

# RF Support for Test Facilities

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- RF expertise exists in multiple lab divisions
- Groups / Leads supporting SCRF include:
- Accelerator Division
  - High Level RF / John Reid
  - Low Level RF / Brian Chase
  - HINS 325 MHz RF / Al Moretti & Dave Wildman
- Technical Division
  - RF Structure design, modeling and measurements / Nikolay Solyak
  - Test and Instrumentation / Ruben Carcagno
- Computing Division
  - Electronic Systems Engineering / Gustavo Canello



# SCRF Facilities Requiring RF Support



Facility	Location	Frequency	Power
Vertical Test Facility	IB1	1.3 GHz	500 W solid-state amplifier
Horizontal Test Facility	Meson	1.3 GHz 3.9 GHz	300 kW klystron 80 kW klystron (planned)
Capture Cavity II Test Facility	Meson	1.3 GHz	300 kW klystron
High Intensity Neutrino Source (HINS)	Meson	325 MHz	3 MW klystron
ILC Test Accelerator	New Muon Lab (NML)	1.3 GHz 3.9 GHz	10 MW, 5 MW, 300 kW klystrons 80 kW klystron
A0 Photo Injector	A0	1.3 GHz	5 MW klystron (will move to NML) 300 kW klystron (will move to NML)
Single-Cell Vertical Test Facility (planned)	A0	1.3 GHz	500 W solid-state amplifier
Third-Harmonic Vertical Test Facility	A0	3.9 GHz	200 W TWT amplifier
Third-Harmonic RF Test Stand	A0	3.9 GHz	80 kW klystron (will move to Meson)



# RF Amplifier Inventory and Plans



Fermilab

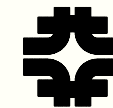
Klystron Amplifier	Application	Location	Present	Future
1.3 GHz, 10 MW Multi-Beam klystron	Cryomodules	NML	0	1
1.3 GHz, 5 MW klystron	RF Gun Cryomodule	A0, NML NML	2	3
1.3 GHz, 300 kW klystron	Capture Cavities Horizontal Test	A0, Meson, NML Meson	4	5
1.3 GHz, 500 kW klystron	Capture Cavity II	Meson	0	1
3.9 GHz, 80 kW klystron	Horizontal Test Coupler Test 3 <sup>rd</sup> Harmonic CM	Meson A0 NML	1	2
325 MHz, 3 MW klystron	HINS	Meson	1	1
1.3 GHz, ~3 MW, TH-2095A klystron	Spare	Storage	5	5
3.9 GHz, 3 kW CW klystron	Spare	Storage	1	1

