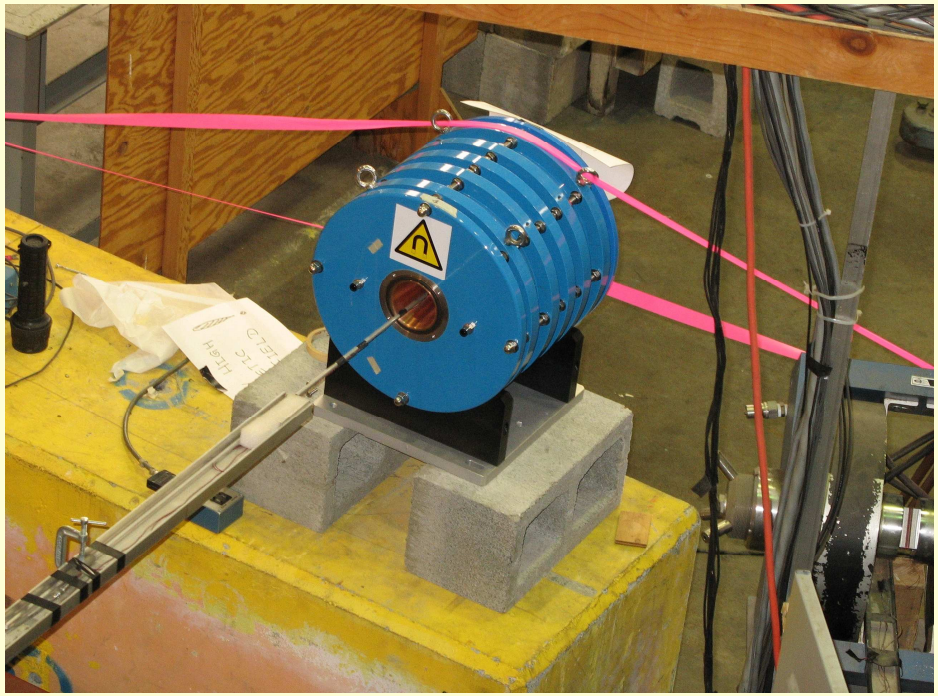
IMMW – 15

Hall Probe Measurements of Supernanogan

Doug Evans - Triumf

Supernanogan – New Permanent Magnet ECR Ion Source for OLIS (Offline Ion Source) for ISAC (Isotope Separation and Acceleration).

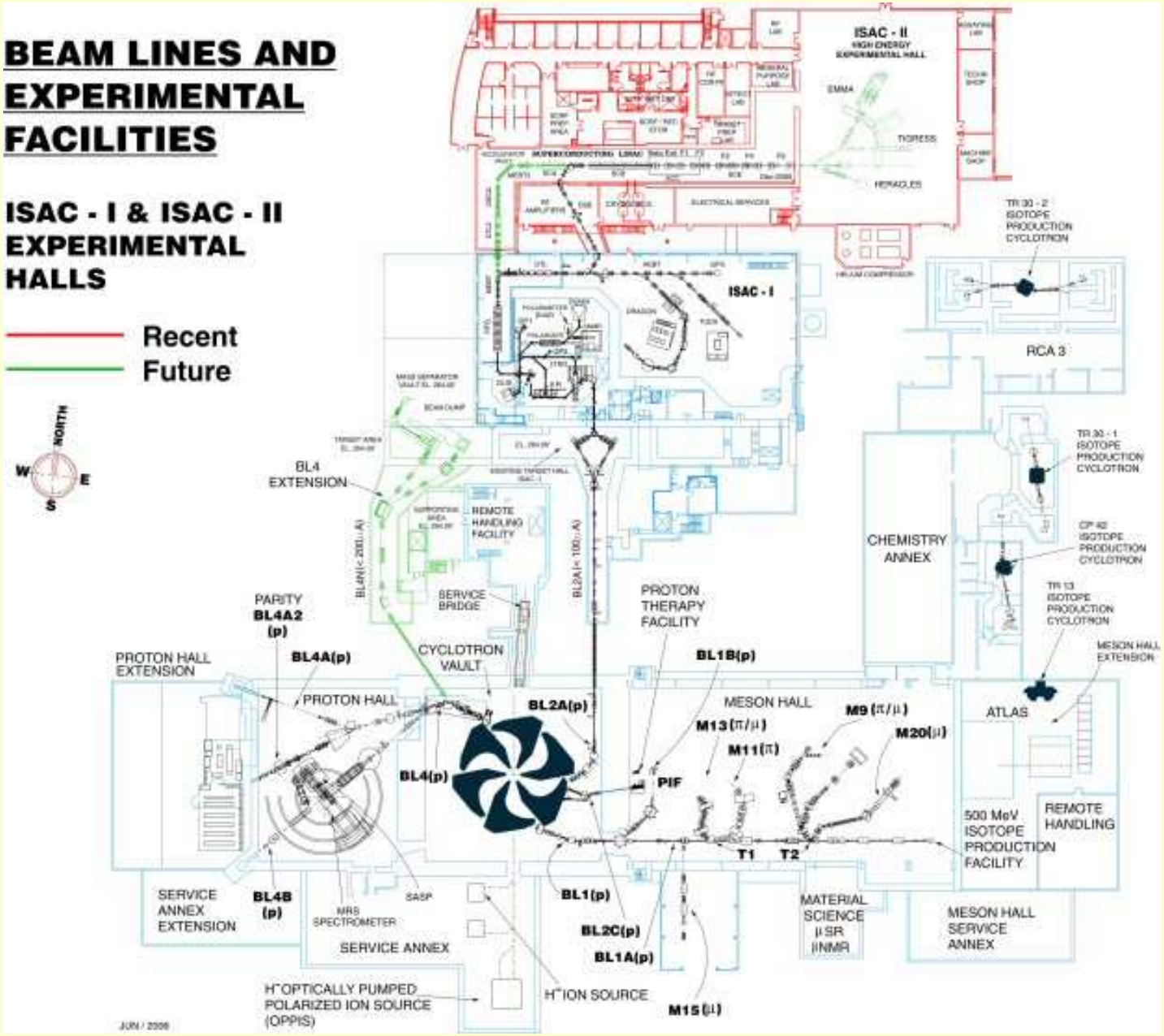


[5]

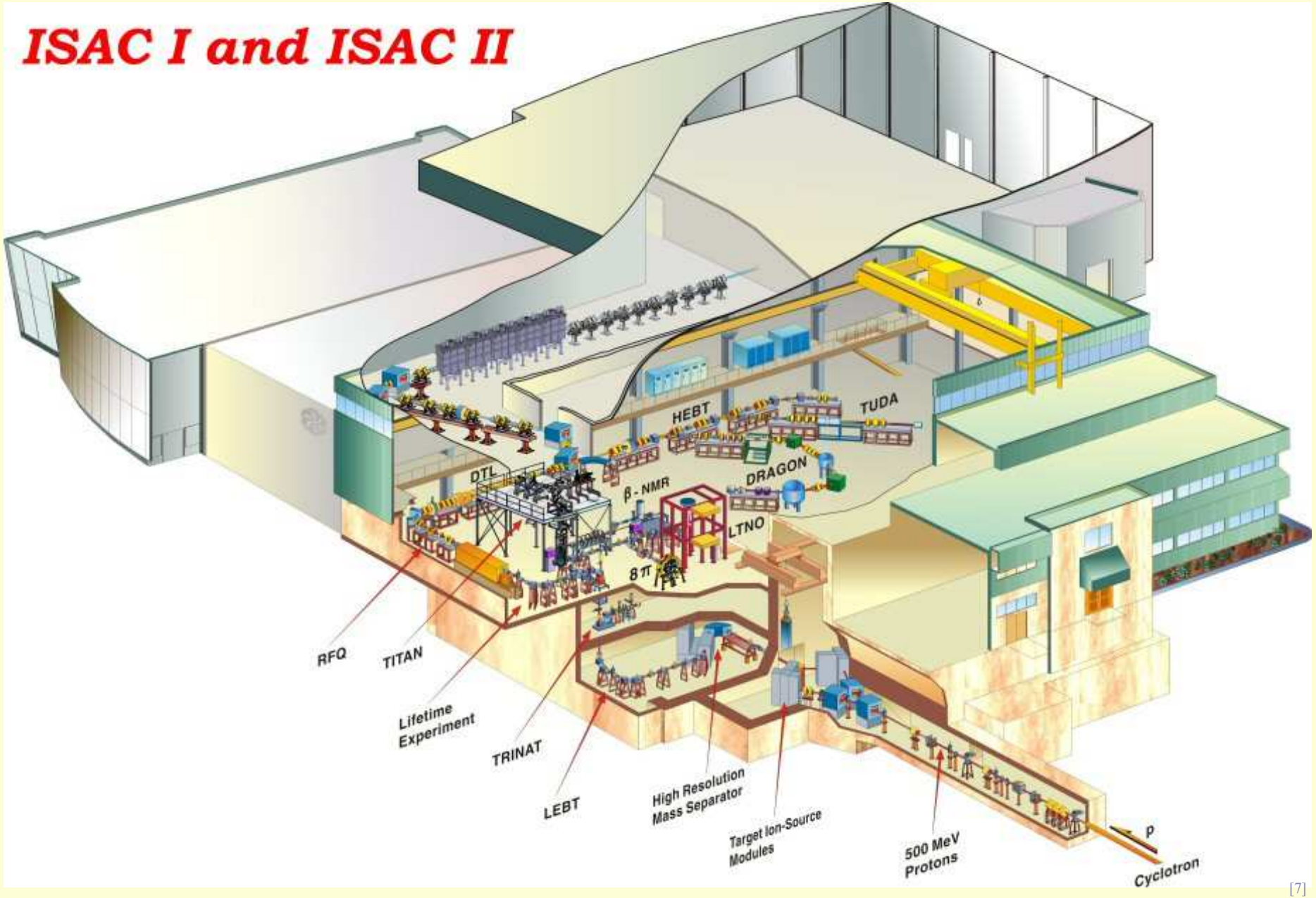
Manufactured by:
Pantechnik, Caen, France

