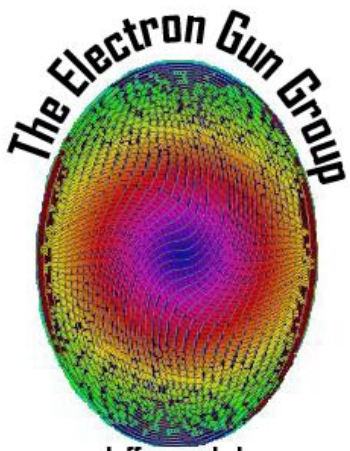
Jefferson Lab Polarized Source

The EGG



Maud Baylac

International Workshop on Parity Violation
Mainz, Germany
June 5-8, 2002

JLab polarized source

Three user groups receive simultaneously high polarization beam

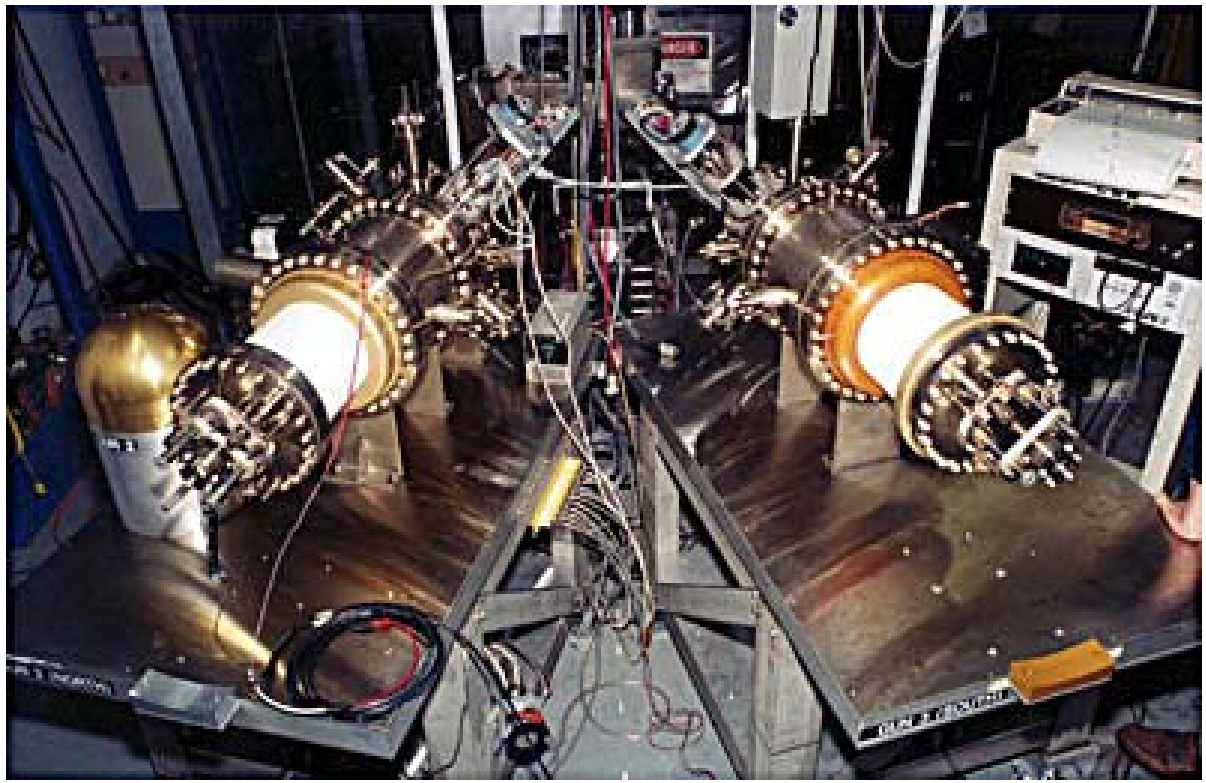
Pe : 70 to 80 %

I : up to 100 uA

Two guns at injector

one for production

one for spare



Presently, both guns operational with long lifetime

Lifetime (1/e)

