

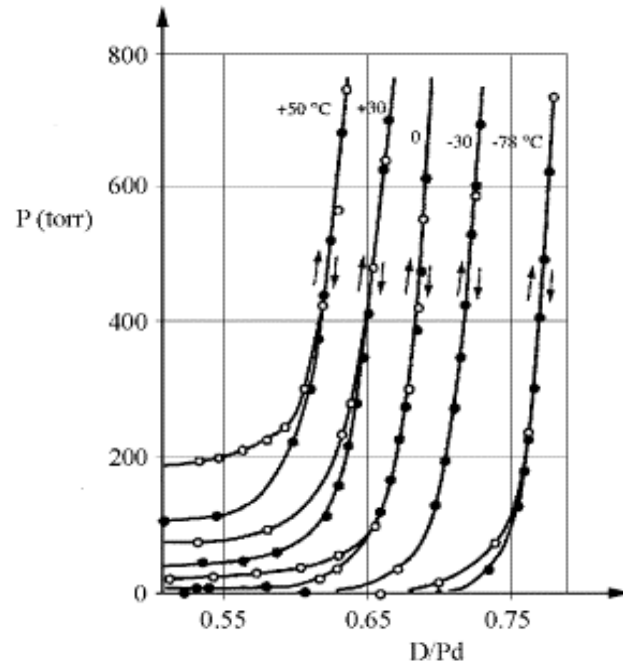
# LOW TEMPERATURE GAS LOADING OF DEUTERIUM IN PALLADIUM

F. Scaramuzzi

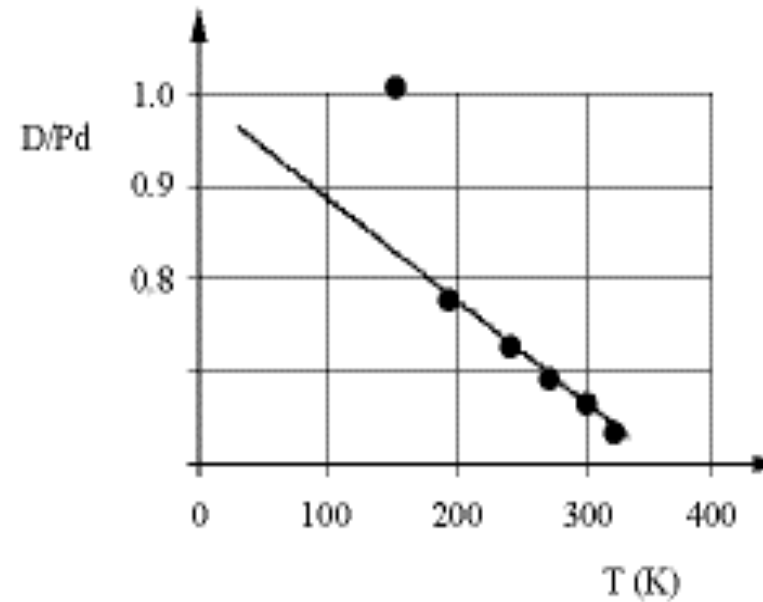
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# Why low temperature?



