DOE REVIEW TASK C
WORK AT SLAC Aug. 19, 2004

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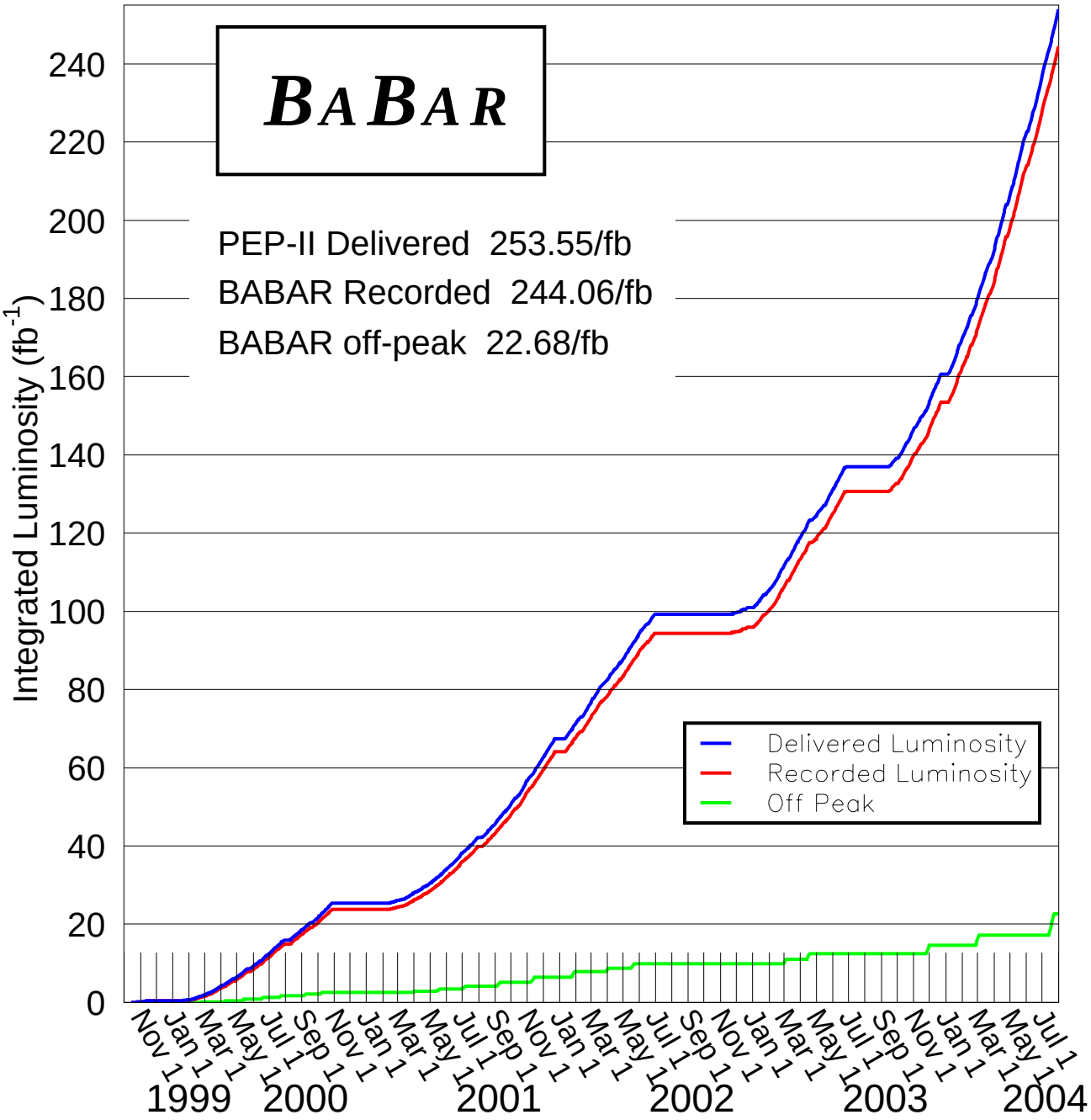
S. Dasu	Faculty
H. Band	Senior Scientist
K. Flood	Post Doc
* A. Mohapatra	Post Doc
* F. Di Lodovico	Post Doc
A. Eichenbaum	Student Thesis Complete
J. Hollar	Thesis 12/05
P. Tan	Thesis 8/05
R. Gavin	Entering Student
A. Rubin	Completed MS 6/1/04

