

Third International Accelerator School for Linear Colliders – Curriculum (v.8, 07/23/2008)

October 19-29, 2008, Oak Brook Hills Marriott Hotel, Oak Brook, Illinois, U.S.A.

Daily Schedule

Breakfast	08:00 – 09:00
Morning	09:00 – 12:30, including ½-hour break
Lunch	12:30 – 14:00
Afternoon	14:00 – 17:30, including ½-hour break
Dinner	17:30 – 19:00
Tutorial & homework	19:00 – 22:00

List of Courses

	Morning	Afternoon	Evening
October 19		<i>Arrival, registration</i>	<i>Reception</i>
October 20	Introduction	Sources & bunch compressors	Tutorial & homework
October 21	Damping ring I	Linac I	Tutorial & homework
October 22	Damping ring II	Linac II	Tutorial & homework
October 23	LLRF & high power RF	Beam delivery & beam-beam	Tutorial & homework
October 24	<i>Site visit to Fermilab</i>	<i>Site visit to Fermilab</i>	<i>Free time</i>
October 25	Superconducting RF & ILC I	<i>Excursion</i>	Tutorial & homework
October 26	Superconducting RF & ILC II Room temperature RF & CLIC I	Room temperature RF & CLIC II	Tutorial & homework
October 27	Instrumentation & control	Muon collider	Tutorial & homework
October 28	<i>Final exam</i>	Operations; Physics & detectors	<i>Banquet; Student Award Ceremony</i>
October 29	<i>Departure</i>		

Program

	Monday, October 20	Tuesday, October 21	Wednesday, October 22	Thursday, October 23
Morning 09:00 – 12:30	Opening remarks (10) Young-Kee Kim (Fermilab/Univ. of Chicago) Lecture 1 – Introduction (180) Carlo Pagani (INFN/ Univ. of Milano) • Why LC • What's ILC • Layout of ILC • Parameter choices & optimization • Overview of accelerator issues • Other future lepton colliders: CLIC and muon collider	Lecture 3a – Damping ring I (180) Mark Palmer (Cornell Univ.) • Role of damping rings • High-level overview of structure, and principles of operation • Review of basic linear beam dynamics • Damping ring lattice • Radiation damping (derivation of damping times, and the need for a damping wiggler in LC damping rings) • Quantum excitation and equilibrium beam emittances	Lecture 3b – Damping ring II (180) Mark Palmer (Cornell Univ.) • Brief overview of technical systems • R&D challenges for selected technical components ➢ injection/extraction kickers ➢ damping wiggler • Brief overview of beam dynamics issues • Selected beam dynamics issues ➢ impedance effects ➢ electron cloud effects	Lecture 5 – LLRF & high power RF (180) Stefan Simrock (DESY) • RF system overview • LLRF • Timing and synchronization • Modulators • Klystrons • RF distribution
Afternoon 14:00 – 17:30	Lecture 2 – Sources & bunch compressors (180) Masao Kuriki (Hiroshima Univ.) • e- gun • e+ sources • Polarized sources • Bunch compressors • Spin rotator	Lecture 4a – Linac I (180) Toshiyasu Higo (KEK) • Phases & superposition • Basics of RF cavities • Lumped circuit analogy, metrics • RF Pillbox cavity • Coupled rf-cavities, mode structure • Shunt impedance, transit-time factor • Standing wave linacs and structures • Beam loading and power coupling • Slow wave structures	Lecture 4b – Linac II (180) Toshiyasu Higo (KEK) • Traveling wave linacs • Structure parameters • Scaling relationships for TW linacs • Power flow & beam loading • Multi-bunch energy gain • Wakefields & impedances • Linac lattice • Emittance preservation & instabilities • Beam based alignment	Lecture 6 – Beam delivery & beam-beam (180) Deepa Angal-Kalinin (Daresbury) • Overview • Beam-beam interaction and crossing angle • Collimation • Accelerator-detector interface, shielding and beam dump • Background and detector protection • Beam monitoring and control at final focus • Luminosity optimization
Evening 19:00 – 22:00	Tutorial & homework	Tutorial & homework	Tutorial & homework	Tutorial & homework

Program (cont'd)