[5]

TRIUMF
Vancouver, B.C., Canada


BEAM LINES AND EXPERIMENTAL FACILITIES
ISAC - I & ISAC - II EXPERIMENTAL HALLS
Recent
Future
NORTH
W
E
S
ISAC - II
HIGH ENERGY EXPERIMENTAL HALL
EMMA
TIGRESS
HERACLES
TR 30 - 2 ISOTOPE PRODUCTION CYCLOTRON
ISAC - I
RCA 3
TR 30 - 1 ISOTOPE PRODUCTION CYCLOTRON
CP 42 ISOTOPE PRODUCTION CYCLOTRON
TR 13 ISOTOPE PRODUCTION CYCLOTRON
MESON HALL EXTENSION
ATLAS
CHEMISTRY ANNEX
BL4 EXTENSION
REMOTE HANDLING FACILITY
SERVICE BRIDGE
PARITY BL4A2 (p)
BL4A(p)
PROTON HALL EXTENSION
PROTON HALL
CYCLOTRON VAULT
BL2A(p)
BL4(p)
PROTON THERAPY FACILITY
BL1B(p)
MESON HALL
M13 (π/μ)
M9 (π/μ)
M20(μ)
M11(π)
PIF
T1
T2
500 MeV ISOTOPE PRODUCTION FACILITY
REMOTE HANDLING
SERVICE ANNEX EXTENSION
BL4B (p)
MRS SPECTROMETER
SASP
SERVICE ANNEX
BL1(p)
BL2C(p)
BL1A(p)
MATERIAL SCIENCE μSR /NMR
MESON HALL SERVICE ANNEX
H⁻OPTICALLY PUMPED POLARIZED ION SOURCE (OPPIS)
H⁻ION SOURCE
M15(μ)
JUN / 2006

ISAC I and ISAC II



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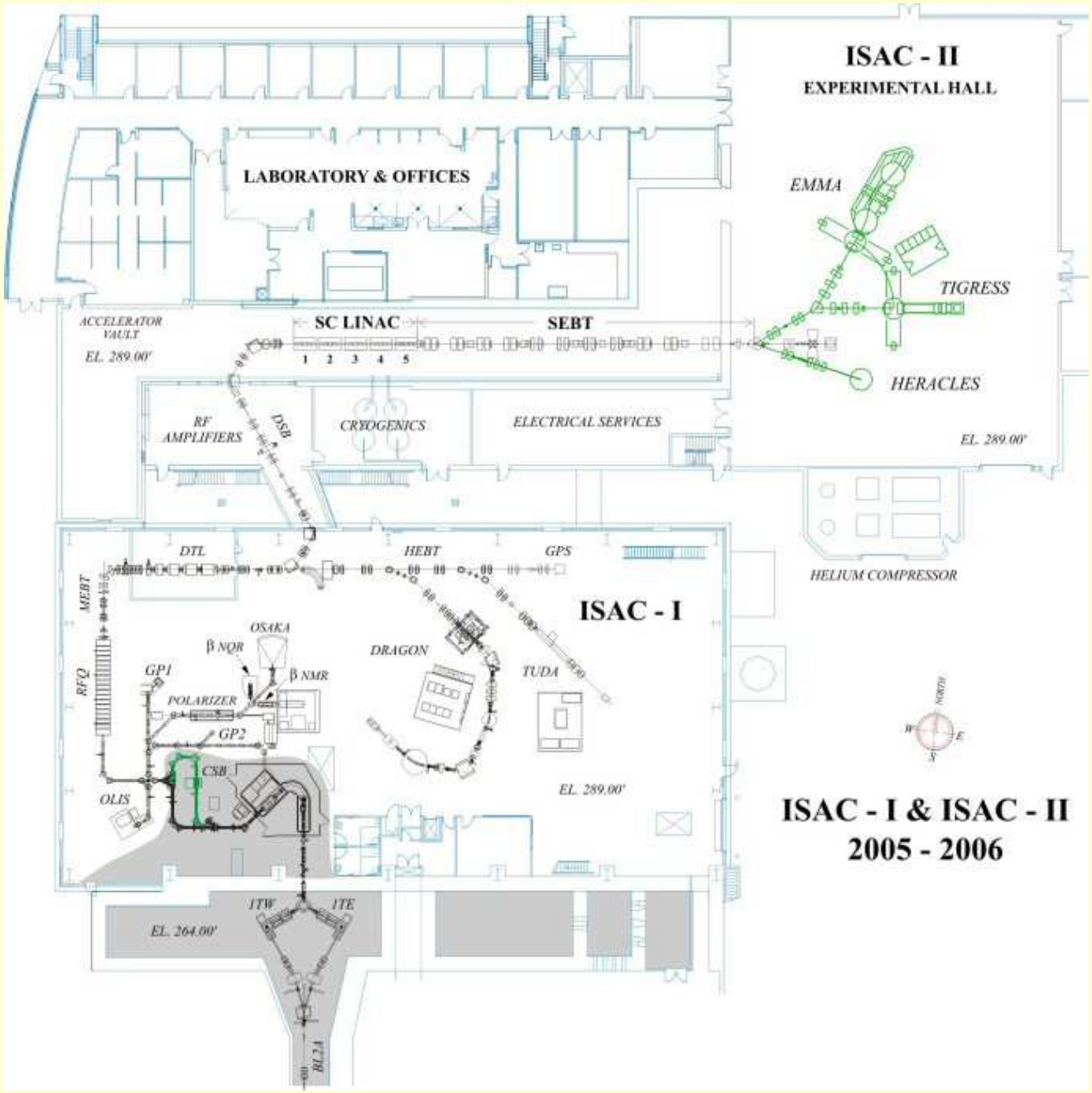
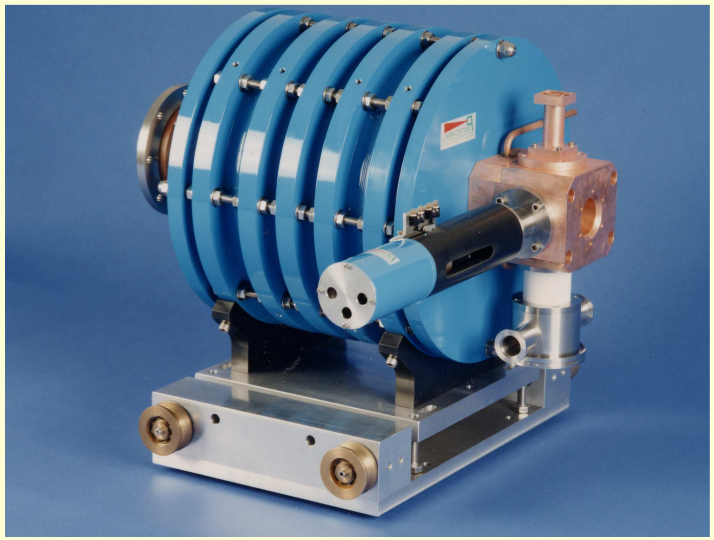

ISAC - II
EXPERIMENTAL HALL
LABORATORY & OFFICES
EMMA
TIGRESS
HERACLES
ACCELERATOR VAULT
EL. 289.00'
SC LINAC
SEBT
1 2 3 4 5
RF AMPLIFIERS
DSB
CRYOGENICS
ELECTRICAL SERVICES
EL. 289.00'
HELIUM COMPRESSOR
DTL
HEBT
GPS
MEBT
ISAC - I
OSAKA
β NQR
β NMR
DRAGON
TUDA
RFQ
GP1
POLARIZER
GP2
CSB
OLIS
EL. 289.00'
ITW
ITE
EL. 264.00'
BL2A
NORTH
W
E
S
ISAC - I & ISAC - II
2005 - 2006

