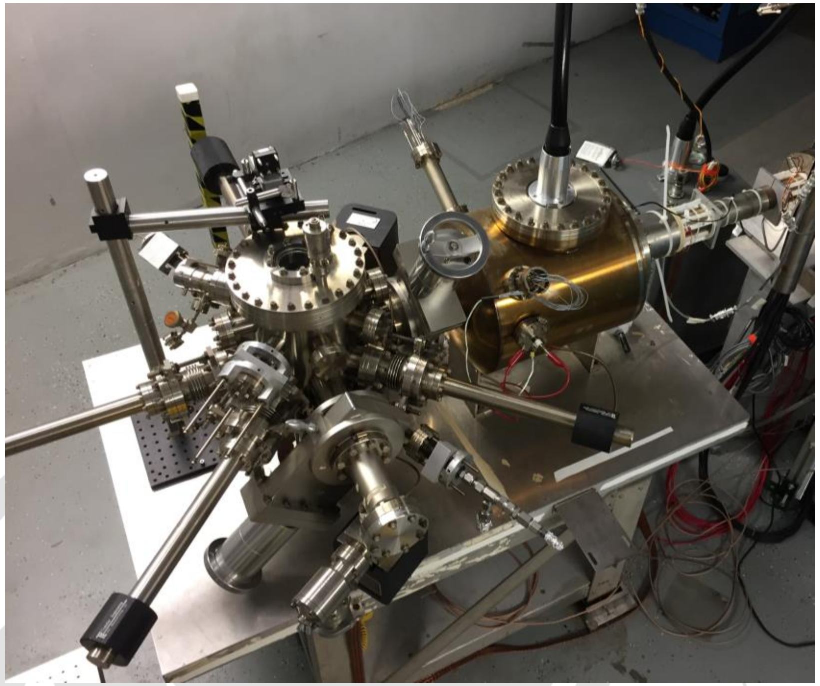
Polarized Electrons for Polarized Positron Beams

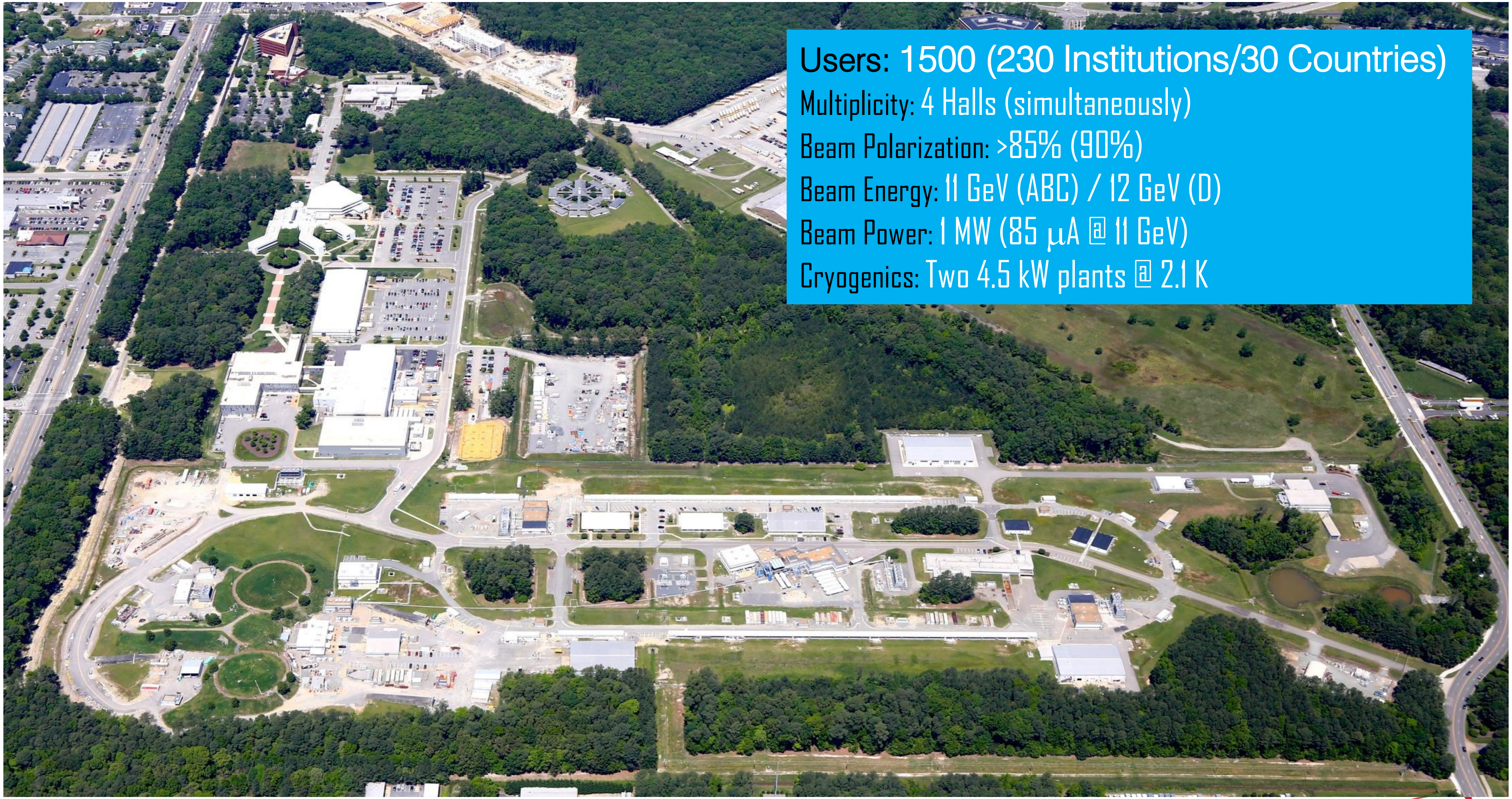


- **P**olarized **E**lectrons for **P**olarized **Po**sitrons (PEPPo)
- Positrons at **CEBAF**
  - Low Energy Concept
  - High Energy Concept
- Positrons for **JL**ab **E**lectron **I**on **C**ollider (JLEIC)
- Why not PEPPo for the **ILC** ?
- Polarized Electron Source R&D

Joseph Grames, Jefferson Laboratory, USA
Malek Mazouz, University of Monastir, Tunisia
Eric Voutier, IPN-Orsay, France

International Workshop on Future Linear Colliders (LCWS 2018)
October 22-26, 2018

Jefferson Lab : CEBAF @ 12 GeV



Users: 1500 (230 Institutions/30 Countries)

Multiplicity: 4 Halls (simultaneously)

Beam Polarization: >85% (90%)

Beam Energy: 11 GeV (ABC) / 12 GeV (D)

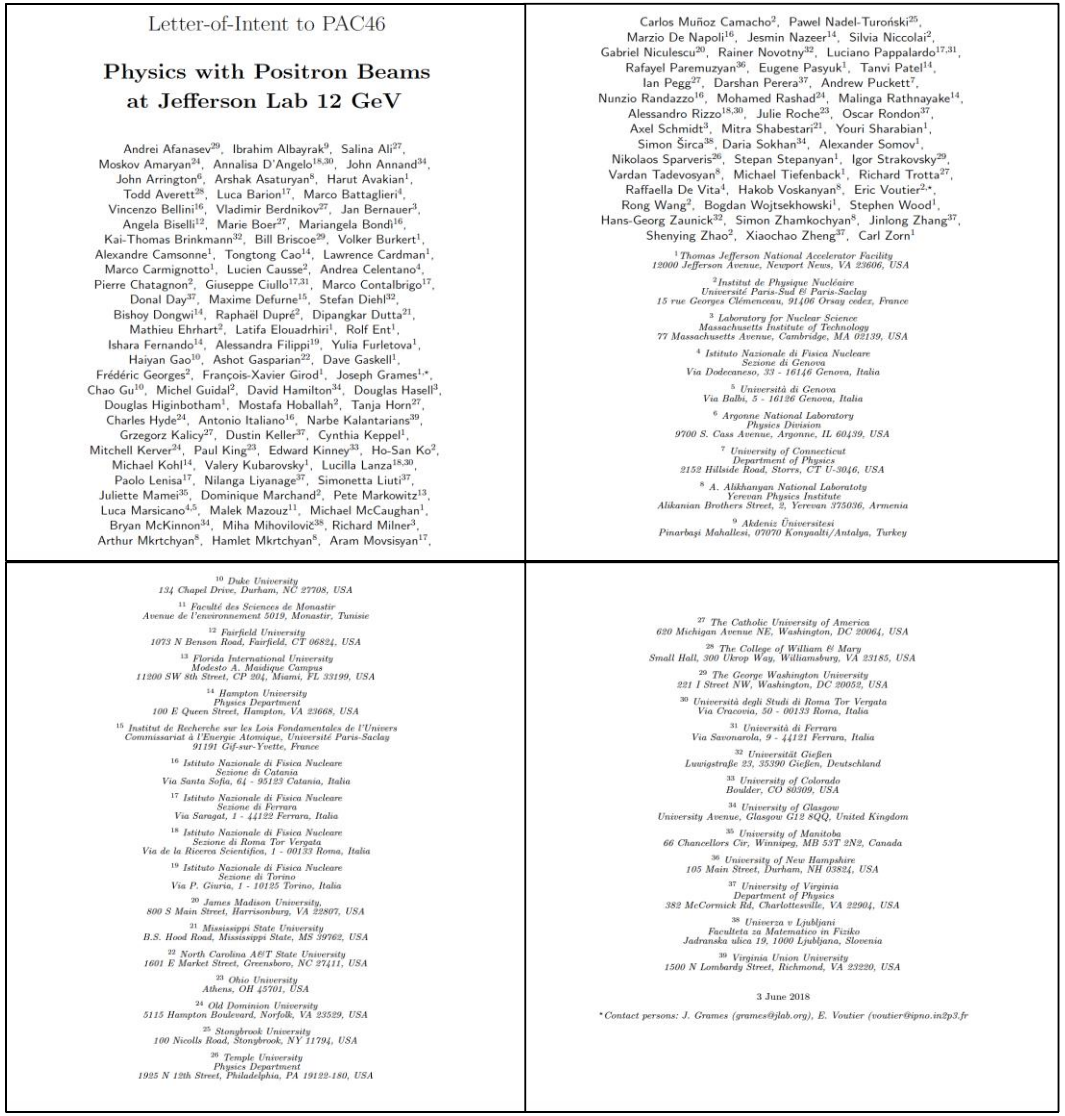
Beam Power: 1 MW (85 μA @ 11 GeV)

Cryogenics: Two 4.5 kW plants @ 2.1 K

Why Polarized Positrons at Jefferson Lab?

Parameter	CEBAF 12 GeV Electron Beam	Proposed 12 GeV Positron Beam
Beam Intensity	85 µA	> 100 nA (pol) > 1 µA (unpol)
Duty Factor	100% (cw)	100% (cw)
Bunch Frequency	249.5/499 MHz	249.5/499 MHz
Spin Polarization	>85%	>50%
Helicity Reversal	30 – 2000 Hz (Pockels cell)	30 – 2000 Hz (Pockels cell)

Letter of Intent to PAC46 (LOI-12-18-004)



