Interest and importance of the different detector characteristics for the design of the readout electronics

Basic informations

- ***Expected number of channels of the different detectors***: estimation of the number of chips needed for the EIC project, impact on electronics integration (size, power consumption,...)
- ***Peaking time range***: integration period of the detector signals. Strongly depends on the length of the detector signals and the noise frequencies. Impact on the final noise level, gain and sampling rate, also impact on the time resolution of the readout. This parameter can have also an impact on some technology choices to be done for the microelectronics design (in particular for high value resistors and capacitors)
- ***Expected signal amplitude***: needed to determine the dynamic range of the chip, in order to take advantage of the maximum of the chip dynamics
- ***Detector electrode capacitance***: required to adapt the front-end design to the capacitance. Impact on the final noise level, on the gain and on the signal speed
- ***Polarity of the signals***: to determine if the chip should be able to read both positive and negative signals (for instance read-out of cathodic electrodes)

Required performance of the detector readout

- ***Time resolution***: important to determine peaking time, sampling rate, maximum noise level of the readout chip
- ***Required dynamics***: we need to know if the chip should be able to manage in the same time small and large signals, in order to foresee a mechanism to compress large signals
- ***Amplitude resolution***: impact on chip design to optimize noise level, gain stability, ADC calibration, number of ADC bits
- ***Double peak discrimination***: capacity of the chip to identify two close peaks, impact on the peaking time and the noise level
- ***Expected rate***: capacity of the chip to treat hit rate, in average (to determine data flux), in peak (for double peak discrimination), and also during bursts of hits. During bursts the charge amplifier could reach a saturation point, and such a situation should be avoided. The relevant value to be known is the maximum charge on the channel input integrated over the interval of time needed for the recovery of the charge amplifier (10 to 20µs in general).

Requirements on data treatment

- ***Basic treatments***: include pedestal subtraction, common mode correction, zero suppression. Please indicate if other treatments are required
- ***Optional advanced treatments***: could include clusterization, peak finding, time extraction, energy computation, others features ?
- ***Trigger features***: an external trigger input could be required, could also include the possibility to generate trigger signals from data treatment for specific usage
- ***Scaler***: the chip could include the possibility to count hits for each channel

Constraints on general specifications

- ***Die/package size***: impact on the number of channels in the chip, on features implemented in the chip. Also important for the detector and the readout electronic card designs
- ***Power consumption***: impact on front-end performance, number of channels, this can also limit the digital treatments. Direct impact on the heat produced by the chip
- ***Max temperature***: linked with power consumption
- ***Max radiation***: impact on detector technology, ADC and data treatment bloc structures
- ***Magnetic field***: large magnetic fields has an impact on the component choice and on the design of readout card