Supernanogan Photo Gallery



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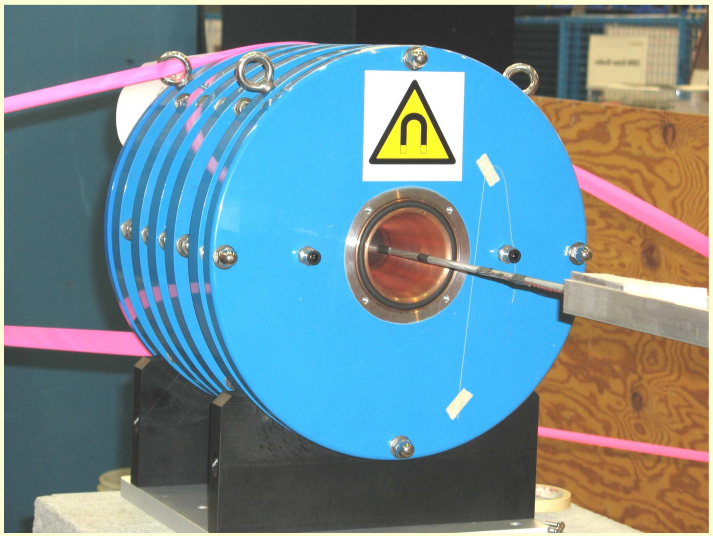

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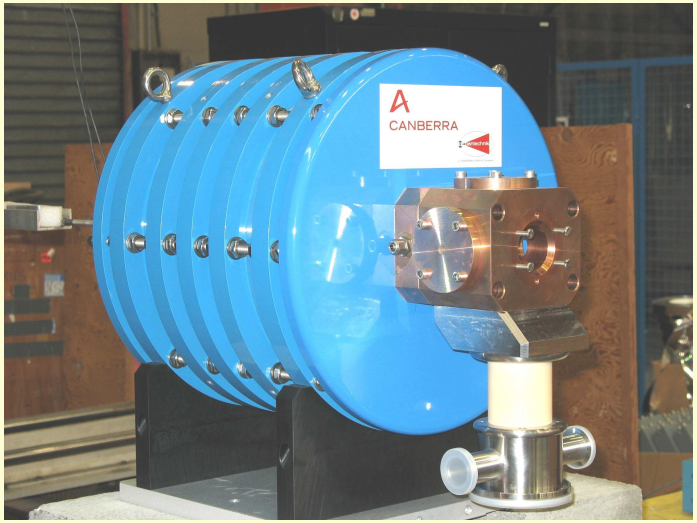

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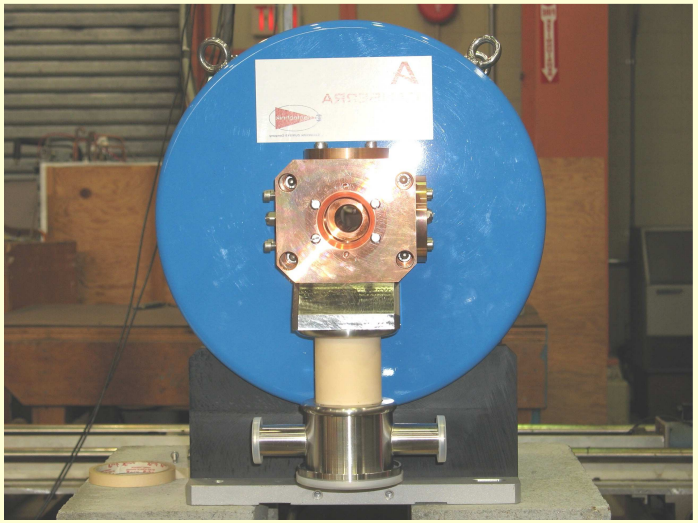


[5]

OLIS is used to provide stable beams for commissioning beamlines, accelerators, setting up tunes and experimental calibrations.

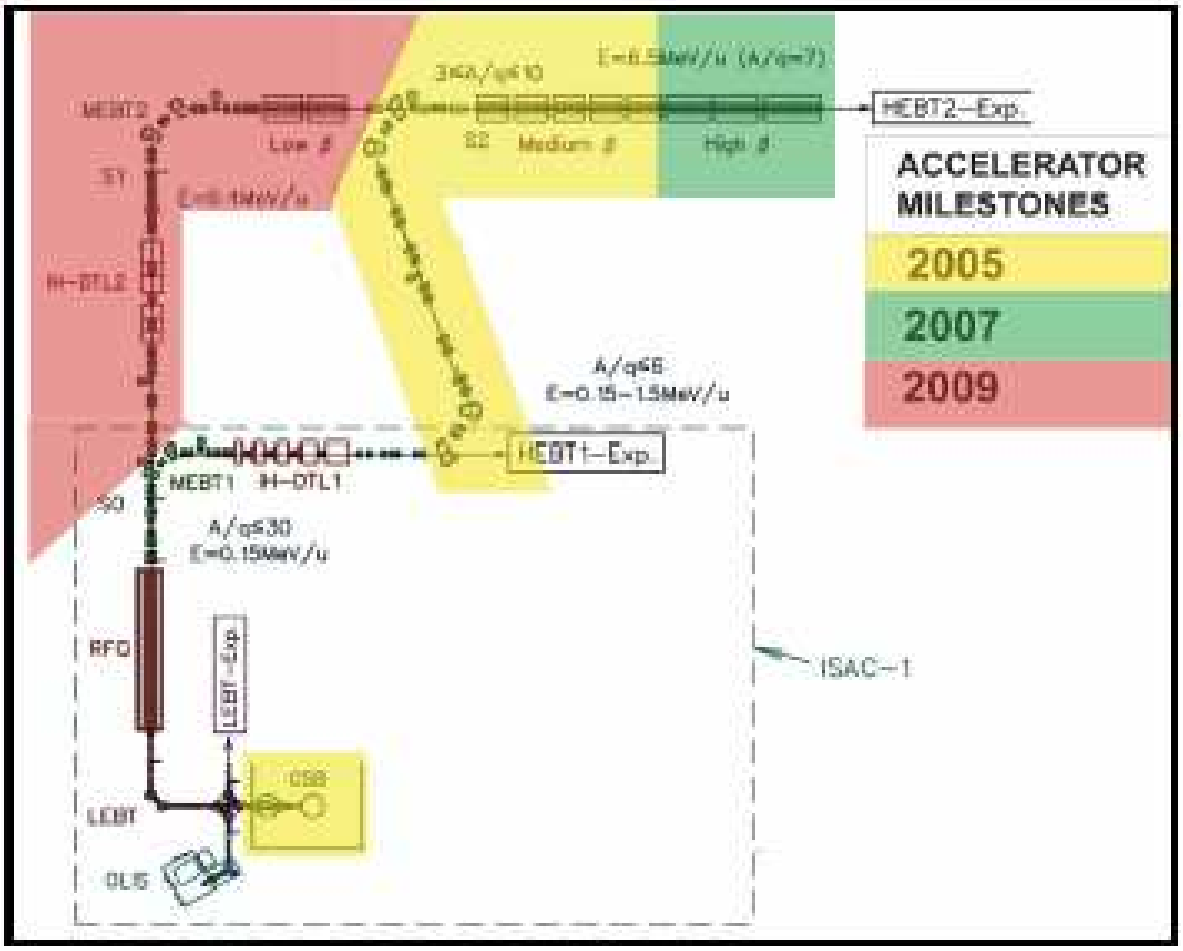
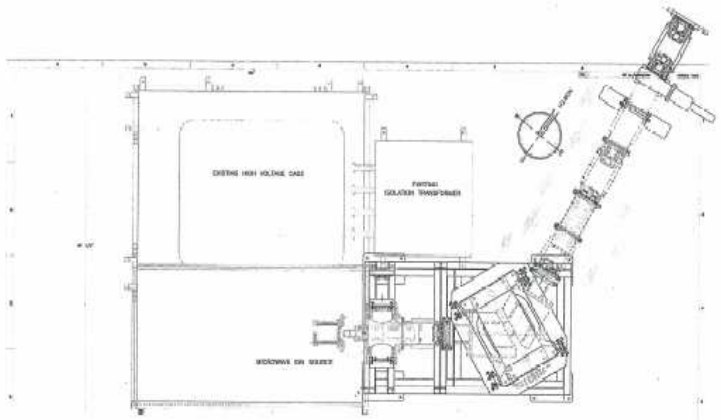


Figure 2. ISAC II accelerator layout with the projected completion dates for the three phases (color-coded).