- Low current (< 100 uA) :

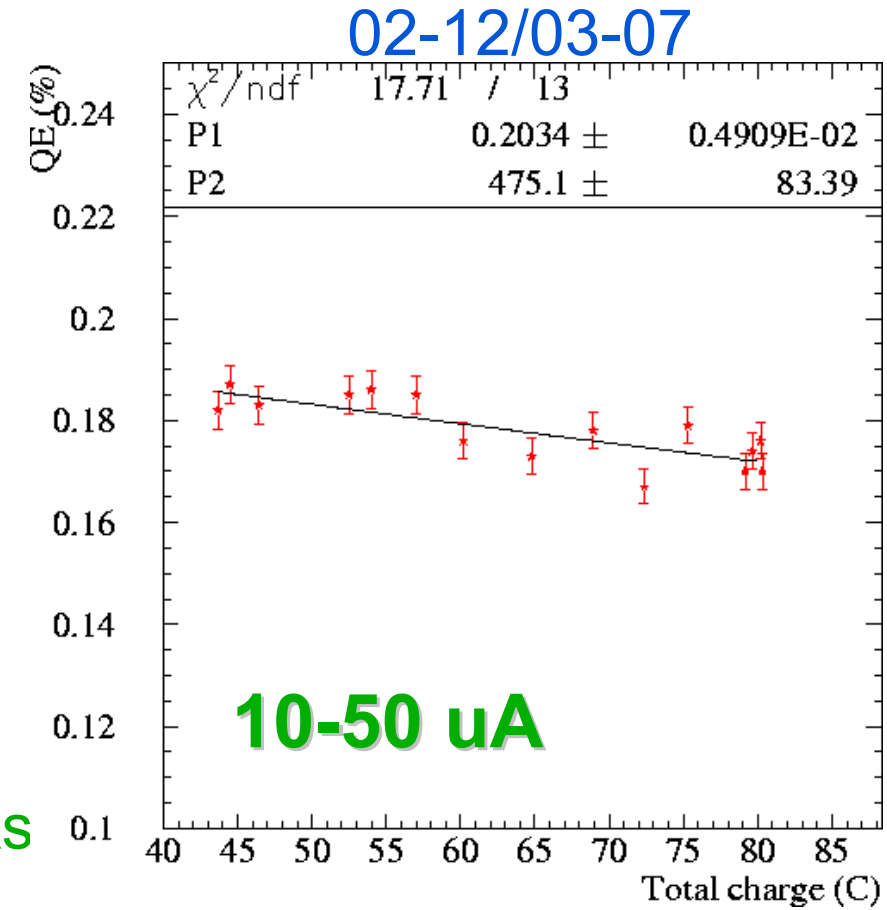
  T ~ 600 C

  beam to 3 halls for 3 months
  with one single activation

- High current (< 200 uA):

  T ~ 300 C

  uninterrupted beam for 3 weeks



- **One year with only 3 activations!**

Lasers

- **Diode** (gain switched, laser amplifier)
  - easy, low maintenance, reliable
  - low noise ~ 0.1% @ 30 Hz
  - low power < 100 mW
  - DC light => leakage
  - Original vendor SDL quit selling amps
  - Currently testing amps from new vendor Toptica

