The NPS SRF Photoinjector

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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

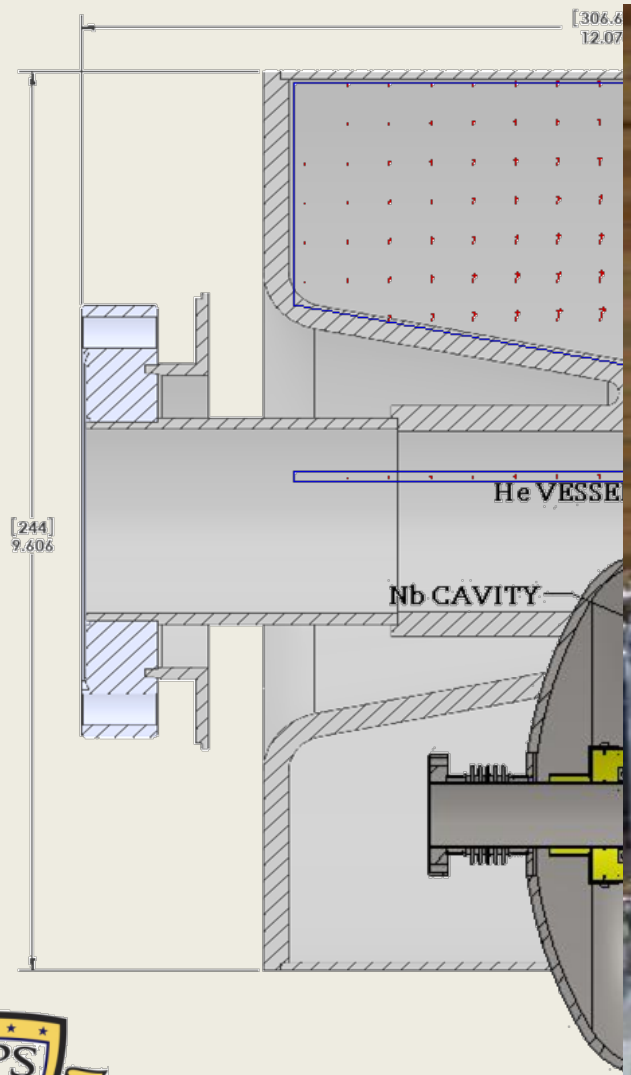
- Meeting organizers

- 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

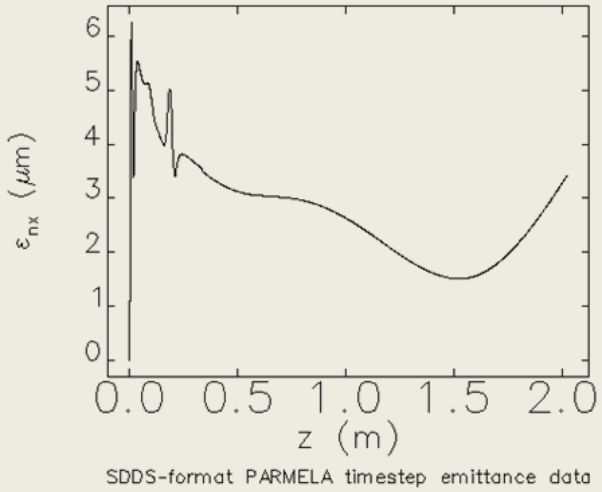
- Why a quarter-wave structure?
  - High transit-time factor ($\sim\lambda/7$ gap)
  - High on-cathode gradient for exit beam energy
  - Compact size for resonant frequency

