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HINS  $\overline{\text{PMG}}$

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June 2<sup>nd</sup>, 2006

# Agenda

*HINS*

- Reactions to the AAC Meeting
- Status of the MOUs
- Technical Status
- Issues

# Reactions to AAC Meeting

- Caveat: no official report received yet.

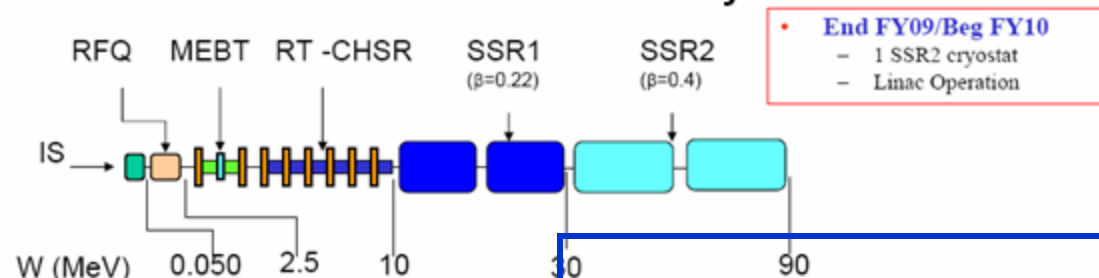
## Committee response

- The committee recognizes the need for R&D in technologies that support alternate possibilities for the future in accelerator-based high energy physics
- The committee supports the High Intensity Neutrino Source R&D plan in the development of technologies for a possible future 2 MW proton source based on a superconducting linac
- While recognizing the priority of the ILC, continued support at a level allowing the HINS R&D activities to reach their planned conclusions would offer the possibility of an ongoing strong neutrino science program, as well as synergies to other programs and projects
  - Recommend that diagnostics be more strongly addressed

Corlett (Chair)

- Reaction: Thanks !
  - More on diagnostic later

## Overall Front-End Layout



We have understood the different stages of the R&D plan scheduled for the next years (until FY10).

The plan has a number of challenges but is very promising w.r.t. the technology development. Many of the components are at the frontier of the actual R&D in this field. The overall schedule seems to be ambitious but manageable.

- End FY06/Beg FY07
  - Klystron/Modulator/Power Distribution
  - RFQ
  - Test Cryostat/Prototype SSR
  - Klystron & Power Distribution

- End FY07/Beg FY08
  - RT Cavities
  - Focusing Solenoids
  - Buncher Cavities

- End FY08/Beg FY09
  - 2 SSR1 cryostats
  - Chopper & PS
  - Linac Operation

- End FY09/Beg FY10
  - 1 SSR2 cryostat
  - Linac Operation

We are missing beam diagnostic stations in the layout!!! If the tunnel is too short, skip one SSR2 module but add beam diagnostics.

- Agreed:
  - Especially true for SSR1 & SSR2
  - FNAL “entrance” into new field
- Yes.
  - Agrees with our strategy in terms of
    - Schedule Risk
    - Cost Risk

- Activities:
  - Definition of Beam Diagnostic Elements
  - Allocation of Beam Diagnostic along Beam Line (P.O.)

# Beam Diagnostic Elements

## ■ Elements:

- *Current transformers (CT)*: RFQ exit, MEBT exit, RT exit , between the cryostats, end of the linac
- *Beam phase pick-up*: after RT section, between the cryostats and at the end of linac
- Initial tune-up of the cavity field and phase
  - *360 deg slow phase shifter* in the ~Integral Design of RF Cavities ironically controllable
  - Use *RT and SC cavities as a phase pick-up* BNL MOU
- *Beam profile wire scanners* (or/and *laser scanners*)
  - MEBT – at least 1 scanner, 4 scanners after RT cavities, at least 2 scanners at the end of linac
- *Beam loss monitors* – about 20 – distribute along the linac

