AS Damping Ring Review

Susanna Guiducci, Andy Wolski, Jie Gao, Mike Zisman

A plan for the RDR was established early

- Local (to the damping rings) experts were identified, to work with the Area System Leaders on specifying and counting components in the damping rings.
- Parameters are recorded on “Component Specification Sheets”, which include references to information sources, and contact details for the responsible people.
- A “Specifications and Costs Coordinator” (Andy Wolski) will manage and collect component specifications and costs and compile the Sheets
- Completed Component Specification Sheets are kept in a central repository, to act as a central resource and reference.
- The repository was kindly set up by Mark Palmer at Cornell:
  - https://wiki.lepp.cornell.edu/ilc/bin/view/Public/DampingRings/ReferenceDesignReport

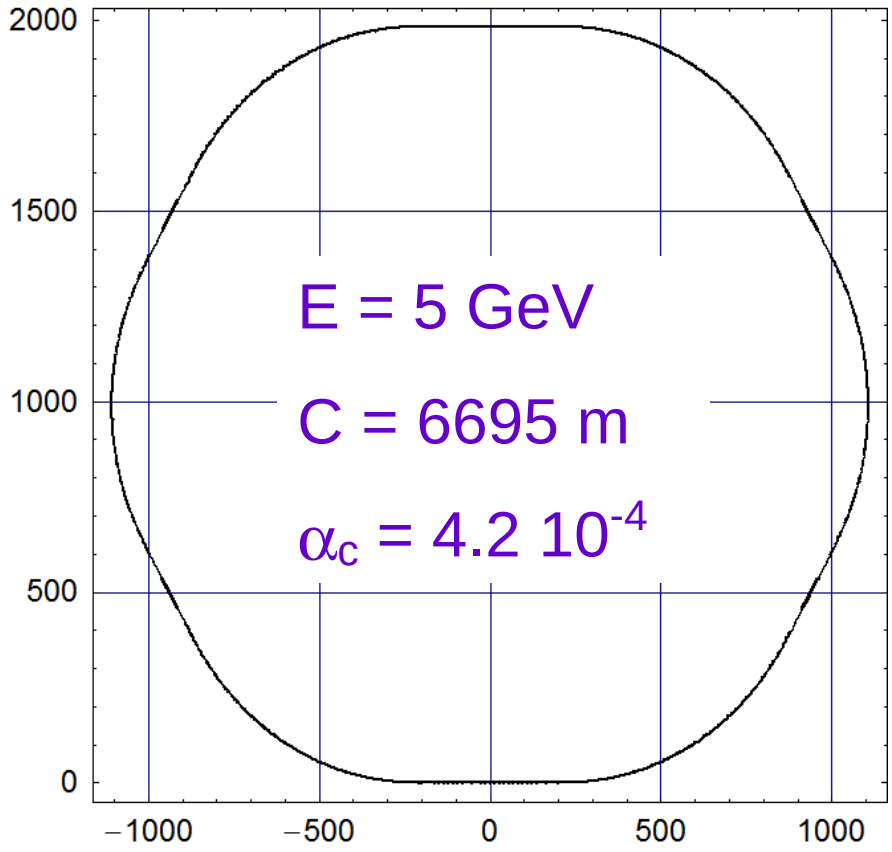
Responsibilities are shared between Area System Leaders

Technical or Global Group	DR AS Contact	TG or GG Contact
Magnets	Mike Zisman	John Tompkins
Cryogenics – wiggler	Mike Zisman	Laurent Tavian
Cryogenics – RF	Susanna Guiducci	Laurent Tavian
RF Power	Susanna Guiducci	Shigeki Fukuda
Instrumentation	Susanna Guiducci	Mark Ross
Controls	Susanna Guiducci	John Carwardine
Vacuum	Andy Wolski	John Noonan
Conventional Facilities/Siting	Andy Wolski	Tom Lackowski
Design Cost Board	Andy Wolski	Jean-Pierre Delahaye
Dumps and Collimators	Mike Zisman	Tom Markiewicz
Installation	Mike Zisman	Fred Aseri
Commisioning, Ops, Reliability	Mike Zisman	Tom Himel

