Room Temperature Cavity Design

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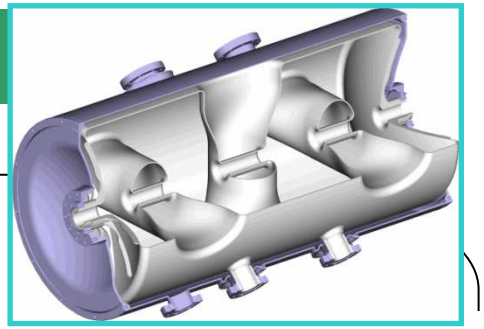
Talk Outline

- **8 GeV proton linear accelerator structure**
- **Front end structure**
- **RF design of RT CH cavity**
- **Mechanical design and fabrication of RT CH cavity**
- **High power test of first RT CH cavity.**

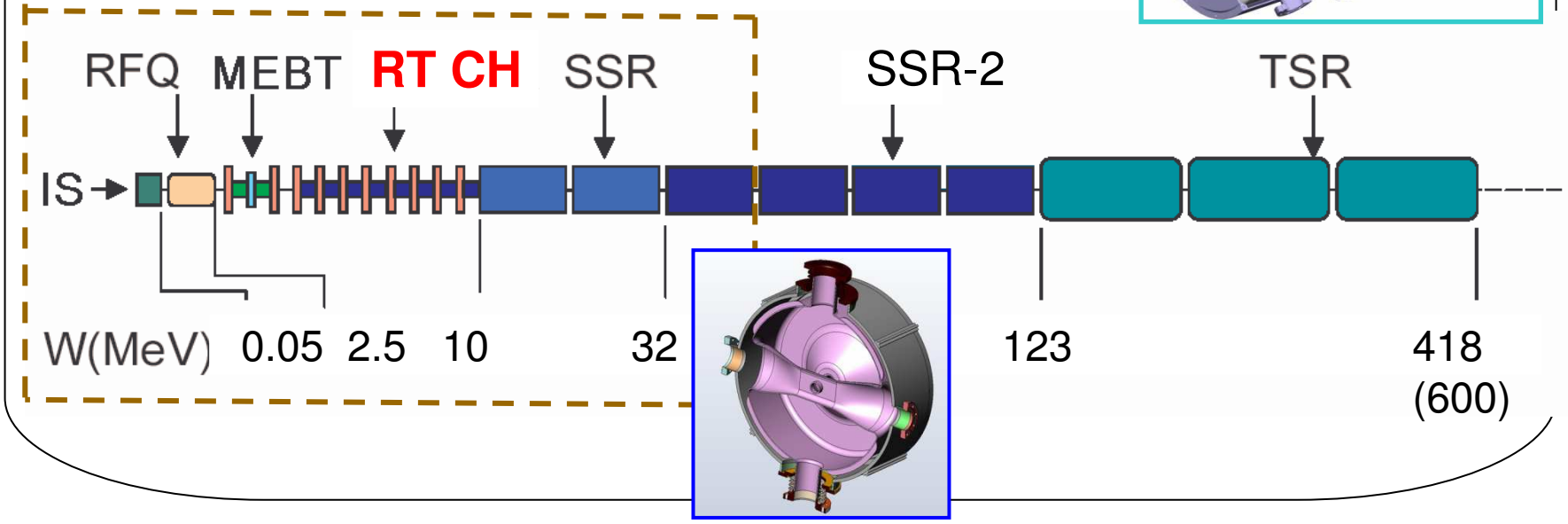
8 GeV Proton Linac Structure

Major Linac Sections

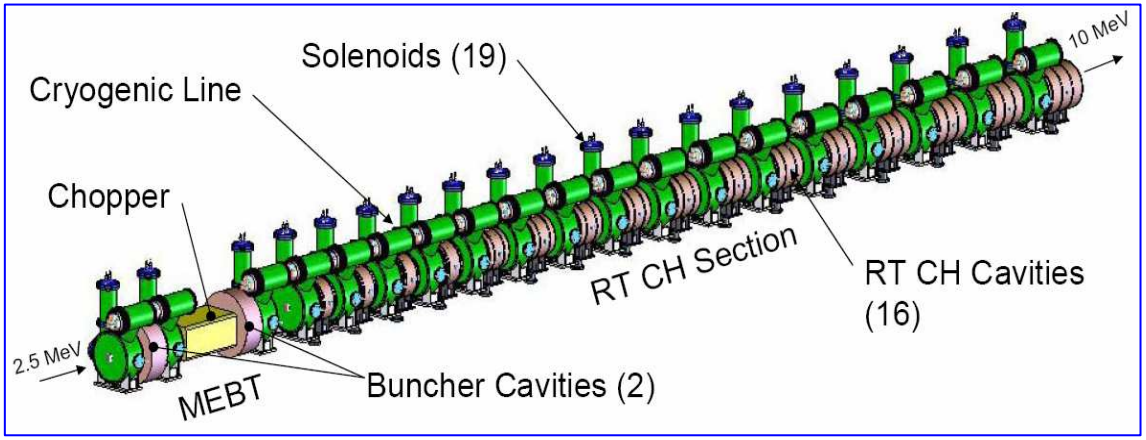
Low beta Front end	Medium beta ILC-style	High beta ILC-style
325 MHz	1300 MHz	1300 MHz