Letter-of-Intent to PAC46

Physics with Positron Beams
at Jefferson Lab 12 GeV

Andrei Afanasev[29], Ibrahim Albayrak[9], Salina Ali[27],
Moskov Amaryan[24], Annalisa D'Angelo[18,30], John Annand[34],
John Arrington[6], Arshak Asaturyan[8], Harut Avakian[1],
Todd Averett[28], Luca Barion[17], Marco Battaglieri[4],
Vincenzo Bellini[16], Vladimir Berdnikov[27], Jan Bernauer[3],
Angela Biselli[12], Marie Boer[27], Mariangela Bondì[16],
Kai-Thomas Brinkmann[32], Bill Briscoe[29], Volker Burkert[1],
Alexandre Camsonne[1], Tongtong Cao[14], Lawrence Cardman[1],
Marco Carmignotto[1], Lucien Causse[2], Andrea Celentano[4],
Pierre Chatagnon[2], Giuseppe Ciullo[17,31], Marco Contalbrigo[17],
Donal Day[37], Maxime Defurne[15], Stefan Diehl[32],
Bishoy Dongwi[14], Raphaël Dupré[2], Dipangkar Dutta[21],
Mathieu Ehrhart[2], Latifa Elouadrhiri[1], Rolf Ent[1],
Ishara Fernando[14], Alessandra Filippi[19], Yulia Furletova[1],
Haiyan Gao[10], Ashot Gasparian[22], Dave Gaskell[1],
Frédéric Georges[2], François-Xavier Girod[1], Joseph Grames[1,*],
Chao Gu[10], Michel Guidal[2], David Hamilton[34], Douglas Hasell[3],
Douglas Higinbotham[1], Mostafa Hoballah[2], Tanja Horn[27],
Charles Hyde[24], Antonio Italiano[16], Narbe Kalantarians[39],
Grzegorz Kalicy[27], Dustin Keller[37], Cynthia Keppel[1],
Mitchell Kerver[24], Paul King[23], Edward Kinney[33], Ho-San Ko[2],
Michael Kohl[14], Valery Kubarovsky[1], Lucilla Lanza[18,30],
Paolo Lenisa[17], Nilanga Liyanage[37], Simonetta Liuti[37],
Juliette Mamei[35], Dominique Marchand[2], Pete Markowitz[13],
Luca Marsicano[4,5], Malek Mazouz[11], Michael McCaughan[1],
Bryan McKinnon[34], Miha Mihovilovič[38], Richard Milner[3],
Arthur Mkrtchyan[8], Hamlet Mkrtchyan[8], Aram Movsisyan[17],
Carlos Muñoz Camacho[2], Pawel Nadel-Turoński[25],
Marzio De Napoli[16], Jesmin Nazeer[14], Silvia Niccolai[2],
Gabriel Niculescu[20], Rainer Novotny[32], Luciano Pappalardo[17,31],
Rafayel Paremuzyan[36], Eugene Pasyuk[1], Tanvi Patel[14],
Ian Pegg[27], Darshan Perera[37], Andrew Puckett[7],
Nunzio Randazzo[16], Mohamed Rashad[24], Malinga Rathnayake[14],
Alessandro Rizzo[18,30], Julie Roche[23], Oscar Rondon[37],
Axel Schmidt[3], Mitra Shabestari[21], Youri Sharabian[1],
Simon Širca[38], Daria Sokhan[34], Alexander Somov[1],
Nikolaos Sparveris[26], Stepan Stepanyan[1], Igor Strakovsky[29],
Vardan Tadevosyan[8], Michael Tiefenback[1], Richard Trotta[27],
Raffaella De Vita[4], Hakob Voskanyan[8], Eric Voutier[2,*],
Rong Wang[2], Bogdan Wojtsekhowski[1], Stephen Wood[1],
Hans-Georg Zaunick[32], Simon Zhamkochyan[8], Jinlong Zhang[37],
Shenying Zhao[2], Xiaochao Zheng[37], Carl Zorn[1]

[1] *Thomas Jefferson National Accelerator Facility*
12000 Jefferson Avenue, Newport News, VA 23606, USA

[2] *Institut de Physique Nucléaire*
Université Paris-Sud & Paris-Saclay
15 rue Georges Clémenceau, 91406 Orsay cedex, France

[3] *Laboratory for Nuclear Science*
Massachusetts Institute of Technology
77 Massachusetts Avenue, Cambridge, MA 02139, USA

[4] *Istituto Nazionale di Fisica Nucleare*
Sezione di Genova
Via Dodecaneso, 33 - 16146 Genova, Italia

[5] *Università di Genova*
Via Balbi, 5 - 16126 Genova, Italia

[6] *Argonne National Laboratory*
Physics Division
9700 S. Cass Avenue, Argonne, IL 60439, USA

[7] *University of Connecticut*
Department of Physics
2152 Hillside Road, Storrs, CT U-3046, USA

[8] *A. Alikhanyan National Laboratoty*
Yerevan Physics Institute
Alikanian Brothers Street, 2, Yerevan 375036, Armenia

[9] *Akdeniz Üniversitesi*
Pinarbaşi Mahallesi, 07070 Konyaalti/Antalya, Turkey

[10] *Duke University*
134 Chapel Drive, Durham, NC 27708, USA

[11] *Faculté des Sciences de Monastir*
Avenue de l'environnement 5019, Monastir, Tunisie

[12] *Fairfield University*
1073 N Benson Road, Fairfield, CT 06824, USA

[13] *Florida International University*
Modesto A. Maidique Campus
11200 SW 8th Street, CP 204, Miami, FL 33199, USA

[14] *Hampton University*
Physics Department
100 E Queen Street, Hampton, VA 23668, USA

[15] *Institut de Recherche sur les Lois Fondamentales de l'Univers*
Commissariat à l'Energie Atomique, Université Paris-Saclay
91191 Gif-sur-Yvette, France

[16] *Istituto Nazionale di Fisica Nucleare*
Sezione di Catania
Via Santa Sofia, 64 - 95123 Catania, Italia

[17] *Istituto Nazionale di Fisica Nucleare*
Sezione di Ferrara
Via Saragat, 1 - 44122 Ferrara, Italia

[18] *Istituto Nazionale di Fisica Nucleare*
Sezione di Roma Tor Vergata
Via de la Ricerca Scientifica, 1 - 00133 Roma, Italia

[19] *Istituto Nazionale di Fisica Nucleare*
Sezione di Torino
Via P. Giuria, 1 - 10125 Torino, Italia

[20] *James Madison University,*
800 S Main Street, Harrisonburg, VA 22807, USA

[21] *Mississippi State University*
B.S. Hood Road, Mississippi State, MS 39762, USA

[22] *North Carolina A&T State University*
1601 E Market Street, Greensboro, NC 27411, USA

[23] *Ohio University*
Athens, OH 45701, USA

[24] *Old Dominion University*
5115 Hampton Boulevard, Norfolk, VA 23529, USA

[25] *Stonybrook University*
100 Nicolls Road, Stonybrook, NY 11794, USA

[26] *Temple University*
Physics Department
1925 N 12th Street, Philadelphia, PA 19122-180, USA

[27] *The Catholic University of America*
620 Michigan Avenue NE, Washington, DC 20064, USA

[28] *The College of William & Mary*
Small Hall, 300 Ukrop Way, Williamsburg, VA 23185, USA

[29] *The George Washington University*
221 I Street NW, Washington, DC 20052, USA

[30] *Università degli Studi di Roma Tor Vergata*
Via Cracovia, 50 - 00133 Roma, Italia

[31] *Università di Ferrara*
Via Savonarola, 9 - 44121 Ferrara, Italia

[32] *Universität Gießen*
Luwigstraße 23, 35390 Gießen, Deutschland

[33] *University of Colorado*
Boulder, CO 80309, USA

[34] *University of Glasgow*
University Avenue, Glasgow G12 8QQ, United Kingdom

[35] *University of Manitoba*
66 Chancellors Cir, Winnipeg, MB 53T 2N2, Canada

[36] *University of New Hampshire*
105 Main Street, Durham, NH 03824, USA

[37] *University of Virginia*
Department of Physics
382 McCormick Rd, Charlottesville, VA 22904, USA

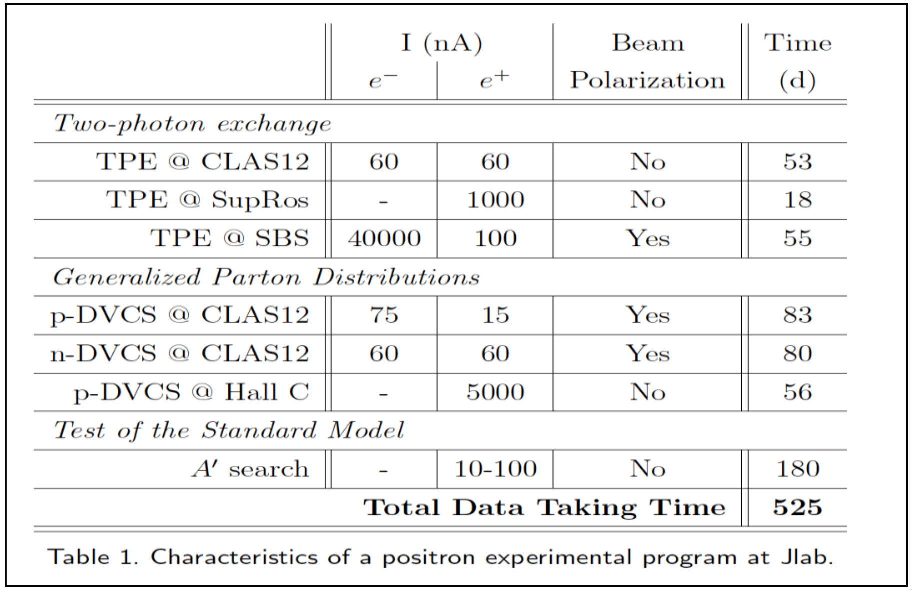
[38] *Univerza v Ljubljani*
Faculteta za Matematico in Fiziko
Jadranska ulica 19, 1000 Ljubljana, Slovenia

[39] *Virginia Union University*
1500 N Lombardy Street, Richmond, VA 23220, USA

3 June 2018

[*] *Contact persons: J. Grames (grames@jlab.org), E. Voutier (voutier@ipno.in2p3.fr*

- Jefferson Lab Positron Working Group (JLAB-PWG) formed in 2016
  - **120 members** (>90% are Users), and growing
  - **39 institutions**
- Letter of Intent "*Physics Program with Positron Beams at CEBAF 12 GeV*" submitted to PAC46 (July 2018), highlighting 7 mini-LOI's
- ***Summary***: *"These measurements all have significant physics interest. The proposers should carefully evaluate feasibility and present the best case possible in a future proposal."*



	I (nA)		Beam Polarization	Time (d)
	e^-	e^+		
Two-photon exchange				
TPE @ CLAS12	60	60	No	53
TPE @ SupRos	-	1000	No	18
TPE @ SBS	40000	100	Yes	55
Generalized Parton Distributions				
p-DVCS @ CLAS12	75	15	Yes	83
n-DVCS @ CLAS12	60	60	Yes	80
p-DVCS @ Hall C	-	5000	No	56
Test of the Standard Model				
A' search	-	10-100	No	180
			Total Data Taking Time	**525**

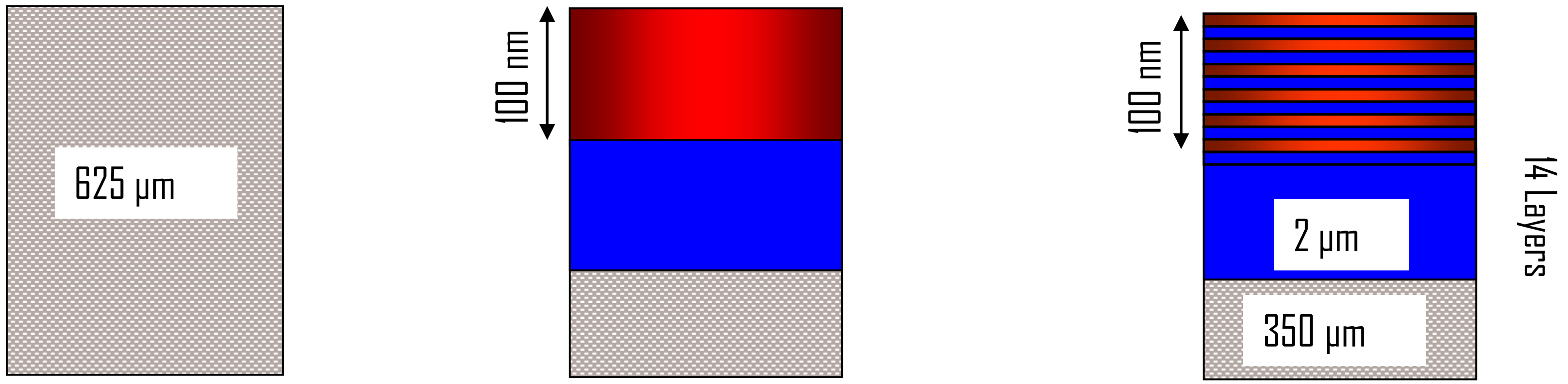
Table 1. Characteristics of a positron experimental program at Jlab.

