Evidence of radiation from Ni-H system

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Summary

We report 3 experiments → different excited states

- Energy production
- Neutron measures
- Radiation emission
- Sample's surface analysis

Introduction

We study metal samples, planar or cylindrical rod

- Pure Ni
- Nickel alloys
- Nickel-plated

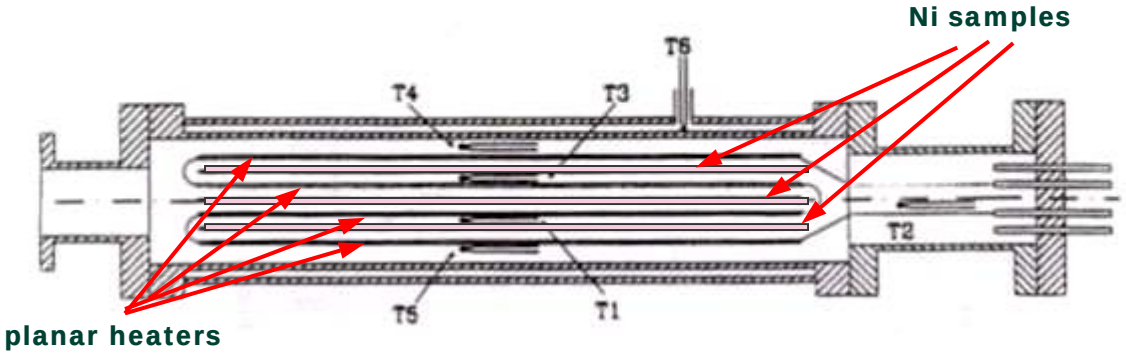
Cleaning: chemical and physical

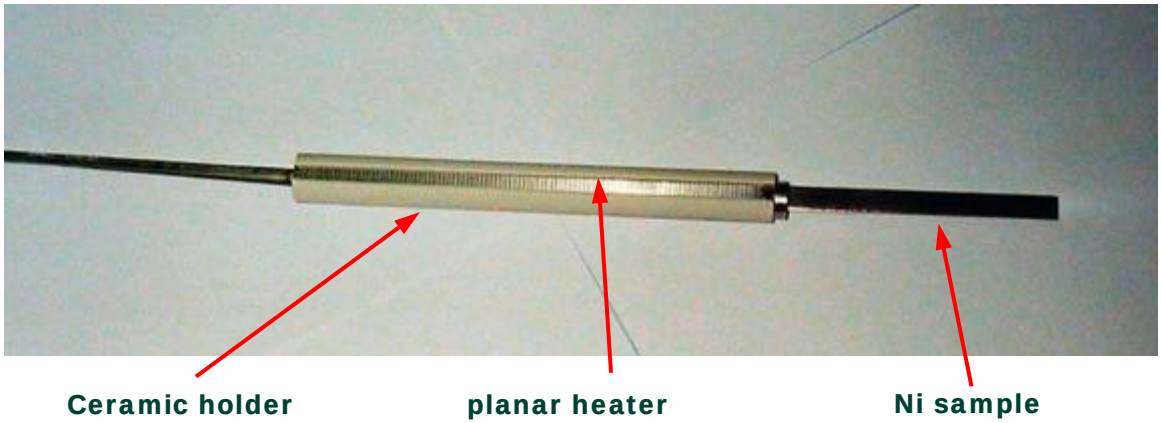
Loaded with Hydrogen

pressure	$100\ mbar < P_H < 1000\ mbar$
temperature	$150\ °C < T_S < 450\ °C$

