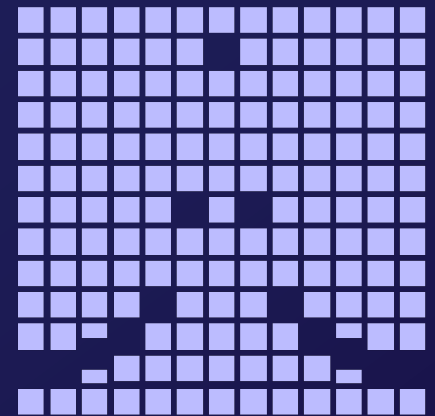


Vertical Field Mapping System

FMU-1200 Product Introduction

RESONANCE



RESEARCH

FMU-1200 spectrometer



MAGNETIC FIELD MAPPING SYSTEM FOR VERTICAL BORE MAGNETS

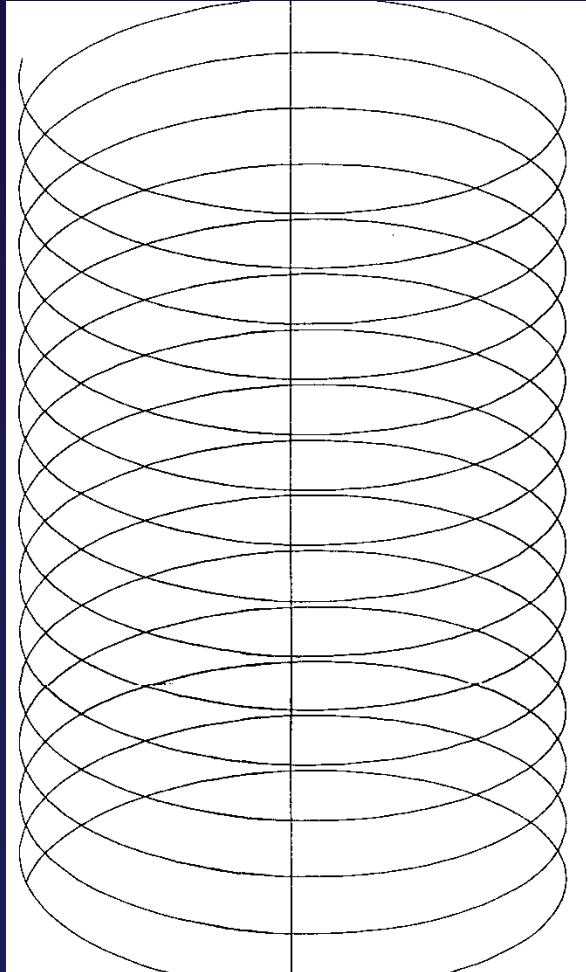
- RRI's FMU-1200 system, used for mapping static magnetic fields in vertical-bore, NMR magnets
- Operates on 1H NMR and a heli-cylindrical NMR probe actuator.
- Digitally synthesized RF with FAST-SWEEP NMR Spectrometer with 10 MHz range
- The spectrometer operates from below 5 MHz (0.12 Tesla) to above 1500 MHz (35 Tesla).

MAGNETIC FIELD MAPPING SYSTEM

MAIN OPERATING PROPERTIES

- Operation at proton (H-1) resonance frequency
- Equipped with a heli-cylindrical path electro-mechanical probe and designed for a single sample operation.
- High resolution stepper motor under computer control with 1600 steps per revolution
- The heli-cylindrical probe actuator was designed for use in bore diameters between 32 and 89 mm.
- Use of the helical probe is very efficient and result in data suitable for axial and radial component analysis simultaneously.
- System completes a full mapping and analysis cycle in less than 8 minutes.

