Test Facilities

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SLAC

Summary of SLAC Facilities

- NLCTA (3 RF stations, one Injector, one Radiation shielding)
  - Two 240ns pulse compressor, 300 MW peak, powered by two X-band 50 MW klystrons
  - One 400 ns/200 ns, variable pulse length pulse compressor, 300MW/500 MW peak, powered by 2 X-band 50 MW klystrons
  - 65 MeV injector with a ~0.3 nC charge/bunch
  - Shielding enclosure suitable for up to 1 GeV
- Klystron Test Lab (4 RF stations, 4 modulators, 2 shielding enclosures)

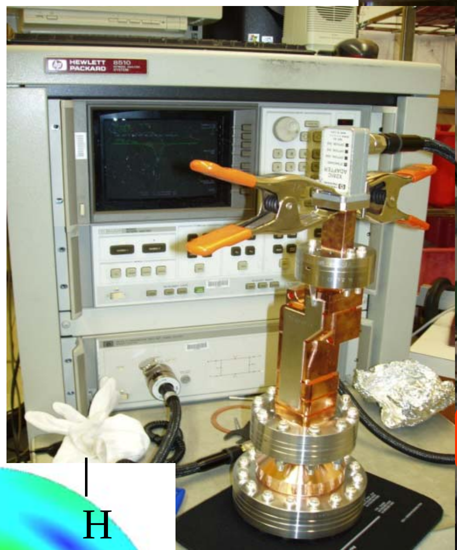
  RF Stations
  - ASTA:
    - Stations 6 and 8, two 50 MW klystrons that can be combined and 63ns/132ns/264ns-up to 1.5 us pulse compressor that can produce up to 550 MW at the smallest pulse length and 100 MW at the longest pulse length.
    - Shielding enclosure
    - Two experimental outputs (can run two experiments at the same time)
    - Second generation RF complements
    - Cost effective testing due to versatility and new design of a gate valve (original idea by Alexi Gudiev)
  - Station 4, 50 MW klystron:
    - Dedicated for testing standing wave accelerator structure
    - Has a stand alone shielding enclosure
  - Station 2, 50 MW klystron
    - Dedicated for pulsed heating testing
    - No sheilding

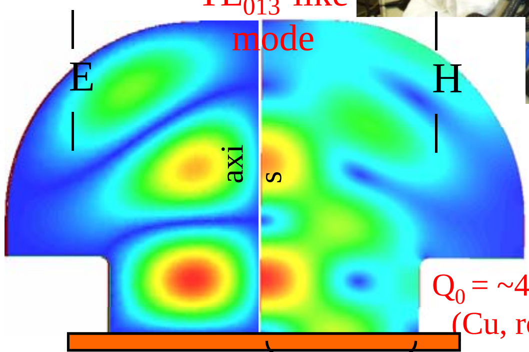
  Modulators
  - Station 1, ~500 kV, ~200 A modulator
  - Station 13, ~500 kV, ~200 A modulator
  - Station 3, 500 kV, ~xxx A modulator

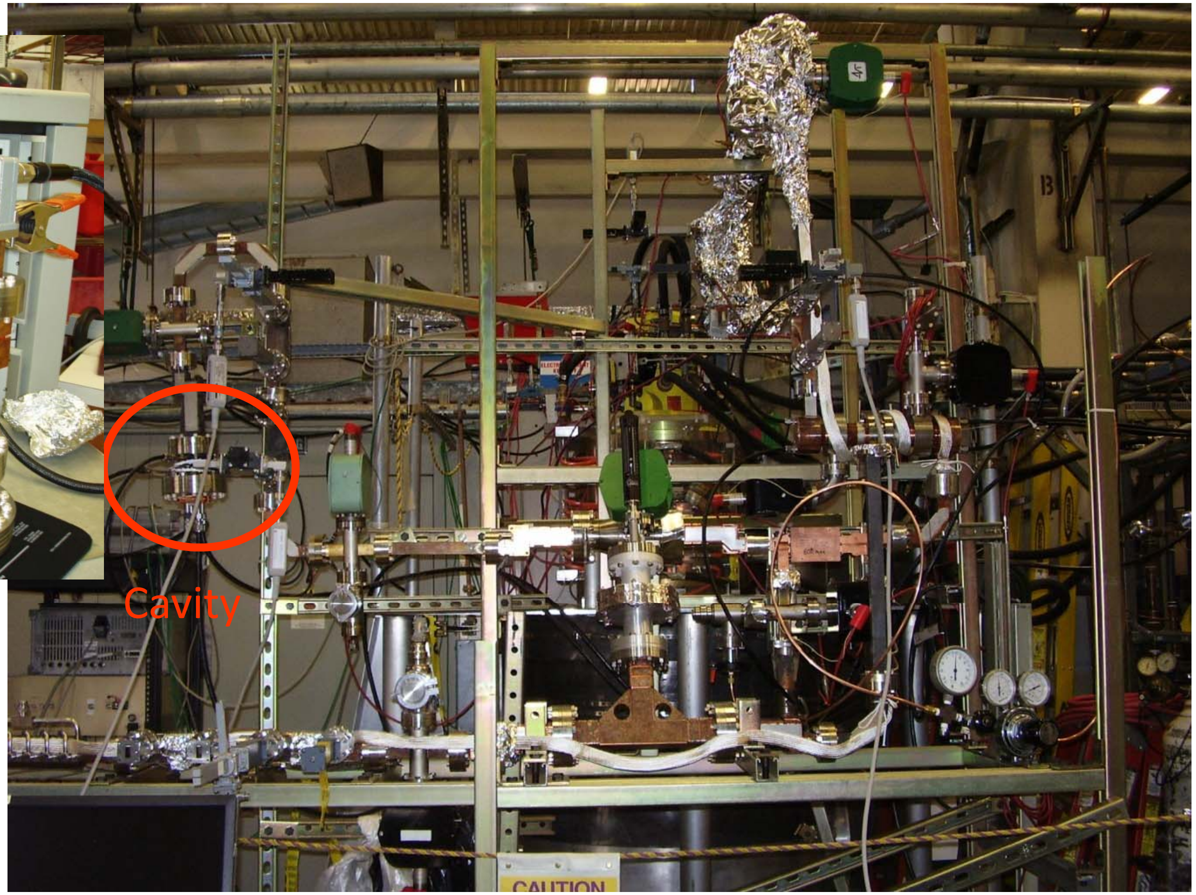
  Radiation Shielding
  - A shielding enclosure suitable for up to 100 MeV (ASTA Bunker)
  - A shielding enclosure suitable for up to 5 MeV (station 4)

Pulsed Heating Experiment

- Station 2 at the klystron test lab, a dedicated 50 MW Klystron station for material testing
- Will be retrofitted with a closed cycle cryocooler to be able to perform tests from room temperature to 4.2K



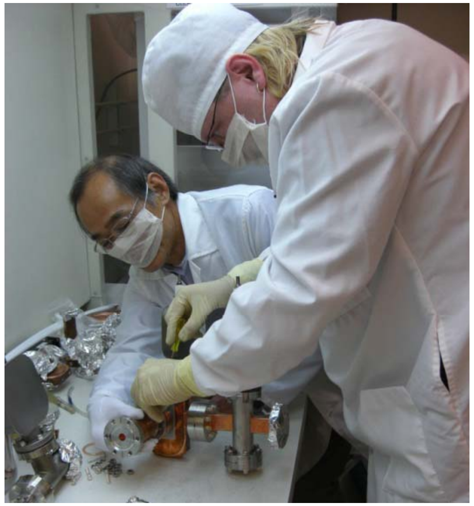




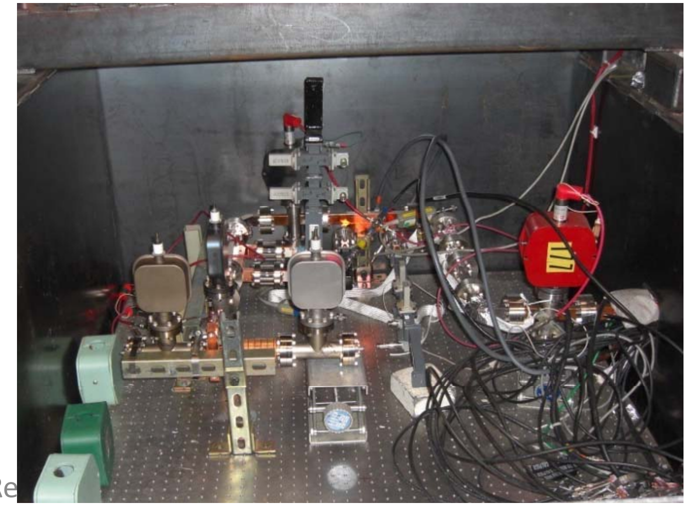
Standing-wave Accelerator Structure Testing