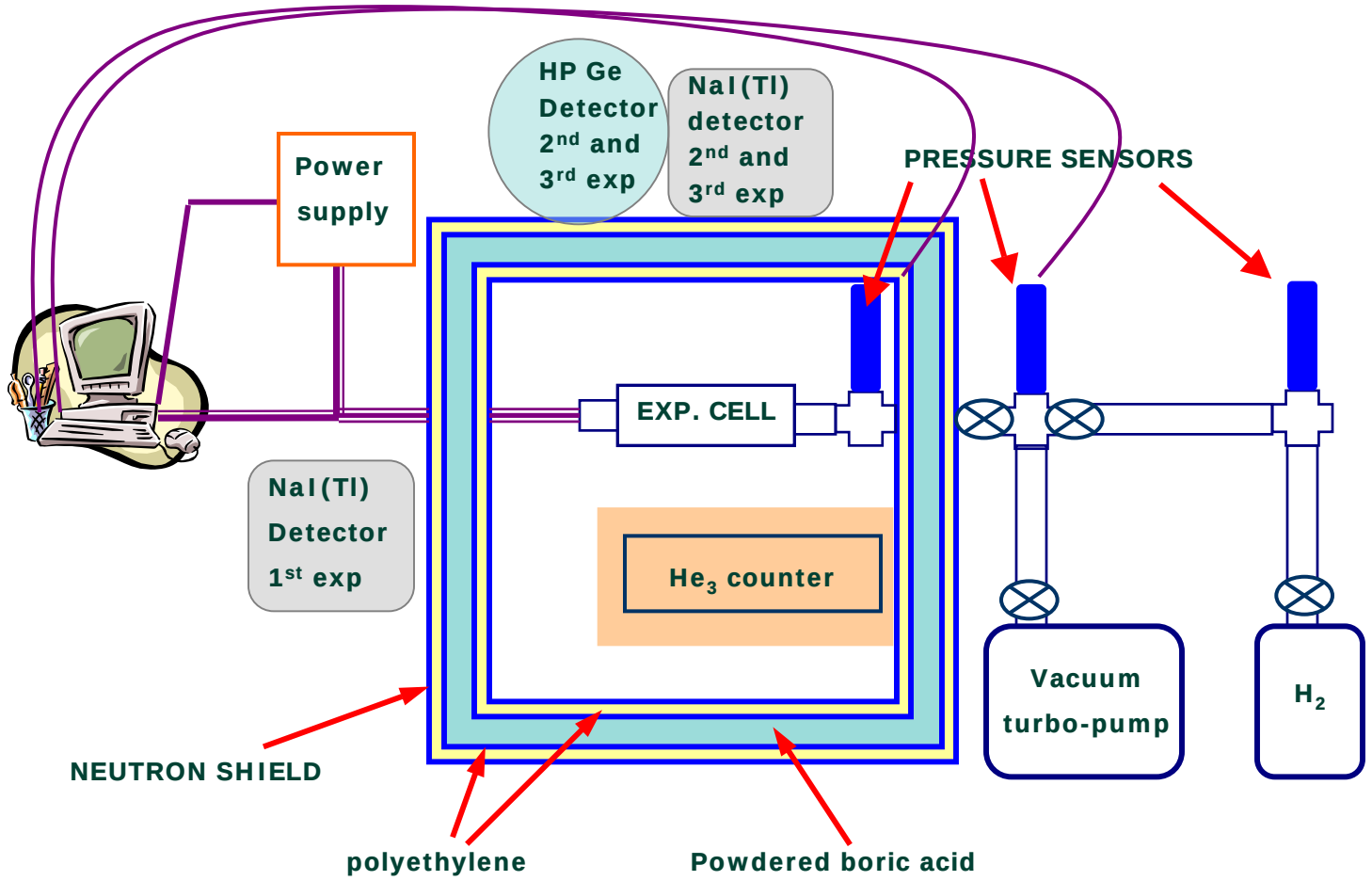
Experimental cell

T_i thermocouples





Experimental setup



Photon detectors

100 keV < E_γ < 4600 keV

***NaI(Tl)* detector** ⇨

⇦ **High Purity Germanium detector**

First experiment: sample preparation and hydrogen loading

Pressure $100\ mbar < P_H < 1000\ mbar$

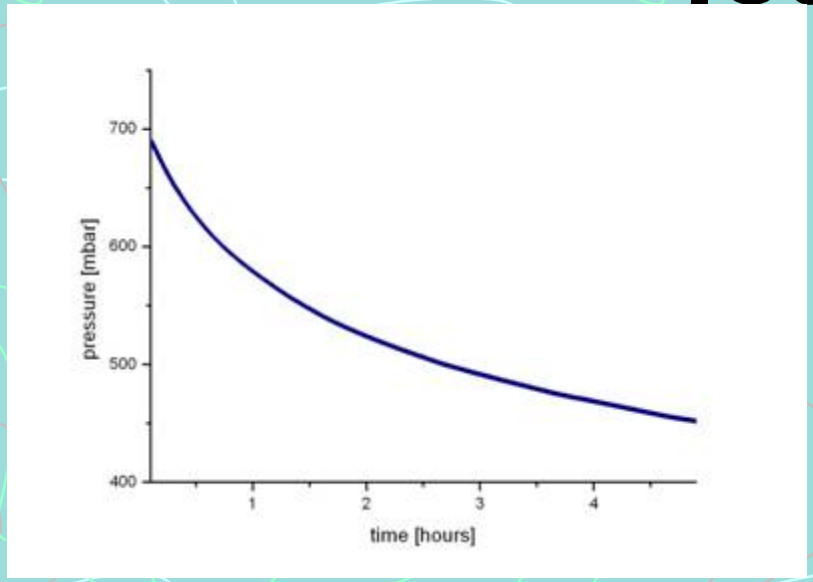
Temperature $150\ °C < T_S < 450\ °C$

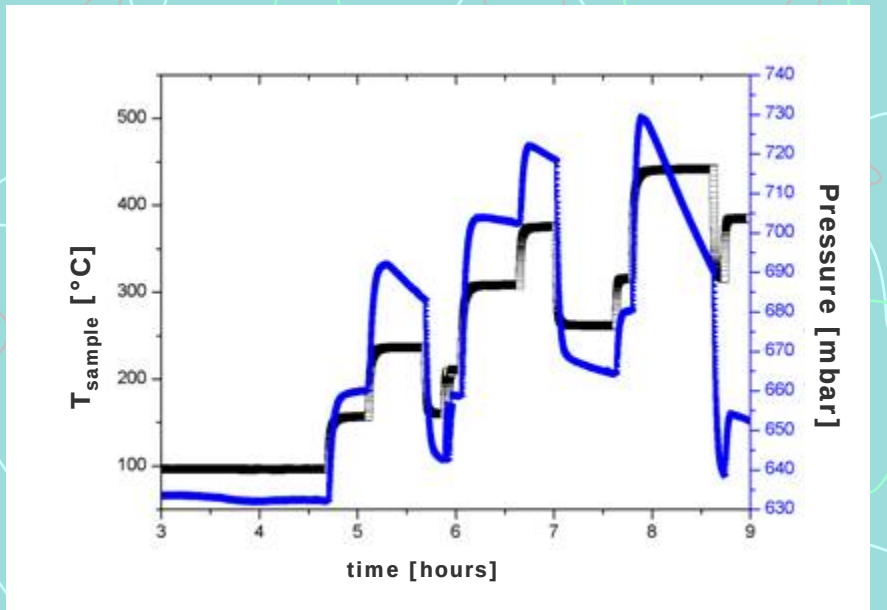
Annealing cycles

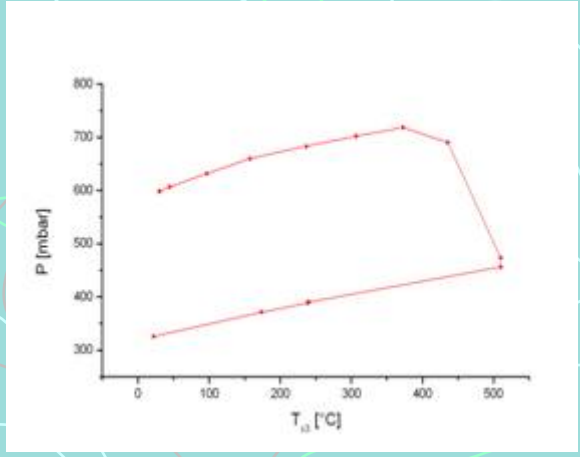
- **in vacuum** $T_{MAX} < 550\ °C$
- **in Hydrogen** $T_{MAX} < 450\ °C$