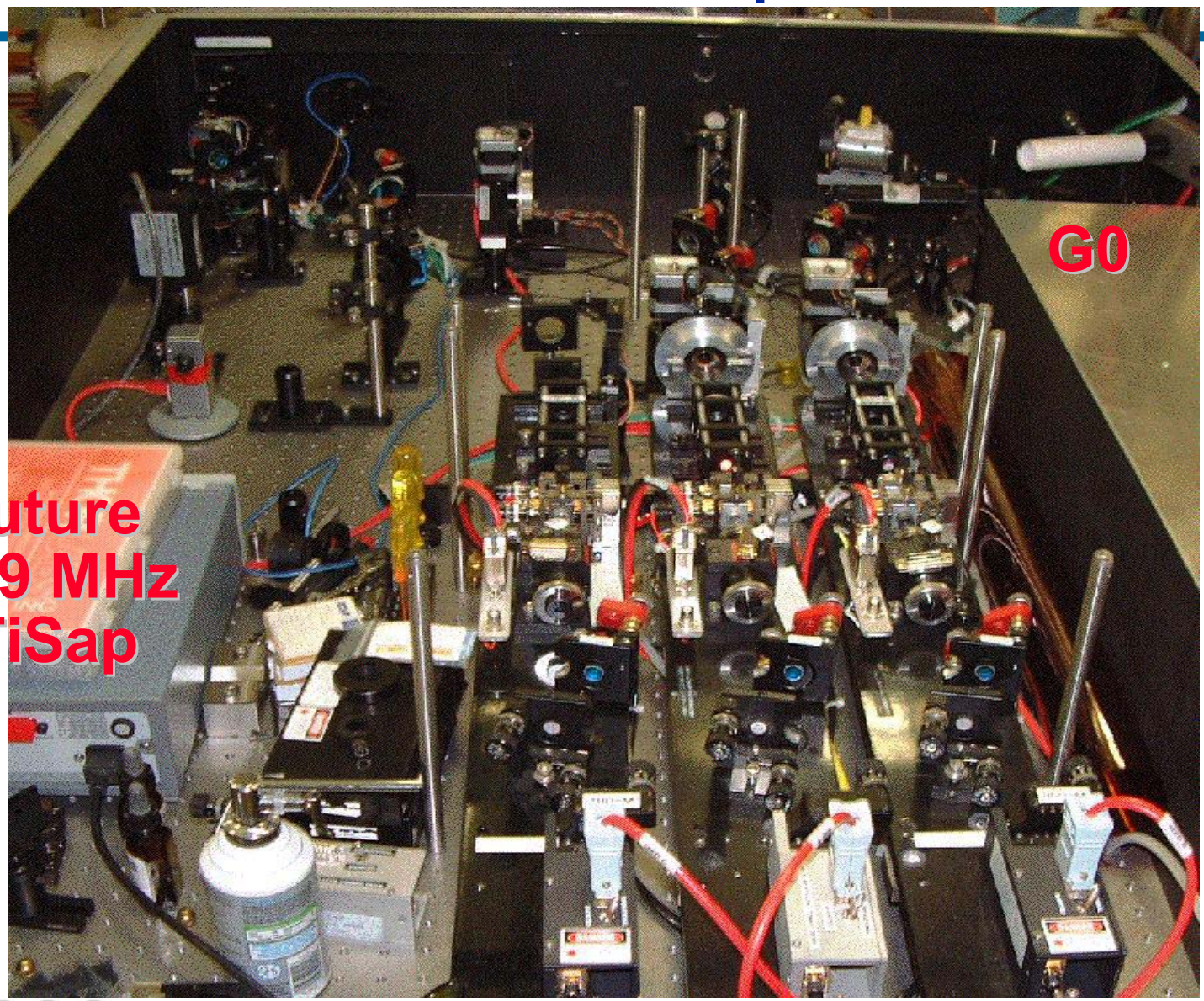
used for low current & high polarization experiments
high current & low polarization experiments

Lasers (cont.)

- **Homebuilt TiSap**:
  - active mode-locking using seed light from gain switched diode laser
  - high power ~ 300 mW
  - wavelength adjustable
  - high maintenance
  - noisy ~ 1% @ 30 Hz

used for high current & high polarization experiments

Present setup



How we manage helicity correlations

- ***Charge asymmetry***

Pockels cell (circular light and correction)	**PITA**
Rotatable λ/2-plate (correction)	**RWP**
Seed laser power modulation (correction)	**TACO**

