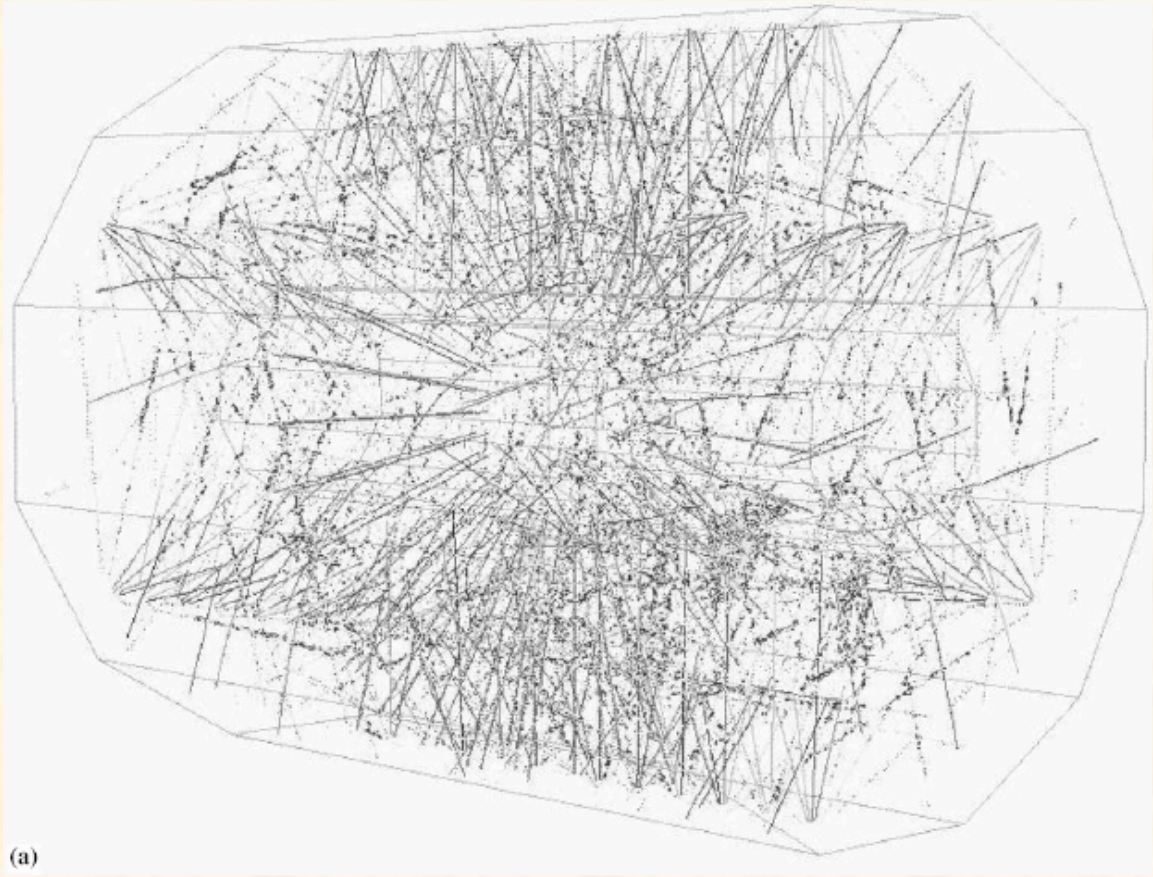
STAR Laser Calibration System

(Abele, et al., NIMA 499, 692, 2003)



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NSCL

MICHIGAN STATE UNIVERSITY

Objective

- Achieve maximum two particle resolution
- Must understand all sources of field distortions
  - Variation in drift velocity caused by gas mixture, temperature, pressure and electric field changes
  - ✯ Space charge buildup
  - Radial inhomogenities of E and B fields
  - Misalignment of E and B fields
- Problematic for:
  - High multiplicity expts
  - Beam ionization

Application

- Use narrow UV laser beam to simulate straight charged particle tracks in chamber
  - Indep of multiple scattering
  - Indep of magnetic field
  - Distribute tracks throughout chamber
- Criteria
  - Laser beams should fill the TPC volume uniformly
  - Electron density must be higher than track ionization
  - Position accuracy and stability better than 200μm azimuth, 700μm axial
  - Clock synchronization better than 5ns

