$H\Psi = E\Psi$

Theoretical Nuclear & Hadron Physics

$$\mathscr{L}_M = \frac{f_\pi^2}{4\pi}\mathrm{Tr}(\partial_\mu U^\dagger \partial_\mu U) + \cdots$$

핵/강입자 이론물리 연구실

- 그룹 홈페이지: http://sites.google.com/site/knuhadron
- 연구주제: From quarks to nuclei and and neutron stars
- 관심분야:
  - 강입자의 질량 스펙트럼 분석
  - 강입자의 전자기 구조
  - 강입자의 생성 반응
  - 핵의 구조와 반응
  - 핵물질 연구와 중성자별의 구조

핵/강입자 이론물리 연구실

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- 공동연구

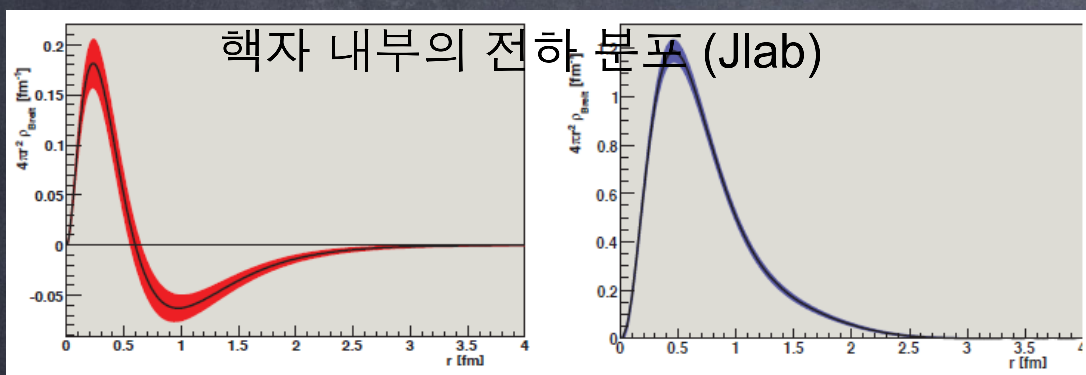
  - 국내
    최호명(경북대), 이수형(연세대),…

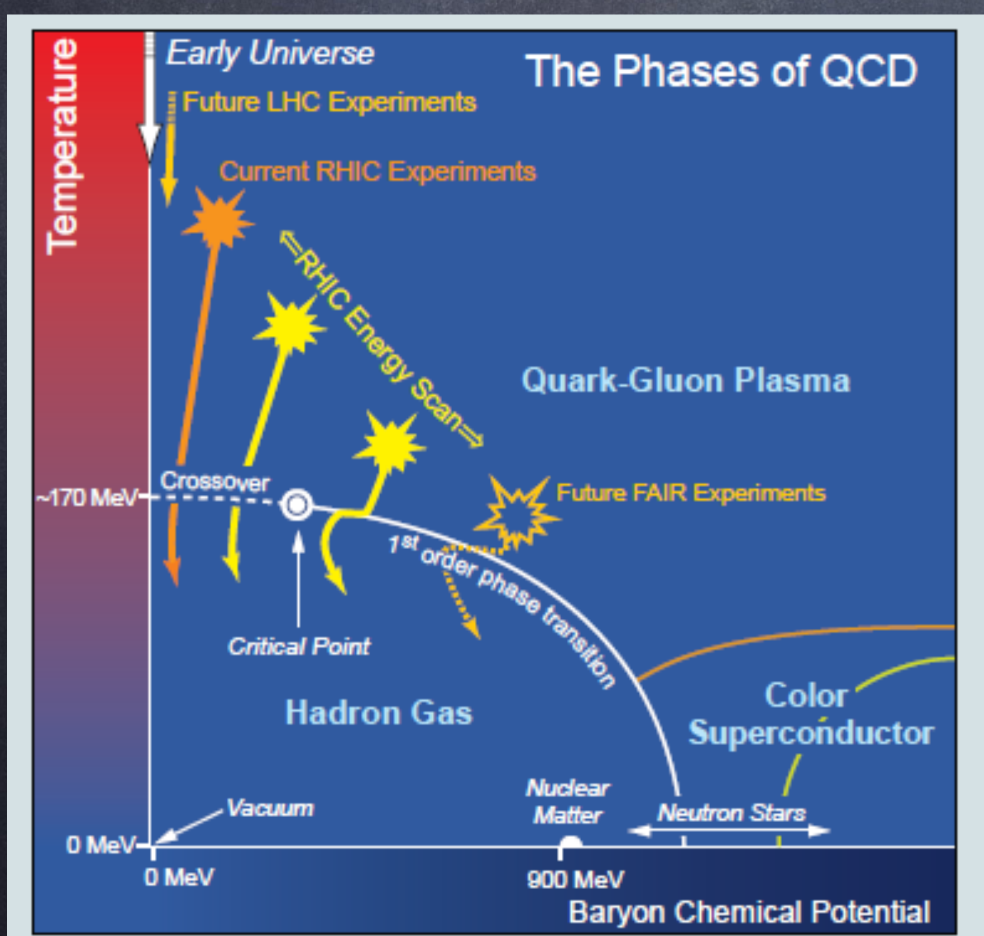
  - 해외
    North Carolina State Univ. Univ. do Sul, Sao Paulo
    Saclay, France Texas A&M Univ.
    George Washington Univ. Univ. of Georgia …