Mapping Probe Parameters



Probe trajectory

Helix

Radius

8.5 mm

Pitch

2.5 mm

Length

100 mm

Sample size

1 mm³

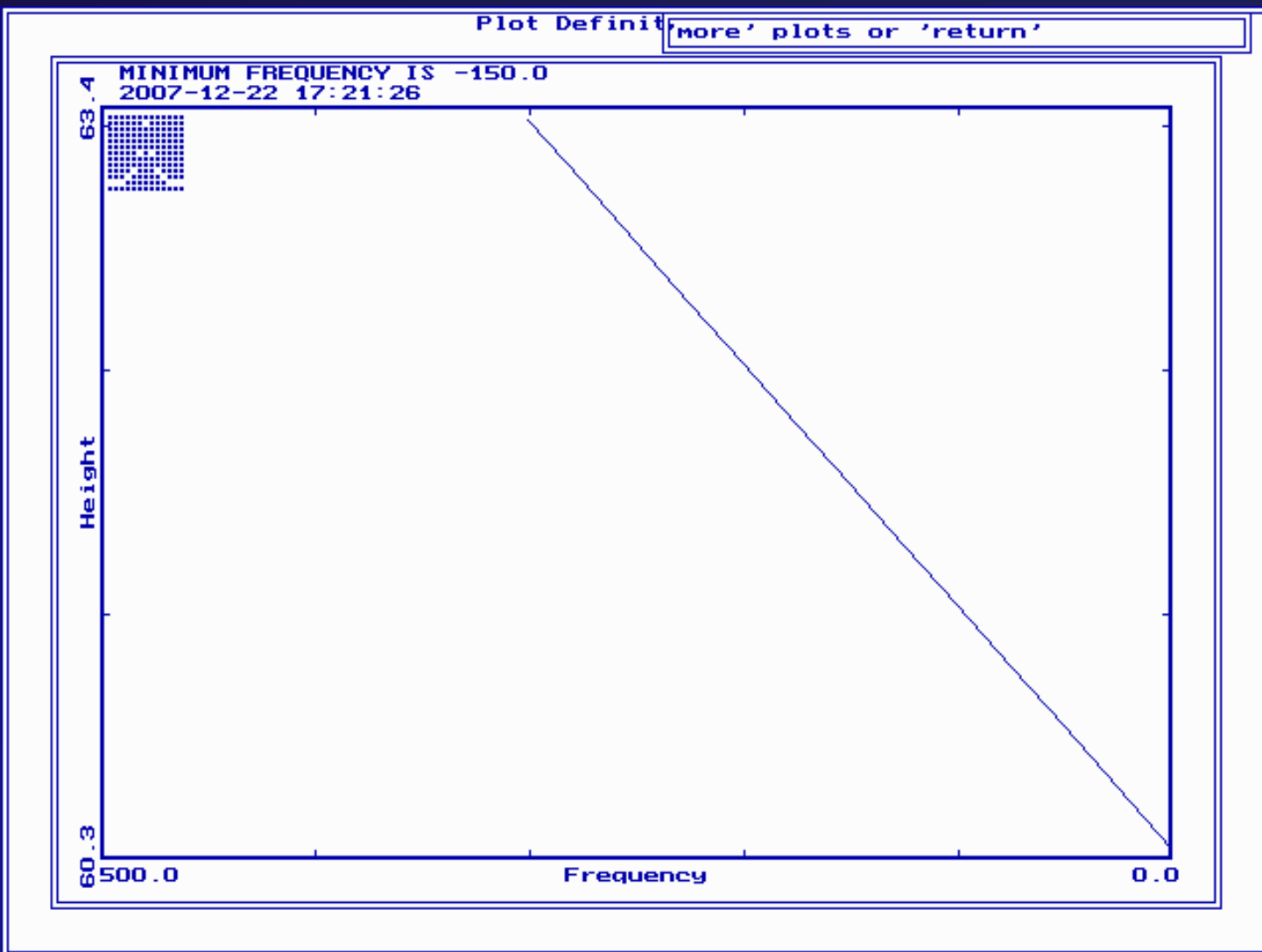
Mapper Principles of Operation

- Magnet center and probe orientation by difference plot, typically ZX
- Shim calibration by difference plot and spherical harmonic analysis
- Results stored in .STR files
- Shim convergence by matrix inversion using the .STR files
- Option for remote shim power supply operation
- Residual gradient calculation with SD error

