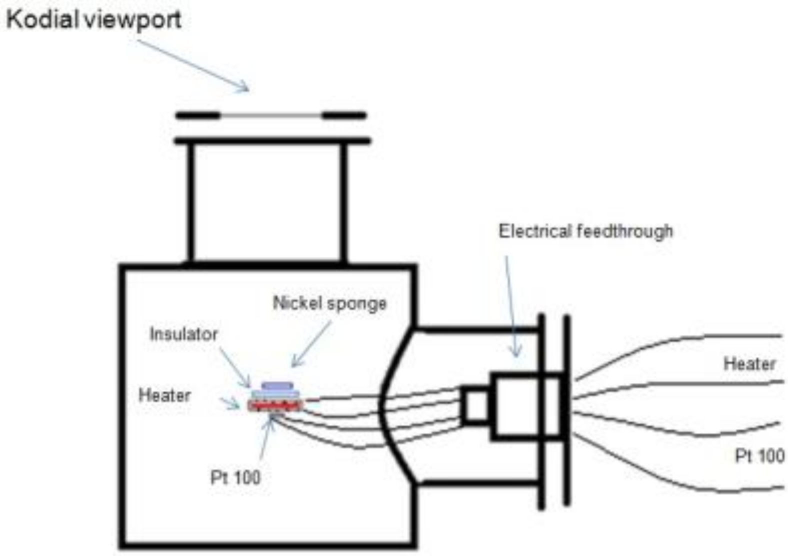
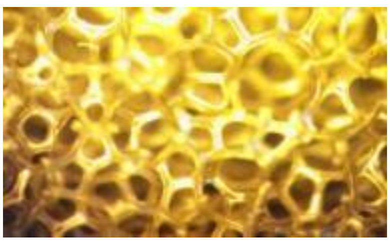
Preliminary report on an attempt to replicate Mizuno's experiment (nano Palladium on Nickel)

Report on a Mizuno Experiment Replication Test with nanometric palladium on nickel grid pre-treated in hydrogen atmosphere.
The reactor employed is the number 1 of the Bareggio ARGAL laboratory, which has a volume of about 300 cc.
The test embodiment is illustrated in the diagram below.



The heater is made of an iron wire wound around a boron nitride holding plate suspended by the wire itself to the vacuum feedthrough (wire thickness ¼ of mm); on the heater there is placed a second boron nitride plate to isolate the material to be tested; this material consists of a fragment of spongy nickel of square form with side of about 1 cm and thickness of 1 mm. Picture of it is below.



Nickel structure 50 X

Pd electrodepositing setup

Other photos on the following page show the reactor with the sample inside, the deuterium entry configuration and the second sample with lightweight Palladium deposition. The holes that you see are made to connect the platinum wire to the sample for the electrodeposition.

Reactor 1 with the material inside; configuration to fill D2 gas; sample with Pd deposit (II test)

Degassing and calibration

The first operation we performed was a degassing treatment of the material in vacuum and then in hydrogen up to 300 degrees for 12 hours. Subsequently, we calibrated the hydrogen system at about 60 mbar by varying the power from 5 to 1 watt with a decrease of 1 W at a time and waiting for each power decrease to stabilize the reactor temperature.

Deposition of nanometric palladium and hydrogen and deuterium testing

After calibrating, the nickel material was extracted from the reactor and treated in Palladium Chloride 0.05 Molar solution for an electrochemical deposition of Palladium. The treatment has been prolonged (about 2 h to 5 mA) so the material become dark black and brittle due to high thickness of the Pd deposition. Having had no previous experience, we went far beyond the need. Anyway, we continued with the test by inserting the material as it was in the reactor. After a vacuum degassing for one night, we put hydrogen and brought the power to 3 W. As soon as the temperature reached about 200 degrees there was a strong absorption by the material for which the pressure went from 75 mbar start at 55 mbar. Data for 3, 4, and 5 Watts are listed in the tables and charts below.

Hydrogen replacement with deuterium.

