A high performance Front End Electronics for Drift Chamber readout in MEG experiment upgrade

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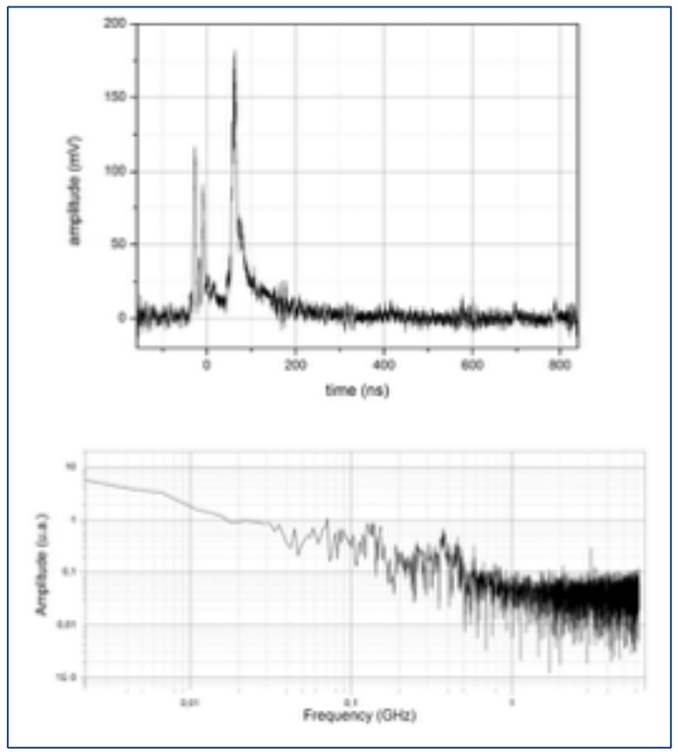
The new positron tracker for the spectrometer of the MEG experiment at Paul Scherrer Institute (Zurich), produces typical time separation between consecutive ionization acts in helium-based gas mixture of few nanoseconds. Therefore the electronic readout interface has to be able to process such high speed signals. In order to reach this goal we propose a high performance eight-channels front end electronics which amplifies weak signals from MEG drift chamber tracker. The front end board is designed and tested at INFN of Lecce electronics laboratory and it is based on commercial devices.
Each front end channel is a two stage amplifier with low noise and low power consumption. In order to compensate the attenuation introduced by the output cable a double stages of pre-emphasis is implemented to produces a high frequency peak in frequency response and a 1GHz -3dB bandwidth over 5m cable is achieved. Simulation performed by Spice shows a voltage gain of the order of 10 constant over the entire bandwidth, in agreement with preliminary measurements.

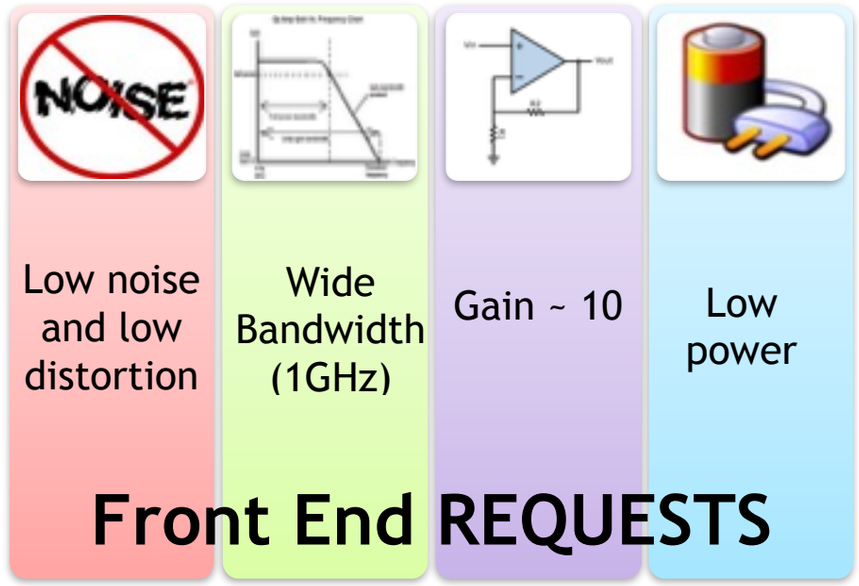
Typical Drift Chamber signal and related Fourier Transform