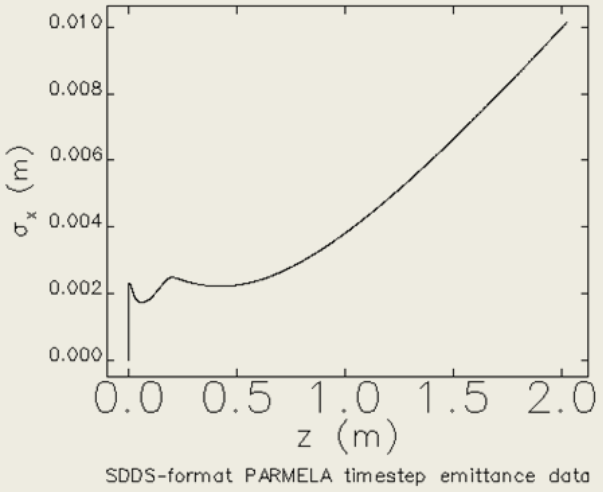
- Why a prototype?
  - At lower cost:
    - Validate the beam dynamics
    - Learn the design “gotcha!”s
  - Reduce the development cycle time (1 year concept-to-RF)

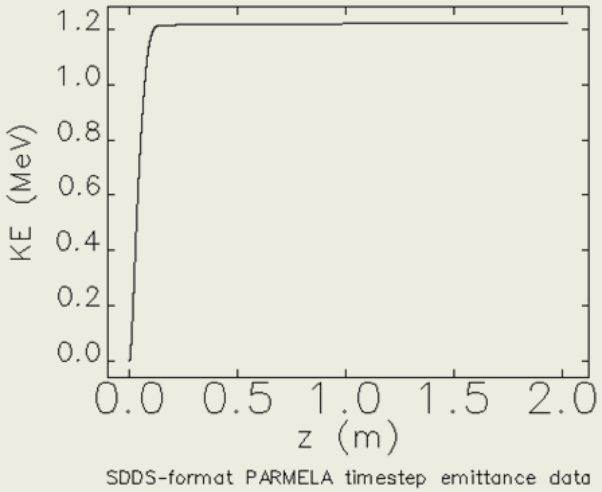
What Does “Prototype” Mean?

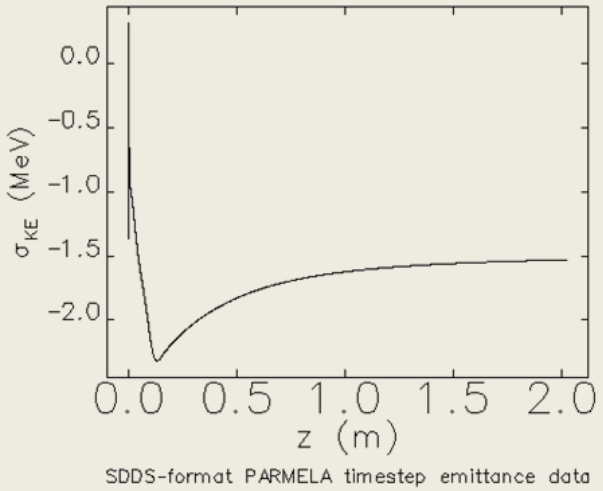
- No cavity tuners – close, but not right on, 500 MHz
- Small He volume – have to refill frequently, or use an external tank
- Metal cathode, no load-lock
- “Simple” on-axis power coupler & cathode stalk designs
- Low average beam power (100-W RF source)

