

# References

- [Aj90] Ajzenberg-Selove, F., “Energy Levels of Light Nuclei  $A = 11-12$ ,” *Nucl. Phys. A* **506** (1990) 1.
- [Aj91] Ajzenberg-Selove, F., “Energy Levels of Light Nuclei  $A = 13-15$ ,” *Nucl. Phys. A* **523** (1991) 1.
- [Ak92] Akimov, Y., *et al.*, “Positive-Pion Production on Carbon at Low Pion Energies,” *Nucl. Phys. A* **541** (1992) 433.
- [Al88] Alons, P., *et al.*, “Microscopic Description of the  $A(p, \pi)A+1$  Reaction,” *Nucl. Phys. A* **480** (1988) 413.
- [Al89] Alons, P., *et al.*, “The  ${}^3\text{He}(p, \pi^+){}^4\text{He}$  Reaction Near Threshold,” *Nucl. Phys. A* **493** (1989) 509.
- [As76] Ashcroft, N. and Mermin, D., *Solid State Physics* (Saunders College), 1976.
- [Ba81] Baudinet-Robinet, Y., “Equilibrium Charge-State Distributions of Highly Stripped Ions in Carbon Foils,” *Nucl. Instr. and Meth.* **190** (1981) 197.
- [Be90] Bent, R., *et al.*, “Energy Dependence of the  ${}^3\text{He}(p, \pi^+){}^4\text{He}$  and  ${}^3\text{H}(n, \pi^-){}^4\text{He}$  Reactions,” *Nucl. Phys. A* **511** (1990) 511.
- [Be92] Bent, R., *et al.*, “Role of the  $\Delta$ -Isobar in the  $A(p, \pi)A+1$  Reaction,” *Nucl. Phys. A* **548** (1992) 637.
- [Bl90] Blankleider, B., “Pion Production in NN Collisions,” in: *Particle Production Near Threshold, Amer. Inst. Phys. Conf. Proc.* **221** (ed. Nann, H. and Stephenson, E.) (1991) 150.
- [Bn68] Brown, R., *et al.*, “Equilibrium Charge State Fractions for 11.5 to 37.3 MeV  ${}^{16}\text{O}$  Ions in Carbon,” *Nucl. Instr. and Meth.* **58** (1968) 274.

- [Br82] Breskin, A., "Progress in Low-Pressure Gaseous Detectors," *Nucl. Instr. and Meth.* **196** (1982) 11.
- [Bu76] Budker, G., *et al.*, "Experimental Studies of Electron Cooling," *Particle Accelerators* **7** (1976) 197.
- [Ca93] Camerini, P., *et al.*, "Threshold Behaviour of the  $\pi^+\pi^-$  Invariant Mass in Nuclei," *Nucl. Phys. A* **552** (1993) 451.
- [Ce75] Cesini, G., *et al.*, "Evaluation of Fission Fragment Ranges in Any Medium," *Nucl. Instr. and Meth.* **127** (1975) 579.
- [Ch68] Charpak, G., *et al.*, "The Use of Multiwire Proportional Counters to Select and Localize Charged Particles," *Nucl. Instr. and Meth.* **62** (1968) 262.
- [Co82] Cooper, E. and Sherif, H., "Distortion Effects in a Relativistic One-Nucleon Model for the  $(p, \pi^+)$  Reaction," *Phys. Rev. C* **25** (1982) 3024.
- [Da71] Dahlgren, S., *et al.*, "Positive-Pion Production in Nuclear Reactions Induced by 185 MeV Protons," *Phys. Lett. B* **35** (1971) 219.
- [Dh83] Dakhno, L., *et al.*, "Measurement of the Cross-Sections for Production of Pion Pairs in Nucleon-Nucleon Collisions at Energies Below 1 GeV. Isospin Analysis," *Sov. J. Nucl. Phys.* **37** (1983) 540.
- [Di82] Dillig, M., *et al.*, "Proton-Induced Pion Production in the Rescattering Model," in: *Pion Production and Absorption in Nuclei - 1981*, *Amer. Inst. Phys. Conf. Proc.* **79** (ed. Bent, R.) (1982) 275.
- [Di89] Dillig, M., private communication (1989).
- [Dk91] Daehnick, W., *et al.*, "A Proposal for the Construction of an Experimental Station at the 6 Degree Bend of the Indiana Cooler Ring," *IUCF Internal Report: Equipment Proposal* (1987).
- [Dr91] Derenchuk, V. and Friesel, D., "Accelerator Performance," *IUCF Technical and Scientific Report* (1991) 187.
- [Du87] Dubach, J., *et al.*, "NN  $\rightarrow$  NN $\pi$  at Intermediate Energies: Predictions of a Unitary Model," *Nucl. Phys. A* **466** (1987) 573.
- [Ei80] Eisenberg, J., "The  $(\pi, \pi\pi)$  Process as a Possible Probe of Pion Condensation Precursor Phenomena," *Phys. Lett. B* **93** (1980) 12.