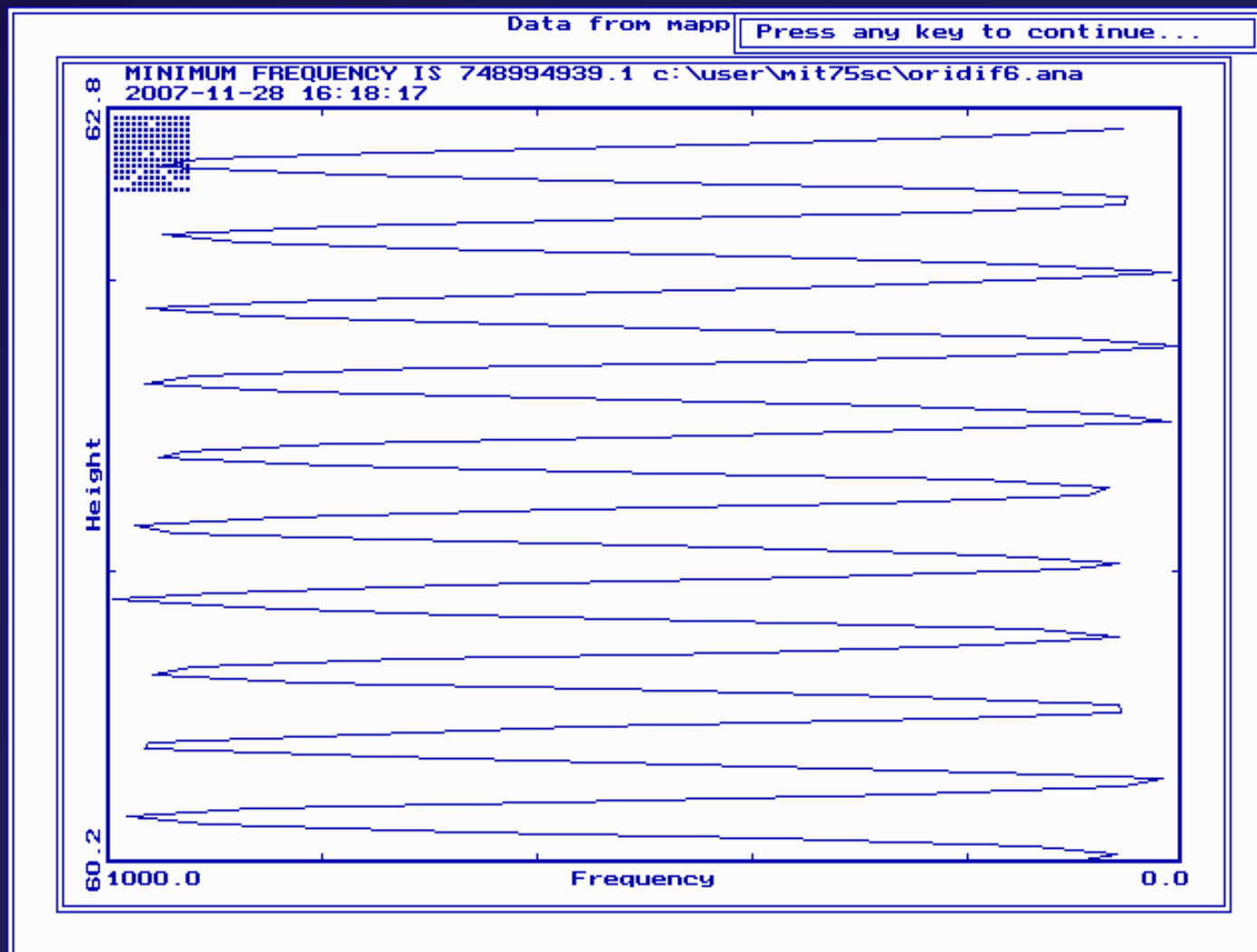
Shim Calibration by Difference plot

- Acquire magnet Map 1 with shim setting to Value 1
- Acquire magnet Map 2 with shim setting to Value 2
- Automated difference map plot
- Spherical harmonic coefficient calculation
- Store data