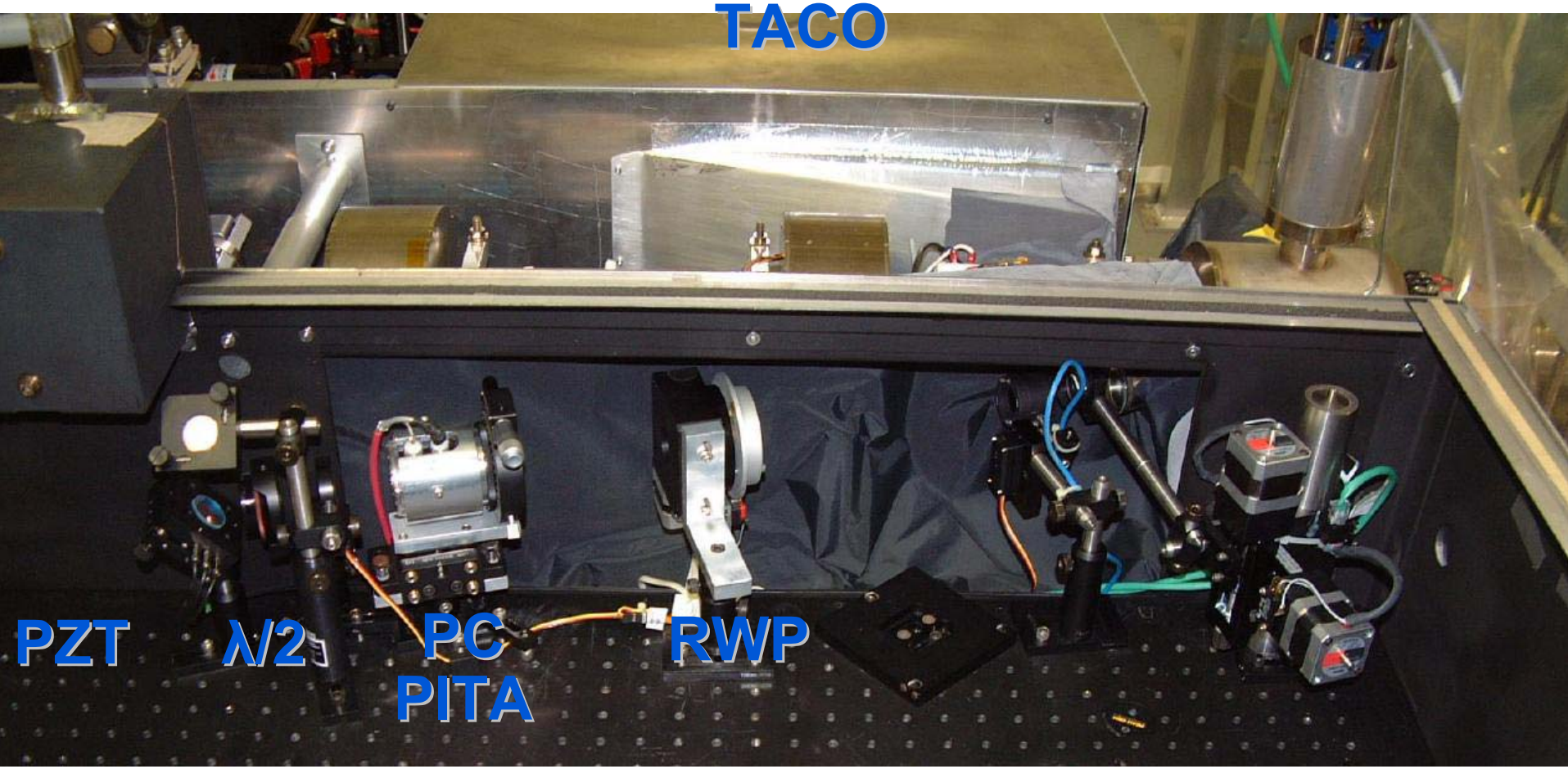
- ***Position differences***

Piezo-driven X/Y mirror (testing only)	**PZT**

- ***Overall systematics***

Insertable λ/2-plate (systematic reversal)	**λ/2**

Present HC control knobs



Charge asymmetry results

Experiments	Charge asymmetry (ppm) per physics run
Hall B	w/o TACO < 2000 w/ TACO < 500
GEn	TACO < 1000
GEp	< 1000
GDH	RWP 300 to 1000
g2n	RWP < 50