Study of the signals spectral density done using a single 8 mm diameter drift tube with the 90% helium - 10% isobutane mixture

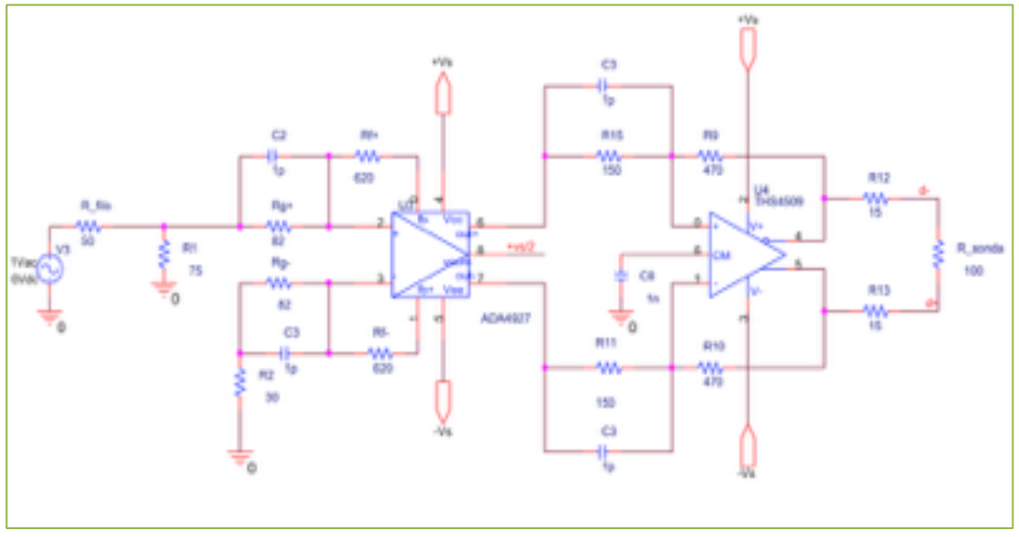
- Signal bandwidth of the order of 1 GHz
- Peak separation clusters: few ns to few tens of ns