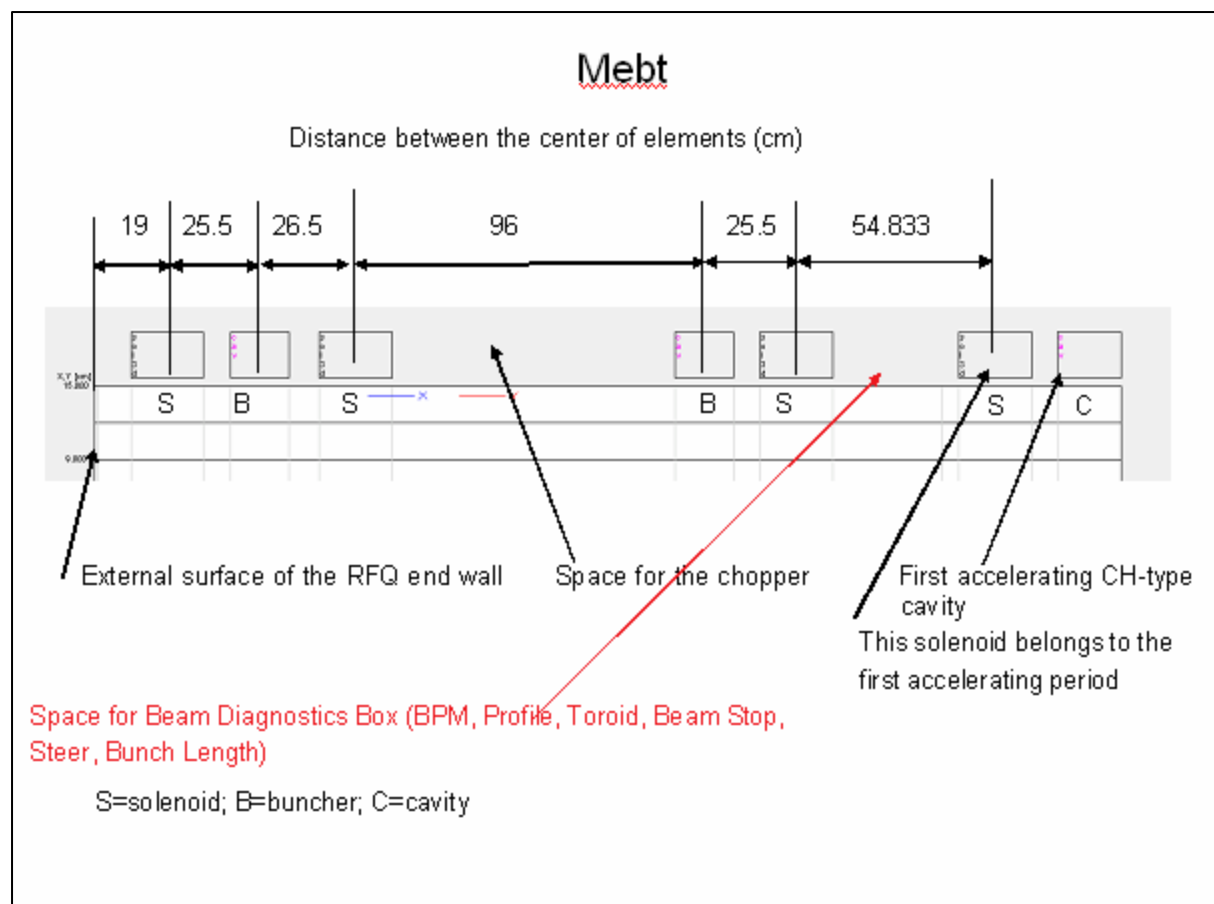
## ■ Inter-cryostat space should include