Design Status

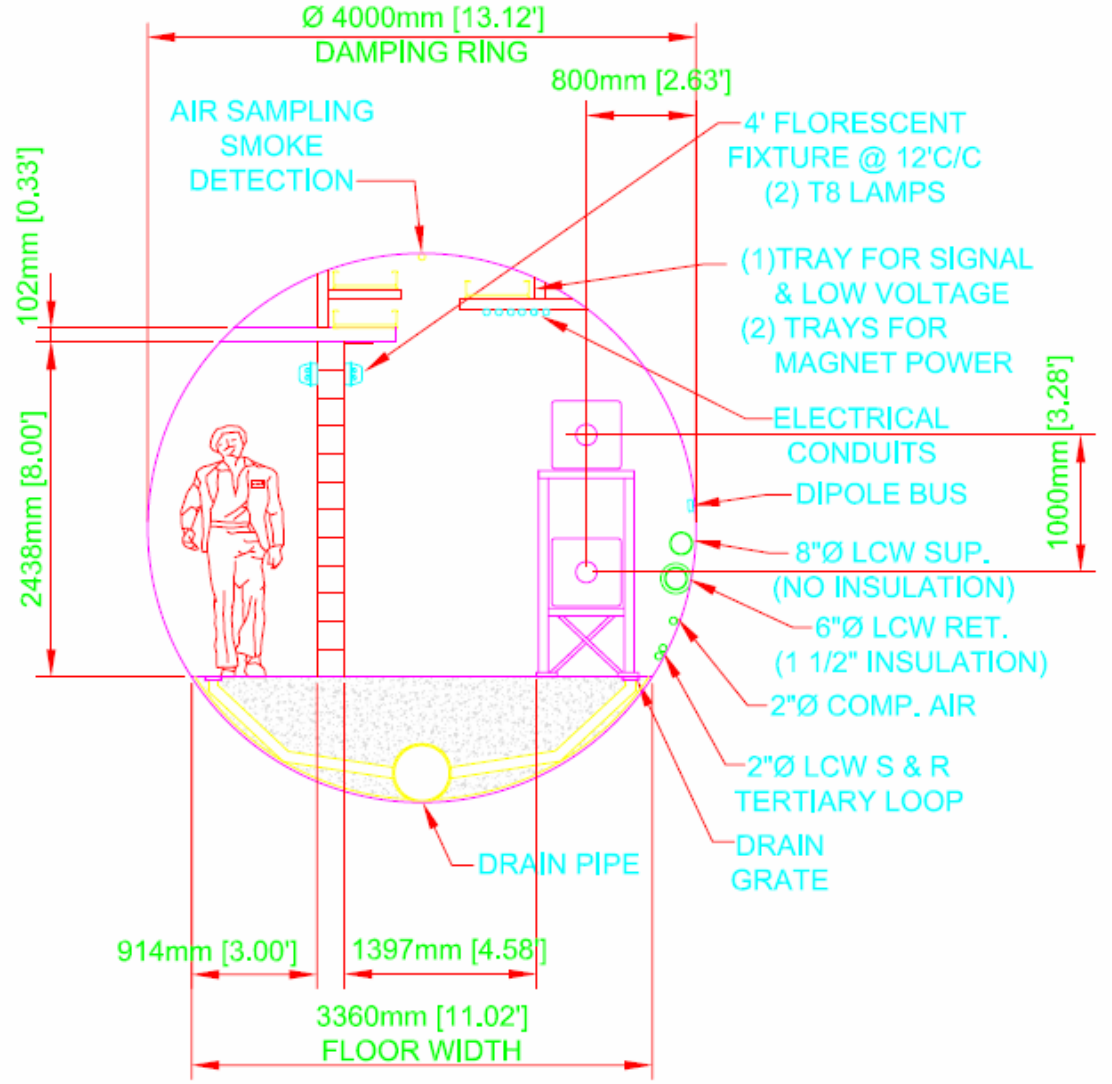
- Technical subsystem specifications are set by the lattice
- Having a single, stable, lattice design is essential for a consistent cost model
- A lattice satisfying basic requirements on circumference, damping times, emittance, bunch length, dynamic aperture etc. has been presented at Bangalore
- From discussion with Technical/Global groups the requirement of minimizing the number of wiggler/RF sections, to reduce costs associated with access shafts, came out
- A final “RDR” version of the lattice, including suggested modifications has been now put on the web (Aimin Xiao, ANL)
- Alternative configurations (FODO lattice) are being studied (Yi Peng Sun, IHEP)