Expected performance

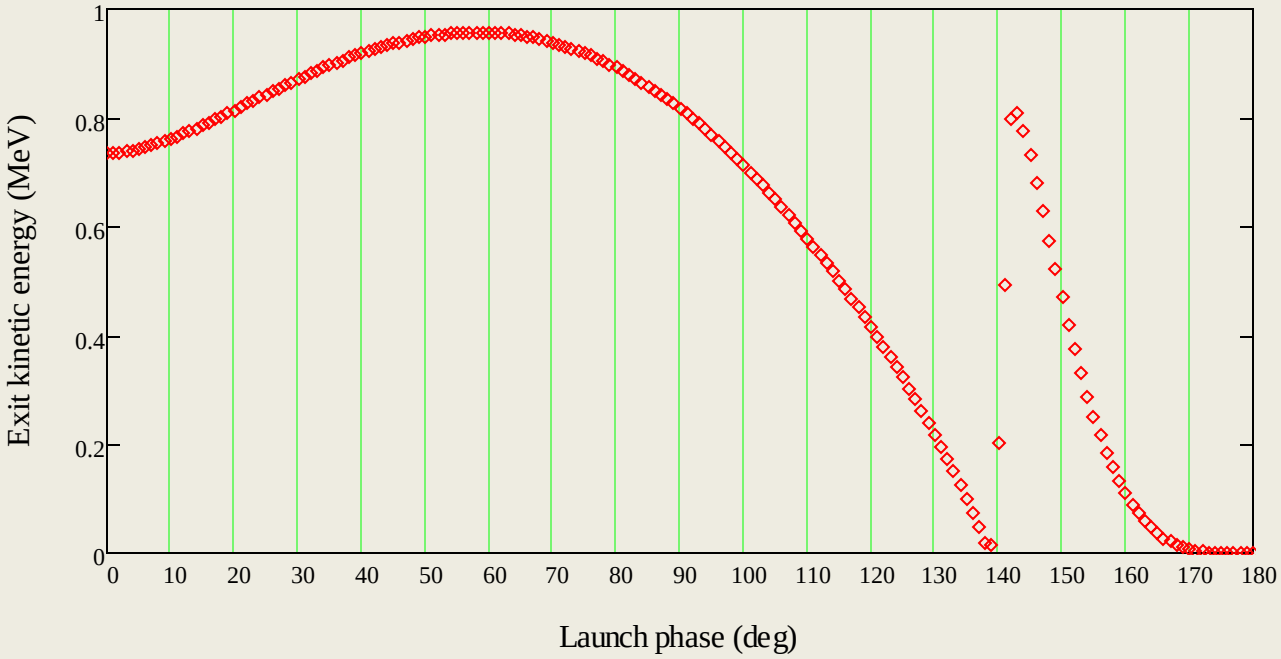








Beam Voltage vs. Launch Phase

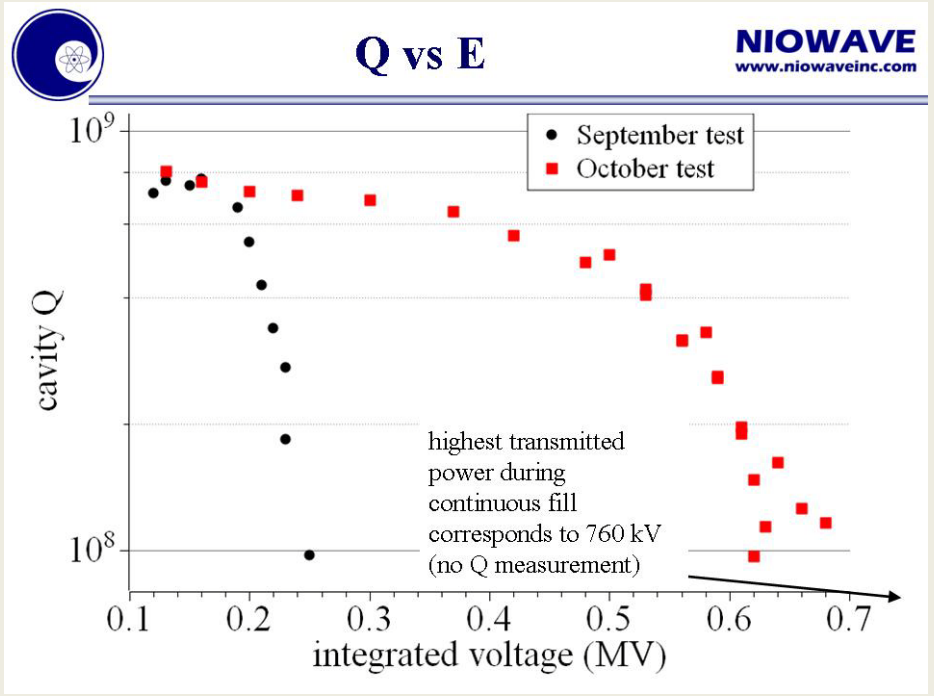


High transit-time factor + high on-cathode gradient

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

build new

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

upgrade / rebuild

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