Physics with Light Polarized Ions – Resources & Tips

Prof. Elena Long

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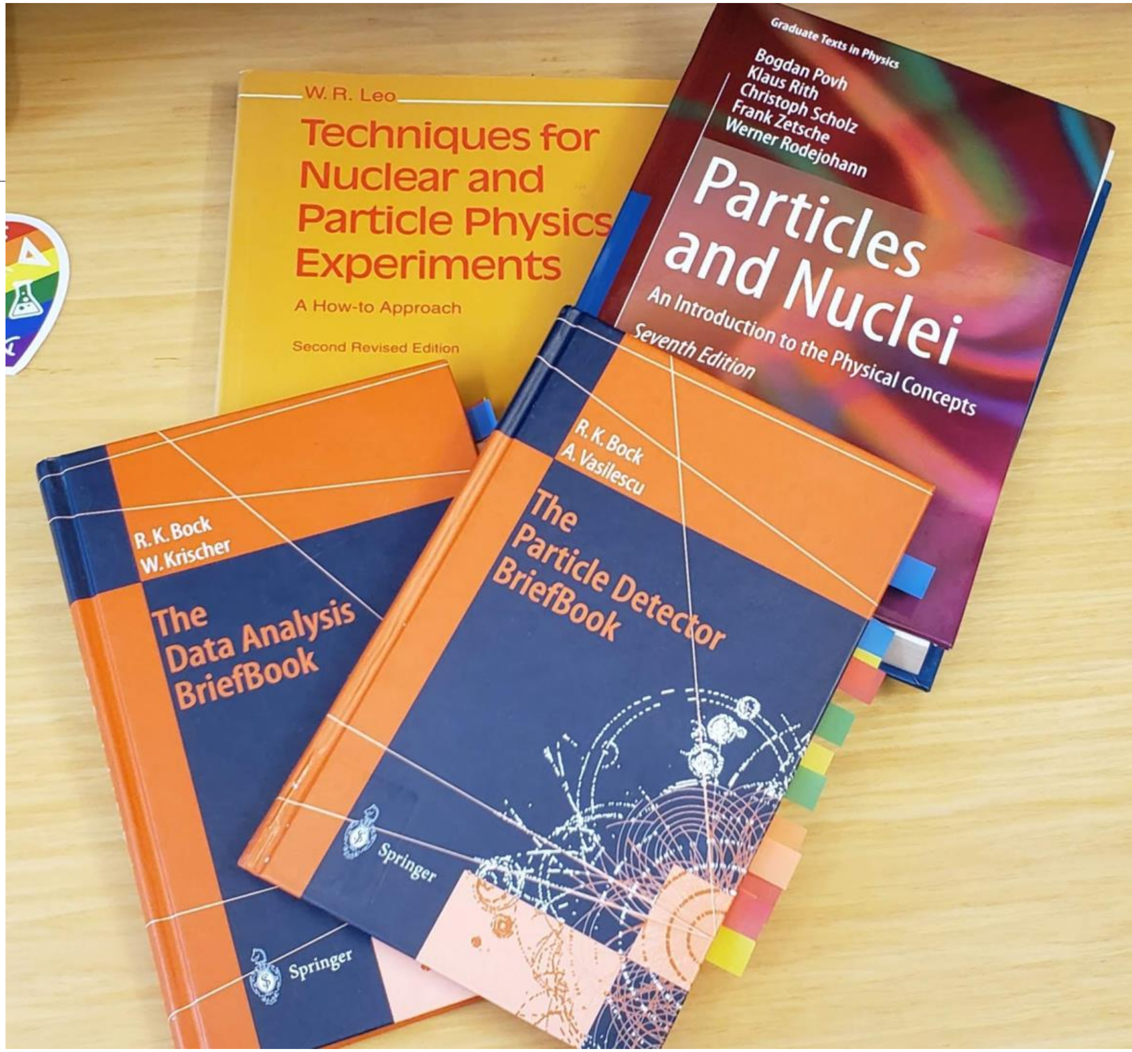
Useful Resources

- Particles and Nuclei, 7th Ed. – B. Povh, et al.
- The Particle Detector BriefBook – R.K. Bock, A. Vasilescu
  - bit.ly/ParticleDetectorBriefbook
- The Data Analysis BriefBook – R.K. Bock, W. Krischer
  - bit.ly/DataAnalysisBriefbook
- iNSPIRE HEP
  - inspirehep.net
- arXiv
  - arxiv.org
- ROOT Data Analysis Framework
  - root.cern.ch
- Techniques for Nuclear and Particle Physics Experiments: A How-To Approach, 2nd Ed. – W.R. Leo



Useful Constants & Nuclear Physics Tips

- *Always check the units!!!*

- $1\ \mathrm{fm} = 10^{-15}\ \mathrm{m}\ \approx$ radius of a proton

- Always use MeV or GeV for energy/mass/momentum & leave c's as c
  - $m_e = 0.511\ \mathrm{MeV}/c^2$
  - $m_p = 938.727\ \mathrm{MeV}/c^2 \approx 1\ \mathrm{GeV}/c^2$

- Always group $\hbar$ with c to make your life easier
  - $\hbar c = 197.3\ \mathrm{MeV} \cdot \mathrm{fm} \approx 200\ \mathrm{MeV} \cdot \mathrm{fm}$

- $\alpha = \frac{e^2}{4\pi\varepsilon_0 \hbar c} \cong \frac{1}{137}$ is useful to turn pesky charge units into 1 easy-to-remember #

Useful Constants & Nuclear Physics Tips

- $1\ \text{mb} = 10^{-27}\ \text{cm}^2$

- Steradians (sr) define a solid angle ('angular area') → $\Omega = \frac{A}{r^2}\ \text{sr} = \Delta\theta \cdot \Delta\phi$

- $\frac{h}{k_B} = 4.799 \times 10^{-5}\ \frac{\text{K}}{\text{MHz}} \approx 5 \times 10^{-5}\ \frac{\text{K}}{\text{MHz}} = 1\ \text{atomic specific heat constant}$

- If units in a paper don't work, check if they used natural units $\hbar = c = \varepsilon_0 = 1$ and work backwards from what the units should be

- When highly relativistic ($>$10 MeV for electrons; >20 GeV for nucleons), use $pc \approx E$

Useful Equations*

* For fixed-target scattering scaled by nucleon mass. More general terms are given in Povh & the Particle Detector BriefBook.

- $Q^2 = 4EE' \sin^2\left(\frac{\theta}{2}\right)$ ← 4-momentum transfer. Inversely proportional to resolution $\left(\lambda \propto \frac{1}{\sqrt{Q^2}}\right)$
- $\nu = \omega = E - E'$ ← Energy transfer ≈ How hard did we hit it?
- $x = \frac{Q^2}{2m_p\nu}$ ← Bjorken x ≈ How massive was the thing we hit?
- $W^2 = m^2 + 2m\nu - Q^2$ ← Invariant Mass Squared of Hadronic System