RDR Lattice

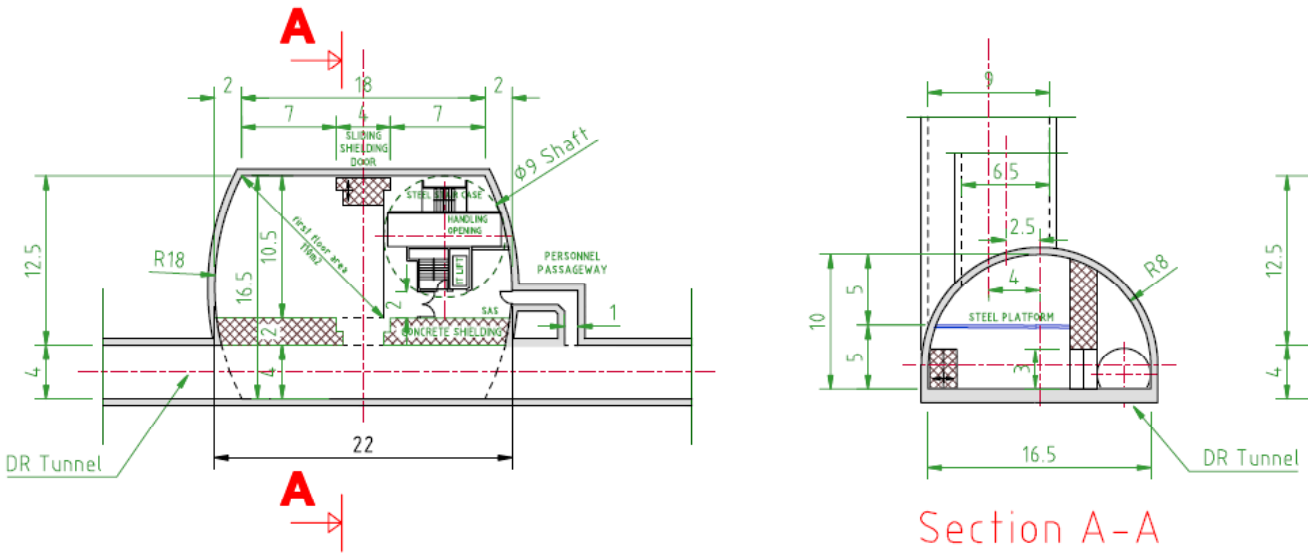


- The ring is has roughly 6-fold symmetry, with 6 straight sections.
- 4 short straight sections contain wigglers and RF cavities
- 1 long straight section accommodates injection/extraction lines
- 1 long straight section accommodates abort line
- Each of the 6 arcs is made of 18 TME cells plus dispersion suppressor

Tunnel Layout



Tunnel Layout



4 major alcoves 18x10.5x10 m^3, 9 m shaft:

wigglers and RF sections

EDR-CONV- Component sheets at:

https://wiki.lepp.cornell.edu/ilc/bin/view/Public/DampingRings/EdrAllCompSpecSheets