- Status & Plans





# Horizontal Test Facility



Fermilab

- **Photos of RF system at Meson**
- **Status and Plans**

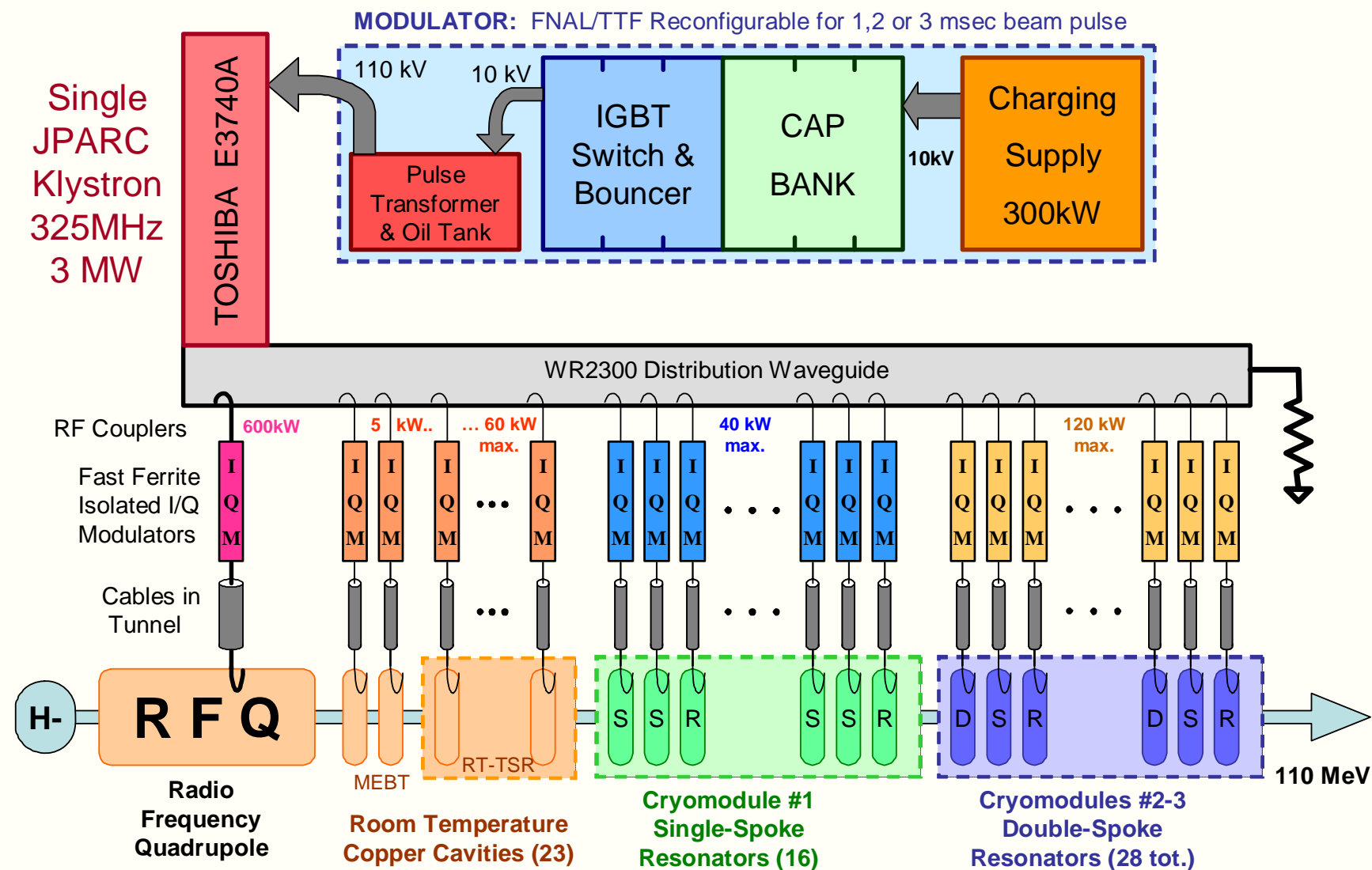


# Capture Cavity II Test Facility



- **Photos of RF system at Meson**
- **Status and Plans**

# HINS 325 MHz RF System





## Status and Plans

- ...



