Performance of S-band Photocathode RF-gun with Coaxial Coupler

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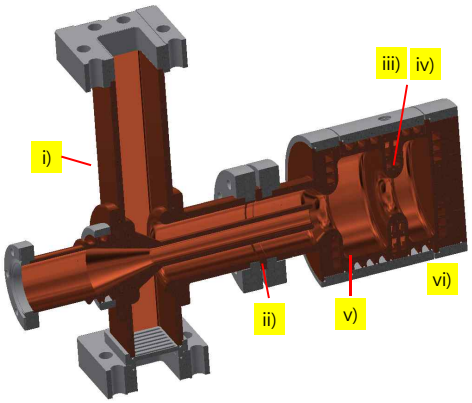
Abstract

To improve the characteristics of electron beams, new S-band photocathode RF gun with a coaxial coupler has been developed and fabricated at the Pohang Accelerator Laboratory (PAL). This new RF gun is improved the field symmetry inside a cavity cell by applying the coaxial coupler, and the cooling performance by improving the cooling lines. The RF gun is installed in the injector test facility (ITF) for high power rf test. This paper reports the recent results on the RF conditioning process and the beam tests of the rf gun with high power rf at ITF. We present and discuss the measurement results of the basic beam parameters.

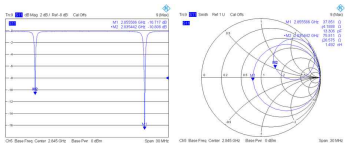
Coaxial Coupler Type RF-gun

i) Coaxial coupler: Axisymmetric E-field, To eliminate the high-order fields
ii) Gasket between Gun&Coupler: To adjust coupling coefficient
iii) Large coupling iris radius and short coupling iris length: To increase 0 and π-mode separation
iv) Elliptical iris: To reduce the surface E-field
v) Rounded cell edge: To increase the quality factor, To decrease the thermal stress
vi) Modified Cooling channels: To be uniform the RF heating



*(#): Design Value

Property	Coaxial Type
Frequency [MHz]	2856
Mode Separation [MHz]	20
β	1.1 (1±α)
Q	14400
Repetition rate [Hz]	10 (1000)
Maximum Field Gradient @ Cathode [MV/m]	130 (120)

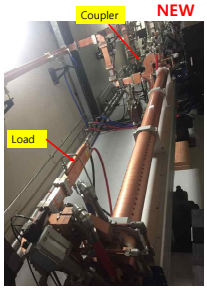


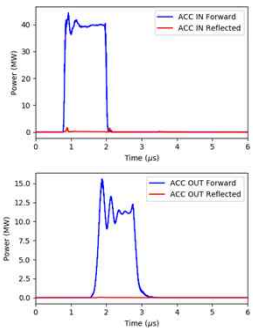
ITF Setup & Performance

Accelerating Column (ACC)

Dual-feed racetrack type

NEW

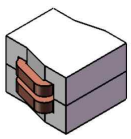




P_{max} = 40 MW
$f_{rep.}$ = 10 Hz
τ_{pulse} = 1.2 μS

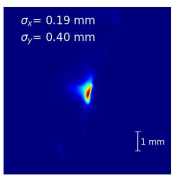
Energy Spectrometer

Dipole Magnet (DM)



RADIABEAM
135 MeV Dipole (30 °)

Screen Monitor (S3)