  - 연구소
    Jefferson Lab. Argonne RIKEN APCTP

QCD Effective Theories

핵자 내부의 전하 분포 (Jlab)



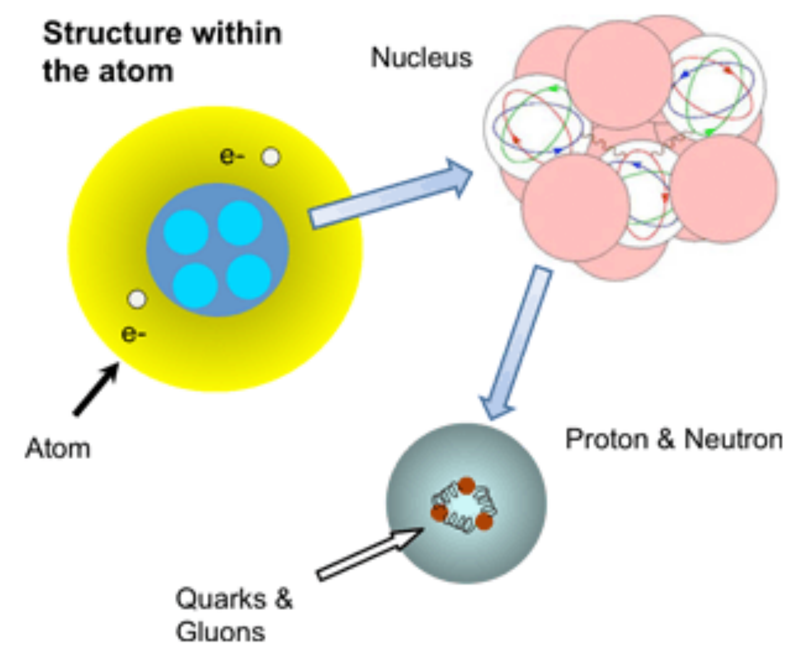


연구실명	**핵/강입자 물리 이론연구실 (Nuclear/Hadron Physics Theory Group)**
지도교수	 오용석 교수 **홈페이지** : http://sites.google.com/site/knuhadron **연구실** : 제1과학관 127호 **전화번호** : +82-53-950-7373 **e-mail** : yohphy@knu.ac.krr

핵/강입자 물리학은 원자핵에서부터 초기우주, 소립자의 세계까지 넓은 영역에 걸쳐 물질을 이루는 기본 입자에 대한 근본 이론에 대한 연구를 수행하는 학문이다. 현 표준 모형에서 물질을 이루는 가장 기본적인 입자는 쿼크이며 이들 사이의 상호작용은 글루온이 매개한다. 핵/강입자 물리는 원자핵과 원자핵을 이루는 핵자의 구조와 상호작용을 이런 근본입자를 통해 이해하려고 한다. 핵물리의 연구 대상은 아주 넓지만 본 연구실에서는 핵자의 구조와 강한 상호작용에 대한 이론적 연구, 고온, 고밀도 상태에서 핵물질의 성질 연구, 그리고 무거운 원자핵에 대한 이론 연구 등을 수행한다.

본 연구실에서 수행하는 연구는 위 분야에서 관찰되는 현상에 대한 모형 개발과 그 검증을 위한 실험을 제안하고 그 결과를 예측하는 등의 활동을 포함하고 있으며 이론 계산과 함께 수치 계산을 통한 해석능력이 요구된다.