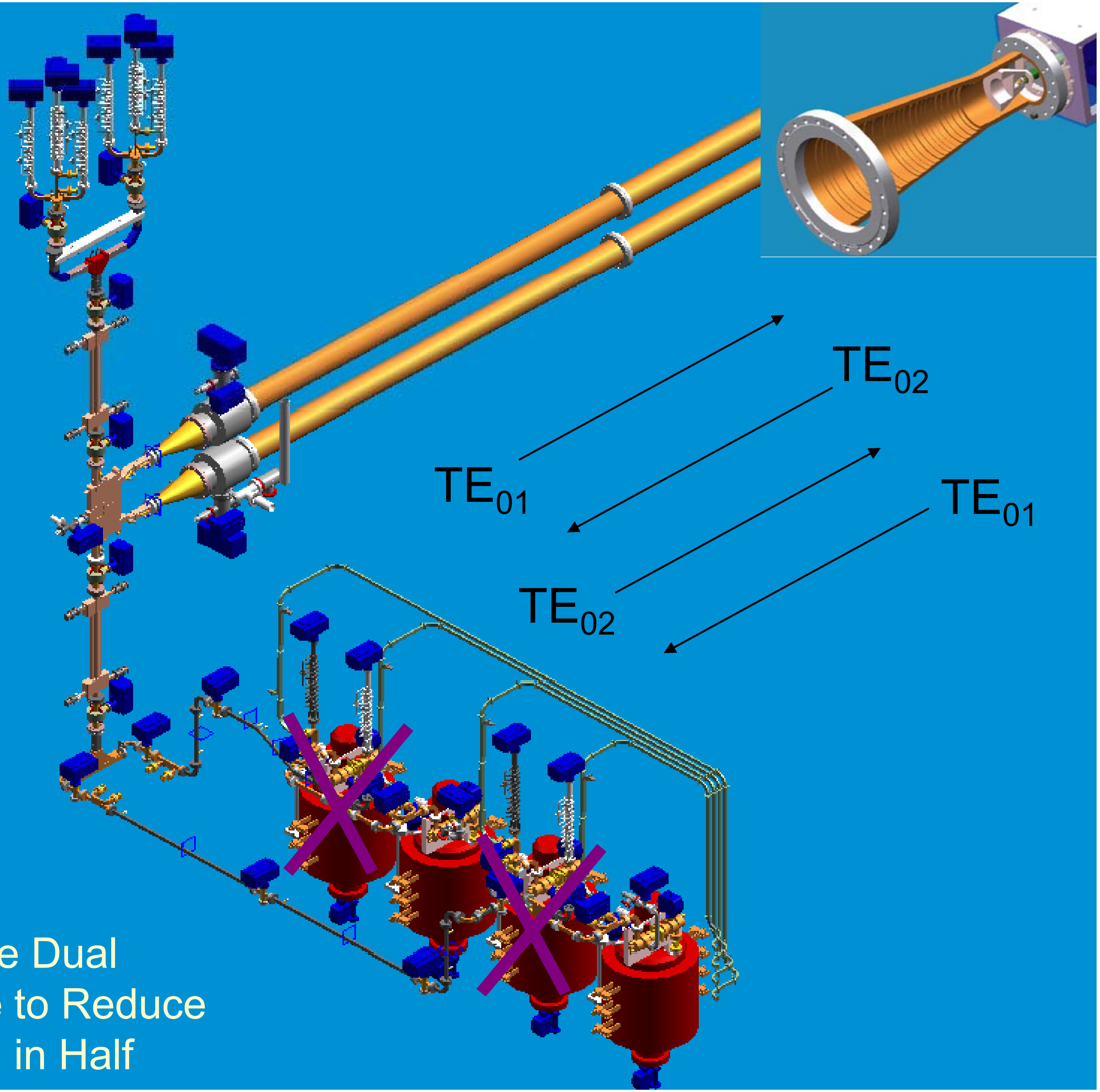
- A dedicated station with one 50 MW klystron
- A shielding enclosure built specially for testing short accelerator structure
- Very productive due to international participation(SLAC, KEK and frascatti structure testing program.

Dr. Yasuo Higashi and Richard Talley assembling Three-C-SW-A5.65-T4.6-Cu-KEK-#2



The structures are housed inside an a dedicated lead inside box suitable for up to 5 MeV

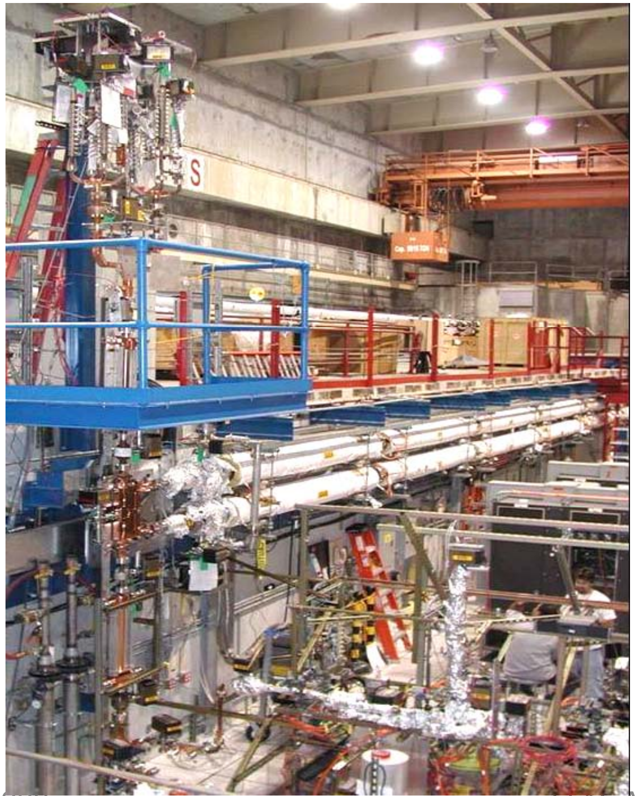




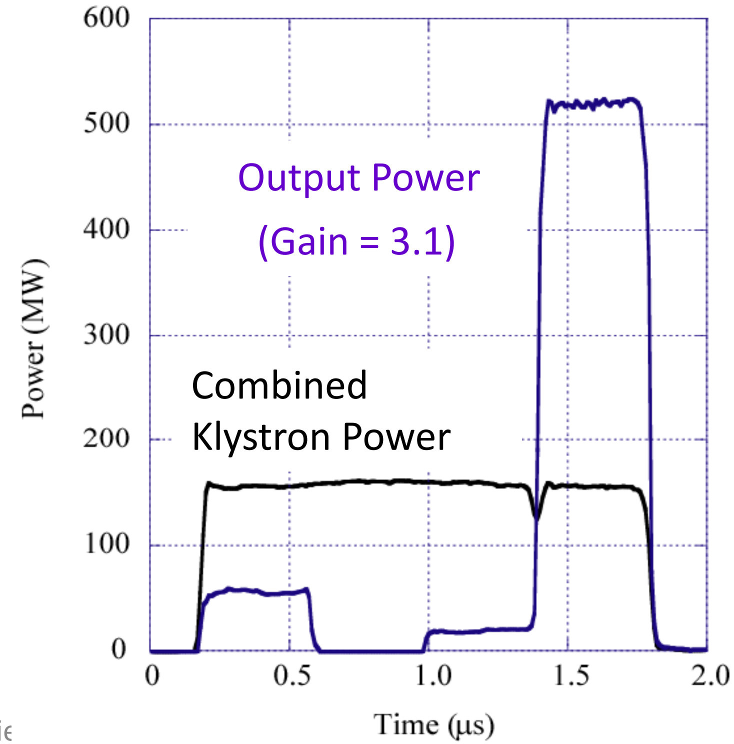
For NLC/GLC, Use Dual Moded Delay Line to Reduce Delay Line Length in Half

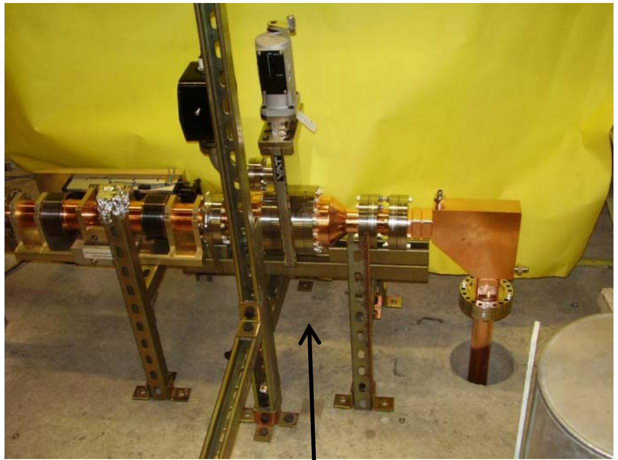
The Two-Pack/Dual-Moded SLED-II at NLCTA