Enabling Technology : CEBAF Polarized Electron Sources based on GaAs

Bulk GaAs

Strained GaAs:
GaAs on GaAsP

Strained Superlattice GaAs:
Layers of GaAs on GaAsP



QE ~ 5%, 30 mA/W
Pol ~ 35% @ 780 nm

QE ~ 0.2%, 1 mA/W
Pol ~ 75% @ 850 nm

QE ~ 1%, 6 mA/W
Pol ~ 89% @ 780 nm

P_{e-}	35%	35%	75%	75%	85%	89%	90%
I_{e-}	30μA	100μA	50μA	100μA	150μA	250μA	4000μA
	1995	1998	1999	2000	2004	2012	2017

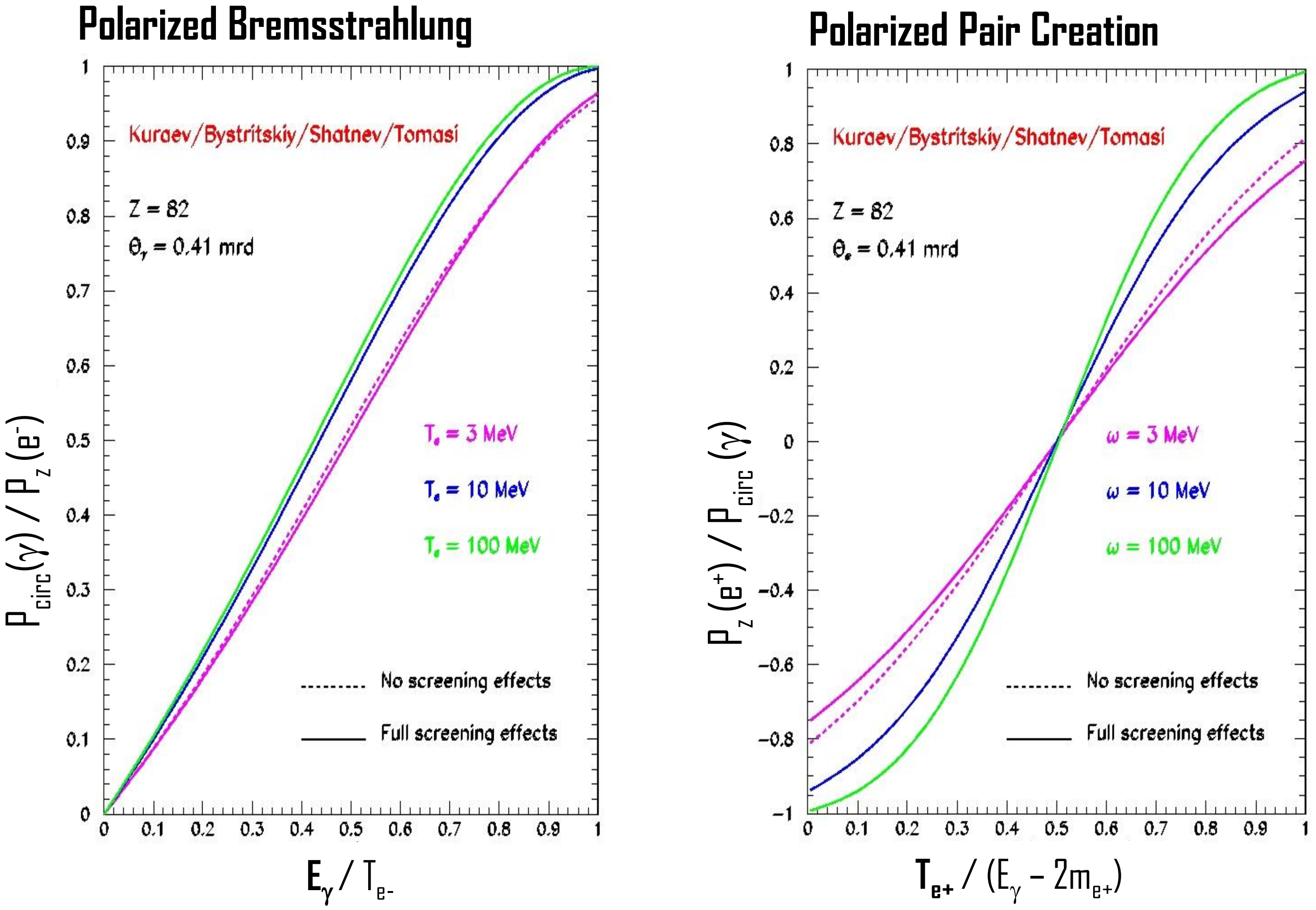
Figure-of-Merit (P^2I) has improved by a factor of 43 over the span of the CEBAF "6 GeV era"

High Current Lifetime Studies at CEBAF

New Method : Exploit Electron Beam Spin Polarization

$$\vec{e}^- \rightarrow \overset{\circlearrowright}{\gamma} \rightarrow \vec{e}^+ \ (+\ \vec{e}^-)$$

Longitudinal spin polarization passes from incident electrons to outgoing pair-produced positrons in the electromagnetic shower, when incident on a target, e.g. high-Z material useful.



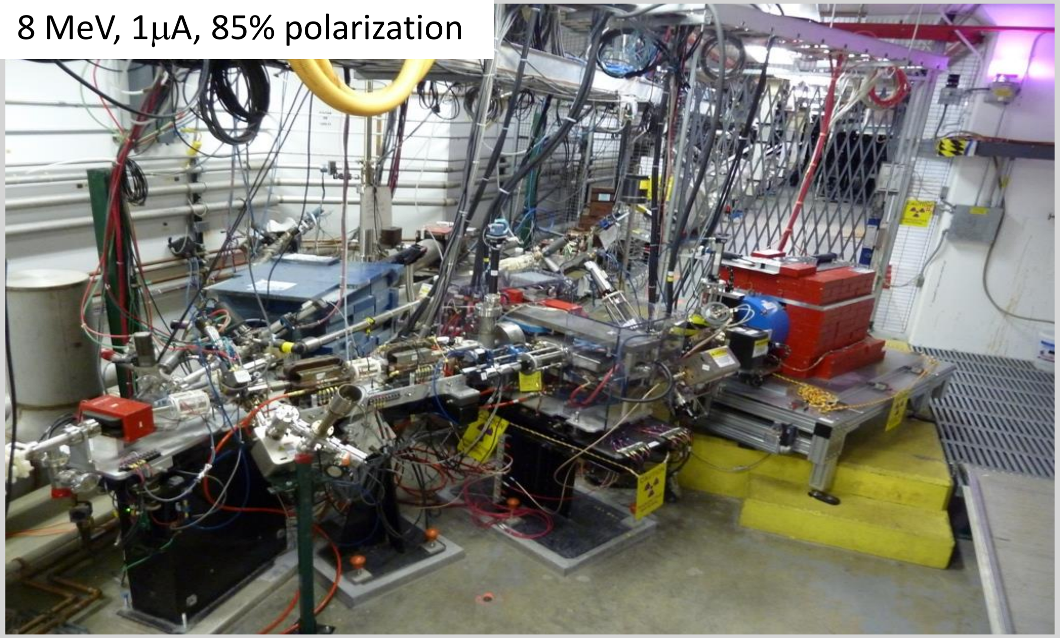
E.A. Kuraev, Y.M. Bystritskiy, M. Shatnev, E.Tomasi-Gustafsson, PRC 81 (2010) 055208

PEPPo Experiment : Feasibility Demonstration at the CEBAF Injector (2012)

PEPPo (**P**olarized **E**lectrons for **P**olarized **Po**sitrons) => ***demonstrate feasibility*** of using bremsstrahlung radiation of **MeV energy Polarized Electrons** for production of **Polarized Positrons**.

J. Grames, E. Voutier et al., JLab Experiment E12-11-105 (2011)

8 MeV, 1μA, 85% polarization



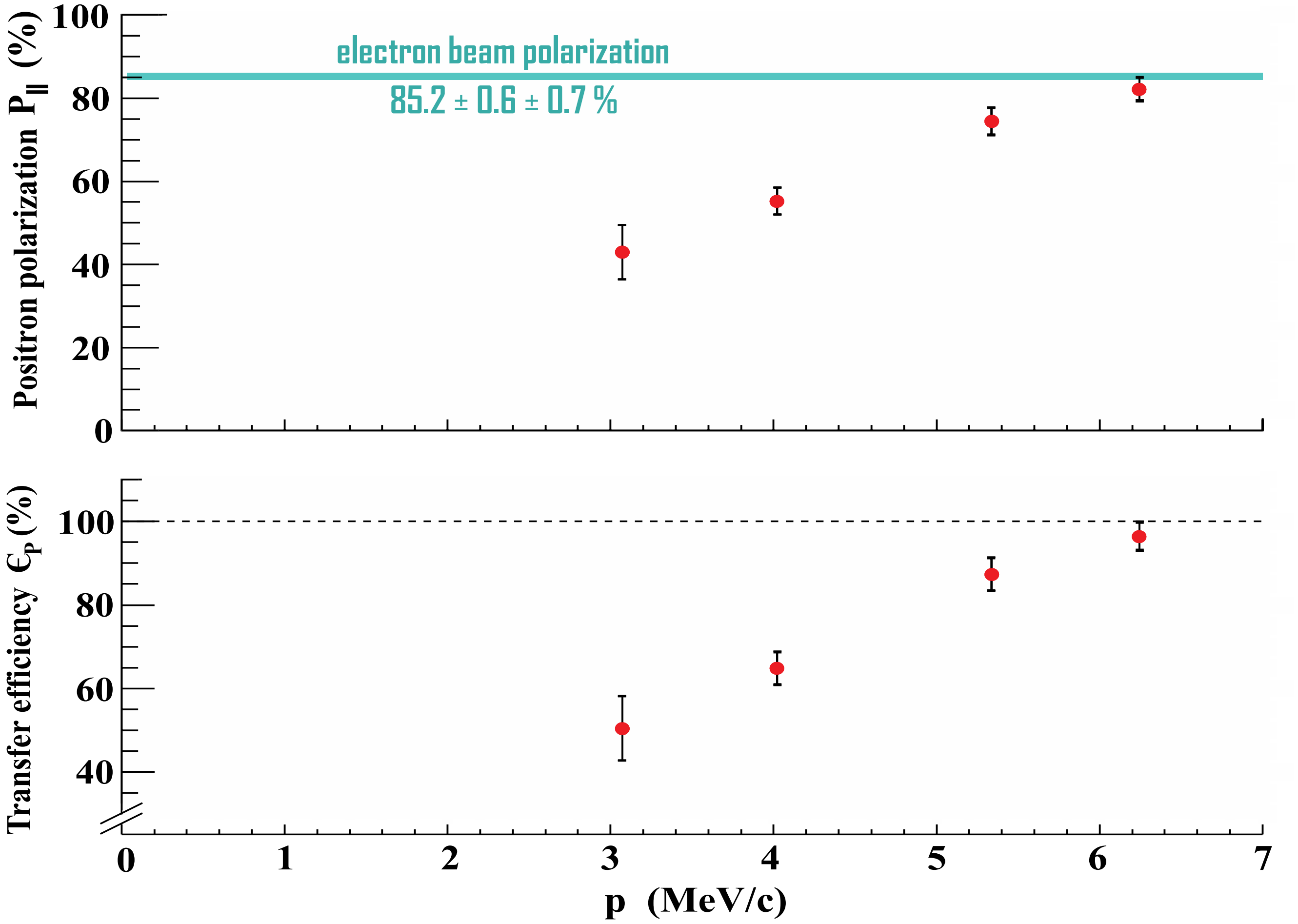
Tungsten (1mm)

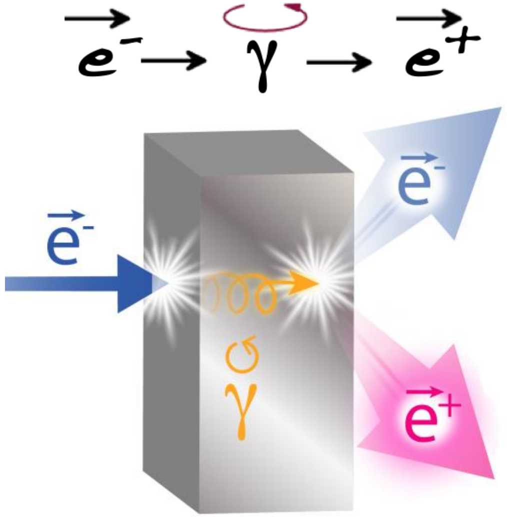
PEPPo possible due to support from ***SLAC*** *E166,* ***DESY****,* ***Princeton****,* ***Cornell****,* ***International Linear Collider Project*** *and the* ***Jefferson Science Associates***

PEPPo : Polarized Positron Production

(PEPPo Collaboration) D. Abbott et al. , Phys. Rev. Lett. 116 (2016) 214801

PEPPo demonstrated **efficient polarization transfer** of **8.2 MeV/c polarized electrons** to **positrons**, expanding polarized positron production using **MeV electron beam energies.**





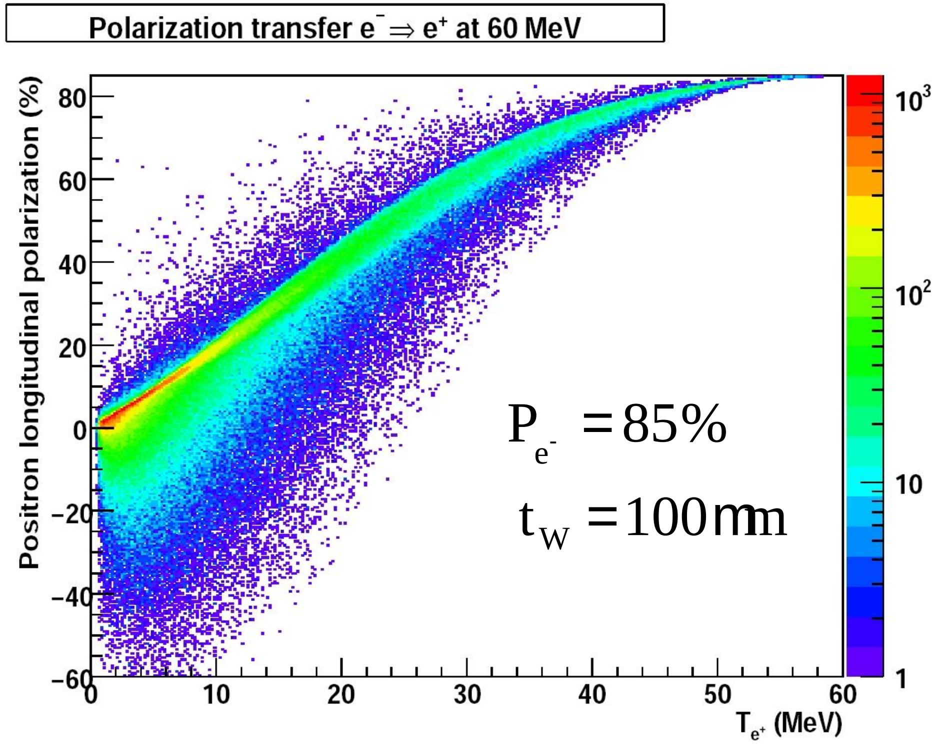
Whenever producing e^+ from e^-, polarization is coming for free, if initial electrons are polarized.