After extracting hydrogen from the reactor, we brought the material back to 300 degrees after vacuuming to try to extract hydrogen trapped in palladium before introducing the deuterium. After several hours the pressure in the reactor ranged from 0 to 10 mbar. At this point, again the vacuum, we put the deuterium at a pressure of 12 mbar (to be closer to the Mizuno conditions of 7.6 mbar). The deuterium test was programmed as for hydrogen from 1 to 5 W, but noting that the temperature rise of the same power was lower, we continued the temperature rise with power up to 9 W.

(update of 19 September 2017)

We add the data for two subsequent tests, the first with the material covered with nanometric Pd deposited in about 10 minutes at 1.5 mA current and tested in a Deuterium at various temperatures; the second on the same material retained in the reactor, but changing, after recharging the reactor in a hydrogen atmosphere at room temperature.

The tables and graphs summarized below are as follows.

Power W	T heater °C	Tc Reactor °C	Ta ambient °C	Pressure P/Po	Tc – Ta °C	Rth C/W	R heater Ohm
0,011	26	25,1	25,1	1	0		0,89
1	108	27,13	24,71	1,05	2,42	2,42	1,25
2	171	30	24,9	1,09	5,1	2,55	1,6
3	220	32,6	25,2	1,13	7,4	2,466667	1,9
4	263	35	25,4	1,16	9,6	2,4	2,18
5	299	37,15	25,43	1,17	11,72	2,344	2,45

Table for calibration (palladium-free material in hydrogen)

Power W	T heater °C	Tc Reactor °C	Ta ambient °C	Pressure P/Po	Tc – Ta °C	Rth C/W	R heater Ohm
0	26			1			0,89
3	217	33,9	26,76	1,11	7,14		1,92
4	257	36,2	26,8	1,15	9,4	2,38	2,2
5	291	37,62	26	1,18	11,62	2,35	2,45
5,5	307	38,8	26,2	1,2	12,6	2,29	2,55
6	322	40,25	26,71	1,21	13,54	2,25	2,65

Testing table with hydrogen-containing palladium-based material

Power W	T heater °C	Tc Reactor °C	Ta ambient °C	Pressure P/Po	Tc – Ta °C	Rth C/W	R heater Ohm
0	25		25	1	0		0,9
1	65	28	25,32	1,1	2,68	2,68	1,02
2	100,75	29,74	24,96	1,17	4,78	2,39	1,17
3	137	31,5	24,54	1,24	6,96	2,32	1,34
4	174,75	33,29	24,44	1,3	8,85	2,21	1,49
5	206,6	35,24	24,28	1,37	10,96	2,19	1,67
6	240,45	37,08	24,17	1,43	12,91	2,15	1,85
7	270	38,96	24,12	1,5	14,84	2,12	2,03
8	301	40,7	23,82	1,61	16,88	2,11	2,23
9	329,5	42,49	23,74	1,7	18,75	2,08	2,42

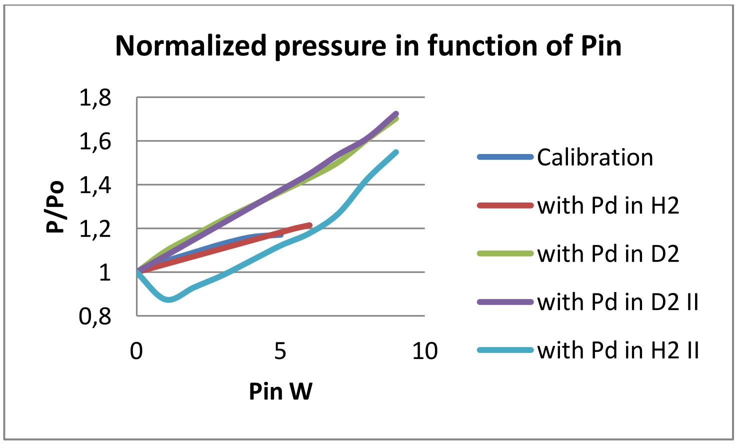
Testing table with palladium-containing material in deuterium

