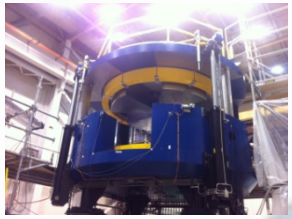


STATUS OF THE WORK PACKAGE #5
CYCLOTRON & LINES

DECEMBER 2014 TECHNICAL ADVISORY COMMITTEE

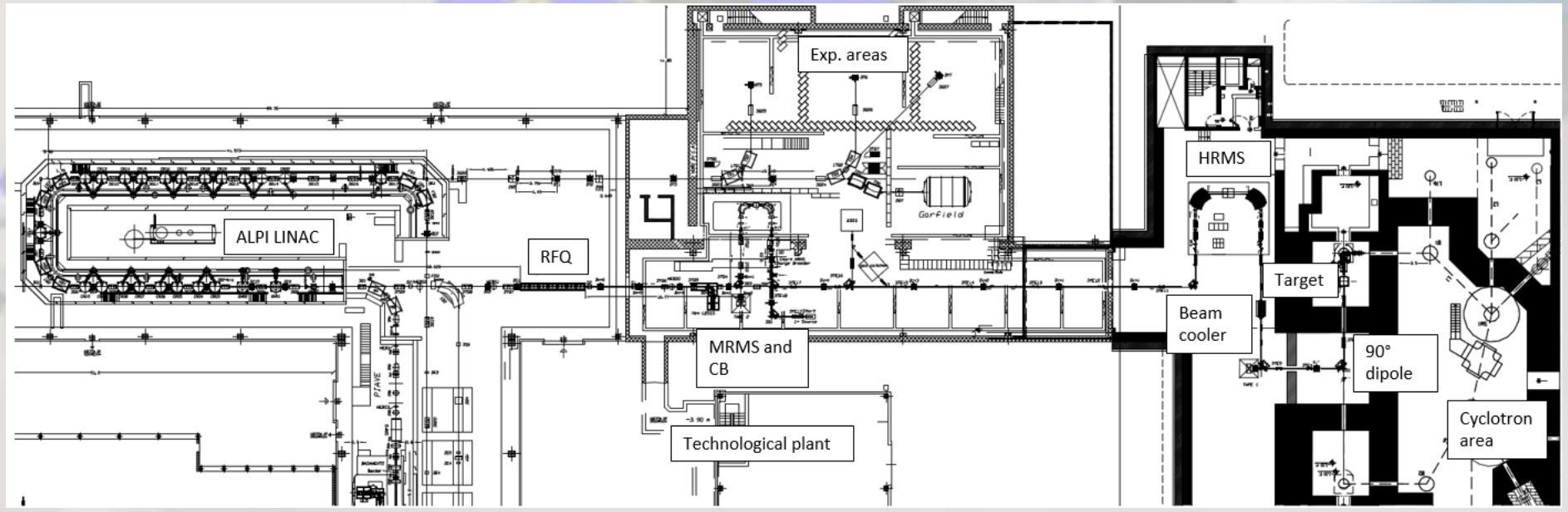
WORK PACKAGE # 5

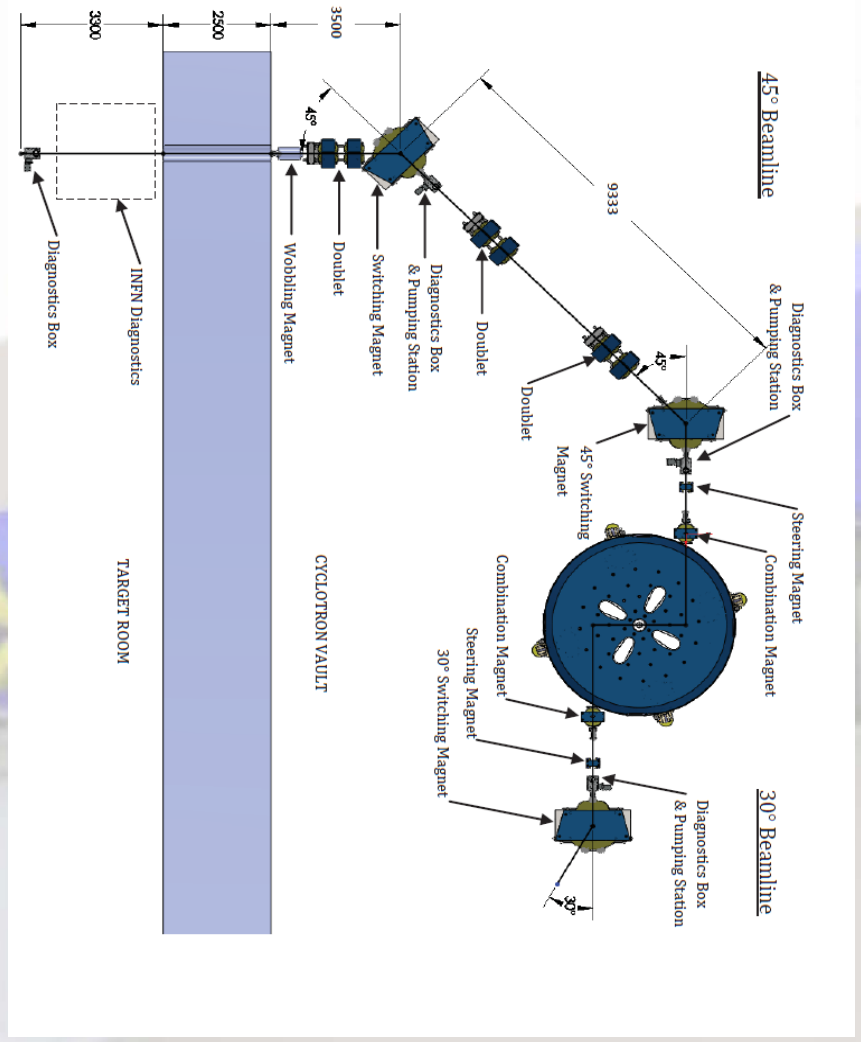
THE CYCLOTRON AND THE BEAM LINE

- INTRODUCTION
- WORK DONE IN 2014
- NEAR FUTURE PLANNING
- SUMMARY

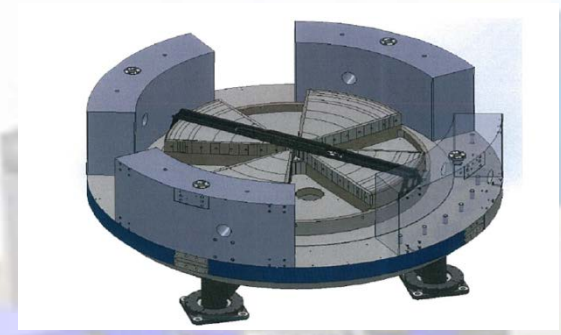
•MANDATE

- Acquisition of a commercial proton accelerator.
