COMET実験のための Straw Gas Chamberの開発

久野研究室 M2

Hiroki Nakai 久野研山中研年末合同発表会



Why need Straw?





Electron Tracker is placed in vacuum(Detector solenoid).

- should withstand for vacuum operation(pressure difference,etc...
- Sufficient energy resolution
 - COMET requires better energy resolution than 1MeV

JP Straw chamber purposes

1. Build (nearly) Full-Scale Prototype

- ✤ approx. 1m length
- wounded Mylar straw
- thickness of straw is 25µm

2. Test in Vacuum

- Establish the stable operation
- Checks, not only gas leak but also deformation

3. Integrate Relevant Items

- Front-end Electronics
- + HV, Gas Controlling, Slow Control System, etc.













Study Items

✤ Gas leak Study

- * First, studied by pressurized 2 atm in air
- * Second, studied by measuring pressure build-up in vacuum
- Deformation Study
 - Small deformation was measured by capacitive sensors as a function of position along wire

Contrinex AG capacitive sensor





Chamber Signal

Raw Signal



Raw Signal

- Raw signal is very good S/N
- ✤ Raw signal level is ~8mV
- QDC&TDC data is being acquiring with B-ray Source(Sr90).
 - QDC shows reasonable landau distribution.
 - TDC shows drift time distribution.
 - in order to investigate the intrinsic position resolution, X-T relation will be extracted from data.



* Test in Vacuum(progressing)

- * Need to operate straw chamber in Vacuum chamber.
- Gas Leak needs to be measured again with N2 gas for Piranigauge calibration.
- Deformation needs to be Corrected , because sensors were leaning.
- Deformation needs to be measure at another Vacuum rate.
- * Need to another study
 - In order to reduce deformation and gas leakage, gluing study between straws will be done, etc...
- Analysis about straw chamber for COMET operation.

SUMMRY

- COMET is aiming a sensitivity better than 10⁻¹⁶
- * Built full scale prototype of COMET straw gas chamber
 - ✤ approx. 1m length,
 - ✤ straw is 25µm thickness,5mm in diameter

* Test in Vacuum(progressing)

- Measured deformation.
 - ~140µm at 2 atm operation,~67µm at Vacuum operation
- * Gas Leak is measured.
 - 0.6199cc/min. at 2 atm operation, 0.2267cc/min. at Vacuum operation
- Pressure study is not consistent with vacuum operation...
- The Straw Chamber can be operated in the air.
- This R&D is just started, More studies will be done!







Capacitive Sensor 時間変化



15



Status: Almost Finished

- Double plane(4tubes + 3tubes)
- 1single tube chamber,2double plane chamber
 - 1double plane chamber will be studied by glued each other
- With Large Gas-manifold to contain HV traces, readout front-ends

To Do Lists

- Straw Chamber
 - Chamber Construction
- Vacuum Chamber
- Gas Control System
- Front-end Electronics
- * Trigger
- Data Acquisition System
- Study Tools
 - Capacitive Sensor study
 - ✤ 2atm Operation study

Straws



Capacitive Sensor Calibration



Calibration

In Air

- Calibrate with M6 Cap
 +1cm×1cm Alumi tape
- In Chamber&VacuumCalibrated

Result

- Repeat Accuracy is not so good
- Use only slope





Capacitive Sensor Calibration





CalibrationIn Air

Calibrate with l cm×lcm
 Alumi tape

✤ Result

- Repeat Accuracy is not so good
- ✤ Use only slope

Vacuum Chamber

Vacuum Chamber Design Work



Status:Ready

- 2m length in order to contain full-size prototype (1m tube with ~20m manifold on both ends)
- the degree of Vacuum is 6.7pa(with nothing included in chamber)
- Build up test is done.

Trigger

* Status: Under Consideration

- * Basically, we may use scintillation counter for RI sources and cosmic rays... just usual way....
- * Pencil Trigger counter is readied.
 - * Tested in Vacuum chamber.



Vacuum Operation

* Detectors is placed in vacuum.

Data Acquisition System



- * Status: Will be finished soon
 - VME;TDC + ADC(minimum set)
 - Modified CAEN sample codes with CAEN's APIs.



- Waveform sampling enables to deal with pile up and to get better time resolution.
- ✤ For operation in vacuum...
 - Low power consumption
 - Reduce number of feedthrough by using an RJ45 connector.