- CT
- BPM, includes phase pick-up
- Wire scanner

## ■ Hard so far to engage proper AD resources

# Is there space for Beam Diagnostic ?

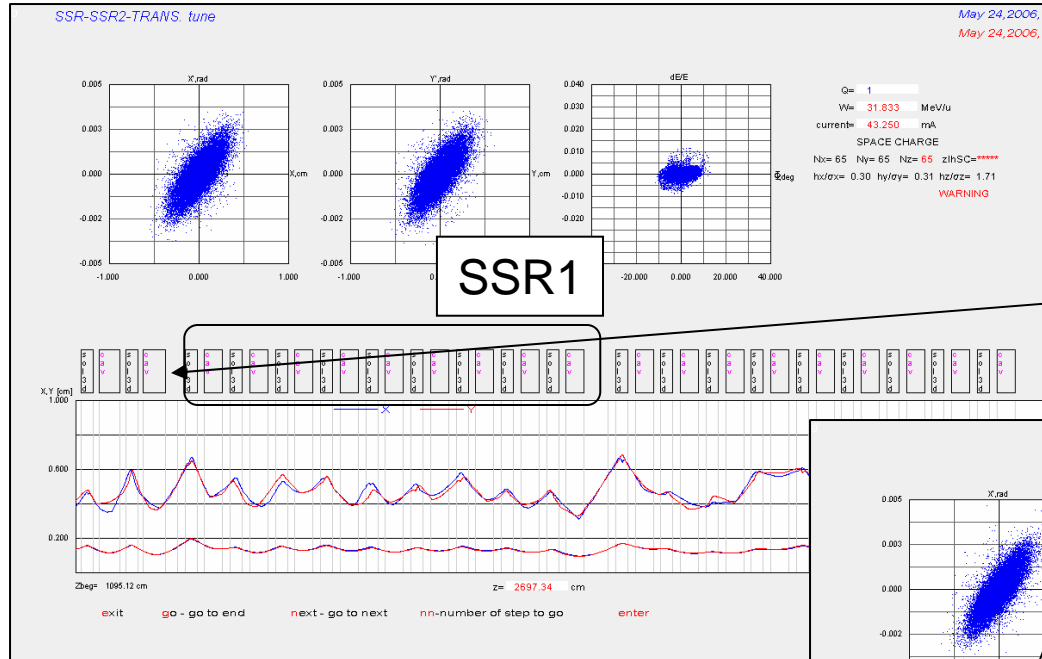
HINS



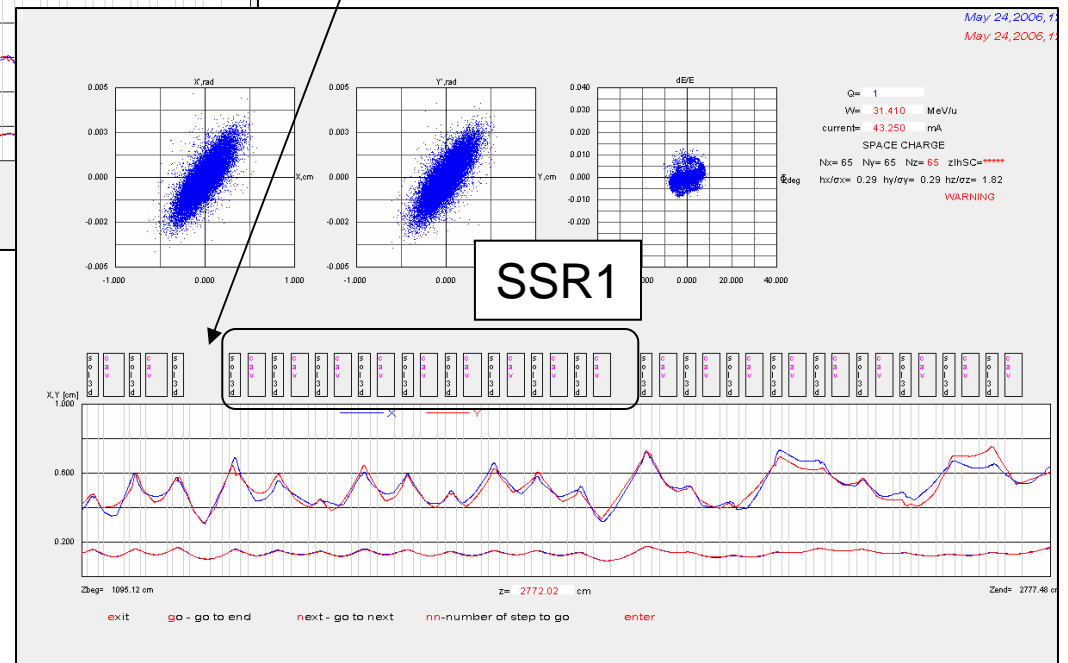
MEBT (2.5 MeV) OK

# Is there space for Beam Diagnostic ?

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Add a Solenoid, increase RT-SC transition space



- The first SSR-1 works as a buncher
- The second SSR1 is off
- Increase the field level in all SSR1 by 10%, the surface field is 31 MV/m
- Minimal impact on beam quality, more studies are required to insure that no additional emittance growth or beam losses

# Is there space for Beam Diagnostic ?

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## ■ Challenge:

- Design integrated diagnostic box
- Detector/Engineering Manpower issue
  - AD most logical source for Det.
    - No resource engagement yet
  - TD most logical source for Eng.
    - No resource available yet

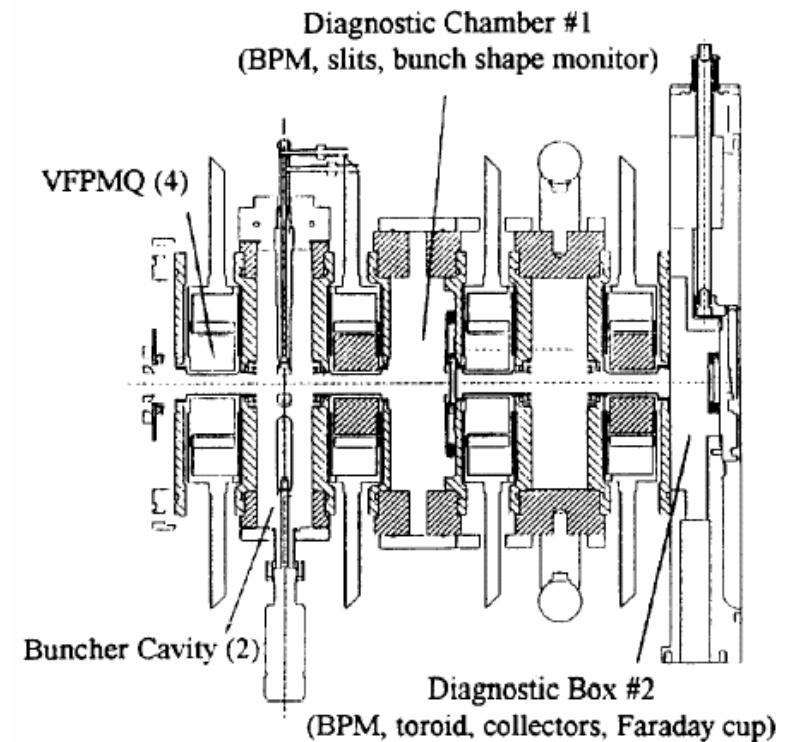
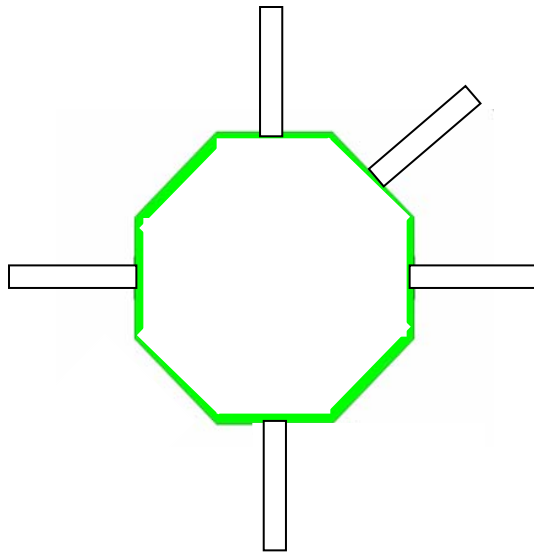
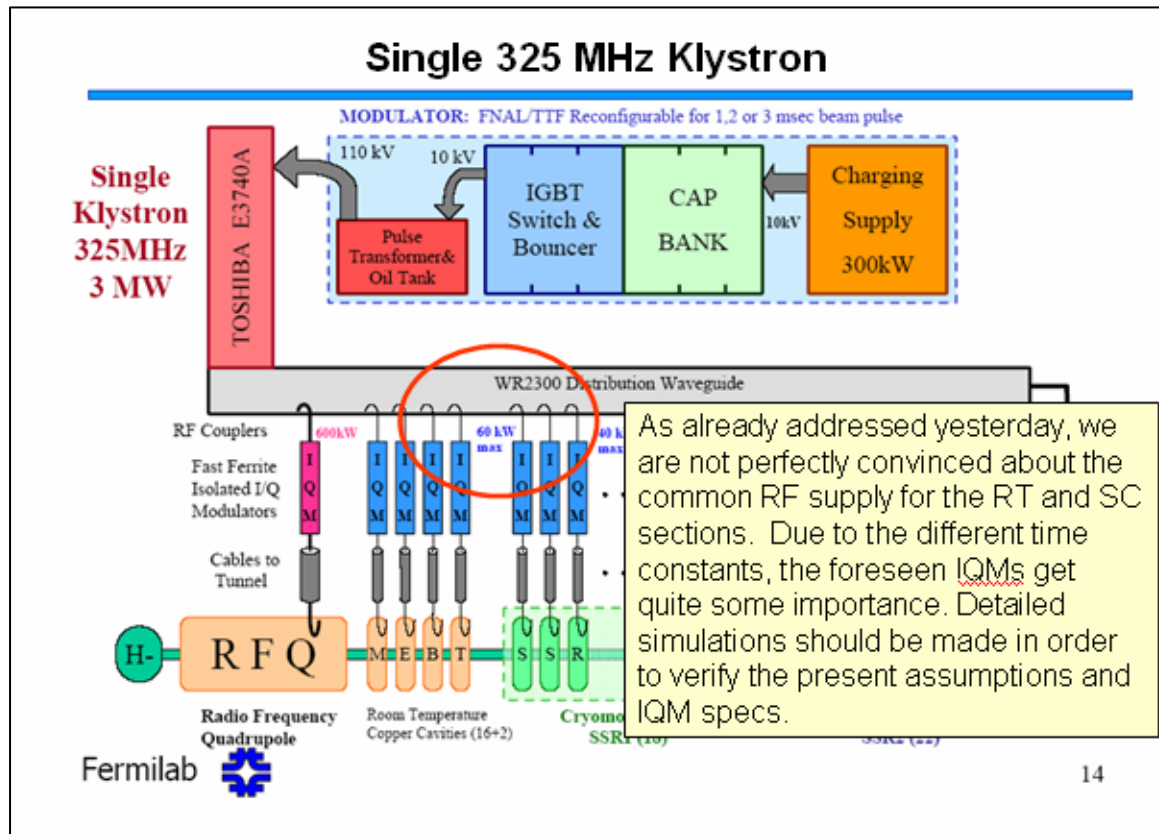