Managing HC asymmetries for future experiments

- ✔ *Minimize HC effects on three beams simultaneously*

  ⇒ **independent knobs : TACO**
  IA
  PZT

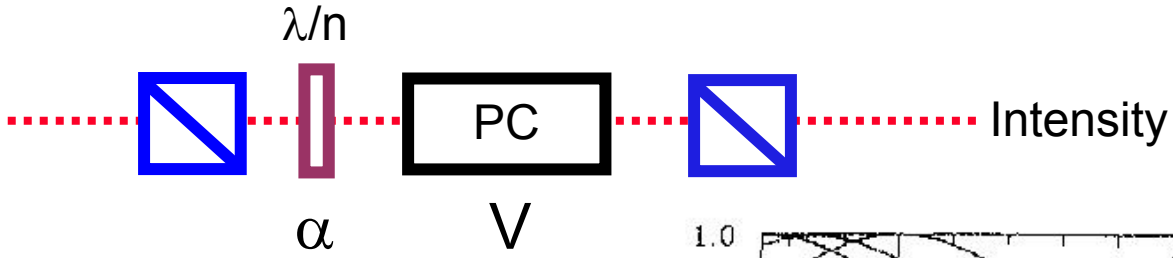
- ✔ *High current, high polarization experiments require TiSa*

  Homebuilt lasers have produced noisy beam compared to diode lasers

  ⇒ **improve TiSap lasers**

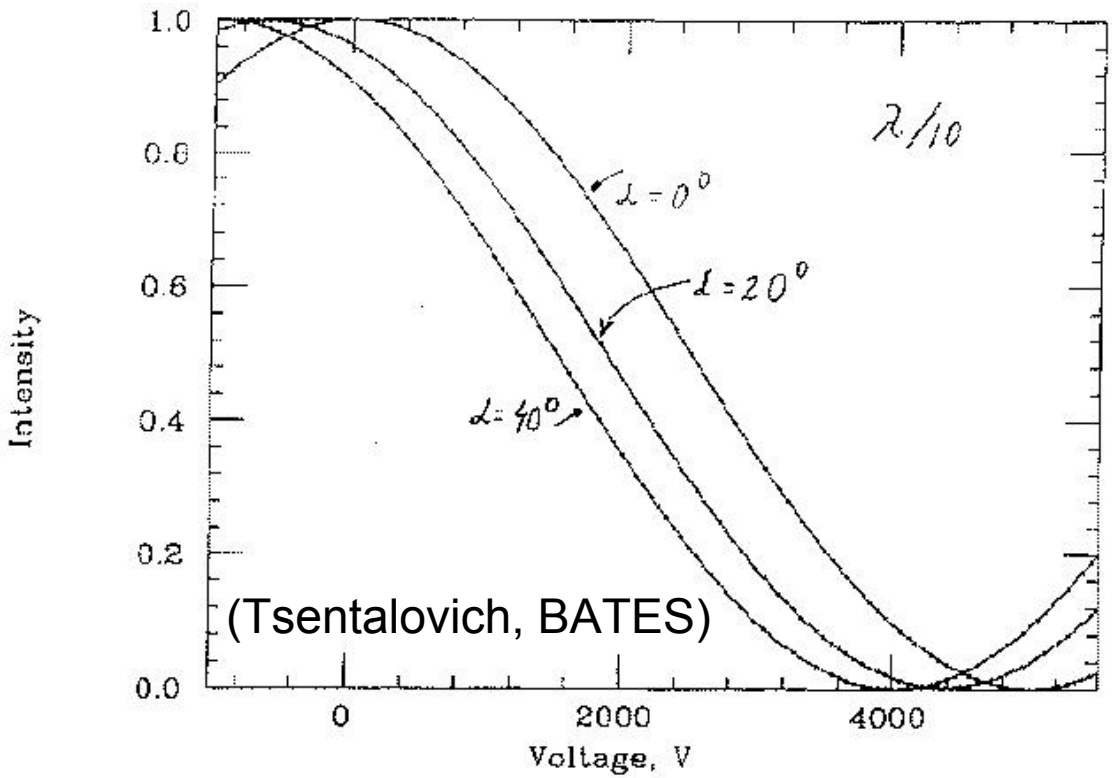
Intensity feedback : IA

Use a low voltage Pockels cell for intensity modulation.



