Evaluation and Improvement of an Integrated Circuit dedicated to medical imaging

In order to reduce significantly the dose administered to the patient during medical imaging, several R&D programs are ongoing. In this context, based both on new detection technologies involving liquid xenon and on a specific 3γ emitter radionuclide, the 3γ imaging has a very high potential from small animal imaging acceptances to whole body clinical applications.

Following a conclusive R&D program around the XEMIS1 prototype (XEnon Medical Imaging System), a second phase dedicated to small animal imaging, XEMIS2, is now under qualification. This new prototype is a monolithic liquid xenon cylindrical camera, which totally surrounds the small animal thanks to its 24 cm axial field of view. The 20480 pads of the ionisation chamber are read thanks to a dedicated ASIC called Idef-X. This 32-channel very-front-end electronics delivers an amplified and filtered signal. This signal delivered by the front-end electronics is readout by a **specific 32-channel circuit, called XTRACT**, in order to deliver the timing and charge of the relevant events.

Each channel of XTRACT is auto-triggered, with a memorization the address of the channel triggered but also the memorization of the peak value of the input voltage signal and its time of arrival. The transmission of this information (amplitude, time and channel numbers) is performed during a reading sequence thanks to an Asynchronous Binary Tree Multiplexer (ATBM).

In order to equip the camera XEMIS 2, a first version of the ASIC XTRACT has been produced, using the technology AMS 0.35 CMOS, in 800 units. **Some possible developments are however already considered in order to improve some performance, particularly concerning the discrimination of the input signals.**

The objectives of this internship is then to participate to the design of an enhanced XTRACT ASIC. The main issues are:
- ✓ Evaluation of the performance of the present XTRACT chip with the detector in collaboration with the Laboratory Subatech in Nantes;
- ✓ Evaluation of the improvements for the new version of XTRACT;
- ✓ Design of the new ASIC, using the Virtuoso Cadence tools:
  - o Schematic drawing and simulations
  - o Layout and floor planning
- ✓ Reporting of the results

The student will be integrated to the microelectronic team of the Laboratoire de Physique de Clermont-Ferrand (LPC) which is composed of six engineers.

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