Figure 1. Side view of the RFQ-DTL matching section.





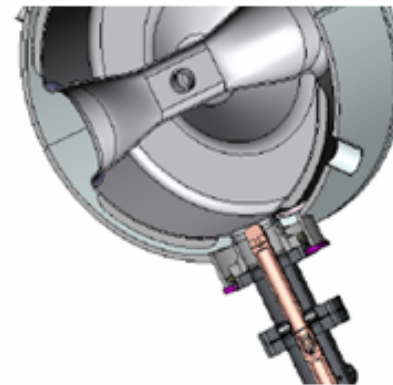
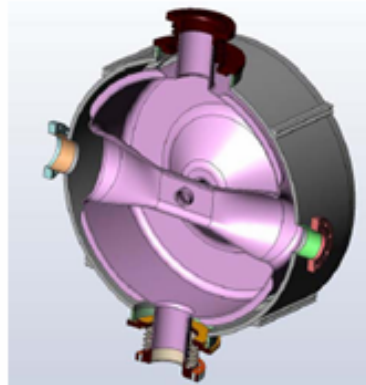
- Homework
- No Progress
- Right mix of “Scientist”+”RF Engineer” needed

# Spoke Cavities Orientation

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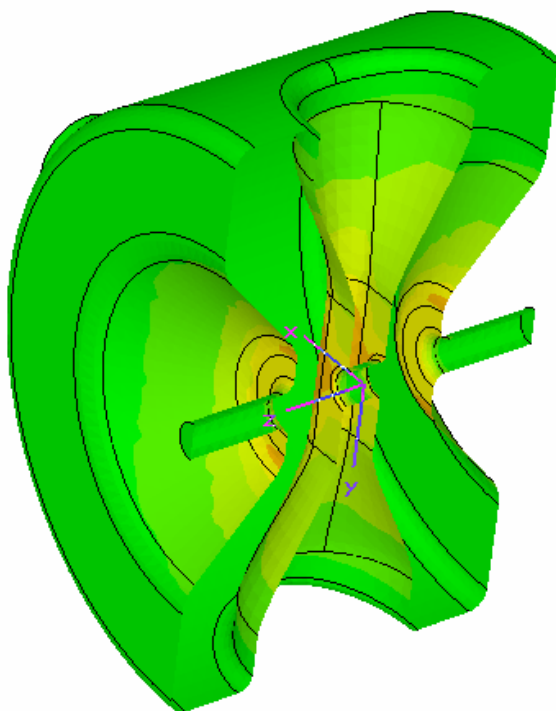
## Spoke cavities

Superconducting SSR is promising and worthwhile to be developed. It is nice to see the continuation of work done previously, e.g. at ANL. Nevertheless, this type of superconducting cavities has never been tested with beam acceleration. Assuming that it will work, its success will open a new field of the use of superconducting cavity technology.

