SNIT 2001

Proposed outline of Lectures on Statistics for Particle Physicists

Louis Lyons
Department of Physics, University of Oxford, Oxford, U.K.

1: Combining experimental results: A paradox. Example of using extra theoretical input. Poissons and Gaussians.
Gaussian in 2 dimensions. Error matrix: understanding the error matrix, and using it.

2: Parameter fitting: Normalization. Methods of moments, maximum likelihood (and extended maximum likelihood), least squares. Examples.
Hypothesis testing.
Comparing 2 hypotheses: a paradox
Kinematic fitting.

3: Determining limits: Bayes v. Frequentists. Method of Feldman + Cousins. Higgs search method at CERN.

4: Monte Carlo calculations: What are they? Integration examples. Non-uniform distributions. Typical applications. Detailed physics examples. Garden of Eden problem.

There will also be a short set of examples for anyone interested.

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Proposed outline of Lectures

Pierre Depommier
Department of Physics, Université de Montréal, Montreal, Quebec

1: Introduction - relativistic quantum mechanics Dirac Equation

2: Spin, polarization
- density matrix
- stockes vector

3: 3 component polarization vector formalism
4 component polarization vector formalism

4: Polarization vector in electromagnetic field
Bargmann - Michel - Telegdi Equation

5: “Magic” momentum (g-2)

6: Depolarization through multiple scattering

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Proposed outline of Lectures

John Ng
Senior Research Scientist, TRIUMF, Vancouver, B.C.

1: These lectures will begin with a thorough discussion of muon decay which is at the foundation of the Standard Model. Important concepts such as universality, lepton numbers and the issue of neutrino masses will be introduced.

2: The role of the Michel Parameters and how their precision measurements impact on the physics beyond the Standard Model will be exposed.

3: A discussion of beta decays of nuclei will be given with emphasis on the crucial role they play in establishing the Standard Model.

4: Finally, we return to discuss how future precision measurements in muon physics such as the anomalous magnetic moment and rare decays can illuminate the new physics which is being revealed in neutrino oscillation experiments.

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Proposed outline of Lectures on Atomic Physics for Subatomic Physicists

John Behr
Research Scientist, TRIUMF, Vancouver, B.C.

This will be a biased overview of atomic physics needed for several weak interaction experiments at TRIUMF. Most of the atomic physics will be at textbook level (although the applications are not), with some hints of the rich phenomena that occur in atomic systems perturbed by photons. (Only atoms in vacuum with photons in weak external fields are treated; atoms in the solid state or in high-density spin-exchange optical pumping situations are beyond my ken.)

You will learn whether you should expect the sign of your bias B field to change your polarization.

Feedback and suggested topics will be welcomed until about July 6, after which they will not (that includes the August organizing committee members!!)

1: How to polarize a nucleus with a laser. The standard 30-second handwave "the atoms absorb light until they are fully polarized, F=I+J is the good quantum number, The End".

The hyperfine interaction
Electric dipole matrix element generalization
Optical pumping: classical rate equations (what everyone does) density matrix formulation with quantum coherences.
External fields

Examples of optical pumping of atoms in vacuum: collinear laser fast beam (for solid-state physics and beta decay) optical pumping of laser-cooled atoms.

2: Laser cooling and trapping
Forces from photon absorption
Sub-Doppler "Sisyphus" cooling
Magneto-optical traps
Dipole forces: "optical tweezers"
Magnetostatic traps (the power and the horror)
Circularly polarized dipole force traps: the revolution

3: Experimental examples:
Atom traps for nuclear beta decay: the beta-neutrino angular correlation, spin-polarized experiments (please restrain the lecturer from technical detail rampage).
Atomic PNC: weak neutral currents and anapole moments
Electric Dipole Moment searches in atoms: Rn at TRIUMF: gamma-ray anisotropies as a polarization probe.

4. Resonant Photoionization ("Laser ion source")
Basic formulae. Sensitivity of the technique
Practical issues: achievements of Troitsk group at ISOLDE

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Proposed outline of Lectures on Isotope Production Methods at ISAC

Marik Dombsky
TRIUMF, Vancouver, B.C.

The focus will be on target techniques for on-line production of short-lived isotopes, with specific emphasis on current ISAC methods. Topics will include:

- nuclear production mechanisms;
- product transport by diffusion and effusion;
- delay losses;
- efficiencies and the estimation and determination of product yields.

Power dissipation problems encountered with intense proton beams and examples of target selection criteria will be discussed.

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Proposed outline of Lectures on Nuclear Reaction Rates

Jutta Escher
TRIUMF, Vancouver, B.C.

Review the goals of nuclear astrophysics and then focus on some typical reactions that nuclear physicists and astrophysicists are interested in. In particular, talking about capture reactions, and discussing some of the (experimental and theoretical) difficulties associated with determining the desired cross sections. In that context, some general background information, e.g. hydrogen burning in stars, will also be covered. The main idea would be to give the students a flavor of the sort of questions that arise in nuclear astrophysics and how we go about answering them. The topic will be covered in two one-hour lectures.