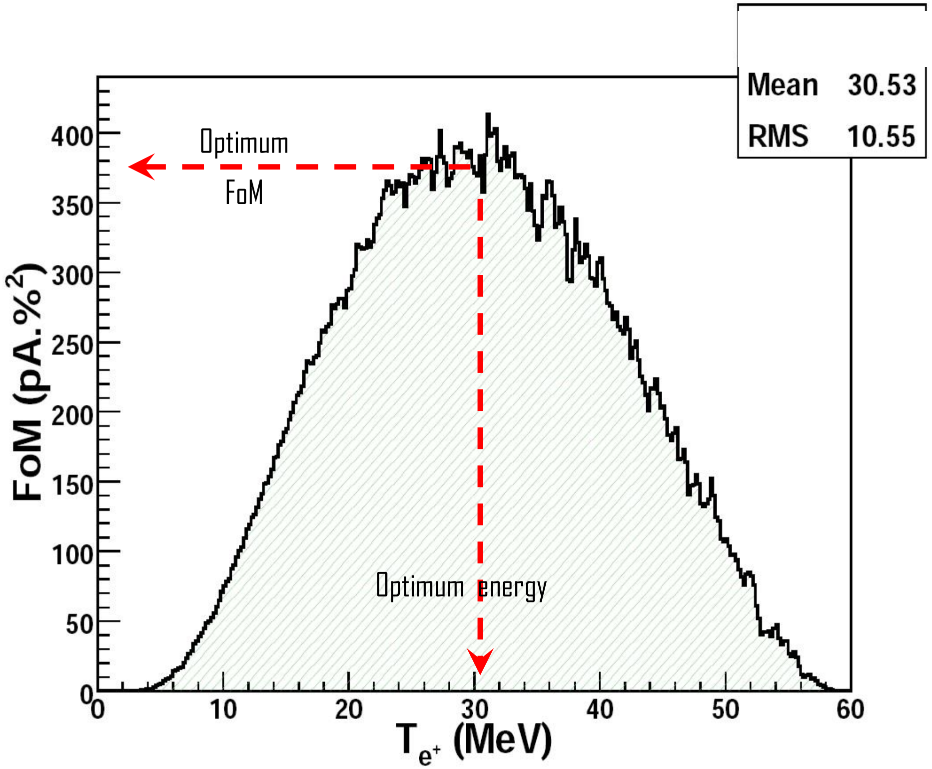
Figure of Merit for Electron Energy 60 MeV (Injector Energy of 6 GeV CEBAF)

R. Dollan, K. Laihem, A. Schälicke, NIM A 559 (2006) 185,
J. Dumas, J. Grames, E. Voutier, JPos09, AIP 1160 (2009) 120
J. Dumas, Doctorate Thesis (2011)

The polarization distribution of generated positrons is dominated by **low-energy events**.

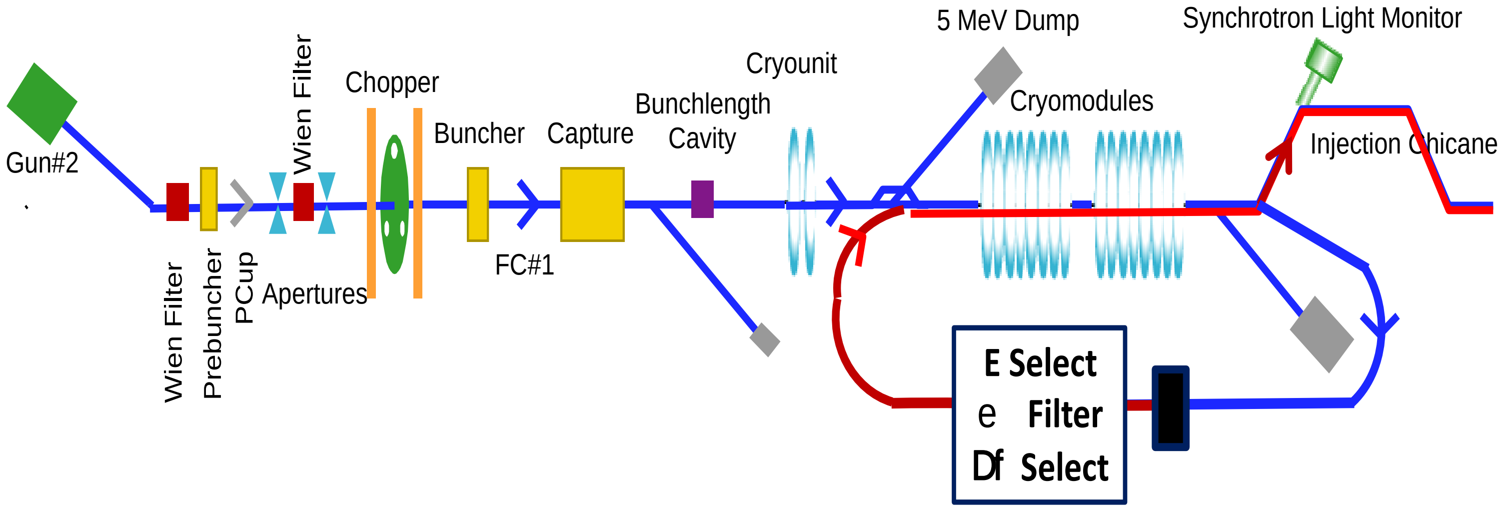
The positron energy at the optimum FoM (P^2I) is about **half** of the electron beam energy.

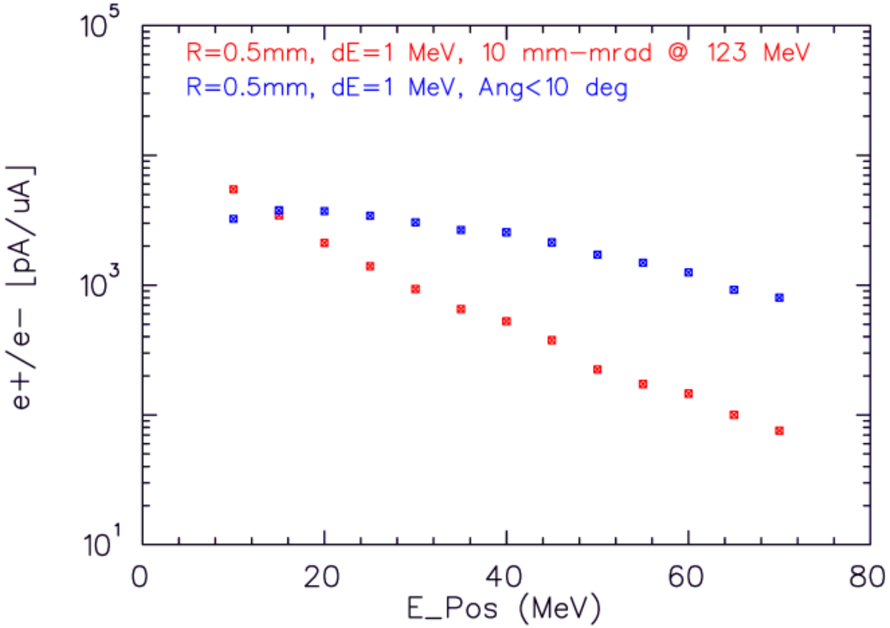


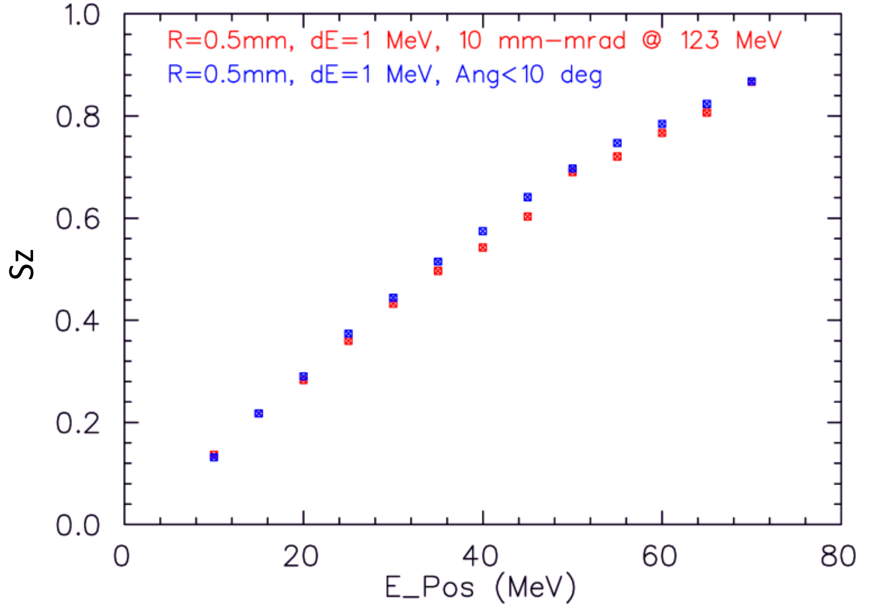


12 GeV CEBAF: Low Energy (123 MeV) with High Current + Modest Bunch Charge

Positrons would be created at the CEBAF injector, using the **123 MeV** electron beam.





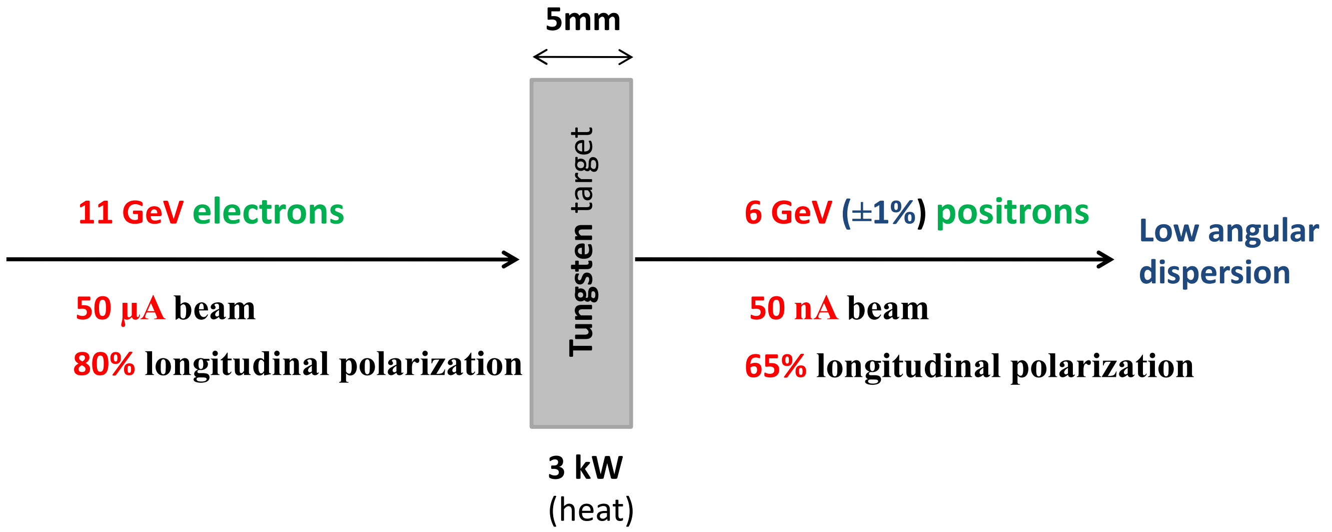


Selecting **60 MeV** positrons maximizes the FoM (**60%, 100 nA**).

Selecting **6 MeV** positrons maximizes the flux (**> 1 µA**).

