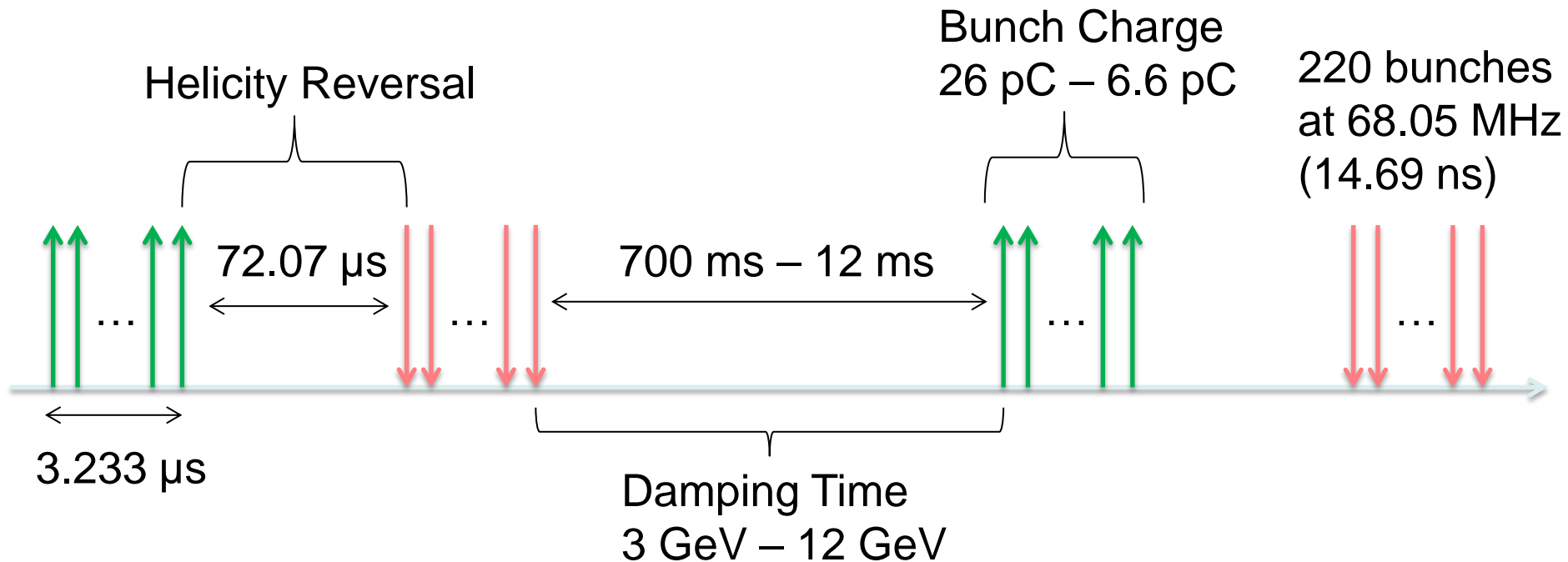


MEIC Polarized Electron Source

April 29, 2015

MEIC Polarized Source



- Pockels cell switching time at CEBAF today $\sim 70 \mu\text{s}$. Planned for Moller Exp. $\sim 10 \mu\text{s}$
- Bunch charge 72 x larger than typical CEBAF, 20 x greater than G0 – Expect to use a gun operating at higher voltage
- 68.05 MHz pulse repetition rate not be a problem for gun, maybe for LINACs
- We are not considering simultaneous beam delivery to fixed target halls, using typical CEBAF beam
- Message: MEIC polarized source requirements do not pose significant challenges

Source Parameter Comparison

Parameter	JLab/FEL	CEBAF	EIC MEIC	EIC eRHIC	Cornell ERL	LHeC	CLIC	ILC
Polarization	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Photocathode	Bulk GaAs	GaAs / GaAsP			K ₂ CsSb			
Width of microbunch (ps)	35	50	50	100	2	100	100	1000
Time between microbunches (ns)	13	2	14.69	106	0.77	25	0.5002	337
Microbunch rep rate (MHz)	75	499	68.05	9.4	1300	40	1999	3
Width of macropulse	-	-	3.233 μ s	-	-	-	156 ns	1 ms
Macropulse repetition rate (Hz)	-	-	2x83	-	-	-	50	5
Charge per microbunch (pC)	133	0.36	26	5300	77	640	960	4800
Peak current of microbunch (A)	3.8	0.008	0.52	53	38.5	6.4	9.6	4.8
Laser spot size (cm, diameter)	0.5	0.1	0.3	0.6	0.3	0.5	1	1
Peak current density (A/cm ²)	19	1	7.4	188	500	32	12	6
Average current from gun (mA)	10	0.2	0.001	50	100	25	0.015	0.072