Power W	T heater °C	Tc Reactor °C	Ta ambient °C	Pressure P/Po	Tc – Ta °C	Rth C/W	R heater Ohm
0	23,42		23,42	1	0		0,88
1	61,5	26,14	23,42	1,07	2,72	2,72	0,99
2	98,05	28,45	23,42	1,15	5,03	2,51	1,14
3	135	30,75	23,37	1,22	7,38	2,46	1,3
4	170,5	32,6	23,08	1,3	9,52	2,38	1,47
5	205,5	34,5	22,9	1,37	11,6	2,32	1,68
6	237	36,19	22,63	1,45	13,56	2,26	1,85
7	268	37,88	22,38	1,54	15,5	2,21	2,04
8	298,4	39,65	22,16	1,61	17,49	2,18	2,24
9	326,45	41,46	22,16	1,72	19,3	2,14	2,43

Table of data for the second Pd-coated Nickel in Deuterium

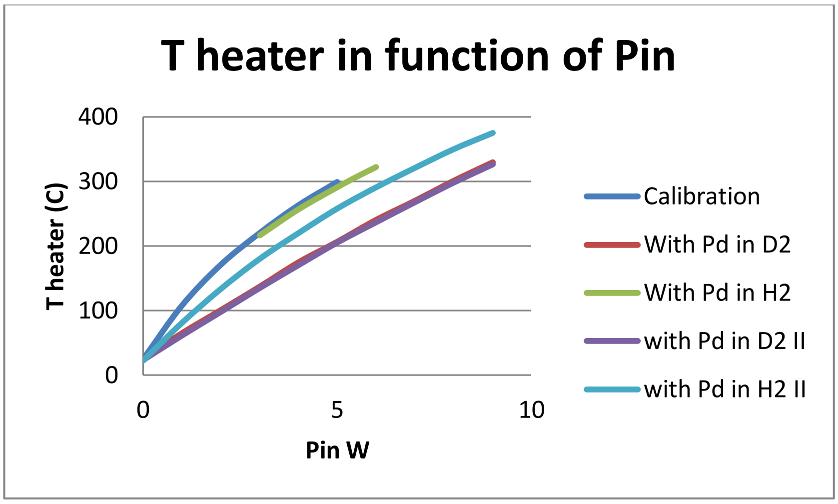
Power W	T heater °C	Tc Reactor °C	Ta ambient °C	Pressure P/Po	Tc – Ta °C	Rth C/W	R heater Ohm
0	22,46		2,51	1	0		0,88
1	81	24,1	21,9	0,87	2,2	2,2	1,09
2	133,45	26,92	22,12	0,93	4,8	2,4	1,33
3	180	29,1	22,5	0,99	6,6	2,2	1,58
4	220	31,2	21,8	1,05	9,4	2,35	1,82
5	258	33	21,55	1,12	11,45	2,29	2,05
6	290,85	34,78	21,45	1,18	13,33	2,22	2,27
7	321	36,78	21,38	1,27	15,4	2,20	2,49
8	350	38,8	21,59	1,43	17,21	2,15	2,7
9	375	40,98	21,96	1,55	19,02	2,11	2,9