Positron source should have tunability
to optimize for Intensity or Polarization

CEBAF: High Energy (11 GeV) with Low Current + Low Bunch Charge



11 GeV electrons

50 μA beam

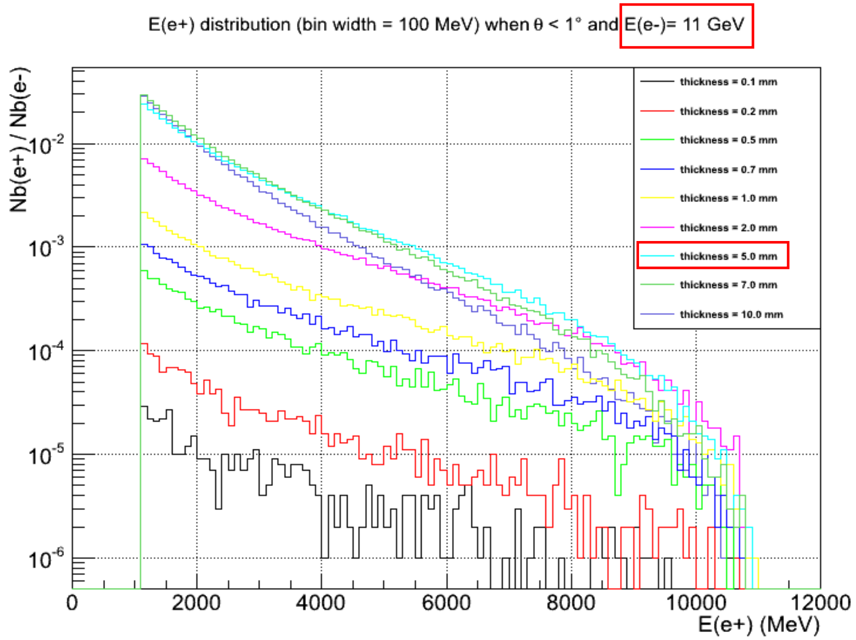
80% longitudinal polarization

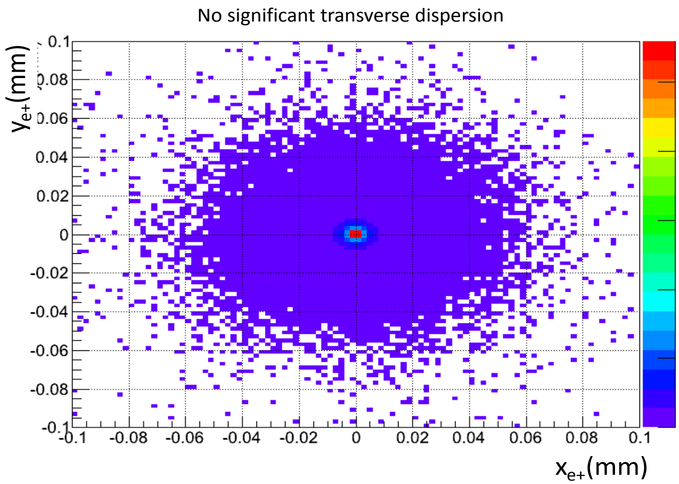
6 GeV (±1%) positrons

50 nA beam

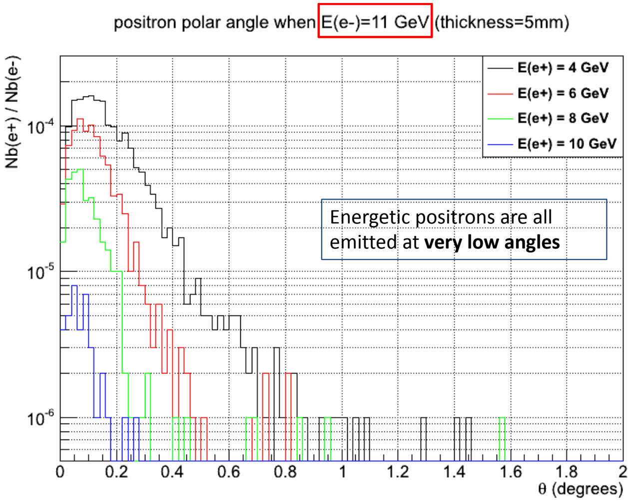
65% longitudinal polarization

Low angular dispersion

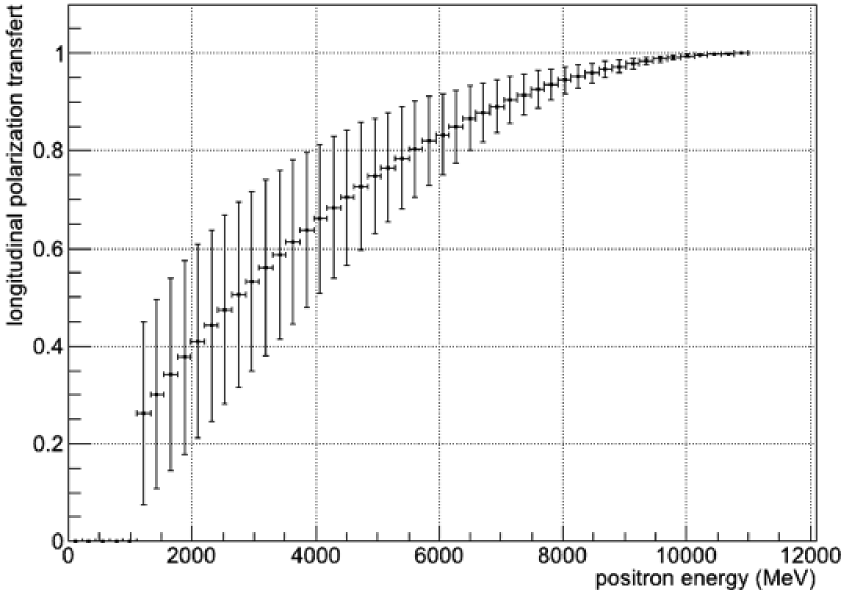




No significant transverse dispersion

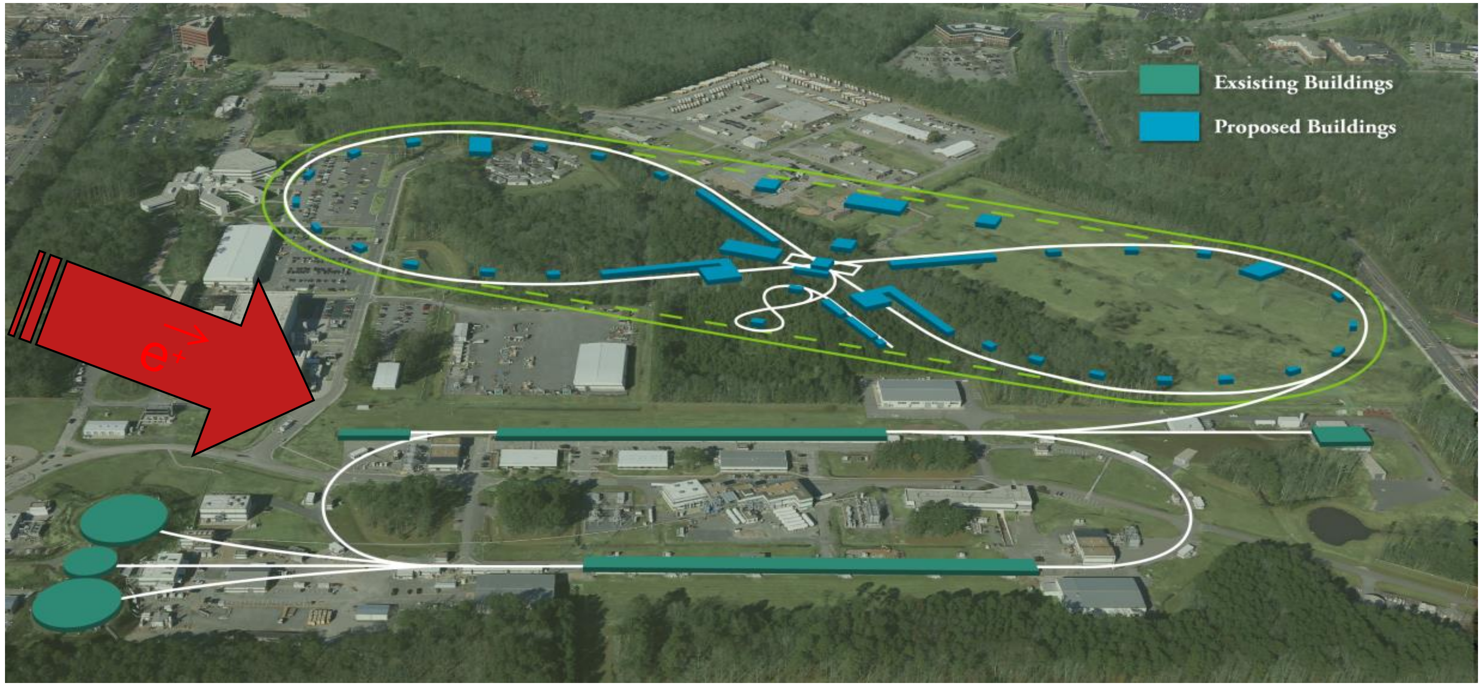


Energetic positrons are all emitted at **very low angles**



J. Grames, LCWS 2018

Polarized Positrons at the Jefferson Lab Electron Ion Collider

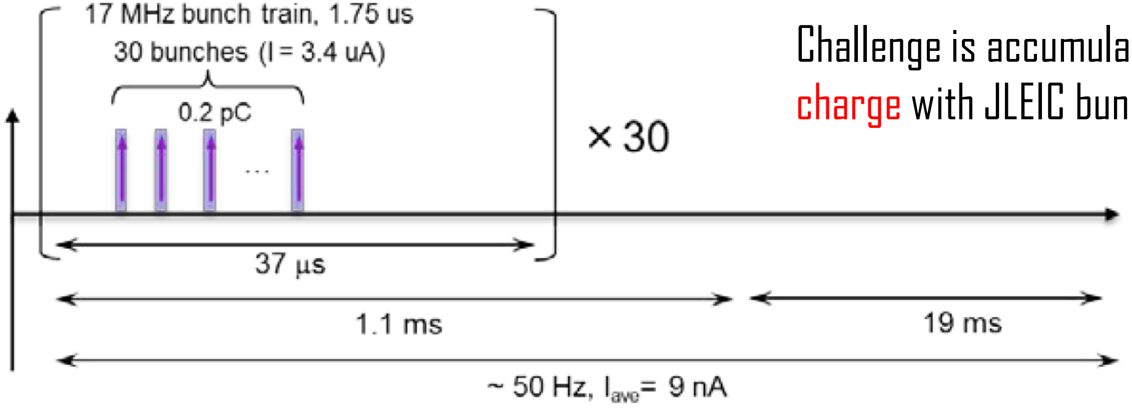


A **polarized positron injector** suitable for the Jefferson Lab Electron Ion Collider (JLEIC) has also been considered.

$\mathcal{L} \geq 10^{33} cm^{-2}s^{-1}$ $P_{e+} \geq 40\%$

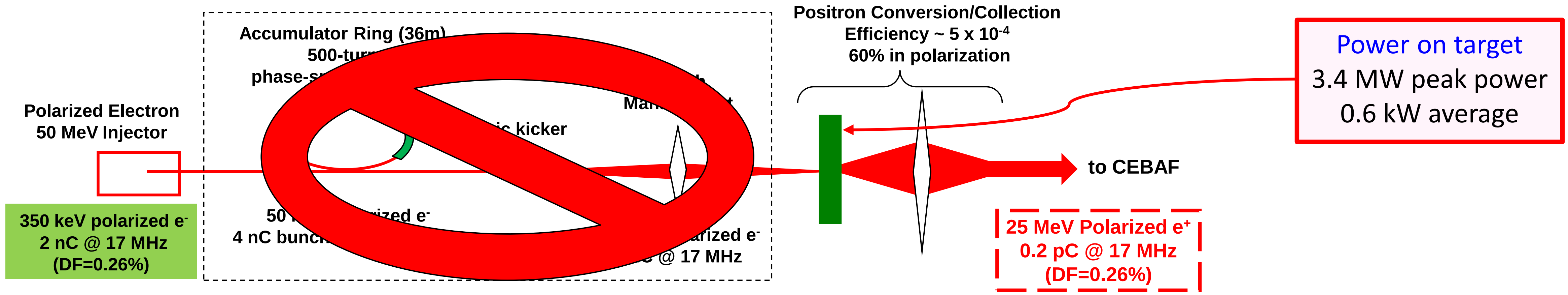
I_{ave} > 10 nA (~10^{10} e+/s)

I_{peak} > 4 μA (~10^{13} e+/s)



Challenge is accumulating positron bunch charge with JLEIC bunch pattern.