Requirements:

- independent control
- stable & sufficient gain
- low insertion loss
- low cell voltage
- compact footprint



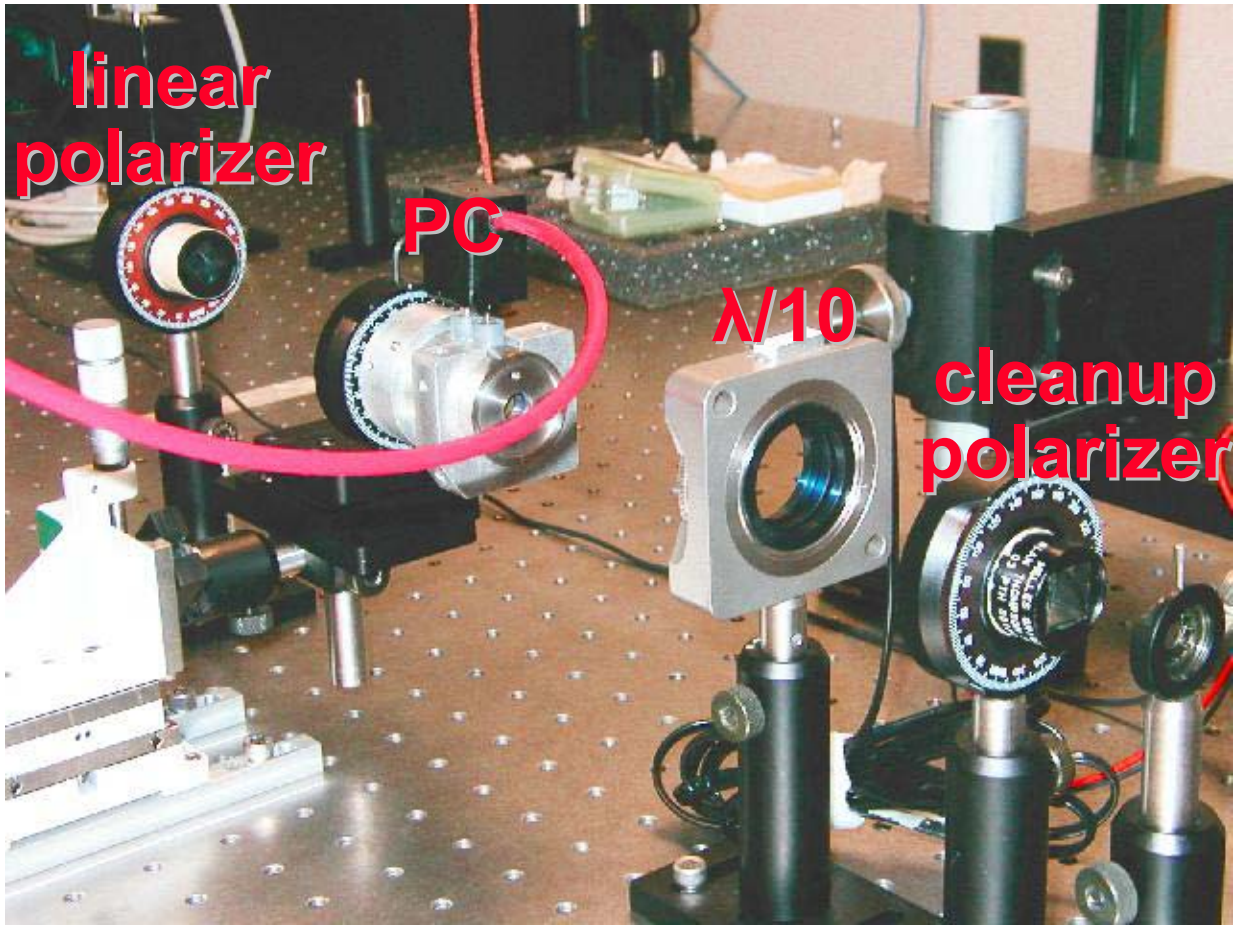
New IA cell

- Operated in lab

$$\frac{d A_i^{\gamma}}{d V} \sim 30 \text{ ppm/V}$$

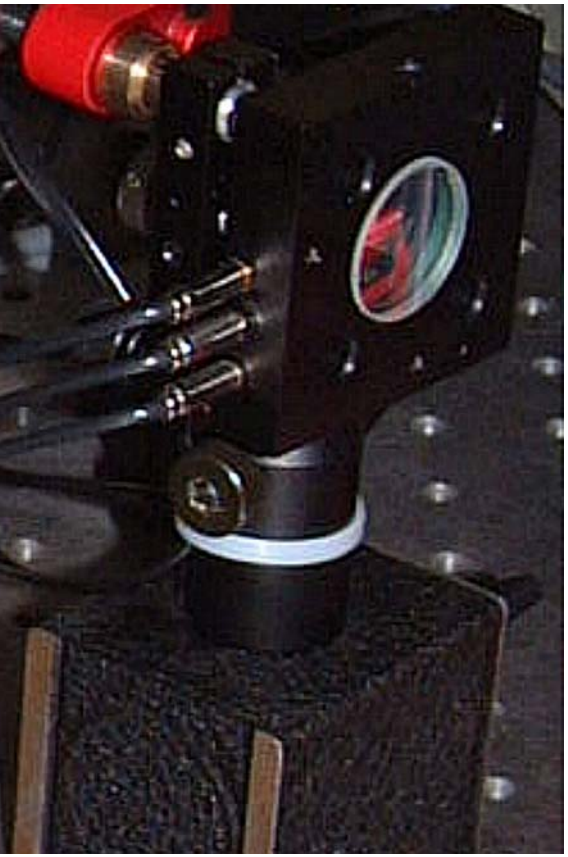
- Installed in tunnel on May 29

- Will be tested on machine in June



Should provide ~ 0.1 ppm level control

Position Feedback



- Mirror on a fast PZT driven stage for HC position control
- Present setup:
  common mirror ~0.1 m before the PC
  new mirror for hall A only (May, 27)