Table of Data for the Second Pd Coated Nickel in Hydrogen

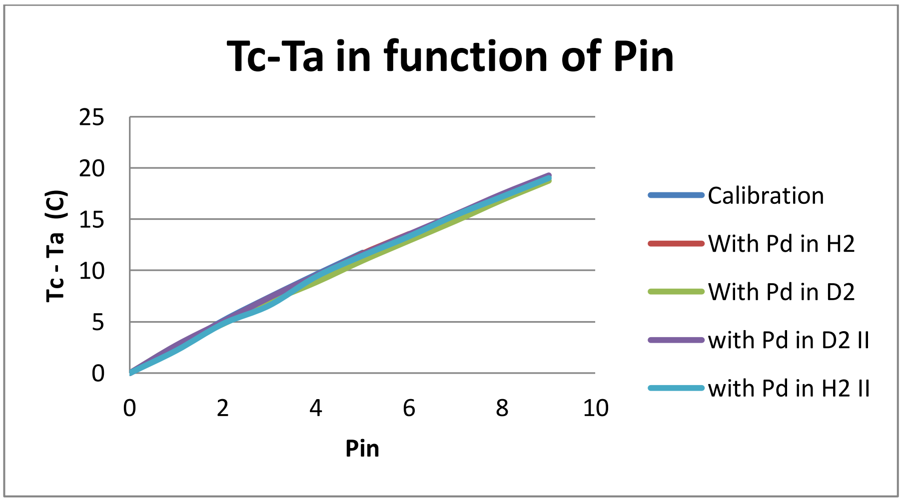


Normalized pressure (P / Po) in the reactor depending on the power on the heater for the different tests; in the case of the second H2 test, displacement on the X axis is due to the decrease of the pressure in the reactor for absorption by Palladium immediately after the introduction of H_2. It is interesting to note that in the case of deuterium has not been found to be appreciable absorption, unless it has been so rapid that it has not been possible to notice it during the gradual introduction of gas into the reactor. The various pressures used are respectively: 60 mbar for the calibration and the first test in H_2, 12 mbar for the first test with D_2, 8 mbar with the second test with D_2 and 12 mbar with the second hydrogen test.

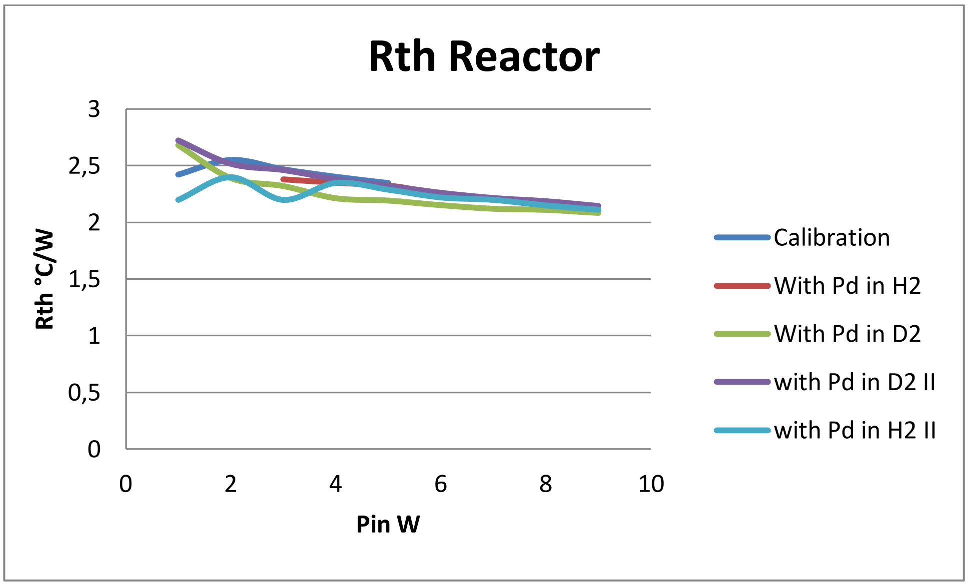
Here are the various graphs that best display the most relevant parameters of the experiments.



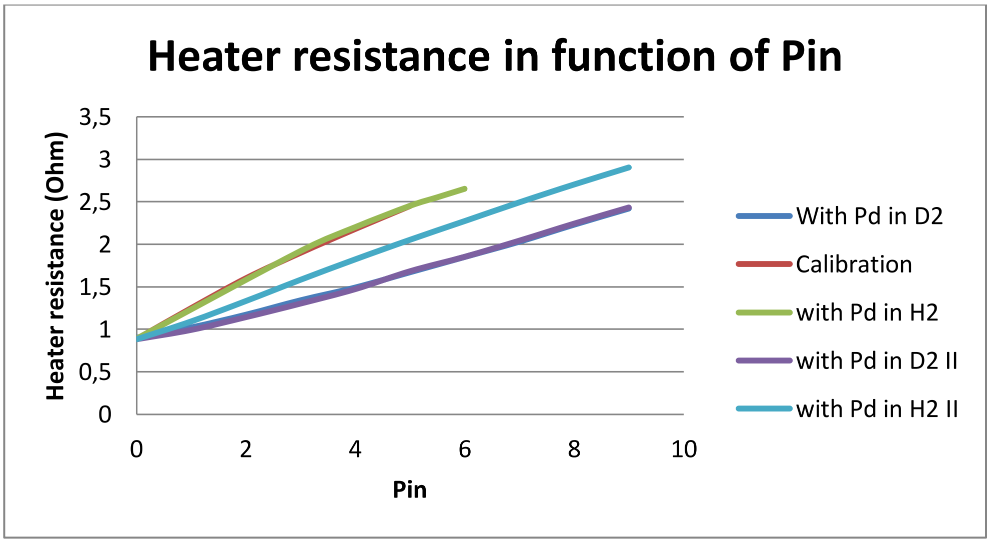
Heater temperature depending on the input power in different conditions. The heater temperature is measured with a lightweight Pt100 probe on the opposite side of the sample.



