- **ANNEX II: TENTATIVE SUMMARY OF CPO COURSE**

Introduction to Charged Particle Optics: Theory and Simulation

Tentative Course Summary

1. TRANSPORT OF CHARGED PARTICLE BEAMS (UCM, AKU, UOC, UOI)

- Charged Particle Motion in Electromagnetic Fields (UCM)
- Gaussian Optics and Transfer Matrices (UCM)
- Charged Particle Beams and Phase Space (UCM,UoC)
- Aberrations in CPO (UCM, AKU, UoC)
- Numerical Methods (FDM,BEM,FEM) for solving Laplace Equation (UCM)
- Numerical Methods for the calculation of charged particles trajectries (UCM)
- Introduction to SIMION 8.0 (AKU, UoC, UoI)

2. ELECTROSTATIC LENSES (AKU, UCM, UOC)

- General properties (AKU, UCM, UoC)
- Two-cylinder Lenses (AKU, UCM, UoC)
- Three-cylinder Lenses (AKU, UCM, UoC)
- Four- and Five-cylinder Lense (AKU, UCM, UoC)

3. ENERGY DISPERSIVE DEVICES (UOC, AKU, UOI, UCM)

- General properties (UoC)
- Parallel plate Analyzers (UoC)
- Hemispherical Deflector Analyzers (UoC, AKU, UoI, UCM)
- Cylindrical Zoom Lenses and Hemispherical Deflector Analyzers (UoC, AKU, UoI, UCM)
- Two-stage analyzers (UoC)

4. TIME OF FLIGHT DEVICES (SU, UOI, UOC, AKU, TUW)

- General properties (SU,AKU, UoI,UoC)
- Space Focusing (SU, AKU)
- Time Focusing (SU, AKU,TUW)

5. IMAGING DEVICES (UOI, UOC, SU, TUW)

- General properties (UoI,UoC)
- Motion in Static Electric Fields (UoI,UoC)
- Motion in Static Electric and Magnetic Fields (UoC,UoI)
- Velocity Mapping and Slice Imaging (UoC,UoI,SU)

Recommended course books:

- M. Yavor, *Optics of Charged Particle Analyzers*, Advances in Imaging and Electron Physics, Edited by P. Hawkes (Elsevier, 2009}, vol. 157, chapters 1-3, 5, 7,8.
- S. Humphries Jr., *Principles of Charged Particle Acceleration*, (John Wiley & Sons, 1999) chapters 1-9.
- S. Humphries Jr., *Charged Particle Beams*, (John Wiley & Sons, 2002) chapters 1-3.
- SIMION Version 8.0, User Manual (Scientific Instrument Services Inc., Ringoes NJ, 2006)
- D W O Heddle, *Electrostatic Lens Systems* (IoP, 2nd edition, 2000)
- John Moore, Christopher C. Davis, Michael A. Coplan, Sandra Greer, *Building Scientific Apparatus* (Cambridge University Press; 4rth edition, 2009)

Older references:

- H. Wollnik, *Optics of Charged Particles (Academic Press, 1987)*
- David A. De Wolf, *Basics of electron Optics* (John Wiley, 1990)
- Poul Dahl, *Introduction to Electron and Ion Optics* (Academic Press, 1973)

Other Interesting links:

- Cutting edge Numerical tools for your PC
- Charged particle Optics programs