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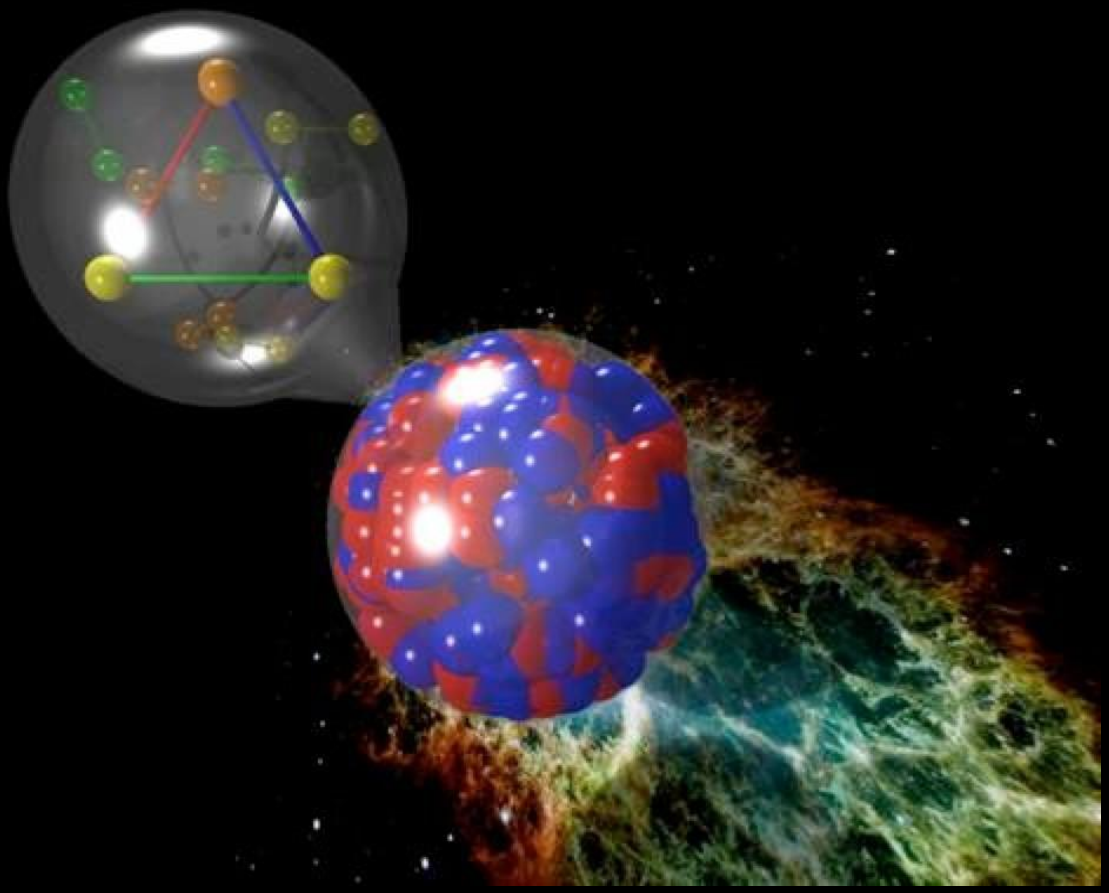

PHYS 4015
Nuclear and Particle Physics

Lecturers: Dr Chris Bouchard (Particle Physics)
Room 537, Kelvin Building
Chris.Bouchard@glasgow.ac.uk

Dr Bjoern Seitz (Nuclear Physics)
Room 515a, Kelvin Building
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Time and place specified in course Timetable on Moodle.

Recommended Texts: "Particle Physics", B. R. Martin and G. P. Shaw, Wiley.
"Introductory Nuclear Physics". K. S. Krane, Wiley.
"An introduction to Nuclear Physics, W.N. Cottingham, D.A. Greenword, Cambridge University Press

Course notes, copies of slides and Question Sheets will be made available on Moodle.

2 Assessment

The course will be assessed via an examination in the April/May diet. It provides 10 H-level credits.

3 Required Knowledge

This is a core course, and thus relies upon knowledge gained in the previous years' core courses.

4 Intended Learning Outcomes

To provide students with an opportunity to develop knowledge and understanding of the key principles and applications of Nuclear and Particle Physics, and their relevance to current developments in physics.

5 Course Outline

Particle Physics

Size, Units, and Kinematics:

The scale of particle physics; natural units; four vectors; and relativistic kinematics as applied to colliding beam and fixed target collider experiments.

Forces and Particles:

The strong, electromagnetic, weak and gravitational interactions and their characteristic strengths; bosons and fermions; fundamental particles and forces of the Standard Model.

Reactions and Conservation Laws:

Conservation of discrete quantum numbers (charge, parity, baryon number, and lepton number); conservation of four momentum; combination of spin and orbital angular momentum and conservation of resulting total angular momentum; Feynman diagrams and allowed interactions in the Standard Model.

Strong Interactions and Quark Structure:

Confinement; baryons and mesons as bound states of quarks; combination of quark spins, angular momenta, charges, and parities.

Parity Violation and Weak Interactions:

Madame C.-S. Wu's 1956 polarized ^{60}Co decay experiment and the violation of parity in weak interactions. Quark flavor-changing interactions and the Cabibo-Kobayashi-Maskawa (CKM) matrix.

Nuclear Physics

Basic properties of the atomic nucleus:

Size and energy scale; chart of nuclides; relative abundances; nuclear masses and binding energies, separation energies, nuclear stability; excited nuclear states, spin and parity; electromagnetic moments.

Models of nuclear structure:

The liquid drop model, terms contributing to semi-empirical mass formula; basic model of fission processes; evidence for shell structure; the nuclear shell model, magic numbers, nuclear potential, spin-orbit force, nuclear levels, pairing force; limits of shell model, deformation.

Nuclear reactions and radioactive decay:

Nuclear reaction processes and their energetics; lifetimes and decay probabilities, natural radioactivity; theory of alpha decay; gamma decay, multipole radiation; beta decay, form of spectrum, the neutrino, transition probabilities, ft-values, polar and axial vector transitions, parity violation.