Difference between the reactor and the ambient temperature for different tests. Good reproducibility of the values is observed and the absence of excess heat as compared to the calibration. This is the main graph for determining any excess heat.

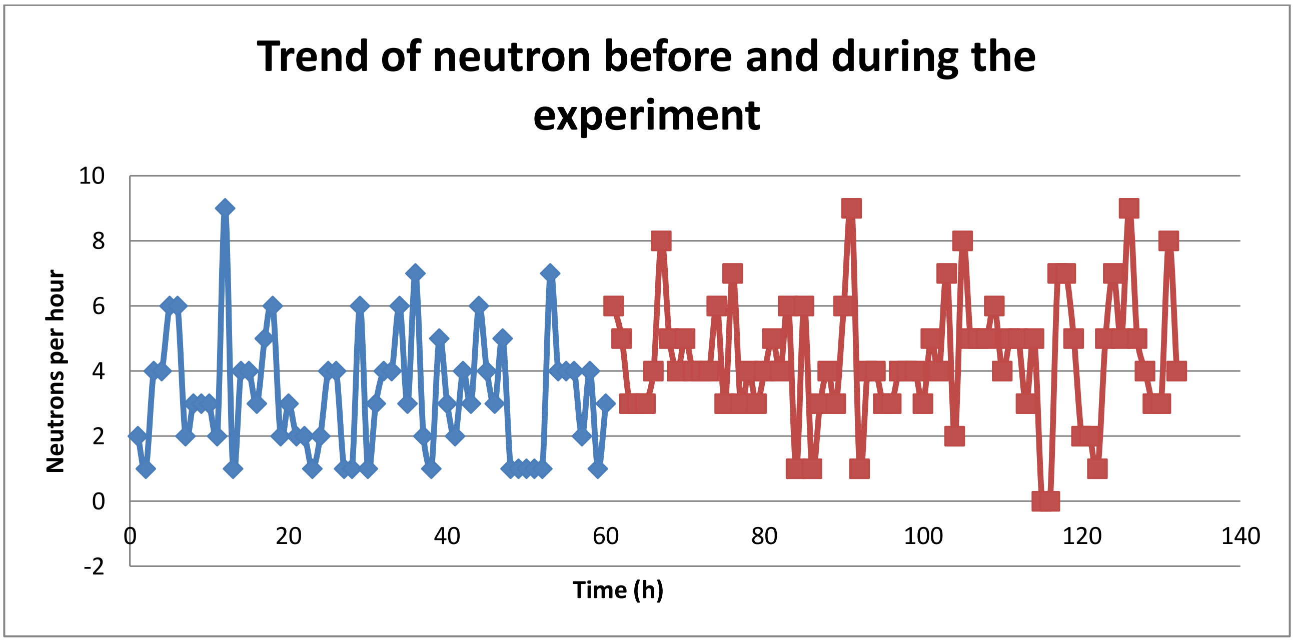


Progress of the reactor thermal resistance that confirms the absence of excess heat. If there was excess heat the curve should point to a lifts going to the right. With low temperature differences the measurement is not very accurate. With more than 4 W it is reliable.