Will be installed in the Meson Lab



Front End Structure



Front end details

Length ≈ 15 m

H^- source – output energy 50 keV

F = 325 MHz

Pulse current = 25 mA

RFQ output energy = 2.5 MeV

RT CH section output energy = 10 MeV

Pulse length = 1 msec (3 msec initially)

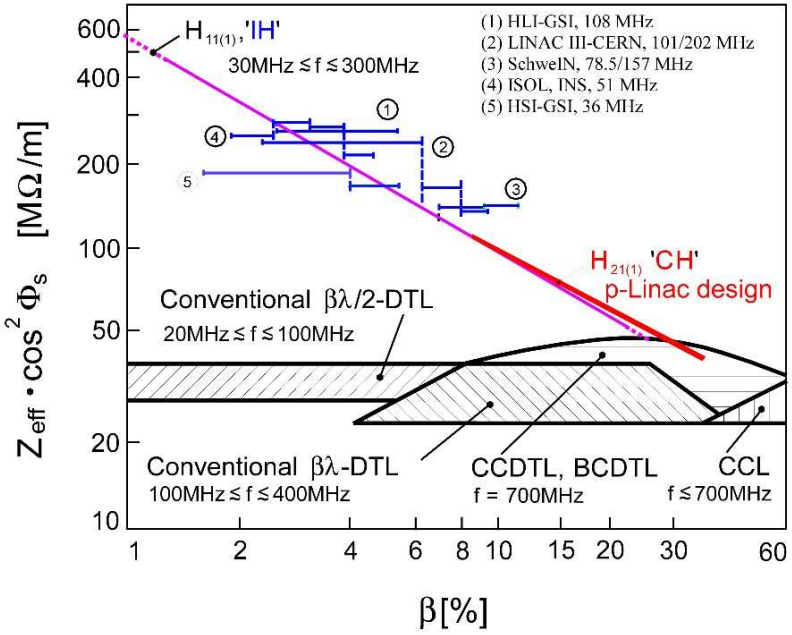
Repetition rate = 10 Hz (2.5 Hz)