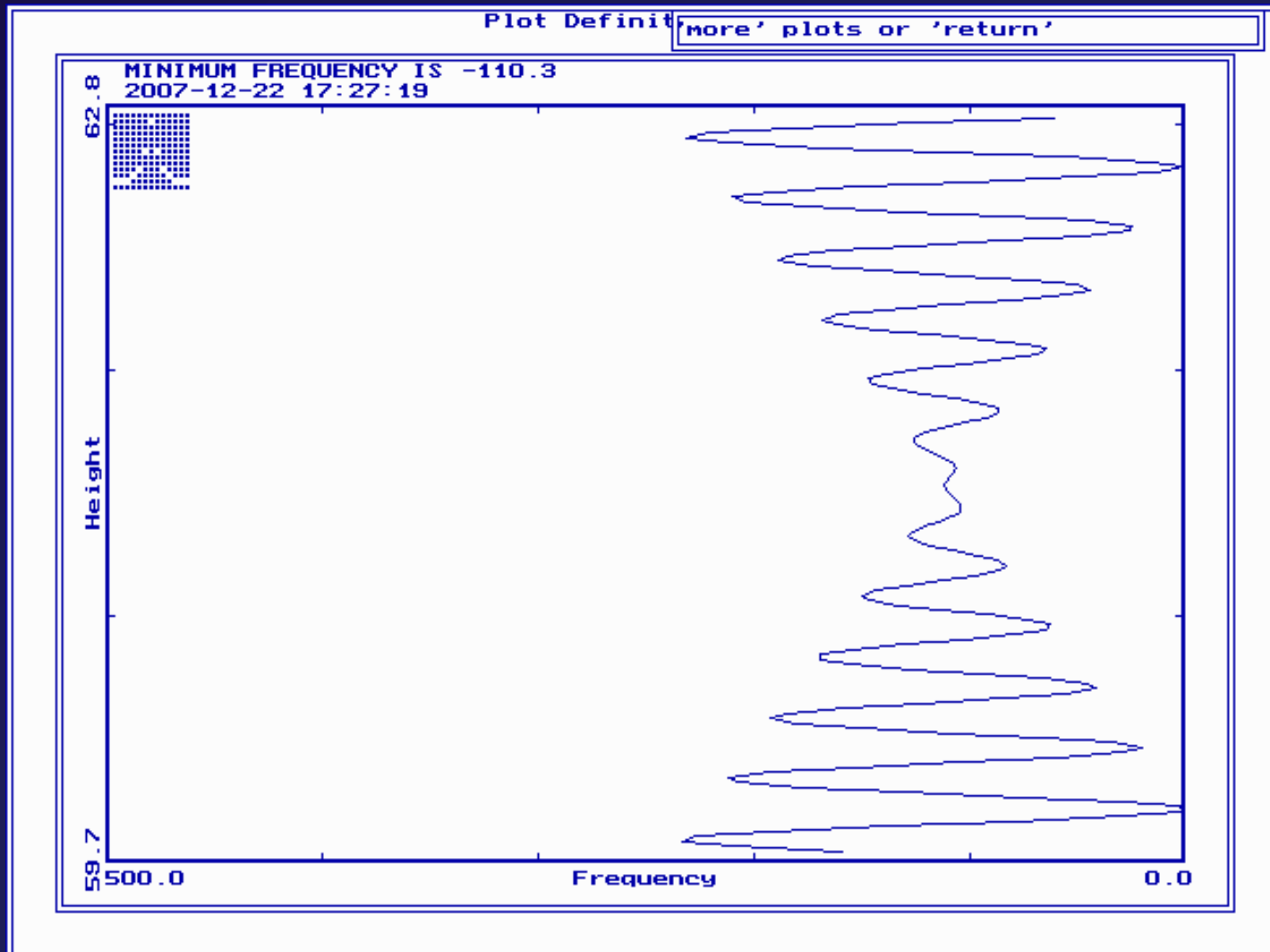
Difference Plot of Z Shim @100 Hz/cm



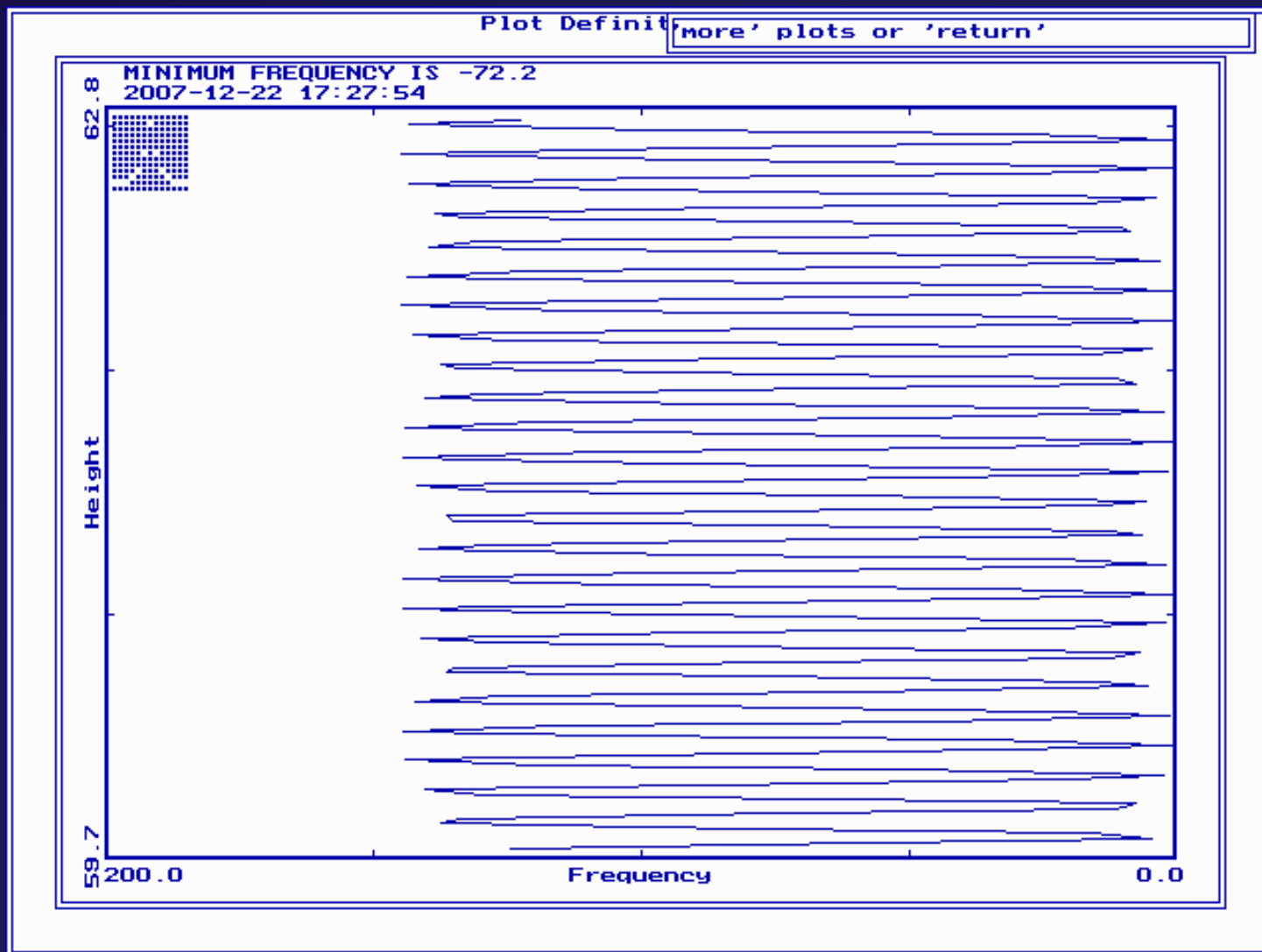