- [Fa86] Falk, W., *et al.*, “Pion Production Cross-Sections and Analyzing Powers in the Inclusive  $^{12}\text{C}(\text{p}, \pi^+)\text{X}$  Reaction at 400 and 450 MeV,” *Phys. Rev. C* **33** (1986) 988.
- [Fe81] Fearing, H., “Pion Production in Nuclei: Things Known and Unknown,” *Progress in Part. and Nucl. Phys.* **7** (1981) 113.
- [Fn90] Feng, X., *et al.*, “Cross-Section for the  $^{27}\text{Al}(\text{p}, \pi^+\pi^+)^{28}\text{Mg}$  Reaction at 800 MeV,” *Phys. Rev. C* **42** (1990) 451.
- [Fr93] Friesel, D., “Accelerator Operations,” *IUCF Newsletter* **52** (1993) 17.
- [Ge54] Gell-Mann, M. and Watson, K., “The Interactions Between  $\pi$ -Mesons and Nucleons,” *Ann. Rev. of Nucl. Sci.* **4** (1954) 219.
- [Gn87] Grion, N., *et al.*, “Measurement of the  $^{16}\text{O}(\pi^+, \pi^+\pi^-)$  Reaction at  $T_{\pi^+} = 280$  MeV,” *Phys. Rev. Lett.* **59** (1987) 1080.
- [Gr82] Green, M., “Recent Developments and Results in  $(\text{p}, \pi^\pm)$  at IUCF,” in: *Pion Production and Absorption in Nuclei – 1981*, *Amer. Inst. Phys. Conf. Proc.* **79** (ed. Bent, R.) (1982) 131.
- [Gr83] Green, M., “The Energy Dependence Near Threshold of Proton-Induced Positive Pion Production in Simple Spin Systems,” *Ph.D. Thesis* (Indiana Univ., unpublished) (1983).
- [Ha93] Hardie, J., private communication (1993).
- [Hd80] Höistad, B., *et al.*, “The  $(\text{p}, \pi^\pm)$  Reaction on  $^{12,13}\text{C}$  at 200 MeV,” *Phys. Lett. B* **94** (1980) 315.
- [He93] Heimberg, P., private communication (1993).
- [Hi75] Highland, V., “Some Practical Remarks on Multiple Scattering,” *Nucl. Instr. and Meth.* **129** (1975) 497.
- [Ho87] Homolka, J., *et al.*, “Measurement of High Momentum Transfer Reactions by Recoil Detection,” *Nucl. Instr. and Meth. A* **260** (1987) 418.
- [Ho92] Homolka, J., *et al.*, “Measurement of the  $^{12}\text{C}(\text{p}, \pi^0)^{13}\text{N}$  Reaction by Recoil Detection,” *Phys. Rev. C* **45** (1992) 1276.