* Appointments Ended 3/01/04 and 4/01/04

Task Highlights

- J/Psi Photoproduction and A Dependence.
- MAC Discovery of Long B Lifetime.
- MAC First Measurement of EW Jet Charge Asymmetry.
- MAC Gamma-Jet Charge Asymmetry: Fractional Quark Charge
- Precision Measurement of R.
- Development of Compton Polarimeter: SPEAR Resonance Study.
- Development of Strained High Polarization Photocathodes.
- SLD A_{LR}, Heavy Quark Asymmetries.
- Polarized Spin Structure Experiments: E-142, E-143, E-154, E-155.

2004/08/15 09.21



PEP-II Eight Year Run Plan for FY2003 Thru FY2010						
Year	Months	Days	Average to peak lumin. ratio	Peak luminosity xE33 (at end)	Integrated luminosity per period fb-1	Cumulative integrated luminosity fb-1
	Start		0.5	4.4		103.0
2003	Jan-July	200	0.5	7.53	46.4	149.4
2003	Aug-Sept	60	0	0	0.0	149.4
2003	Oct-Dec	80	0.4	7.53	10.4	159.8
2004	Jan-June	170	0.55	11.4	72.3	232.0
2004	July-Sept	90	0	0	0.0	232.0
2004	Oct-Dec	80	0.4	11.4	15.8	247.8
2005	Jan-June	170	0.55	15.4	107.2	355.0
2005	July-Dec	180	0	0	0.0	355.0
2006	Jan-Mar	80	0.4	15.4	21.3	376.3
2006	Apr-July	120	0.5	19.1	97.7	474.0
2006	Aug-Sept	60	0	0	0.0	474.0
2006	Oct-Dec	80	0.4	19.1	26.4	500.4
2007	Jan-July	200	0.55	20.4	205.1	705.4
2007	Aug-Sept	60	0	0	0.0	705.4
2007	Oct-Dec	80	0.45	20.4	31.7	737.2
2008	Jan-July	200	0.6	25	274.0	1011.1
2008	Aug-Sept	60	0	0	0.0	1011.1
2008	Oct-Dec	80	0.45	25	38.9	1050.0
2009	Jan-July	200	0.6	25	311.0	1361.0

Task Activities

- BaBar Systems

  IFR Management/Hardware

- BaBar Particle ID

  Muon ID/Neural Net Development and Software Integration

- BaBar Analyses/ Papers
- NLC

  Polarized Photocathode R&D

  Laser Development

Babar Systems/Hardware

- Resistive Plate Chamber System Management – Band
- RPC Studies and Gas Chemistry
- Forward End Cap Chamber Upgrade
- RPC Operations

  Primarily Band + Students

BaBar Particle ID

- Muon Identification

  Neural Net Analysis: Mohapatra/Hollar/Band

- Neutral Particle Identification

  F. DiLodovico had been Particle ID Group Convener

PAC Champagne Challenges

- List of 15 challenges is in BAD 736

Challenge #4: First improvement in any subsystem

calibration/alignment or reconstruction method leading to more than 15% gain in any standard measure of performance with respect to previous best.

Ajit Mohapatra, Joerg Stelzer, Jonathan Hollar for

Improvements to Muon Detection Efficiency Based on Neural Net Selector and Kalman Filter Tracking

BaBar Active Analyses

- $b \rightarrow s\,\gamma$ Semi-inclusive — A. Eichenbaum
- $B \rightarrow K^{*}\gamma$ $B \rightarrow \rho\,\gamma$ — P. Tan
- $b \rightarrow s\,l^{+}l^{-}$ — J. Hollar
- $B \rightarrow K\,\gamma\,\gamma$ — A. Rubin

