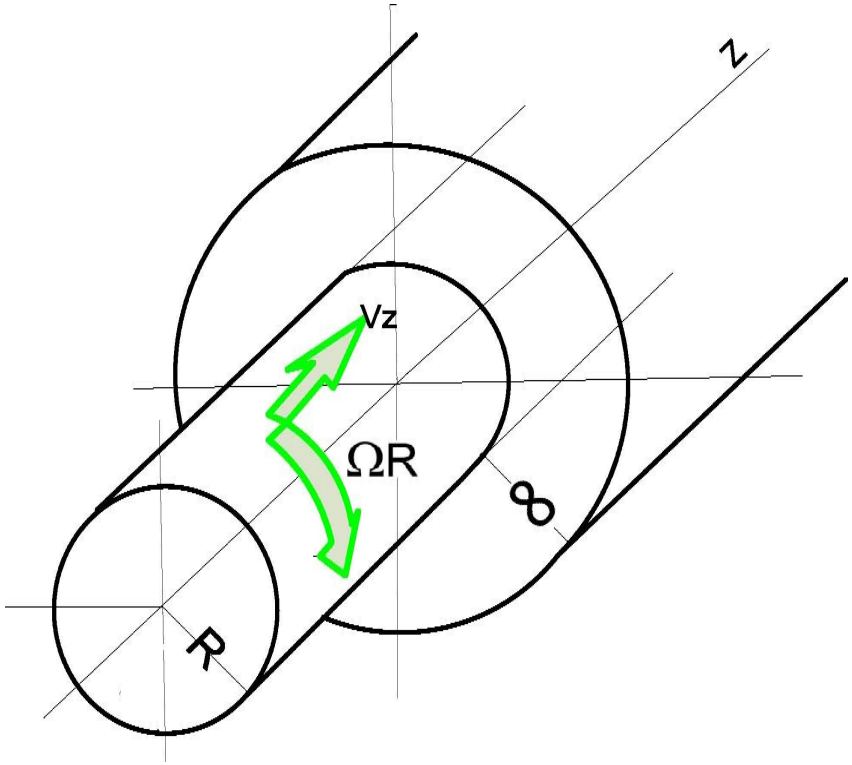
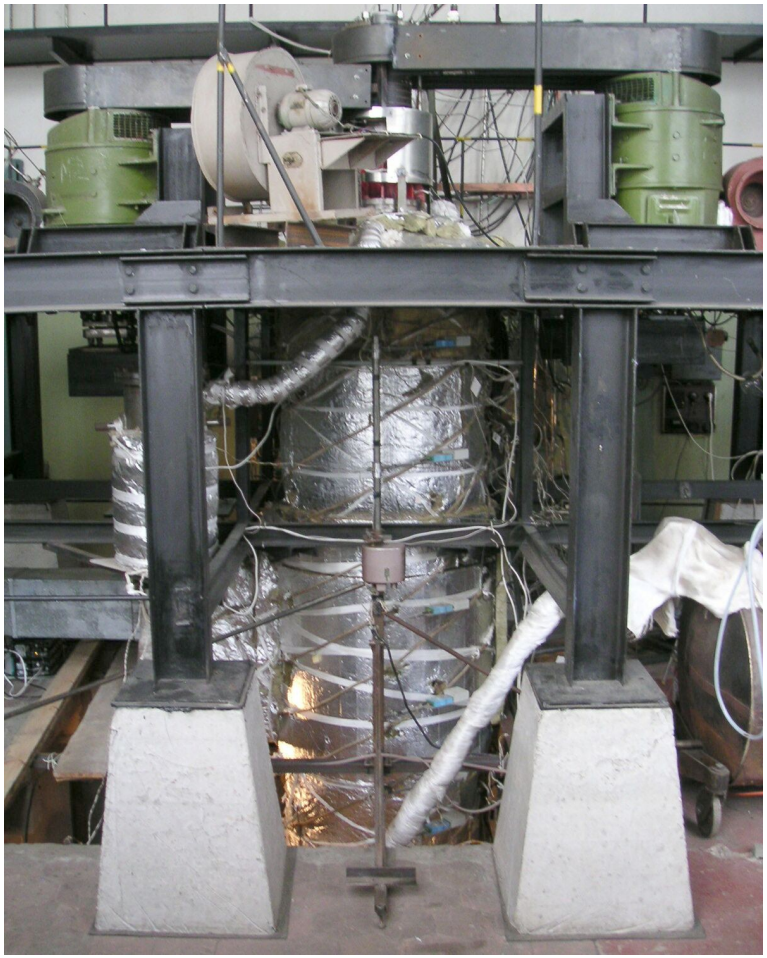
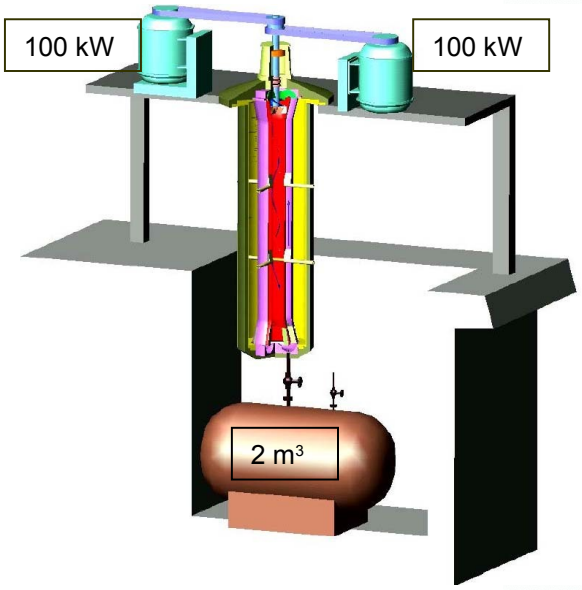
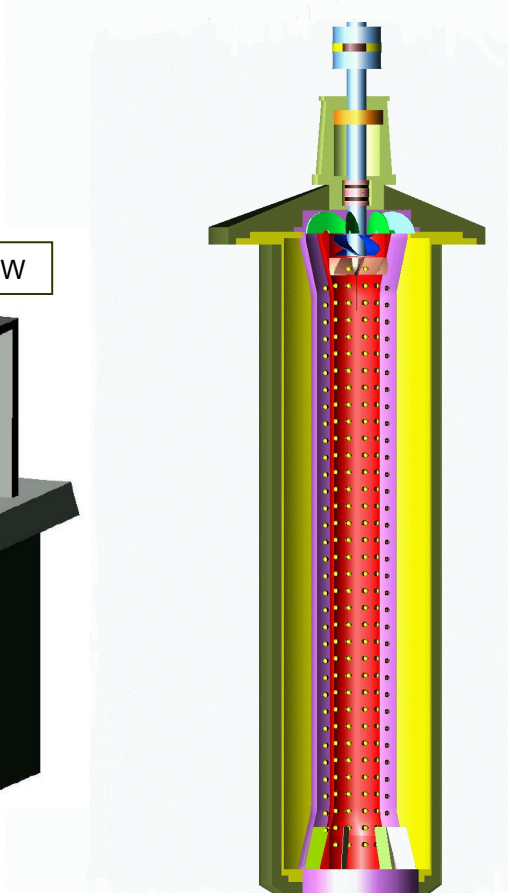
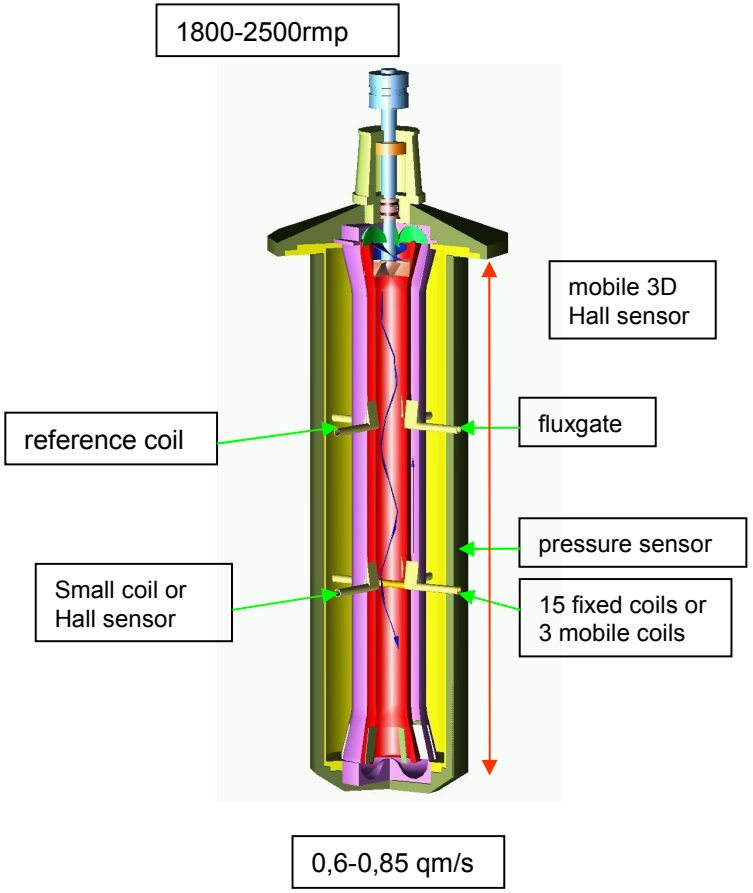
Riga Dynamo experiment