- Has two X-band 50 MW klystrons
- Can feed accelerator structures inside the NLCTA enclosure
- The delay line were retrofitted with a variable mode converter to change the pulse length beween 400 to 200 ns.
- The input of the delay line have been changed to allow the insertions of active switches.
- Will be used for active pulse compression experiments during the next half a year, and then will become another station at NLCTA



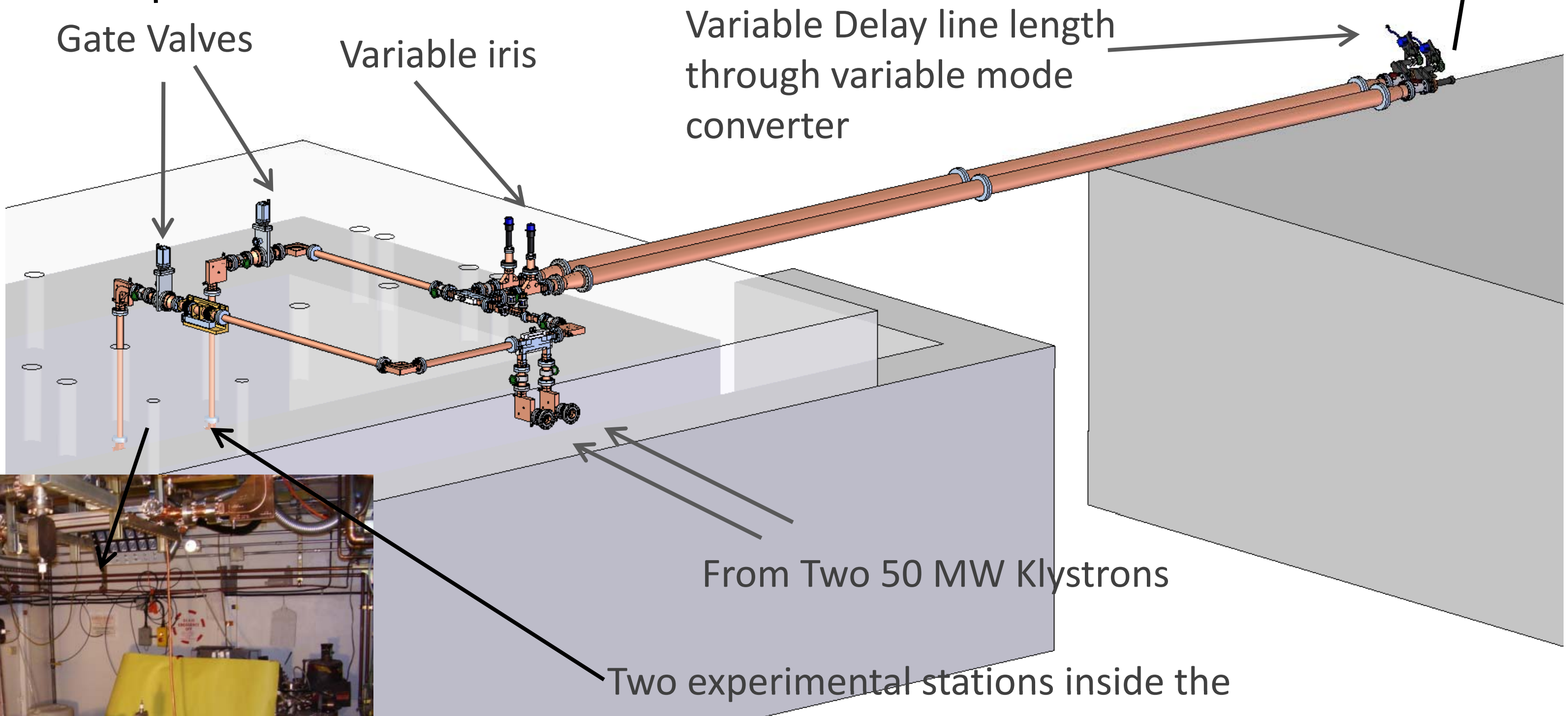
Pulse compressor already tested up to 500 MW

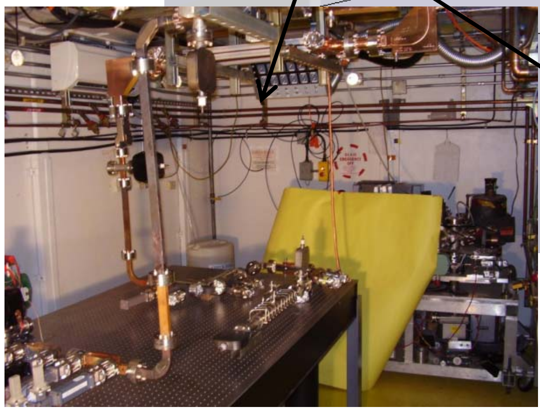




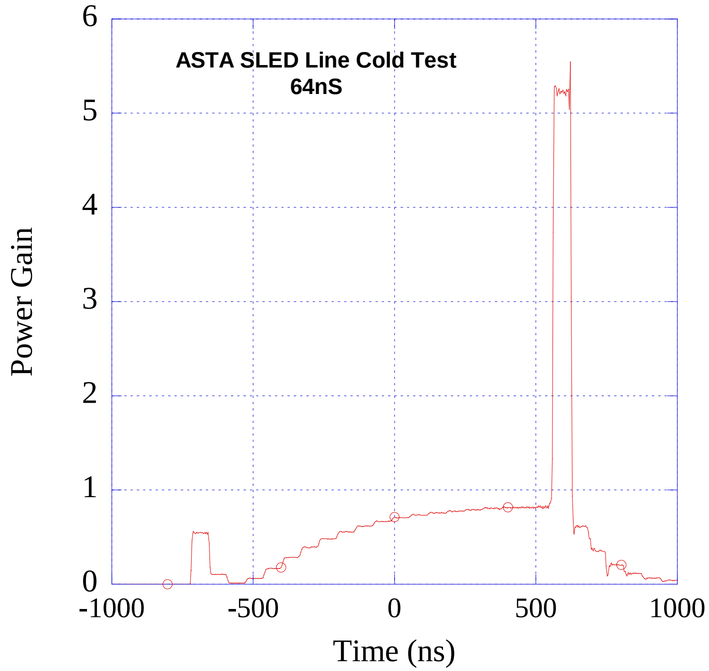
ASTA RF system

- Designed for economical testing of TW, SW accelerator structures, and waveguides.
- Versatile structure for future applications
- Will be retrofitted with an electron gun to test gradients within a year
- Wil find other applications and may be demanded for other applications (may be not related to high gradient work)

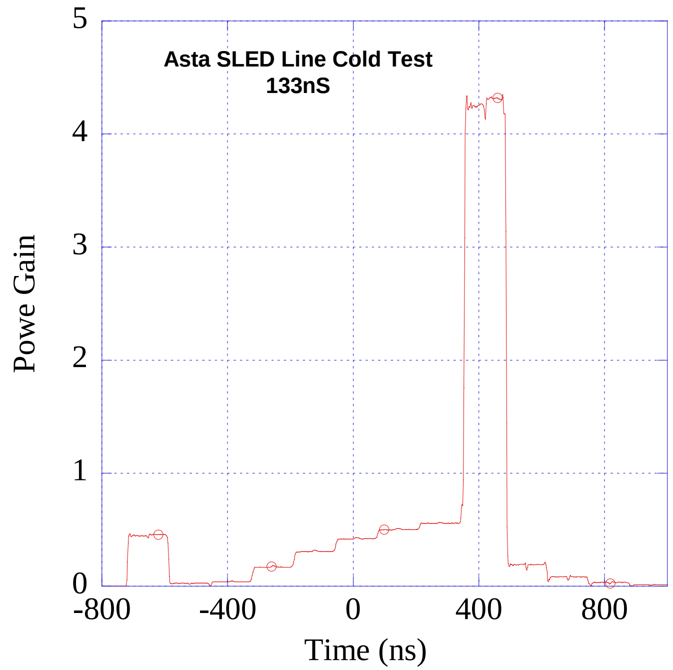




ASTA Pulse Compressor Cold Tests



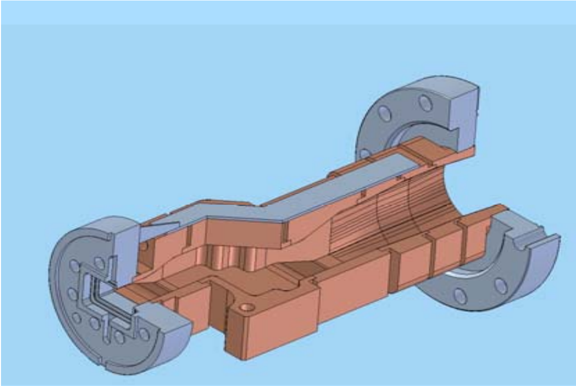
Test with a single mode in the delay line