- D Meson Mixing Measurement — K. Flood

Babar Papers

- **Eichenbaum** $B \rightarrow X_s \gamma$ A_{CP} and Branching Fraction
  A_{CP} **-** Published **SLAC PUB-10386, PRL 93,21804 (2004)**
  Branching Fraction – Sum Of Exclusive Modes
  PRL in Preparation
- **Ping** $B \rightarrow K^* \gamma$ A_{CP} and Branching Fraction
  PRL Submitted **SLAC PUB-10529**
  $B \rightarrow \rho \gamma$ PRL Submitted **SLAC PUB-10608**
- **Hollar** $B \rightarrow X_s l^+ l^-$ Analysis in Final Stages
- **IFR (Band)** Two papers submitted to NIMA
  SLAC PUB-10477
  SLAC PUB-10471

NLC

- Proposal to LC Accelerator R&D at Universities.
- Submitted 10/04, Notice of Award 7/04.
- Funding Request $34.6k .
  Budget for X-Ray Analysis, SIMS Analysis
  and Laser Heads for Photoluminescence System.

Cathode Publications

- Polarized Photocathode R&D

  1989-2004 10 Publications

- SLD ALR Measurements

  1993-2000 6 Publications

- SLD Heavy Quark and Lepton Asymmetries

  1995-2002 8 Publications

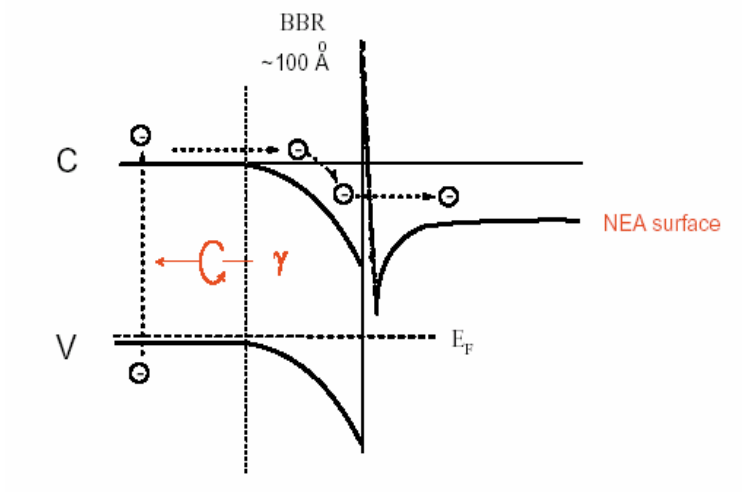
- Polarized Spin Structure Measurements

  1993-2003 14 Publications

OUTLINE

- Polarized photoemission
- Strained superlattice R&D
- E158 RUN III
- Atomic hydrogen cleaning
- Multi-bunch laser development
- Summary

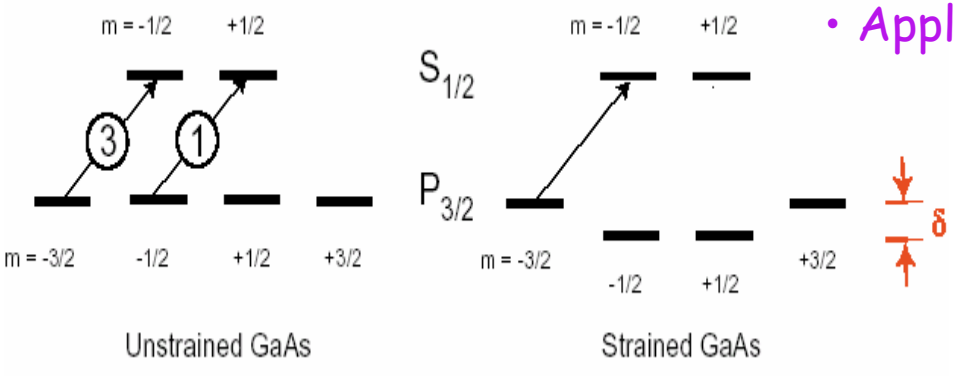
Polarized photoemission



- Circularly polarized light excites electron from valence band to conduction band
- Electrons drift to surface
  L < 100 nm to avoid depolarization
- Electron emission to vacuum from Negative-Electron-Affinity (NEA) surface