Difference Plot of X Shim @500 Hz/cm



Difference Plot of ZX Shim @100 Hz/cm²

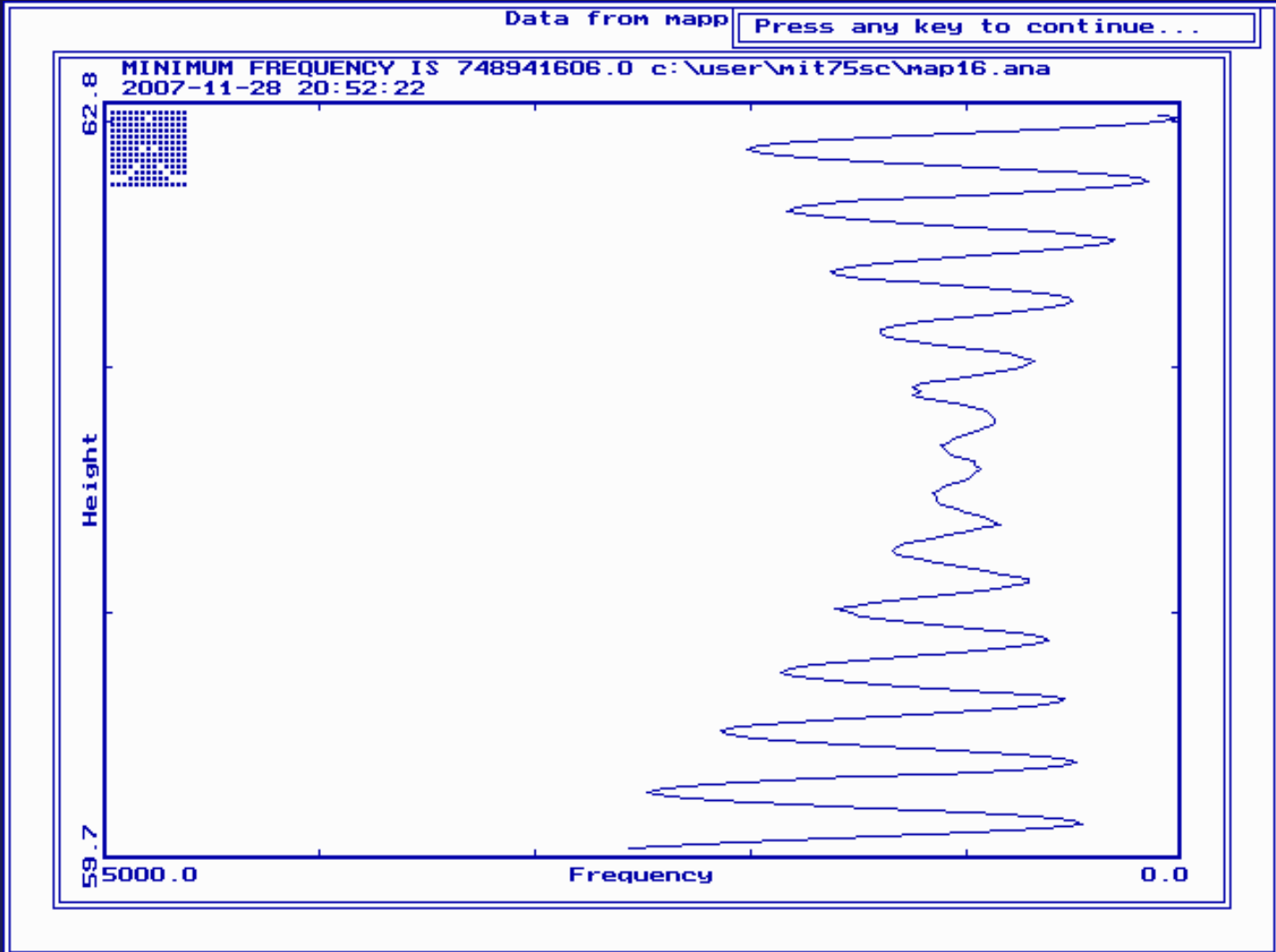


Difference Plot of C2 Shim @100 Hz/cm²



SC Convergence of 750 MHz magnet (magnet with defective ZX SC shim)