Implementation

- UV laser excites two photon ionization in organic contaminants
- Use frequency quadrupled Nd:YAG laser
  - Beam diameter = 30mm
  - Wavelength = 266nm
  - Energy density 1-20μJ/mm^2
  - Pulse length 3ns
- Optical splitting with steering mirrors provides ~500 beams distributed throughout the volume
- Mirror = glass rod w/ 45º cut, polished & coated w/ dielectric
- Predefined event fraction dedicated to laser calibration events

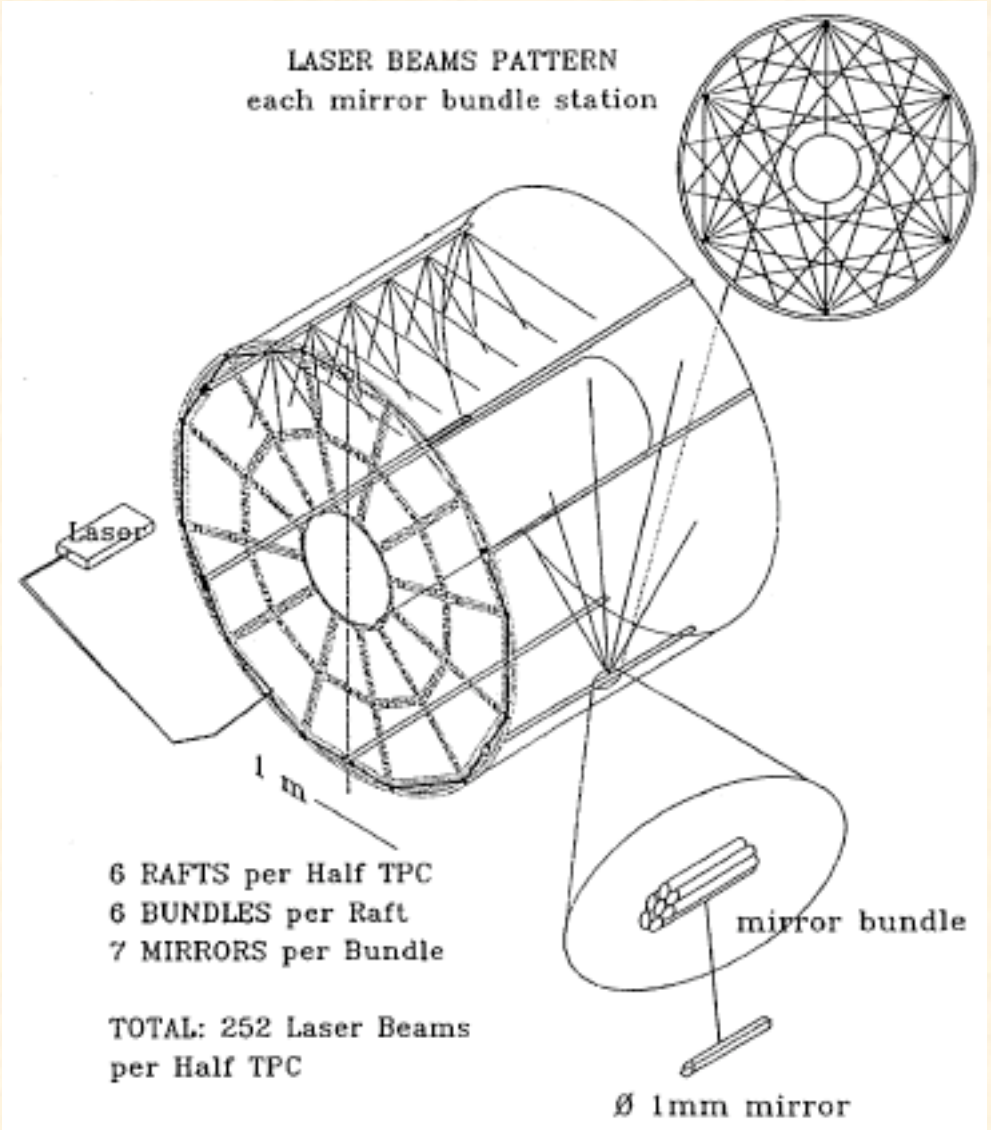

Fig. 1. Conceptual design of the laser system.