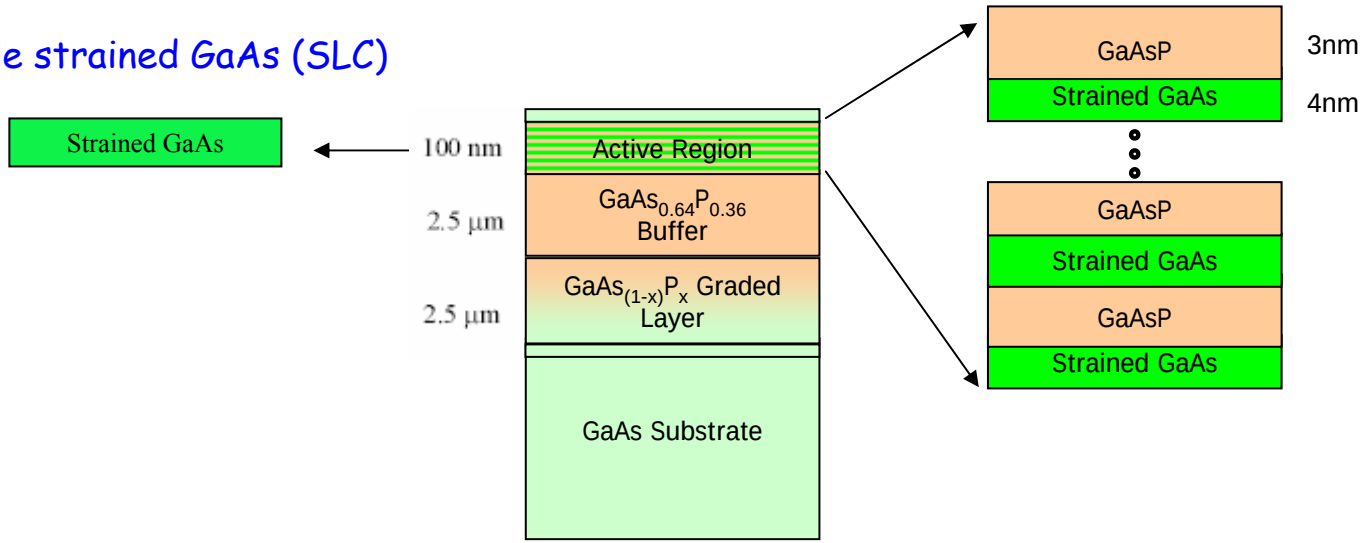
NEA Surface – Cathode "Activation"

- Ultra-High-Vacuum < 10^{-11} Torr
- Heat treatment at 600° C
- Application of Cesium and NF_3



Strained-superlattice

Single strained GaAs (SLC)



- High gradient doping: $5\times10^{19}/cm^3$ in the 5 nm surface layer and $5\times10^{17}/cm3$ in the rest → No surface charge limit
- Each superlattice layer is thinner than the critical thickness
  → GaAs layers are highly strained

SBIR with SVT Associates

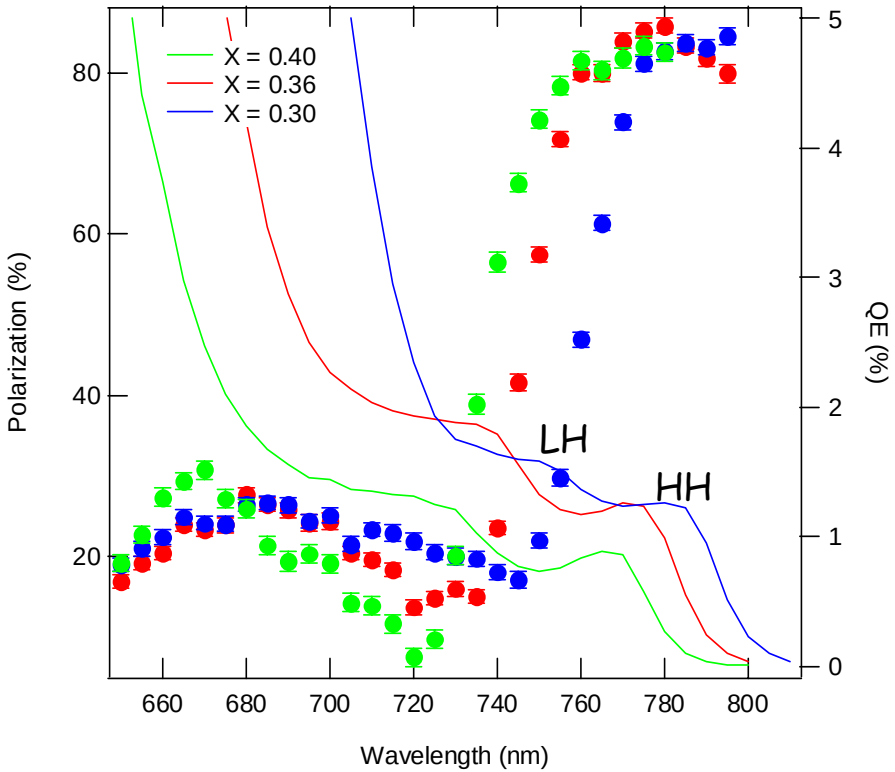
"Advanced Strained-Superlattice Photocathodes for Polarized Electron Sources"