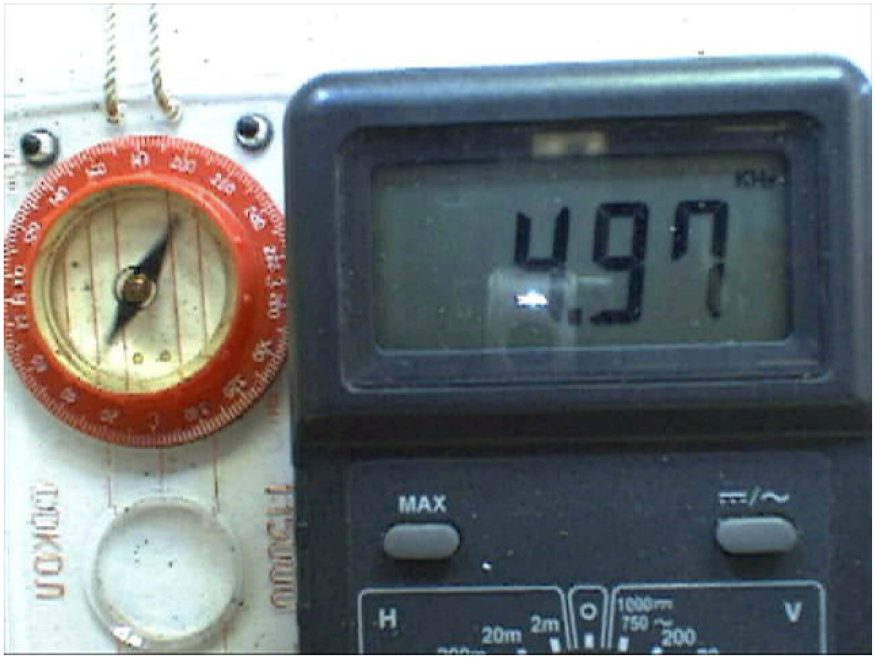




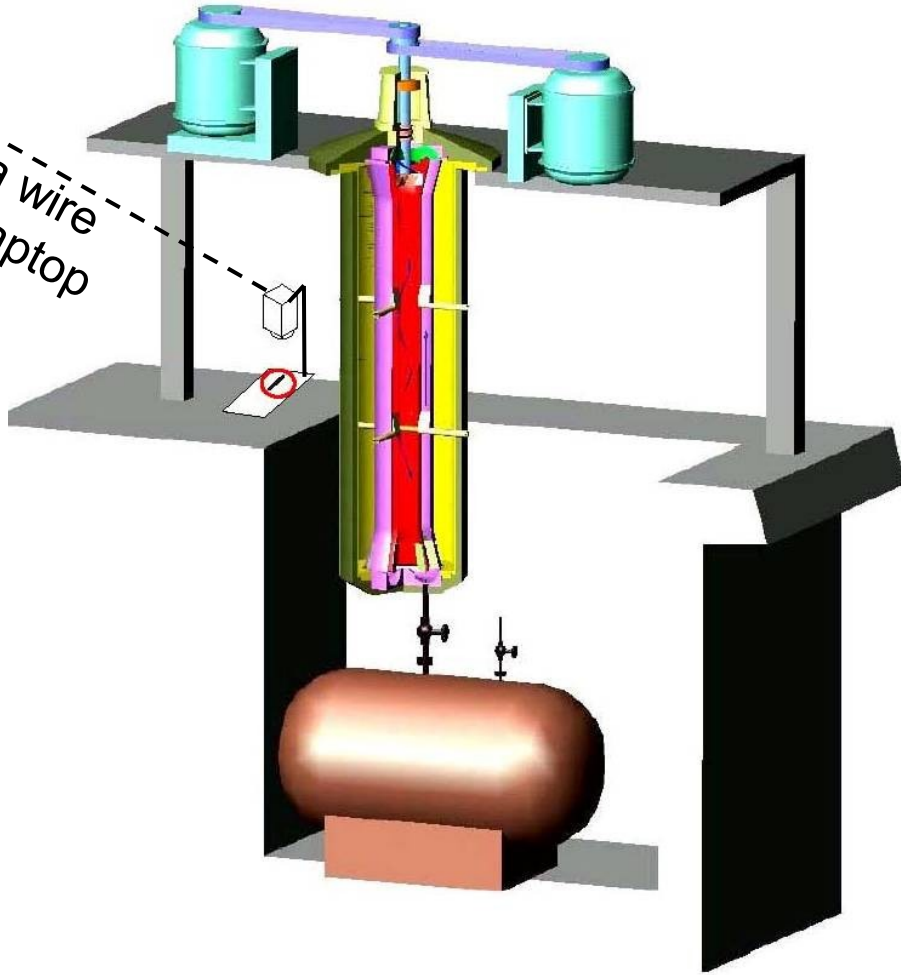

100 kW
100 kW
2 m3




1800-2500rmp
mobile 3D
Hall sensor
fluxgate
reference coil
pressure sensor
Small coil or
Hall sensor
15 fixed coils or
3 mobile coils
0,6-0,85 qm/s