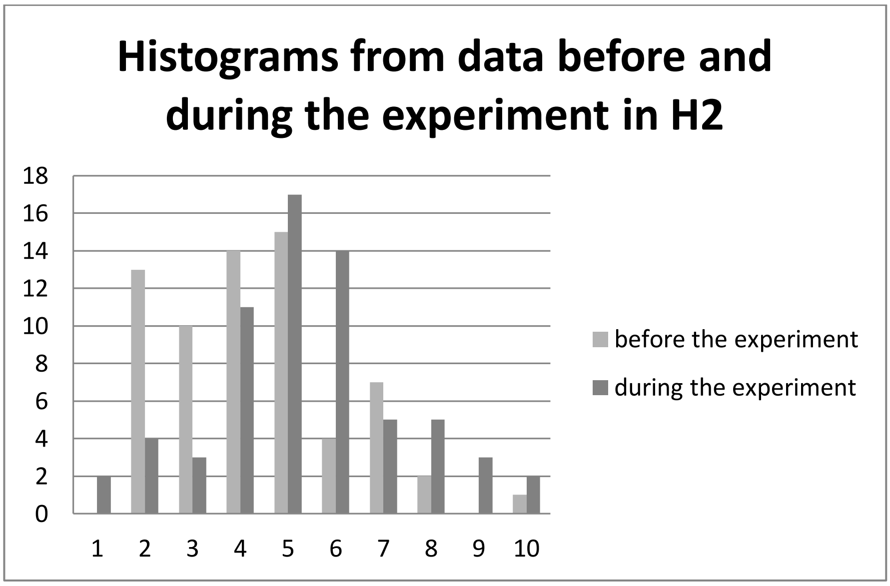


The heater's resistance with the input power highlights a different pattern depending on the gas in the reactor and its pressure. By the increasing of the resistance coefficient with the heater temperature, it is confirmed that the heater material is iron (4.5-10 ^ -3).

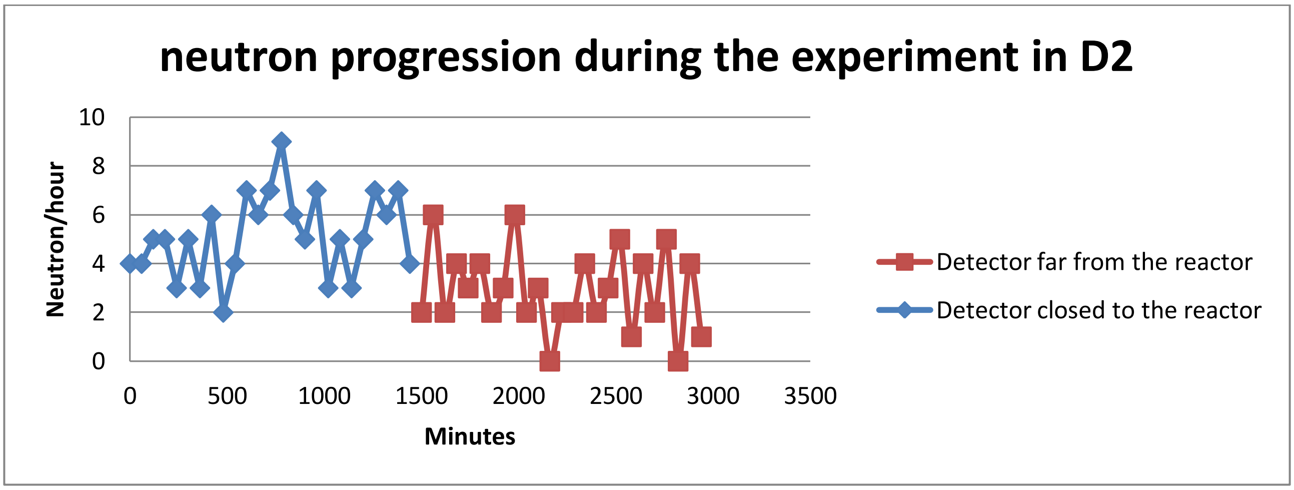
Gamma monitoring, always active, shows no abnormalities compared to the background in experiments with H2, while in the second experiment with deuterium we have noticed a slight increase in mean counts after gas entering the reactor. As far as neutrons are concerned, experiments with Palladium first deposition, when the amount of Palladio was greater, show an increase in counts (neutrons / hr) with hydrogen, but more with deuterium, while in the second experiment with low Palladium deposition (10 minutes at 1.5 mA), only Deuterium experiment showed a greater emission of about 20%.