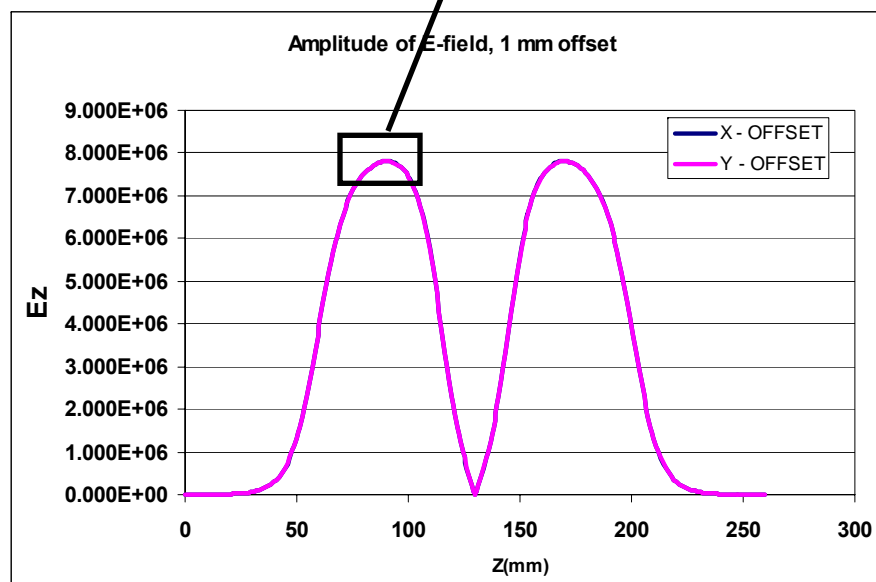
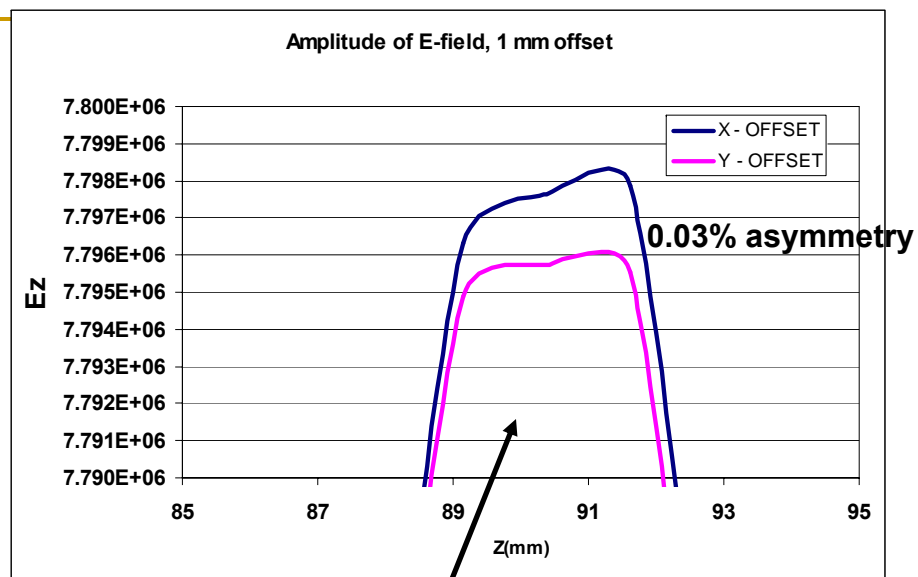


Caveat: The SSR uses the same orientation of spokes and input couplers. This arrangement may / will create some asymmetric field. The strength of this asymmetric field should be assessed and its impact to the beam should be studied

# Investigation of E-field asymmetry on beam dynamic



Electric field distribution in Single Spoke Resonator,  $\beta=0.22$



Magnitude of electric field along z direction with 1 mm offset in X and Y axis's

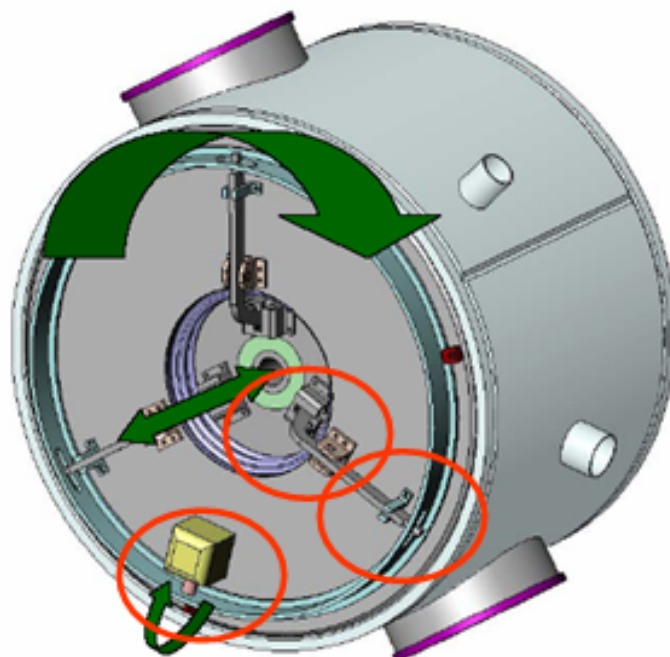
# Analysis of HOM in SSR

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First Stage Program: ~4 months

- MWS calculations of HOM frequencies, fields profile, R/Q, kick factor and Q external for monopole and dipole modes in SSR up to 3GHz
- Investigations of modes trapping possibilities and manufacturing imperfection
- With these HOM information, repeat the beam instability simulations and the HOM induced power analysis
- Resources: Gonin, Romanov, Ostroumov (ANL), etc.