- July 2001 SBIR Phase I awarded
  Very first sample produced 85% polarization
- Sep. 2002 SBIR Phase II awarded (2 year project)

- Polarized photocathodes are commercially available (SLAC Spin Polarizer Wafers).

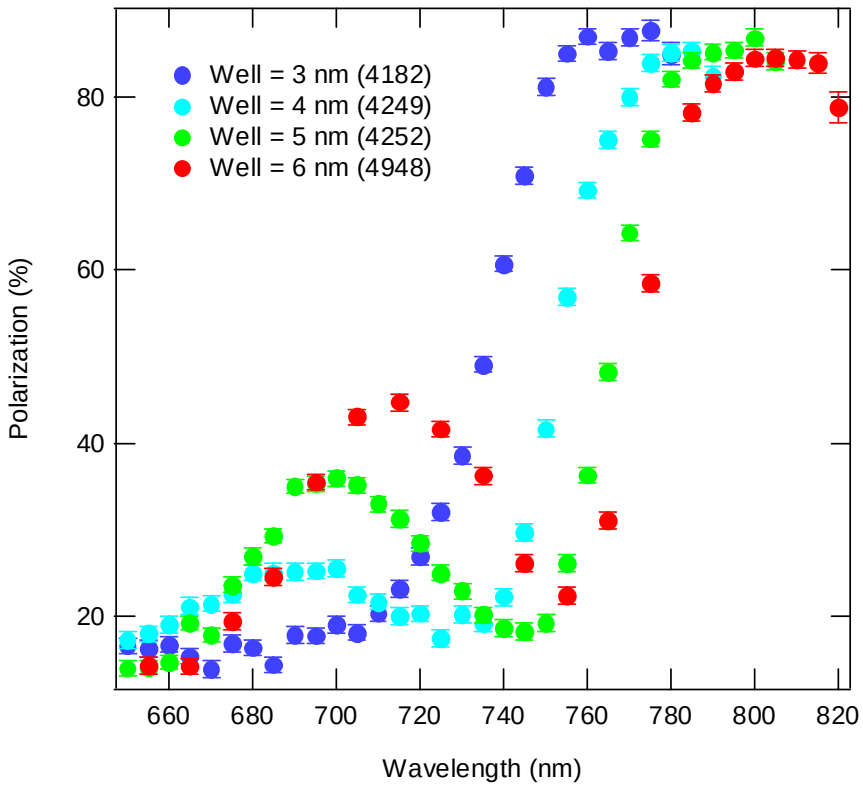
- Phosphorus containing wafers are usually grown by MOCVD.
- Gas-source MBE is used at SVT Associates.

Strain effect: Vary x in $GaAs_{1-x}P_x$



- Max. polarization ~86%
- QE ~1% (x5 SLC Cathode QE)
- HH and LH transitions observed
- HH-LH splitting increases with x.