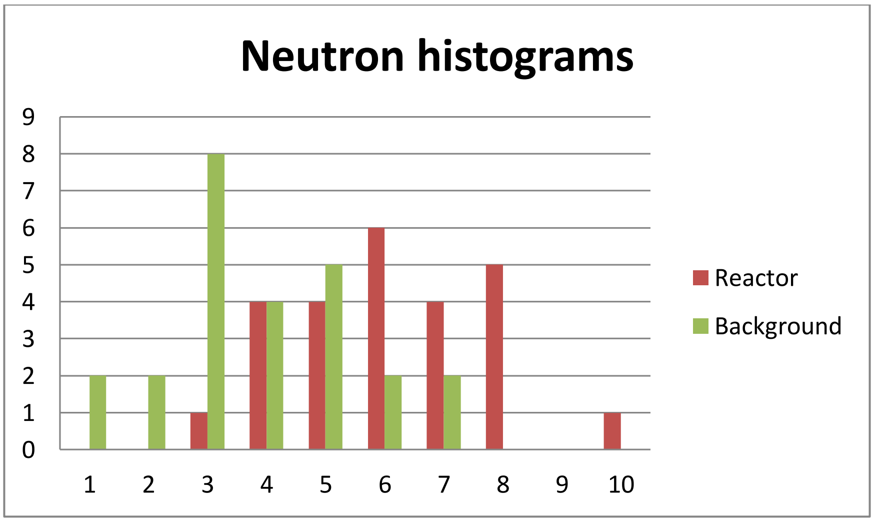
Neutron Sensor Detection Graph before experimenting with hydrogen palladium (blue) and during experiment (red).



Neutron histograms before and during Mizuno's hydrogen replication test (288 counts versus 220, about 30% more), considering the same number of monitoring hours.



Neutron performance during the Mizuno replication test with deuterium, blue with helium3 detector under the reactor and in red with the detector 2 meters away from the reactor. 157 counts against 97, about 60% more (in the same time frame).



Histograms of the two neutron monitoring periods illustrated in the previous graph.

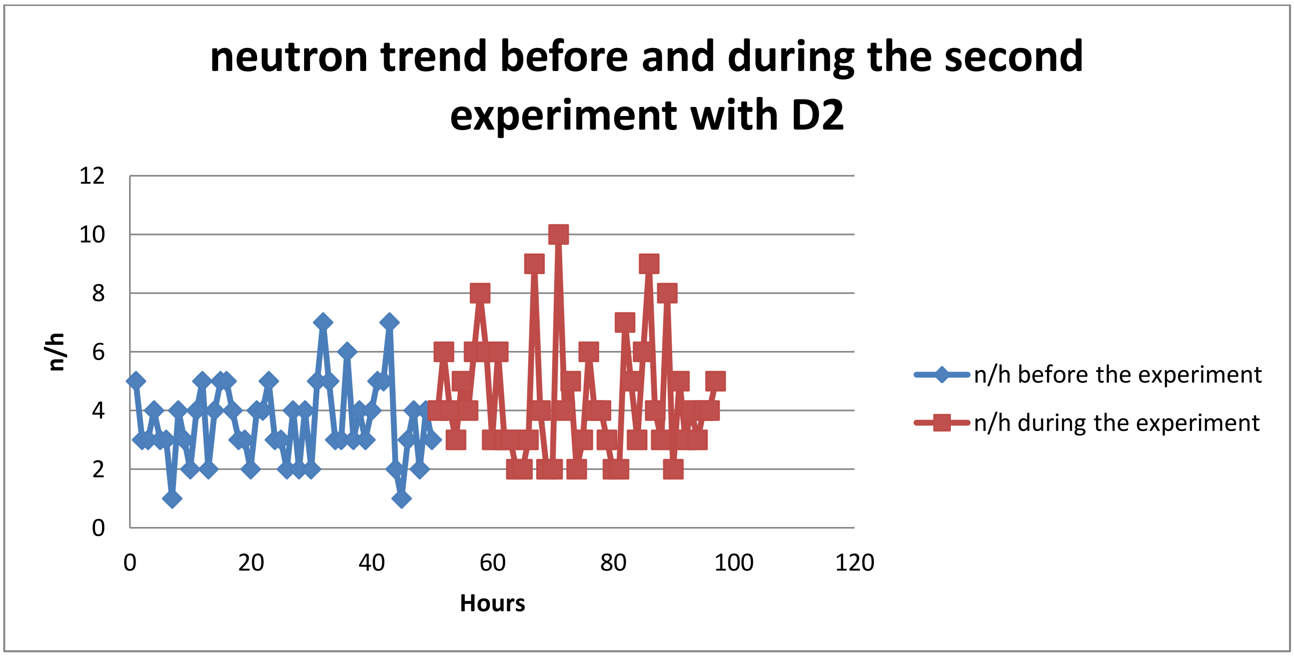
First considerations.