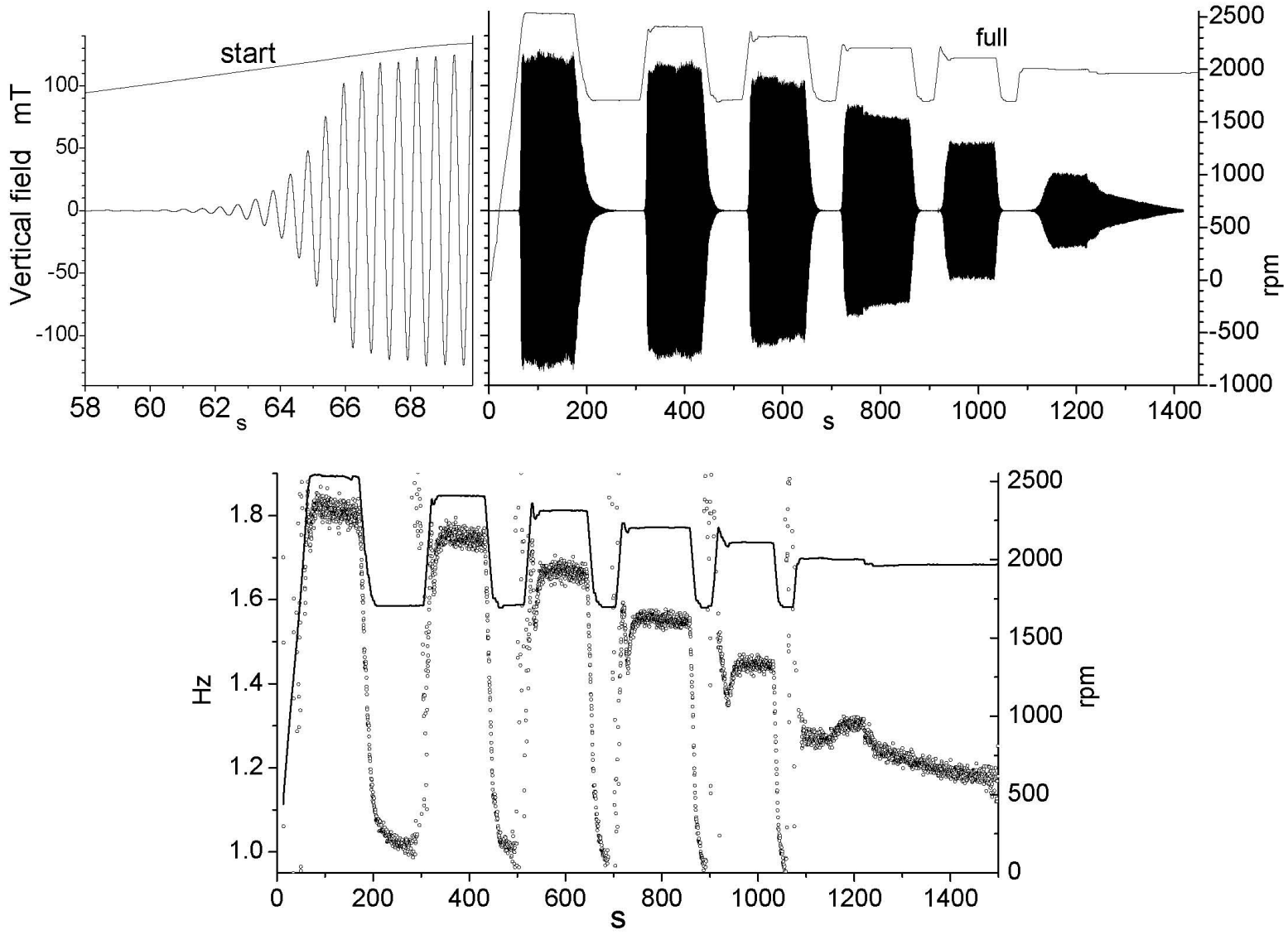


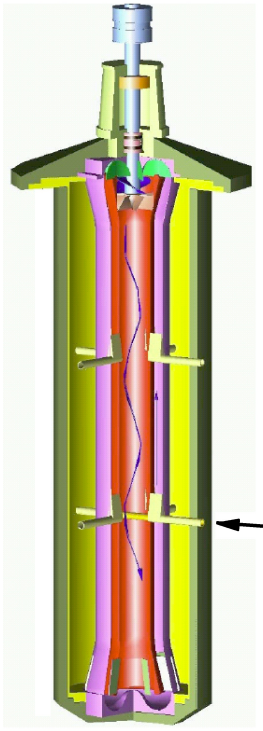
a wire
to laptop

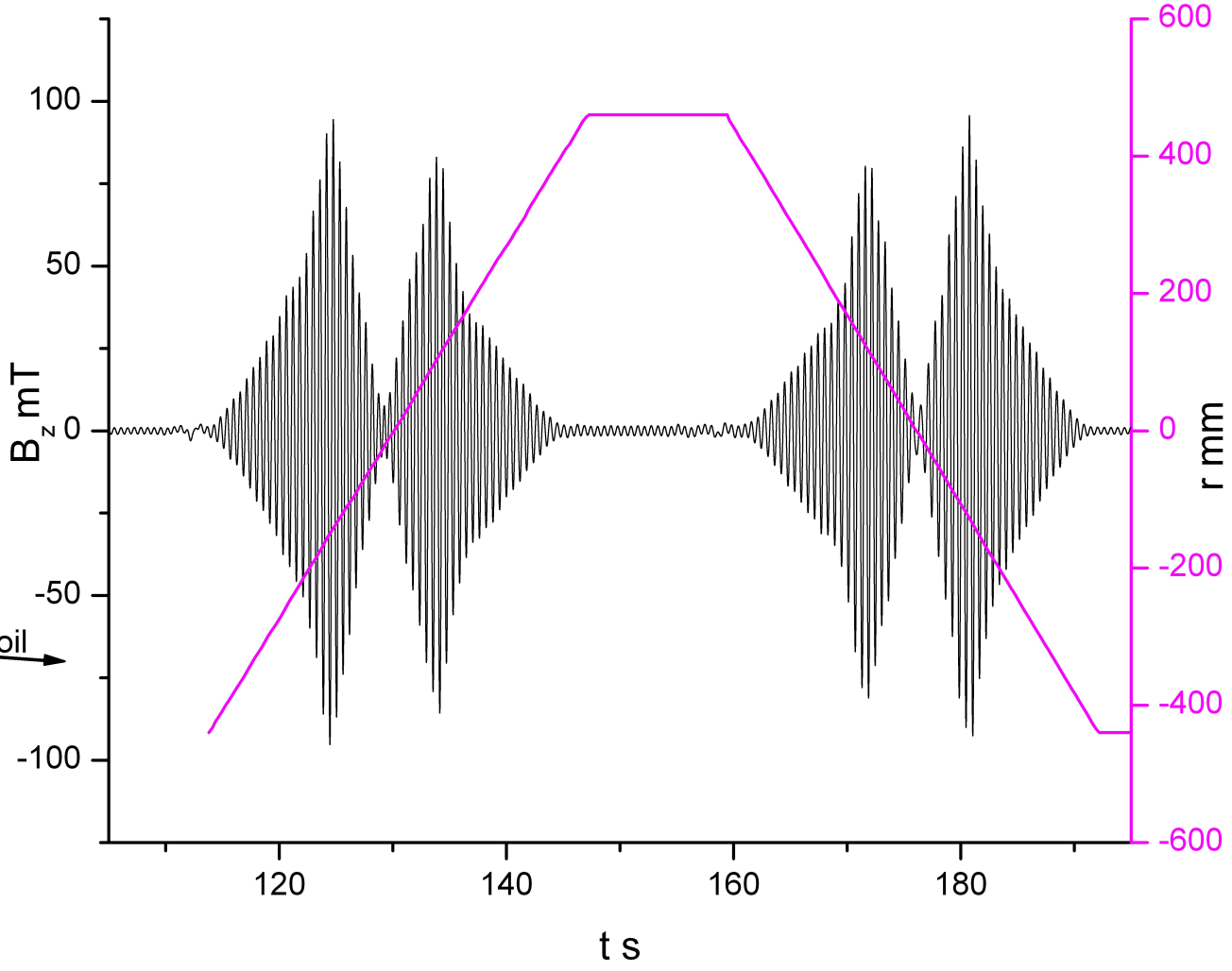


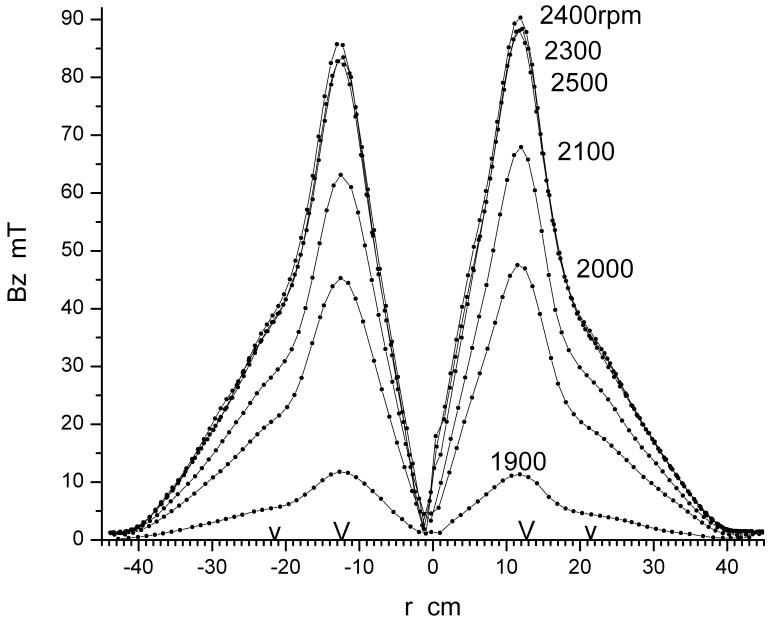
Video during the experiment

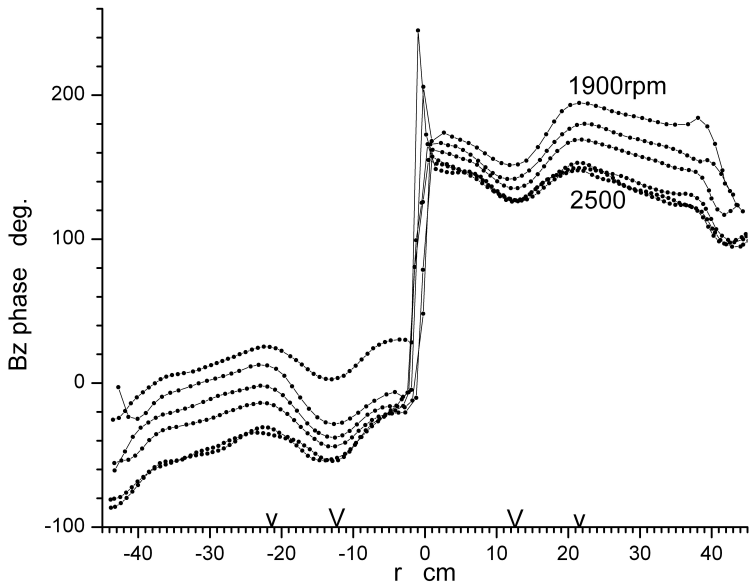

Сокол

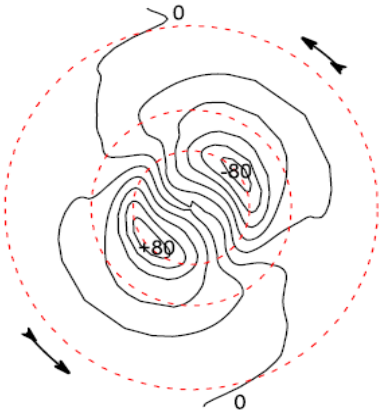

start
full
Vertical field mT
100
50
0
-50
-100
58
60
62
64
66
68
s
0
200
400
600
800
1000
1200
1400
s
2500
2000
1500
1000
500
0
-500
-1000
rpm
Hz
1.8
1.6
1.4
1.2
1.0
0
200
400
600
800
1000
1200
1400
s
2500
2000
1500
1000
500
0
rpm