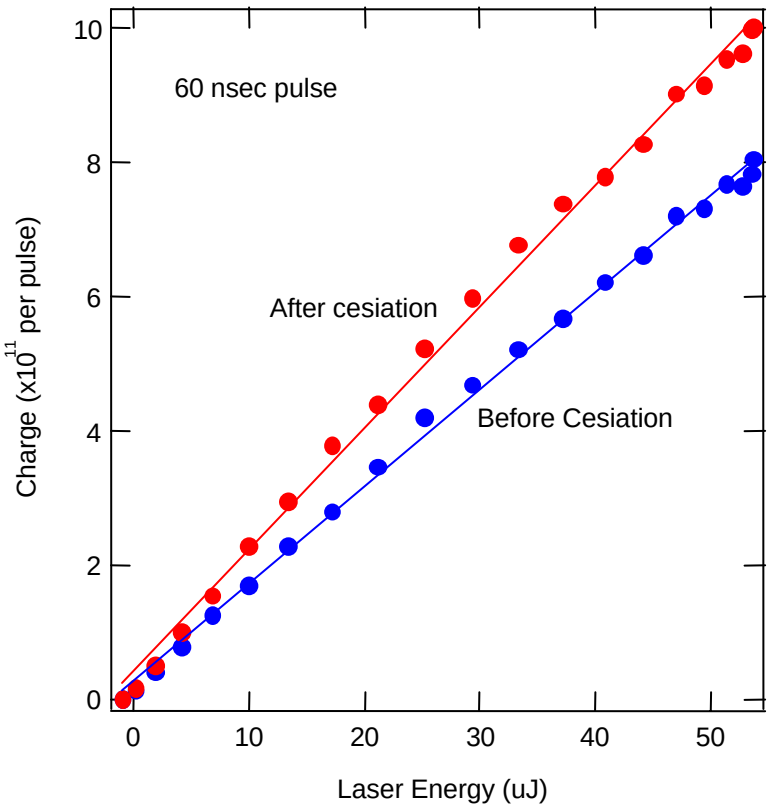
Well Dependence

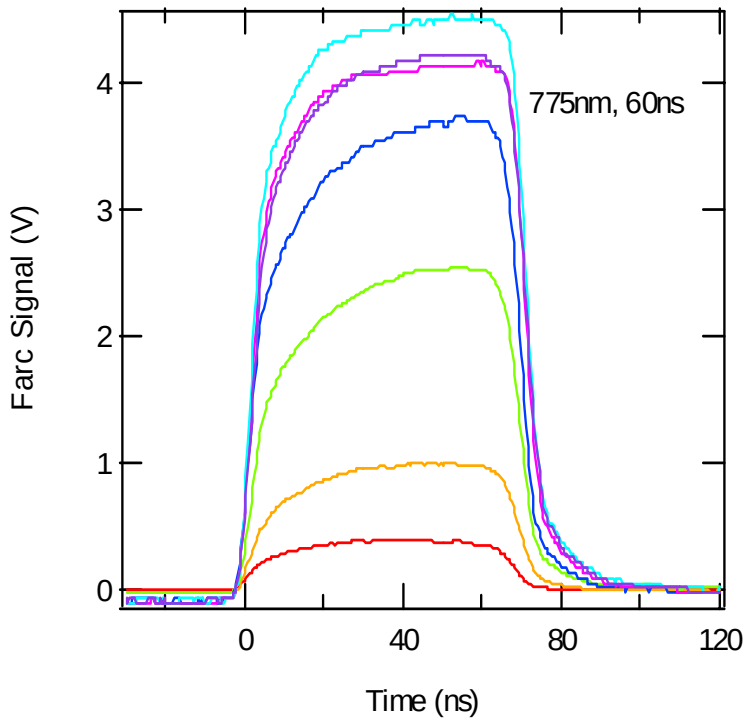


- Max. polarization ~86%
- QE ~ 1%
- Second peak is sensitive to HH2 → opportunity to test superlattice model.

No Charge Limit

1×10^{12} e- in 60 ns → 4.5×10^{12} e- in 270 ns (x3 NLC train charge)





E158 RUN III

- Cathode installed in May 03.
- E158 ran successfully.
- ESA Moller measured 90%.
- But it showed a charge limit ~7×10^{11} e-/300 ns
- Could not make NLC train charge but OK for E158.
- What happened?