High loading → **fast loading**

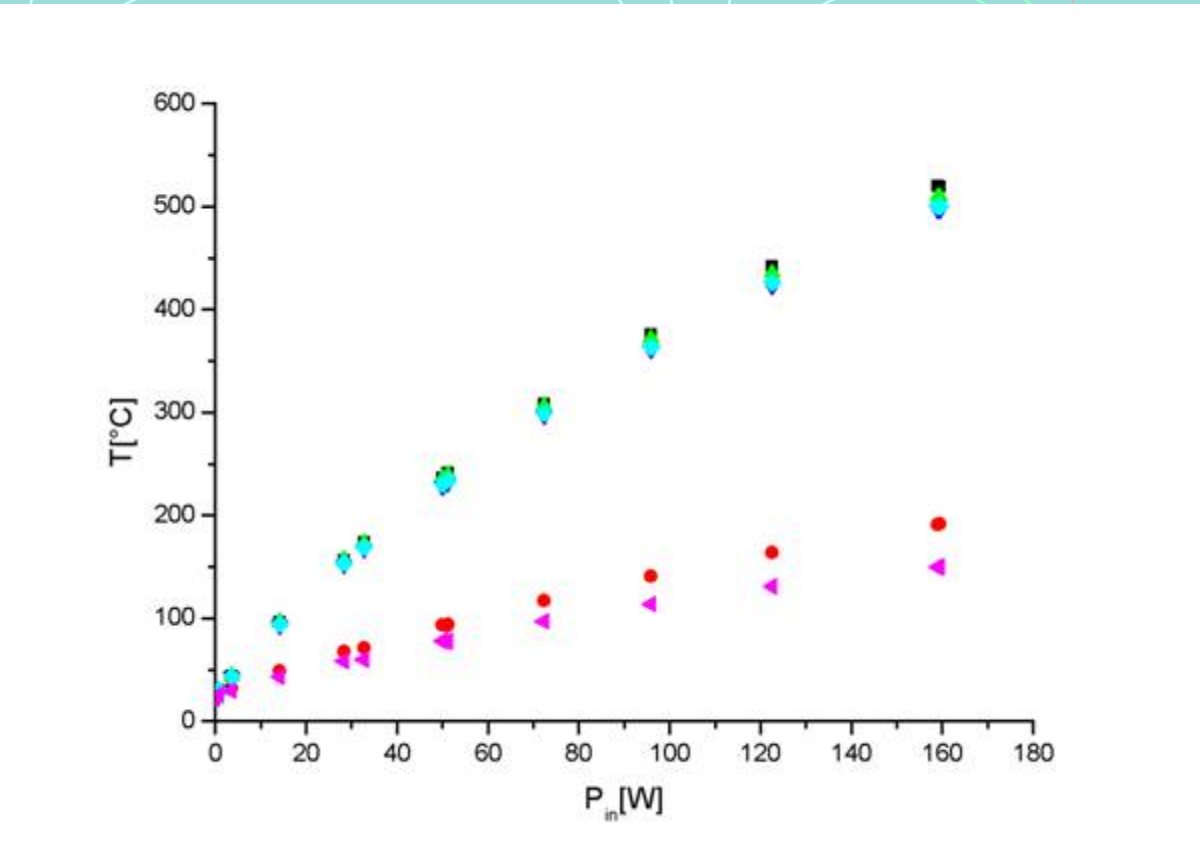
First experiment: hydrogen loading



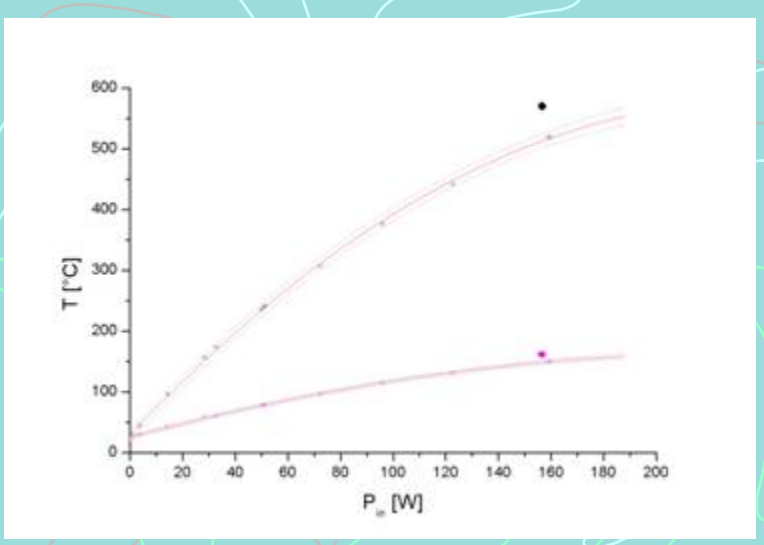


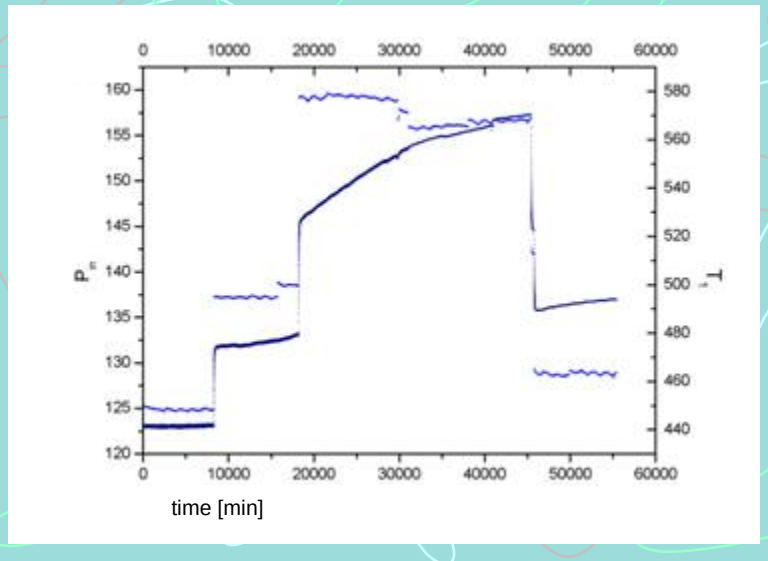


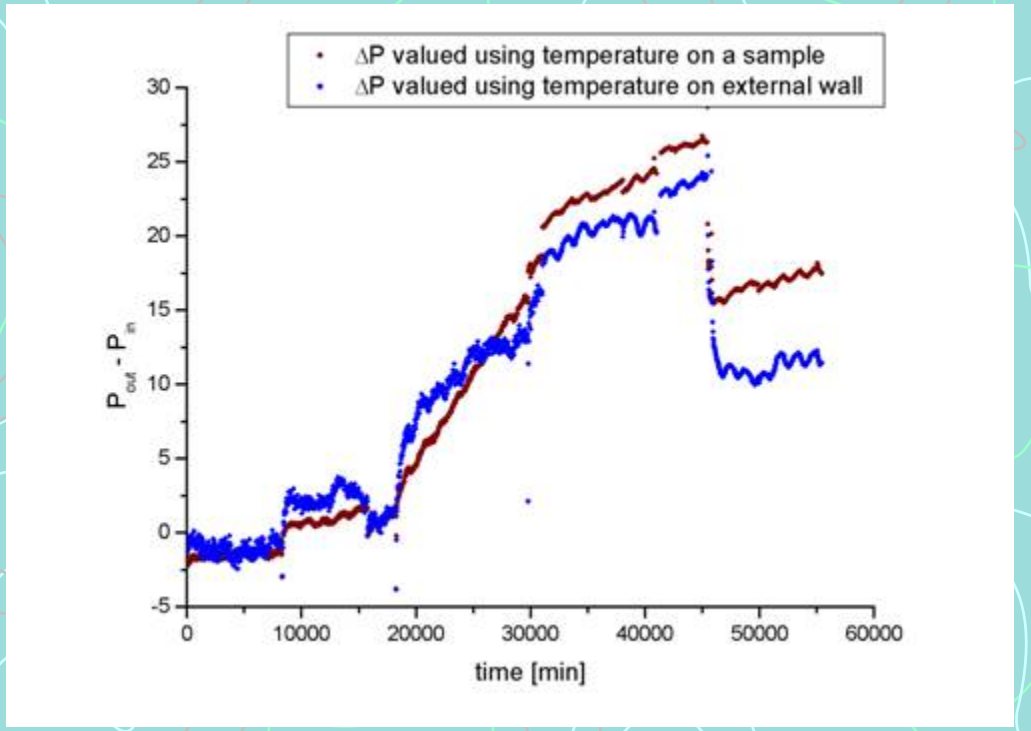
First experiment: calibration



First experiment: excess heat production