## Cold Frequency Tuner



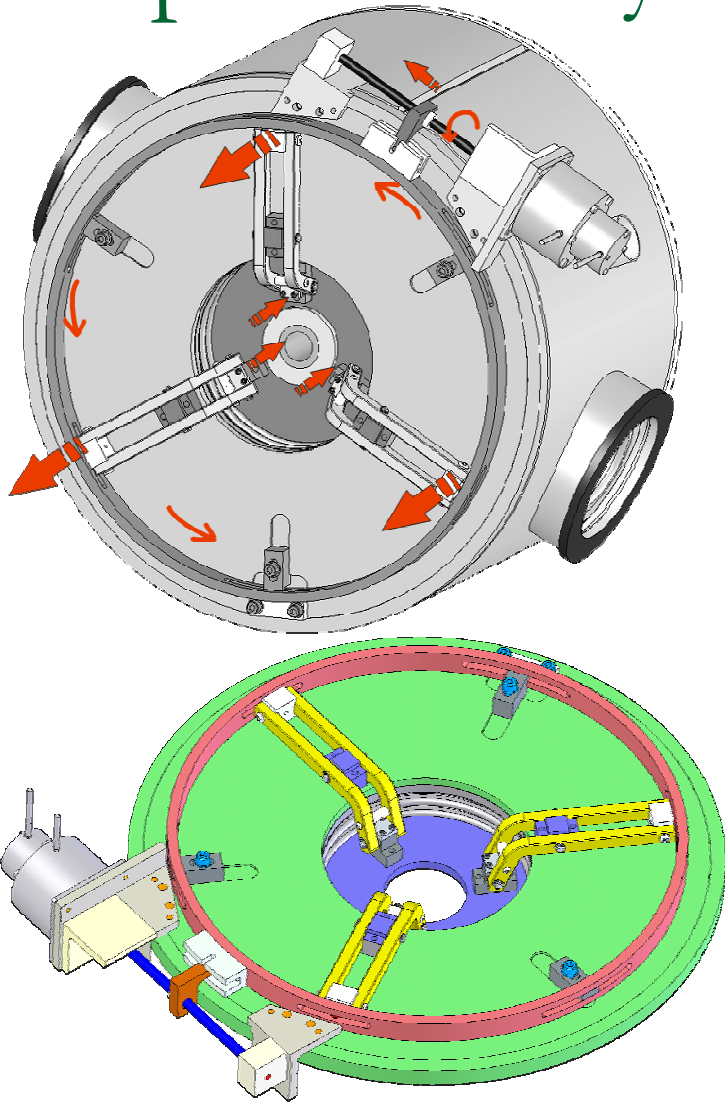
moving parts

The tuner for SSR cavities uses stepping motors and gears, which are located inside the cryostat. Such systems are in operation for other SC accelerators.

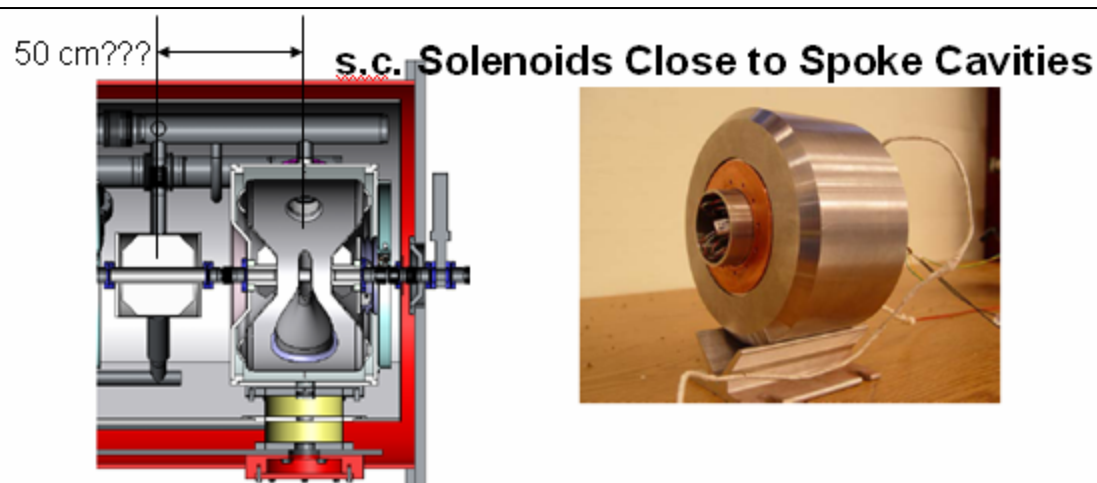
Nevertheless, the whole tuner system (motor / gear system) should be tested for its function and long term reliability. This could be done before attaching it to the cavity and 'burying' it inside the cryostat.

