H. Kozima, "Development of the Solid State-Nuclear Physics," *International Conference on the Atomic and Nuclear Physics* (*ICANP*)-2018, July 24, 2018, Osaka, Japan)

Introduction

Quantum mechanical treatments of microscopic objects have a common difficulty of many-body problem compared to the classical mechanics of simple systems; the three-body problem is, in general, impossible to solve exactly in classical and quantum mechanics: we have to depend on some approximations to treat the many-body system even if there are only linear interactions between components.

In *the* ***Solid State-Nuclear Physics*** in between the nuclear physics and the solid-state physics, we have accumulated very many experimental data sets for the cold fusion phenomenon (CFP), nuclear reactions in CF materials at around room-temperature without any acceleration mechanism, in these almost 30 years. The numbers of data sets increasing day by day. Despite of the situation, the CFP has not been accepted into scientific world. It should be recognized that the tremendous nuclear effect caused by tiny atomic cause which is impossible to control by the macroscopic treatment.

The stumbling stone for acceptance of the CFP into the scientific society seems in the frame of thinking accustomed in the modern science developed in these 300 years. We can point out two decisive factors in the traditional science rejecting the CFP [Kozima 2012, 2017].

The first one is the deductive logic in modern science since the time of Newton. It should be noticed that the induction or the inductive reasoning is superior over the deduction in such problems as the cold fusion phenomenon where complexity governs the system composed of particles interacting nonlinearly in dynamical system. We have used the induction unintentionally in our phenomenological approach to the CFP [Kozima 1998, 2006, 2017]. A typical example of this sort is revealed already in the first half of the 20th century as the problem of the continental drift in geophysics.

The second factor in the CFP different from that in the traditional science is the method of analysis of data. The analyses used in the phenomenological approach to the CFP might be classified into the meta-analysis [Kozima 2006, 2012] used from 18th Century in astronomy and frequently in the modern evidence-based medicine [Plackett 1958, Tsutani 2003, Walker 2008]. The samples of the CF materials have common nature as the patients in medical science in the characteristics of minor differences from a sample to another. We have used the meta-analysis unintentionally in the deduction of three laws in the CFP from experimental data sets obtained in different experiments [Kozima 2012].

