collaboration and will be integrated in the ATLAS detector during its Phase-I upgrades in 2019.
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- FELIX back end software elements
  - NetIO messaging layer
  - WIB link separation
  - Trigger-matching in a circular buffer
  - QAT data compression

**Conclusion**

FELIX is a cutting-edge solution for long-lasting systems that require capable and flexible data acquisition. Its generally applicable hardware ensures the longevity of the system and allows for the use of more complex software. The challenges faced within the ProtoDUNE-SP project have been as good as overcome: on a single link, the nominal design requirements have been exceeded. The system is now moving towards data taking stability in expectation of the SPS beam at the end of August.

**References**

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**Acknowledgements**

We would like to thank the ATLAS collaboration for having shared the FELIX hardware, firmware and software developments with us.

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