Pulse power consumption with nominal beam current ≈ 1.1 MW

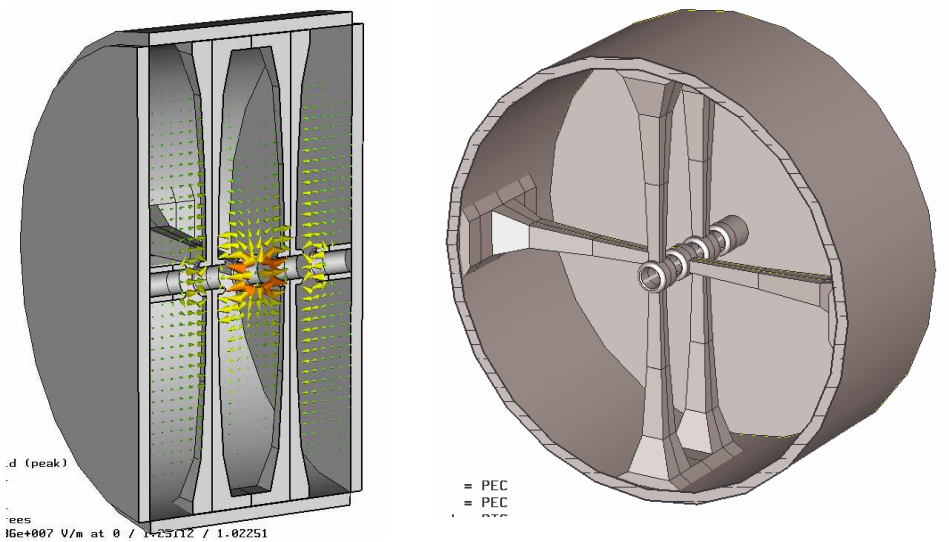
Main parameters of the RT CH cavities

Cavity number	Beta of cavity	Rsh MΩ	Q	Voltage eff, MV
1	0.074	10.4	9270	0.14
2	0.077	10.9	9662	0.25
3	0.080	11.3	10051	0.33
4	0.084	11.6	10461	0.39
5	0.088	17.2	10772	0.48
6	0.092	18.0	11078	0.51
7	0.096	18.8	11374	0.57
8	0.101	19.5	11680	0.61
9	0.106	20.2	11945	0.73
10	0.111	20.9	12220	0.70
11	0.115	21.5	12465	0.74
12	0.120	22.0	12750	0.80
13	0.126	22.6	13005	0.86
14	0.131	23.2	13271	0.92
15	0.137	23.6	13494	0.991
16	0.142	23.9	13723	0.97

RF Design of RT CH



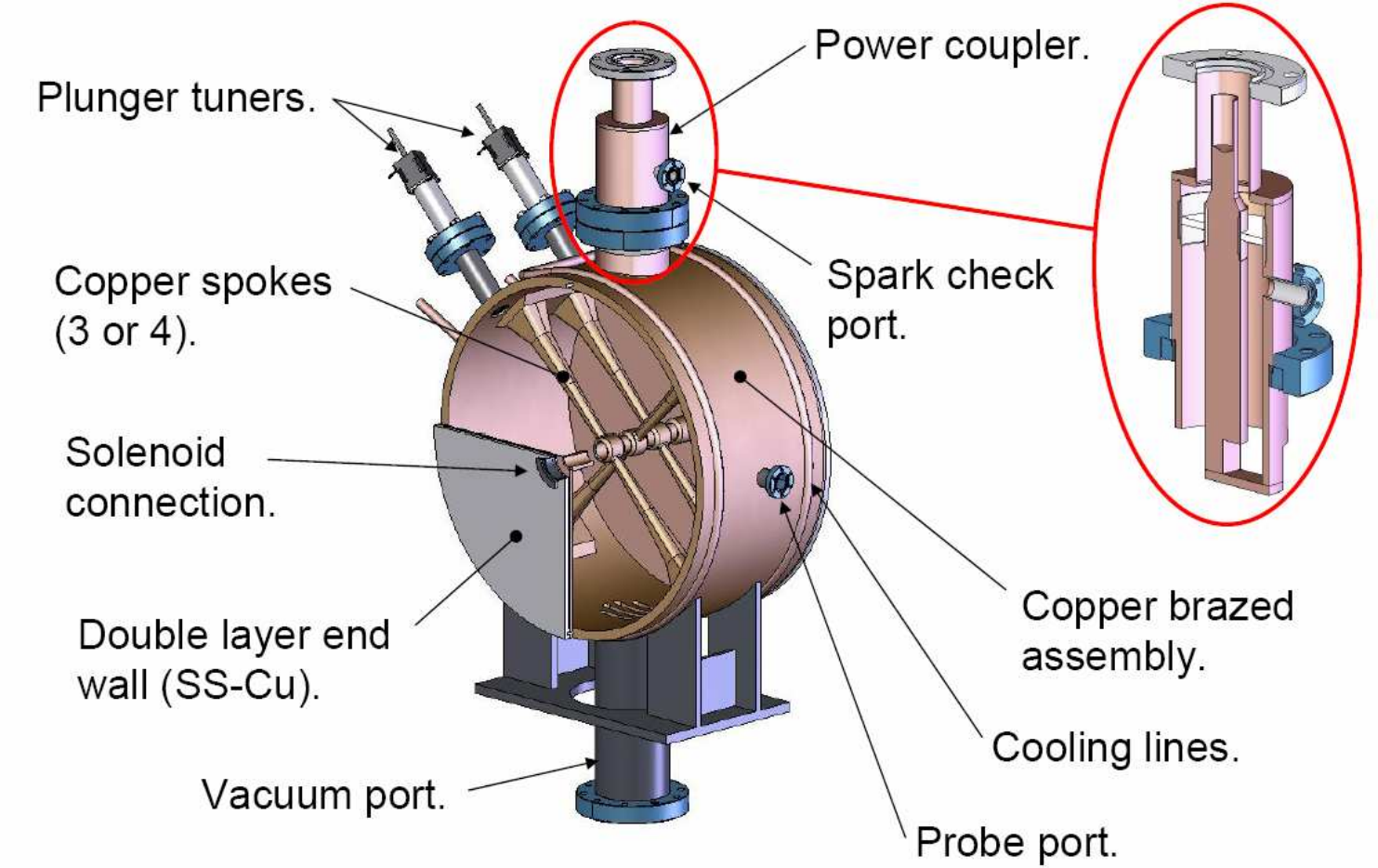
CST Microwave Studio model of RT CH-1 cavity



