

Sample Environment on ID24

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Bernard Gorges
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Outline



The ESRF Sample Environment Service

ID24: Advantages and Problems

ID24: Examples

Conclusion

What we do

Fire brigade: supply help, advice, anything to get the experiment running

Pool: equipment for loan

Engineering: development of new experiments

Team members

Peter van der Linden: group leader, magnetic field, cryogenics

Ricardo Steinmann: engineer cryogenics

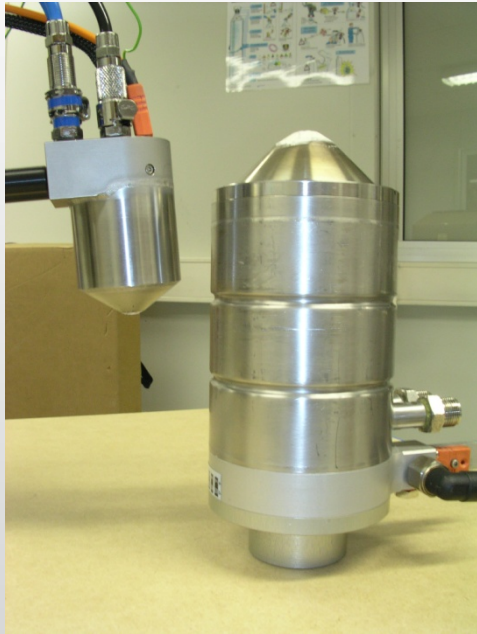
Bernard Gorges: engineer high temperature

Jeroen Jacobs: technician general support, high pressure

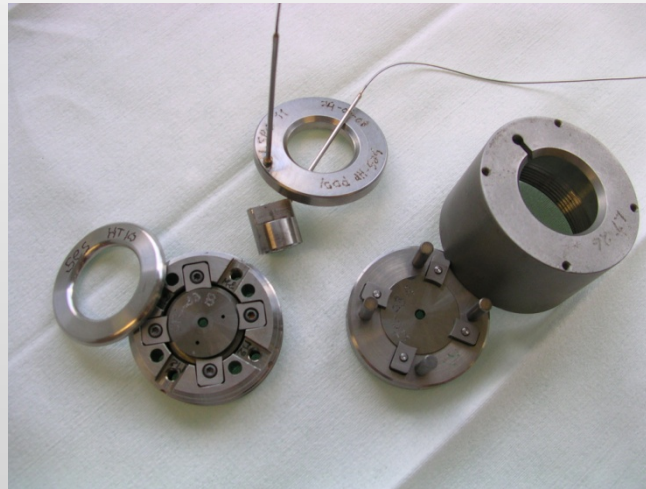
Hugo Vitoux: technician general support, high and low T

Pool material for loan

To propose standard material



Diamond Anvil high pressure cell
Pressure 1 to 100 GPa

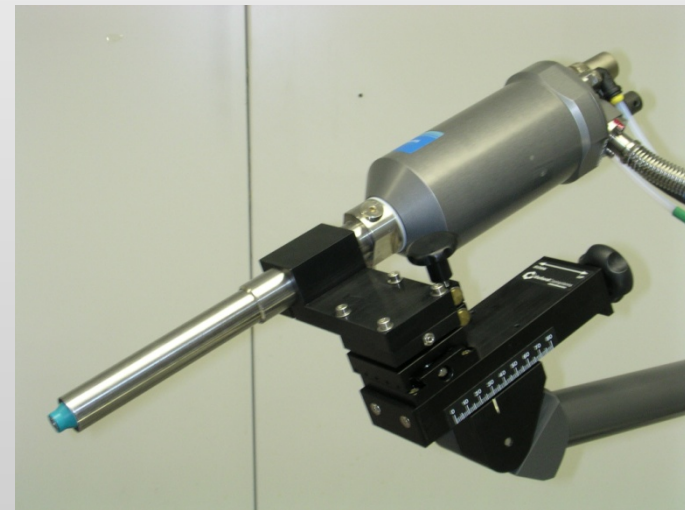


Gas blower furnace 200 to 1000 °C

Open flow of air

Left: New mini (5cm diameter)