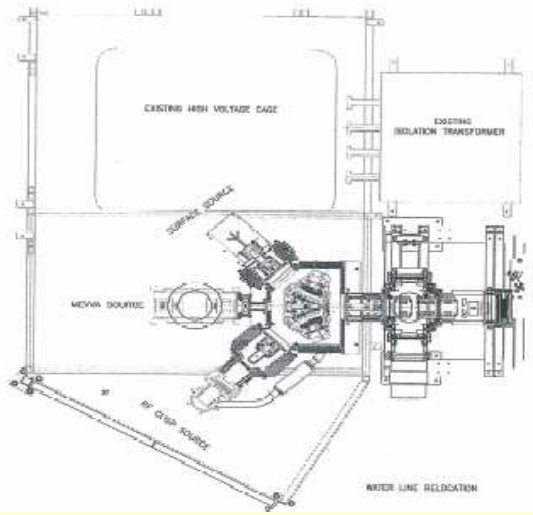
[2]

OLIS Upgrades for Heavier Ions and More Intensity

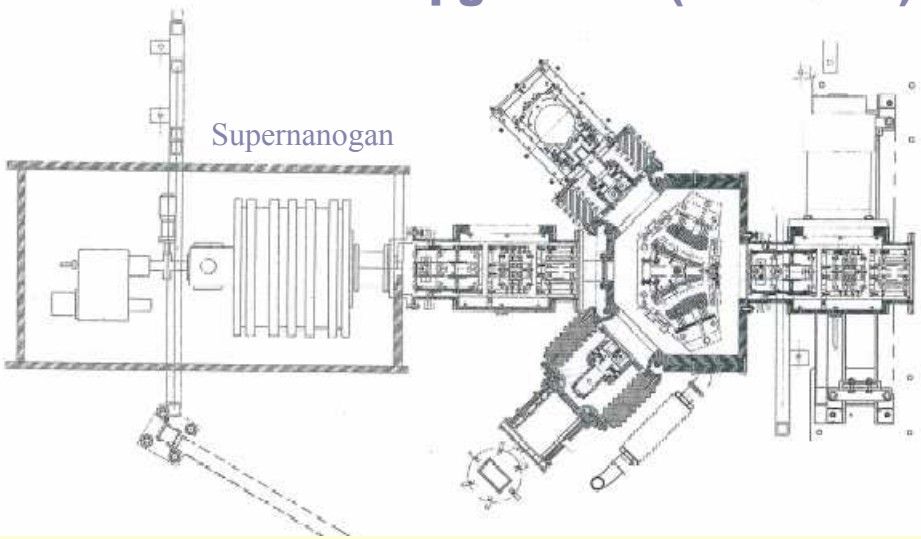
ORIGINAL OLIS (1996)



OLIS upgrade II (2001)

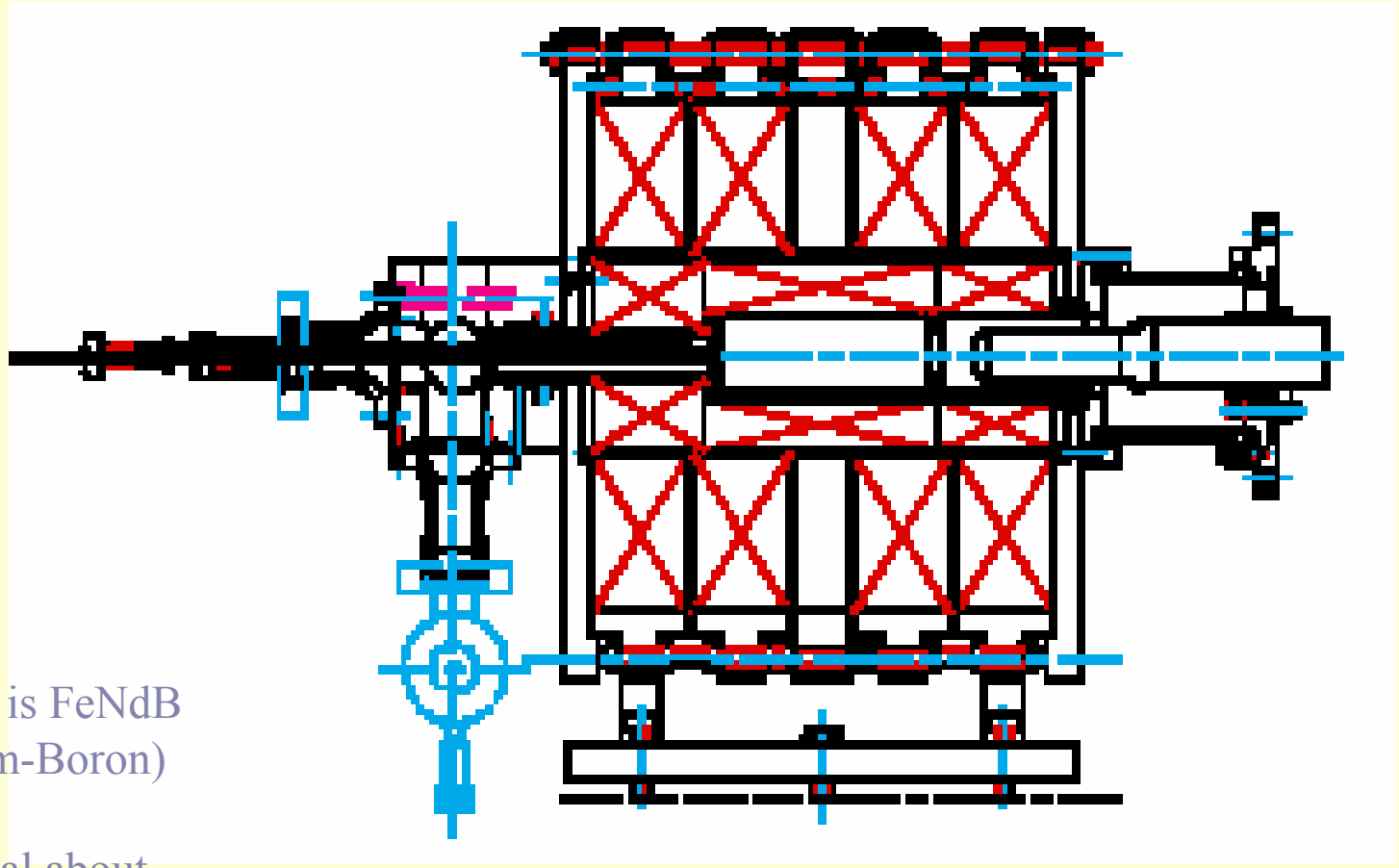


OLIS upgrade III (2006 - 07)



[1]

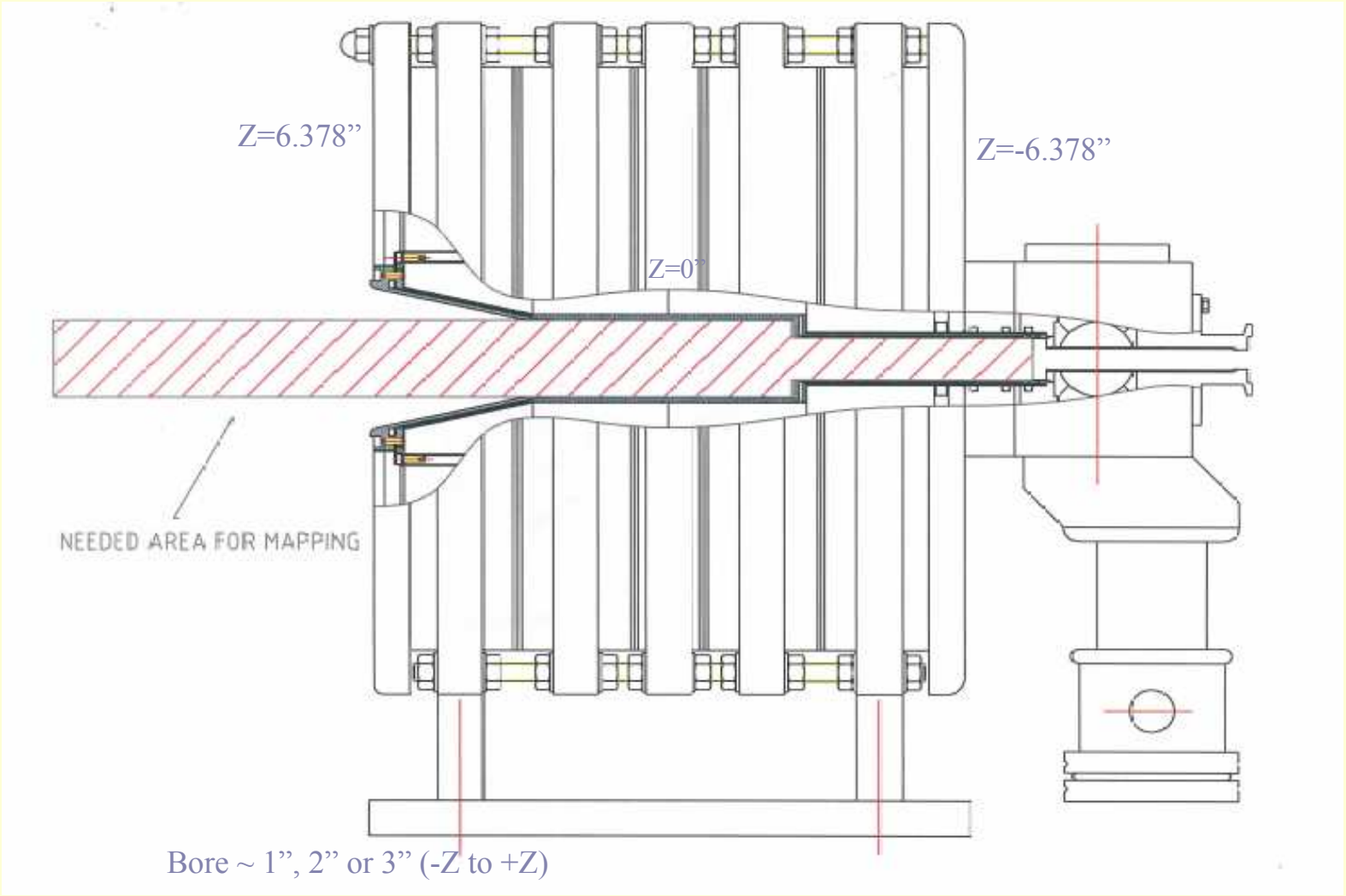
Supernanogan Permanent Magnet Positions (Axial B and Sextupole B magnet blocks).