Design Status

- Preliminary estimates for the technical subsystems are in progress.
  - **Specifications are based on the final "RDR" version of the lattice, with RF and wigglers are placed in 4 straight sections**
- Component specifications are kept in a central repository:

https://wiki.lepp.cornell.edu/ilc/bin/view/Public/DampingRings/WebHome

Magnets

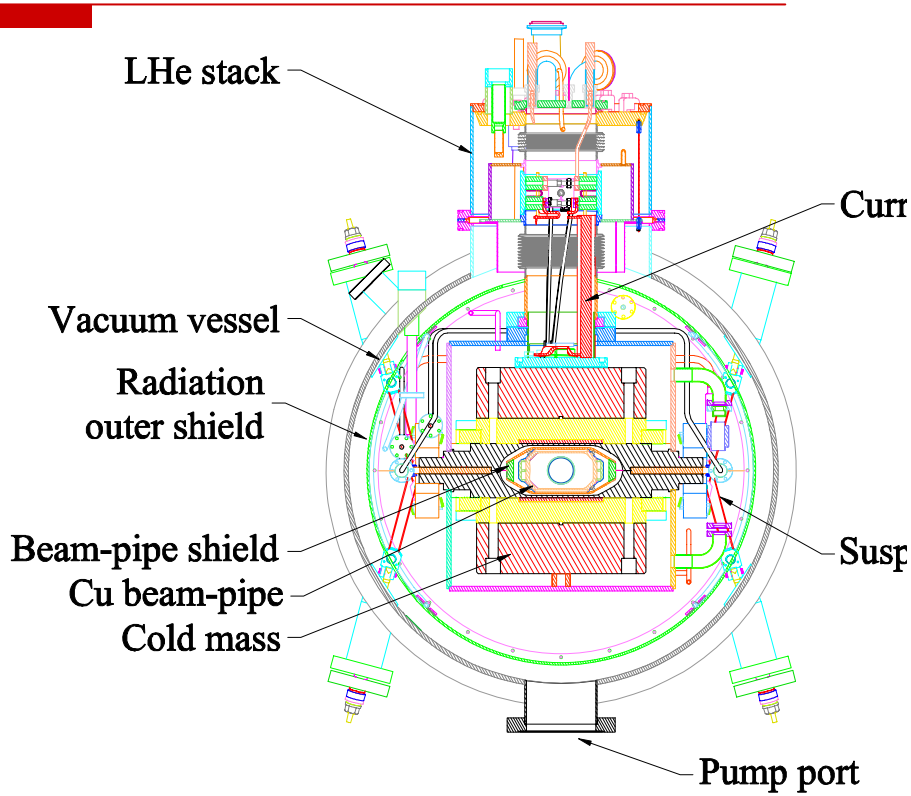
- Mark Palmer has led the compilation of magnet specifications based on the March version of the lattice.
  - **https://wiki.lepp.cornell.edu/ilc/pub/Public/DampingRings/MagDocs/OCS2_Magnet_Summary.xls**
- Several specification sheets are available in the repository.
- There are cost estimates based on experience with similar magnets (IHEP, LBNL, Cornell):
  - **Power supplies**
  - **Magnets**

Wiggler

- Superconducting wiggler will be based on CESR-c design.
- Work is being done (by Jeremy Urban, Cornell) on design optimization for reduced cost.
- Final specifications and costing will be done by Cornell (Mark Palmer and Jeremy Urban).
- Present estimate is based on existing CESR-c wiggler

Vacuum Chamber

- CESR-c Design:
  - CESR chamber integral to cryostat assembly
  - Cold mass bore has 17 cm horizontal aperture
  - 2.5 kW/wiggler
- ILCDR Requirements:
  - 21 (e^+) or 42 (e^-) kW/wiggler
  - 10 wigglers/60 m section