JLEIC: Low Energy (50 MeV) with Low Current + High Bunch Charge



Polarized Electron
50 MeV Injector

350 keV polarized e$^-$
2 nC @ 17 MHz
(DF=0.26%)

Accumulator Ring (36m)
500-tur
phase-s
Man
ic kicker
50
ized e$^-$
4 nC bunc
arized e$^-$
@ 17 MHz

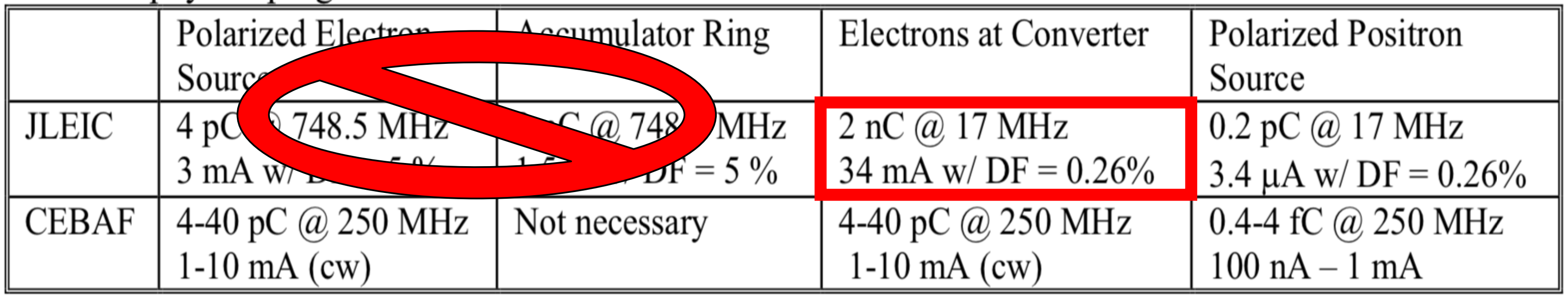
Positron Conversion/Collection
Efficiency ~ 5 x 10^{-4}
60% in polarization

to CEBAF

25 MeV Polarized e$^+$
0.2 pC @ 17 MHz
(DF=0.26%)

Power on target
3.4 MW peak power
0.6 kW average

Table 1. Beam parameters at each stage of the polarized positron injection scheme for both JLEIC and CEBAF physics programs.



	Polarized Electron Sourc	Accumulator Ring	Electrons at Converter	Polarized Positron Source
JLEIC	4 pC [illegible] 748.5 MHz 3 mA w/ [illegible]	[illegible]C @ 748 [illegible] MHz 1 [illegible] DF = 5 %	2 nC @ 17 MHz 34 mA w/ DF = 0.26%	0.2 pC @ 17 MHz 3.4 μA w/ DF = 0.26%
CEBAF	4-40 pC @ 250 MHz 1-10 mA (cw)	Not necessary	4-40 pC @ 250 MHz 1-10 mA (cw)	0.4-4 fC @ 250 MHz 100 nA – 1 mA

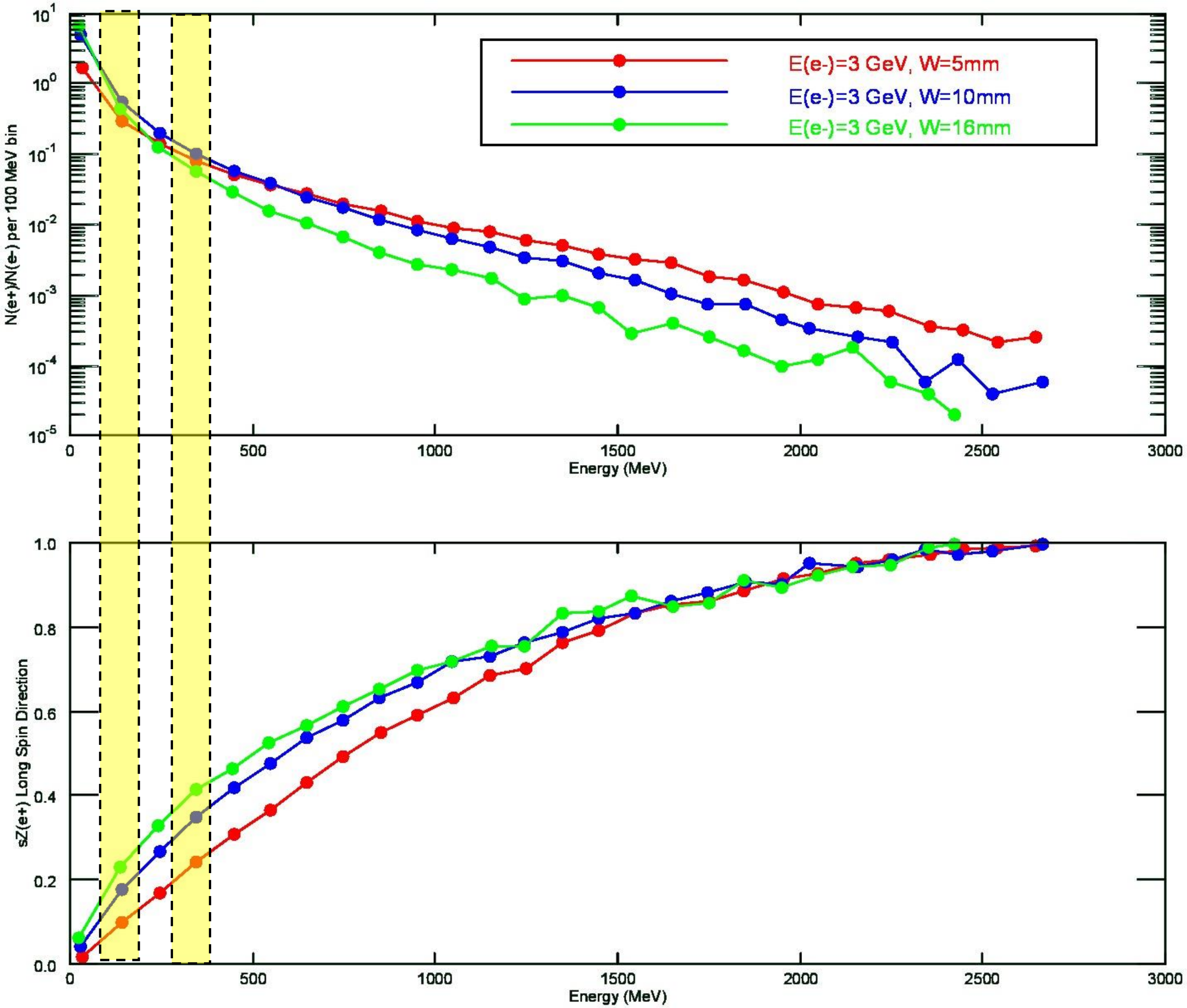
ILC : Spin Polarized Electron Driven Source ?

What is expected (w/o any cuts) for a 3 GeV spin polarized electron beam over range of target thickness (5mm – 16 mm)

- Thicker targets improve yield of lowest energy positrons, and provide a degree of spin filtering.
- Thinner targets conversely improve yield of highest energy positrons, and with less impact by spin filtering.

E(e-)=3 GeV
W=16mm

E(e+)	N(e+)/N(e-)	<Sz>	P (%)
150 MeV	0.436	0.23	21
350 MeV	0.056	0.41	37



ILC : Spin Polarized Electron Driven Source ?

What is expected (<u>w/o any cuts</u>) if the electron beam energy were lowered, for the same target thickness (16mm).

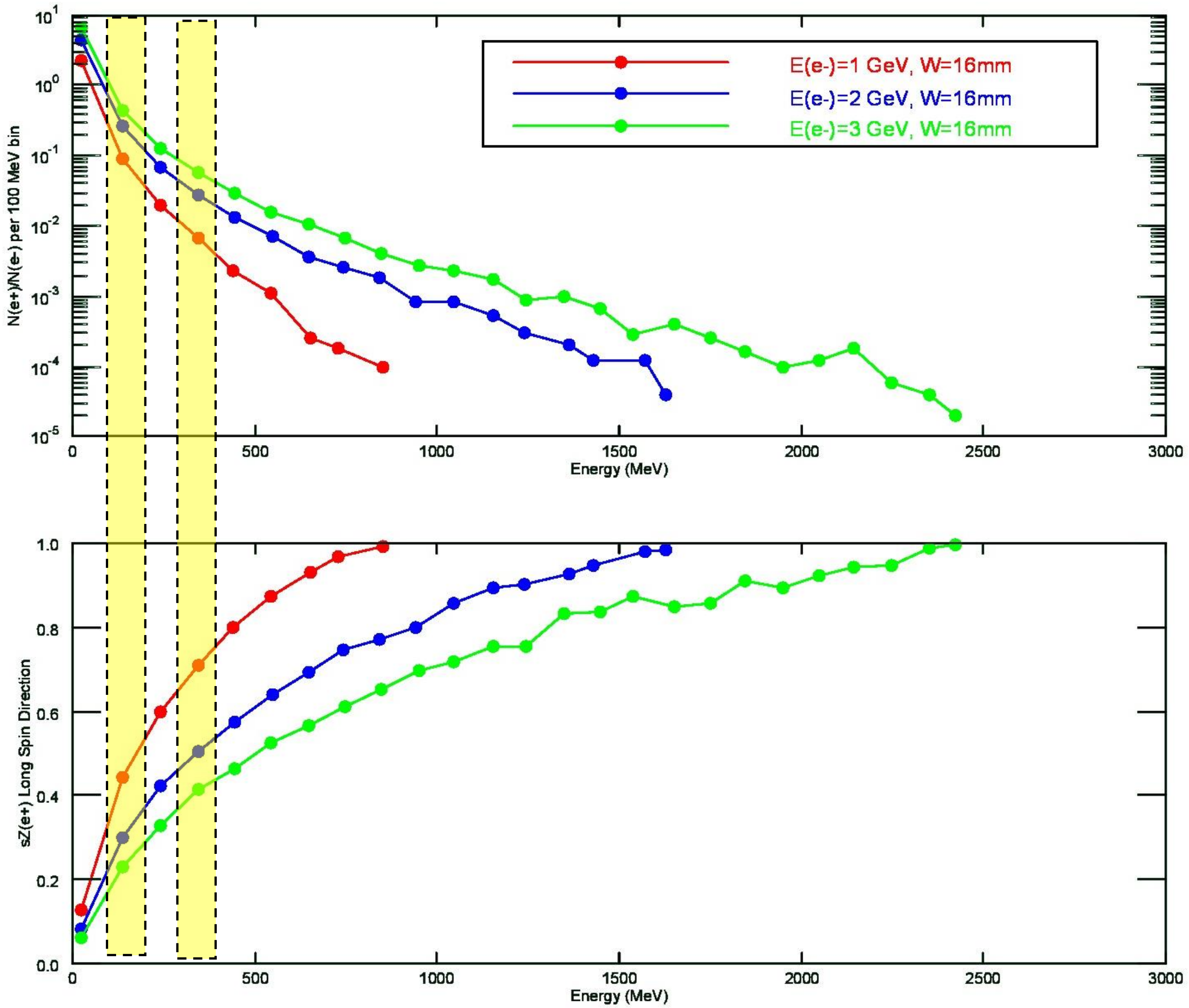
- Lower electron beam energy results in lower yield, expectedly, preferentially at low positron energy.
- Lower electron beam energy results in high spin polarization at same positron energy

E(e+)=150 MeV
W=16mm

E (e-)	N(e+)/N(e-)	<Sz>	P (%)
3 GeV	0.436	0.23	21
1 GeV	0.091	0.44	40

E(e+)=350 MeV
W=16mm

E (e-)	N(e+)/N(e-)	<Sz>	P (%)
3 GeV	0.056	0.41	37
1 GeV	0.007	0.71	64



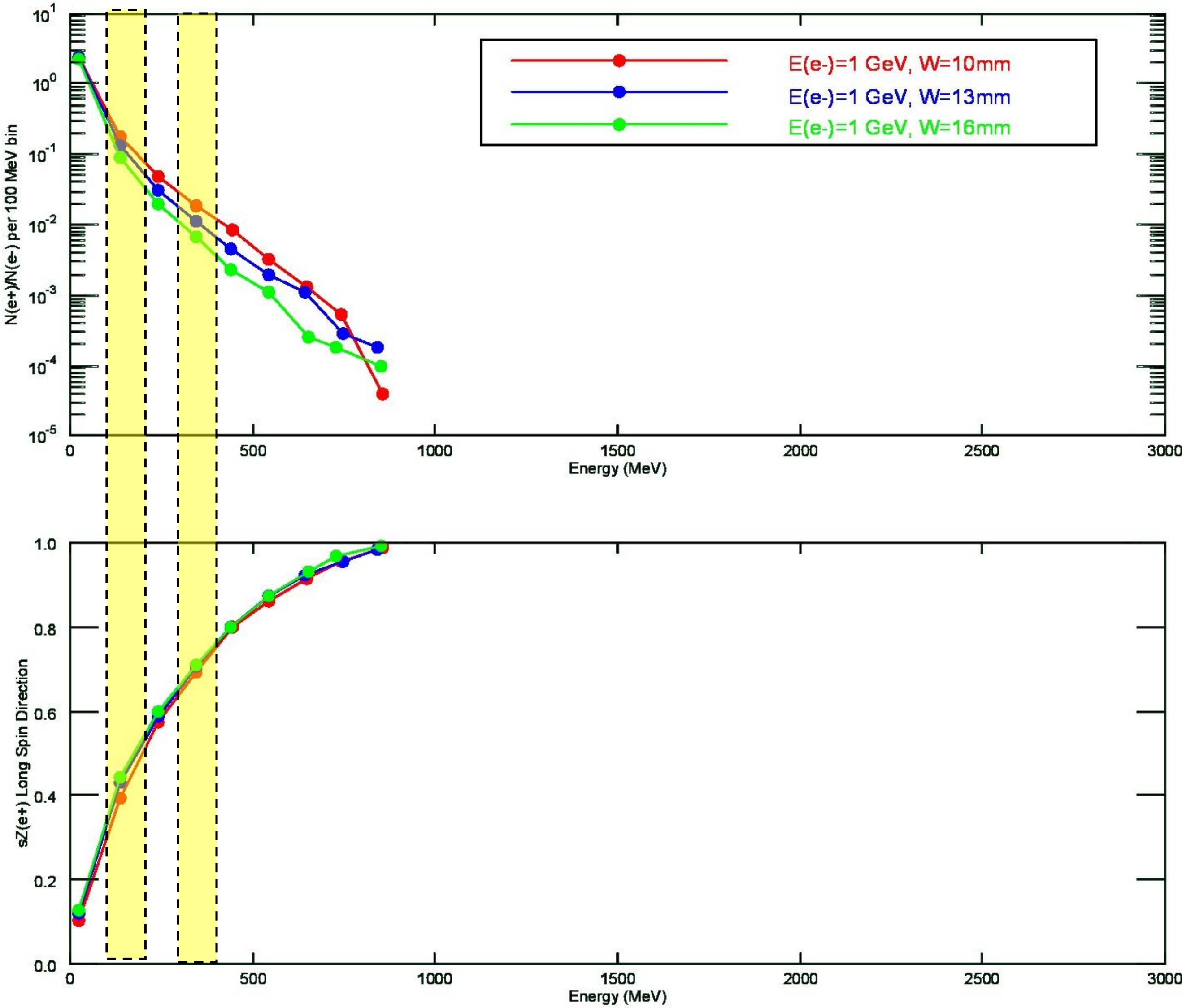
ILC : Spin Polarized Electron Driven Source ?

