

ILC Damping Rings Research and Development Objectives

2. Beam Dynamics Studies

2.1 Single-Particle Dynamics

2.1.1 Lattice Design

2.1.1.1 Lattice design for baseline positron ring

Required for Baseline Priority: Very High

2.1.1.2 Lattice design for baseline electron ring

Required for Baseline Priority: Very High

2.1.1.3 Lattice design for alternative positron ring

Required for Alternate Priority: Moderate

2.1.1.4 Lattice design for alternative electron ring

Required for Alternate Priority: Moderate

2.1.1.5 Lattice design for injection/extraction lines

Required for Baseline Priority: High

2.1.1.6 Optics designs for injection/extraction sections in damping rings

Required for Baseline Priority: High

2.1.2 Acceptance

2.1.2.1 Characterize damping rings acceptance

Required for Baseline Priority: High

2.1.2.2 Optimize the damping rings acceptance

Required for Baseline Priority: High

2.1.2.3 Specify magnet field quality required to ensure good acceptance

Required for Baseline Priority: High

2.1.3 Optics Measurement and Correction

2.1.3.1 Develop techniques for optics measurement and correction

Required for Baseline Priority: Moderate

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2.1.4 Low-Emittance Tuning

2.1.4.1 Develop strategies for low-emittance tuning

Required for Baseline Priority: High

2.1.4.2 Specify requirements for survey, alignment and stabilization

Required for Baseline Priority: High

2.1.4.3 Demonstrate < 2 pm vertical emittance

Required for Baseline Priority: Very High

2.1.4.4 Specify support schemes for damping rings magnets

Required for Baseline Priority: High

2.1.4.5 Specify orbit and coupling correction scheme

Required for Baseline Priority: High

2.2 Multi-Particle Dynamics

2.2.1 Single-Bunch Impedance

2.2.1.1 Develop single-bunch impedance models

Required for Baseline Priority: High

2.2.1.2 Characterize single-bunch impedance-driven instabilities

Required for Baseline Priority: Very High

2.2.2 Multi-Bunch Impedance

2.2.2.1 Develop long-range wakefield models

Required for Baseline Priority: High

2.2.2.2 Characterize multi-bunch instabilities

Required for Baseline Priority: High

2.2.2.3 Characterize the effects of injection transients

Required for Baseline Priority: High

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2.2.3 Electron Cloud

2.2.3.1 Characterize electron-cloud build-up

Required for Baseline Priority: Very High

2.2.3.2 Develop electron-cloud suppression techniques

Required for Baseline Priority: Very High

2.2.3.3 Develop modeling tools for electron-cloud instabilities

Required for Baseline Priority: Very High

2.2.3.4 Determine electron-cloud instability thresholds

Required for Baseline Priority: Very High

2.2.4 Ion Effects

2.2.4.1 Characterize ion effects

Required for Baseline Priority: Very High

2.2.4.2 Specify techniques for suppressing ion effects

Required for Baseline Priority: Very High

2.2.5 Other Collective Effects

2.2.5.1 Characterize space-charge effects

Required for Baseline Priority: Moderate

2.2.5.2 Estimate the impact from CSR

Required for Baseline Priority: Moderate

2.2.5.3 Estimate emittance growth from IBS

Required for Baseline Priority: Moderate

2.2.5.4 Determine the Touschek lifetime

Required for Baseline Priority: Moderate

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2.3 Integrated Dynamics Studies

2.3.1 Integrated Dynamics Studies

2.3.1.1 Perform integrated beam dynamics simulations

Required for Baseline Priority: Moderate

3. Technical Subsystem or Component Development

3.1 Vacuum

3.1.1 Vacuum Chamber

3.1.1.1 Specify vacuum chamber material and geometry

Required for Baseline Priority: High

3.1.1.2 Develop technical designs for principal vacuum chamber components

Required for Baseline Priority: High

3.1.1.3 Characterize vacuum system performance

Required for Baseline Priority: High

3.1.2 Vacuum Pumps

3.1.2.1 Specify vacuum pumps

Required for Baseline Priority: Low

3.1.3 Vacuum Diagnostics and Controls

3.1.3.1 Specify vacuum diagnostics and controls

Required for Baseline Priority: Low

3.1.4 Vacuum Valves

3.1.4.1 Specify vacuum valves

Required for Baseline Priority: Moderate

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3.3 Normal-Conducting Magnets