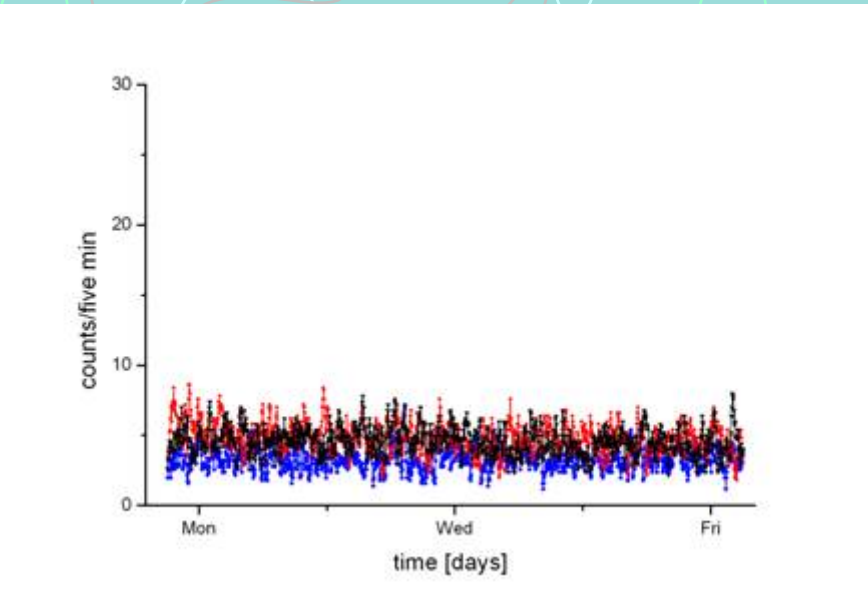






38 days

First experiment: no neutron production

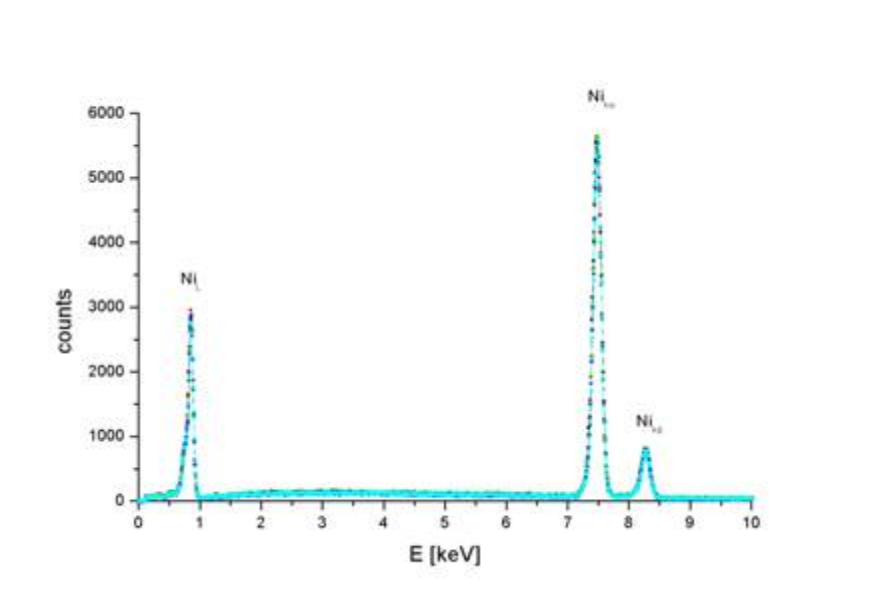


Moderator: paraffin or polythene

He^3 counters

$He^3 + n \rightarrow p + H^3$

First experiment: surface analysis



Scanning Electron Microscope

X-microprobe

Energy Dispersive X-ray system for elemental analysis