Doubles the moment arm to cathode, but also increases distance to the PC to ~1 m

Will be tested in hall A
Could be installed this summer for hall C

G0 experiment

- Time structure

  31.2 MHz versus standard 499 MHz

- Modest average current, but high peak current

  40 uA @ 31.2 MHz is like transporting **640 uA @ 499 MHz**

  ie: 8.10^{6} e^{-}/bunch

  ⇒ **beam optics issues**

- Parity quality beam

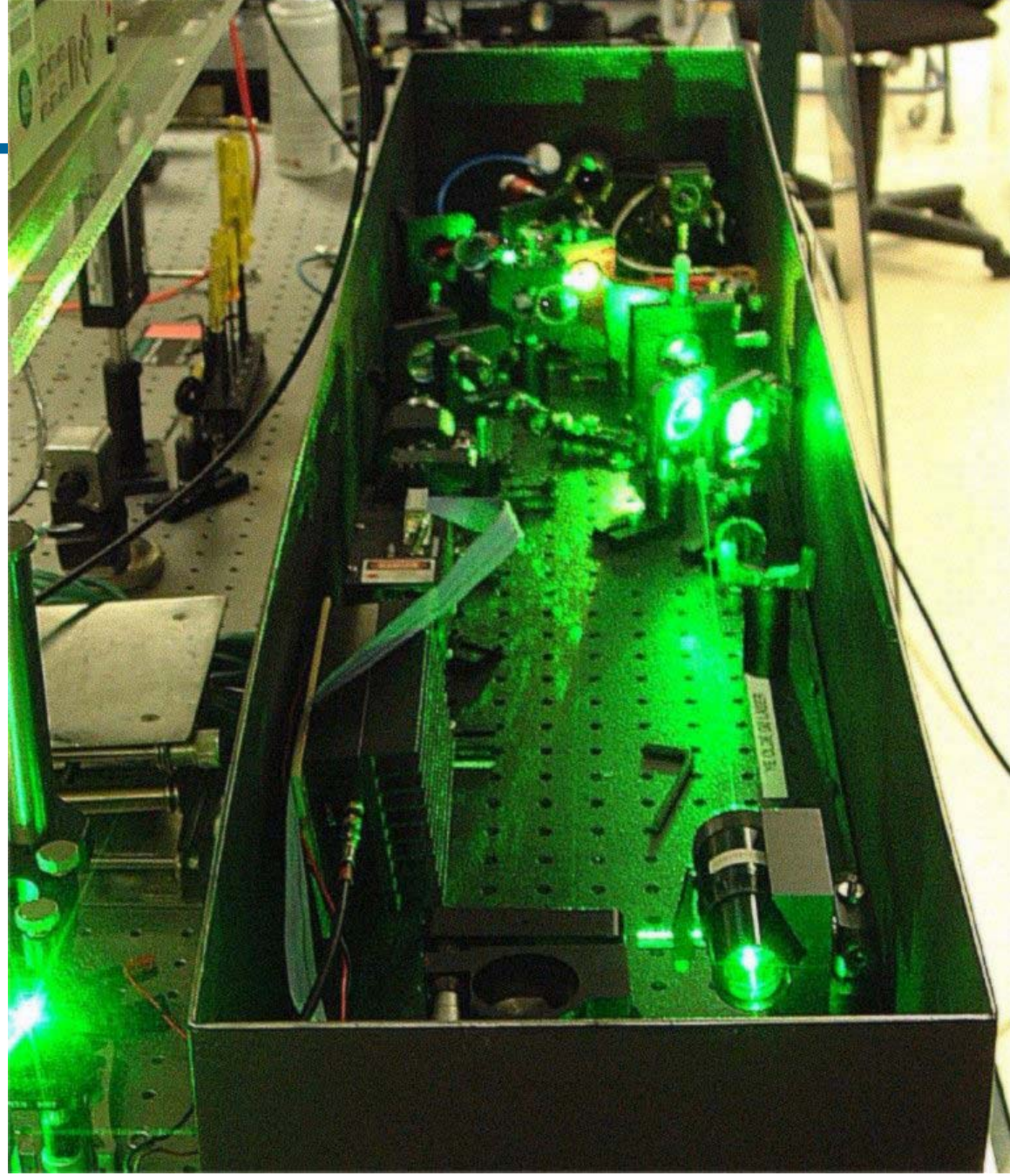
- Two other halls running simultaneously

success ⇒ mode-locked TiSa Laser

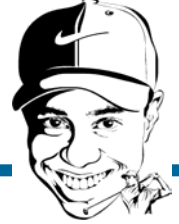
Latest News

- Homebuilt diode seeded TiSap
- Five-fold cavity : L~ 5m
- Tested in lab:
  FWHM ~ 150 ps
- Installed in tunnel
  on May 27

40 uA of beam to end of injector!!



Commercial G0 Laser



- Time-Bandwidth Products (Switzerland), http://www.tbwp.com/
- **TIGER** Laser, with internal pump
- **SESAM** passive mode-locking technique, better than ours?
- Customized

  70 ps pulses
  31 MHZ rep rate
  < 1% amplitude noise RMS
  1 ps timing jitter
  tunable wavelength, centered at 840 nm
  output power ~ 250 mW

- TBWP may build a 499 MHz laser for HAPPEx 2, etc …

Conclusions

- **Our guns deliver high current beam with long lifetime**

- **2002-2003 : high profile year for parity violation experiments at JLab (HAPPEx 2, G0)**
  - *TiSap:*
    laser from TBWP may solve noisy beam problem
  - *Helicity Correlated asymmetries*:
    independent knobs are being installed & tested

- **This coming period will help us prepare the future of parity violation at JLab**

Outlooks

- ***Research program : QE, Pe always higher***
- ***High polarization cathodes with lower, or no analyzing power***
- ***Modulation on each beam to provide independent asymmetry measurement at the injector***
- ***DC gun :***

  use cheap "clean" high power DC diode lasers rather than "noisy" TiSap lasers

- ***Kerr cell ?***