Courtesy of Dr. Christopher Turner MIT



Analysis of SC Convergence

Results of Analysis

2007-12-24 14:59:04
c:\user\mit75sc\map16.dat

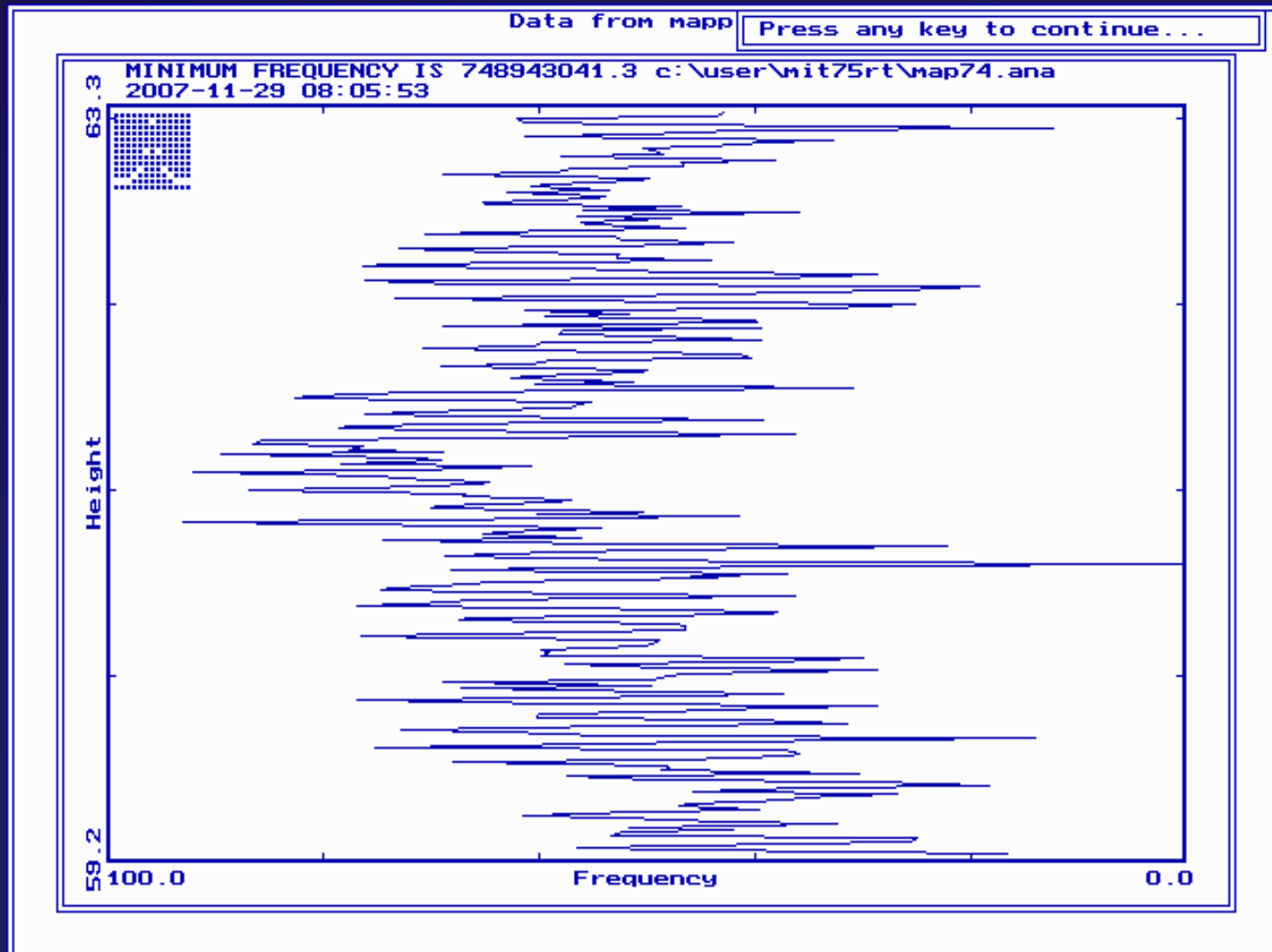
Gradient	z0 =	-1478.71	+/-	3.55	Hz/cm^n
Gradient	z =	-147.46	+/-	3.11	Hz/cm^n
Gradient	z2 =	151.04	+/-	4.17	Hz/cm^n
Gradient	z3 =	-21.79	+/-	4.91	Hz/cm^n
Gradient	z4 =	-3.02	+/-	6.64	Hz/cm^n
Gradient	z5 =	0.0000			
Gradient	z6 =	0.0000			
Gradient	z7 =	0.0000			
Gradient	z8 =	0.0000			
Gradient	z9 =	0.0000			
Gradient	z10 =	0.0000			
Gradient	z11 =	0.0000			
Gradient	x =	-45.99	+/-	5.36	Hz/cm^n
Gradient	y =	93.22	+/-	5.38	Hz/cm^n
Gradient	zx =	878.85	+/-	8.01	Hz/cm^n
Gradient	zy =	-113.18	+/-	8.11	Hz/cm^n
Gradient	c2 =	4.64	+/-	6.61	Hz/cm^n
Gradient	s2 =	9.18	+/-	6.60	Hz/cm^n
Gradient	z2x =	3.55	+/-	6.08	Hz/cm^n
Gradient	z2y =	-5.07	+/-	6.29	Hz/cm^n
Gradient	zc2 =	-5.68	+/-	5.58	Hz/cm^n
Gradient	zs2 =	-3.81	+/-	5.56	Hz/cm^n
Gradient	c3 =	-1.90	+/-	5.66	Hz/cm^n
Gradient	s3 =	5.52	+/-	5.64	Hz/cm^n
Gradient	z3x =	-6.89	+/-	8.04	Hz/cm^n
Gradient	z3y =	4.97	+/-	8.58	Hz/cm^n
Gradient	z2c2 =	-27.59	+/-	7.30	Hz/cm^n
Gradient	z2s2 =	-11.60	+/-	7.27	Hz/cm^n
Gradient	zc3 =	2.31	+/-	6.58	Hz/cm^n
Gradient	zs3 =	5.50	+/-	6.50	Hz/cm^n

