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Title
How can 30% of nickel in Rossi's reactor be transmuted into copper?

Abstract

In the present article I would like to answer a question posed by L. Kowalsky in a recent paper: how can 30% of nickel in Rossi's reactor be transmuted into copper? "Everything should be made as simple as possible, but not simpler", says a guy. I apologizes if I am too simplistic here.

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Introduction

The interest on Andrea Rossi's Nickel-Hydrogen Cold Fusion technology is accelerating [1]. However, Rossi says that about 30% of nickel was turned into copper, after 6 months of uninterrupted operation. Kowalski [2]. says that "this seems to be impossible because the produced copper isotopes rapidly decay into Ni". But how it works?
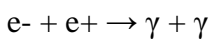
How it works

Following Focardi Rossi [3]. a Ni58 nucleus produces a Copper nucleus according to the reaction

Ni58 + p → Cu59
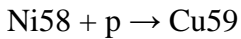
Copper nucleus Cu59 decays with positron (e+) and neutrino (ν) emission in Ni59 nucleus according to

Cu59 → Ni59 + ν + e+

Then (e+) annichilates with (e-) in two gamma-rays

e- + e+ → γ + γ

Starting [3] from Ni58 which is the more abundant isotope, we can obtain as described in the two above processes Copper formation and its successive decay in Nickel, producing Ni59, Ni60, Ni61 and Ni62. Because Cu63, which can be formed starting by Ni62, is stable and does not decay in Ni63, the chain stops at Ni62 (i.e. Cu63). Each process means some MeV.

Of course how can a proton p gets captured by the Ni58 nucleus? (and subsequent Ni59, Ni60, Ni61 and Ni62). Following Stremmenos [4]. a neutron-like particle, an electron proton pair, a mini-atom, a proton masked as a neutron, gets captured by the Ni58.

Proton p, rejected

Proton p, masked as a neutron n

p

n

p + e-
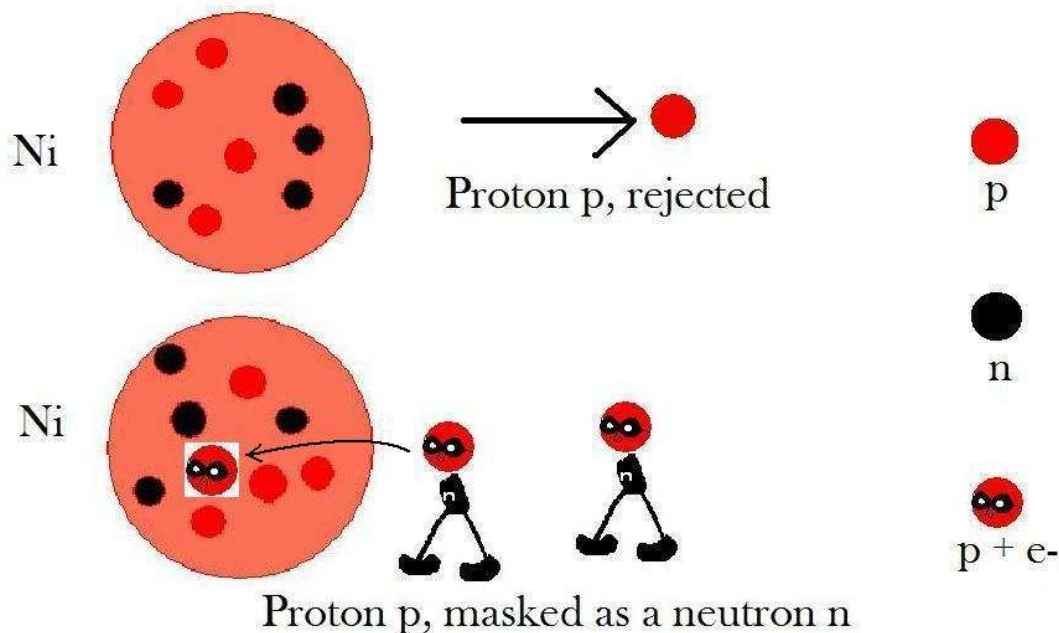
If the masked proton becomes a neutron the result is Ni59.
In order to have Cu59 (increase of atomic number from 28 to 29) the electron (of the masked proton) gets ejected from the nucleus. The masked proton becomes a proton.