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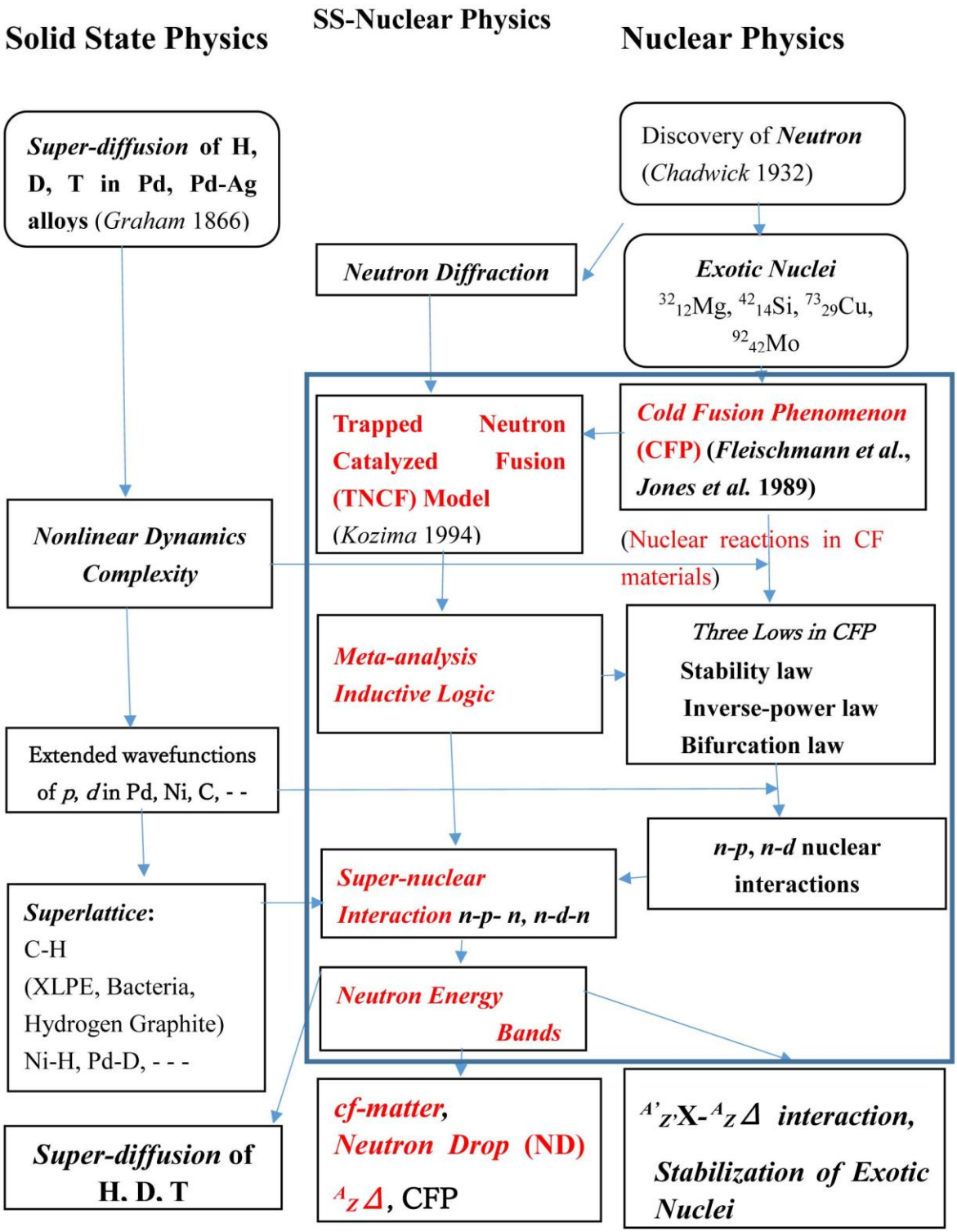

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OBJECTIVES OF META-ANALYSIS [Walker 2008 (p. 432)]

The main objectives of a meta-analysis are to:

• Summarize and integrate results from a number of individual studies

• Analyze differences in the results among studies

• Overcome small sample sizes of individual studies to detect effects of interest, and analyze end points that require larger sample sizes

• Increase precision in estimating effects

• Evaluate effects in subsets of patients

• Determine if new studies are needed to further investigate an issue

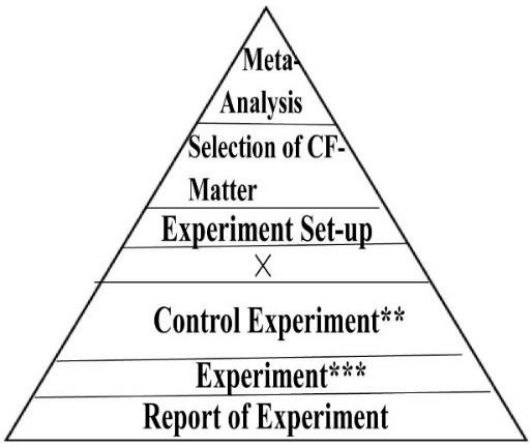
• Generate new hypotheses for future studies.

These lofty objectives can only be achieved when the meta-analysis satisfactorily addresses certain critical issues, which we will discuss next.

Meta-Analysis in Medical Science*

A subset of systematic reviews; a method for systematically combining pertinent qualitative and quantitative study data from several selected studies to develop a single conclusion that has greater statistical power.

***Study Design 101**
https://himmelfarb.gwu.edu/tutorials/studydesign101/metaanalyses.html



Meta-Analysis in the Cold Fusion Phenomenon (tentative)

****Control Experiment** – With no hydrogen isotopes

*****Experiment** – With hydrogen isotope H or D to measure NT (nuclear transmutation), *Q* (excess heat), *n* (neutron emission), *t* (tritium), $^{4}_{2}$He (helium 4), etc.

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