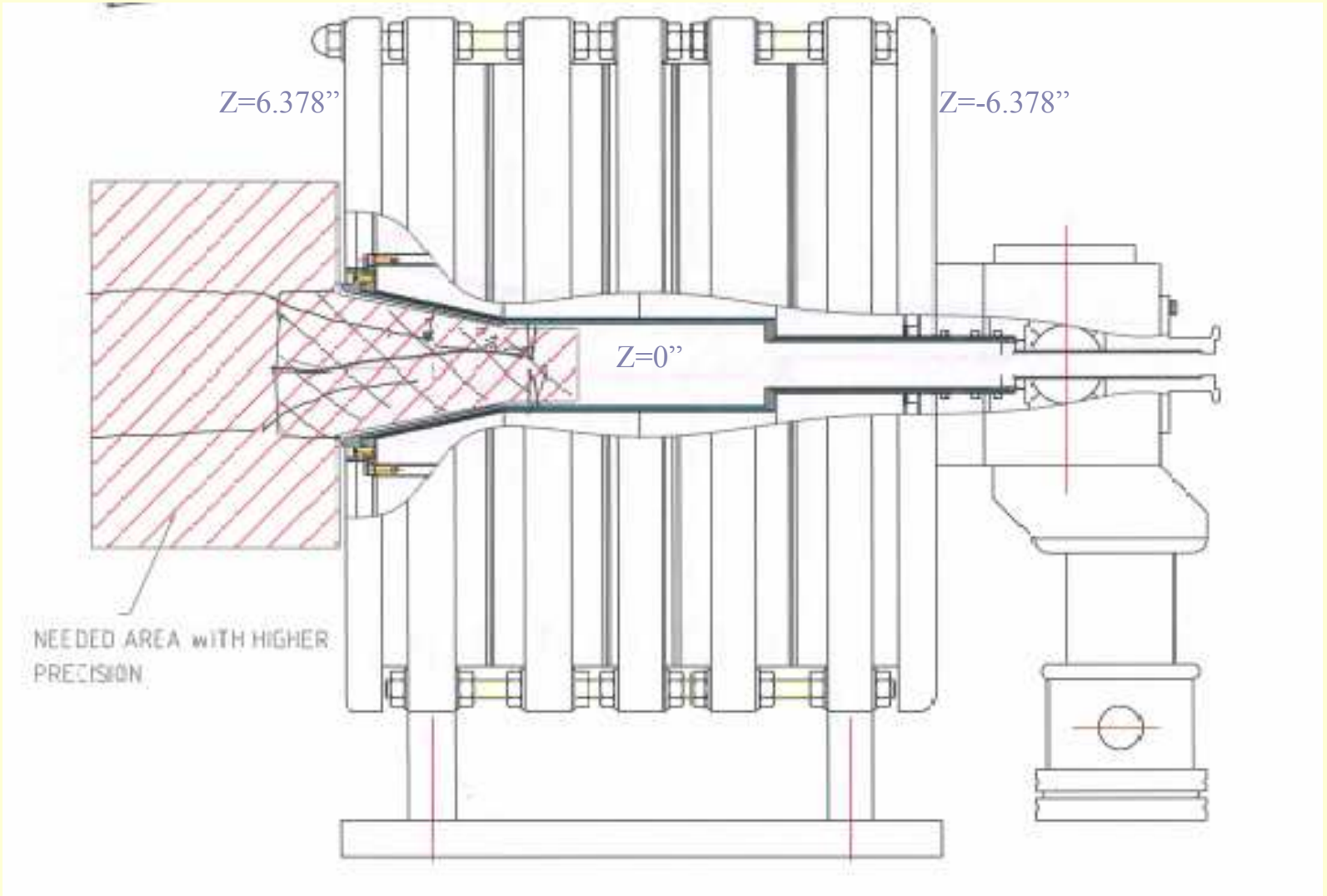
- Magnet Material is FeNdB (Iron-Neodymium-Boron)

-FeNdB blocks total about 265 lbs.

Schematic of Supernanogan showing required mapping area of all three B components.



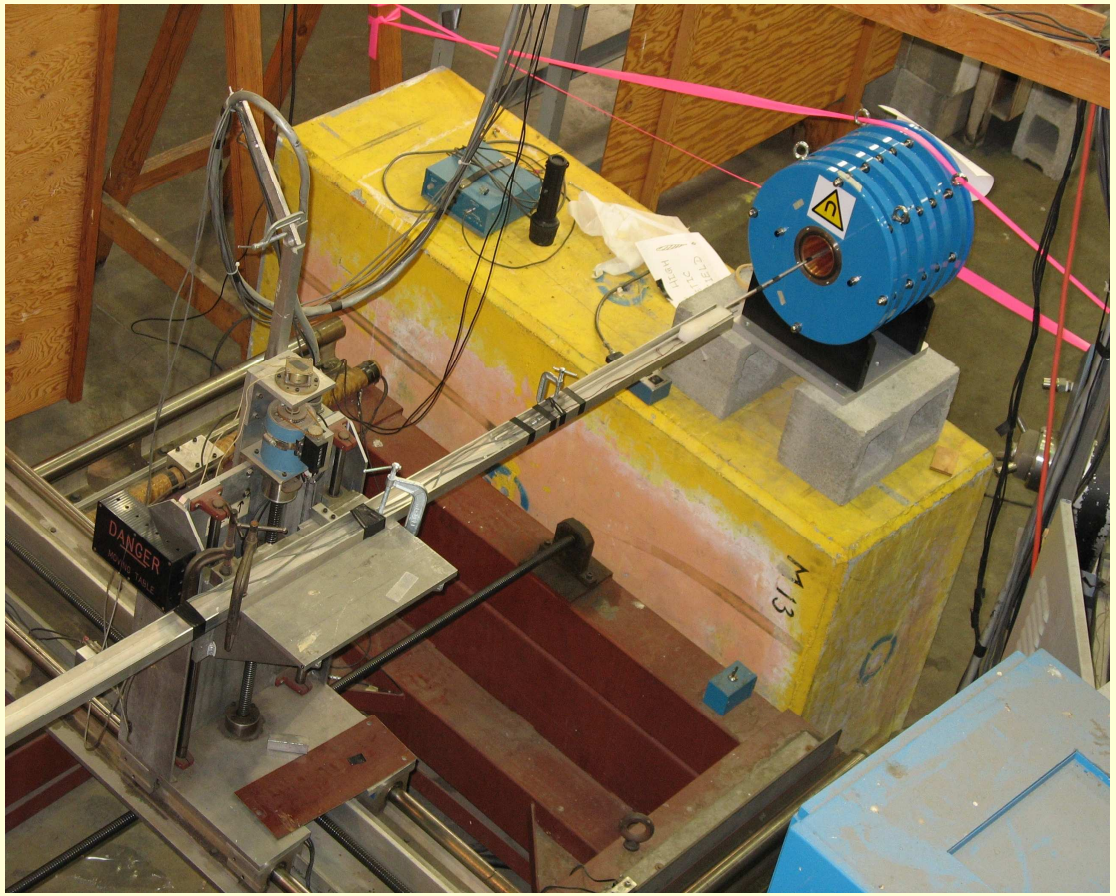
Supernanogan Schematic with required high precision mapping area shown.



[4]

Setup for Magnet Survey of Supernanogan for ISAC "Offline Ion Source" (OLIS).

- 3D Magnet Survey Table used. Moves on Rectangular grid or Cylindrical grid.
- Hall probes are Bell bht-910 probes.
- Measure in bore which is between 1.0" and 3.0" dia. and measure fringe field as well.
- Strong axial B with a sextupole field superimposed.
- Measure all 3 B components.



Specifications for Bell 910 Hall Probes

F.W.BELL

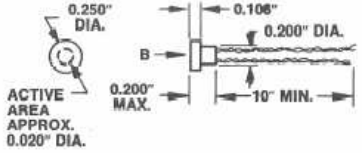
HIGH PERFORMANCE HALL GENERATORS

BH 900 SERIES
Cryogenic
High Linearity
High Field

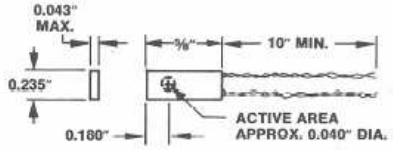
F. W. Bell, Inc. introduces the Series 900 Hall-Paks, a new line of high performance Hall generators bringing new standards of linearity, field range, and operating temperature range to the area of magnetic field measurements. This significant advancement in magnetic field sensors is the result of years of intensive development by F. W. Bell's Semiconductor Division. All units in this series are encapsulated in rugged, epoxy-sealed ceramic cases. A room temperature linearity error curve from −30 to +30 kG will be supplied indicating optimum operating conditions for each device. The models 900 and 921 are not calibrated above 30 kG.