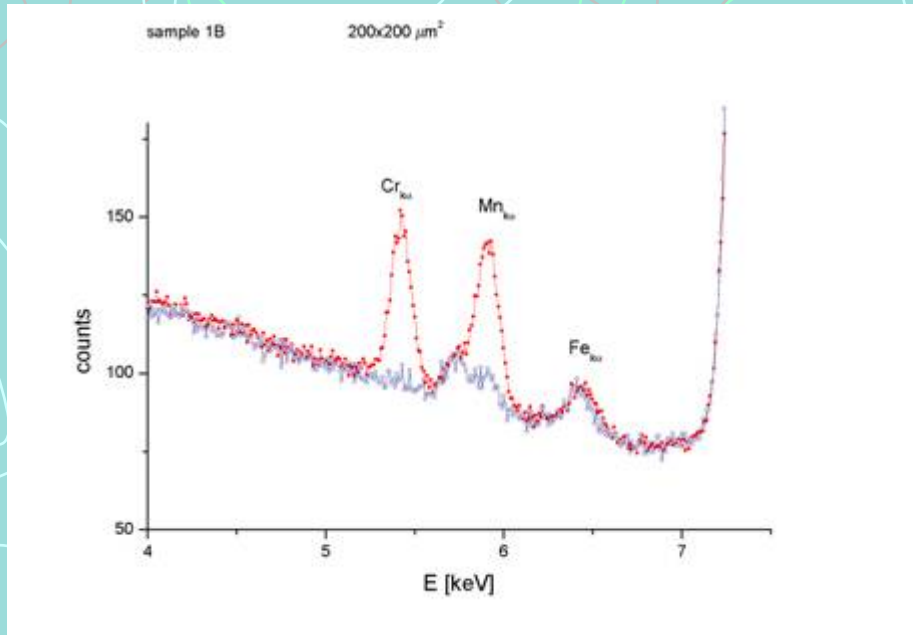
Elemental analysis

Electrons 20 kV

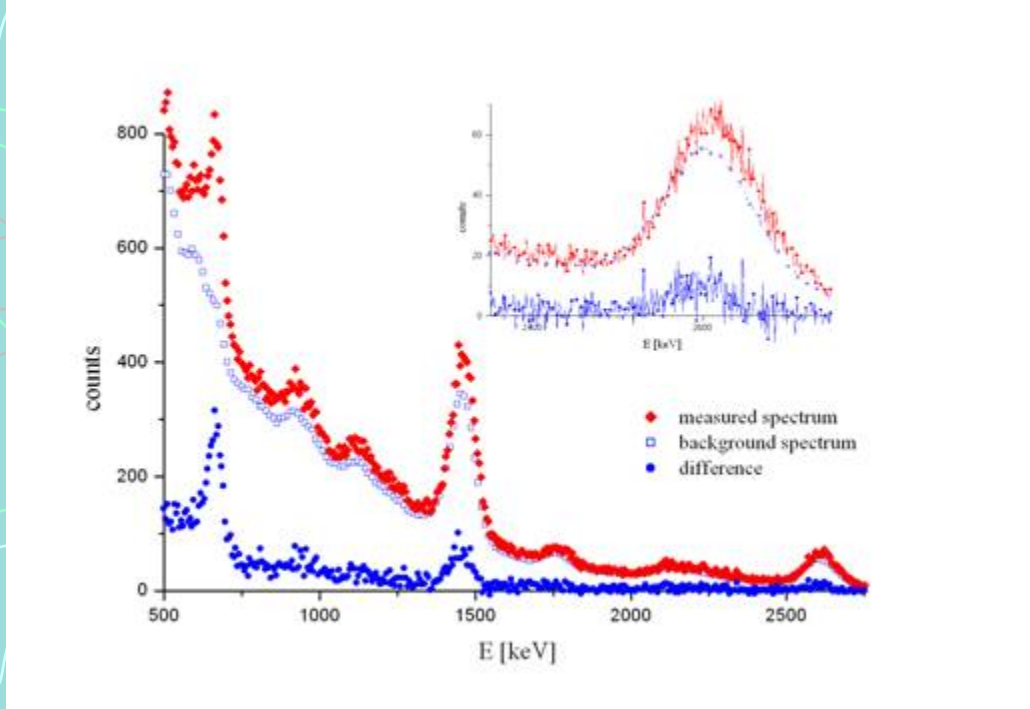
Spot dim ~ 2÷6 nm

200×200 μm²

t_{acq} = 100 s

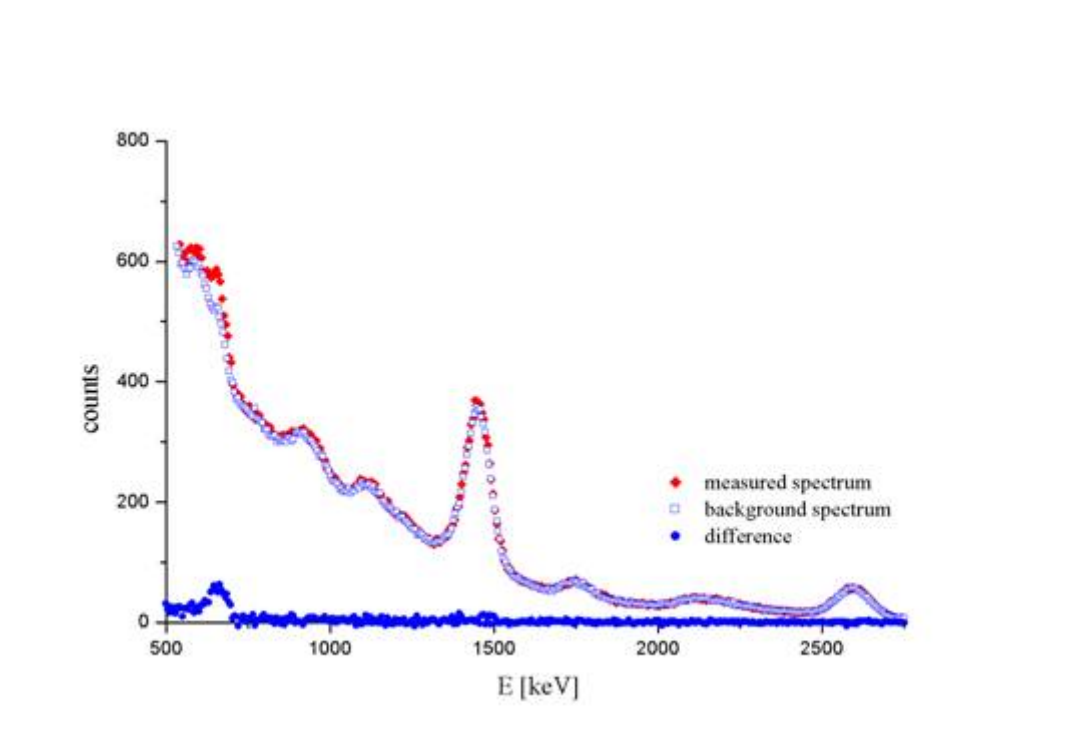


First experiment: radiation emission



During initial degassing of samples **5 days**