- Schematic showing layout of RF systems

- Photos of RF systems
- Status and Plans

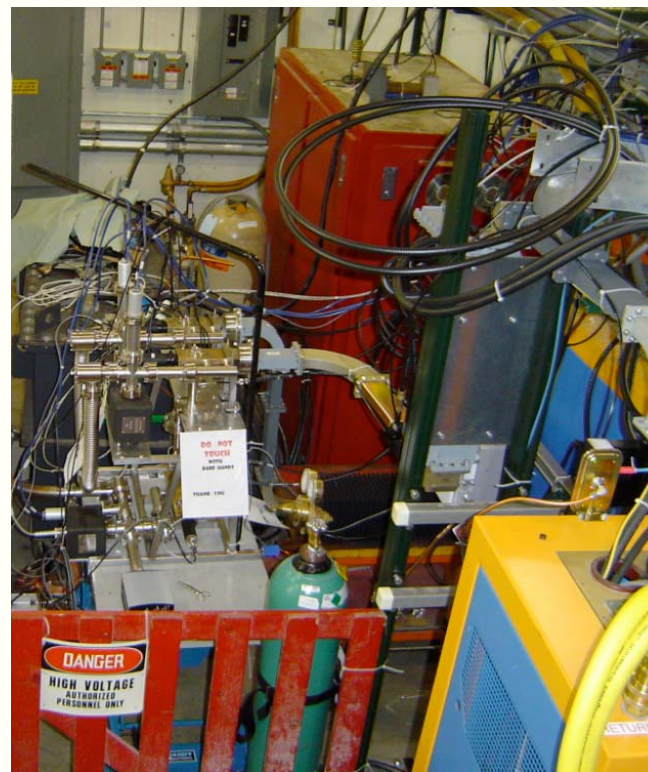


# Third-Harmonic RF Test Stand



Fermilab

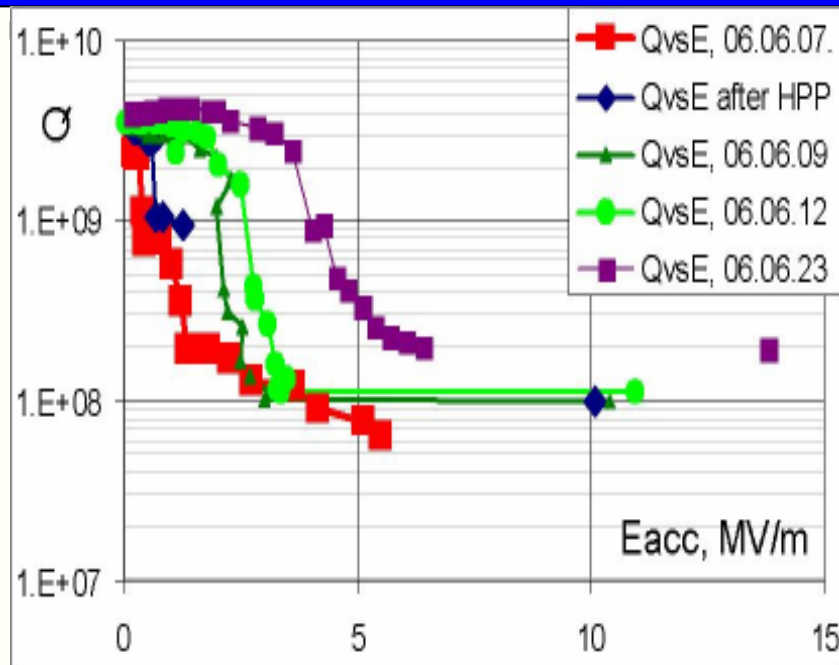
## Status and Plan



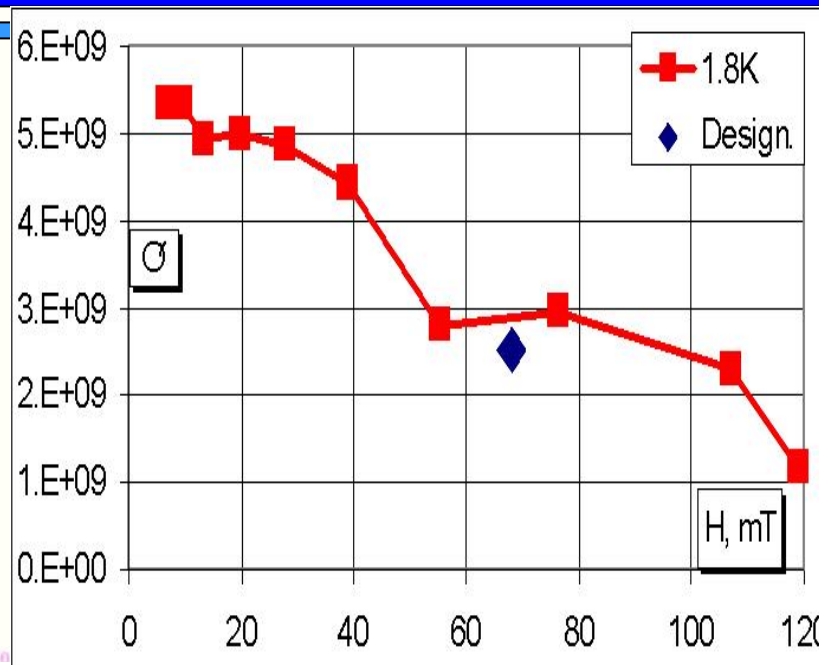
Coupler Test Stand