What is expected (w/o any cuts) if the electron beam energy were 1 GeV, and target thickness reduced.

- Small reduction in target thickness has the effect of increasing yield (at this lower electron beam energy).
- Target thickness has less impact when positron energy large fraction of electron energy.

	E (e-)	Target	N(e+)/N(e-)	<Sz>	P (%)
E(e+)=150 MeV	3 GeV	16 mm	0.436	0.23	21
	1 GeV	10 mm	0.178	0.39	35

	E (e-)	Target	N(e+)/N(e-)	<Sz>	P (%)
E(e+)=350 MeV	3 GeV	16 mm	0.056	0.41	37
	1 GeV	10 mm	0.018	0.69	62



GaAs Polarized Electron Source Parameters

Parameter \ Machine =>	CEBAF	SLC	JLab/FEL	Cornell ERL	LHeC	eRHIC	CLIC	ILC	JLEIC(e+)	CEBAF (e+)
Polarization	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Number electrons/microbunch	2.5 x 10^{6}	1 x 10^{11}	8.3 x 10^{8}	4.8 x 10^{8}	1 x 10^{9}	2.2 x 10^{10}	6 x 10^{9}	3 x 10^{10}	1.2 x 10^{10}	2.5 x 10^{8}
Number of microbunches	CW	2	CW	CW	CW	CW	312	3000	900	CW
Width of microbunch	50 ps	2 ns	35 ps	2 ps	100 ps	~ 100 ps	~ 100 ps	~ 1 ns	100 ps	50 ps
Time between microbunches	2 ns	61.6 ns	13 ns	0.77 ns	25 ns	71.4 ns	0.5002 ns	337 ns	1.33 ns	4 ns
Microbunch rep rate	499 MHz	16 MHz	75 MHz	1300 MHz	40MHz	14MHz	1999 MHz	3 MHz	750 MHz	250 MHz
Width of macropulse	-	64 ns	-	-	-	-	156 ns	1 ms	1.1 ms	-
Macropulse repetition rate	-	120 Hz	-	-	-	-	50 Hz	5 Hz	50 Hz	-
Charge per micropulse	0.4 pC	16 nC	133 pC	77 pC	500 pC	3.6 nC	0.96 nC	4.8 nC	2 nC	40 pC
Charge per macropulse	-	32 nC	-	-	-	-	300 nC	14420 nC	1800 nC	-
Average current from gun	200 uA	2 uA	10 mA	100 mA	20 mA	50 mA	15 uA	72 uA	88 uA	10 mA
Average current in macropulse	-	0.064 A	-	-	-	-	1.9 A	0.0144 A	0.034 A	-
Duty Factor	2.5 x 10^{-2}	2.8 x 10^{-7}	2.6 x 10^{-3}	2.6 x 10^{-3}	4 x 10^{-3}	1.4 x 10^{-3}	0.2	3x10^{-3}	2.6 x 10^{-3}	1.2 x 10^{-2}
Peak current of micropulse	8 mA	8 A	3.8 A	38.5 A	5 A	35.7 A	9.6 A	4.8 A	20 A	0.8 A
Current density*	4 A/cm^{2}	10 A/cm^{2}	19 A/cm^{2}	500 A/cm^{2}	100 A/cm^{2}	182 A/cm^{2}	12 A/cm^{2}	6 A/cm^{2}	20 A/cm^{2}	16 A/cm^{2}
Laser Spot Size*	0.05 cm	1 cm	0.5 cm	0.3 cm	0.5 cm	0.5 cm	1 cm	1 cm	1 cm	0.10 cm

* Loose estimates

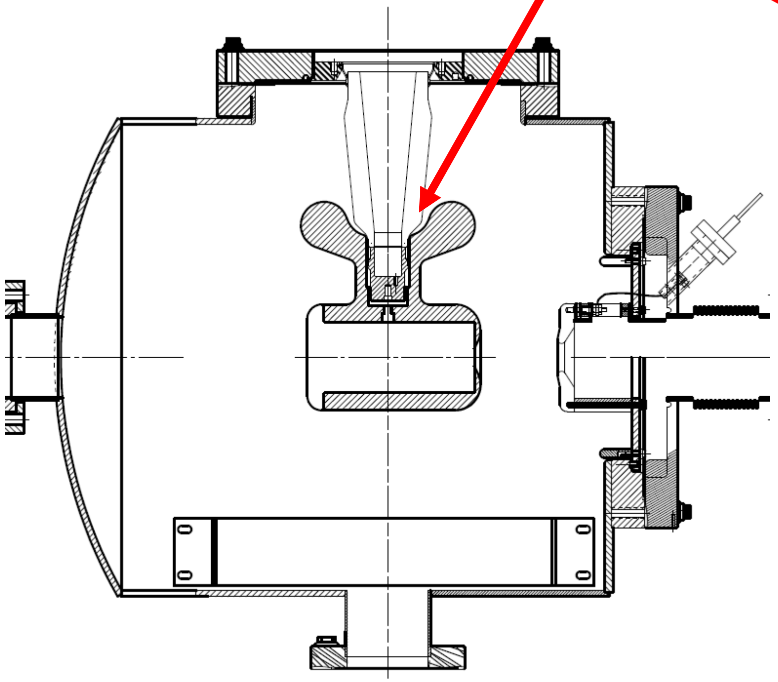
Demonstrated

Proposed (excuse outdated values)

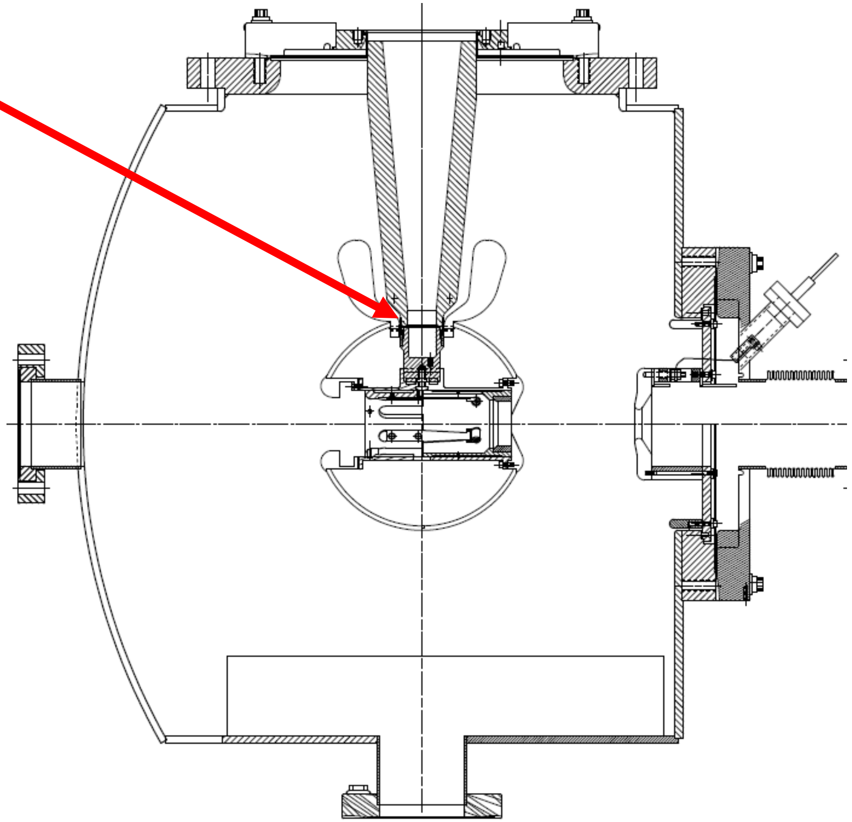
My Speculations

Jefferson Lab: Inverted Insulator Photogun

with **optimized triple point shields** and mildly conductive insulators



CEBAF 200 kV Gun



350 kV gun for GTS and UITF

Both designs, maximum field strength < 10 MV/m

Jefferson Lab: High Voltage (200-350 kV) Inverted Insulator Photo-guns

CEBAF 200 kV

Installed June 2018
(operates at 130kV until
an upgrade in 2020)