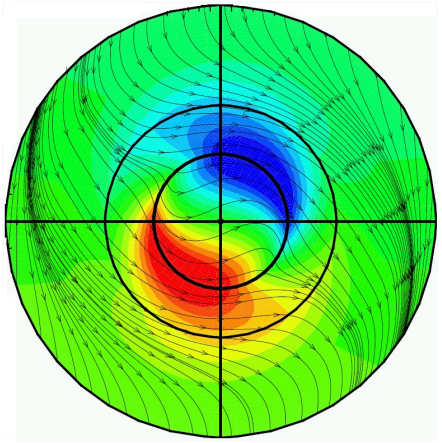

coil


100
50
0
-50
-100
B_z mT
600
400
200
0
-200
-400
-600
r mm
120
140
160
180
t s

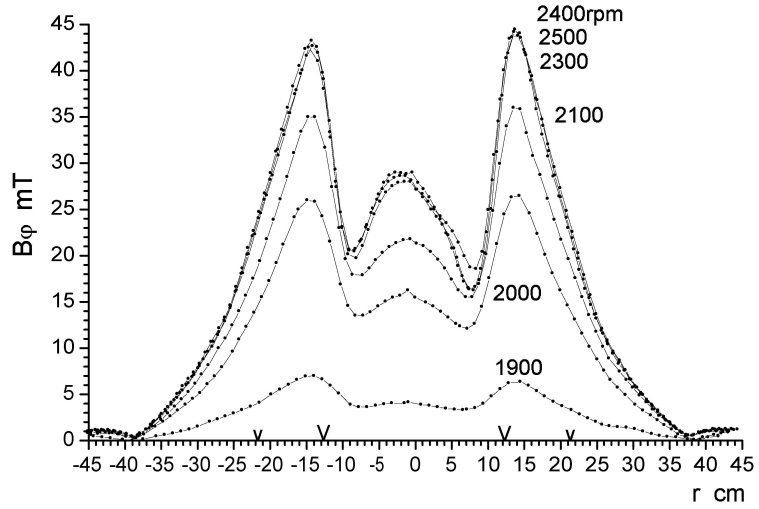

Bz mT
r cm
2400rpm
2300
2500
2100
2000
1900

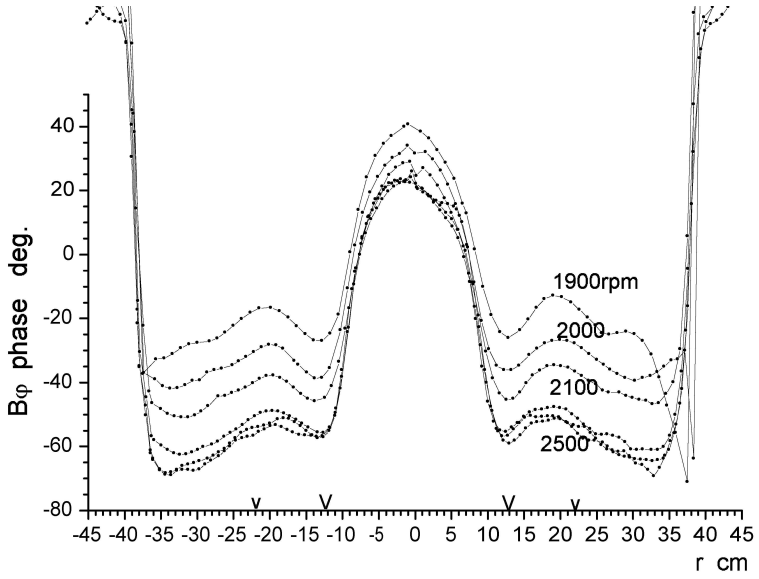

Bz phase deg.
r cm
1900rpm
2500

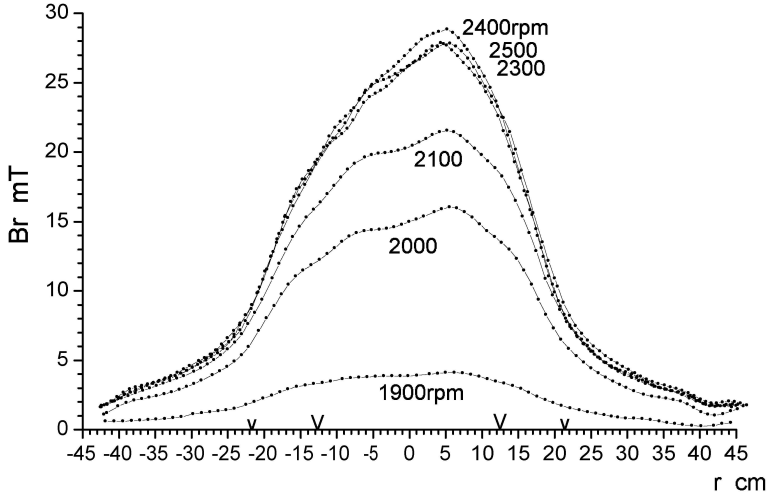

0
-80
+80
0

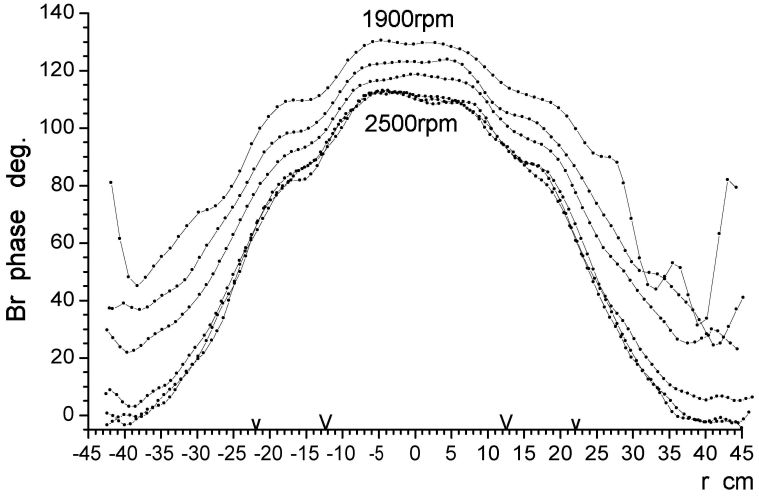


Horizontal field









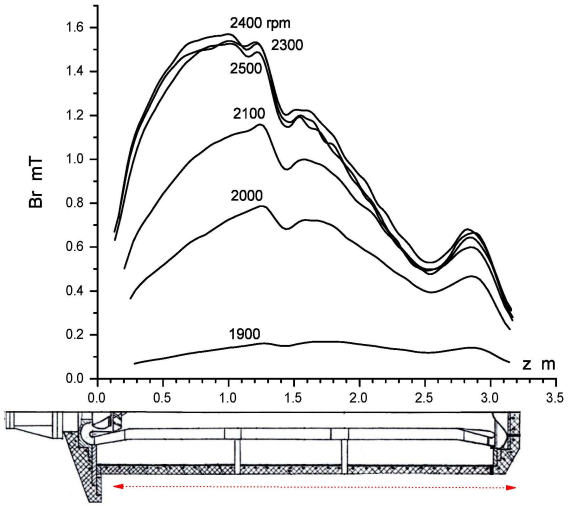
Energy balance at 2300 rpm:

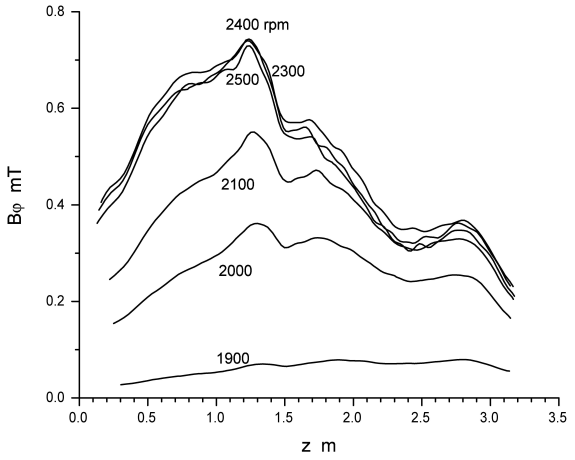
Unperturbed kinetic energy from water test:

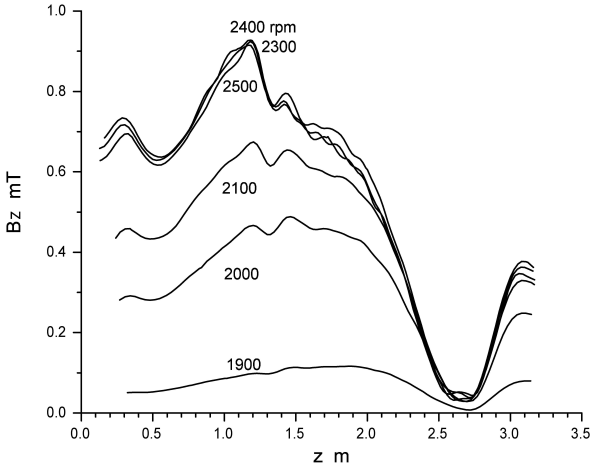
In direct flow	5000 J/m
In rotation	1300 J/m
In back flow	2500 J/m
total	8800 J/m

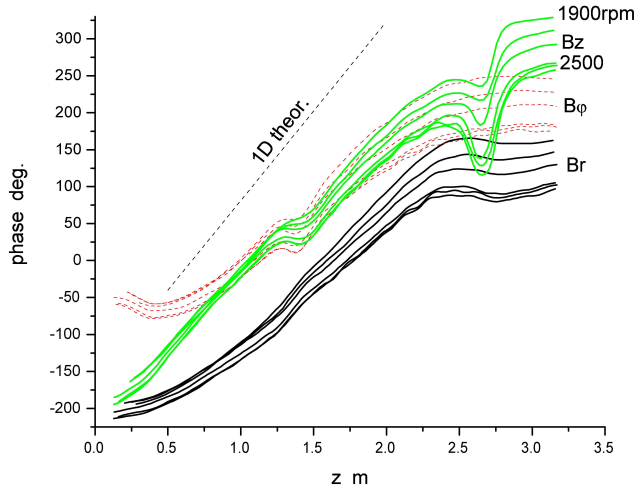
At measured level:

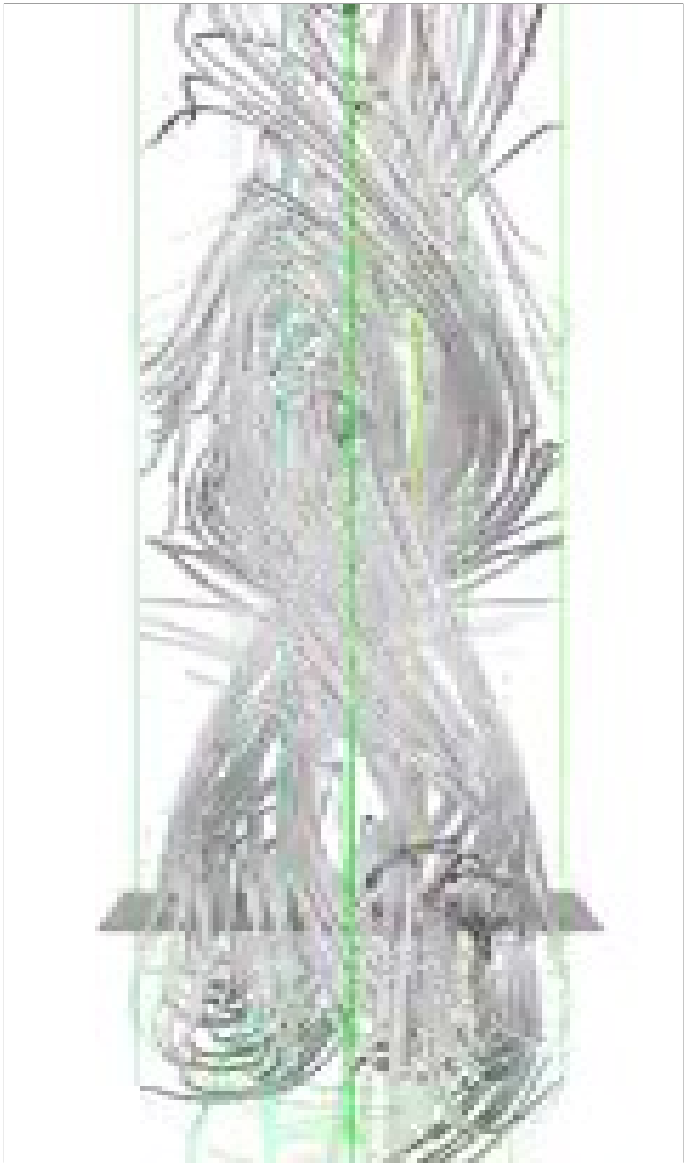
Magnetic energy	175 J/m
Magnetic/kinetic	2%

