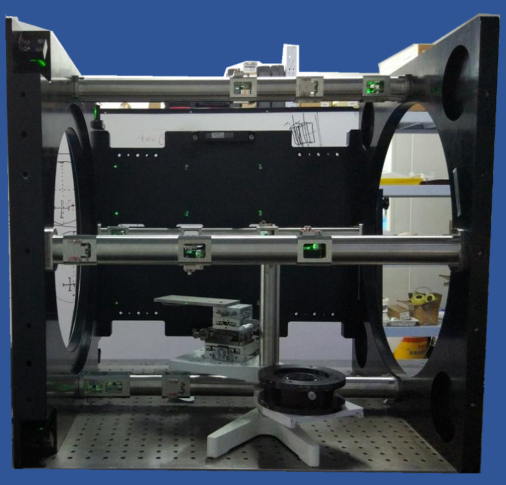
Progress of 266nm laser test and calibration design for TPC prototype



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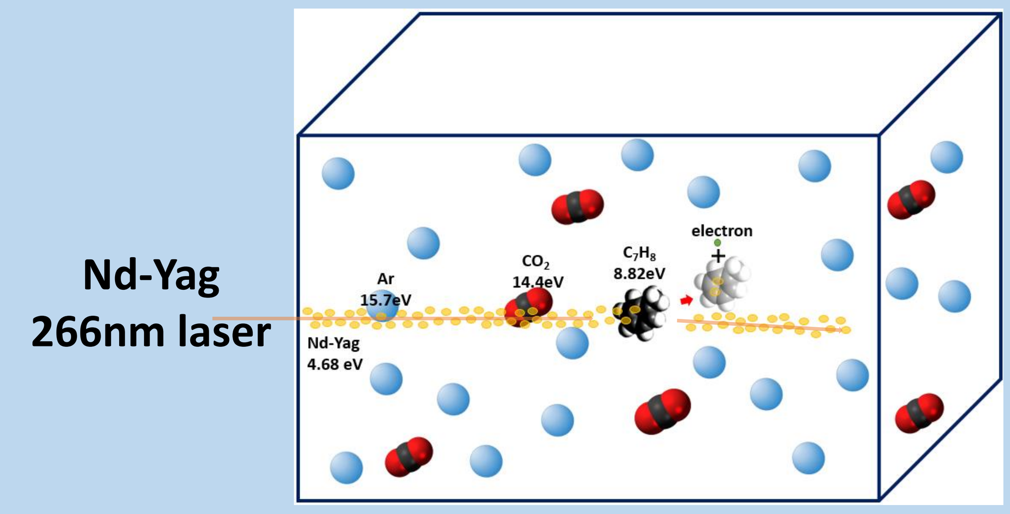
Laser has been proven to be a simple and powerful tool for calibration, surveying and monitoring of gas tracking detectors. The principle of this method, some experimental results and the preliminary calibration design are given in this poster.

Basic Principle: 2-photon ionisation

UV laser is used to produce ionization track in the impurity gas but unable to ionize the working gas. Because photon energies of standard UV laser is lower than typical chamber gases ionization energies. But some low percentage substances with ionization potential lower than 9.4eV/7.4eV make the 2-photon ionization possible.



Laser property test Ⅰ

- Angular uncertainty:
  - Introduced by the micro square-mirror
  - guaranteed by the laser collimator
  - example as mirror s4