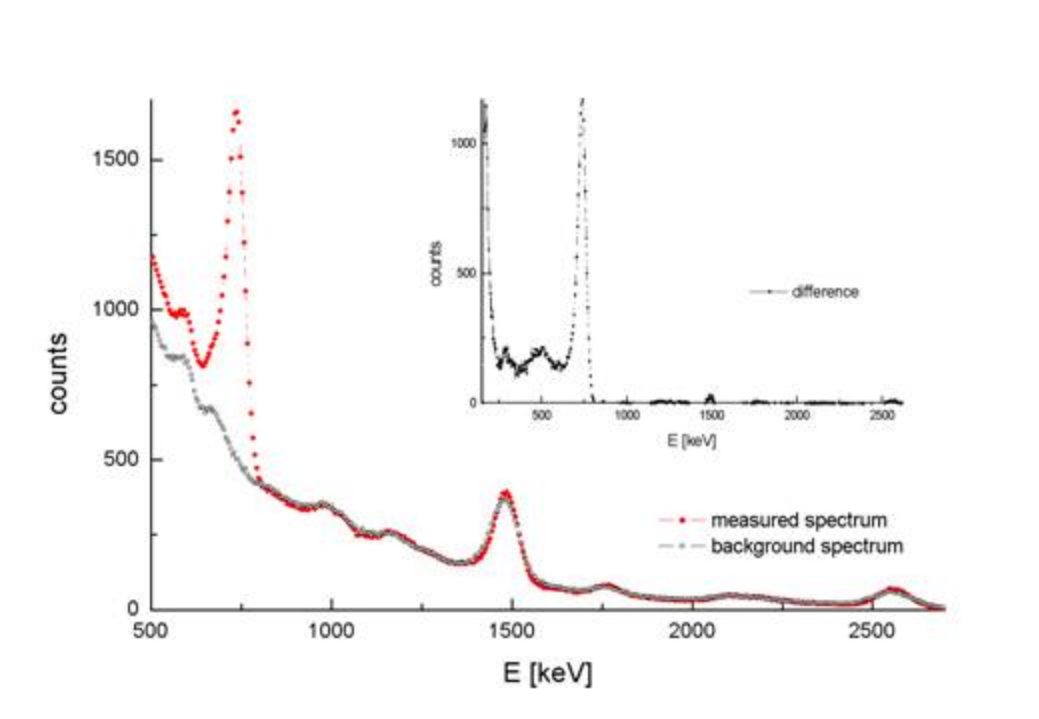
First experiment: radiation emission



40 days

no changes with H loading after 19 days

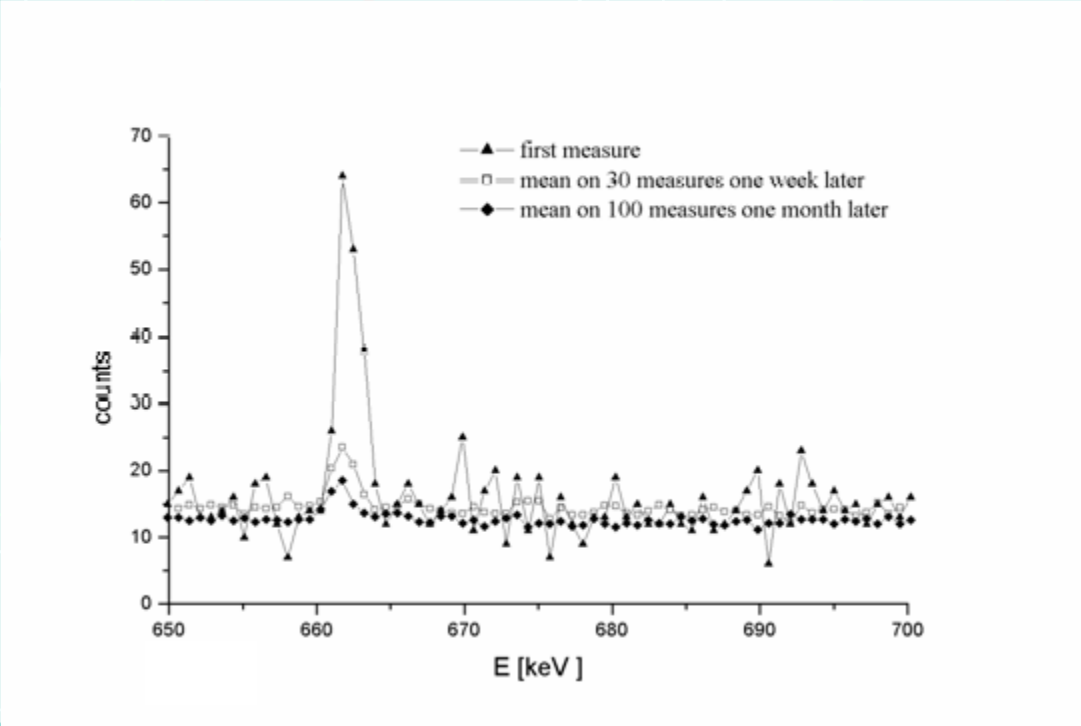
Second experiment: radiation emission



Began with initial degassing of samples **52 days**

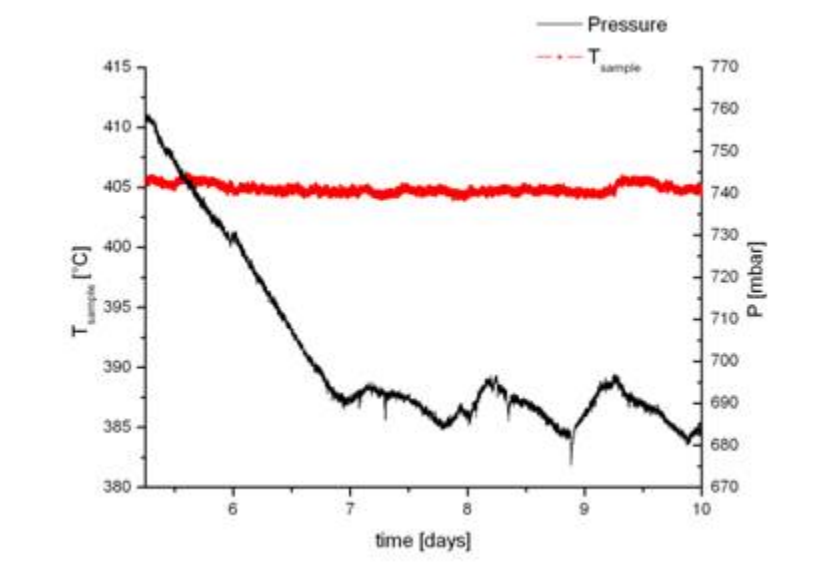
Persisted with the inlet of H **26 days**