- Follow the realization and the delivery
- Follow the installation, the commissioning and the acceptance test
- Acquisition of the personnel for the running supervision

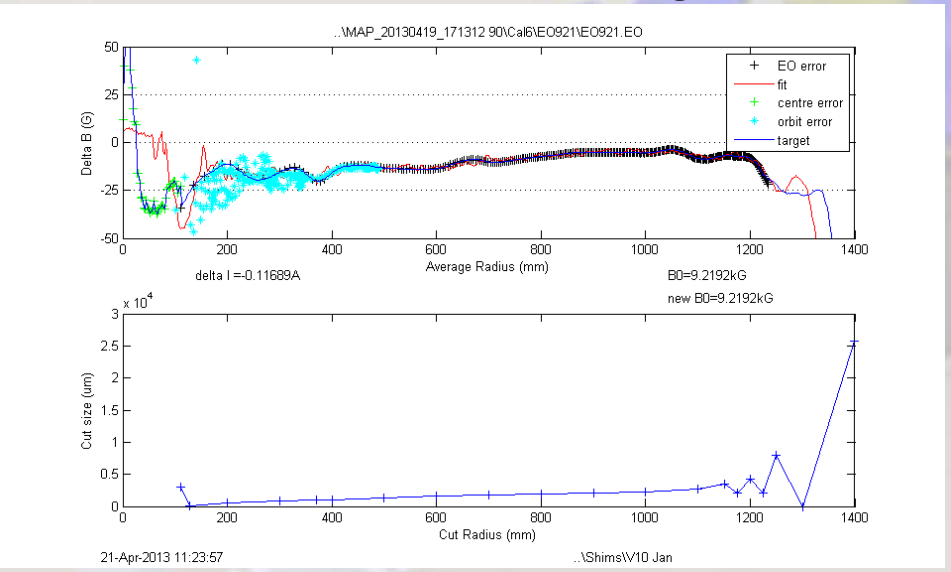




A proton driver based on a cyclotron with energy 40-50 MeV and current 0.2 mA fulfils the requirements for the SPES project as the direct target is actually designed for 8kW power. A driver with a capability of ≈50KW (70 MeV, 0.7 mA)