- [Ho93] Homolka, J., *et al.*, “Readout Electronic [sic] for the Silicon Detector Array of the Indiana Experiment,” Jahresbericht, Technische Universität München (1992) 160.
- [Hu87] Huber, G., *et al.*, “Energy Dependence of the  $^{12}\text{C}(\text{p}, \pi^+)^{13}\text{C}^*$  Reaction in the Region of the  $\Delta_{1232}$  Resonance,” *Phys. Rev. C* **36** (1987) 1058.
- [Iq85] Iqbal, M. and Walker, G., “Intermediate Isobar Effects in a Two-Nucleon Mechanism for  $(\text{p}, \pi)$ ,” *Phys. Rev. C* **32** (1985) 556.
- [Ja85] Jacobs, W., “High-Spin States with the  $(\text{p}, \pi)$  Reaction,” in: *Nuclear Structure at High Spin, Excitation, and Momentum Transfer*, Amer. Inst. Phys. Conf. Proc. **142** (ed. Nann, H.) (1985) 181.
- [Jk90] Jäkel, O., *et al.*, “Chiral Symmetry and the Near Threshold Pion-Induced  $2\pi$  Production on the Nucleon (I),” *Nucl. Phys. A* **511** (1990) 733.
- [Jo82] Jones, G., “ $\text{NN} \rightarrow \pi\text{d}$  and  $\text{NN} \rightarrow \text{NN}\pi$ : A Review of Experimental Results,” in: *Pion Production and Absorption in Nuclei – 1981*, Amer. Inst. Phys. Conf. Proc. **79** (ed. Bent, R.) (1982) 15.
- [Js86] Jones, K., *et al.*, “Energy Dependence of Deformation Parameters in the  $^{12}\text{C}(\text{p}, \text{p}')^{12}\text{C}$  Reaction,” *Phys. Rev. C* **33** (1986) 17.
- [Ju84] Julien, J., *et al.*, “Evidence for a Resonant Structure in Inclusive  $\text{Cu}(\text{p}, \pi^+)\text{X}$  Reactions,” *Phys. Lett. B* **142** (1984) 340.
- [Kn89] Knoll, G., *Radiation Detection and Measurement, 2<sup>nd</sup> Edition* (Wiley), 1989.
- [Ko89] Korkmaz, E., *et al.*, “ $^{12,13}\text{C}(\vec{\text{p}}, \pi^\pm)$  Reactions at  $T_p = 200$  MeV,” *Phys. Rev. C* **40** (1989) 813.
- [Kr82] Krasnov, V., *et al.*, “Analysis of Pion Spectra in Production by 240–500 MeV Protons on Nuclei,” *Phys. Lett. B* **108** (1982) 11.
- [Ks84] Keister, B. and Kisslinger, L., “Microscopic Two-Baryon Dynamics and the  $(\text{p}, \pi)$  Reaction,” *Nucl. Phys. A* **412** (1984) 301.
- [Ku90] Kurepin, A., “Production and Decay of  $\Delta$  Isobars in Nuclei,” *Nucl. Phys. A* **519** (1990) 395c.
- [Le93] Lee, T. and Riska, D., “Short Range Exchange Contributions to the Cross-Section for  $\text{pp} \rightarrow \text{pp}\pi^0$  Near Threshold,” *Phys. Rev. Lett.* **70** (1993) 2237.