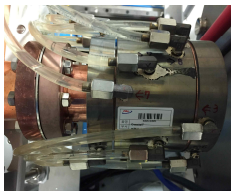


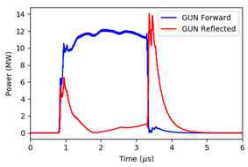
U = 70 MeV
ΔU < 0.1 %

GUN

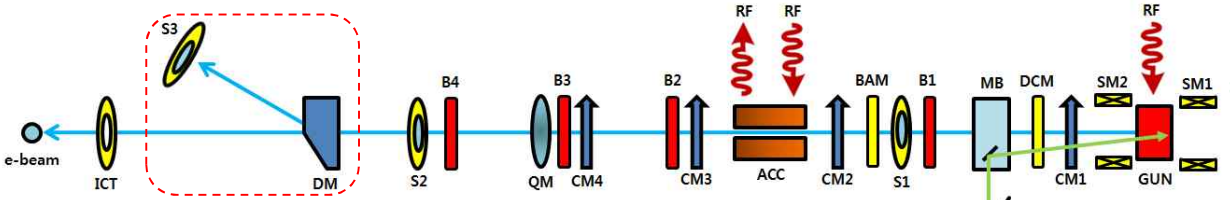
Coaxial coupler type

NEW



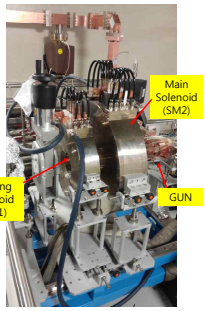


P_{max} = 12 MW
$f_{rep.}$ = 10 Hz
τ_{pulse} = 2.5 μS



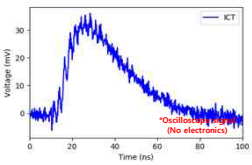
Solenoid Magnet (SM)

NEW



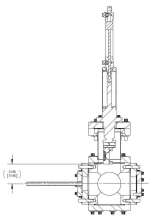
Integrating Current Transformer (ICT)

BERGOZ
ICT-CF4.5

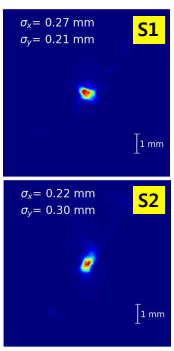


Q = 200 pC
QE = 4.5x10^{-5}

Screen Monitor (S1 & S2)



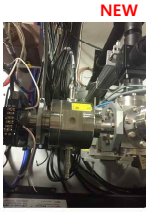
RADIABEAM
Yag:Ce
Φ25.4 mm x
X 100 μm



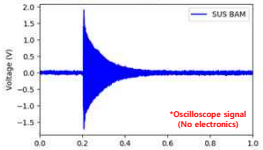
Bunch Arrival-time Monitor (BAM)

SUS Material type

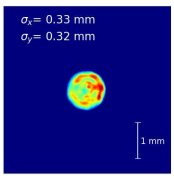
NEW



f = 2826 MHz
β = 0.25
Q_0 = 1120
Q_L = 760
τ_L = 40 ns

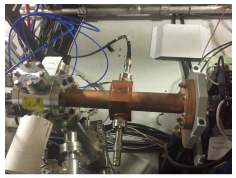


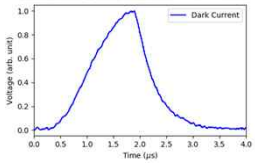
UV Laser



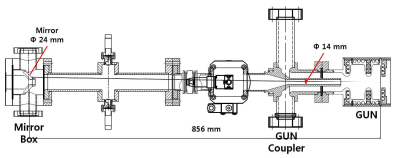
P_{laser} = 20 μJ
σ_T = 3 pS (FWHM)

Dark Current Monitor (DCM)





***Top view (from gun to laser mirror box)**



Difficult laser transmission → "Laser Mirror Box" will be modified

1st Electron generation by Coaxial Coupler Type RF-gun at PAL

Parameter	Value	Unit
Electron Beam	**(GUN / GUN+ACC)**	
Energy	6 (estimate) / 70	MeV
Energy Spread	- / 0.1	% (rms)
Charge	200	pC

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Parameter	Value	Unit
RF	**(GUN / ACC)**	
Peak power	12 / 40	MW
RF-pulse Width	2.5 / 1.2	μs
Repetition Rate	10	Hz
Laser		
Spot size	0.32	mm (rms)
Pulse Length	3	ps (FWHM)
Pulse energy	20	μJ

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