Proposed

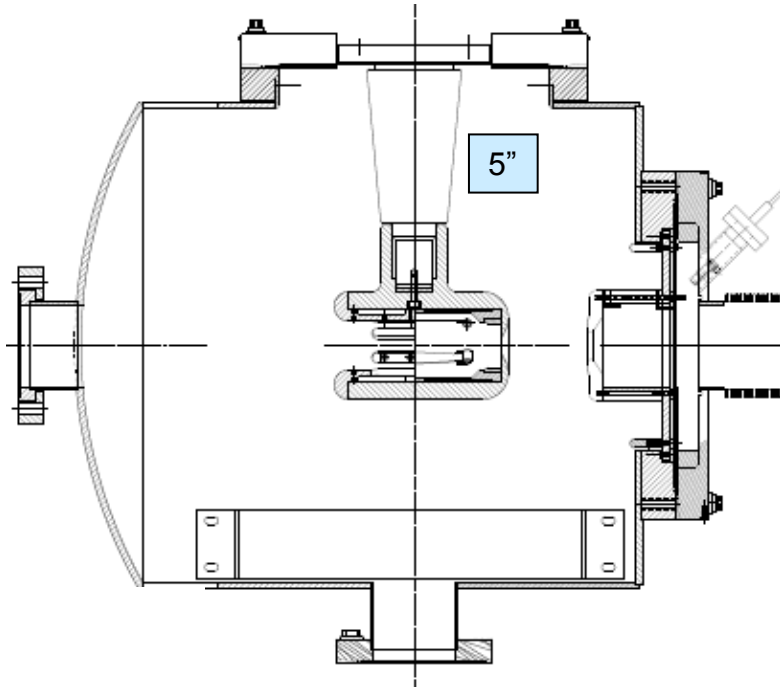
* Unpolarized: Bulk GaAs (Cs,F), K₂CsSb, Na₂KSb, ...
Polarized: GaAs/GaAsP (Cs,F).

Addressing MEIC Bunch Charge

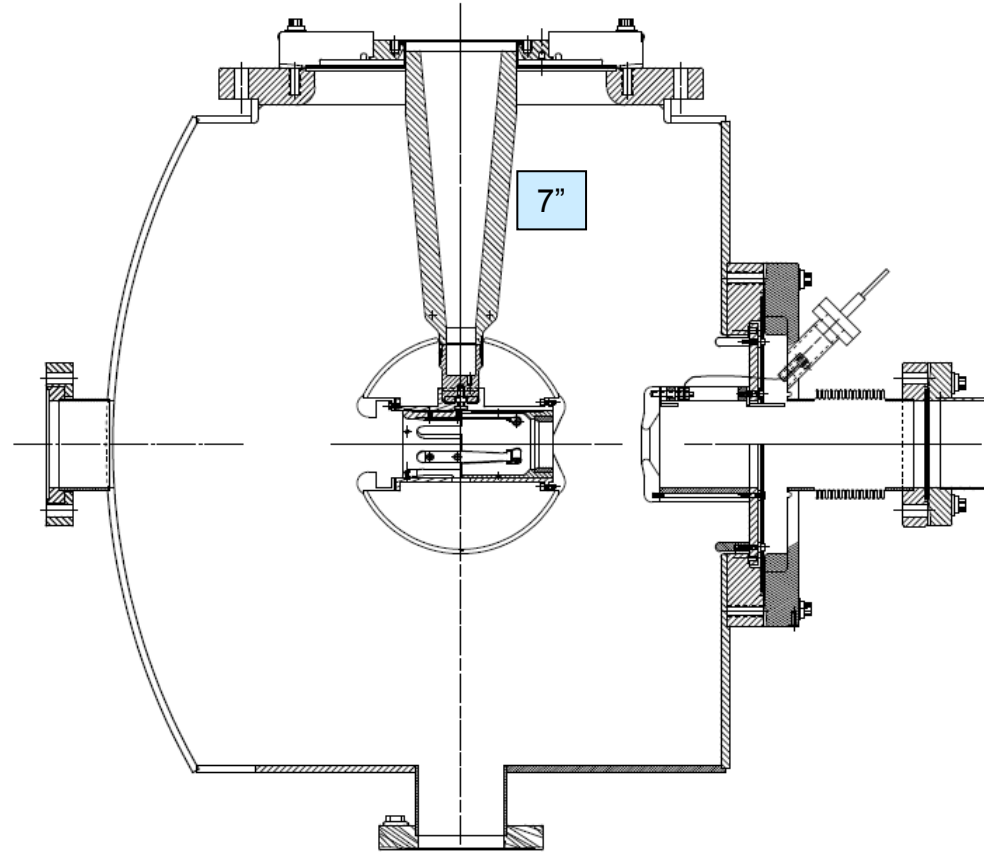
20 to 72 times larger than CEBAF

- I. Larger Laser Size (reduces space-charge emittance growth and suppresses surface charge limit)
- II. Higher Gun Voltage:
 - Reduce space-charge emittance growth, maintain small transverse beam profile and short bunch-length; clean beam transport
 - Compact, less-complicated injector
- III. To accelerate large bunch charge in CEBAF: use RF feedforward system for C100 cryomodules

JLab 500 kV Inverted Gun



200 kV Inverted Gun



- Longer insulator
- Spherical electrode