3.9 GHz, 80 kW klystron

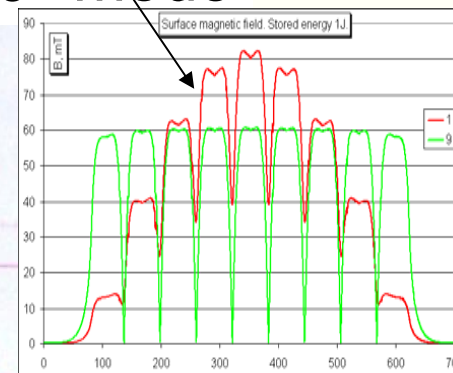
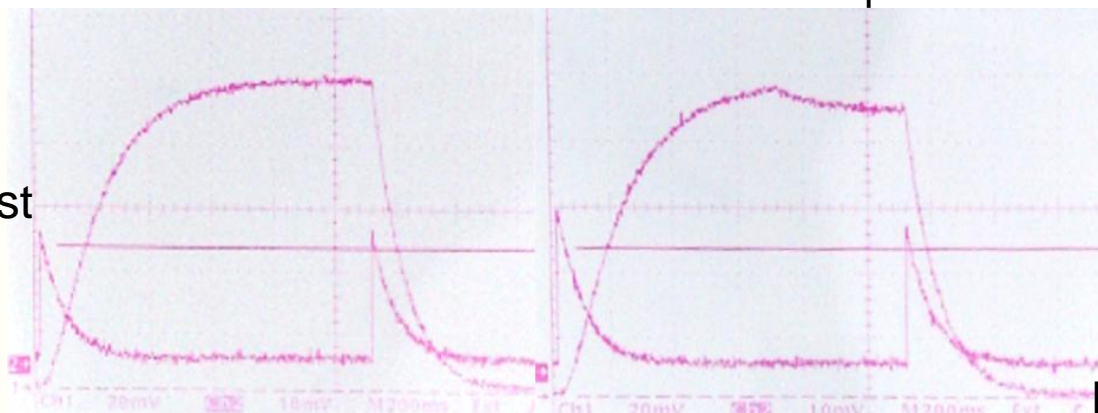


Q vs. E for  $\pi$ -mode



Q vs.  $H_{peak}$  for "0"-mode

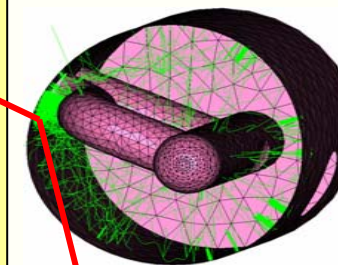
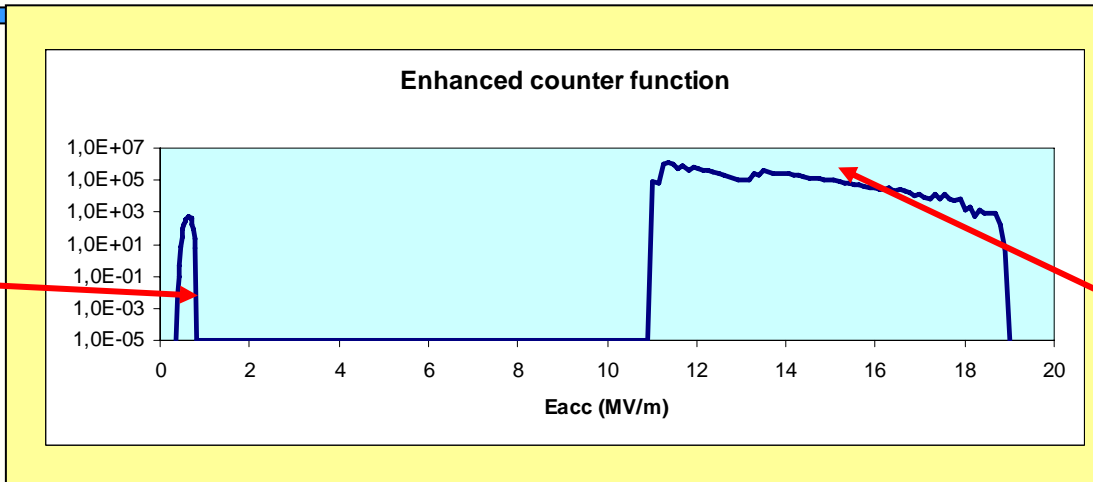
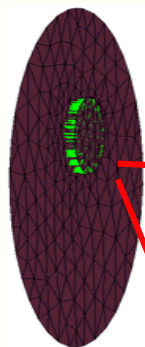
MP in vertical test