3.3.2 Dipoles

3.3.2.1 Develop physics designs for main dipoles

Required for Baseline Priority: Moderate

3.3.2.2 Develop engineering designs for main dipoles

Required for Baseline Priority: Low

3.3.3 Quadrupoles

3.3.3.1 Develop physics designs for quadrupoles

Required for Baseline Priority: Moderate

3.3.3.2 Develop engineering designs for quadrupoles

Required for Baseline Priority: Low

3.3.4 Sextupoles

3.3.4.1 Develop physics designs for sextupoles

Required for Baseline Priority: Moderate

3.3.4.2 Develop engineering designs for sextupoles

Required for Baseline Priority: Low

3.3.5 Higher-Order Multipoles

3.3.5.1 Develop physics designs for higher-order multipoles

Required for Baseline Priority: Moderate

3.3.5.2 Develop engineering designs for higher-order multipoles

Required for Baseline Priority: Low

3.3.6 Steering Magnets

3.3.6.1 Specify steering magnets

Required for Baseline Priority: Moderate

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3.3.7 Skew Quadrupoles

3.3.7.1 Specify skew quadrupoles

Required for Baseline Priority: Moderate

3.4 Superconducting Magnets

3.4.6 Damping Wiggler

3.4.6.1 Develop physics designs for damping wigglers

Required for Baseline Priority: Moderate

3.4.6.2 Develop engineering designs for damping wigglers

Required for Baseline Priority: High

3.5 Kickers

3.5.1 Damping Ring Injection/Extraction Kickers

3.5.1.1 Develop a fast high-power pulser for injection/extraction kickers

Required for Baseline Priority: Very High

3.5.1.2 Develop physics designs for kicker striplines

Required for Baseline Priority: High

3.5.1.3 Develop engineering designs for kicker striplines

Required for Baseline Priority: Moderate

3.6 Damping Ring RF Systems

3.6.1 RF System

3.6.1.1 Specify 650 MHz RF system

Required for Baseline Priority: High

3.6.1.2 Prototype complete 650 MHz RF unit and test at high power

Required for Baseline Priority: High

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3.6.2 RF Cavities

3.6.2.1 Develop conceptual design for 650 MHz RF cavities, cryomodules and supporting hardware

Required for Baseline Priority: High

3.6.2.2 Develop engineering design for 650 MHz RF cavities, cryomodules and supporting hardware

Required for Baseline Priority: High

3.6.4 RF Controls (Low-Level RF)

3.6.4.1 Develop RF controls

Required for Baseline Priority: High

3.7 Instrumentation and Diagnostics

3.7.1 Beam Intensity Diagnostics

3.7.1.1 Develop beam lifetime instrumentation

Required for Baseline Priority: Moderate

3.7.1.2 Develop fast loss monitors

Required for Baseline Priority: Moderate

3.7.2 Beam Position and Phase Diagnostics

3.7.2.1 Develop beam position monitors

Required for Baseline Priority: Moderate

3.7.2.2 Develop feedforward for extraction kicker stabilization

Required for Baseline Priority: High

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3.7.3 Beam Size and Bunch Length Diagnostics

3.7.3.1 Develop high-precision beam size monitor

Required for Baseline Priority: Moderate

3.7.3.2 Develop precision bunch-by-bunch beam size monitor

Required for Baseline Priority: Moderate

3.7.3.3 Develop instrumentation for measuring injected phase space

Required for Baseline Priority: Moderate

3.7.3.4 Develop instrumentation for monitoring emittance damping

Required for Baseline Priority: High

3.7.3.5 Develop fast coupling monitor

Required for Baseline Priority: Moderate

3.7.4 Higher-Order Beam Diagnostics

3.7.4.1 Develop coherent signal receivers

Required for Baseline Priority: Moderate

3.7.5 Other Instrumentation and Diagnostics

3.7.5.1 Develop tune monitors

Required for Baseline Priority: Moderate

3.7.5.2 Develop instrumentation for fast dispersion measurements

Required for Baseline Priority: Moderate

3.7.6 Integrated Instrumentation and Diagnostics Systems

3.7.6.1 Specify overall requirements for instrumentation and diagnostics

Required for Baseline Priority: High

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3.8 Feedback Systems

3.8.1 Damping Ring Bunch-by-Bunch Feedback Systems

3.8.1.1 Specify bunch-by-bunch feedback systems

Required for Baseline Priority: Moderate

3.8.1.2 Model bunch-by-bunch feedback systems

Required for Baseline Priority: Moderate

3.8.1.3 Develop bunch-by-bunch feedback systems

Required for Baseline Priority: Moderate

3.10 Supports and Alignment Systems

3.10.1 Normal-Conducting Magnet Supports

3.10.1.1 Specify alignment techniques appropriate for different sections of the rings

Required for Baseline Priority: Moderate

3.10.1.2 Specify support and stabilization hardware

Required for Baseline Priority: High

3.13 Multiple Systems

3.13.1 Systems Integration

3.13.1.1 Develop integrated mechanical design

Required for Baseline Priority: High