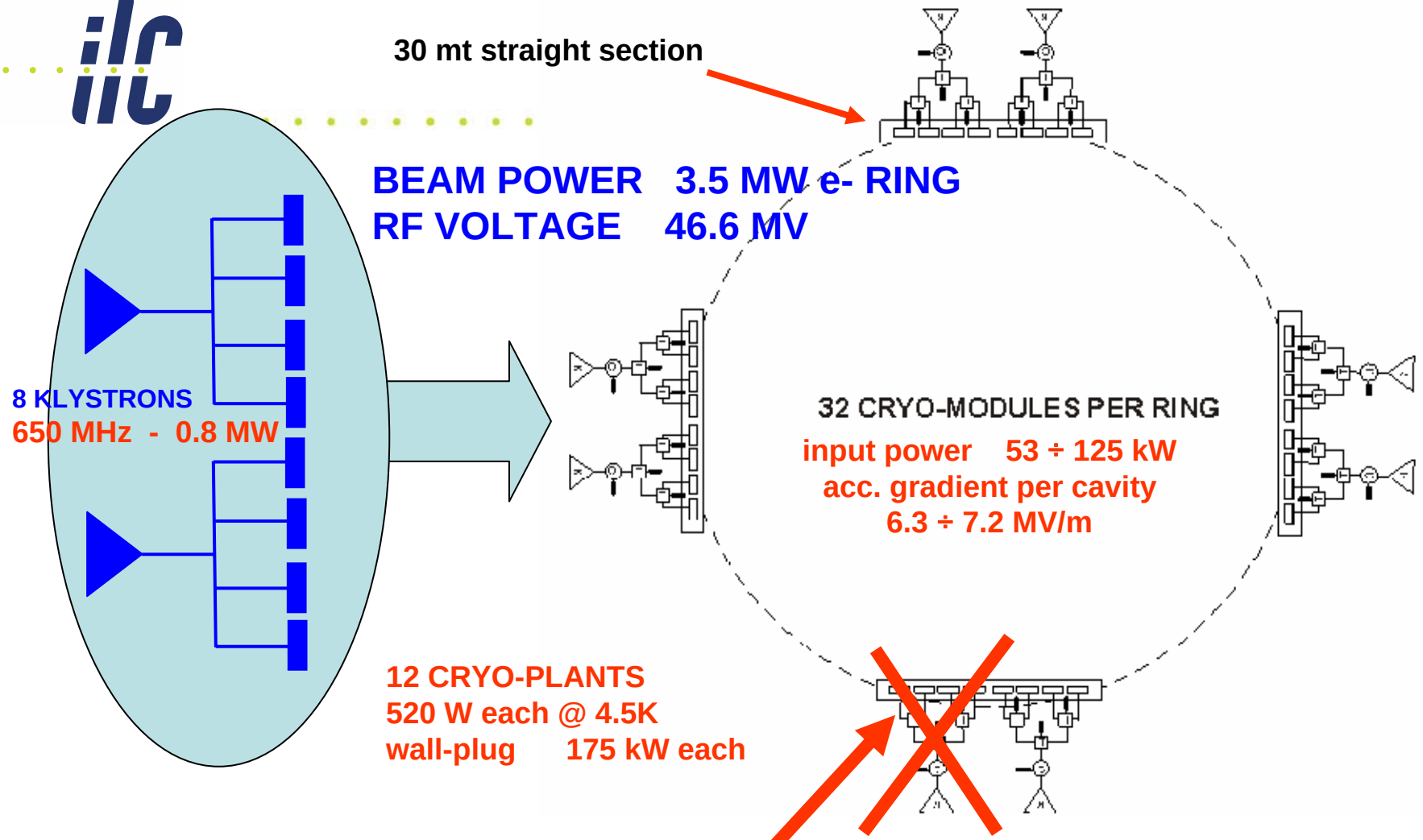


- RDR plan
  - Separated vacuum chamber compatible with present cold bore [Steve Marks,Dave Plate]

RF System and Fast Feedback Systems

- RF system has been specified by Roberto Boni (LNF).
  - **Component Specification Sheets for RF system components have been posted in the repository**
  - **Costing has been done**
  - **Does not include 650 MHz R&D and test facility**

- Fast feedback systems have been specified and costed by Alessandro Drago (LNF).
  - **Component Specification Sheets are posted in the repository**
  - **Costing has been done**



The system is powerful enough to meet the specifications in case of one RF station fault

Vacuum System

- Vacuum system is being dealt with in two parts:
- Arcs and straight sections:
  - **Relatively conventional: low radiation power loads, wide apertures.**
  - **Work is being done by Oleg Malyshev and Ron Reid (ASTeC, Daresbury).**
  - **Specifications and Cost estimate are based on scaling from existing machines.**
- Wiggler section:
  - **Rather more challenging: very high radiation power loads, tight aperture restrictions.**
  - **Cost estimate is based on a technical design developed in more detail than for the arcs and straights.**
  - **Work is being done by Steve Marks and David Plate (LBNL)**