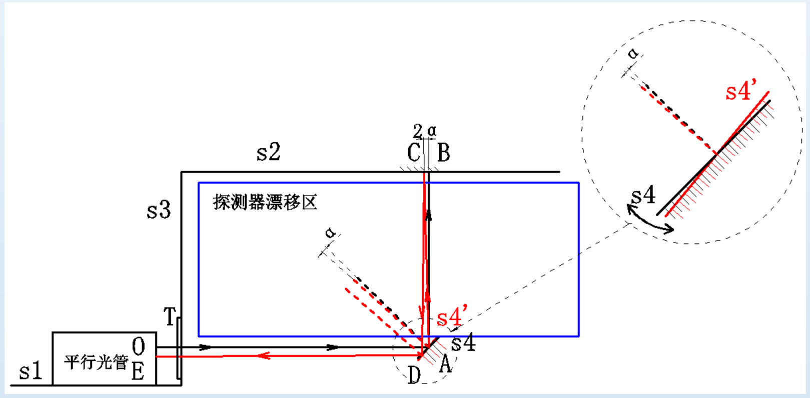


Diagram of the laser beam track in gas detector

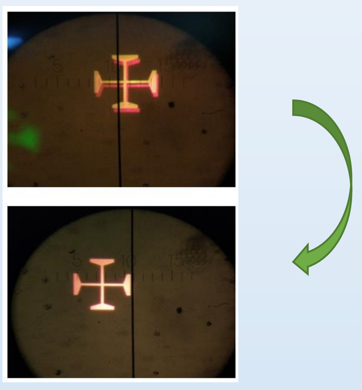
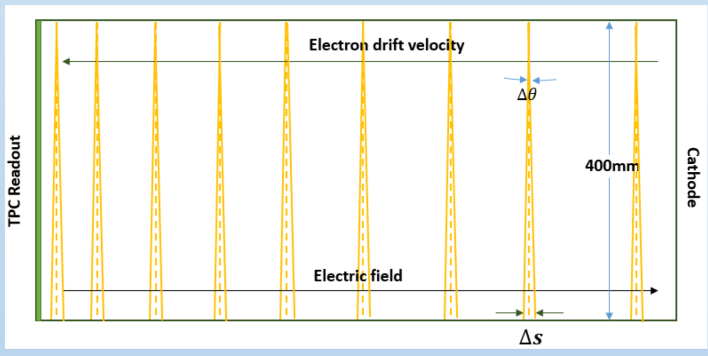
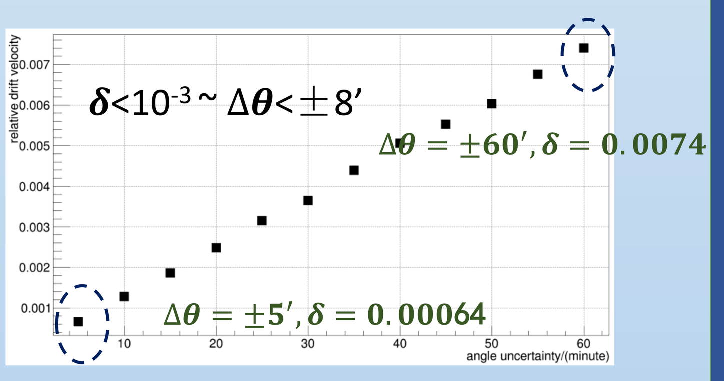


Image in collimator

- Requirement of angular uncertainty:
  - δ<10^{-3} ~ $\Delta\theta$<±8′
  - Path length of each narrow beam~350mm

Relative error of drift velocity: $\delta = \frac{\sigma_v}{v_{mean}}$

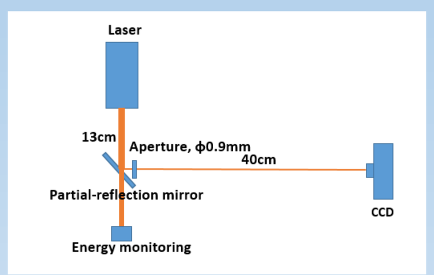


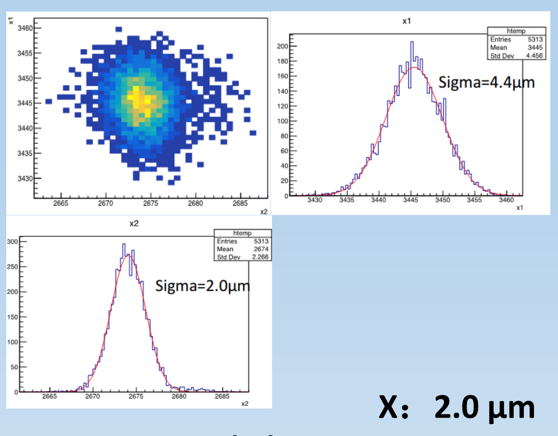


Laser distribution and pointing stability

- $\Delta\theta$=±5′, $\Delta Z = 0.33mm(@500mm\ drift\ length)$
- (ILC ,σ_{rz}0.4~1.4mm for zero ~ full drift)

- Pointing stability:

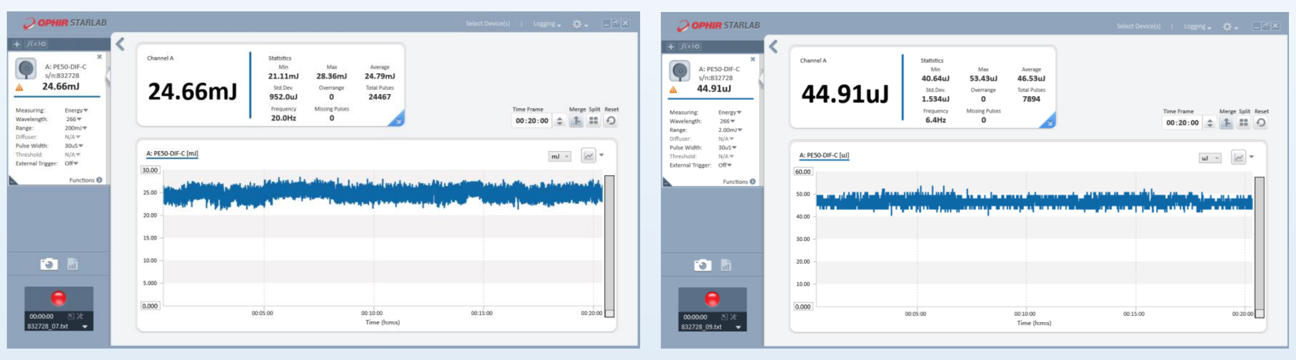




- Measure time: ~10min
- Pointing stability: X: 2.0 μm Y: 4.4 μm

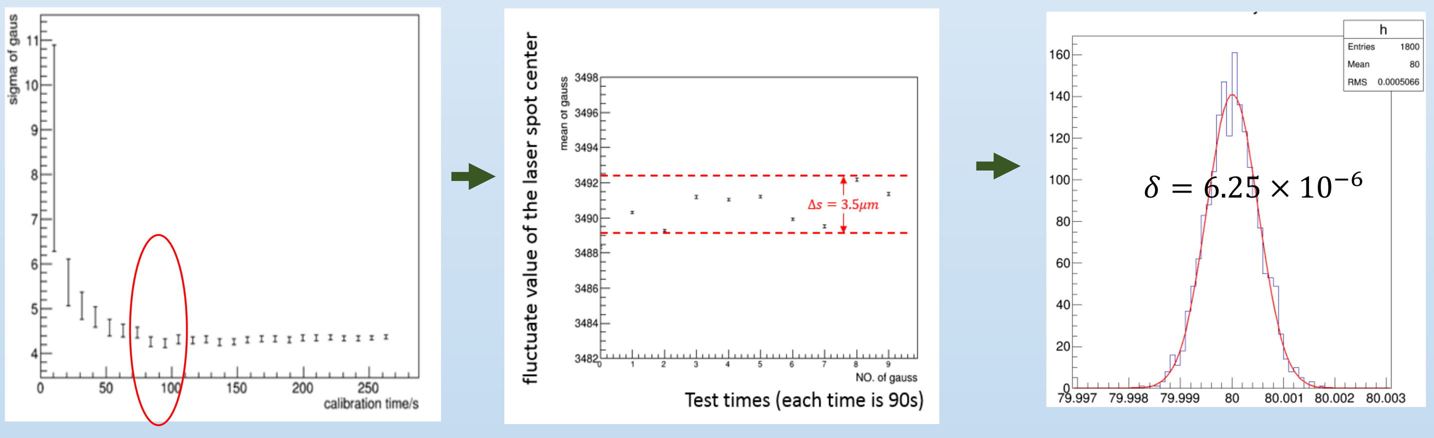
Laser property test Ⅱ

- Laser energy stability(high power-mJ/low power-uJ):



- Measure time: 20mins
- Average energy: 24.79mJ/shot (high power); 46.53μJ/shot (low power)
- Energy stability: 3.84% (high power); 3.3% (low power)

- Choose of calibration time:

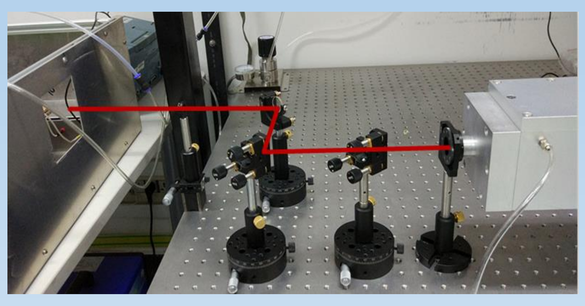


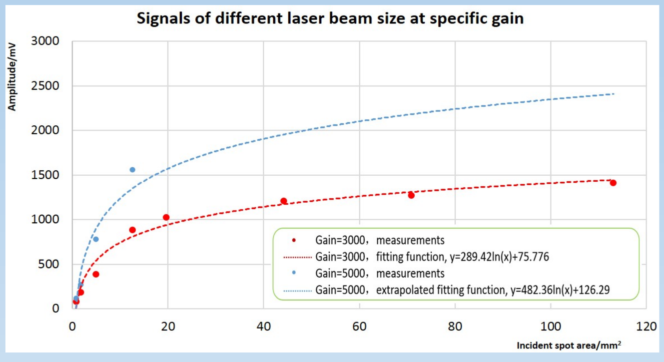
- Measure time: 4.5mins
- Events counts: 5400events
- Laser frequency: 20Hz
- Fluctuation: < 3.5μm

- Laser signal test:

Experimental setup:

- Gas: Ar:CO2=70:30
- Source: 266nm laser
- Pre-amplifier: IHEP- pre amplifier(@~5mV/fC)
- Amplifier: ORTEC 572A, gain~×10, shaping time~0.5us
- 100mm×100 mm Triple-GEM, △Vg1= △Vg2= △Vg3=390V
- Drift/transfer1/transfer2/induction=500V/cm, 1500 V/cm, 1500V/cm
- Strip readout





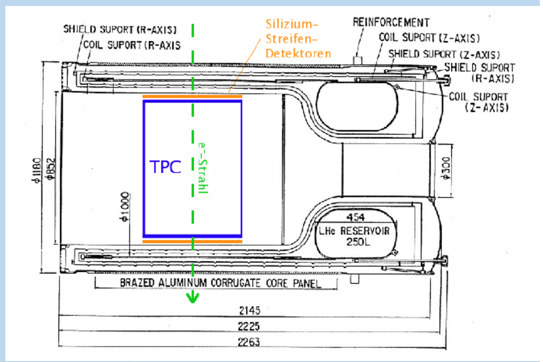
Laser calibration system design & processing & adjustment

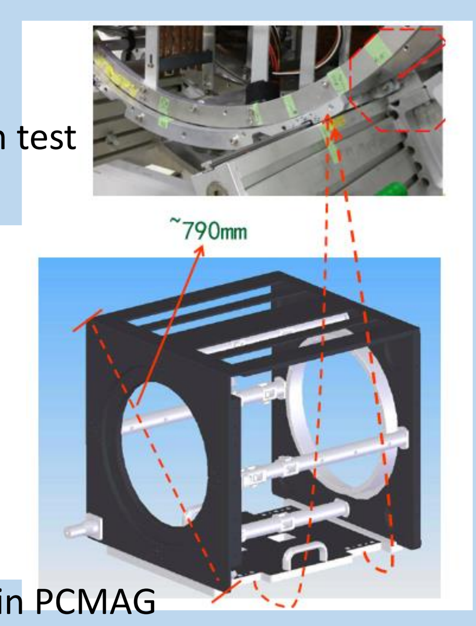
Laser parameter:

- Quantel Q-smart100
- Wavelength~266nm
- frecquency~20Hz
- 25mJ/pulse, Gauss distribution

Main mechanical design:

- Easy to move
- Easy to assemble
- Applicable to magnetic field
- Applicable to cosmic test and beam test
- Separable : TPC + Laser system

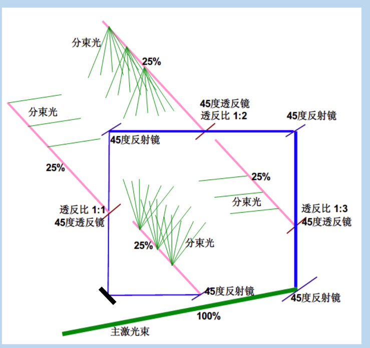




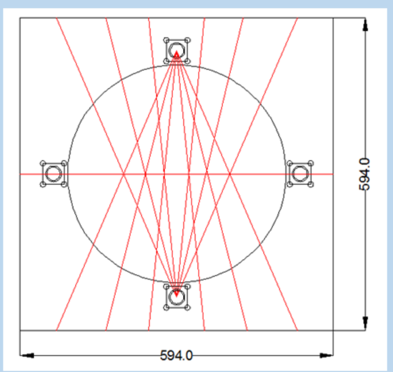
Detector in PCMAG

Main laser map design:

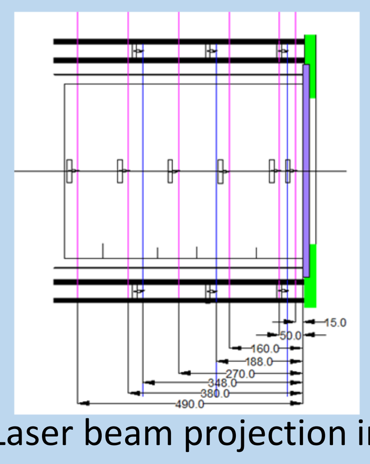
- Optical path design
- Total laser beam number: 42
- Size of each narrow beam: 0.8mm×0.8mm



- Projection of laser beam

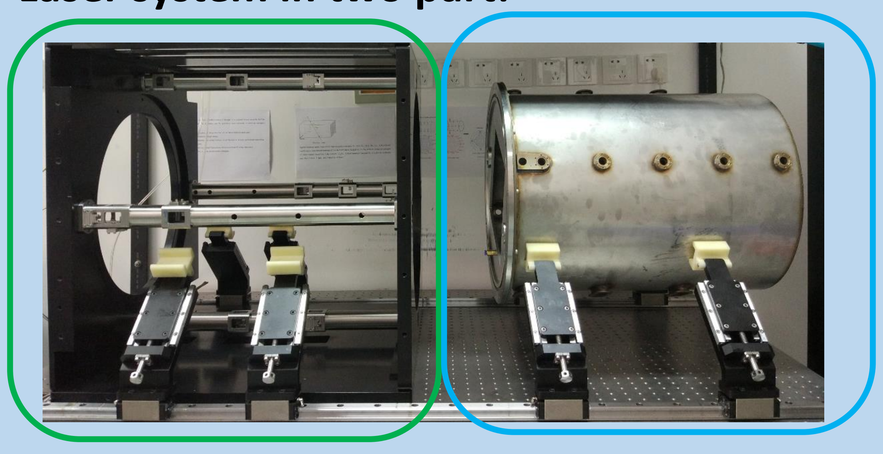


Laser beam projection in X-Y direction

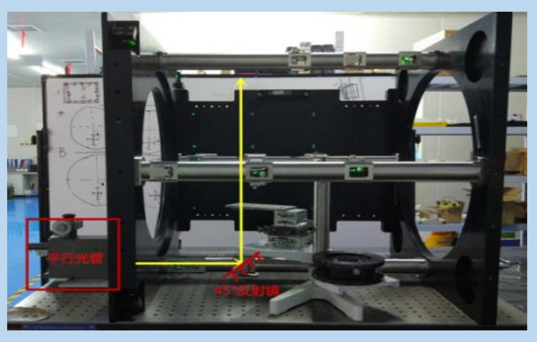


Laser beam projection in Z direction

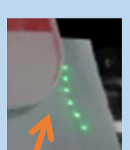
Laser system in two part:

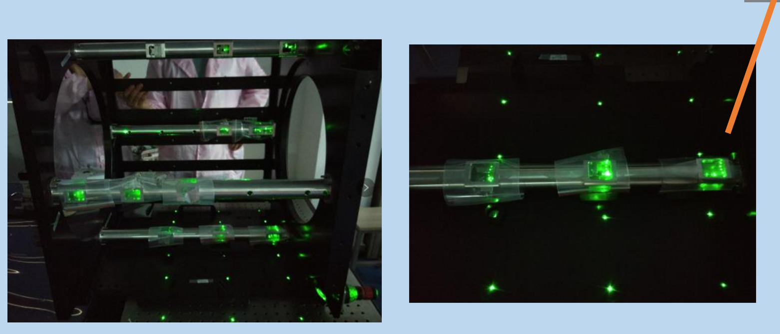


Laser system adjustment:



Laser adjustment using collimator





Light projection with laser

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