The NPS SRF Photoinjector

John W. Lewellen
for the NPS-FEL Team

Naval Postgraduate School
Monterey, CA 93943
Acknowledgements & Thanks

• NPS-FEL Team: Joe Blau, Keith Cohn, Bill Colson, John Harris, Brian Rusnak, Todd Smith, Rich Swent,

• Collaborators: Mark Curtin, Terry Grimm, Bill Graves, Bob Legg

• Too many people to mention individually at Argonne, Boeing, JLab, LANL, Niowave

• Meeting organizers

• The Office of Naval Research
• The High-Energy Laser Joint Technology Office
Outline

• What is the NPS SRF Photoinjector?
• Why are we building it?
• What is it supposed to do?
• What is the present status?
• Where are we going with this?
What is this thing?
Why are we building it?

• *Prototype* of a 500-MHz quarter-wave cavity SRF photoinjector

• Why a quarter-wave structure?
  – High transit-time factor (~λ/7 gap)
  – High on-cathode gradient for exit beam energy
  – Compact size for resonant frequency

• Why a prototype?
  – At lower cost:
    • Validate the beam dynamics
    • Learn the design “gotcha!”s
  – Reduce the development cycle time (1 year concept-to-RF)
What Does “Prototype” Mean?

- No cavity tuners – close, but not right on, 500 MHz
- Small He volume – have to refill frequently, or use an external tank
- Metal cathode, no load-lock
- “Simple” on-axis power coupler & cathode stalk designs
- Low average beam power (100-W RF source)
Expected performance
Beam Voltage vs. Launch Phase

High transit-time factor + high on-cathode gradient

Good platform for novel cathode testing, e.g. field emitters
What’s the Present Status?

- We have had two runs at Niowave so far
  - cathode not installed
  - up to ~ 700 kV gap voltage
  - made runs at reduced temperature: behavior as expected

- Beamline under construction

- Preparing for 1ˢᵗ runs with cathode stalk installed
What’s the Eventual Goal?

- Source for exploring nC-range bunch charge dynamics in compact ERL lattices
  - merge optics
  - CSR studies
  - halo formation

- Flexible platform for cathode testing

- Driver / beam source for cavity characterization

- 10-mA NPS-FEL Linac Injector
  - 10 pC – 1 nC bunch charge @ up to 100 MHz
Project Pathway

Prototype Mk. I
- single-bunch
- not tunable
- no loadlock

NPS-FEL Source Mk. II
- 1 – 10 mA
- tunable
- loadlock

NPS-FEL Source Mk. I mod A
- 1 – 10 mA
- tunable
- loadlock

Build
New
Rebuild
Upgrade