Update progress of TPC module and prototype R&D

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Simulation of IBF effect Status of electronics R&D TPC prototype R&D

Simulation of IBF effect

Simulation

- **Based on the ILC-KEK codes**
- Re-established model
- Validated with 3 ions disks
- Still more works with the simulation module till now

MarlinTPC

● C 💡 0 ★ 0 ① 0 👖 0 Updated 27 days ago

yokaRawMonNeo

A software for analyzing ALTRO DAQ data for TPC studies.

● C++ 💡 0 ★ 0 ① 0 🕅 0 Updated on Mar 20, 2018

KalTest

Kalman filter implementation based on ROOT

● C++ 🖇 0 🖈 0 ① 0 🕅 0 Updated on Oct 31, 2016



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Preliminary results



Validated with 3 ions disks along drift length Results of the continuous ion disks along drift length at high lumi.@Z

Status of electronics R&D

- Develop a low power and highly integration front-end ASIC in 65 nm CMOS
- Each channel consists of the analog front-end (AFE) and a SAR ADC in 10b and up to 40 MSPS
- Less than 5 mW per channel







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1320um x 838um

• AFE test summary

• SAR ADC test summary

	Specifications	Test Results
Gain	10mV/fC	10.5mV/fC
Dynamic Range	120fC	>120fC
INL	<1%	0.41%
Power consumption	2.50mW/ch	2.18mW/ch
ENC	500e @ 10pF	448e @ 10pF
Xtalk	<1%	<0.36%

	Specifications	lest Results
Sampling rate	40 MSPS	50 MSPS
Resolution	10 bit	10 bit
INL	<0.65 LBS	<0.5 LSB
DNL	<0.6 LSB	<0.5 LSB
ENOB	>9 bit	9.18 bit
Power consumption	<2.5 mW/ch	1 mW/ch

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Electronics from Tsinghua

- Amplifier
 - CASAGEM chip
 - □ 16Chs/chip
 - 4chips/Board
 - Gain: 20mV/fC
 - □ Shape time: 20ns
 - □ 128 Chs ->1000 Chs
- **DAQ**
 - **• FPGA+ADC**
 - 4 module/mother board
 - 64Chs/module
 - □ Sample: 40MHz



Electronics, DAQ and one signal sample

Progress on the prototype

- □ All part of the prototype
 - Drift chamber (Done)
 - Field cage design and assembled (Done)
 - High voltage power crate (Done)
 - **GEM detector test (Done)**
 - **Readout PCB board (Done)**
 - HV training of resistance chain (Done)
 - Gas pre-test (Still testing)



Assembled Field cage







Drift chamber



Field cage



Readout PCB board

Summarized of the prototype prototype

Parameters list

	Items	Design	Test parameters
	Pointing stability	< 10µm	X@ 3.08μm Y@1.87 μm
Laser System	Track point accuracy	< 5'	< 3'
	Energy dynamic range	< 30%	<3.84%
	Duration time of cal.	< 5mins	90s
TPC Chamber			
High voltage power supply		Assembled	
Support platform		& R eady	
	FEE electronics and D	AQ	128 channels ready & Testing more channels

Performance study of a prototype with 128 Channels readout

New setup detector testing



Setup and photo of the detector module

Detector setup



Setup and photo of the detector module



Preliminary results of Laser tracker energy spectrum and tracker

Charge distribution using 55Fe



⁵⁵Fe radioactive source

Charge distribution using a laser



Charge distribution

Operation gases and gas purity

The three operation gases for the detector compared with ILC DESY and KEK working gas

- **T2K**
- **P10**
- Ar/CO2=90/10
- Gas purity
 - Ar (99.999%)
 - **CO2 (99.999%)**
 - **CH4 (99.999%)**
 - **CF4 (99.999%)**
 - Isobutane (99.9%)

Gain measurement



Signal with the laser at T2K



激光信号随入射光斑平均能量密度变化关系

Ionization density with the laser at T2K/P10



Ionization density unit: [N]/cm (N is the primary electron number per 0.97mm²) Pad size: 0.9mm×6.0mm - 18 -

Summary and next steps

- Continuous IBF module for CEPC: Simulation of Continuous Ion Back Flow supression, Low discharge and the good energy spectrum
- Prototype with laser calibration for CEPC : It needs very sophisticated calibration in order to reach the desired physics performance at Z pole run, Prototype has been designed with laser (Developed in IHEP and Tsinghua)
- All parts of the small prototype will be assembled with more than 1000 channels readout.
- $\begin{tabular}{ll} \hline \Box & \end{tabular} Measurement of the IBF suppression as a function of the optimized ΔV applied to the hybrid detector. \end{tabular}$
- Comparison of the measured the x/y resolution and dE/dx resolution with the laser tracks and the electron beam tracks.
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Thanks.