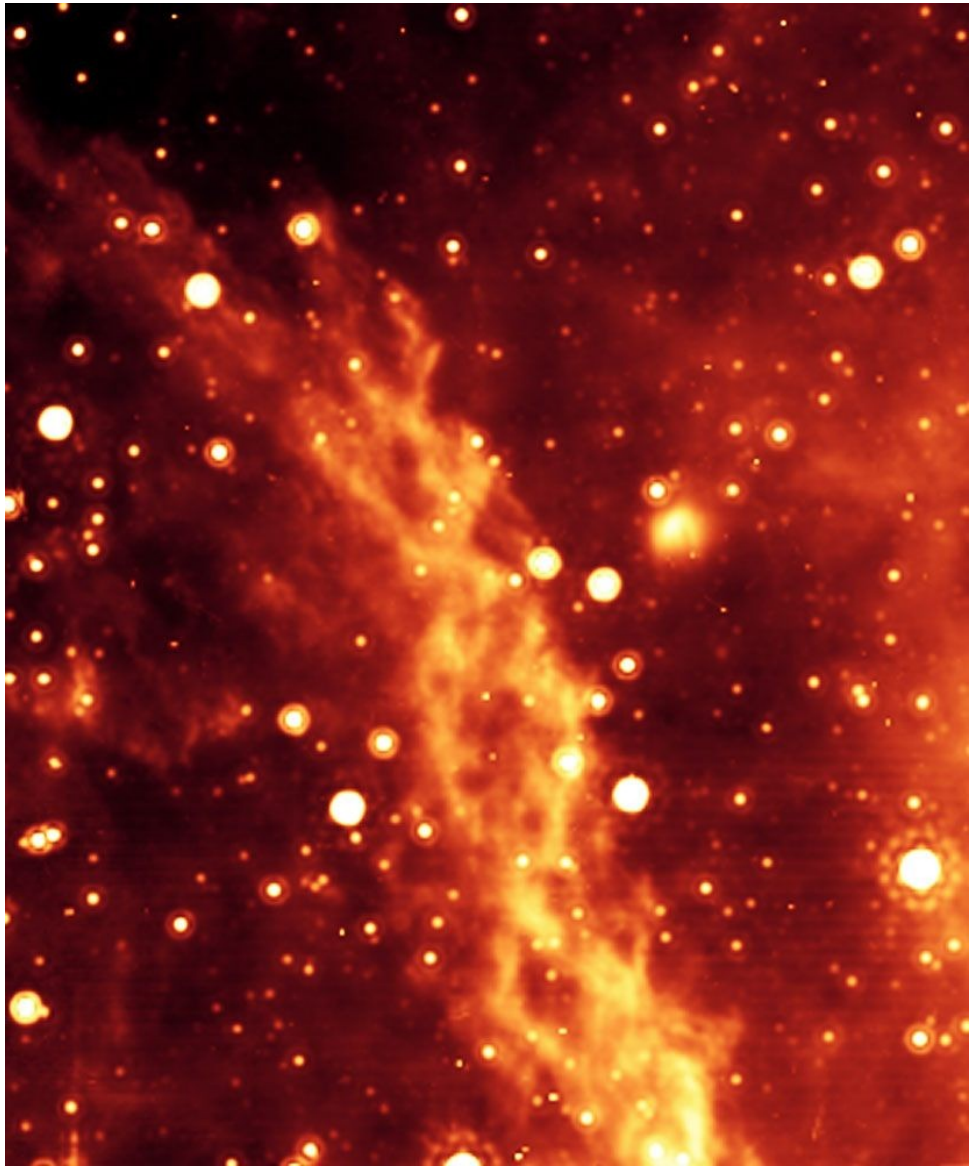

2400 rpm
2300
2500
2100
2000
1900
Br mT
z m

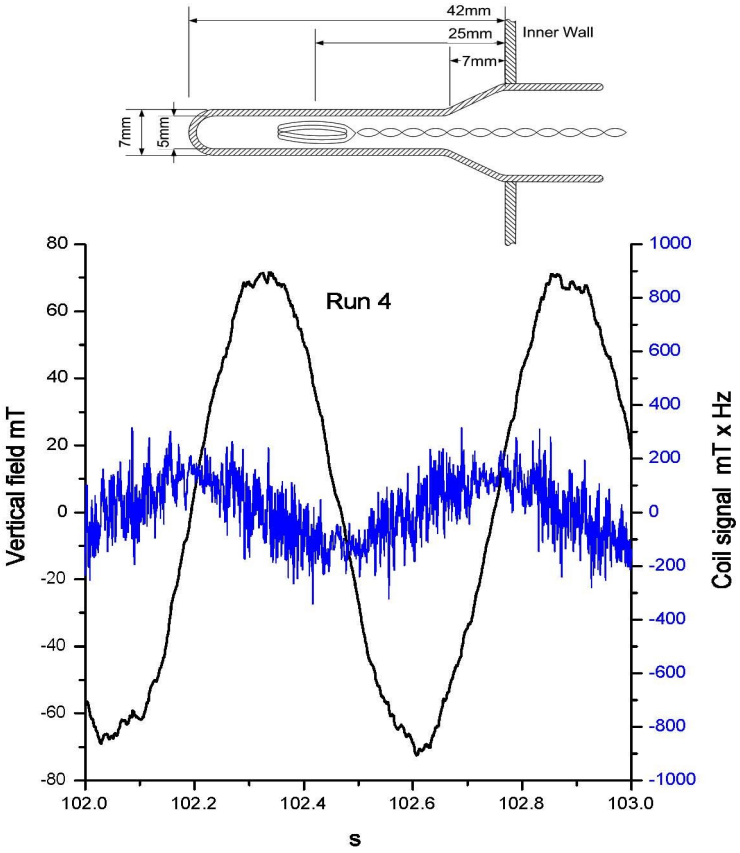

2400 rpm
2500
2300
2100
2000
1900
Bφ mT
z m

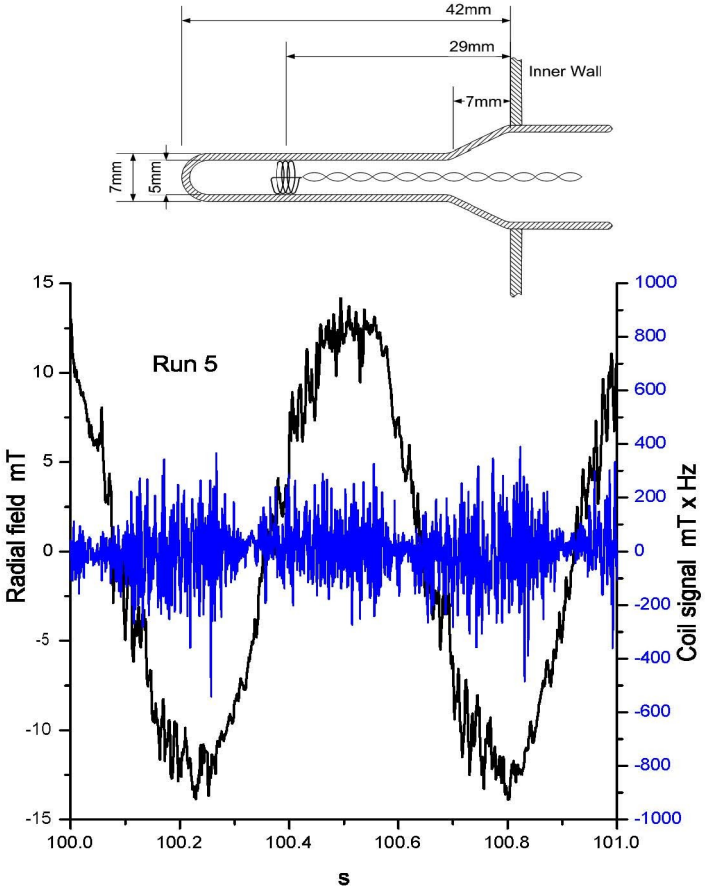

2400 rpm
2300
2500
2100
2000
1900
Bz mT
z m

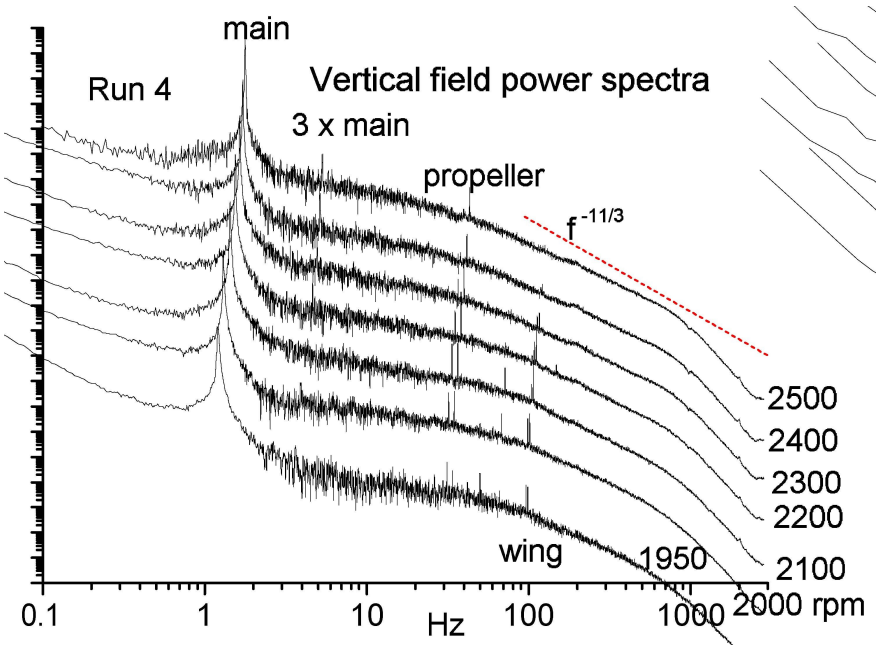

1900rpm
Bz
2500
Bφ
Br
1D theor.
phase deg.
z m

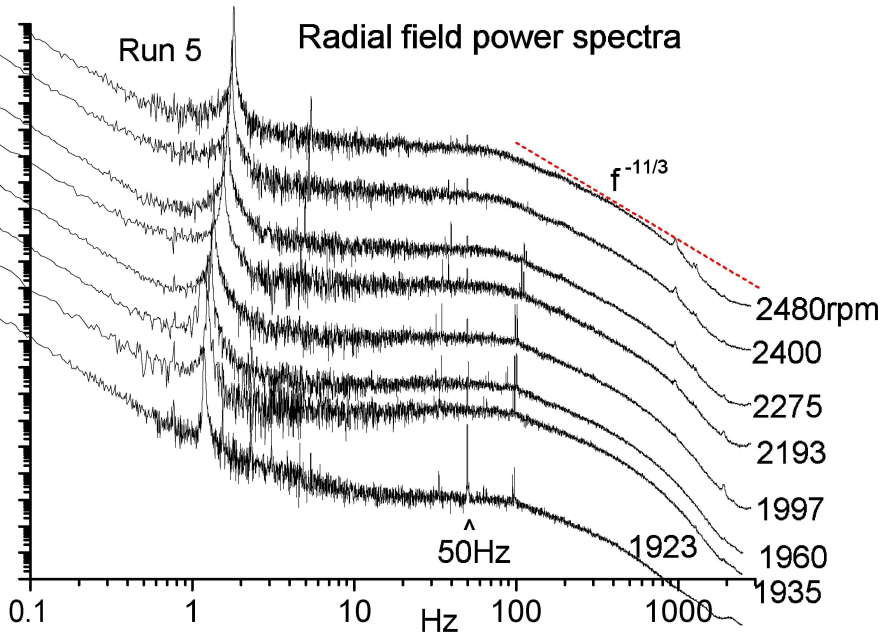


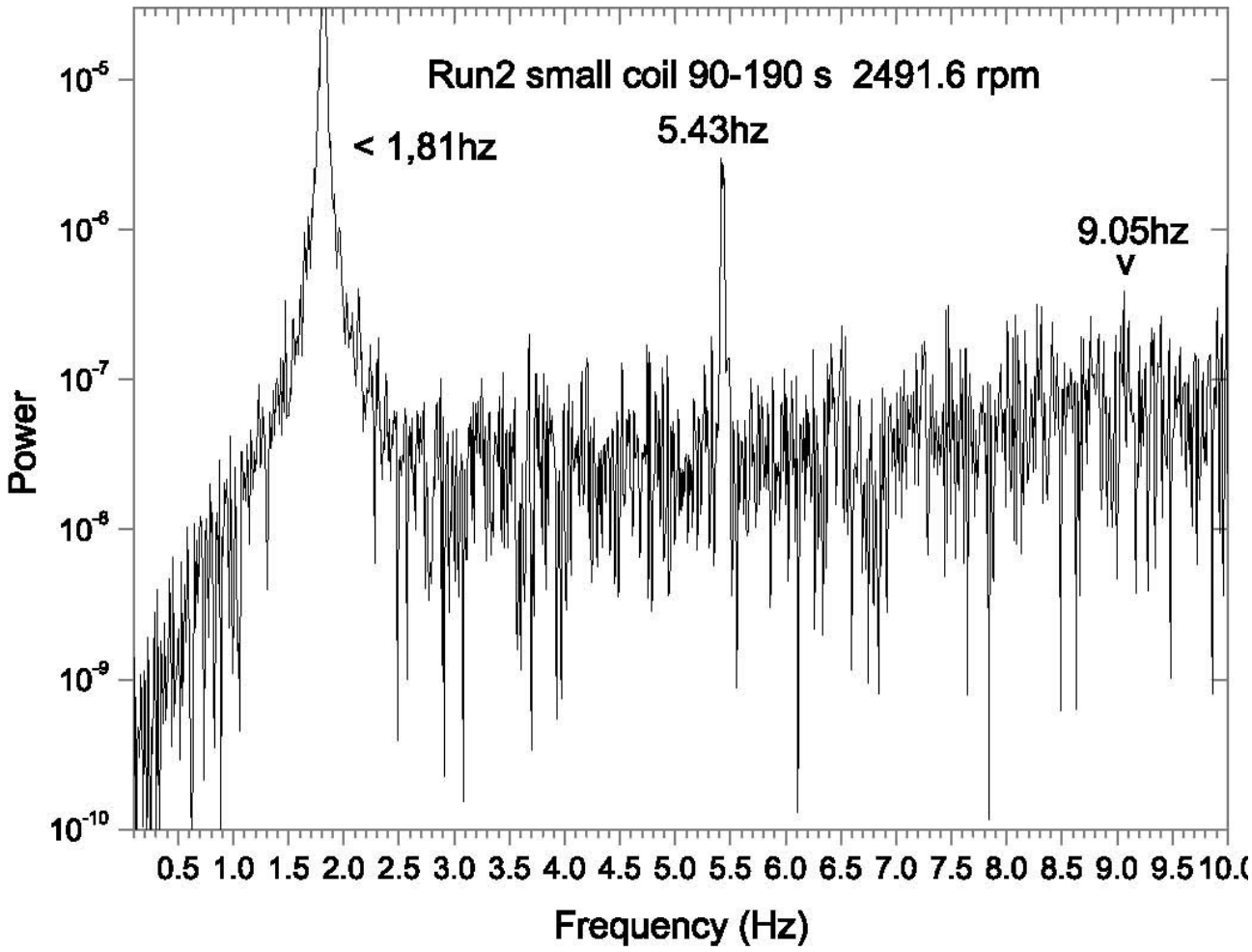