Second experiment: radiation emission



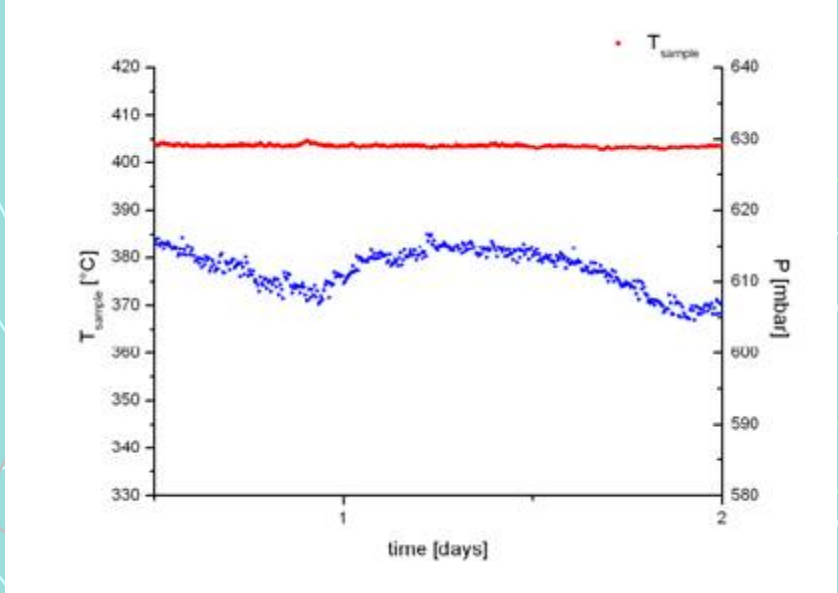
E_γ = 662 ± 1 keV

Second experiment: hydrogen loading



Slow loading

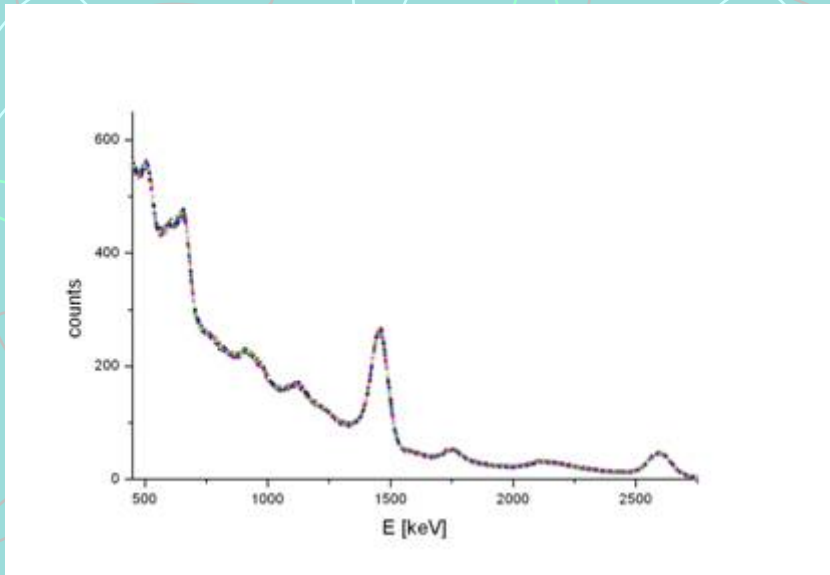
Very low loading



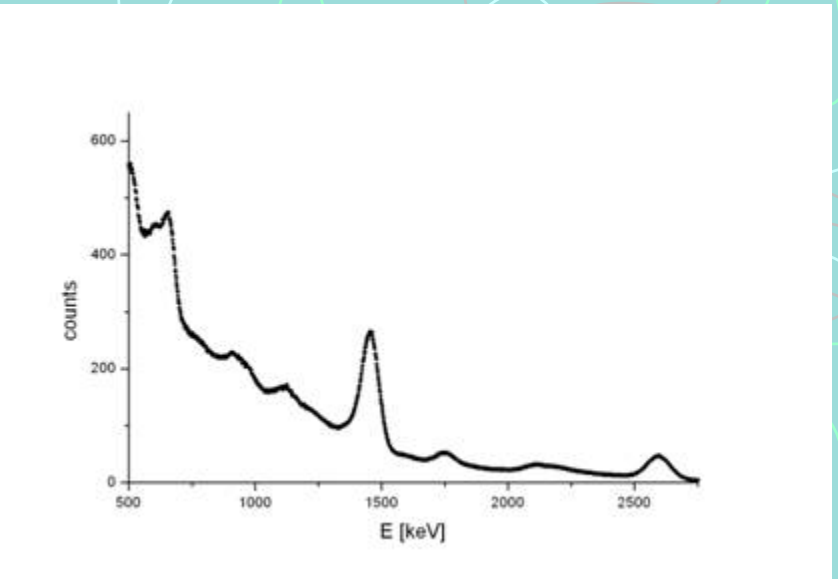
Second experiment: other measures

- No neutron emission
- No excess heat production
- No quantitative changes on surface of Ni

