

# Magnetic- versus electromagnetic-fields and the specific low frequent application in biophysics (SPIONs).

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**Abstract—** Abstract: The two terms “magnetic” and “electromagnetic” are defined by J.C.Maxwell in 1855. The first is a DC or low frequent- the second a high frequent field application. In the high frequent application, material constants cannot be neglected and herewith a certain heat generation, which is intended in biomed applications, e.g. “Hyperthermia”. Here however (Fig.2) we avoid to heat up the treated cells and work magnetically (low frequently) with tagged magnetic particles like SPIONs.

## I. INTRODUCTION

J. C. Maxwell wrote in 1855 his famous set of equations (Fig.1) in order to establish a mathematical description of Faraday’s ideas about electro-magnetism [1]

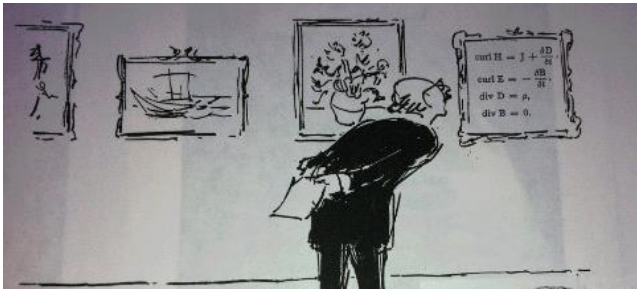


Figure 1. Politiken(Danish Newspaper) in 1.4. 1992 “Fysikkens Skonhed”

## II. METHODS

It is wrong to write: Maxwell’s equations are the basis for the description of all electric events [2]. They are quantum-mechanically incorrect!

The first equation connects magnetic- with electric values and this is the one, which defines a “magnetic” frequency range, where magnetic particles are not noticeable heated up, when energized (Fig.2)!

### Results

We developed a device, controller screen see below (Fig.2), which is able to move particles without noticeable intrinsic particle heating.



Figure 2. A field generator[2][3] (now fully digitalized and remotely controlled[net or mobile], produces a dynamic fiels, which moves every single magnetic particle – individually!- without generating particle heat! Relevant data are documented by the machine.

## III. DISCUSSION

The particles (e.g. SPIONs) integrated into the cells/cell-spheres allow further “cold” magnetic treatment [3], like moving, membrane wiggling or the jamming of cell spheres.

(1)

## REFERENCES

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- [2] [2] G.Bosse, “Grundlagen der ElektrotechnikII“, BI Mannheim, 1967, p.139.
- [3] [3] E.Zhang, M.F. Kircher, M.Koch, L.Eliassen, S.N. Goldberg, E.Renstroem, “Dynamic Magnetic Fields Remote-Control Apoptosis via Nanoparticle Rotation“, ACS Nano, 2014, pp.3192-3201

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