Sum of squared residuals is 44306.7
Correlation coefficient is 0.999517
RMS uncertainty is 6.307



PRESS <Enter> TO CONTINUE

Plot of Final RT Convergence



Final RT Convergence with Matrix RT Shim 39 channels

map77.dat	DAC bits	%		DAC bits	%
z1	-1214	-3.7049			
z2	-1453	-4.4343			
z3	1089	3.3235			
z4	-311	-0.9491			
z5	161	0.4913			
z6	0	0.0000			
z7	0	0.0000			
z8	0	0.0000			
x	-1267	-3.8667	y	-787	-2.4018
zx	100	0.3052	zy	6780	20.6915
z2x	-784	-2.3927	z2y	152	0.4639
z3x	-377	-1.1505	z3y	83	0.2533
z4x	12	0.0366	z4y	214	0.6531
z5x	-421	-1.2848	z5y	-1748	-5.3346
c2	-1688	-5.1515	s2	908	2.7711
zc2	583	1.7792	zs2	-544	-1.6602
z2c2	-1013	-3.0915	z2s2	224	0.6836
z3c2	562	1.7151	z3s2	-970	-2.9603
z4c2	-677	-2.0661	z4s2	352	1.0743
c3	-4032	-12.3051	s3	-2927	-8.9328
zc3	-930	-2.8382	zs3	-8305	-25.3456
z2c3	-4803	-14.6580	z2s3	-244	-0.7447
z3c3	-4579	-13.9744	z3s3	-15973	-48.7472
c4	235	0.7172	s4	-632	-1.9288
zc4	-162	-0.4944	zs4	194	0.5921

Other Functions

- **Drift measurement**
 - Single point frequency plotted against time
- **Multiple map repeat and analysis**
- **Probe tuning**
- **Extended analysis and map editing options**
- **Shim simulations**
- **Shim power calculations**
- **Passive shimming as service by RRI**

Thank you for your attention