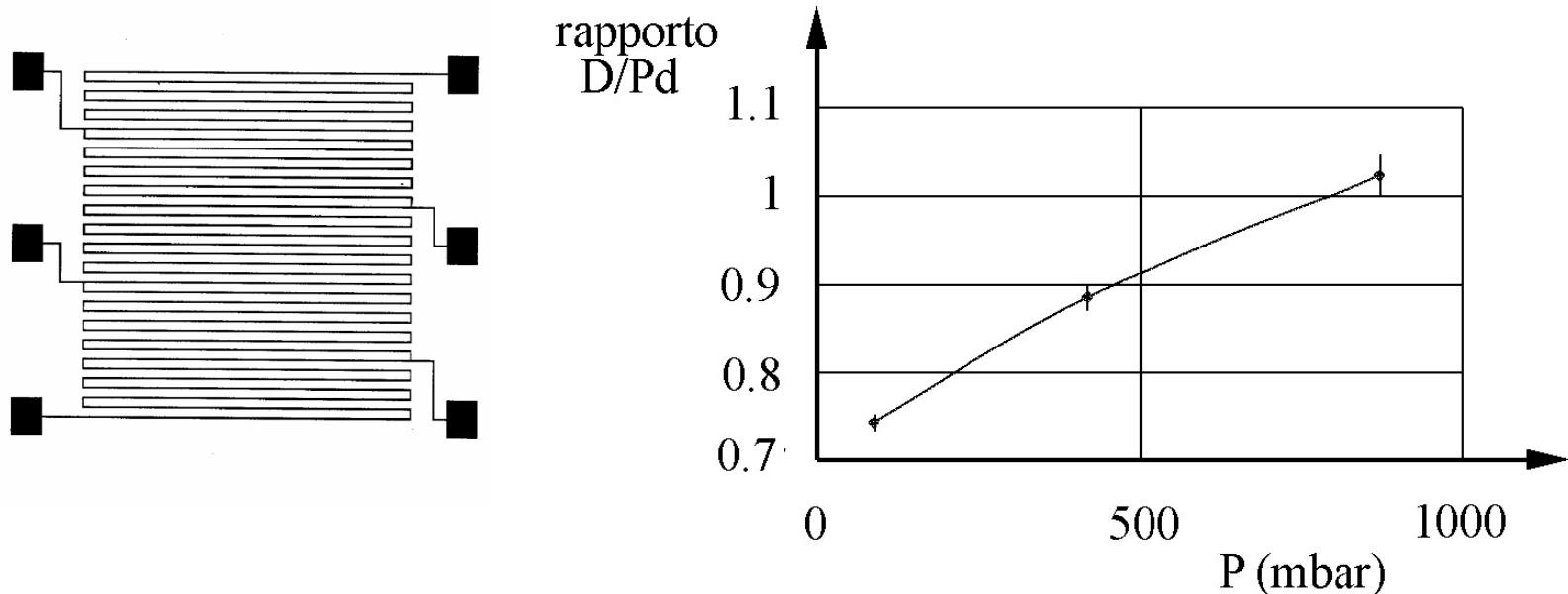
(a)



Everything started from these data

[Von E. Wicke, G.H. Nernst, Ber. Bunsenges. phys. Chem., 68, 224 (1964)]

# First Measurement (ENEA Frascati 2002)



Measuring the D/Pd ratio at 150 K as a function of pressure. The sample is roughly 10 mg of Pd, in a film 3  $\mu\text{m}$  thick. It took almost a month to perform the measurement.