Probably the excess of palladium deposited on nickel "sponge" did not have the effect of hoping to have excess heat from the reaction of deuterium or hydrogen with nickel. This could have been buried by palladium without being able to participate in the reaction with atomic hydrogen absorbed and desorbed by palladium.

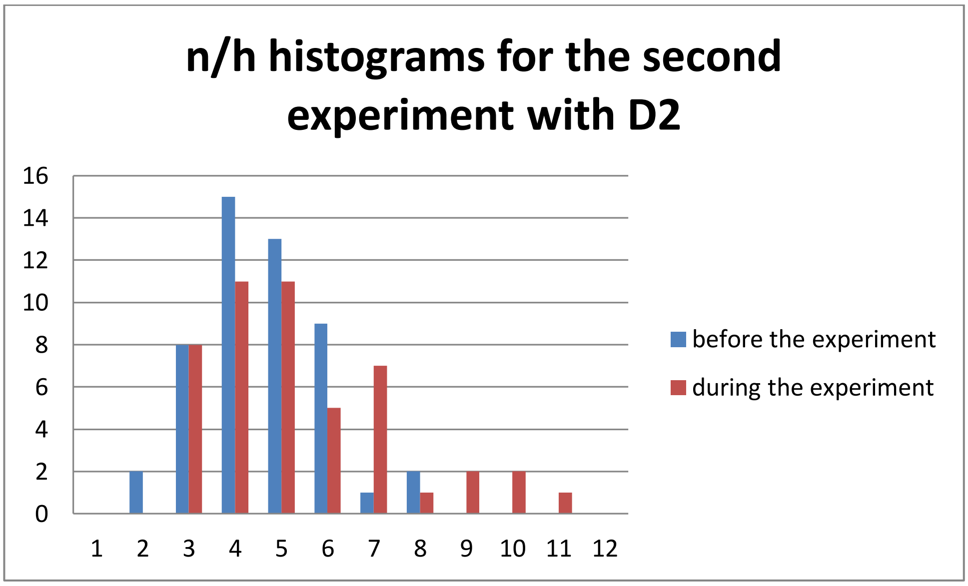
There is still a slight difference in the production of neutrons by injecting gases with palladium on the nickel sample, a symptom of nuclear activity at temperatures up to 350 degrees.

From the ARGAL laboratory in Bareggio

There, September 13, 2017 - Author, Ubaldo Mastromatteo



Neutron development before and during the second experiment with Pd deposited on nickel in deuterium at 8 mbar initial pressure. In blue counts for 50 hours with vacuum in the reactor.



Histogram for the previous graph for the two data populations before and during the experiment. The average before the experiment is 3.6 n / h and that during is 4.4 n / h.

It should be noted that the amount of palladium deposited in this second experiment is lower than that of the first experiment in a deuterium atmosphere where the populations are well distinguished, whereas in this case there is overlap of the prevailing part of the background.

Report Update:

There, September 19, 2017

Ubaldo Mastromatteo