Degree of Variation

- P10 gas at 1atm
- Variation due to:
  - Barometric pressure
  - Cathode voltage
  - Temperature
  - Clock freq
  - Methane concentration

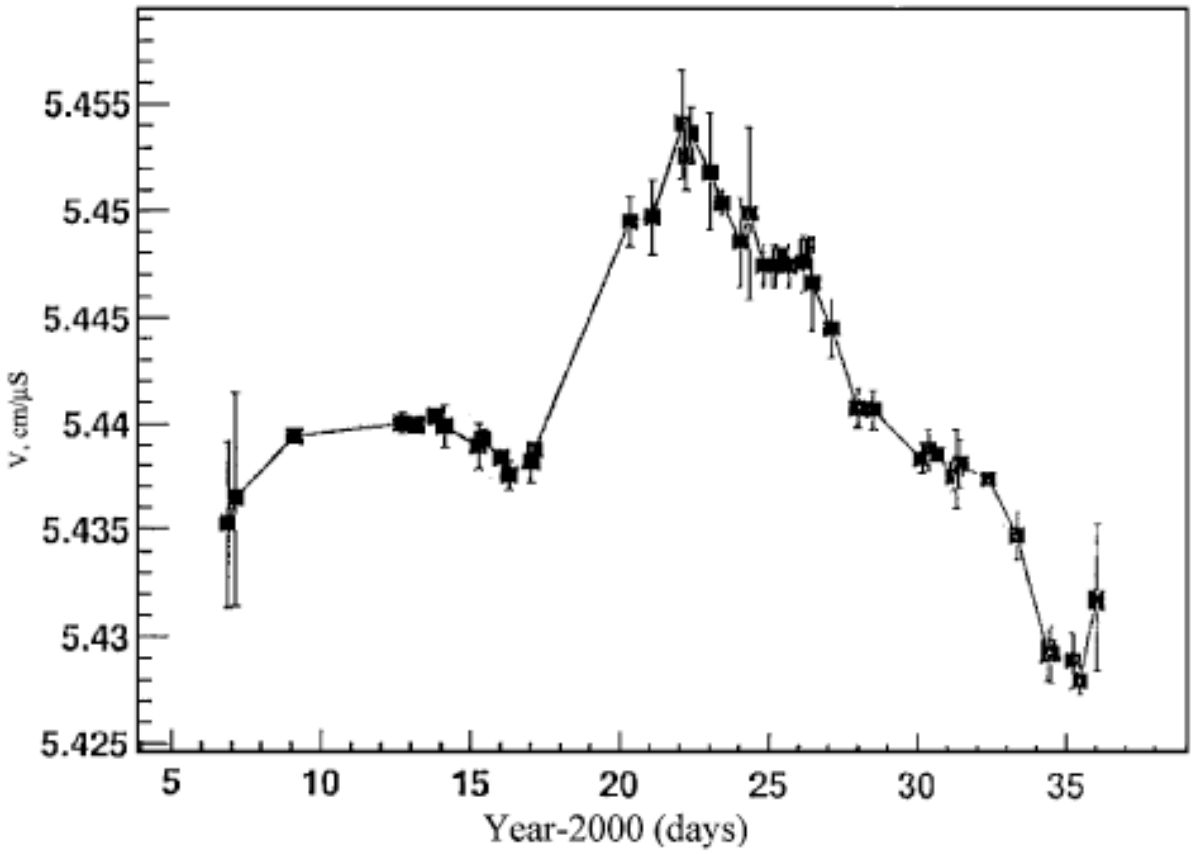

Fig. 8. Laser drift velocity measurement over one month during year 2000.

Newport Corporation
Corporate Headquarters
1791 Deere Avenue, Irvine, CA 92606
Tel (800) 222-6440
Federal I.D. 94-0849175

Spectra-Physics Lasers Division
1335 Terra Bella Avenue, Mountain View, CA 94043
Tel 800-SPL-LASER (800-775-5273)
Fax (650) 964-3584

Quotation No.
QART912

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Quotation Date:	Customer Reference:	Quote Firm for:	Payment Terms:	F.O.B.	Ship By
24-October-2008	Request for Quote	30 Days	Net 30	Origin PPA	Best Way

ITEM	QTY	DESCRIPTION	APPROX. SHIP DATE	EACH	TOTAL
1	1	**LAB-130-10** Compact Nd:YAG laser. 450 mJ at 1064 nm with 70% Gaussian fit beam. Nominal repetition rate is 10 Hz. Laser head allows integration of harmonic generator, dichroics, and injection seeder into one compact unit. Mechanical and electrical components are guaranteed to be free from defects for 2 years, and flash lamps, crystals and optics are guaranteed to be free from defects for 90 days.		$39,000.00	$39,000.00
2	1	**HG-2 D** High efficiency, angle tuned, temperature stabilized, harmonic generator with SHG Type II KD*P crystal, and FHG KDP crystals		$9,765.00	$9,765.00
3	1	**IHS-266** Pair of mounted 266 nm dichroic beam splitters		$4,200.00	$4,200.00
4	1	**BD-6** BD-6 - Water-cooled beam dump for internal use in Quanta-Ray pulsed Nd:YAG lasers.		$578.00	$578.00
				Subtotal	$53,543.00
				Discount	-$6,425.16
				Total	$47,117.84