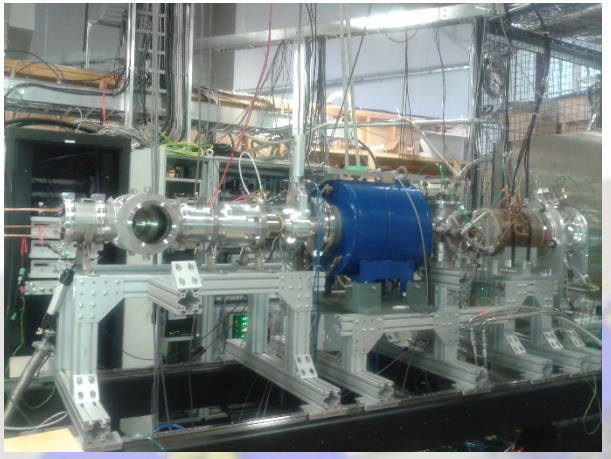
Magnetic field measuring device



- **Excellent agreement model to measurement**
- **Excellent predictability of changes**
- **Very low imperfection harmonics (<2 G)**
- **Shimming completed on May 2013**

Within 20G before coil adjustment

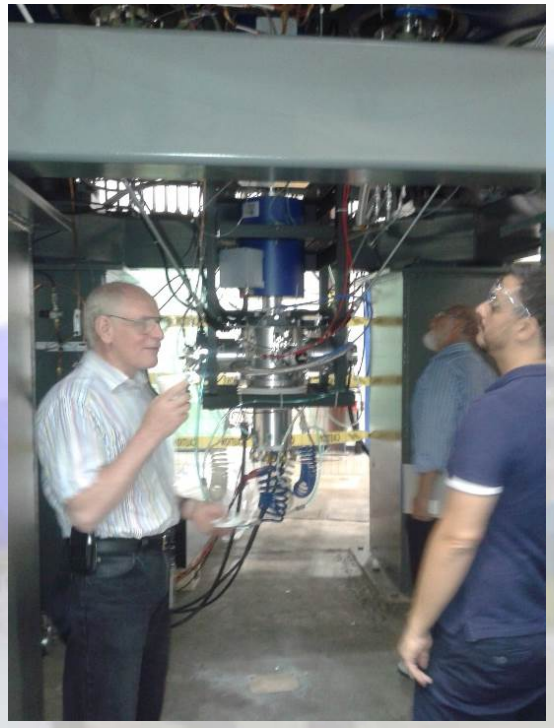
Vancouver visit of May 2014

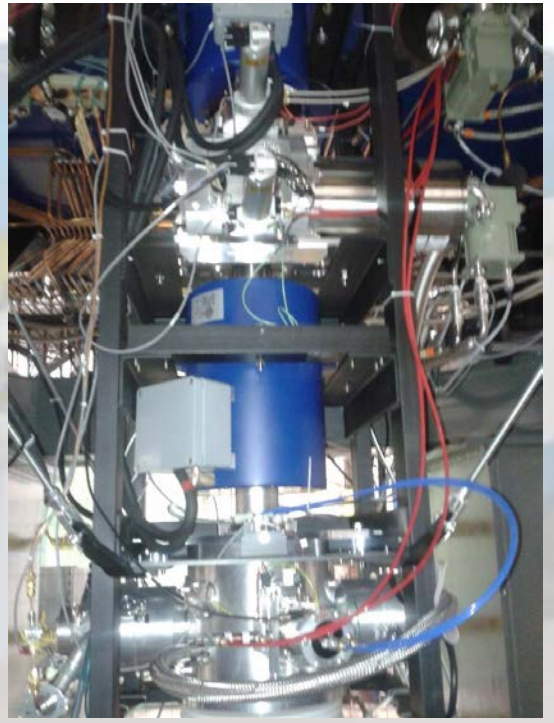


Acceptance Test for Ion Source:

- 6 mA of H- have been extracted with good reliability
- Waiting for upgrade up to 10 mA
- Injection line was assembled and preliminary test of beam transmission was done