- **HIGH LINEARITY** 0.1% to 30 kG (model 910)
- **CRYOGENIC OPERATION** 1.5 to 370 Kelvin (model 921)
- **WIDE DYNAMIC RANGE** −150 to +150 kilogauss (models 900 & 921)
- **50 ppm/°C TEMPERATURE STABILITY** (models 900 & 910)
- **SMALL SENSING AREA**
- **TRANSVERSE & AXIAL PACKAGES**

MECHANICAL SPECIFICATIONS



AXIAL HALL GENERATORS
BHA-900, 910 & 921



Note: Cross indicates tail of magnetic field vector.

TRANSVERSE HALL GENERATORS
BHT-900, 910 & 921

LEADS
Material: AWG 34 copper with teflon insulation (Model 921) or polyurethane insulation (Models 900 & 910).
Color Code: Control Current (I_c) — red, black; Hall Voltage (V_H) — blue, yellow.

POLARITY
If the control current enters the red lead (connected to the positive terminal of the current supply) and the magnetic field direction is as indicated above, a positive Hall voltage will be generated at the blue lead.

HALL PLATE LOCATION (Axial Hall Generators)
The Hall plate is symmetrical with the center line of the assembly and is located approximately 0.025" behind the front edge of the assembly.

BH 900 SERIES

HIGH PERFORMANCE HALL GENERATORS

ELECTRICAL SPECIFICATIONS

	BHT 900	BHT 910	BHT 921	BHA 900	BHA 910	BHA 921
Nominal control current, I_{cn}	100mA	100mA	100mA	100mA	100mA	100mA
Maximum Continuous control current, I_{cmax} (in 25°C static air)	300mA	300mA	300mA	300mA	300mA	300mA
Magnetic Sensitivity, γB, I_c = 100 ma	0.8mV/kG ±30%	0.8mV/kG ±30%	0.8mV/kG ±30%	0.8mV/kG ±30%	0.8mV/kG ±30%	0.8mV/kG ±30%
Typical Load Required for proper linearity	500Ω	50 to 500Ω	500Ω	500Ω	50 to 500Ω	500Ω
Linearity Error (I_c = 100ma) −30 to +30kG	±1.0% (max.)	±0.1% (max.)	±1.0% (max.)	±1.0% (max.)	±0.25% (max.)	±1.0% (max.)
Linearity Error (I_c = 100ma) −150 to +150kG	±1.5% (max.)		±2.0% (max.)	±1.5% (max.)		±2.0% (max.)
Operating Temperature Range	−40 to +100°C	−40 to +100°C	−269 to +100°C	−40 to +100°C	40 to +100°C	269 to +100°C
Mean Temperature Coefficient of Hall Voltage, β_T	±50 ppm/°C (max.)	±50 ppm/°C (max.)	±100 ppm/°C (max.)	±50 ppm/°C (max.)	±50 ppm/°C (max.)	±100 ppm/°C (max.)
Mean Temperature Coefficient of Resistive Residual Voltage, D_T	±0.07μV/°C (max.)	±0.07μV/°C (max.)	±0.07μV/°C (max.)	±0.07μV/°C (max.)	±0.07μV/°C (max.)	±0.07μV/°C (max.)
Mean Temperature Coefficient of Resistance, α_T	±0.15% / °C (max.)	±0.15% / °C (max.)	±0.6% / °C (max.)	±0.15% / °C (max.)	±0.15% / °C (max.)	±0.6% / °C (max.)
Resistive Residual Voltage, Vm, (I_c = 100mA)	50μV (max.)	50μV (max.)	200μV (max.)	50μV (max.)	50μV (max.)	200μV (max.)
Input Resistance in Zero Field, R_{in} (including leads)	1.0Ω*	1.0Ω*	1.0Ω*	1.0Ω*	1.0Ω*	1.0Ω*
Output Resistance in Zero Field, R_{out} (including leads)	1.0Ω*	1.0Ω*	1.0Ω*	1.0Ω*	1.0Ω*	1.0Ω*

Specifications subject to change without notice.

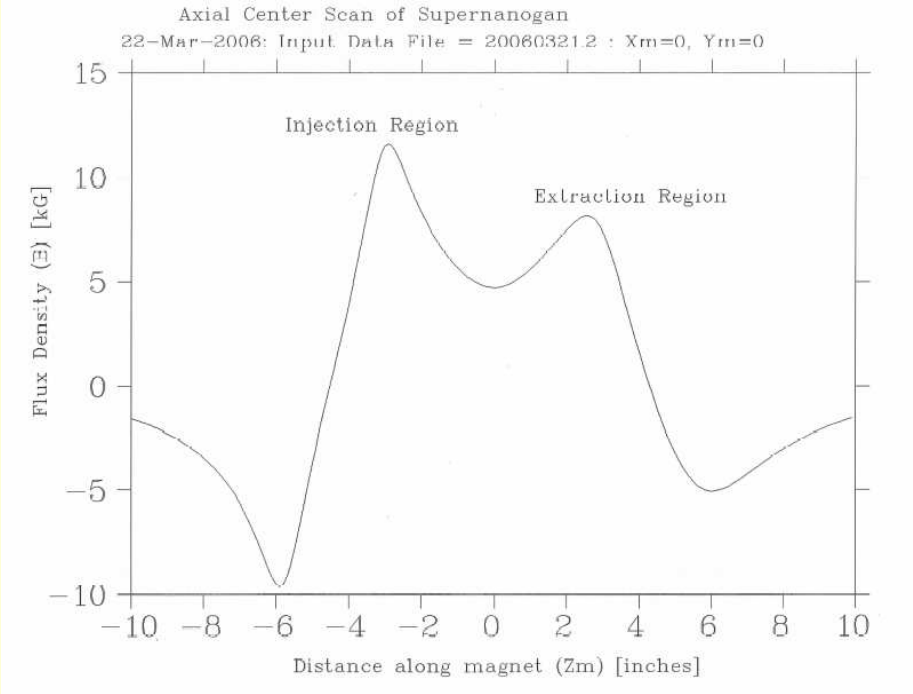
*Approximate value.

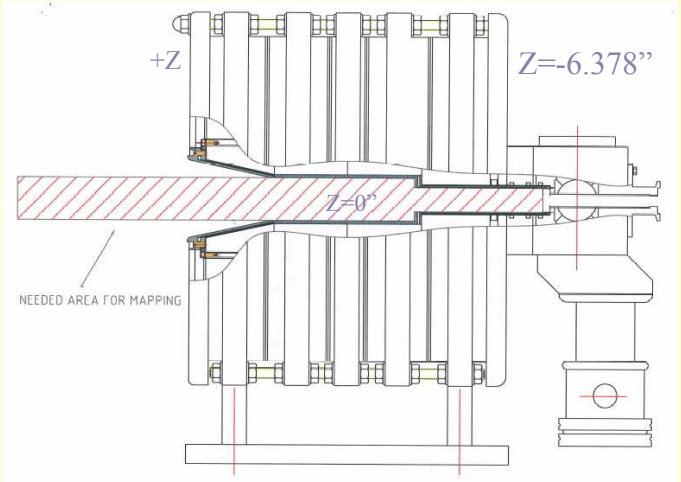
See MIL-STD-750-1 (WP) for definitions.

Note: Unless otherwise stated, all specifications apply at nominal control current with T = 25°C.

F.W.BELL
An Allegheny International Company
6120 Hanging Moss Rd.
Orlando FL 32807
Phone: 305-678-6900
TWX: 810-853-9115

Axial B Component Meas. Of Supernanogan.