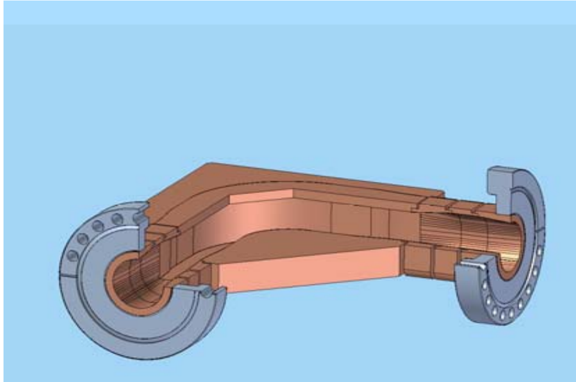
Test with a dual-mode in the delay line (the Miller cup is tuned for two modes)

With input pulse modulation one gets a gain of about 3 at 266 ns and a gain of about 2 at 399 ns

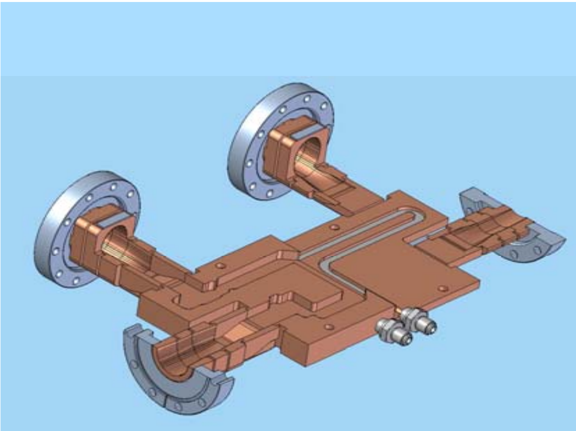
Ultra-Power RF Components



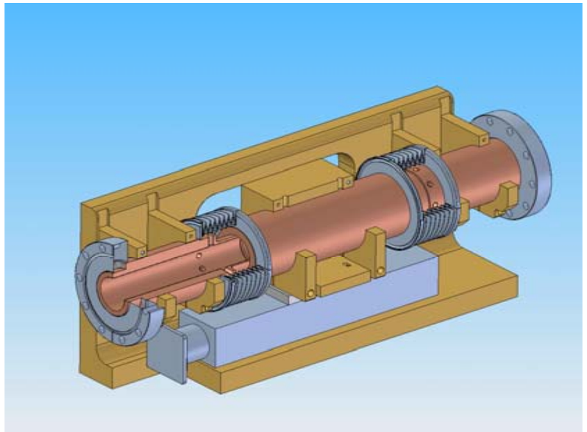
Te10 to TE01 Mode converter



TE01 over moded Bend

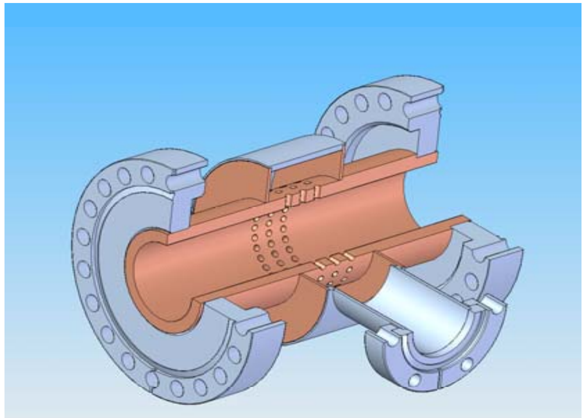


Overmoded 3dB hybrid

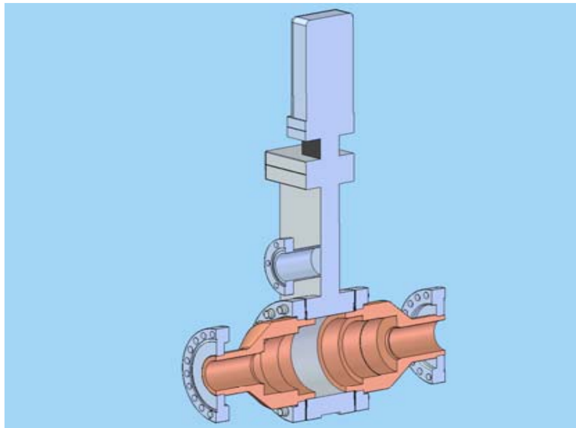


Phase Shifters

Vacuum RF Components

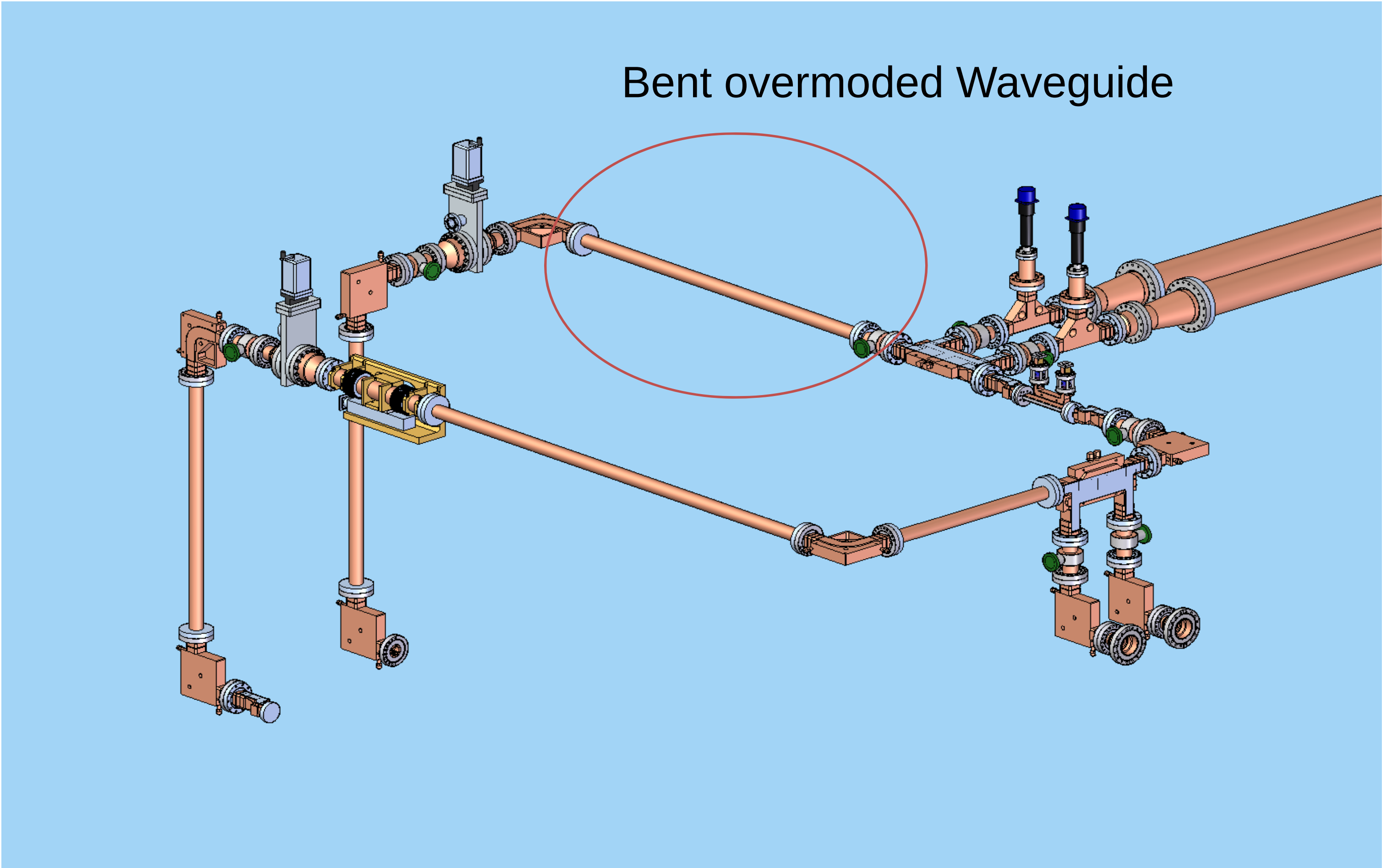


TE01 mode Pump-out

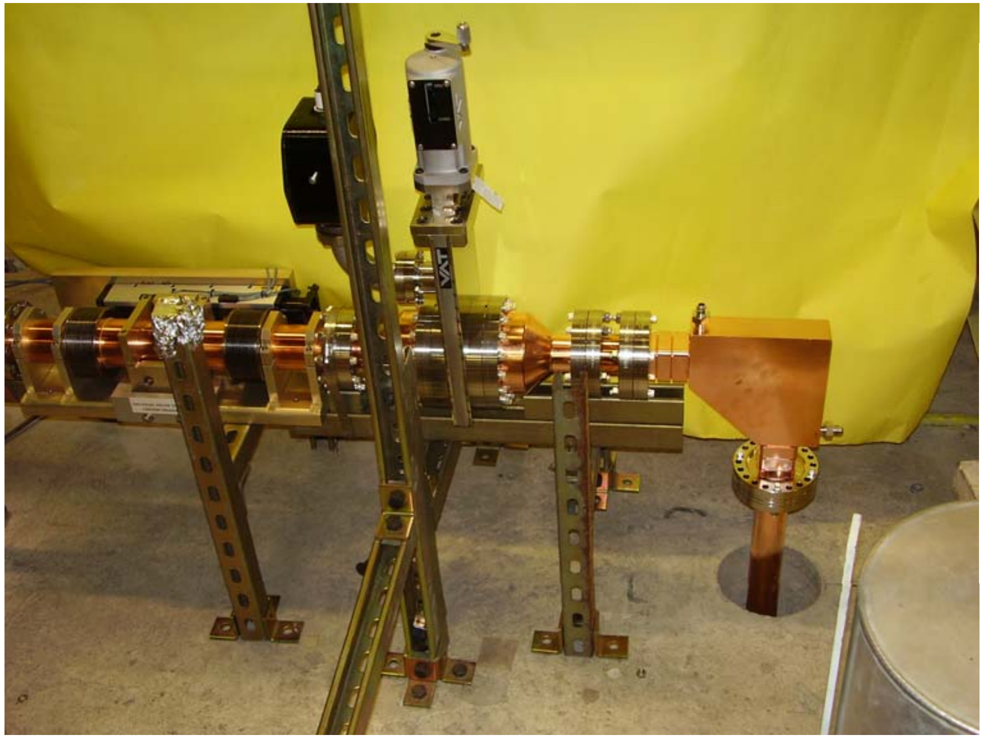


TE01 Gate Valve

ASTA Pulse Compressor



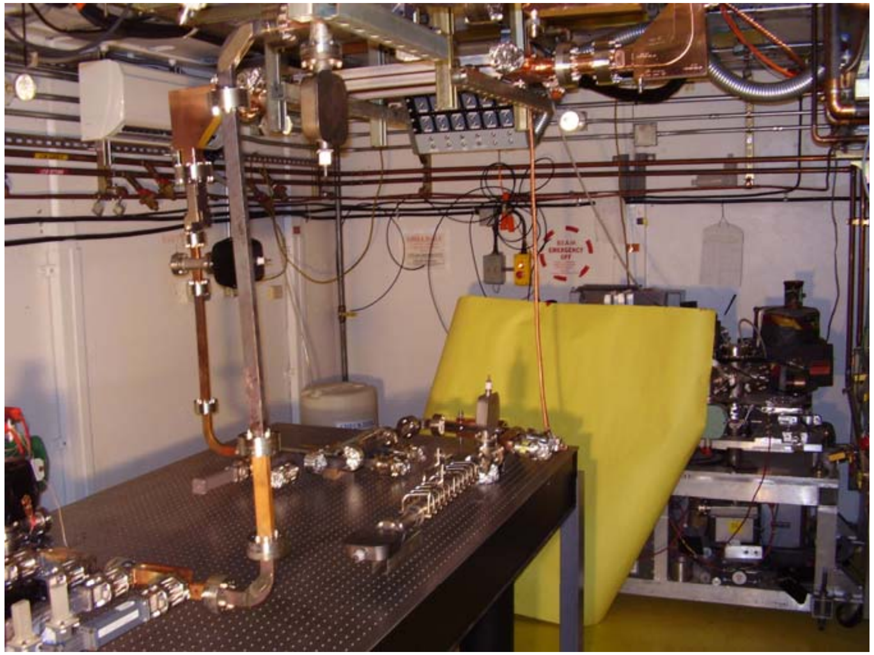
ASTA (Continued)



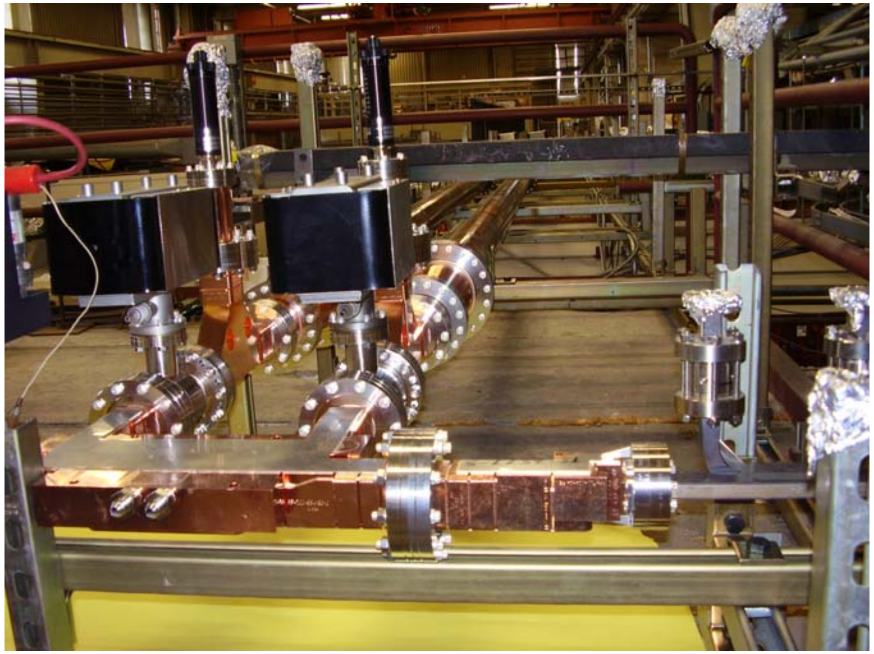