Ottawa visit of August 2014





Resonator tuned at: $f_o = 56.199600 MHz$

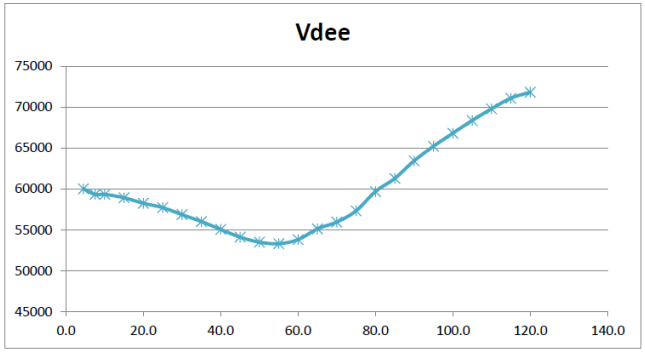
Input reflection coef: $S_{11} = -65dB$ (average value -56dB)

Quality factor loaded: $Q_l = 3156$ unloaded value expected to be approximate 6300.

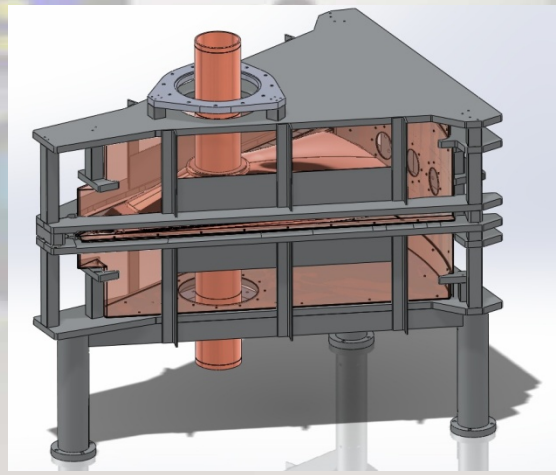