  The 600° C heat-cleaning is destroying the high gradient doping profile.

Parameter	E-158	NLC-500
Charge/Train	5 x 10^{11}	14.4 x 10^{11}
Repetition Rate	120 Hz	120 Hz
Energy	45 GeV	250 GeV
e^- Polarization	85-90%	> 80%
Train Length	270ns	267ns
Microbunch spacing	0.3ns	1.4ns
Beam Loading	13%	22%
Energy Spread	0.15%	0.3%

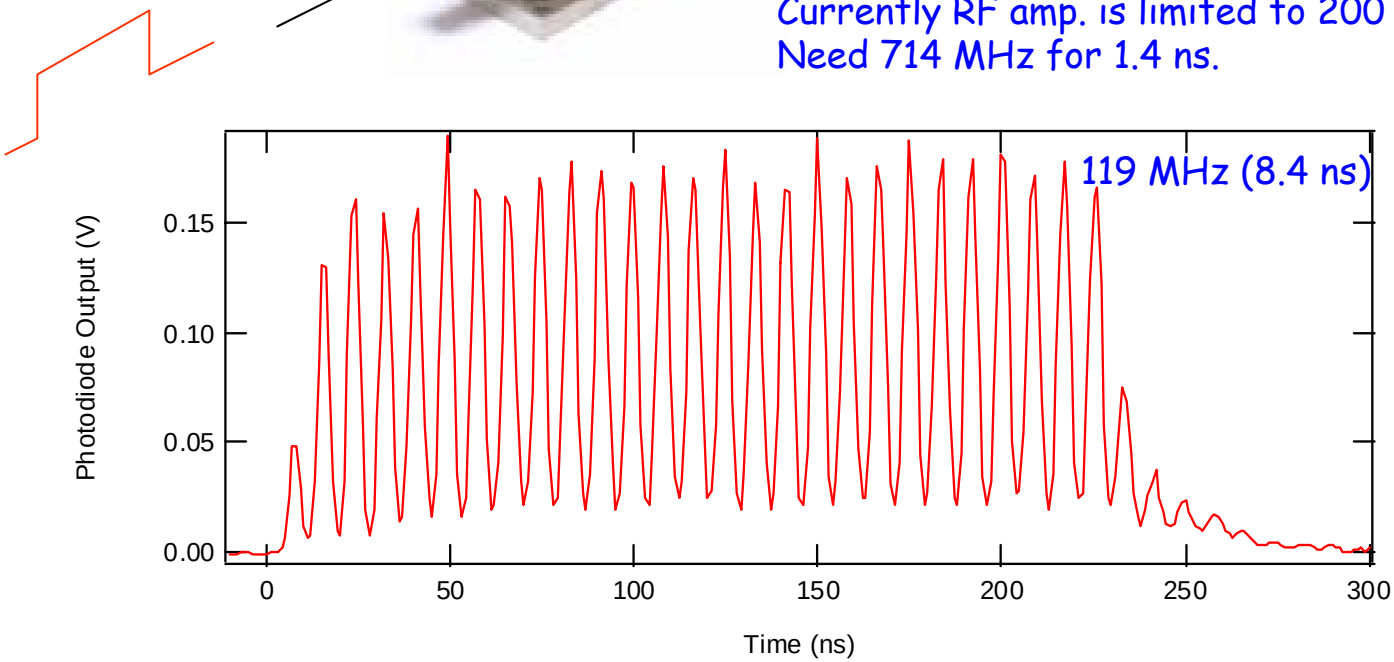
Multi-bunch laser development

Laser modulator

RF Amp.

RF Gen.

Currently RF amp. is limited to 200 MHz.
Need 714 MHz for 1.4 ns.



Summary

- High gradient doped strained-superlattice GaAs-GaAsP has been developed under SBIR and is commercially available.
- Peak polarization of 86% with ~1% QE and no charge saturation up to 1×10^{12} e- in 60 ns.
- Used successfully in E158 Run 3, yielding 90% polarization at ESA.
- High gradient doping is vulnerable to high temperature heat cleaning.
- To lower the heat-cleaning temperature, the atomic hydrogen cleaning technique has been developed.