Design

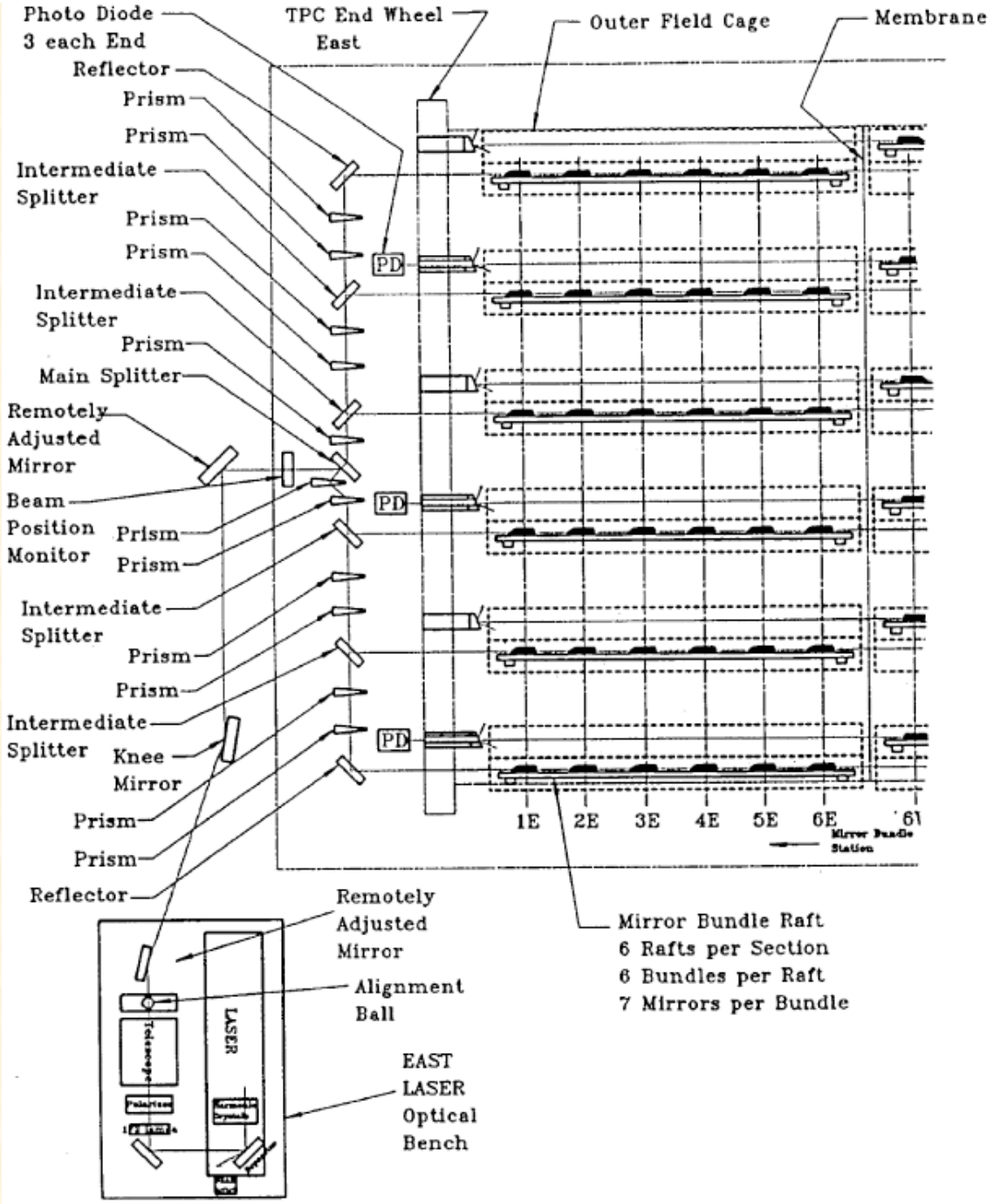

Fig. 2. Optical scheme for one-half TPC.