연구실 소개



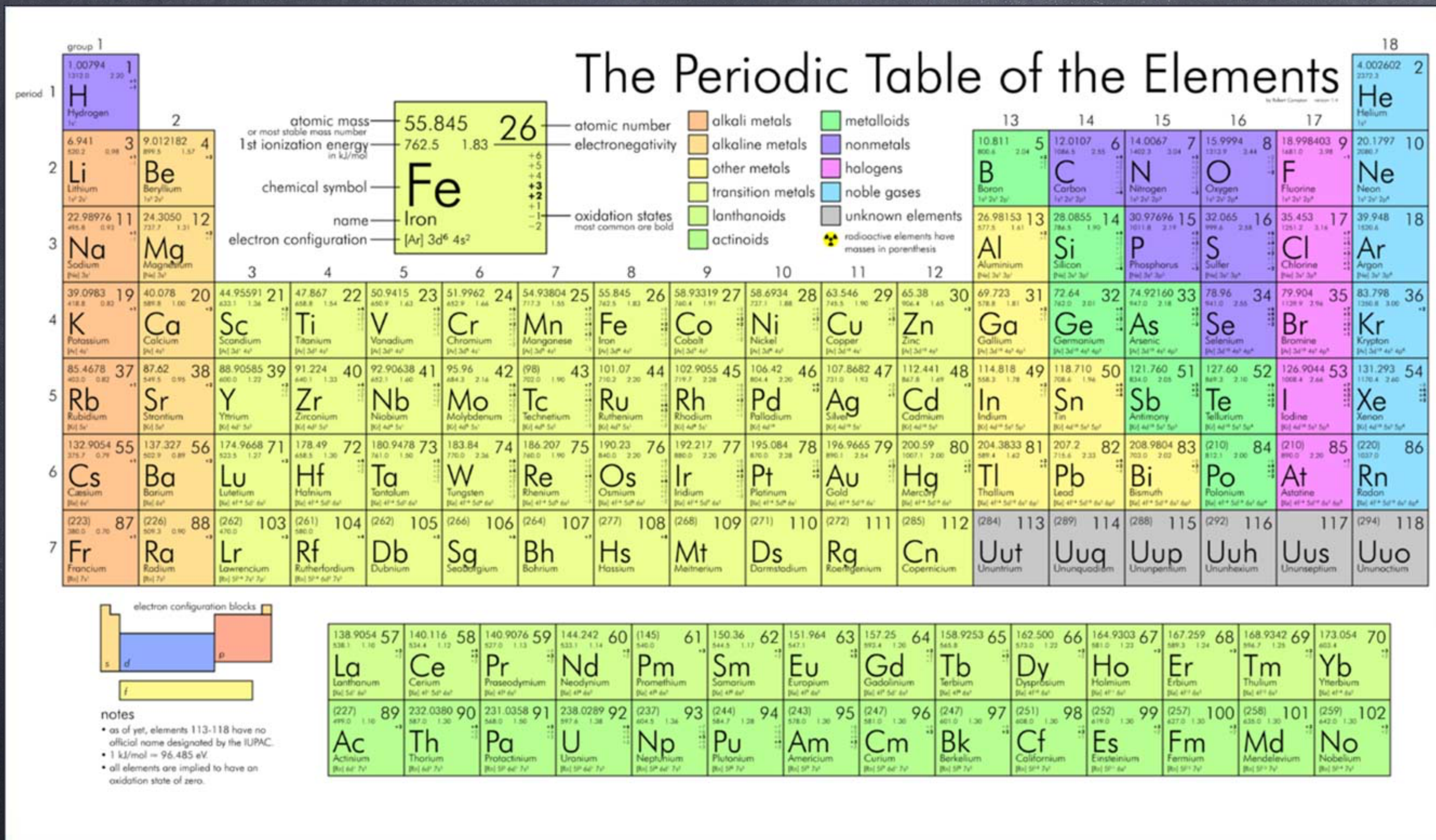