GOAL: Spatial resolution 100 μm

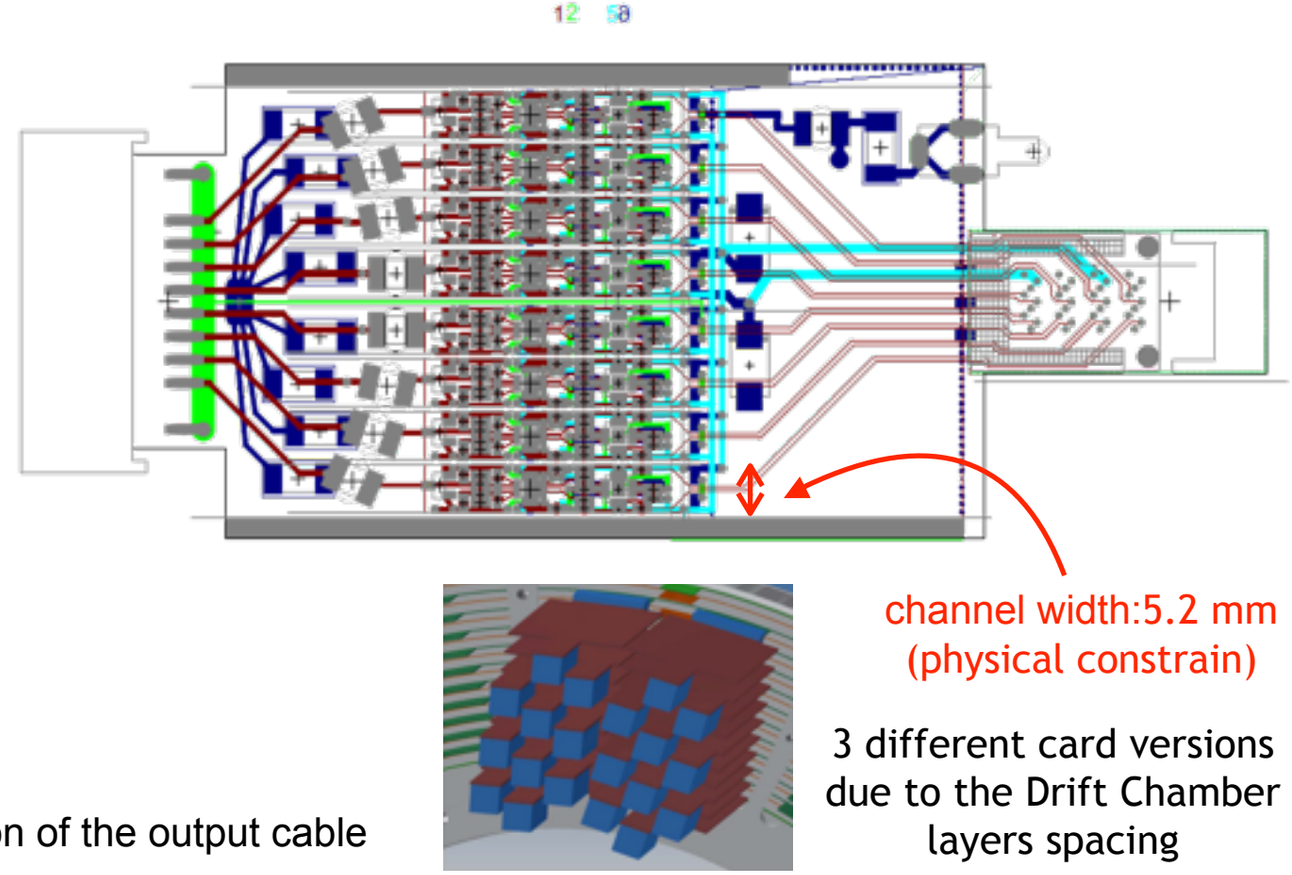


FRONT END

Schematic



Board

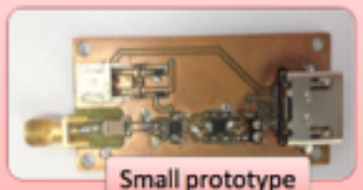


- 8 channels, each channel amplifies a single drift wire
- FE schematic tested by Pspice Simulator
- PCB board designed by Eagle PCB Design Software
- 2 gain stages performed by ADA4927 and THS4509
- Differential output in order to improve the noise immunity
- Pre-emphasis on both gain stages to balance the attenuation of the output cable

channel width:5.2 mm
(physical constrain)

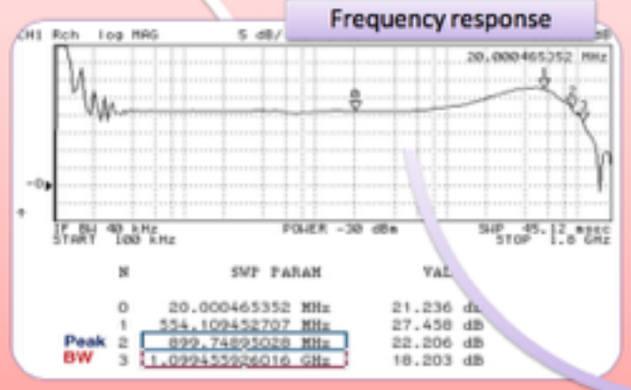
3 different card versions due to the Drift Chamber layers spacing

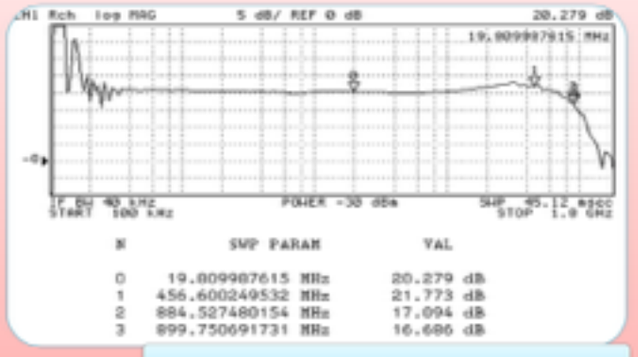
PRELIMINARY MEASUREMENT



Small prototype

Experimental Setup





Frequency response after 5 meters cable long

High performance custom cable: Amphenol Spectra Strip Skewclear that introduces an attenuation of 0.91 dB/m at 1250 MHz and a skew (within pair) less than 10 ps