The ‘Indiana Cooler’ was a storage ring for light ions consisting of a circular magnet lattice of about 100 m in circumference. It was part of the Indiana University Cyclotron Facility (IUCF). Initially, the IU Cyclotron delivered the ion beam for the ring; eventually a dedicated Injector Cyclotron was added. The Cooler ring was built specifically for the purpose of exploiting the novel technology of electron cooling which made the use of an internal target possible. For more, see: H.O. Meyer, The Indiana Cooler: a Retrospective, Annu. Rev. Nucl. Part. Sci. 2007. 57:1-31

During my involvement with the Cooler, many documents concerning the construction and commissioning of the machine and covering much of the conducted research have accumulated in my files. After some culling and ordering, I have submitted these documents to the Indiana University Archives. The material is contained in five boxes. Each box comes with a detailed table of content.

Hans-Otto Meyer, April 2018

Box 1 (series 1): Construction, operation and end of the Cooler

This series covers the conception, planning, construction and operation of the Cooler storage ring. In particular, it illustrates the start-up phase and first attempts to learn about the novel experimental environment and its usefulness in the study of nuclear physics.

1 Proposal
1.1 Original Cooler-Tripler proposal
   Proposal defense at the NSAC meeting of Feb. 9, 1981,
   at the Office of the National Science Foundation, Washington, D.C.
1.2 Alternate versions of the proposal
1.3 The Cooler in the press: newspaper articles

2 Construction
2.1 Quarterly Status Reports
   from #1 (Spring 1983) until #22 (Summer 1988) (these reports offer a detailed account of the
   construction of the Cooler)
2.2 Management issues
   September 1985: Report of the visiting committee
   November 1985: IUCF Cooler Construction Status
   November 1985: letters by Pollock and Vigdor to the directors
   March 1986: NSF Site Visit Review

3 Commissioning and dedication
3.1 Commissioning activities 1988
   detectors, gas flow and target thickness, 45 MeV
   first cooled beam on an internal target, Sunday April 17, 1988
   IU news release: the IUCF Cooler is operational!
   Ramping to 287 MeV, wire chamber tests, moving slits, polarized beam, fiber targets, beam wiggling.
3.2 Commissioning activities 1989
   steering combos, skimmer targets, cycle timing, precession in cooling solenoid, background studies,
   polarization measurements
   micro-particle target (“The Dust Target User Guide”)
   beam stabilizer, memo on preservation of ring vacuum. Experiment Status (9/9/88, H.O. Meyer).
3.3 Cooler Dedication, June 1, 1988, official invitation

4 Development
4.1 Electron cooling
4.1.1 Electron cooling, theoretical issues
   Derivation of cooling force for a flattened distribution
   Mills circle
   Ionization by electron collision
   Heating of ions in an electron beam
   Space charge effects in a cylindrical electron beam
4.1.2 IUCF electron cooling system
   Design drawings
   Reports by Friesel, Ellison, Dermois
4.2 Polarization and Siberian snakes
4.2.1 Use of the CE01 detector as a polarimeter
4.3 Monte-Carlo simulation of the stored, cooled beam (HOM)
4.3.1 Monte Carlo simulation, part 1
   Cooling force, longitudinal cooling, target heating, longitudinal heating, Monte-Carlo without RF,
   treatment of RF cavity, FULLEQ: MC calculation that includes transverse phase space, transverse
   cooling, heating and betatron motion
4.3.2 Monte Carlo simulation, part 2
   Dispersion-coupled losses, fiber targets, vacuum limitations, analytical expressions for transverse Cooler
   beam properties.
4.3.3 Beam-Target interaction
4.3.4 Longitudinal phase space
4.4 Internal targets for the Indiana Cooler
4.4.1 General studies
   Memos by Pollock, Meyer, Pancella, Sperisen (1985)
   Gas dynamics, tubes, nozzles
   Memo by Pancella (1992)
4.4.2 Micro-ribbon targets, part I
   How to make micro ribbons, electron microscope pictures, resistance, sublimation
   Interaction between fibers and stored beam, P. Schwandt’s report on heating
4.4.3 Micro-ribbon targets, part II
   Experimental studies 1988 - 1991
4.4.4 Micro-particle targets, part I
   Interaction between micro-particle targets and the stored beam
   Design and construction of a laser diagnostic device
   Contact charging and electrostatic manipulation (a lot of work, but did not work)
4.4.5 Micro-particle targets, part II
   Gas jet, seeded with micro-particles (idea that worked)
   Heiko Rohdjess, Microparticle beam target test in the Indiana Cooler, Diplomarbeit
   “Dust target user guide”, H. Rohdjess
4.4.6 Skimmer targets, Report on linear motor system (FLIM), Pancella, 1990, Rate stabilization hardware and
   electronics, Flimlet
4.5 Background and scraper slits
4.6 Miscellaneous
   Cooler circumference measured using pd → ³Heπ⁰, Pancella, 2001
   Cooler beam profile measurement, Pancella, 1989
   Floor plans
   ‘combos’ (local beam shift and tilt)
   Ring magnets, details, early documents
5 Startup of experimental program
5.1 Planning for experiments
   Pollock, Meyer memos 1983
   The “Cooler User Guide”, 2nd ed. March 1988, contains everything one needs to know about the ring in
   order to design an experiment

5.2 Towards the first Cooler experiment
   Note: see also the separate file ‘CE01’ dedicated to the first experiment
   Design and equipment procurement of parts
   CE01 working group (19 people)
   Attempts to get adequate resources, 1989
   CE01 run, Aug. 1989, planning for remainder of year
   IUCF Organigram April, 1990

6 Final decade of Cooler operation
6.1 1992 – 1999
   NSAC/NSF review, Dec. 10-11, 1992
   Visiting committee to IUCF, Apr. 27-29, 1994 (ordered by George Walker) and report of that committee
   (recommends keeping up Cooler research)
   Status of Cooler research, Feb. 1996 (list of experiments at that time)
   Various emails concerning end of cyclotron funding by NSF
   1998 annual report to NSF
   1999 annual report to NSF

6.2 1999 - 2002
   NSF site visit and facility review Jan. 14, 1999
   Report of the NSF review panel (recommend 3 more years funding for Cooler research)
   2000 IUCF status report (including separate reports on Pintex, pion production near threshold and the 3-
   nucleon force
   Cooler shutdown scenarios. Pintex plans. Cameron’s objection. Home stretch scenario. Last beam: June
   2002.