H-type structures have
- Highest shunt impedance for low beta particles
- Smaller size compare to DTL
- Simple design of drift tubes without quadrupole lenses
- Higher gradients due to slim drift tubes

RF design goals:
- Design operating frequency and accelerating field distribution
- Optimal shunt impedance for short structure
- Similar parts for all cavities to simplify mechanical design and manufacturing
- Moderate maximal surface field of 30 MV/m for all cavities

Mechanical Design of RT CH-1



Fabrication of RT CH-1

Resonator after brazing spokes and ports

The double layer end-walls

Tuner

Power coupler

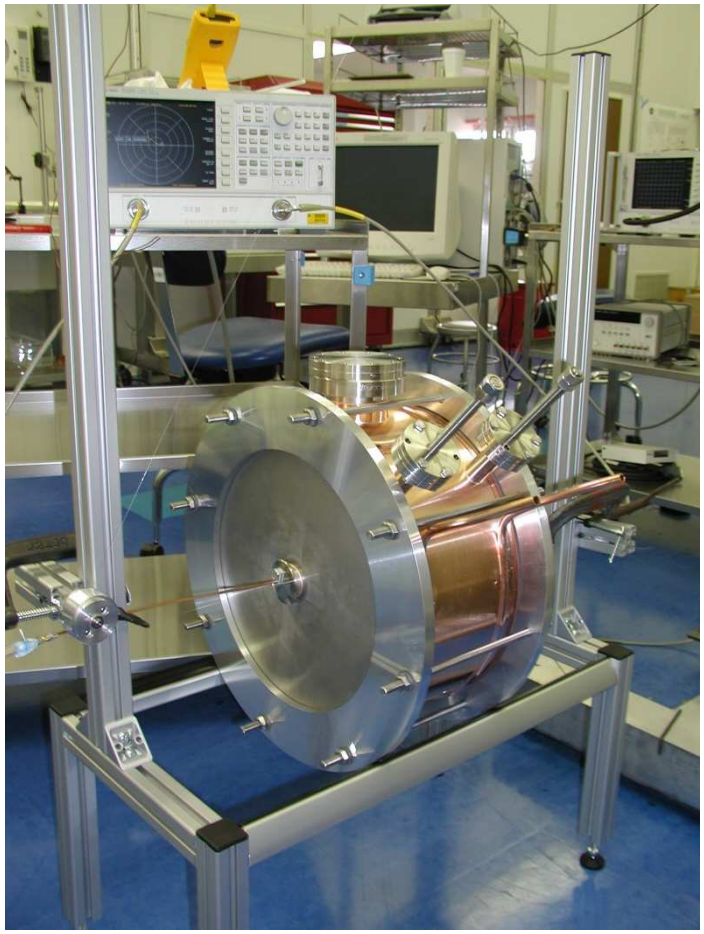
A completed spoke

Resonator after brazing of all port flanges

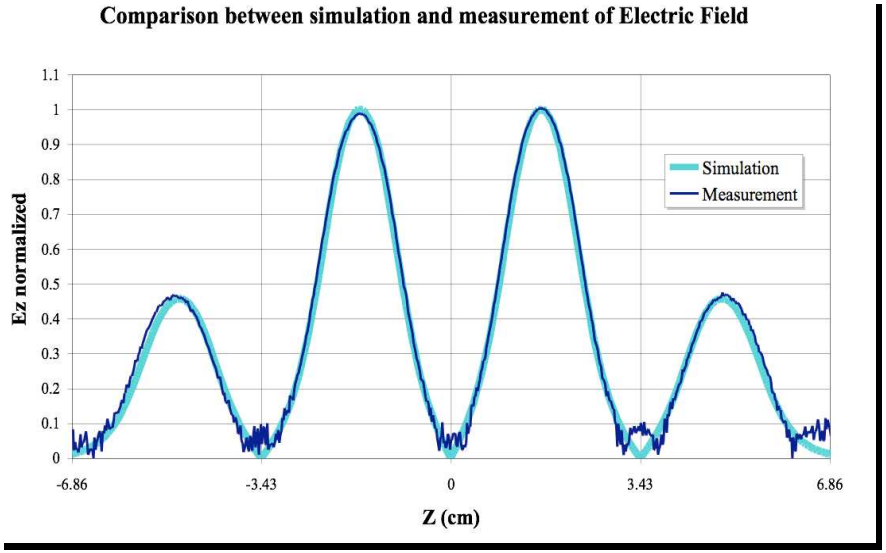
Resonator after welding of end-walls

Fully dressed RT CH-1

RF Tuning



Bead pull measurements on RT CH-1



Frequency = 325 MHz

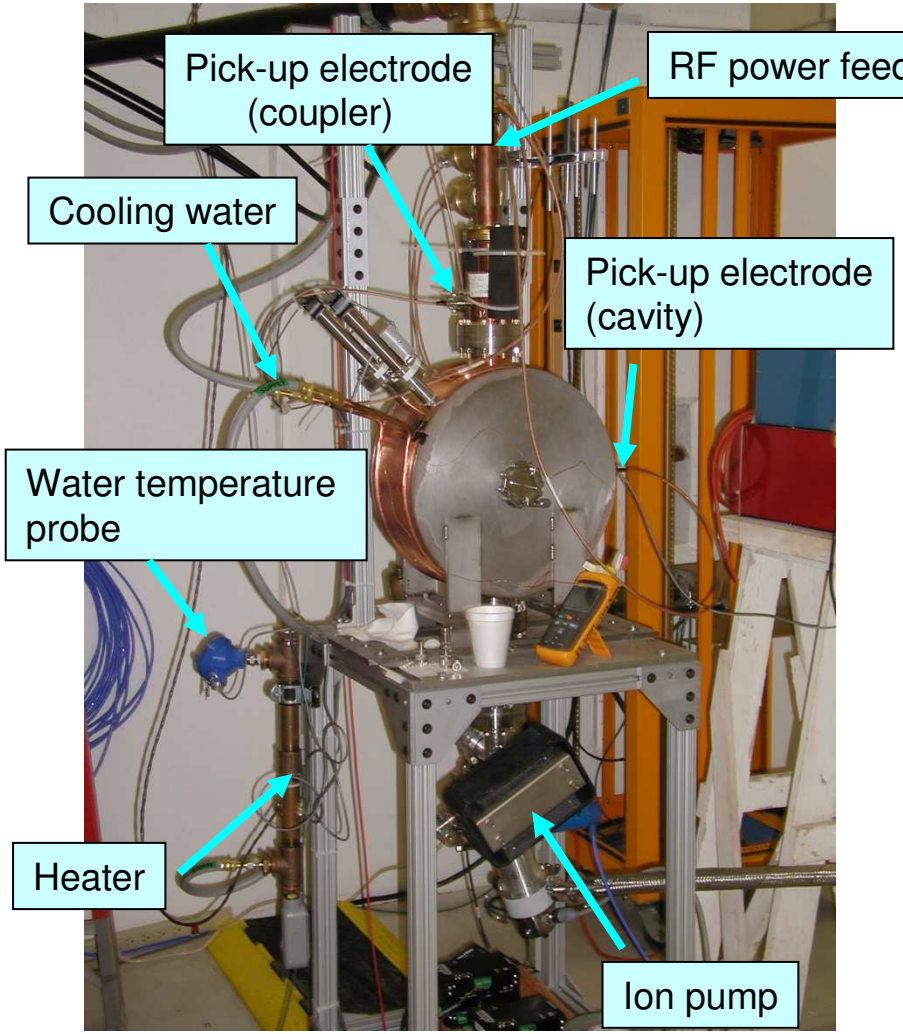
Unloaded Q = 8800

Frequency shift due to vacuum = 43 kHz

Vacuum of $1.7 \cdot 10^{-8}$ Torr achieved

Tuning range = 1.2 MHz

High Power Test



CH-1 cavity in the high power test cave

Smooth and stable operation of the cavity RT CH-1 has been achieved with 3 ms pulses at RF pulse power from 600 W to > 8 kW after ≈ 40 hours of RF conditioning.
The power coupler has been tested up to 35 kW in standing wave regime.

The first RT CH cavity met all design requirements.

CONCLUSIONS

- **The RF and mechanical design has proven to be successful.**
- **The completion of the first cavity, two input couplers and two plunger tuners, demonstrated the overall feasibility of the fabrication process.**
- **The resonator CH1 has been RF conditioned and successfully passed the first high power tests.**
- **Resonators CH2, CH3 and CH4 are being procured and the design for the remaining resonators CH5-CH16 is under completion**