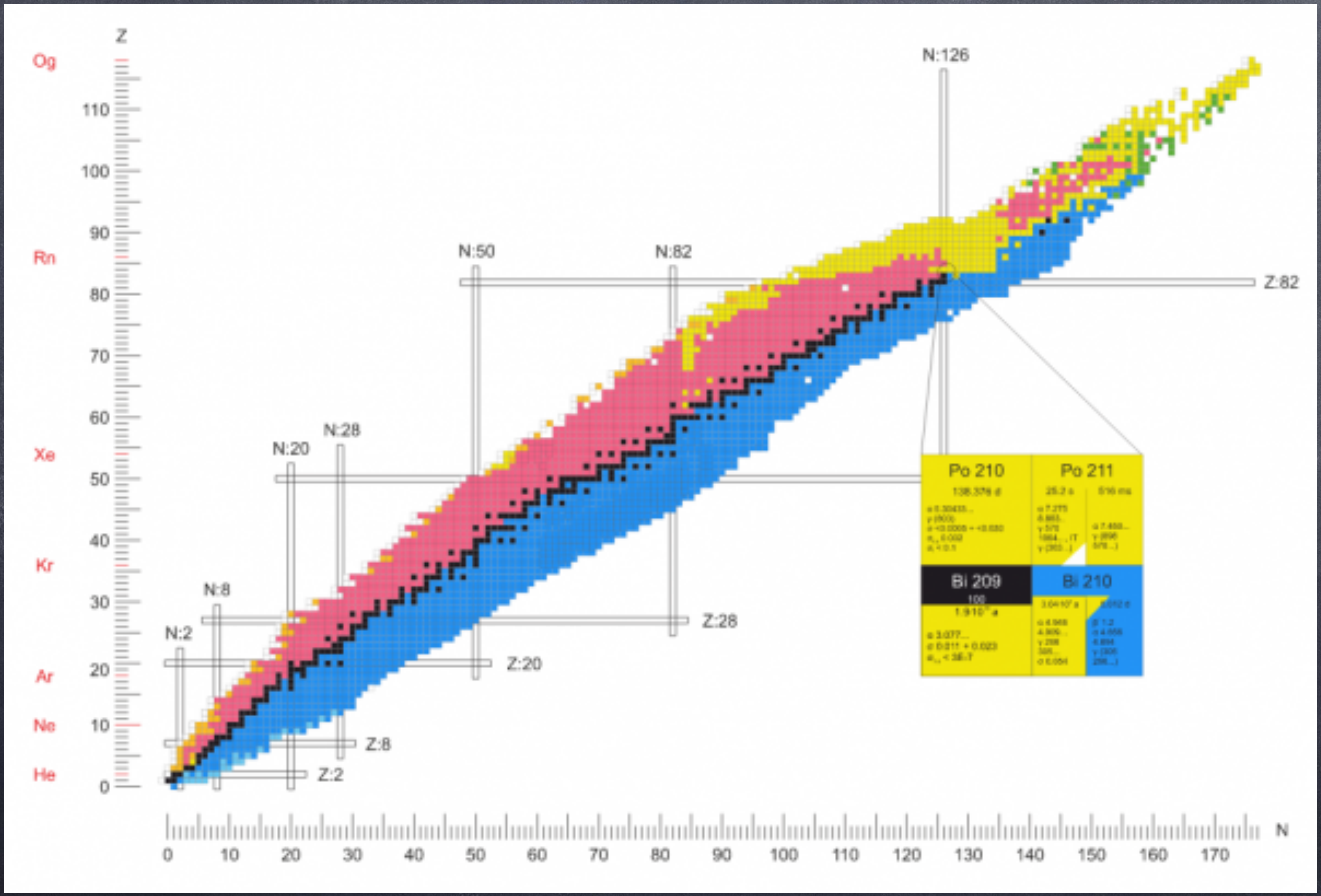