Field for 0 and  $\pi$  mode

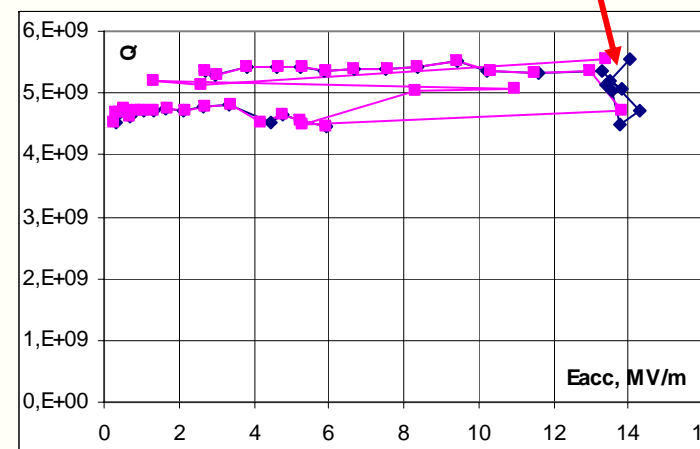
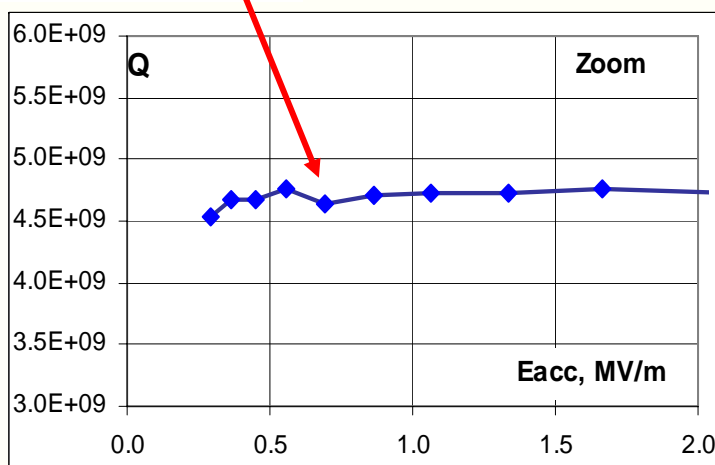
## 3D simulation

### Omega 3P(Analyst)



MP in notch gap 0.6 mm

MP in 2 mm Leg-wall gap



Results of vertical test MP observed at Eacc~0.7MV/m (Q drop). Quench at Eacc~14MV/m. Second resonance frequency of HOM was tuned higher than designed value.

- **Worked with ILC collaborators to produce ILC RDR chapters**
  - **Low-Level RF (LLRF), Controls, Modulators, Klystrons, RF Distribution**
- **Working with JLab on Vertical Test Facility at IB1**
- **Working with SLAC on High-Level RF (HLRF) and modulator for the ILC Test Accelerator at New Muon Lab**
- **Working with DESY LLRF and HLRF teams**
  - **Information exchange, short term changes of station, LLRF hardware exchange**

- **Move 3.9 GHz, 80 kW klystron from A0 to Meson, commission, and support horizontal tests of third-harmonic cavities.**
- **Connect 1.3 GHz, 300 kW klystron at Meson to horizontal test stand, commission, and support cavity testing.**
- **Install and commission 1.3 GHz, 300 kW klystron at NML for Capture Cavity II**
- **Install and commission 1.3 GHz, 5 MW klystron at NML for first cryomodule**
- **Support commissioning and testing at IB1 Vertical Test Facility**
- **Perform vertical tests of 3.9 GHz cavities at A0**
  - **Interpret results and guide HOM design changes**
- **Perform RF measurements, calculations and tuning in support of 1.3 and 3.9 GHz activities**





# Required Funding - RF Systems



Infrastructure - RF Costs	M&S	SWF	Total with Indirect
Vertical Test Stand (VTS 2 & 3)	\$ 80	\$ -	\$ 93
Horizontal Test Stand (HTS 2)	\$ 675	\$ 236	\$ 1,096
NML Facility (ILCTA_NML)	\$ 3,610	\$ 5,144	\$ 10,943
Cryomodule Test Stand	\$ 1,000	\$ 300	\$ 1,558
<b>Total</b>	<b>\$ 4,365</b>	<b>\$ 5,380</b>	<b>\$ 13,690</b>

- **The SCRF RF Group is supporting ongoing SCRF activities and planning for future activities**
- **This is being accomplished through inter-divisional collaboration and work assignments**
- **We will continue our national and international collaborations on SCRF issues**
- **We will engage in ILC EDR activities**
- **We will accomplish this work as a team working together toward common goals**