- [Lm70] Lock, W. and Measday, D., *Intermediate Energy Nuclear Physics* (Methuen), 1970.
- [Ln87] Londergan, J., and MacFarlane, M., "The Nucleon-Nucleon Interaction: From Mesons to Quarks," *IUCF/NTC Internal Report 87-14* (1987).
- [Lo84] Lolos, G., *et al.*, "Polarized-Proton-Induced Exclusive Pion Production in  $^{12}\text{C}$  at 200, 216, 225, 237, and 250 MeV Incident Energies," *Phys. Rev. C* **30** (1984) 574.
- [Lw87] Leo, W., *Techniques for Nuclear and Particle Physics Experiments* (Springer-Verlag), 1987.
- [Lz92] Lozowski, W., private communication (1992).
- [Lz93] Lozowski, W. and Hudson, J., "Improved Carbon Micro-Ribbon Targets and Stripper Foils for the IUCF Cooler Ring," *Nucl. Instr. and Meth. A* **334** (1993) 173.
- [Ma79] Measday, D. and Miller, G., "Hopes and Realities for the  $(p, \pi)$  Reaction," *Ann. Rev. of Nucl. Sci.* **29** (1979) 121.
- [Me83] Meyer, H., *et al.*, "Proton Scattering From  $^{12}\text{C}$  Between 100 and 200 MeV and the Optical Potential," *Phys. Rev. C* **27** (1983) 459.
- [Me85] Meyer, H., "Beam Properties in Storage Rings with Heating and Cooling," *Nucl. Instr. and Meth. B* **10** (1985) 342.
- [Me88] Meyer, H., *Indiana Cooler User Guide, 2<sup>nd</sup> Edition* (IUCF), 1988.
- [Me90] Meyer, H., *et al.*, "Total Cross-Section for  $pp \rightarrow pp\pi^0$  Near Threshold Measured with the Indiana Cooler," *Phys. Rev. Lett.* **65** (1990) 2846.
- [Me92] Meyer, H., *et al.*, "Total Cross-Section for  $pp \rightarrow pp\pi^0$  Close To Threshold," *Nucl. Phys. A* **539** (1992) 633.
- [No70] Northcliffe, L. and Schilling, R., "Range and Stopping-Power Tables for Heavy Ions," *Nuclear Data Tables A* **7** (1970) 233.
- [Os85] Oset, E. and Vicente-Vacas, M., "A Model for the  $\pi^-p \rightarrow \pi^+\pi^-n$  Reaction," *Nucl. Phys. A* **446** (1985) 584.
- [Os86] Oset, E. and Vicente-Vacas, M., "Inclusive  $(\pi, \pi\pi)$  Reactions in Nuclei," *Nucl. Phys. A* **454** (1986) 637.

- [Pa84] Parkhomchuk, V., “Physics of Fast Electron Cooling,” in: *Proc. Workshop on Electron Cooling and Related Applications*, ECOOL (1984) 71.
- [Pd90] Particle Data Group, “Review of Particle Properties,” *Phys. Lett. B* **239** (1990) 1.
- [Pi93] Pickar, M., *et al.*, “Near-Threshold Proton-Induced Neutral Pion Production From  $^{12}\text{C}$ ,” *Phys. Rev. C* **48** (1993) 2763.
- [Po90] Pollock, R., “The IUCF Cooler After Three Years,” in: *Proc. Workshop on Cooler Rings and Their Applications* (ed. Katayama, T.) (1990) 147.
- [Pp90] Pancella, P., *et al.*, “Linear Motion Feedthrough for Target Positioning,” *IUCF Technical and Scientific Report* (1990) 125.
- [Pp94] Pancella, P., private communication (1994).
- [Pr88] Press, W., *et al.*, *Numerical Recipes in C, 1<sup>st</sup> Edition* (Cambridge U. Press), 1988.
- [Pz93] v. Przewoski, B., *et al.*, “Interaction of Stored, Cooled Proton Beams with Fiber Targets,” *Nucl. Instr. and Meth. A* **328** (1993) 435.
- [Re84] Read, S. and Viola, V., “Excitation Functions for  $A \geq 6$  Fragments Formed in  $^1\text{H}$ - and  $^4\text{He}$ -Induced Reactions on Light Nuclei,” *Atomic Data and Nuclear Data Tables* **31** (1984) 359.
- [Rm88] Rehm, K. and Wolfs, F., “A Focal Plane Detector for Reactions with Medium Weight Projectiles,” *Nucl. Instr. and Meth. A* **273** (1988) 262.
- [Sa77] Sauli, F., “Principles of Operation of Multiwire Proportional and Drift Chambers,” *CERN Report 77-09* (1977).
- [Sc86] Schott, W., *et al.*, “Observation of the  $^{12}\text{C}(^3\text{He}, \pi^+)^{15}\text{N}$  Reaction Near Threshold Using Recoil Detection,” *Phys. Rev. C* **34** (1986) 1406.
- [Se87] Segel, R., *et al.*, “Measurements of Nuclear Reactions using Recoil Detection,” *IUCF/NTC Internal Report 87-07*, (1987).
- [Sg92] Solberg, K., private communication (1992).