The Periodic Table of the Elements
atomic mass
1st ionization energy in kJ/mol
chemical symbol
name
electron configuration
atomic number
electronegativity
oxidation states most common are bold
55.845 26
762.5 1.83
Fe
Iron
[Ar] 3d⁶ 4s²
alkali metals
alkaline metals
other metals
transition metals
lanthanoids
actinoids
metalloids
nonmetals
halogens
noble gases
unknown elements
radioactive elements have masses in parenthesis
electron configuration blocks
notes
• as of yet, elements 113-118 have no official name designated by the IUPAC.
• 1 kJ/mol ≈ 96.485 eV.
• all elements are implied to have an oxidation state of zero.

Chart of Nuclides



PHYSICAL REVIEW C **89**, 034622 (2014)

Production cross section of neutron-rich isotopes with radioactive and stable beams

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The production cross section of neutron-rich isotopes of Ca, Zn, Te, Xe, and Pt are predicted in the diffusive multinucleon transfer reactions with stable and radioactive beams. With these isotopes one can treat the neutron shell evolution beyond $N = 28$, 50, 82, and 126. Because of the small cross sections, the production of nuclei near the neutron drip line requires the optimal choice of reaction partners and bombarding energies.

DOI: 10.1103/PhysRevC.89.034622 PACS number(s): 25.70.Hi, 24.10.−i, 24.60.−k

I. INTRODUCTION

One of the primary issues of nuclear physics is an expansion of the present limits of the nuclear chart far from the line of stability. The neutron-rich isotopes located close to the neutron-drip line have attracted interests during the last few decades. In the study of exotic neuron-rich nuclei a variety of

While one can reach only specific isotopes in the complete fusion reactions, the transfer-type reactions can yield a larger variety of isotopes because of the restrictions in the choice of the target. Note that the use of the beam of neutron-rich nuclei in the fragmentation reactions has no advantage compared with the beam of stable isotopes.

PHYSICAL REVIEW C **94**, 024320 (2016)

Nuclear isospin asymmetry in α decay of heavy nuclei

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The effects of nuclear isospin asymmetry on α-decay lifetimes of heavy nuclei are investigated within various phenomenological models of the nuclear potential for the α particle. We consider the widely used simple square-well potential and Woods-Saxon potential and modify them by including an isospin asymmetry term. We then suggest a model for the potential of the α particle motivated by a microscopic phenomenological approach of the Skyrme force model, which naturally introduces the isospin-dependent form of the nuclear potential for the α particle. The empirical α-decay lifetime formula of Viola and Seaborg [J. Inorg. Nucl. Chem. **28**, 741 (1966)] is also modified to include isospin asymmetry effects. The obtained α-decay half-lives are in good agreement with the experimental data, and we find that including the nuclear isospin effects somehow improves the theoretical results for α-decay half-lives. The implications of these results are discussed, and the predictions on the α-decay lifetimes of superheavy elements are also presented.

DOI: 10.1103/PhysRevC.94.024320

I. INTRODUCTION

The nuclear α decay has been one of the most important tools to study nuclear forces and nuclear structure [1]. Even today, its role cannot be overemphasized in the investigation of nuclear properties and, in particular, in identifying syntheses of new elements. (See, for example, Refs. [2,3].)

decay through spontaneous fission, β decay, nucleon, and α emissions, so the role of nuclear symmetry energy or the change in nuclear potential due to nuclear isospin asymmetry in these decay processes deserves to be studied.

In the standard approach, the α-decay lifetimes are governed by the effective potential for the nuclear force which

PHYSICAL REVIEW C **100**, 014312 (2019)

Analysis of nuclear structure in a converging power expansion scheme

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Background: In the framework of the newly developed generalized energy density functional (EDF) called KIDS, the nuclear equation of state (EoS) is expressed as an expansion in powers of the Fermi momentum or the cubic root of the density ($\rho^{1/3}$). Although an optimal number of converging terms was obtained in specific cases of fits to empirical data and pseudodata, the degree of convergence remains to be examined not only for homogeneous matter but also for finite nuclei. Furthermore, even for homogeneous matter, the convergence should be investigated with widely adopted various EoS properties at saturation.

Purpose: The first goal is to validate the minimal and optimal number of EoS parameters required for the description of homogeneous nuclear matter over a wide range of densities relevant for astrophysical applications. The major goal is to examine the validity of the adopted expansion scheme for an accurate description of finite nuclei.

Method: We vary the values of the high-order density derivatives of the nuclear EoS, such as the skewness of the energy of symmetric nuclear matter and the kurtosis of the symmetry energy, at saturation and examine the relative importance of each term in $\rho^{1/3}$ expansion for homogeneous matter. For given sets of EoS parameters determined in this way, we define equivalent Skyrme-type functionals and examine the convergence in the description of finite nuclei focusing on the masses and charge radii of closed-shell nuclei.

Analyticity of the electromagnetic form factor and the longitudinal charge density in scalar ϕ^3 model

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The concepts of causality, linearity, time symmetry, unitarity, and crossing symmetry and their relation to dispersion relations are discussed. Dispersion relations are applied for the analysis of pion form factor in $(1+1)$ dimensions. [to be modified]

I. INTRODUCTION

The light-front (LF) formulation based on the light-front quantization has shown remarkable advantages for calculations in elementary particle physics, nuclear physics, and field theory. One of the advantages is that it allows a forthright application of the impulse and incoherence approximations intimate in nonrelativistic atomic and nuclear physics to relativistic field theory and bound-state problems [1].

As a prototype example of demonstrating the advantage

transform as the measure of the true size of the bound state without involving relativistic corrections.

Even though the DYW formulation is the most rigorous and well-established framework to compute the exclusive processes, its utility has been limited only to the spacelike region ($q^2 = q^+q^- - \mathbf{q}_\perp^2 < 0$) due to the intrinsic kinematic constraint $q^+ = 0$. While the $q^+ \neq 0$ frame can be used in principle to compute the timelike form factors, it is inevitable to encounter the nonvalence diagram arising from the quark-antiquark pair creation (the so-called "Z-graph"). The main