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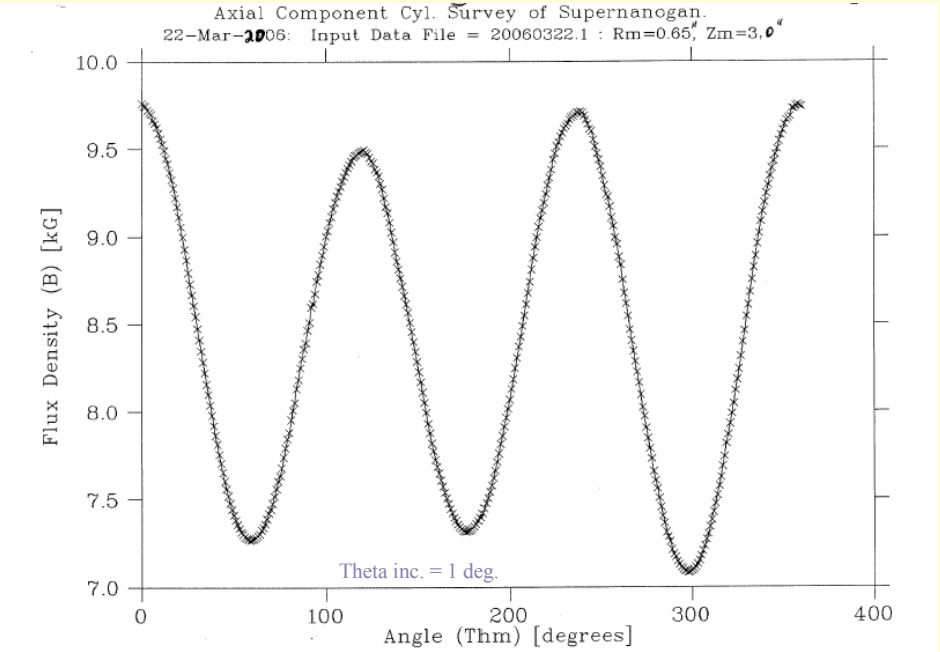
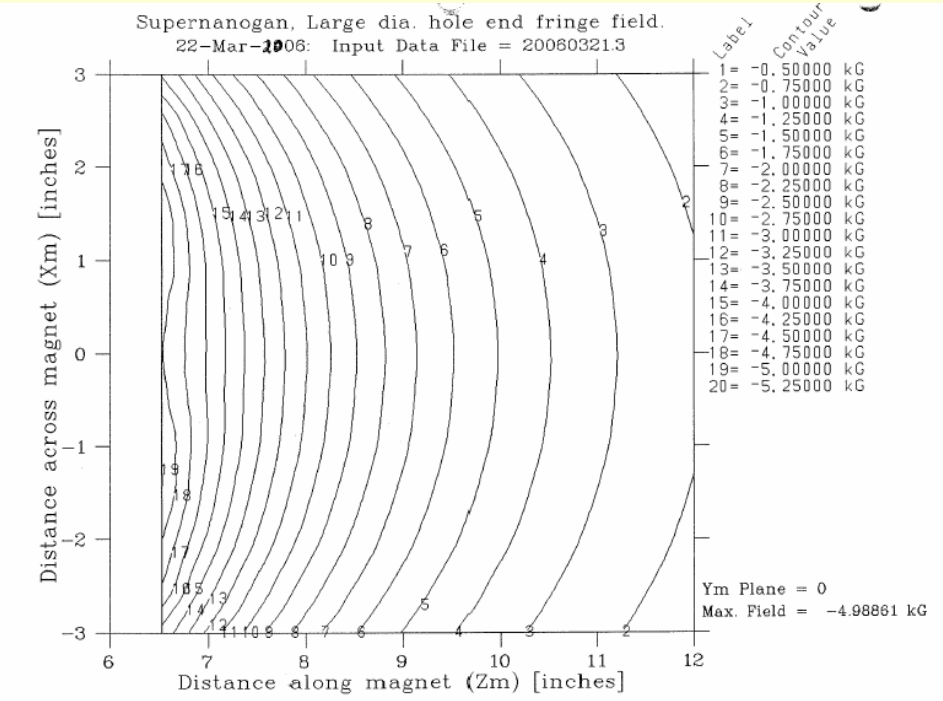
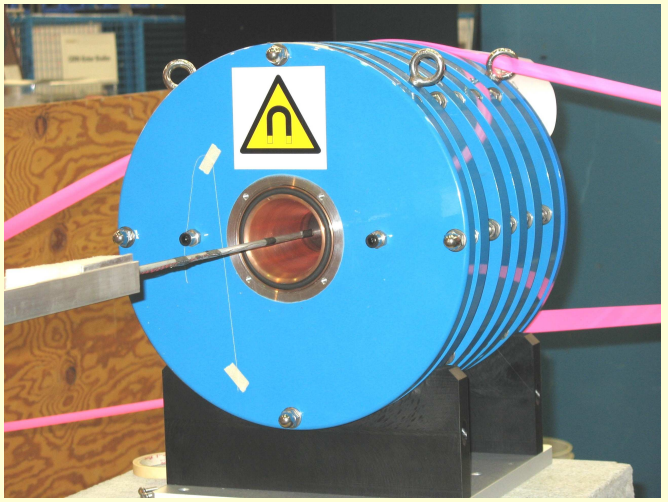


-Axial Peak B = 11.6 kG at the injection region.

-Axial Peak B = 8.1 kG at the extraction region.

Axial Component of B in Extraction Fringe Field Region





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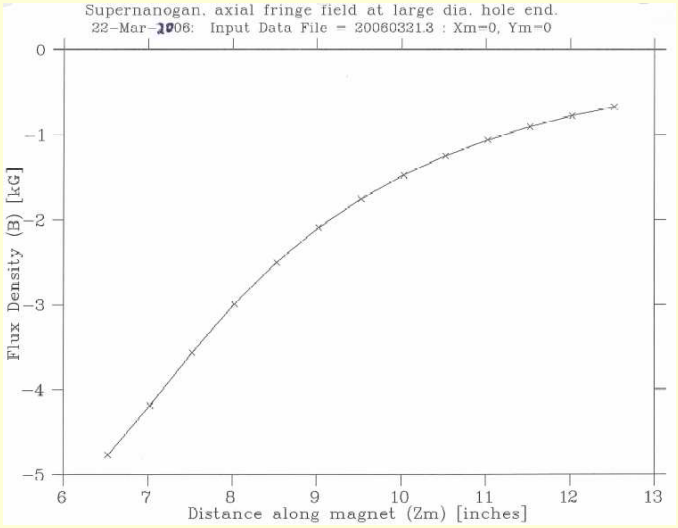
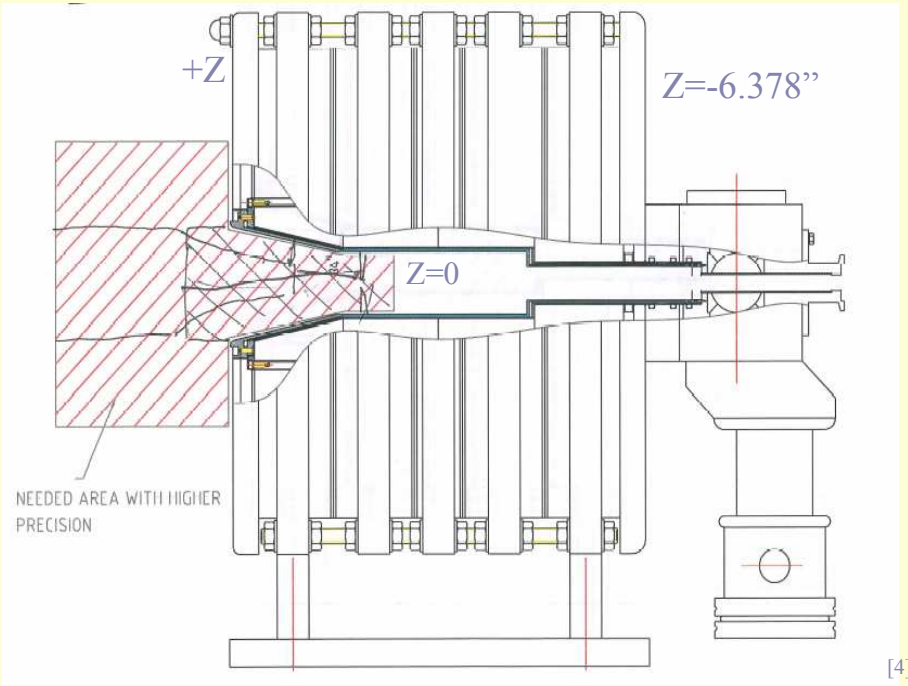
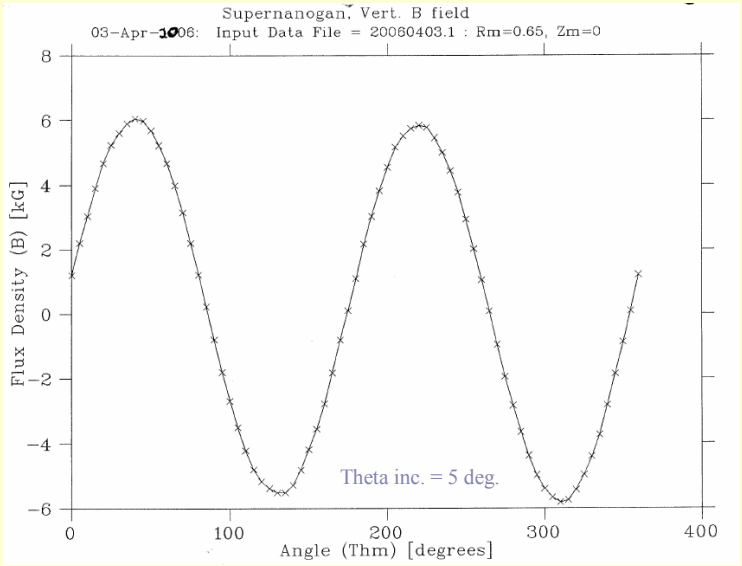
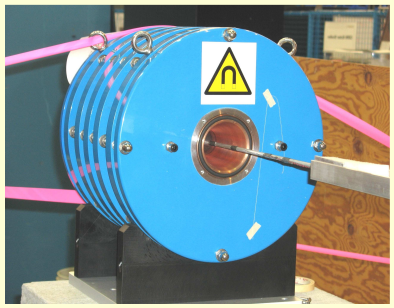




[4]

Cylindrical Survey Results for Vertical B and Horizontal B Components.