$\Delta f_{coarse} = 30.8 kHz/mm$ 161mm

$\Delta f_{fine} = 30.0 kHz/mm$ ±10mm

The main magnet ready for the rf resonators

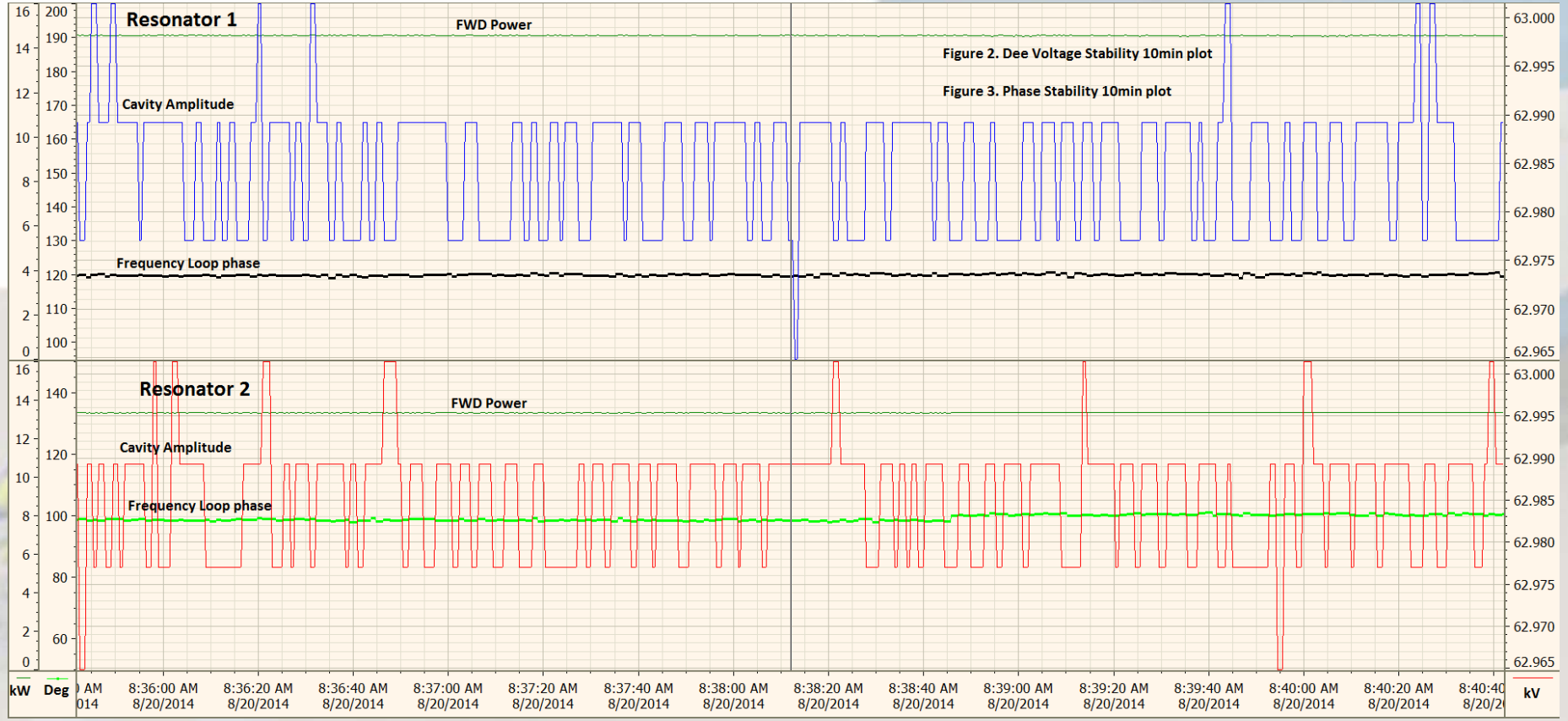


The D voltage distribution



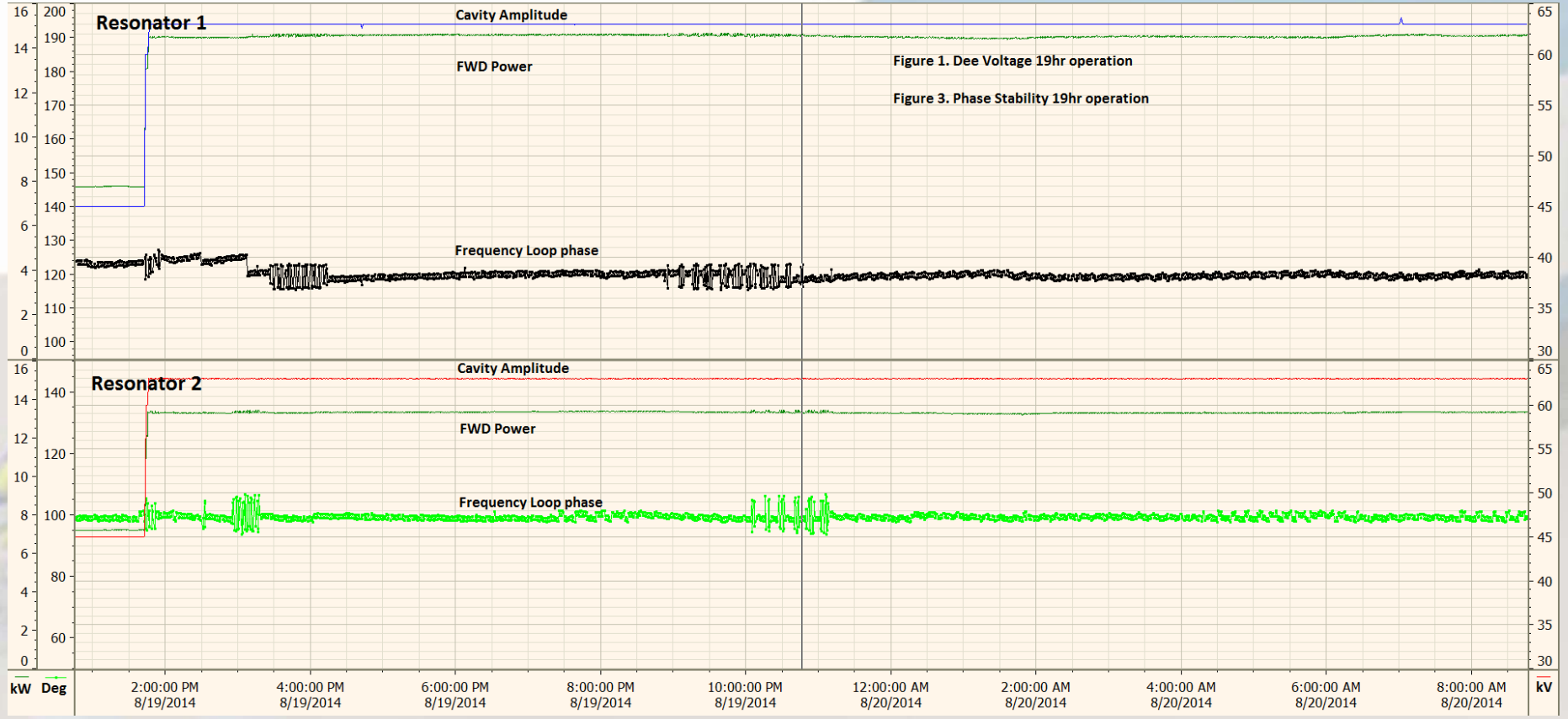
The first rf resonator successfully tested inside the test stand