Vacuum System and Electron Cloud

- Electron cloud studies are being pursued by several groups internationally
- Recent studies by Mauro Pivi and Lanfa Wang (SLAC) suggest that clearing electrodes could be an effective way to suppress the electron cloud, and may allow use of a single 6 km positron damping ring (rather than a pair of 6 km rings)
- Studies of clearing electrodes for suppression of electron cloud are still in a very early stage
  Nevertheless, we plan to discuss at VLCW06 whether to submit a configuration change proposal to the CCB

Conventional Facilities and Siting

- Designs and (preliminary) cost estimates for tunnel are already available from Tom Lackowski (FNAL)
  - **Component Specification Sheets are posted in the repository**
- Specifications/designs for the access shafts are being developed by Jean-Luc Baldy (CERN)
- Power and cooling requirements are being handled by Emil Huedem (FNAL)
  - **Preliminary estimates for power/cooling requirements for RF system, magnets and radiation have been provided**

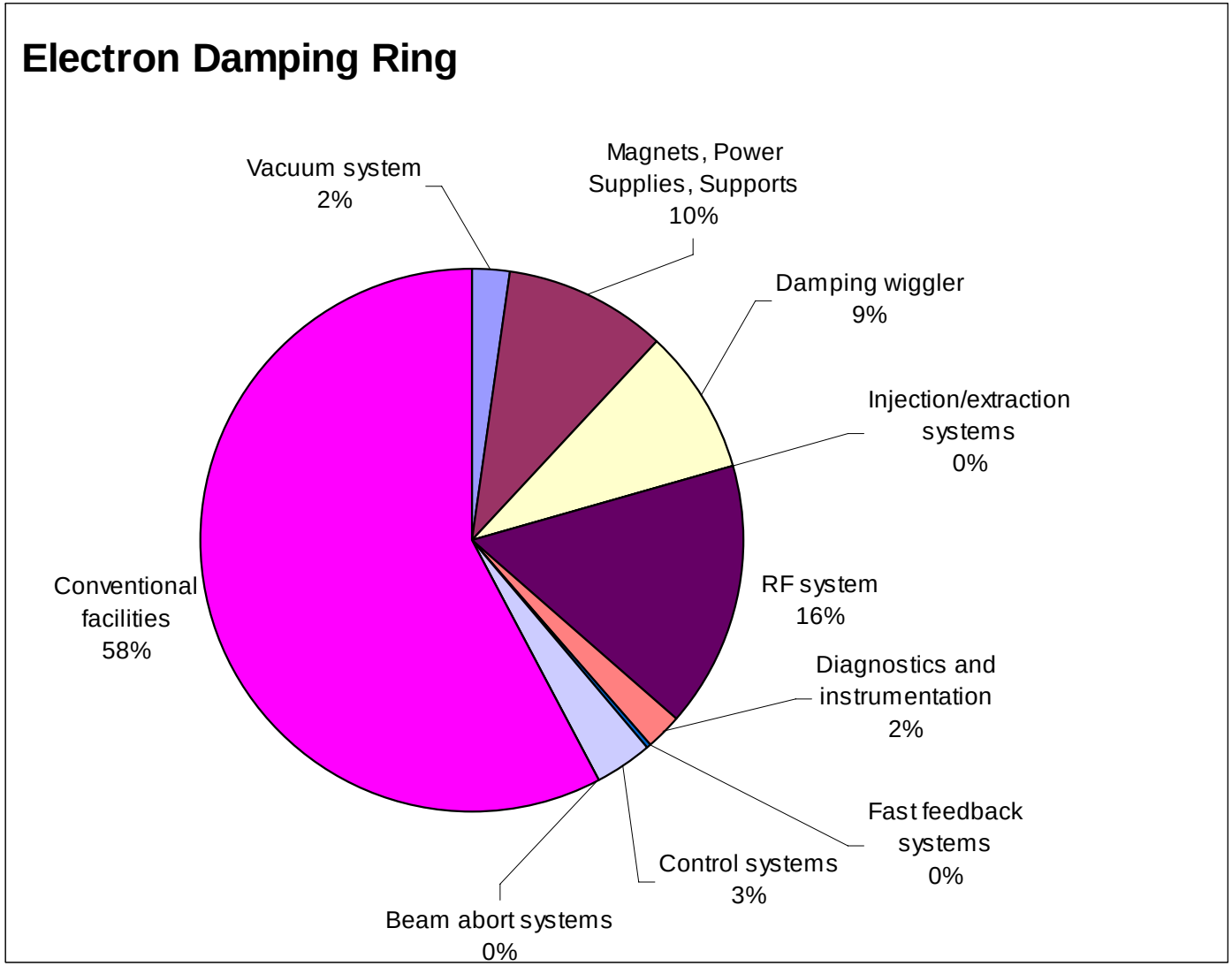
Injection/Extraction Systems

- Specifications and design issues for the injection/extraction kicker systems are being developed (Tom Mattison et al).
  - **Various groups are actively involved in kicker R&D**
  - **Cost estimates could be based on FID pulsers Continued R&D may provide better solutions**
  - **Stripline cost could be estimated from LNF kickers (scaling for the length from 68 to 30 cm)**
- Beamline design is in progress for the injection/extraction lines (Ina Reichel, LBNL).
  - **Layout and geometry requirements have been discussed with Conventional Facilities and Siting**
  - **Optics designs are being developed to match present constraints**

Other Areas

- Diagnostics and Instrumentation
  - **A list of the required items has been compiled**
  - **Main cost driver is the bpms that are a large number**
  - **Costing has been done**
- Controls
  - **A list of the components and the controls required for each component has been prepared**
  - **Cost has been evaluated**
- A 45 kJ dump is specified for occasional beam aborts (not full power).