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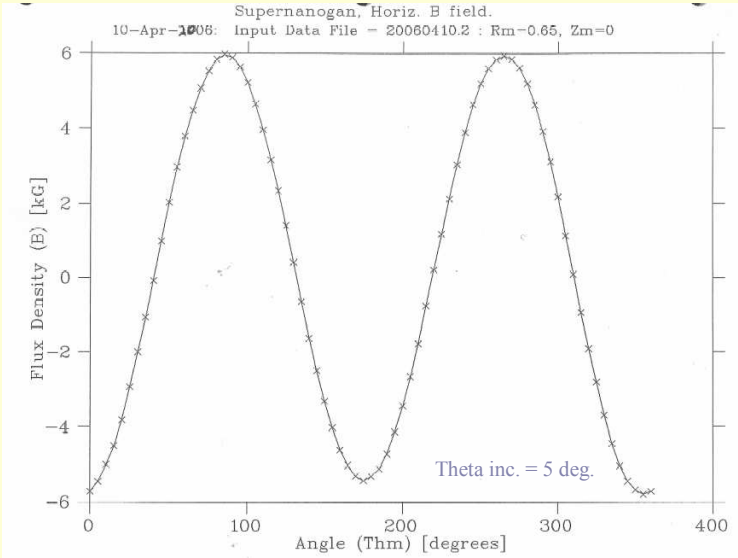

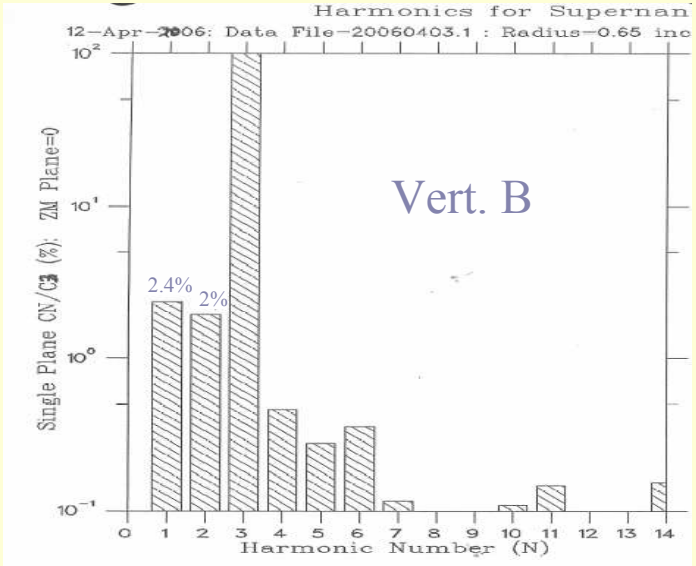

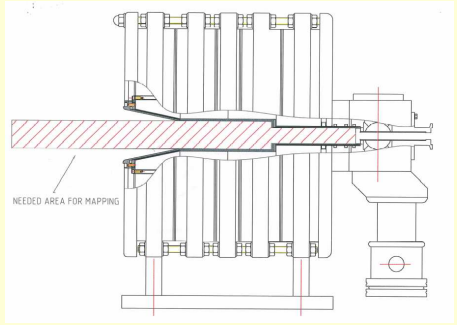

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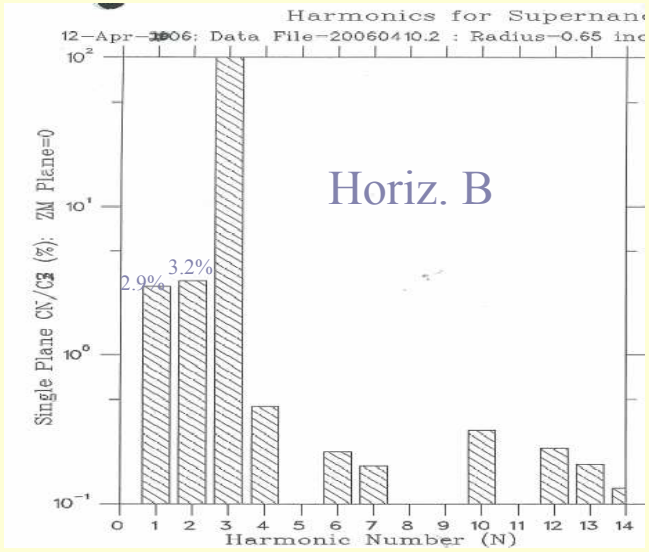
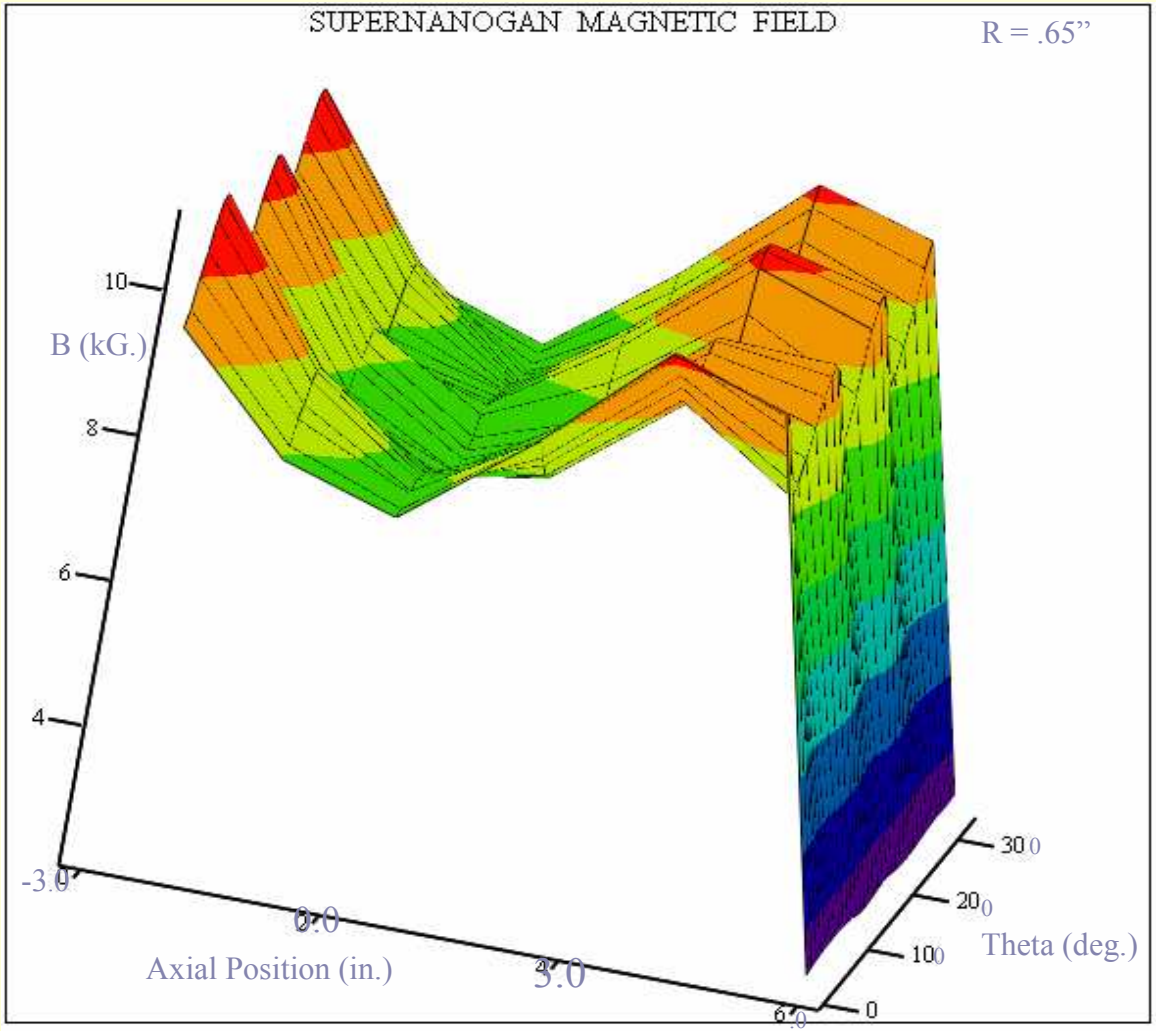


Surface Plot of Supernanogan Total Magnetic Field



[1]

Conclusions:

1) Magnet measurements confirm manufacturer's magnetic field specs.
   - Axial field peak values were confirmed to be as stated.
   - Harmonics of multipole field, other than sextupole were low.

2) Supernanogan is now being commissioned in a test ion source beamline and should be moved to OLIS in the ISAC facility in December 2007.

3) Once installed in the permanent installation (OLIS), tests will begin to confirm the ion source performance from the manufacturer as shown here.

Table of performances

Ion	SUPERNANOGAN output
H^+	> 2 mA
H_2^+	> 1 mA
H_3^+	> 700 µA
He^+	> 800 µA
C^{4+}	> 200 µA
O^{6+}	> 200 µA

[1]

Acknowledgments:

[1] “OLIS Upgrade III (technical) – 2006” & Personal Communication - Keerthi Jayamanna, Triumf, Vancouver, Canada.

[2] “Triumf: ISACII and Beyond” - P. W. Schmor, Triumf, Vancouver, Canada (CYC 2004 – KEK).

[3] “Status & Development of ECR Ion Sources” – P. Sortais, ISN, Grenoble, France (EPAC 2000 – Vienna, Austria).

[4] Pantechnik, Caen, France – Drawings & Photo.

[5] Doug Evans, Triumf, Vancouver, Canada – Photos.

[6] Bell Technologies Inc., Orlando, Florida.

[7] Triumf Library Archive – Drawings & Photos.