42mm
25mm
7mm
Inner Wall
7mm
5mm
Run 4
Vertical field mT
Coil signal mT x Hz
s
80
60
40
20
0
-20
-40
-60
-80
1000
800
600
400
200
0
-200
-400
-600
-800
-1000
102.0
102.2
102.4
102.6
102.8
103.0

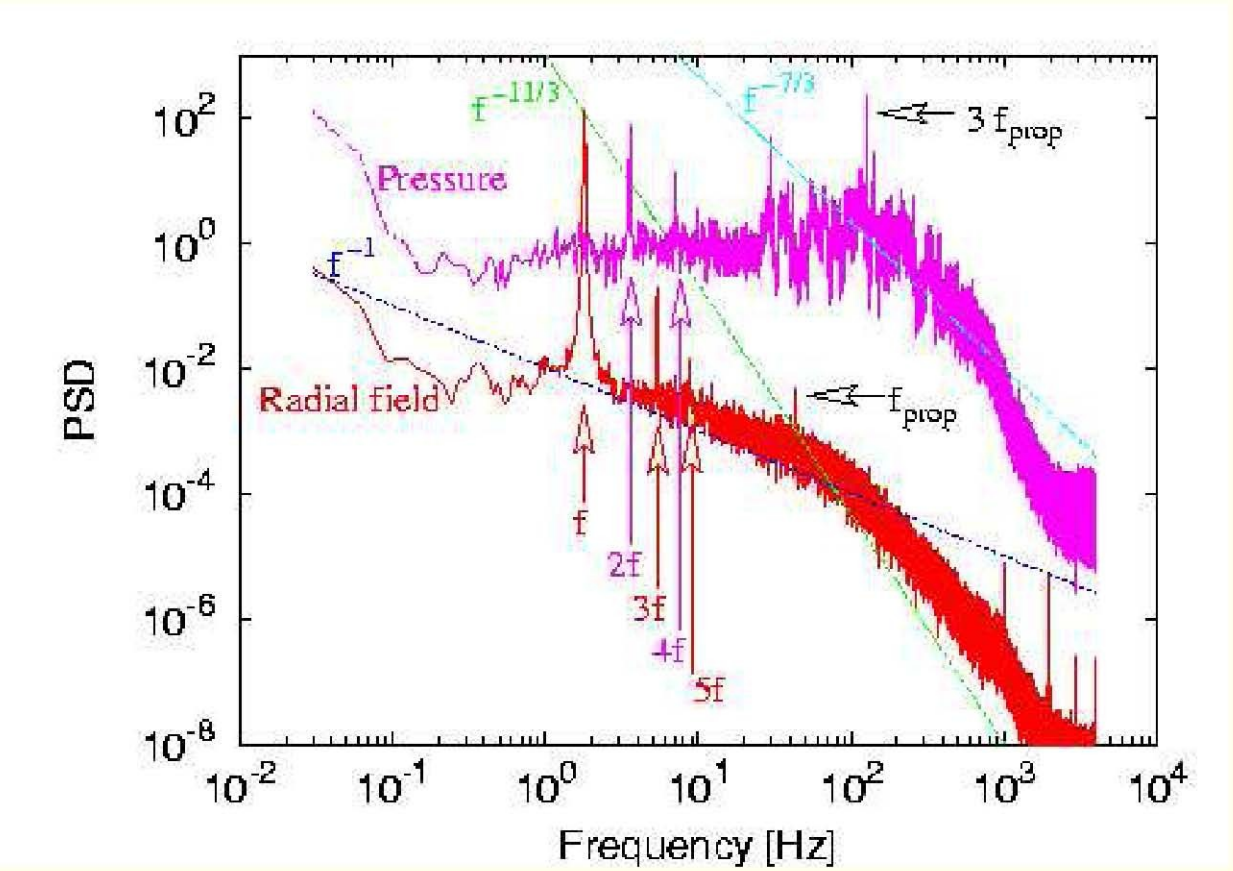

42mm
29mm
7mm
Inner Wall
7mm
5mm
Run 5
Radial field mT
Coil signal mT x Hz
s
15
10
5
0
-5
-10
-15
1000
800
600
400
200
0
-200
-400
-600
-800
-1000
100.0
100.2
100.4
100.6
100.8
101.0