# Spoke Cavity Slow Tuner

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- Build Prototype during summer '06
- Assembly
  - tooling group @ IB2 (L.Elementi)
  - Time: 1 week
- Testing
  - Test & Instrumentation Dept. (R.Carcagno)
  - Meeting scheduled on Jun 6 to define competencies and requirements
  - Time:
    - Short period testing @ 4K
    - At least 1 month (if it works...) @ LN2 T
  - Where: stand 3 @ IB1
  - When: likely October

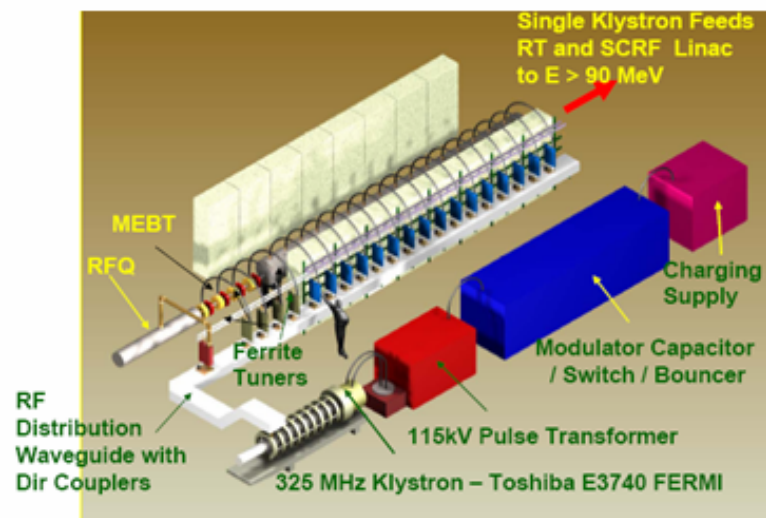


The strength of the SC solenoids is remarkable. The focal length of approx. 13 cm requires a precise alignment (in the cold!). A precision of 0.2 mm was stated. What is the overall alignment concept? How will the alignment be checked inside the cryostat? BPMs were mentioned but where to place them? Solenoid supports? Vacuum forces during cool-down? Correction coils?

The fringe field is clearly an issue. The remanent field of the 5 T solenoid should be down to  $10^{-5}$  at the cavity surface. The leakage field from the solenoid at SSR should be carefully studied and necessary measures to reduce it to an acceptable level should be investigated. In addition, cryoperm is required for earth field shielding. What is the overall concept for the mechanical design?

- All legitimate questions, addressed by ongoing R&D
  - Resources: Nicol/Page for cool-down movements  
Terechkin for cryoperm

## High Power RF



The High Power RF plan seems to be in good shape. The klystron exists. Many WG components are on hand. The concept for the long pulse modulator is there. It was nice to see that the pulse transformer can take a vertical tube (10 MHz MBK to be tested at 'very' long pulses in order to stabilize the act. required 1.5 ms operation.

Concerning LLRF: the high power IQMs need to be well integrated. How easy is the adaptation of state-of-the-art LLRF systems (SNS/DESY)?

## ■ LBL MOU

- LBL designed and developed LLRF for the SNS



# Status of the MOUs

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- ANL (700 k\$) – Beam Simulation, SSR Construction
  - MOU signed at FNAL and ANL
  - 2 reqs in FNAL system
    - Req #187514, not yet a PO (?), signed by Pier, waiting for J. Hall
    - Req #187505, not yet a PO (?), signed by Pier, waiting for J. Hall
  - Technically, collaborating since “day-0”.
- LBL (365 k\$) – Electron Cloud, LLRF, Buncher Cav. design
  - MOU signed at FNAL and LBL
  - 1 req in FNAL system
    - Req #187539, not yet a PO (?), signed by Pier, waiting for J. Hall
  - Technically, ball in our park to define buncher cavities specs
- BNL (800 k\$) – Stripping foil, laser-wire scanner
  - MOU agreed upon (Dave/Alberto work) on May 31<sup>st</sup>, being signed.

- ☑ Reactions to the AAC Meeting
- ☑ Status of the MOUs
- Technical Status
- Issues

## ■ Ion Source

- Plasmatron setup in MS6, testing LEBT
- Magnetron in Linac, waiting for long-pulse PS
  - EE Resources in AD (Steve Hays to deliver in ~2 weeks since last January)
  - Shutdown over, time to move !

# Technical Status

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- RFQ under procurement
  - “Procurement visit” to Accsys in May
    - Accsys to provide Vacuum Vessel calc. to FNAL code
    - DwgS to FNAL for sign off.
    - End Flange/Vacuum flanges configurations
    - Hold Points & Technical Contacts at FNAL
  - RFQ + Support + Tuning/commissioning at FNAL
  - ~522 k\$, contract written, undergoing signature for re-approval of new cost (original was 500 k\$)



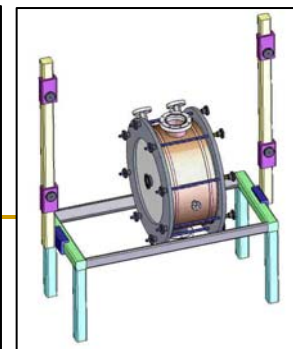
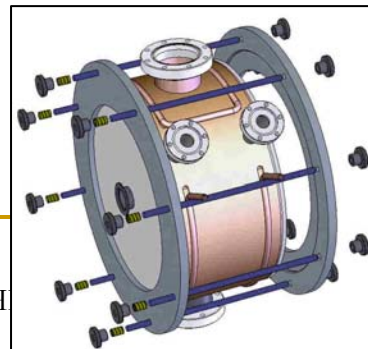
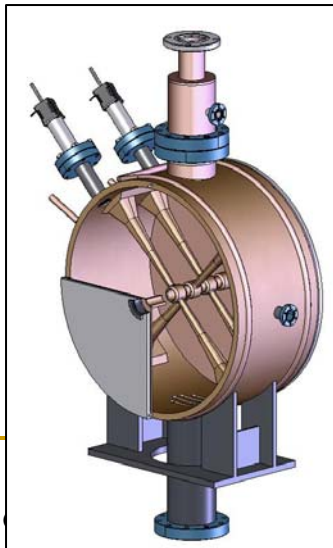
# Technical Status