- [Sk88] Schuck, P., *et al.*, “Bound Two-Pion Cooper Pairs in Nuclei?,” *Zeit. für Physik A* **330** (1988) 119.
- [So81] Soga, F., *et al.*, “Energy Dependence of the Reaction  $^{12}\text{C}(p, \pi^+)^{13}\text{C}$  to Different Final States,” *Phys. Rev. C* **24** (1981) 570.
- [Sp90] Sperisen, F., *et al.*, “Cooler Target Development: Gas Jet Target,” *IUCF Technical and Scientific Report* (1990) 117.
- [Vi82] Vigdor, S., *et al.*, “Dominance of High-Spin Two-Particle, One-Hole Transitions in  $(p, \pi^-)$  Reactions,” *Phys. Rev. Lett.* **49** (1982) 1314.
- [Wa52] Watson, K., “The Effect of Final State Interactions on Reaction Cross-Sections,” *Phys. Rev.* **88** (1952) 1163.
- [Wi71] Wilson, S., *et al.*, “Isospin Invariance in the Reaction  $n+p \rightarrow \pi^0+d$ ,” *Phys. Lett. B* **35** (1971) 83.
- [Yk35] Yukawa, H., “On the Interaction of Elementary Particles (I),” *Proceedings of the Physical-Mathematical Society of Japan* (1935) 48.
- [Yu89] Yu, Z., *et al.*, “Studies of the  $^{12}\text{C}(p, n)$  and  $^{13}\text{C}(p, n)$  Reactions Near  $180^\circ$ ,” *IUCF Technical and Scientific Report* (1989) 43.

# *Index*

- !, 31, 32, 51, 98, 113, 126, 141.
- ABCD, 11.
- antennae, 57.
- bags, 2.
- bifurcation, 43.
- billiard ball, 113.
- Bloomington, 24.
- bomb, 12, 19, 47, 123.
- bottle, 1.
- Bragg, 83.
- cave, 95.
- chiral, 13.
- contact potential, 121.
- cooked, 66.
- cup in!, 50.
- cursor, 14, 135.
- dead, 29, 33, 38, 45, 49, 51, 122, 123.
- Doskow, J., 23.
- duty, 33, 34.
- expensive, 36.
- fingerprints, 123.
- flat, 34, 37, 69, 82, 95, 101, 104, 110.
- Götterdämmerung, 27.
- half-baked, 66.
- Jacobian, 94.
- Jones, 1.
- kernel, 130.
- Knuth, D., *ii*.
- low-pressure, 42, 45, 112, 117, 118.
- Luxnat, M., 23.
- Mandelstam, 104.
- ® 125.
- methane, 31.
- microscopic, 11, 12, 13.
- Old Lace, 120.
- photolithography, 119, 123.
- pickup, 40, 57.
- punch, 97.
- puzzle, 92.
- quench, 117.
- Rokicki, T., *ii*.
- shell, 8, 11, 113, 130.
- shuffling, 40.
- skim, 33, 34.
- soft, 35, 127, 132.
- spikes, 32.
- static, 1, 32, 72, 114.
- thrust, 130.
- ultraviolet, 117.
- whisker, 32.