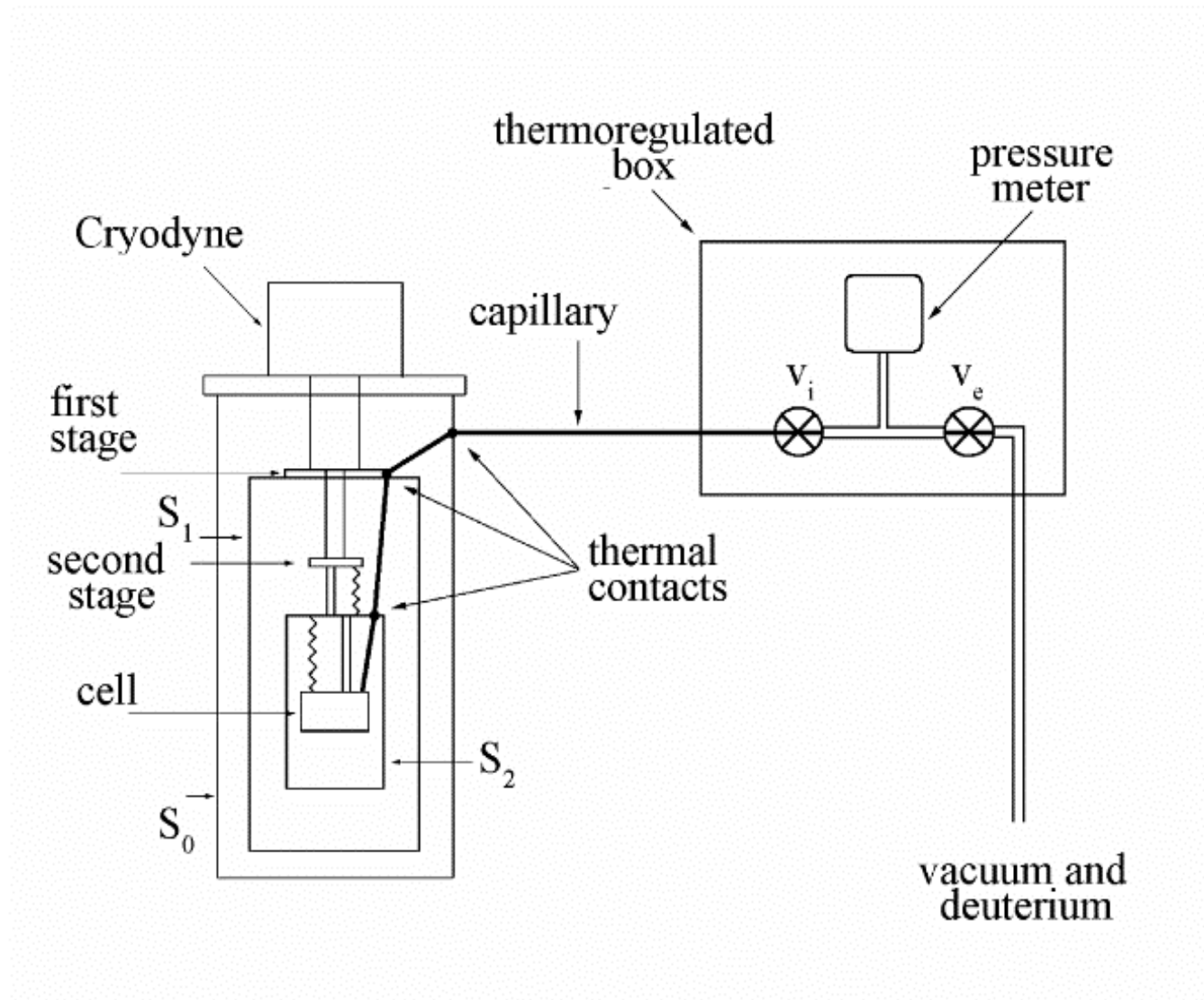
F. Scaramuzzi, **Gas loading of deuterium in palladium at low temperature**, *Journal of Alloys and Compounds*, 385, 19 (2004).

# Objectives of the experiment

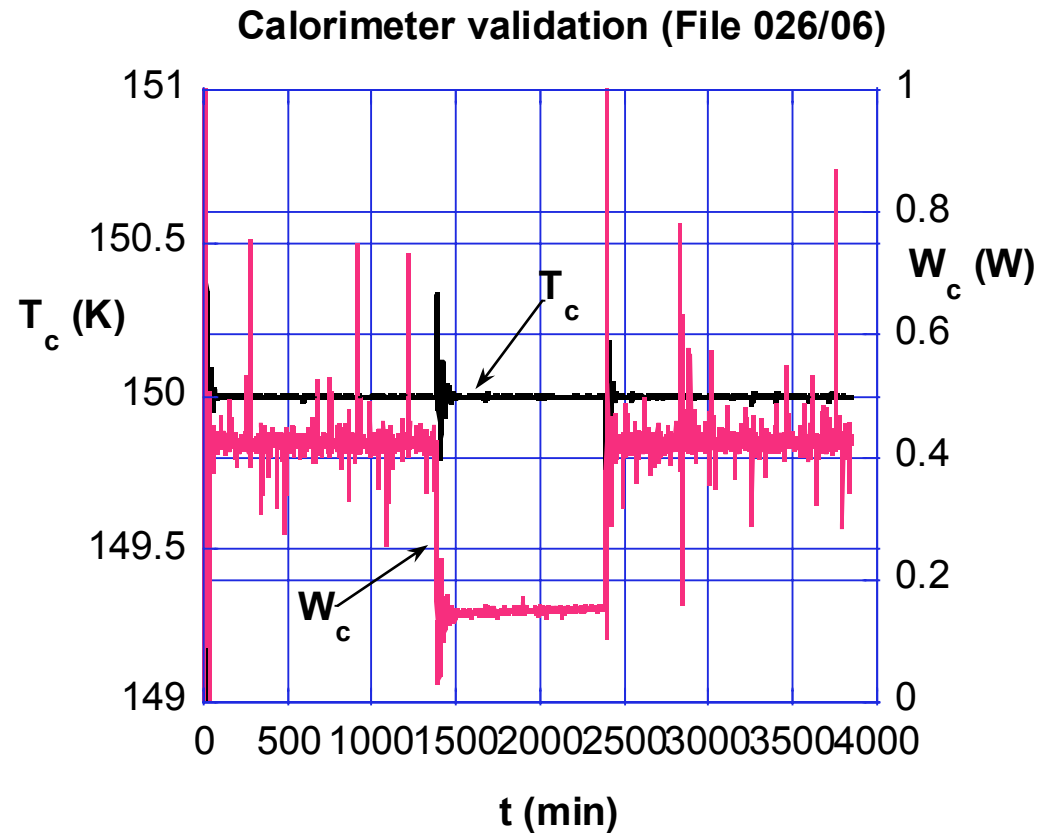
The idea is to realize a conceptually simple experiment, reproducible, and with a straightforward answer:

- To start with, measuring the D/Pd ratio, aiming to high values.
- Possibly detecting excess heat.
- Analyze the gas, looking for  $^4\text{He}$ .
- Studying the loading dynamics.

# The apparatus



# Calorimetry



Shield  $S_2$  and cell are thermoregulated.  $T_c > T_s$ . The power used to keep  $\Delta T$  is monitored: it is the calorimeter.

# The samples

Three types of sample have been used:

- the film shown before (3  $\mu\text{m}$  thick);
- sample from Vittorio Violante (50  $\mu\text{m}$  thick):
- sample obtained by synthesizing Pd powder ( $< 1 \mu\text{m}$ ).

The most promising is the first: there is a chance that more samples will be realized in a cooperation with NRL (Dr. David Knies).

The synthesized sample looks unsatisfactory: the use of nanoparticles is a very interesting perspective: a possible cooperation is being considered.

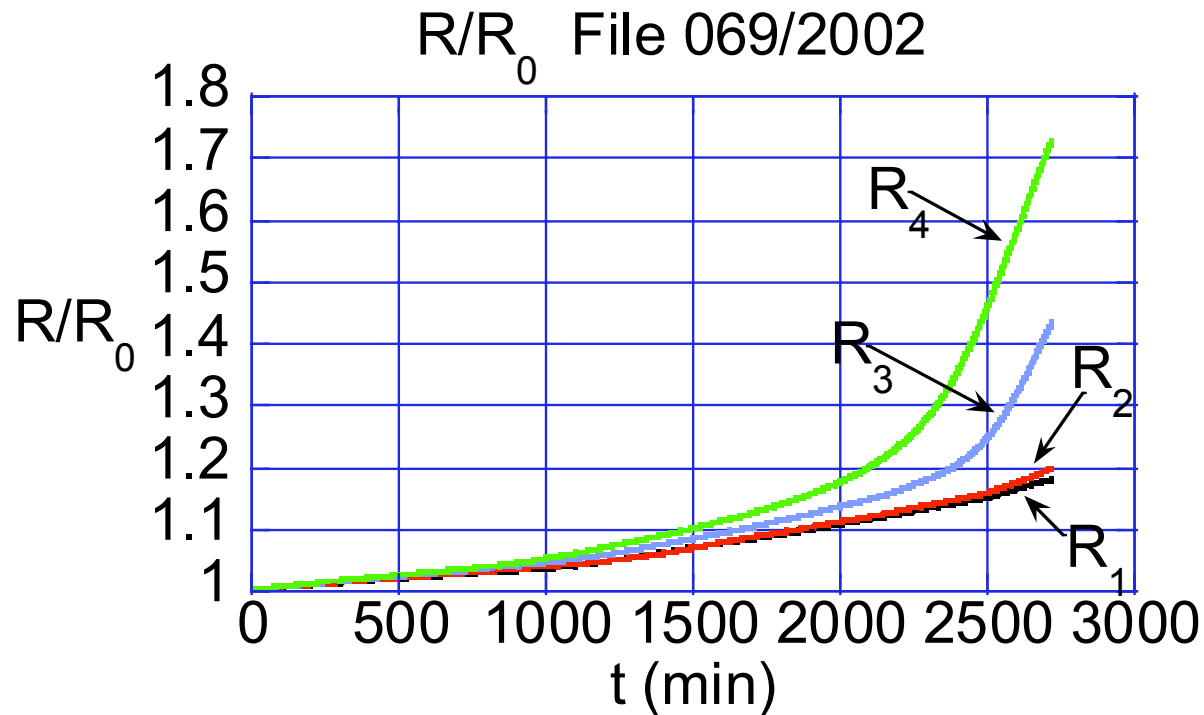




# Loading Dynamics - 1

- The geometry of the first sample allows measuring the electric resistance of each section independently, as a function of time, loading ratio, temperature.
- This has been done, keeping also in mind the “Preparata Effect”.
- The results are quite interesting, but presently rather poor. New samples and new tests are needed.

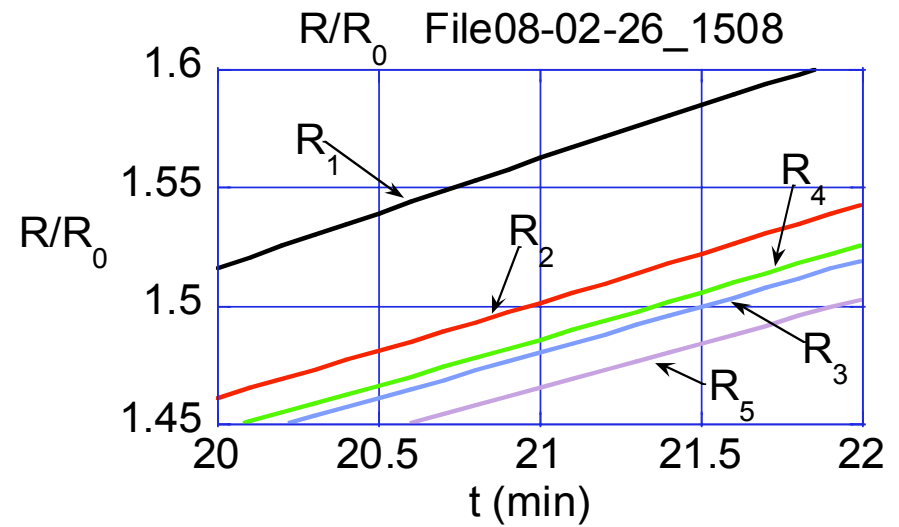
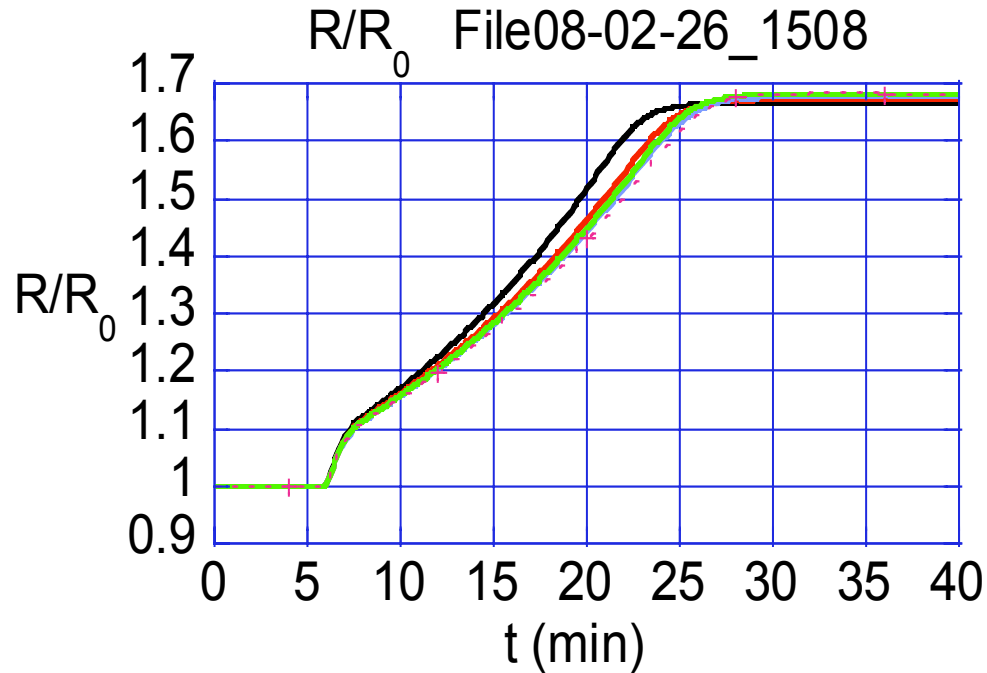
# Loading Dynamics - 2