- RT Prototype
  - ❑ Contract awarded (~40k\$ for first cavity)
  - ❑ Production Plan provided
  - ❑ Copper procured, first Al test pieces machined
  - ❑ Cavity at FNAL by end of August (RF in Meson needed at that time !)
  - ❑ PC to be procured in June.



**Progress report & schedule**  
Regarding Specification for 325 MHz Room temperature Resonator Cavity, #5500-ES-371031,  
P.O. # 569174, Hi-Tech Manufacturing, Inc. reports following progress:

| # | Assembly part #                              | Progress                                                                                                                                                                                                                                                                          | Comments                                                                                                                              |
|---|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1 | MD-440391 SPOKE A                            | Aluminum prototypes: finish June 2<br>Inspection: June 5<br>Send to "Fermi" for inspection: June 5<br>In a mean time, during "Fermi Lab" inspection, we are going to:<br>Rough machining & annealing copper blanks.<br>Not finish them, till "Fermi" approve<br>Aluminum samples. | Finish machining & inspection<br>Shall be approx. in 20 days after aluminum samples approval.<br>For process: See traveler: MD-440391 |
| 2 | MD-440392 SPOKE B                            | Aluminum prototypes: finish June 2<br>Inspection: June 5<br>Send to "Fermi" for inspection: June 5<br>In a mean time, during "Fermi Lab" inspection, we are going to:<br>Rough machining & annealing copper blanks.<br>Not finish them, till "Fermi" approve<br>Aluminum samples. | Finish machining & inspection<br>Shall be approx. in 20 days after aluminum samples approval.<br>For process: See traveler: MD-440392 |
| 3 | MD-440379 CYLINDER                           | Material received: May 23<br>Rough machining & annealing: approx. June 19<br>Final machining: approx. June 26<br>Inspection: June 27<br>Send to "Fermi" for inspection: June 27                                                                                                   | Shall be sent for brazing after inspection: June 28<br>For process: See traveler: MD-440379                                           |
| 4 | MD-440375 END WALL ASSEMBLY with components: | Send components for "Fermi" inspection: Approx. June 9<br>Send for brazing: Approx. June 16                                                                                                                                                                                       | For process: See traveler: MD-440375                                                                                                  |
| 5 | MD-440380 END WALL                           | Material: been ordered & received.<br>Shall be completed by June 2                                                                                                                                                                                                                | For process: See traveler: MD-440380                                                                                                  |
| 6 | MD-440381 END WALL DRIFT TUBE                | Material: been ordered & received.<br>Shall be completed by June 2                                                                                                                                                                                                                | For process: See traveler: MD-440381                                                                                                  |
| 7 | MD-440382 EXTERNAL END WALL                  | Material: been ordered & received.<br>Shall be completed by June 5                                                                                                                                                                                                                | For process: See traveler: MD-440382                                                                                                  |





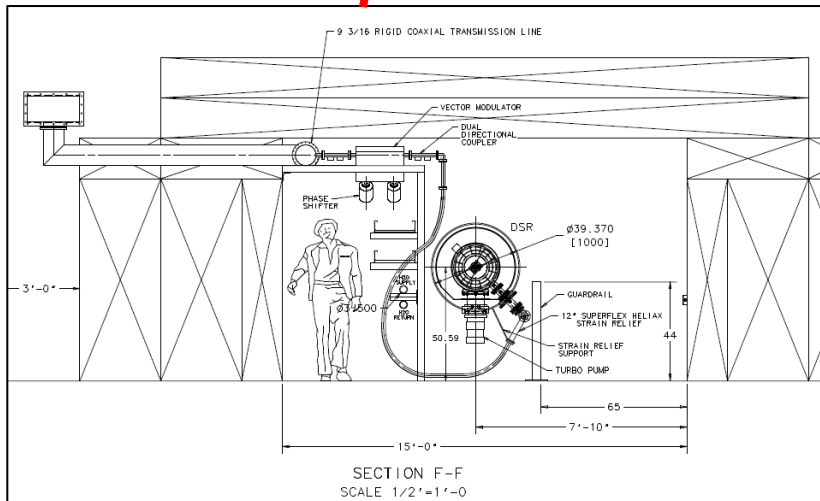
# Meson Preparation

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Mockup Tunnel



Waveguide Support



Klystron-Modulator Umbrella



- Potential Interference with duration of Capture Cavity testing in Meson in present cave
  - Suggestion/indications they wish to stay for ~9 months
    - Why ? No cryo ready in new-muon.
  - RFQ delivery by January 2007. Would like to refurbish area/install ion source ~Nov-Dec '06
    - From HINS point of view can only allow ~6 of 9 months
- Suggestion of using HINS modulator/pulse transformed (4 msec) for 1.3 GHz Klystron test
  - HINS need RF immediately for
    - RF testing (325 MHz klystron, power distribution - now)
    - Cavities Testing (RT cavities - Aug, RFQ - Jan, etc.)