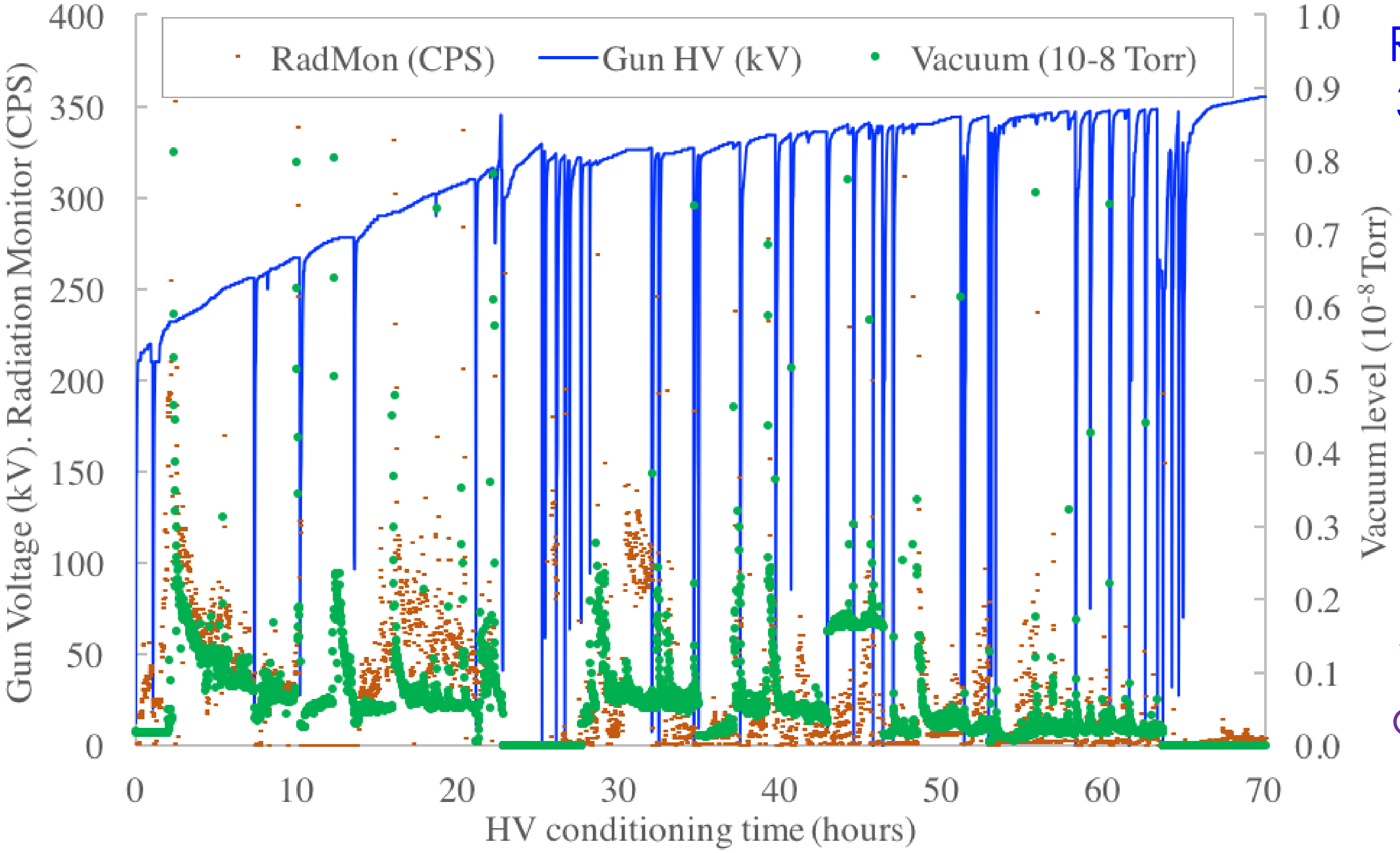
GTS 350 kV

In operation since Nov 2016
with CsK_2Sb photocathode

UITF 350 kV

Polarized Gun
Under assembly

Metric of Success: High Voltage without Field Emission



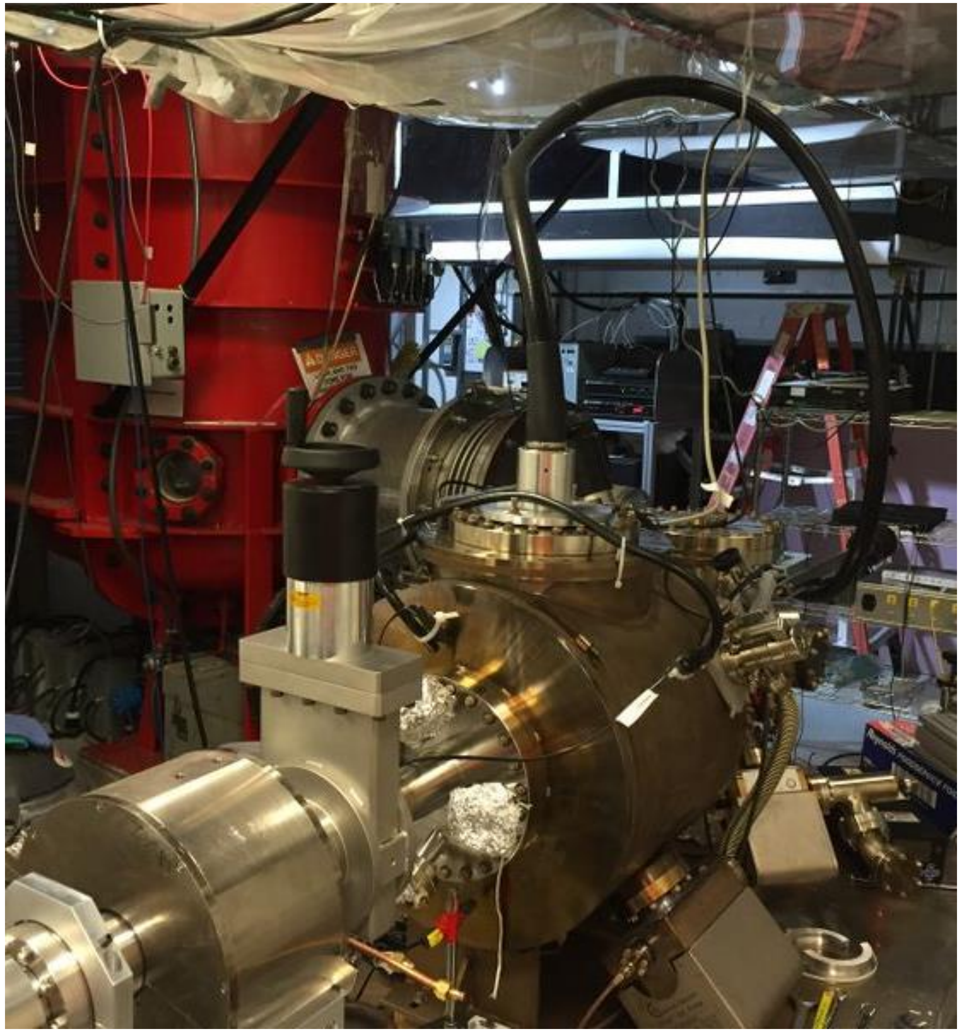
Reached 360 kV in 70 hours

10 MV/m at 350 kV

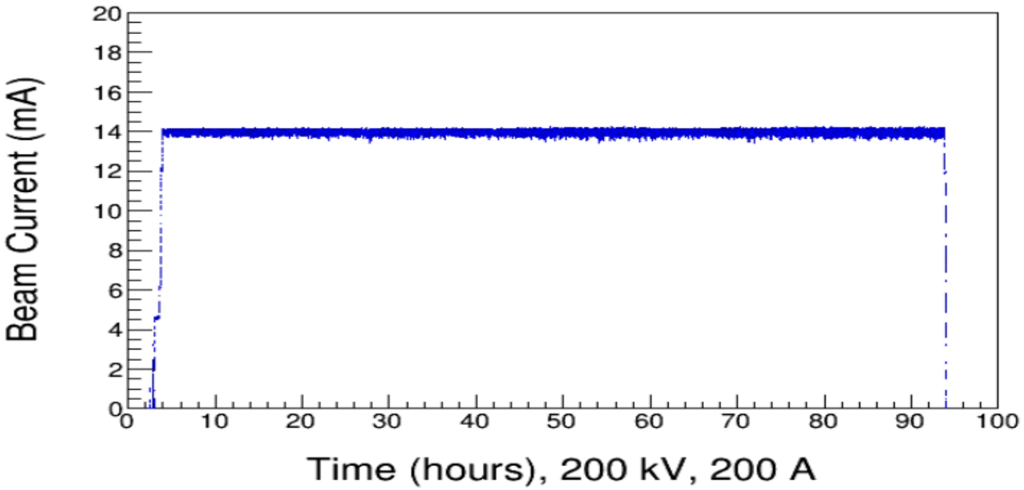
Vacuum and radiation levels indistinguishable from background at 350kV

Magnetized Beam Photogun at the Gun Test Stand (GTS)

Magnetized Beam LDRD, PI's: R. Suleiman and M. Poelker

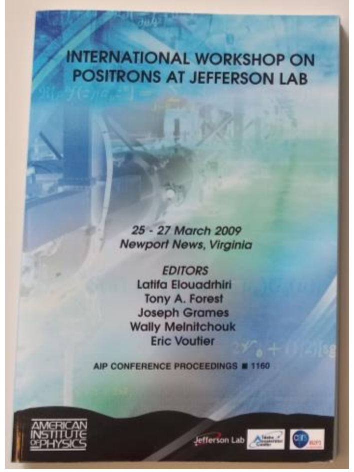


- Load-lock inverted insulator photo-gun (multiple photocathodes), **like CEBAF geometry**.
- **Cable connection** from HVPS to gun.
- Over **1000 hours operating >300kV**; HV conditioning about 1 week.
- Operating with CsKSb photocathodes at **>10 mA average current, and 0.7nC bunch charge.**



Roadmap: Jefferson Lab

JPos'09
(2009)



INTERNATIONAL WORKSHOP ON
POSITRONS AT JEFFERSON LAB

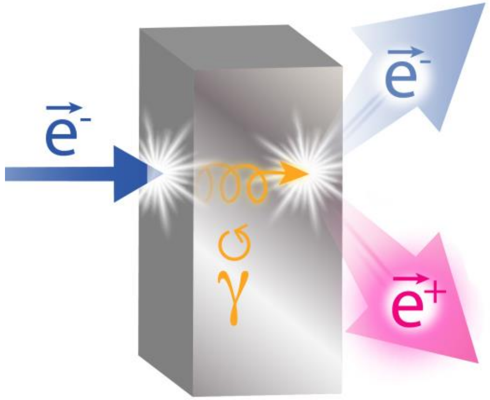
25 - 27 March 2009
Newport News, Virginia

EDITORS
Latifa Elouadrhiri
Tony A. Forest
Joseph Grames
Wally Melnitchouk
Eric Voutier

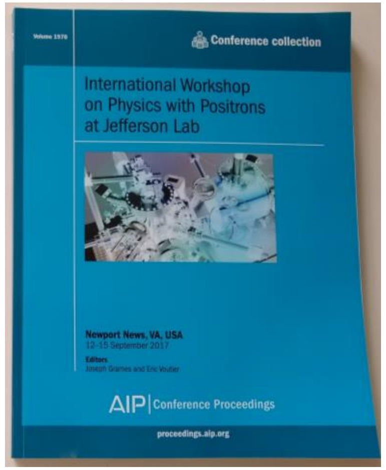
AIP CONFERENCE PROCEEDINGS ■ 1160

AMERICAN INSTITUTE OF PHYSICS

PEPPo
(2012-2015)



JPos'17
(2017)



Volume 1970

Conference collection

International Workshop
on Physics with Positrons
at Jefferson Lab

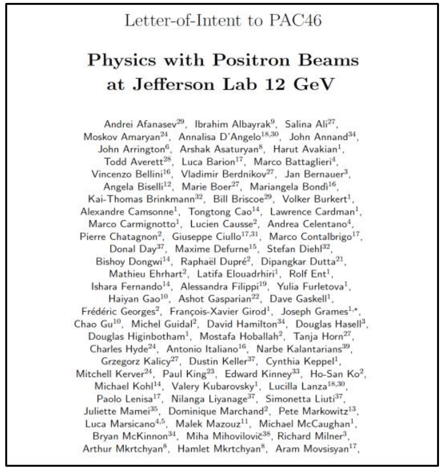
Newport News, VA, USA
12–15 September 2017

Editors
Joseph Grames and Eric Voutier

AIP | Conference Proceedings

proceedings.aip.org

LOI-12-18-004
(2018)



Letter-of-Intent to PAC46

Physics with Positron Beams
at Jefferson Lab 12 GeV

Andrei Afanasev[29], Ibrahim Albayrak[9], Salina Ali[27],
Moskov Amaryan[24], Annalisa D'Angelo[18,30], John Annand[34],
John Arrington[6], Arshak Asaturyan[8], Harut Avakian[1],
Todd Averett[28], Luca Barion[17], Marco Battaglieri[4],
Vincenzo Bellini[16], Vladimir Berdnikov[27], Jan Bernauer[3],
Angela Biselli[12], Marie Boer[27], Mariangela Bondì[16],
Kai-Thomas Brinkmann[32], Bill Briscoe[29], Volker Burkert[1],
Alexandre Camsonne[1], Tongtong Cao[14], Lawrence Cardman[1],
Marco Carmignotto[1], Lucien Causse[2], Andrea Celentano[4],
Pierre Chatagnon[2], Giuseppe Ciullo[17,31], Marco Contalbrigo[17],
Donal Day[37], Maxime Defurne[15], Stefan Diehl[32],
Bishoy Dongwi[14], Raphaël Dupré[2], Dipangkar Dutta[21],
Mathieu Ehrhart[2], Latifa Elouadrhiri[1], Rolf Ent[1],
Ishara Fernando[14], Alessandra Filippi[19], Yulia Furletova[1],
Haiyan Gao[10], Ashot Gasparian[22], Dave Gaskell[1],
Frédéric Georges[2], François-Xavier Girod[1], Joseph Grames[1,*],
Chao Gu[10], Michel Guidal[2], David Hamilton[34], Douglas Hasell[3],
Douglas Higinbotham[1], Mostafa Hoballah[2], Tanja Horn[27],
Charles Hyde[24], Antonio Italiano[16], Narbe Kalantarians[39],
Grzegorz Kalicy[27], Dustin Keller[37], Cynthia Keppel[1],
Mitchell Kerver[24], Paul King[23], Edward Kinney[33], Ho-San Ko[2],
Michael Kohl[14], Valery Kubarovsky[1], Lucilla Lanza[18,30],
Paolo Lenisa[17], Nilanga Liyanage[37], Simonetta Liuti[37],
Juliette Mamei[35], Dominique Marchand[2], Pete Markowitz[13],
Luca Marsicano[4,5], Malek Mazouz[11], Michael McCaughan[1],
Bryan McKinnon[34], Miha Mihovilovič[38], Richard Milner[3],
Arthur Mkrtchyan[8], Hamlet Mkrtchyan[8], Aram Movsisyan[17],

- Based upon preliminary simulations that suggest a CW polarized positron source can be built to meet the CEBAF requirements, a **conceptual design study report is now essential** to inform a plausible scheme that is integrated into the CEBAF program.

- The next R&D priorities include **designing, building and testing a positron beam collection system** to define/optimize useful positron phase space (6D+spin) and **assessing the performance of CEBAF for new positron beam conditions (magnet reversal, low intensity, 6D acceptance)**.

Summary

- Jefferson Lab Users are making the physics case for both high energy **polarized and unpolarized positron beams at CEBAF 12 GeV**.

- **PEPPo demonstrated high positron polarization from polarized electrons** at low energy w/ small footprint (cost, energy, radioactivity), extensible to high energy.

- We are exploring concepts to produce **positron beams for both CEBAF (CW, pC, mA)** and **JLEIC (pulsed, nC, μA) with tunability on intensity and polarization.**

- Recent progress is promising to develop a **350 kV polarized source based on the inverted insulator geometry** necessary for >nC bunch charge.

- Can the PEPPo concept applied to the ILC electron driven positron source **turn a "no polarization" scheme into a "polarization scheme"**, even for a later upgrade?