	R/R <sub>0</sub>	D/Pd
R <sub>1</sub>	1.18	0.13
R <sub>2</sub>	1.20	0.14
R <sub>3</sub>	1.42	0.29
R <sub>4</sub>	1.75	0.52

The 2002 experiment.  $T = 150$  K.  $R_5$  was broken after 1 day.  $R_1$  is the most positive,  $R_4$  the most negative. The time interval is 2 days. In the table the loading ratio.

# Loading Dynamics - 3

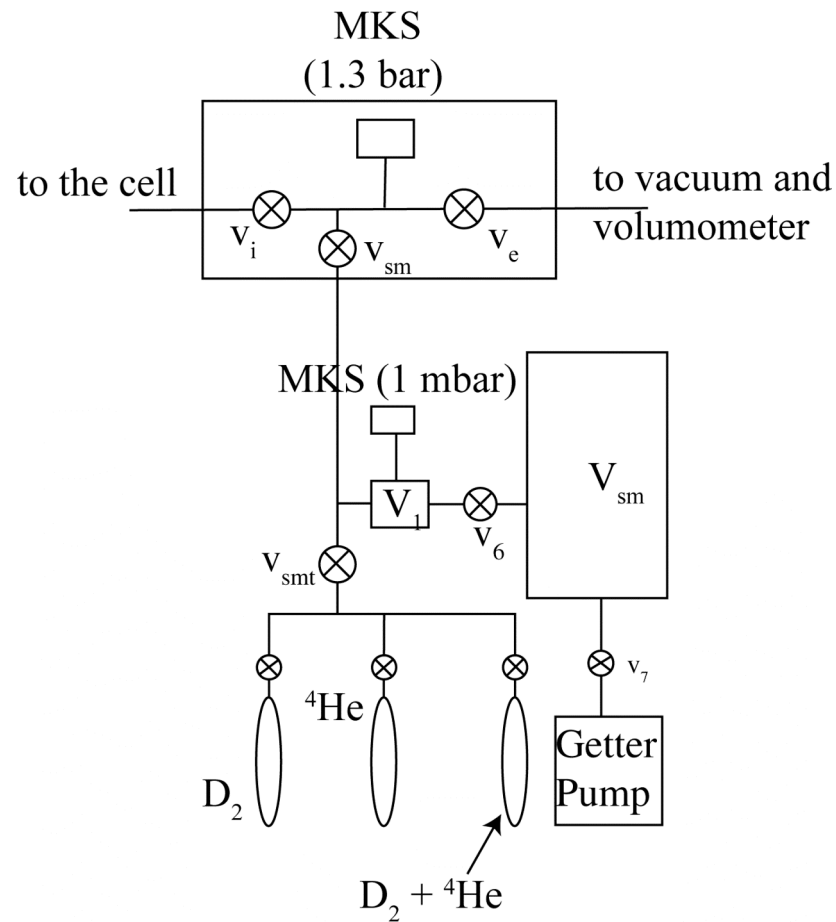


An “old” (5 years) sample at room temperature.  $R_5$  is the most positive,  $R_1$  the most negative. In the long term differences are smaller.

# Acknowledgements

- Since 2005 this experiment was hosted at the LNF of INFN: thanks are due to the Direction of the Laboratory and to Commission 5 of INFN for its support.
- The Author is grateful to his colleague and friend Ivo Modena for continuous scientific support in the conduction of the experiment.
- He thanks warmly Arturo Moleti, Alessio Rocchi and Filippo Sanjust, who took care of the LabView data acquisition system.
- Thanks are due to ENEA and to Alberto Clozza and Angelo Viticchié for procuring valuable instrumentation.
- The experiment would not have been possible without the skillful help of Franco Campolungo, Mauro Iannarelli and Lorenzo Martinis: also to them goes the Author's gratitude.

# The system for the detection of $^4\text{He}$



Not completed

# The apparatus