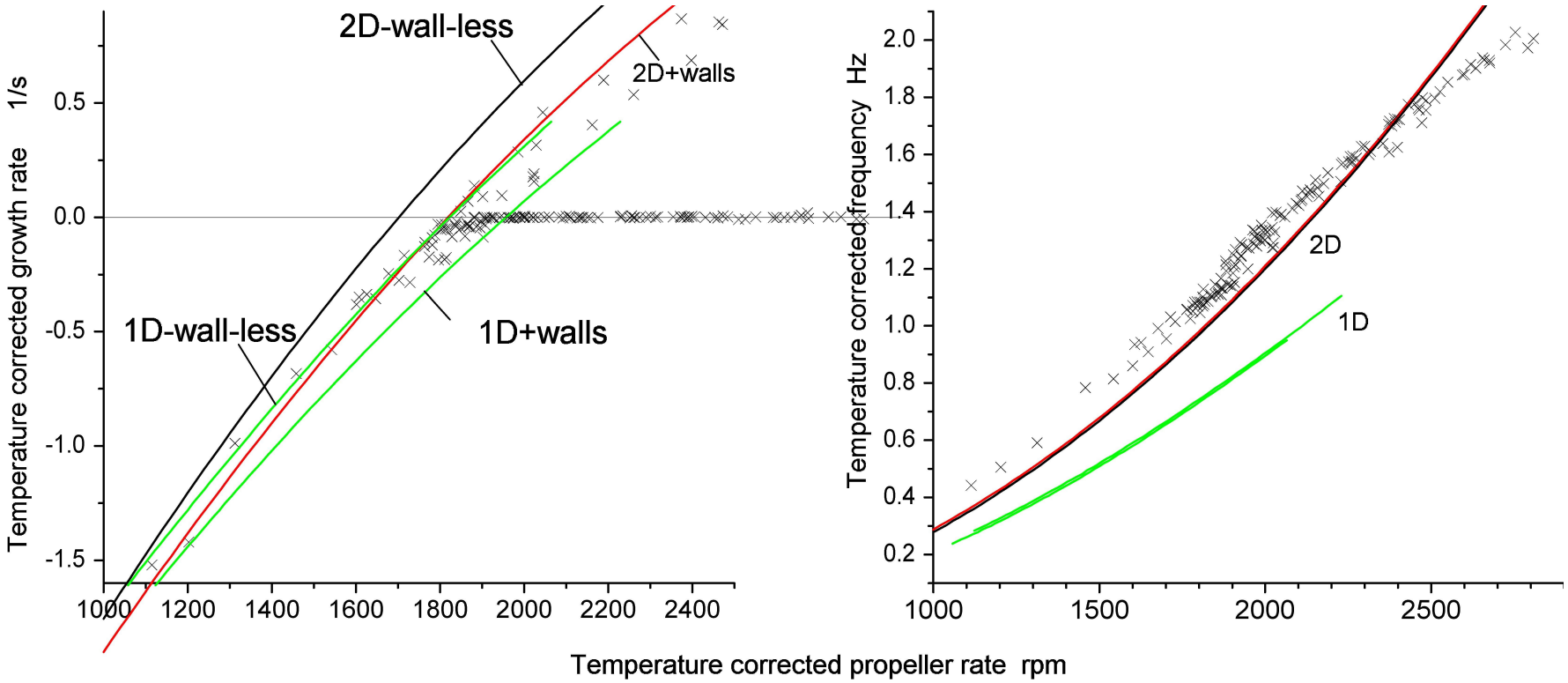

Run 4
main
Vertical field power spectra
3 x main
propeller
f -11/3
2500
2400
2300
2200
2100
2000 rpm
wing
1950
0.1
1
10
Hz
100
1000


Run 5
Radial field power spectra
f -11/3
2480rpm
2400
2275
2193
1997
1960
1935
50Hz
1923
0.1
1
10
Hz
100
1000

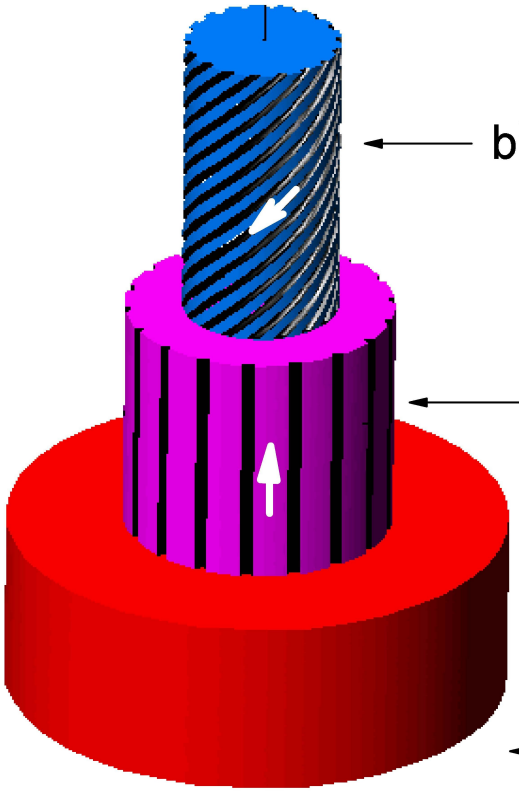

Run2 small coil 90-190 s 2491.6 rpm
< 1,81hz
5.43hz
9.05hz
v
Power
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5
Frequency (Hz)

Run 1 - Spectra of radial field (tip) and pressure




2D-wall-less
2D+walls
1D-wall-less
1D+walls
Temperature corrected growth rate 1/s
0.5
0.0
-0.5
-1.0
-1.5
1000
1200
1400
1600
1800
2000
2200
2400
Temperature corrected frequency Hz
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
2D
1D
1000
1500
2000
2500
Temperature corrected propeller rate rpm

THANK YOU



$$B_r \pm iB_\varphi = b^{\pm}(r)\exp(i(kz+m\varphi-\omega t))$$

$$b^{\pm}(r) = a_1^{\pm} I_{m\pm1}(q_1 r)$$ *for solid velocity*

or power series for

polinomial velocity profiles

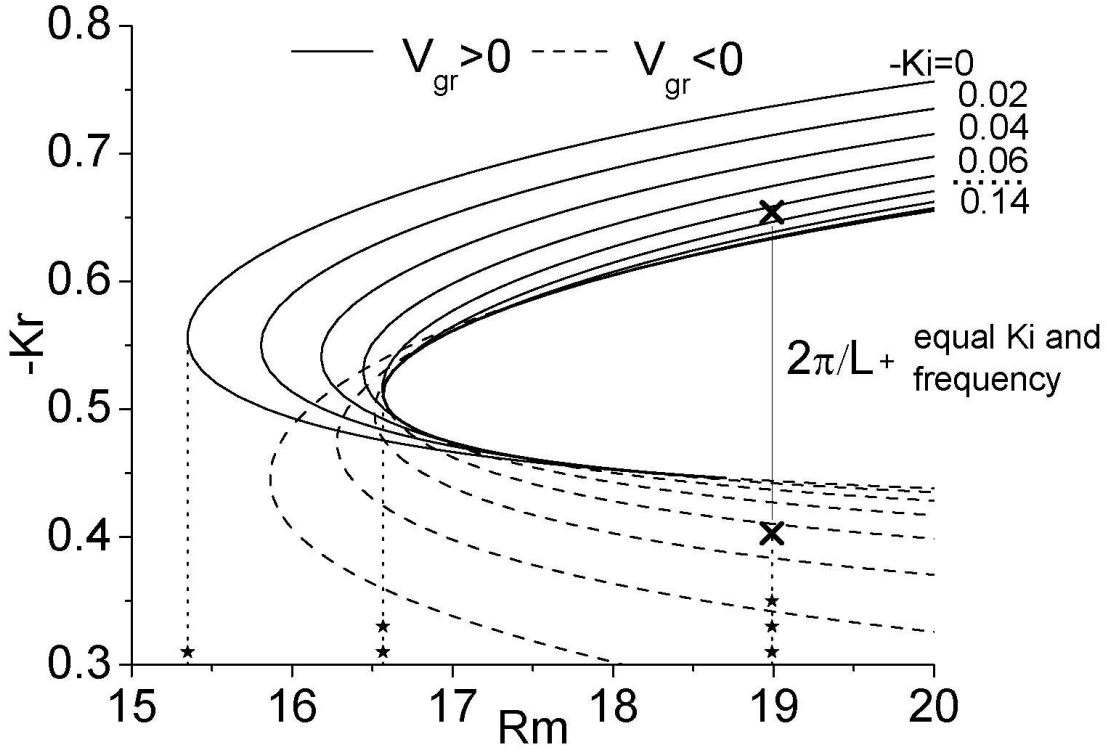
$$= a_2^{\pm} I_{m\pm1}(q_2 r) + c_2^{\pm} K_{m\pm1}(q_2 r)$$

$$= a_3^{\pm} I_{m\pm1}(q_3 r) + c_3^{\pm} K_{m\pm1}(q_3 r)$$

$$= c_4^{\pm} K_{m\pm1}(kr)$$ *in outer space*

$$q_n^2 = k^2 + i\mu_0\sigma\omega_n$$

ω_n *-frequency in co-moving frame*


0.8
0.7
0.6
0.5
0.4
0.3
-Kr
15
16
17
18
19
20
Rm
V_gr>0
V_gr<0
-Ki=0
0.02
0.04
0.06
0.14
2π/L+
equal Ki and
frequency