  - **A possible location in the lattice has been identified.**
  - **No optics work has been done yet, but there have been discussions**
  - **Kicker design being developed**

Cost Distribution



Major Cost Drivers

- Conventional facilities 58%
  - **4 major alcove with 9 m access shafts**
  - **Tunnel diameter 4 m**
- RF system 16%
  - **High α_c to reduce longitudinal instabilities**
  - **Full current operation with one klystron station off**
- Magnets 10%
- Wigglers 9% (preliminary estimate)

Cost Roll-Up Status

- Items costed
  - **Conventional facilities**
  - **RF system**
  - **Magnets and power supply**
  - **Controls**
  - **Diagnostics and Instrumentation**
  - **Fast feedback systems**
- Items partially costed
  - **Wigglers**
  - **Vacuum systems**
- still missing
  - **Injection/Extraction systems**
  - **Beam dump and abort line**

Possibilities for Cost Reductions

- A major cost reduction would be to eliminate the second ring for positrons (20%)
  - **There is a proposal of using clearing electrodes to reduce e-cloud density in the e+ ring in order to allow the same bunch distance as in the e- ring**
  - **R&D on the clearing electrodes is in progress**
  - **The DR parallel session on Friday (SUB 207, 8:30 ÷10:00) will be dedicated to this issue**
- Possible RF system cost reduction
  - **Reduce momentum compaction and RF voltage (< 9%)**
    - Risk for the longitudinal instability
    - Task force on evaluation of vacuum chamber impedance and longitudinal instabilities
    - Study 3rd harmonic RF system to reduce bunch length
  - **Do not require full current operation with one RF station off**
    - Risk for Operation and availability to be evaluated

Towards the TDR

- The organization set up for RDR will evolve towards TDR
- More resources will be needed for some issues
- On Thursday afternoon Damping Ring session (SUB 212A, 13:30÷18:00) we will discuss plans for the completion of the RDR and start up of the TDR
- In the Friday DR session (SUB 207, 10:30÷12:30) we will discuss on R&D plans and schedule
- We expect to have the information required for the RDR for the Valencia workshop