	Friday, October 24
Day	Site visit to Fermilab
09:00	Bus leaving hotel for Fermilab
09:30 – 10:30	Special lecture – How the Fermilab accelerator complex works (60) Roger Dixon (Fermilab)
10:30 – 17:00	Students will be divided into 6 groups. Each group has ~9 students and will receive ~50 minutes hands-on training in the Main Control Room. The instructor is Bob Mau (Fermilab). Students will have lunch at Fermilab and visit several facilities. Details will come later.
17:00	Bus leaving Fermilab for hotel
Evening 19:00 – 22:00	<i>Free time</i>

Program (cont'd)

	Saturday, October 25	Sunday, October 26	Monday, October 27	Tuesday, October 28
Morning 09:00 – 12:30	Lecture 7a – Superconducting RF & ILC I (180) Nikolay Solyak (Fermilab) • Superconductivity basics • Cavity design & SRF constraints • Lorentz force detuning in SCRF • Microphonics & vibration issues • Cavity fabrication and tuning • Surface preparation • Gradient limit and spread • Cryogenics • ILC cryomodules • Alignment issues	Lecture 7b – Superconducting RF & ILC II (90) Nikolay Solyak (Fermilab) • Power Coupler • HOMs & HOM Couplers • Slow and fast tuner • ILC design & challenges Lecture 8a – Room temperature RF & CLIC I (90) Frank Tecker (CERN) • Gradient limits at X-band • Breakdown mechanism • Pulse heating • Pulse train formats • Klystron vs. beam driven • RF power manipulation options	Lecture 9 – Instrumentation & control (180) Toshiyuki Okugi (KEK) • Beam monitoring • Precision instrumentation • Feedback systems • Energy stability • Orbit control • Electronics • Data processing	08:00 – 12:30 Final exam (270)
Afternoon 14:00 – 17:30	Excursion to Downtown Chicago	Lecture 8b – Room temperature RF & CLIC II (180) Frank Tecker (CERN) • CLIC layout • Cavity fabrication and tuning • HOM out-coupling • Thermal stability • Driver beam stability • Power coupling • Alignment issues • CLIC design & technical challenges	Lecture 10 – Muon collider (120) Bob Palmer (BNL) • Muon collider basics • Machine layout • Major sub-systems • Challenges Study time (60)	Lecture 11 – Operations (90) Tom Himel (SLAC) • Reliability • Availability • Remote control and global network Lecture 12 – Physics & detectors (90) Rolf-Dieter Heuer (DESY/CERN) • Tera scale physics • Physics beyond 1 TeV • ILC vs. LHC • Detectors
Evening 19:00 – 22:00	Tutorial & homework	Tutorial & homework	Tutorial & homework	Banquet; Student Award Ceremony

Notes to the Program:

1. There will be 12 lectures, each taught by one lecturer.
2. The curriculum covers both the ILC and CLIC. Those lectures in which the two machines share similarities (e.g. sources, damping rings, beam delivery & beam-beam, instrumentation & control, operations, physics & detectors) should cover both machines.
3. There is also a 90-minute lecture on muon collider, which is another type of future lepton collider. But we will not lecture on plasma/laser acceleration.
4. There are a total of 8 lecture days: Oct 20 – Oct 23 and Oct 25 – Oct 28, with one afternoon excursion/free. October 24 is set for a site visit to Fermilab, where hands-on training in a control room will be given.
5. There will be homework assignments, but no homework due for grade. There will be a final exam, and some of the exam problems are to be taken from the homework assignments. Lectures 11 and 12 take place after the final exam. So they do not take part in the exam. The exam papers will be graded right after the exam and results announced in the evening of Oct. 28 at the student award ceremony.
6. There is a tutorial and homework period every evening. It is part of the curriculum and students are required to attend. Lecturers will be available in the evening of their lecture day during this period.
7. Lecturers are strongly suggested to cover the basics as well as possible. Their teaching material will be made available online to the students well ahead of time (~ 1 month prior to the school), while students are likewise encouraged to study the material ahead of time as much as possible.
8. Lecturers are responsible for the design of homework and exam problems as well as the answer sheet. They are also responsible for grading the exams.
9. The award ceremony will honor top (~10) students based on their exam scores.