Voltage Amplitude Stability



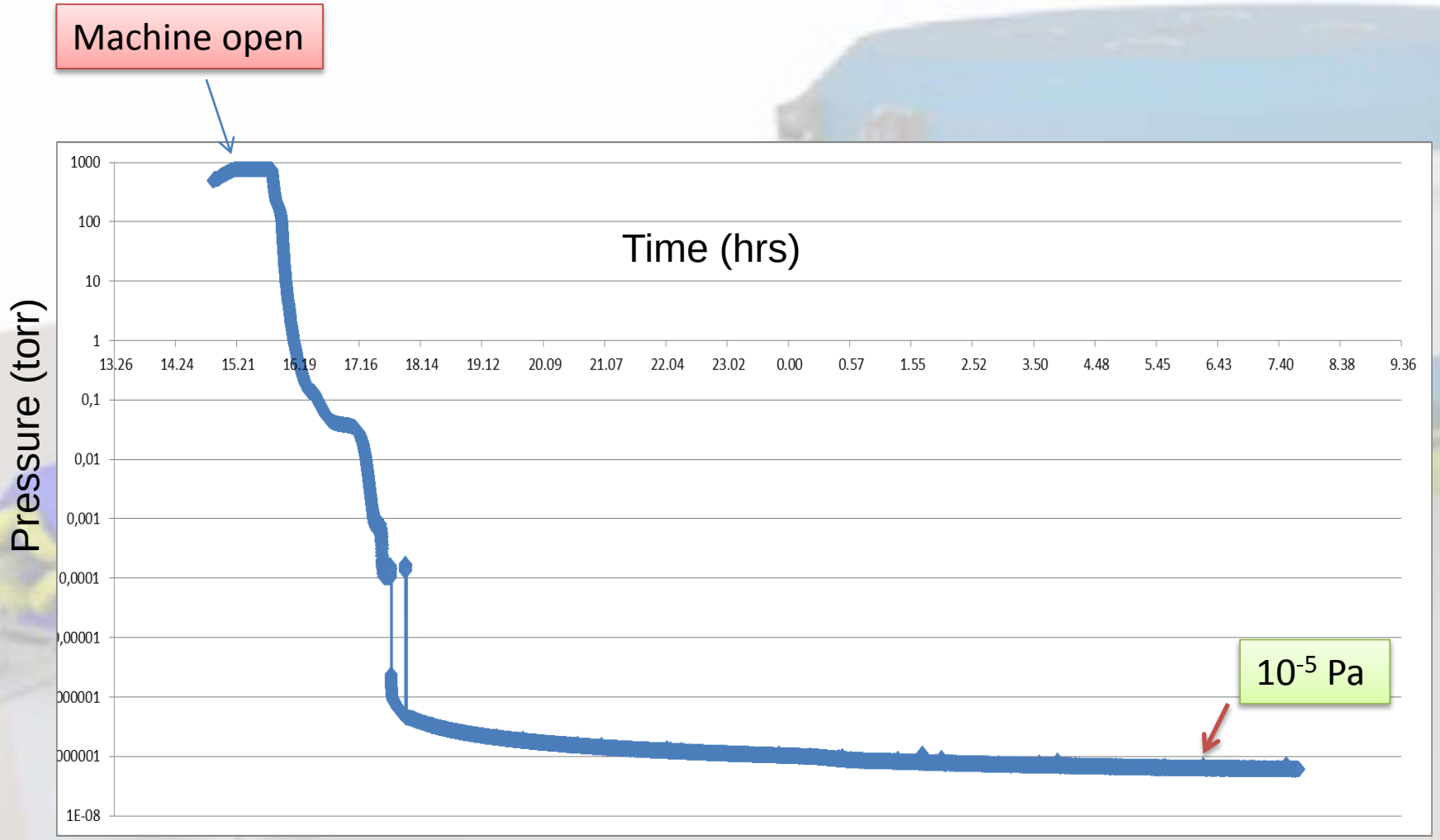
Stability within ± $2.5*10^{-5}$

Long Time Test Stability



Both cavities with 62 kV voltage and 14 kW FWD RF power each

Pressure Vacuum Tank Performance



Test done on October 9th

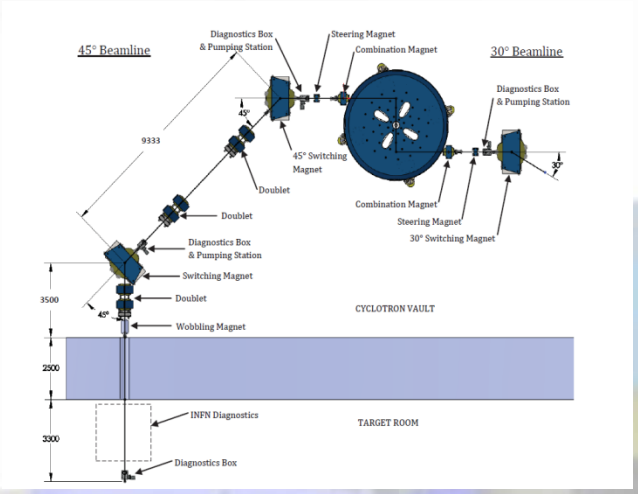


TABLE 1. TRACEWIN STARTING BEAM CONDITIONS (AT THE COMBO MAGNET ENTRY FACE)

Parameter	35 MeV	50 MeV	70MeV
Horiz. RMS Emittance (π mm mrad)	9.893	4.276	1.895
Horiz. Twiss α at crossover	-0.697	-1.115	-1.124
Horiz. Twiss β at crossover	1.998	2.493	2.538