Right: Standard model

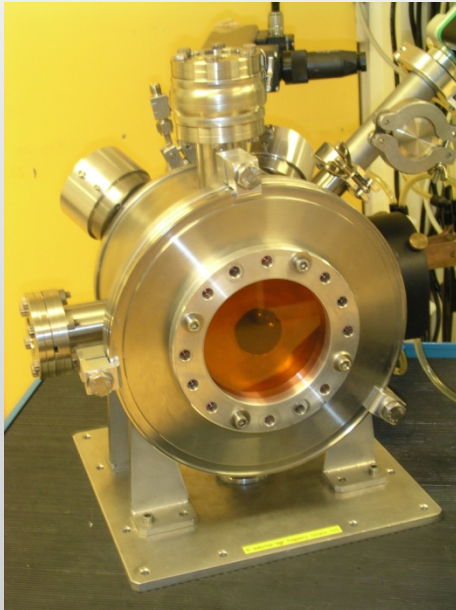


Cryostream: 90 to 300 K

Open flow of N₂ gas

Pool material for loan

To extend the possibilities
of what a single beamline can do



Mini flow cryostat: vibrationless cooling
For XAS, XRD, fluorescence, ...
Down to 2 K



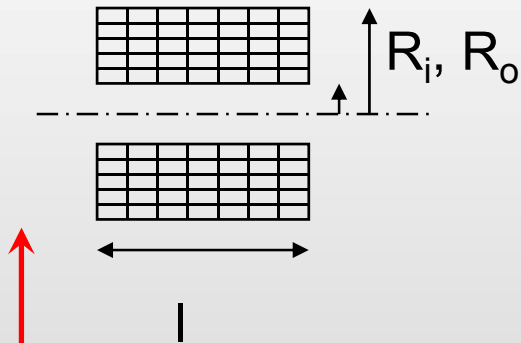
Induction furnace together with spectro-pyrometer: 1000 to 3000 °C
Fast and accurate regulation at high temperature

Engineering of, for example, a pulsed magnet

Geometry of coil design:
dimensions, wire choice

Inductance L,
Resistance R

Capacitor bank
energy $E = \frac{1}{2}CV^2$



$I(t)$ and $B(t)$

Pulse duration limit

Coil heating: $\int_0^{t_e} I^2 R dt = \int_{T_0}^{T_e} C_T dT$

LN2 cooling: $> \sigma_{\max}, < R$

Pulse height limit

Lorenz force gives hoop stress :

$$\sigma = B^2 / 2\mu_0 (1 - R_i / R_o)$$

Wire: high strength σ_{\max} ,
low resistance

ID24 Advantages and Problems

Problem: Beam intensity piercing windows

With the promise that it will get worse!

