A Polarized SRF Gun for ILC

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Opportunity

- To date only DC guns have been used to provide polarized electron beams because of the high vacuum required for Gallium Arsenide (GaAs) cathode material.
- An RF gun capable of producing polarized electron beams may eliminate the need for the electron beam emittance damping ring planned for the International Linear Collider (ILC).
- A Superconducting RF gun cavity may provide the vacuum required for GaAs by the cryopumping of the SRF cavity walls.
SBIR Work Plans

• Design and manufacture hardware in support of experiments to process and test cesiated GaAs cathode material in an SRF gun environment.

• Develop conceptual design of a SRF gun/cathode system that incorporates a solenoid magnetic field on the GaAs cathode that would allow the generation of a flat beam (transverse).
Experiment Setup Hardware

- Gallium Arsenide cathode process system
  - GaAs cathode heating
  - GaAs cathode cesiation
  - In-situ quantum efficiency measurement
  - $10^{-11}$ scale vacuum
- Cathode transport system
  - Magnetically coupled motion feed through
  - Load-lock capabilities with process system and SRF cavity
  - Detachable cathode arrangement
- SRF cavity
  - 1.3 GHZ cavity with receptacle for cathode plug insertion
  - Cathode clamp mechanism
- Experiment Setup
  - Vertical test dewar
  - Beam pipe with NEG plenum
  - High temperature superconducting solenoid.
  - Bend magnet
  - Beam profiling
  - Faraday cup
Process Chamber System

- **GaAs on cathode tip**
- **Ports for:**
  - cesium source
  - laser
  - leak valve
  - vacuum gauge
  - Inst. Feed thru
- **Heater Block**
- **Electrical Isolator**
- **Stalk heater**
- **Cathode Plug inside heater block**
- **Process chamber**
  - 270 l/s Ion pump with TSP
- **Load-lock Pump**
- **Cathode transporter with pump**
- **All-metal gate valves**
Process Chamber System

Magnetically Coupled Transporter and Valve

Process System
Cathode Transport

Cathode transporter coupled with process chamber

Cathode transporter coupled with cavity hermetic string

Transporter hardware (ion pump not shown)
Cathode Plug Arrangement

- Stainless steel flange
- Catode socket
- ∅4mm cathode tip
- ¼-Turn release holder
- Niobium cathode Plug
- RF seal face
- Niobium cavity
Cavity Configuration

Cathode Plugs

Cavity Assembly
Cathode Clamp Arrangement

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- SRF cavity
- Clamp linkage (outside BL vacuum)
- Clamp spring
- Vacuum bellows
- Cathode
- Clamp fork
Cathode Clamp
Experiment Arrangement

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Faraday cup

Beam profile & Vacuum instruments (not shown)

NEG cartridge

HTS Solenoid

RF input/pickup

Cathode load lock valve

Ion pump

Laser port

Bend magnet

Pressure relief

Cryostat cover assembly

NEG plenum

Electrical break

SRF cavity with cathode clamp

Cryostat

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Experiment Hardware

Dewar

1st Hermetic Assembly

HTS Solenoid
Experiment Status

- Design work of process chamber system, cathode transporter, and SRF cavity experiment setup is complete
- Much of the hardware fabrication is complete
- Assembly of process system and experiment setup has begun
- Initial tests of gun without cathode completed
- Work to continue to support tests in FY09