Third experiment: radiation emission

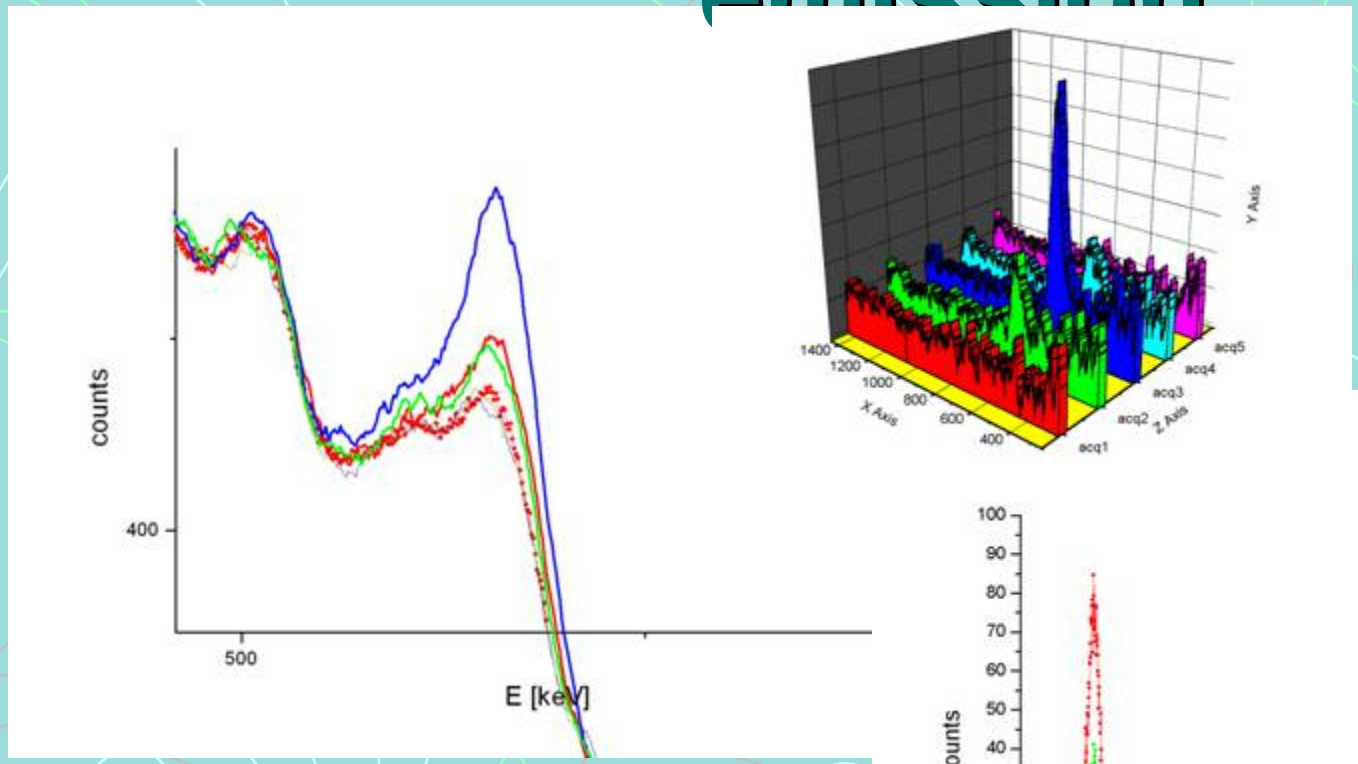


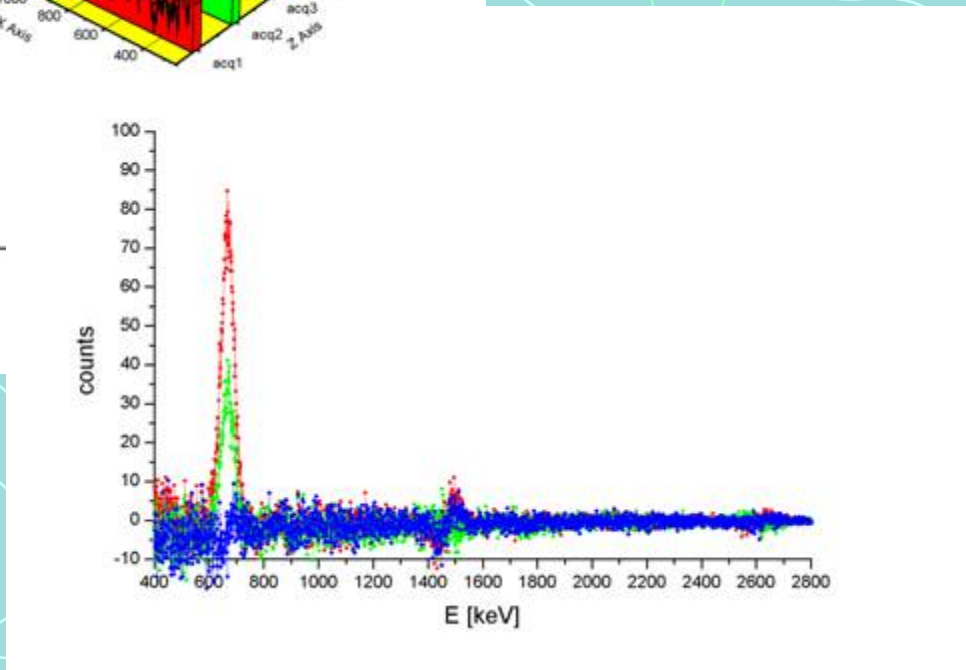
During degassing



In Hydrogen atmosphere

Third experiment: radiation emission

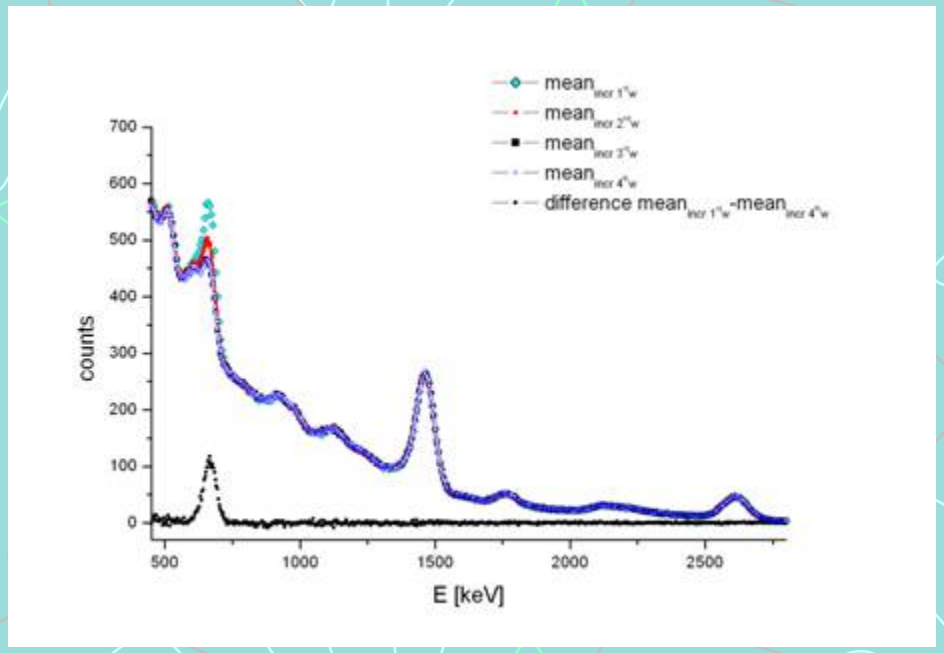


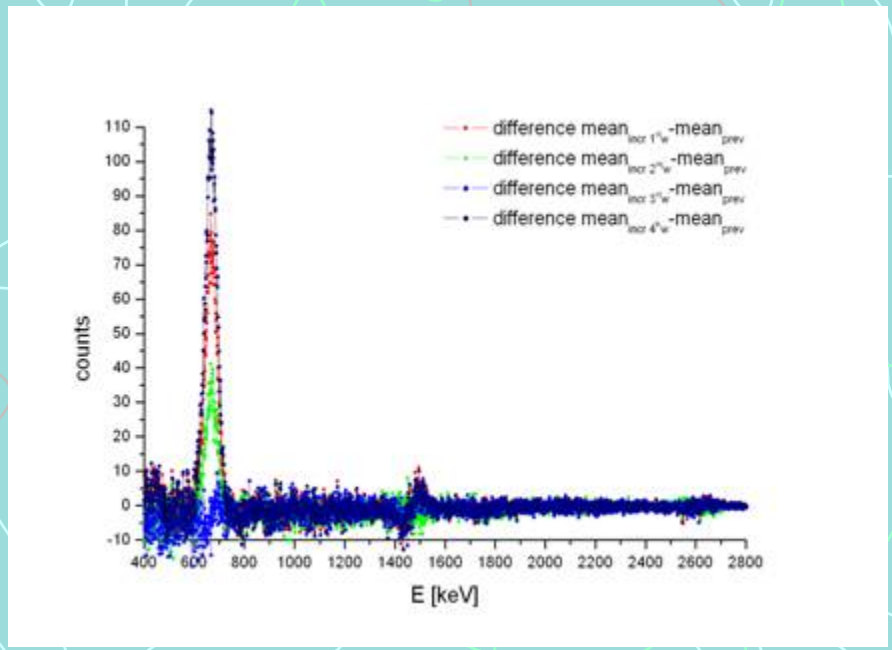


Increasing by thermal excitation (~10 min)

few hours

Third experiment: radiation emission





Spontaneous excitation

3 weeks

Third experiment: other measures

- Low Hydrogen loading (~ few tenths mbar) and slow loading (~ weeks)
- No neutron emission
- No excess heat production

Conclusion

- 1st exp
- 2nd exp
- 3rd exp

— High and fast loading of Hydrogen
— Radiation emission in an early time,
low intensity peaks, they disappeared before
the energy production started
— No neutron emission
— Excess heat
— Altered Ni surface

— Low and slow loading of Hydrogen
— Radiation emission in an early time,
high intensity peak, it disappeared after
about 3 months
— No neutron emission
— No excess heat
— No altered Ni surface

— Low and very slow loading of Hydrogen
— Radiation emission in an early time,
low intensity peak, it is never disappeared,
thermal excitation provoked a transient increasing,
spontaneous increasing persisted for weeks
— No neutron emission
— No excess heat

Conclusion

These experiments shows the complexity of phenomena involved in physics of Ni-H system

References

- S. Focardi, V. Gabbani, V. Montalbano, F. Piantelli, S. Veronesi, *Asti Workshop on Hydrogen/Deuterium loaded metals,* Conference Proceedings **64**, W.J.M.F. Collis editor, (1999) 35
- S. Focardi, V. Gabbani, V. Montalbano, F. Piantelli, S. Veronesi, *Atti Accad. Fisioc.,* Serie XV, **XVIII** 109 (1999)
- E. G. Campari, S. Focardi, V. Gabbani, V. Montalbano, F. Piantelli, S. Veronesi, Asti 19 – 21 marzo 2004, Condensed Matter Nuclear Physics