Cu59

Ni59
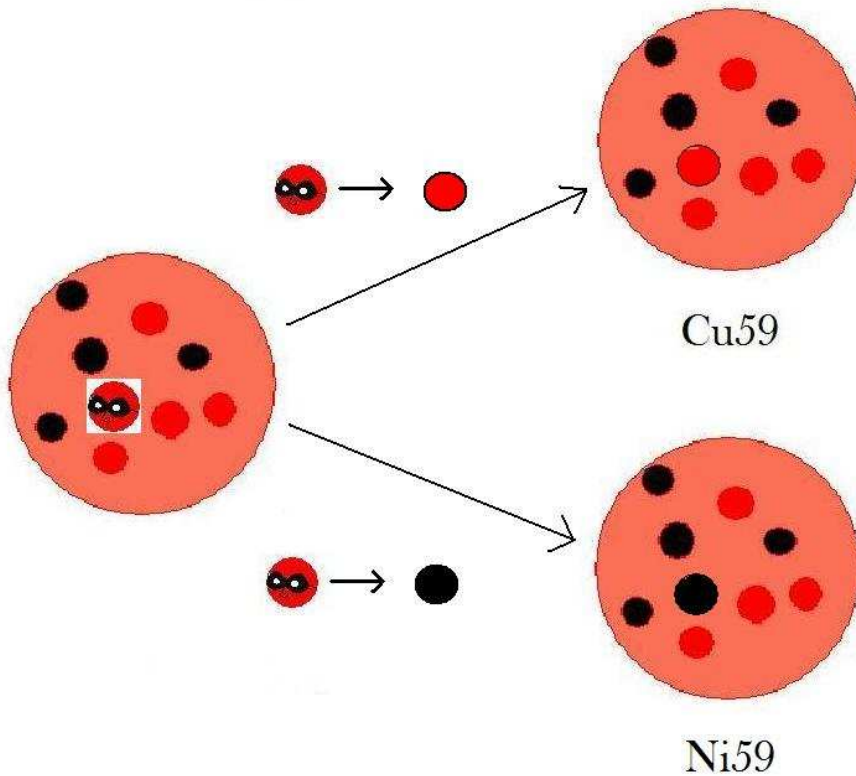
The same process holds for all the subsequent transformations, until Cu63.
It remains to be understood the issue of the gamma radiation in the MeV range.

Numbers

I am an electronic engineer, so I need easy numbers in order to understand.
However "Everything should be made as simple as possible, but not simpler", says a guy. Maybe I am too simple here.
Let's calculate.

MeV for each Ni transformation

I read that starting from **Ni58** we can obtain Copper formation and its successive decay in Nickel, producing **Ni59**, **Ni60**, and **Ni62**. The chain stops at **Cu63** stable.
For simplicity I assume all the Nickel in the reactor in the form **Ni58.**
For simplicity I suppose for each **Ni58** the whole sequence of events from **Ni58** to **Cu63** and as a rough estimate I calculate the mass defect between (**Ni58** plus 5 nucleons) and the final state **Cu63**.
Ni58 mass is 57.9353429 **amu**
The mass of a copper-**Cu63** is 62.9295975 **amu**
Mass of **Ni58** plus 5 nucleons is 57.9353429 +5=62.9353429 **amu**

Mass defect is 62.9353429 - 62.9295975 = 0.0057454 **amu**
1 amu = 931 MeV is used as a standard conversion
0.0057454 x931 MeV= 5.35 MeV
So each transformation of **Ni58** into **Cu63** releases 5.35 MeV of nuclear energy.

Nickel consumption

According to many blogs in the Internet "One hundred grams of nickel powder can power a 10 kW unit for a minimum of six months".
How much of **Ni58** should be transformed, in six months of continuous operation, in order to generate 10 kW?
I follow a procedure outlined in [2].

10 kW is thermal or electrical (?) power. The nuclear power must be larger. Assume a nuclear power twice:
20 kW = 20,000 J/s = 1.25 x 10**17 MeV/s.
Each transformation of **Ni58** into **Cu63** releases 5.35 MeV of nuclear energy.
The number of **Ni58** transformations should thus be equal to (1.25 x 10**17)/5.35 = 23.364 x 10**15 per second.
Multiplying by the number of seconds in six months (1.55 x 10**7) the total number of transformed **Ni58** nuclei is 36.2 x 10**22.
This means 35 grams.
The order of magnitude seems to be plausible. This means also 35 grams of Nickel in Rossi's reactor transmuted into (stable) Copper after six months of continuous operation at the rate of 10 kW.

Conclusions

Rossi says that about 30% of nickel was turned into copper, after 6 months of uninterrupted operation. At first glance this seems to agree with calculations based on simple assumptions.

References

[1] Link, Cold Fusion "Andrea Rossi" Method

[2] L. Kowalski, "Rossi's Reactors Reality or Fiction?", http://vixra.org/abs/1103.0080, March 2011

[3] A.Rossi, S. Focardi, http://www.journal-of-nuclear-physics.com

[4] E. Stremmenos, "Hydrogen/Nickel cold fusion probable mechanism", www.journal-of-nuclear-physics.com/?p=338&cpage, March 2011