The uncompressed arm has a variable phase shifter and a gate valve

The ASTA pulse compressor with variable delay delay-lines(Miller cup)

ASTA



Two feeds for the two experimental stations inside the ASTA bunker



The ASTA pulse compressor with variable iris

Conclusion

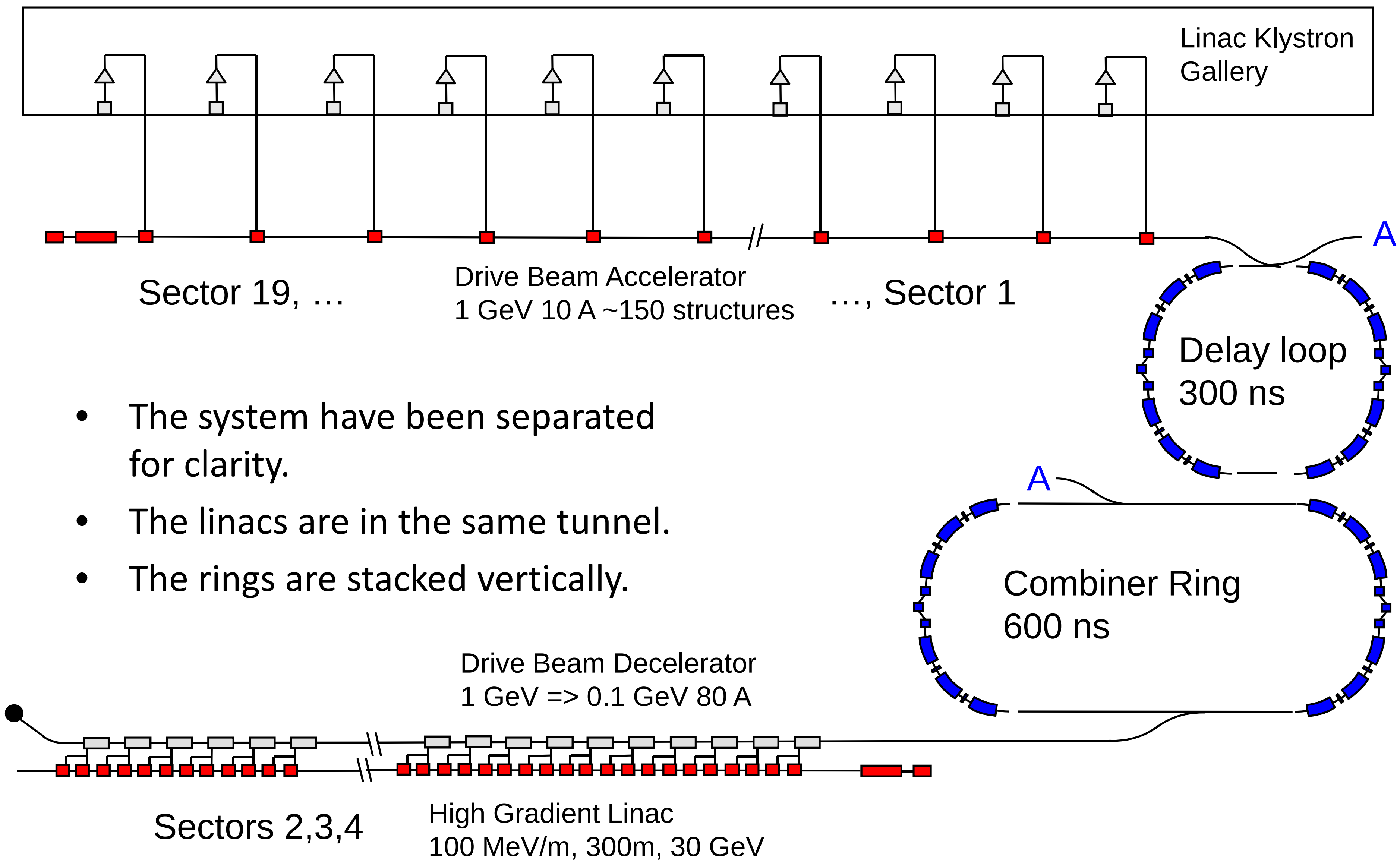
- TS 2 (Pulsed Heating station) and TS 4 (Standing wave accelerator structure station) are running regularly and are extremely productive
- ASTA is being processed, at the moment 150 MW @132 ns.
- Next the law lever RF system and feedback system are going to be commissioned.
- In two weeks, the load and installation of the PETS will take place
- At the end of November, one part of the transmission line is going to changed
- Commissioning of Two pack is next