Problem: Beam intensity heat load on sample at low T

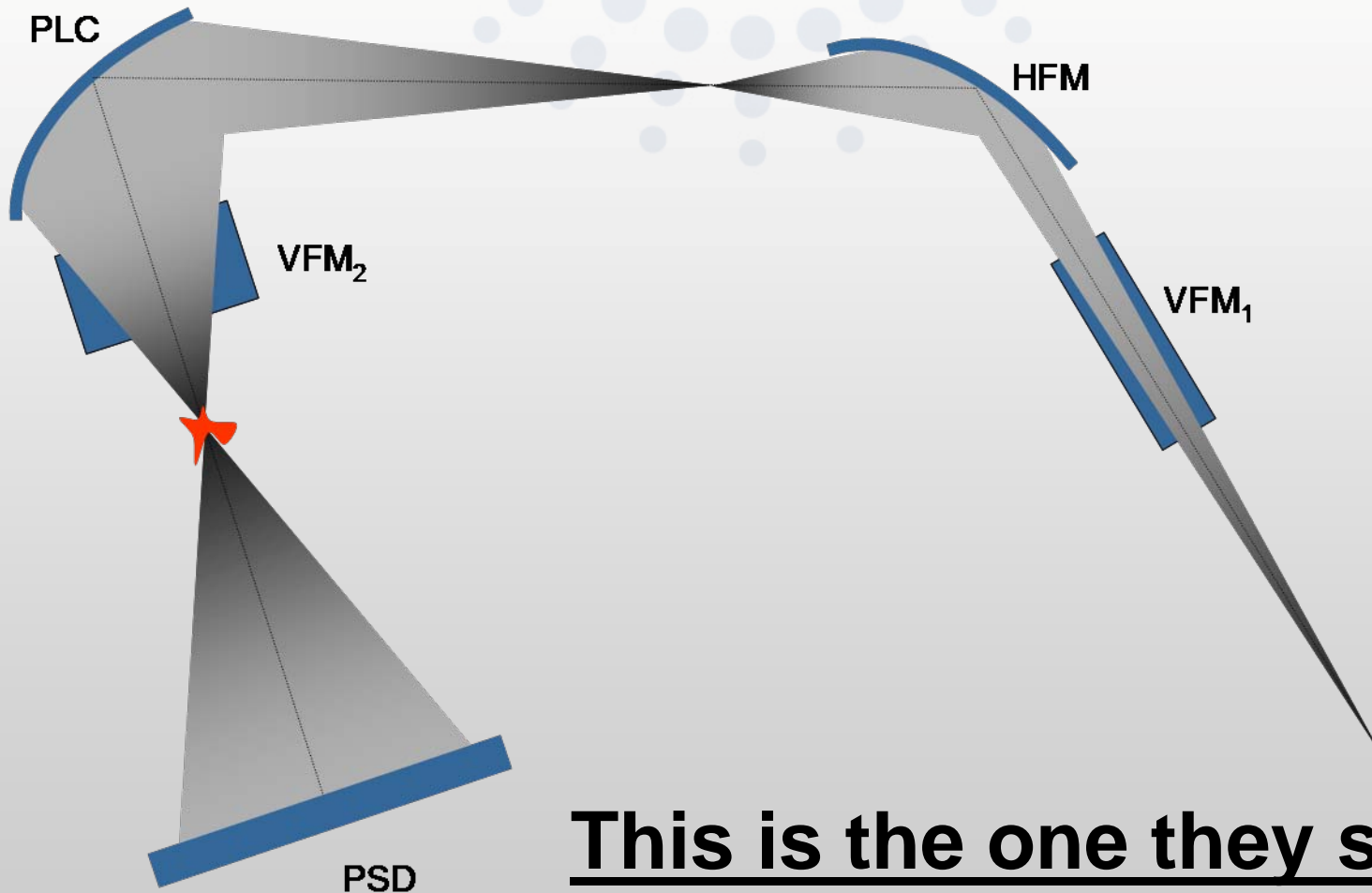
Estimated: $8\text{keV} \times 1.6 \times 10^{-19} \text{ J/eV} \times 10^{13} \text{ ph/sec} = 12\text{mW}$

Thus you can forget low temperatures!

Advantage: Good energy range to work with: 6 to 20 keV

Advantage: challenging projects with good follow up

ID24: advantages and problems



This is the one they show

ID24: advantages and problems

A decorative graphic consisting of numerous light blue circles of varying sizes, arranged in a pattern that tapers to the right, positioned behind the main title.

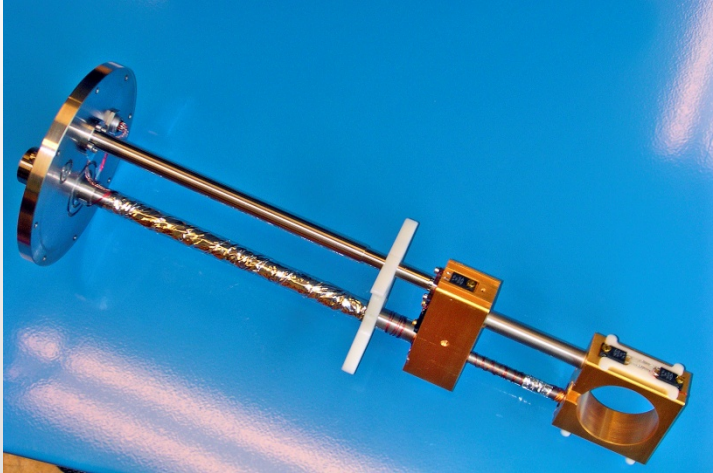
This is what it looks like to me:

ID24: advantages and problems

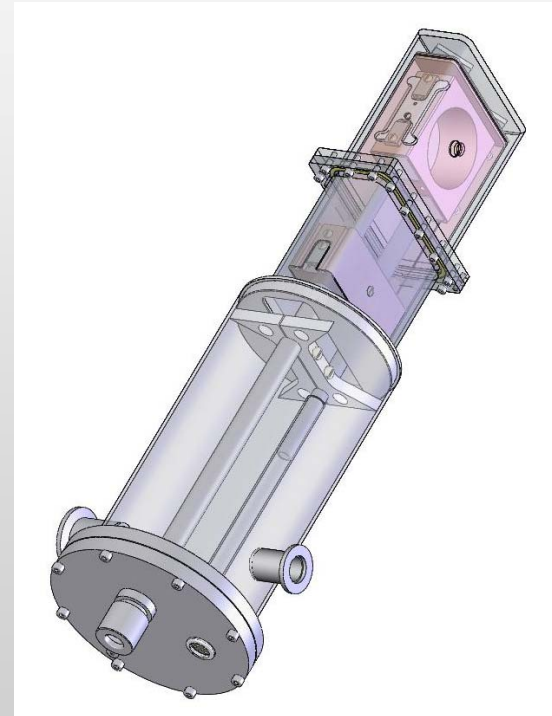
This is reality:



ID24 examples: low temperature/high pressure



LT/HP cryostat to fit in electromagnet
 Minimum temperature 2.5K
 XMCD up to 1.5 Tesla
 Pressure range 40 Gpa
 CuBe cell, membrane driven
 Position stability, temperature stability

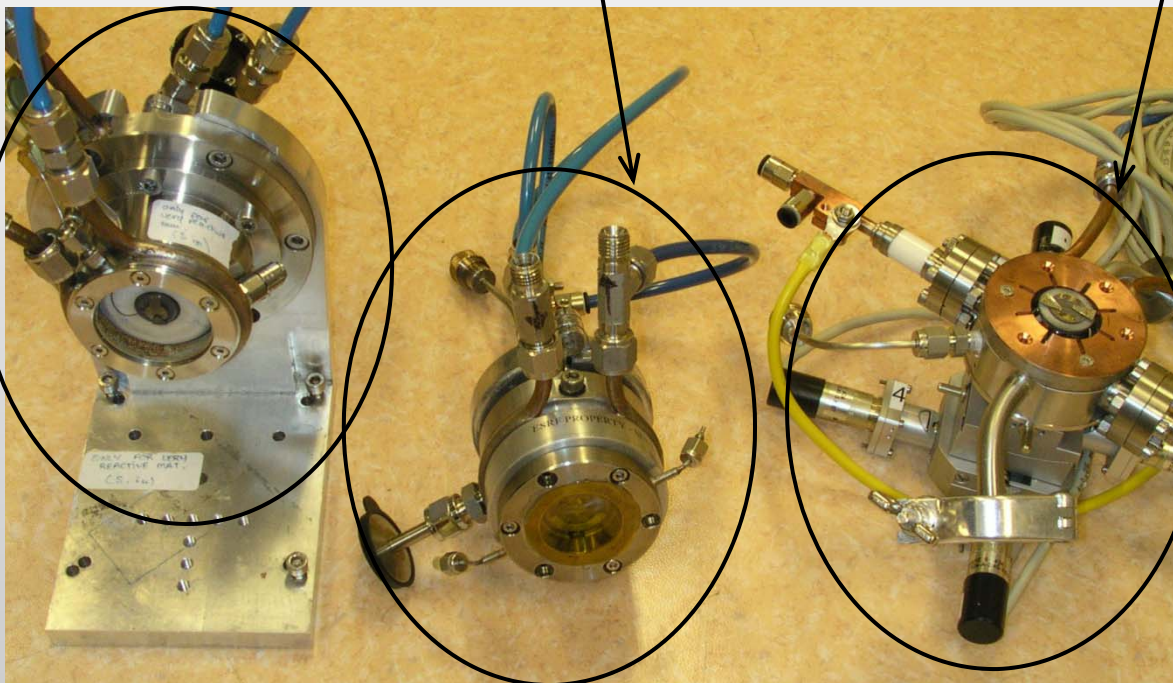


ID24 examples: high temperature

catalysis furnace 1
 Thermocoax heater
 Tmax 800 °C

catalysis furnace 2
 Maxthal heater
 Tmax 1000 °C

ID01 furnace
 Sample quenching
 Maxthal heater
 Tmax 1200 °C



ID24 examples: pulsed magnetic field

Sample cryostat:

- Temperature 4 to 250 K
- Quick sample change
- Beam on axis

Pulsed coil:

Maximum field 30 Tesla

Optimised cooling

Coil life duration...



Beam axis
Field axis

Conclusion



This beamline allows to do MBar pressures, temperatures from below 4 Kelvin to above 2000C, magnetic field up to 30 Tesla, ...

There still is more to do, and more will come: laser heating, optical spectroscopies, microreactor / microfluidics, ...

Acknowledgements

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The SES technicians Jeroen Jacobs and Hugo Vitoux
All of ID24 / BM29