Horiz. Twiss α at combo entry	-0.585	-0.981	-0.991
Horiz. Twiss α at combo entry	1.806	2.179	2.221
Vert. RMS Emittance (π mm mrad)	7.792	6.544	5.730
Vert. Twiss α at crossover	-0.561	-0.235	-0.165
Vert. Twiss β at crossover	0.721	0.853	1.288
Vert. Twiss α at combo entry	-0.287	-0.050	-0.045
Vert. Twiss β at combo entry	0.594	0.810	1.256

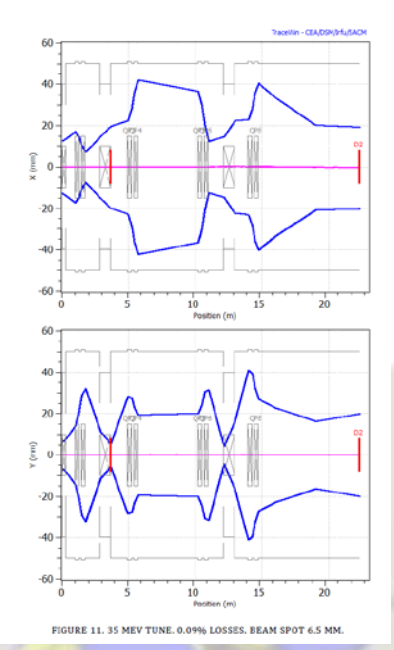


FIGURE 11. 35 MEV TUNE. 0.09% LOSSES. BEAM SPOT 6.5 MM.

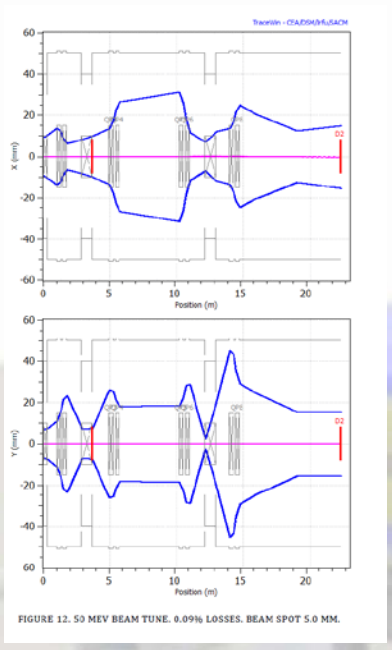
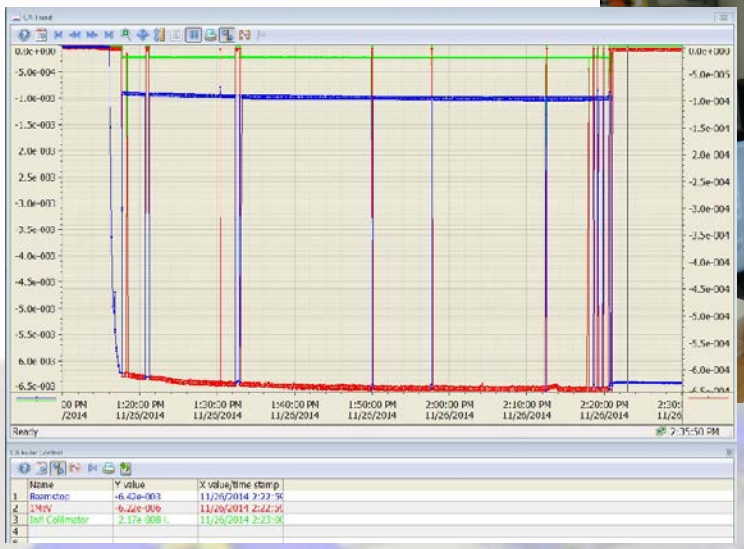