SLAC Two-Beam Test

Work in Progress

Ron Ruth et. al.

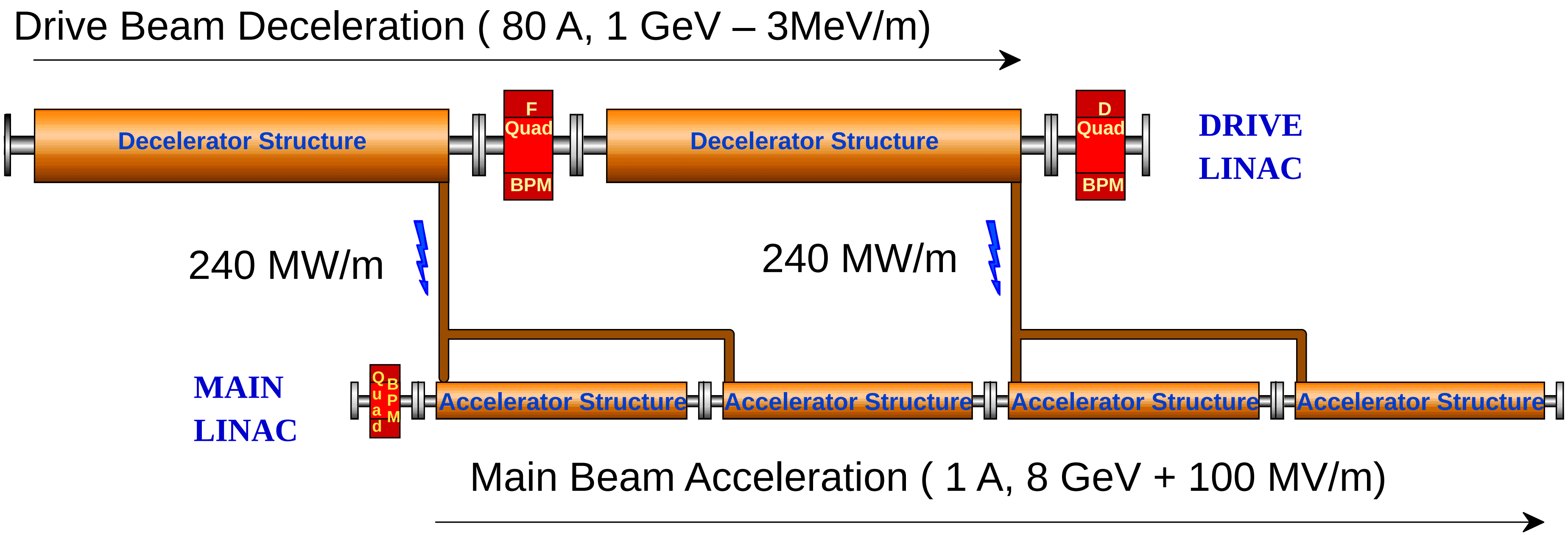
The SLAC Linac Housing



- The system have been separated for clarity.
- The linacs are in the same tunnel.
- The rings are stacked vertically.

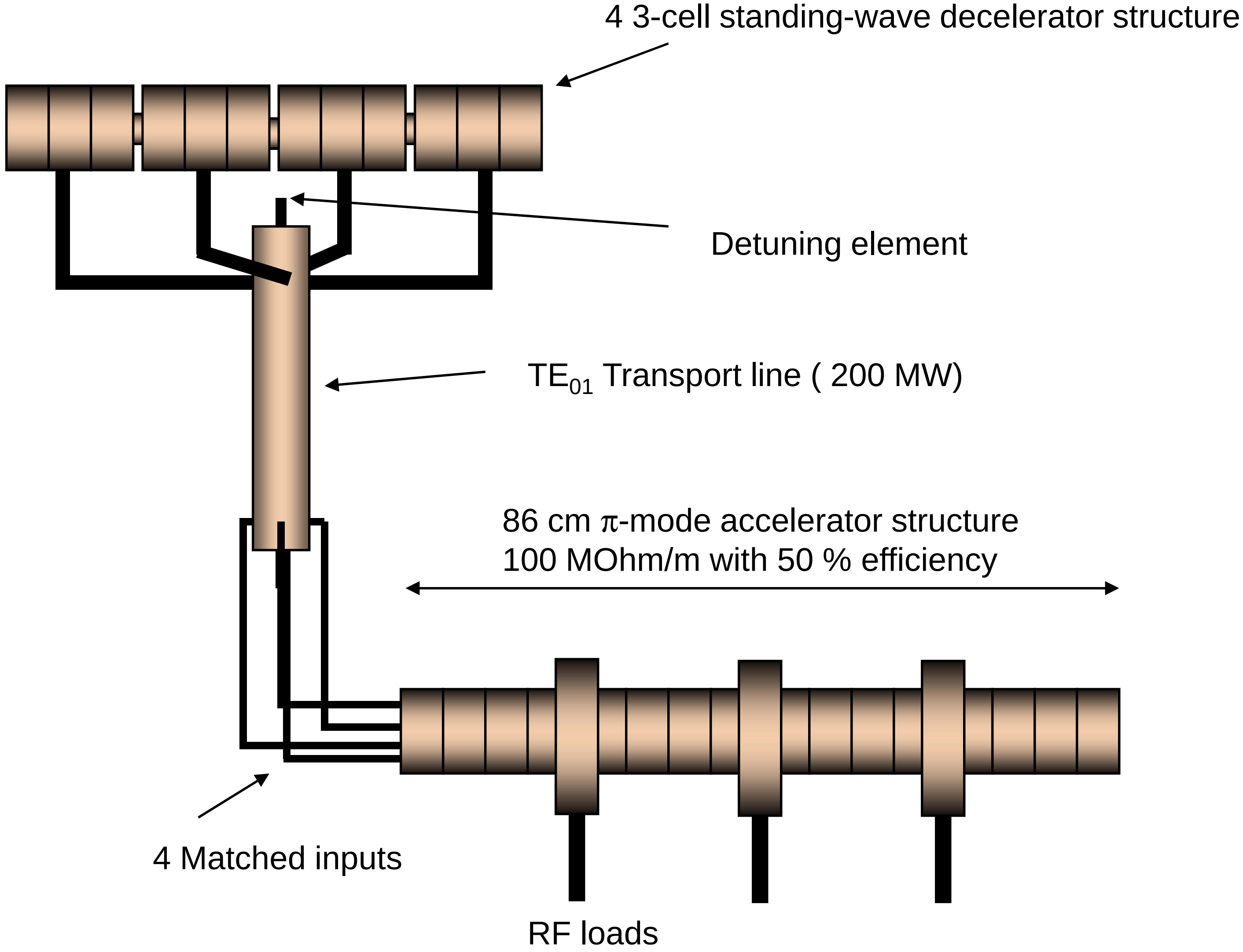
In the Tunnel Two Beam Looks Relatively Passive

Two-Beam Module Layout



Two Beam Acceleration (TBA)