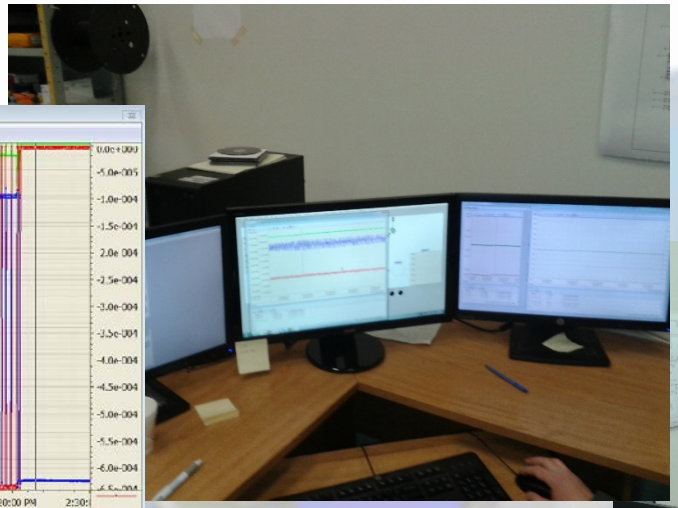
FIGURE 12. 50 MEV BEAM TUNE. 0.09% LOSSES. BEAM SPOT 5.0 MM.

Simulations

Real components

Ottawa November 25-28 2014





The Factory Acceptance related to the beam test:

- Low current test completed (440 microA @ 1MeV)
- High current test partially completed (700 microA @1MeV)
- Reliability problem (electonic control board, Insulation transformer,..)
- Components to be replaced (lower coil, insulation trensformer, source upgrading)

The proposed schedule for the completion of the Cyclotron delivery made by the BEST company

Best Theratronics

MEMORANDUM

Topic:	Milestone schedule
Date:	14 October 2014
System:	Best 70p Cyclotron INFN-LNL
Document Serial Number:	ME700_01_002
Author:	Leandro AC Piazza

Summary

This memorandum describes the proposed update to the milestone schedule from what was originally agreed in the Best 70 Cyclotron Technical Offer, March 2010 [BEST] and further updated with the Best Milestone Schedule Memorandum [ME700_01_001].

Memorandum ME700_01_0

Going forward, Best does not anticipate any further delays to the schedule.

Proposal

Based on the FAT progress achieved on October 9th, Best proposes the following revised milestone schedule.
Cyclotron services installation at INFN-LNL will start at the achievement of Milestone 4:

Milestone	Target
MS0: Contract effective date	Complete
MS1: Submitting technical docs to INFN-LNL for approval	Complete
MS2: Start of development and manufacturing	Complete
MS3: Start of cyclotron factory tests	Complete
MS4: Delivery of cyclotron to INFN-LNL (leaving Ottawa)	Jan 2015
MS5: Beginning of installation at INFN-LNL	March 2015
MS6: End of installation and start of on-site test	May 2015
MS7: Beginning of commissioning (and SAT)	June 2015
MS8: End of commissioning	Sept 2015

This memorandum is official when approved by one of the following:

Richard R. Johnson
General Manager
Best Cyclotron Systems Inc

Vasile Sabaiduc
Director of Operations
Best Cyclotron Systems Inc.

Future

- **Preparation of the Acceptance Tests Documents and protocols**
  - **Site Acceptance Test (SAT)**
- **Definition of FAT (additional) and SAT schedule.**
- **Synchronization of the Cyclotron delivery and the Building construction**
- **Supervision of the Site Installation and interface with the Building Construction activities**
- **Participation at the SAT**

HAPPY ENDS

Thank you for the attention

The working group

Group leader (RUP)	A. Lombardi
Machine Phisicist (Deputy)	M. Maggiore
Machine Phisicist	Daniela Campo
Consultant	L. Calabretta
Consultant	C. De Martinis

The BEST Theratron Company