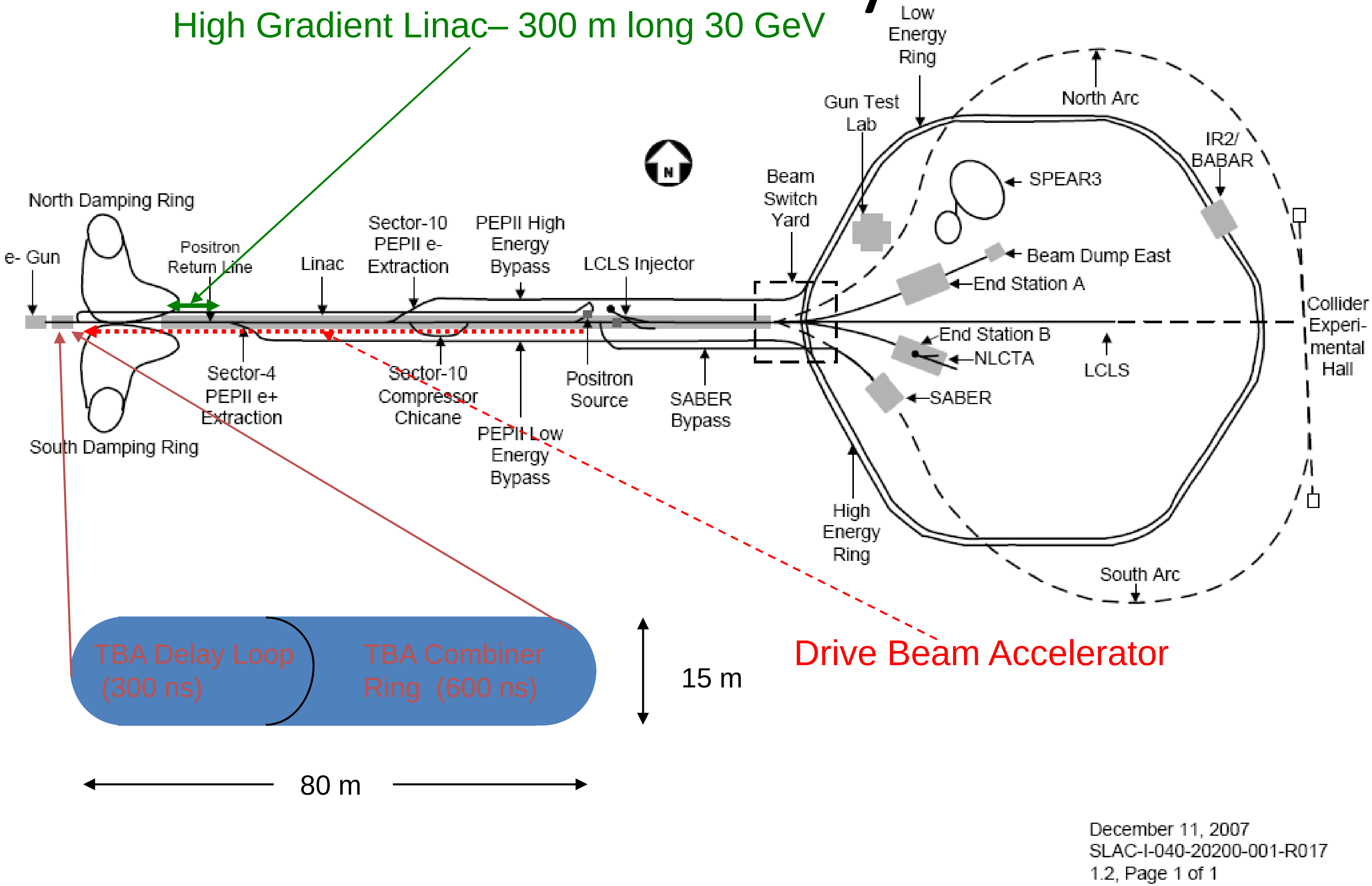
Accelerator/Decelerator structures



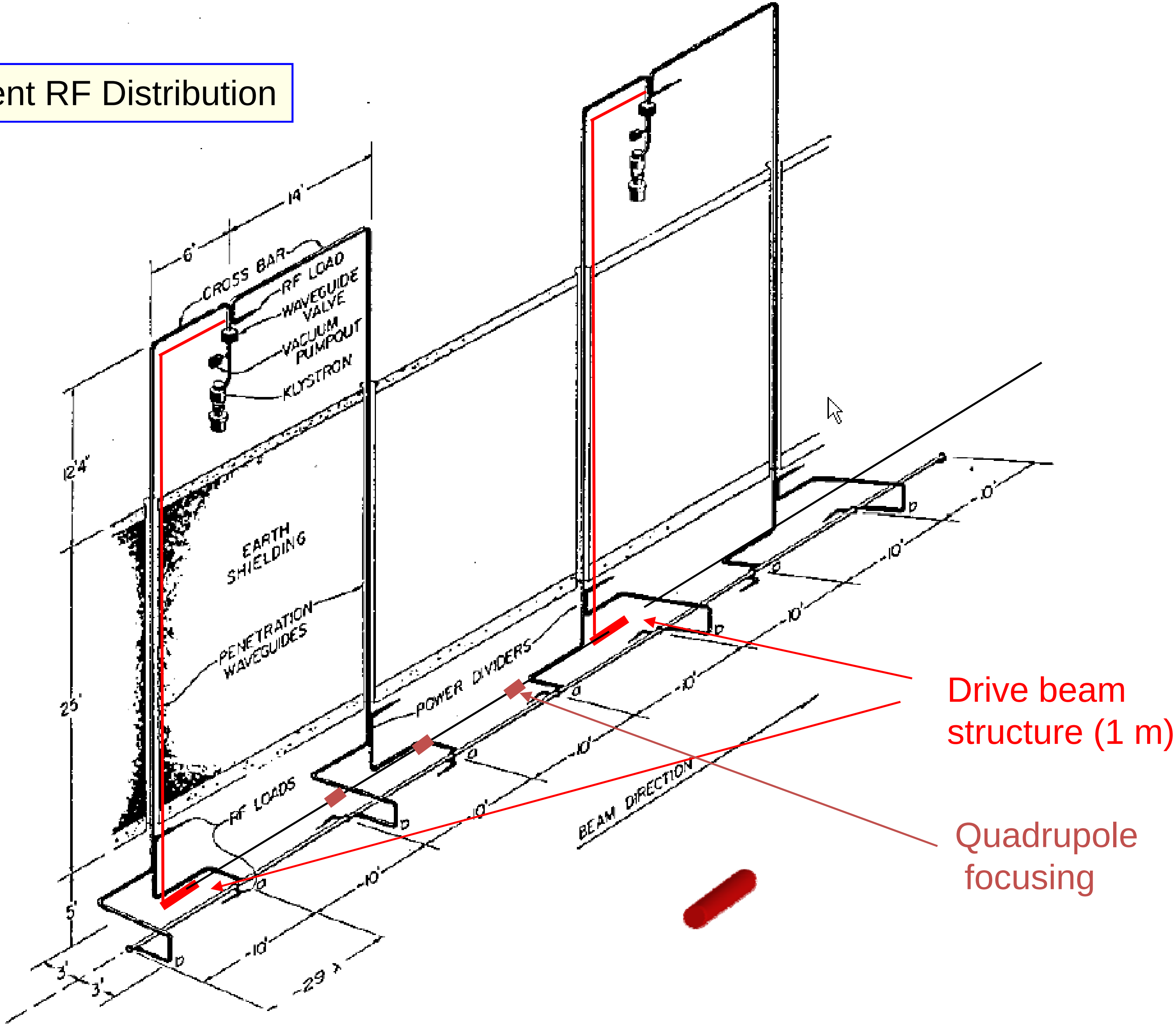
Basic parameters of a possible facility

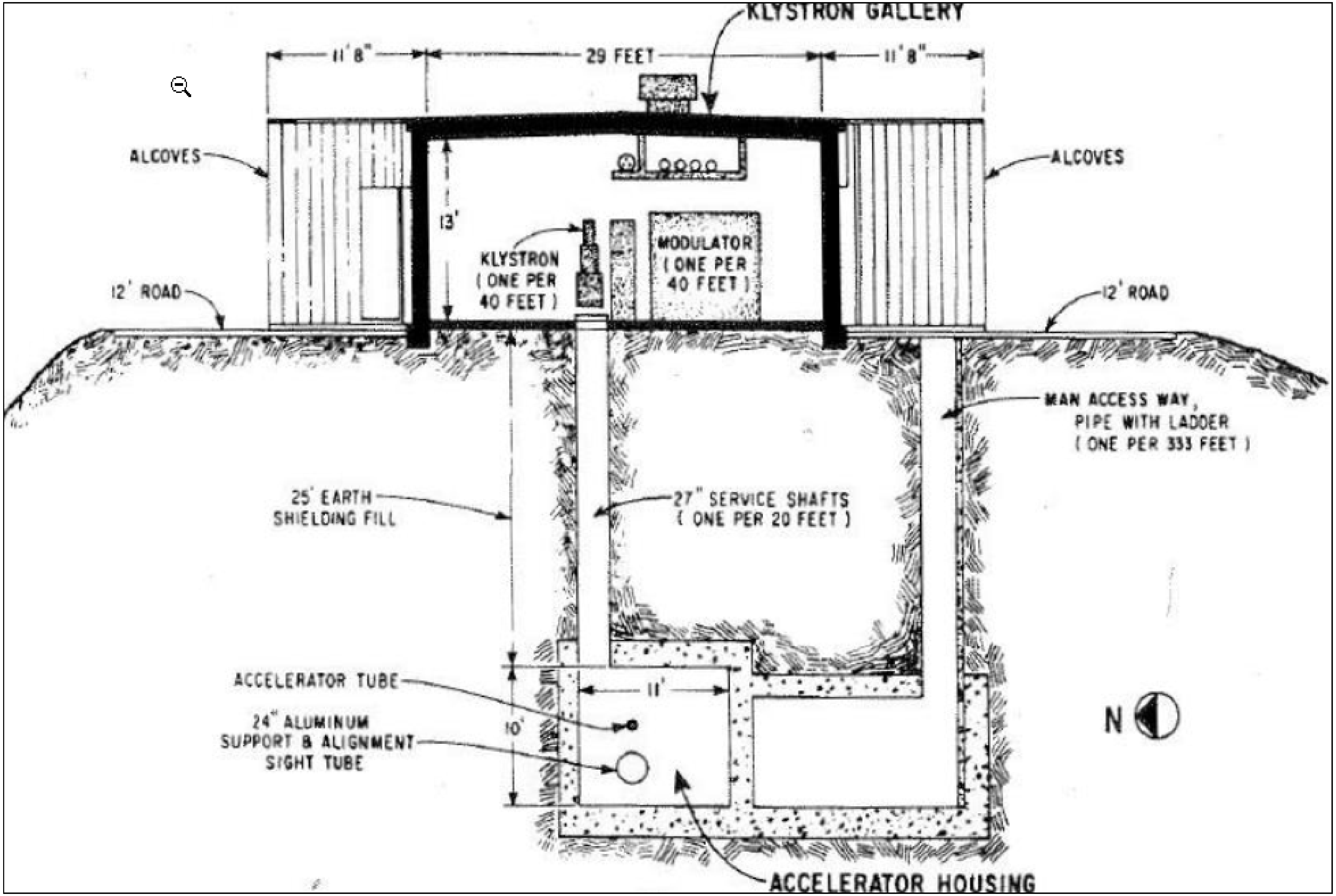
Linac Current 10 A
Final energy 1 GeV
Drive Beam Accelerator Structure 1 m long
Drive Beam gradient 6.8 MV/m
Number of structures 160
Drive Beam pulse length 300x8 + extra nsec
One delay loop x2 (300 nsec circumference)
One combiner ring x4 (600 nsec circumference)
Main Beam acceleration gradient 100 MV/m loaded

Overview of the SLAC Two Beam Test Facility

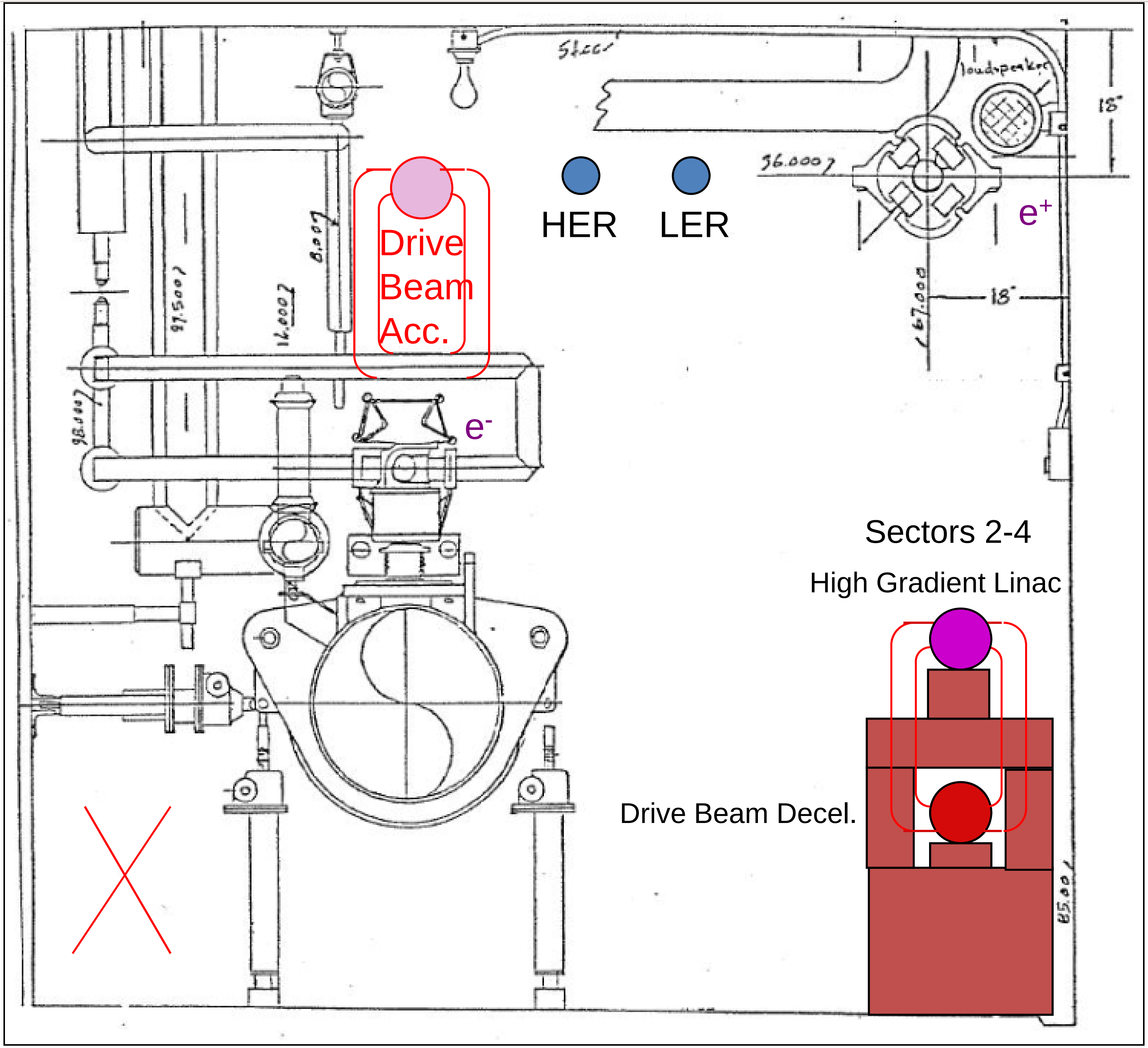


Current RF Distribution





KLYSTRON GALLERY
11'8"
29 FEET
11'8"
ALCOVES
ALCOVES
13'
KLYSTRON
(ONE PER
40 FEET)
MODULATOR
(ONE PER
40 FEET)
12' ROAD
12' ROAD
MAN ACCESS WAY,
PIPE WITH LADDER
(ONE PER 333 FEET)
25' EARTH
SHIELDING FILL
27" SERVICE SHAFTS
(ONE PER 20 FEET)
ACCELERATOR TUBE
11'
24" ALUMINUM
SUPPORT & ALIGNMENT
SIGHT TUBE
10'
N
ACCELERATOR HOUSING



Drive Beam Acc.
HER
LER
e+
e-
loudspeaker
18"
36.000
67.000
97.500
16.000
8.000
98.000
85.00
Sectors 2-4
High Gradient Linac
Drive Beam Decel.

CLIC vs CTF3 Drive beam vs SLAC Two Beam

Test

SLAC Two

Beam Accelerator

		CTF3	CLIC	STBT	Issues
Energy	GeV	0.15	2.38	1.0	Stability, emittance
Current	A	35	101	80	Stability,
Normalized (geom) emittance	µm-rad	100 (0.3)	100 (0.02)	100 (0.05)	Emittance Generation preservation
Pulse length	ns	140	241	300	RF breakdown rate, statistics
Train length in linac	µs	1.5	139	2.4	Stability, loading, losses
RF Frequency	GHz	3	1	2.856	Structure cost optimization
[illegible]	%	[illegible]	[illegible]	[illegible]	Decelerator

Conclusion

- CTF3 is a key test facility to demonstrate the feasibility of aspects of a two-beam system.
  - Full beam loading, efficient acceleration
  - Beam combination with RF deflectors
  - Initial component designs
- STBT is required as a “10%” test of a Two-Beam System
  - Stability of Drive beam Acceleration
  - Stability of Drive Beam Deceleration
  - Long pulse Main beam acceleration at high gradient
  - Emittance preservation and beam loading effects
  - RF Combination system effects, circumference feedback etc.