



# Plan for Development of a Fast High-Power Pulser and ILC DR Injection/Extraction Kicker

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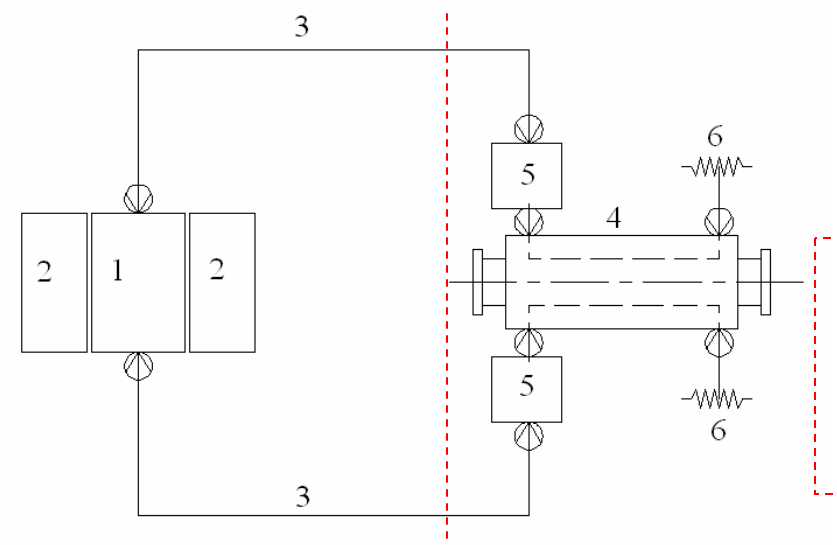
# Plan for Development of a Fast High-Power Pulser

# R&D Plan for ILC DR Pulser

I see several scenarios for the ILC DR pulser development. Let us assume that the DESY (Behlke based) and/or LLNL/SLAC (induction stack based) pulser will demonstrate ±5 kV, 3 MHz reliable pulse train with FWHM ~10 nsec (i.e. longer than we would like to use for the DR kicker). There could be a configuration where the DSRD-based topology is integrated with the DESY or LLNL pulser as shown in the following diagram.

Many alternative booster configurations are possible if the DESY or LLNL devices are not available.




1 – Induction Stack (or the other booster)

2 – Pulsers

3 – Coaxial Feeders

4 – Kicker

5 – DSRD-Based Pulse Forming Network

6 – Load

Placed in the DR tunnel

# R&D Plan for ILC DR Pulser (cont.)

- Objective is to demonstrate the DSRD advantages (features) and to develop a full 3MHz prototype
- Items for study:

1. Self-matching topology with the DSRD
2. Classical topology with the DSRD and HOM filters

# R&D Plan for ILC DR Pulser (cont.)

3. Alternative booster topologies

   ( inductive stack and pulse power supply comprises a lot of electronic components and ferromagnetic media; is there a simpler alternative?)

4. Design and manufacture of the HV broadband instrumentation

   ( design a broadband resistor dividers or HV broadband couplers; etc. )

# R&D Plan for ILC DR Pulser (cont.)

5. Design and manufacture of the optimal DSRDevice for ILC DR pulser

   (All electronic components for the pulser system, including the DSRD structure, must be from USA, European, and Japanese sources)

6. System design: to integrate the pulser and feeders into DR according to the fill patterns

# R&D Plan for ILC DR Pulser (cont.)

## Present Organization of DSRD-based Activities

The DSRD-based activity is mainly carried out under Phase I SBIR DOE Grant No. DE-FG02-06ER84459 (Diversified Technologies, Inc.). There is hope that this activity will be supported by a DoE Phase II in the future. The initial DSRD experiments were performed at SLAC and reviewed at DTI.

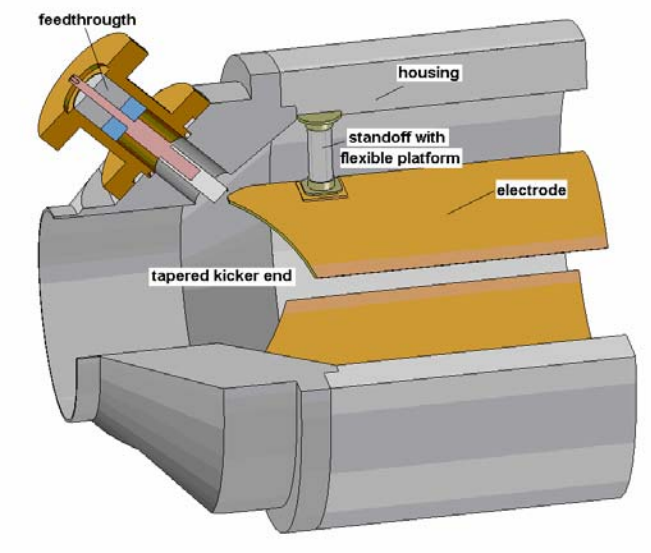
DTI (Bedford, MA) will investigate two approaches for the development and demonstration of solid-state kicker pulsers for the ILC DR: the first will use commercially available MOSFETs, and the second will employ DSRD technology. Dr. Arntz Floyd is PI.

Two physicist (Dr. Kardo-Sysoev and Dr. Krasnykh) are consultants to DTI.

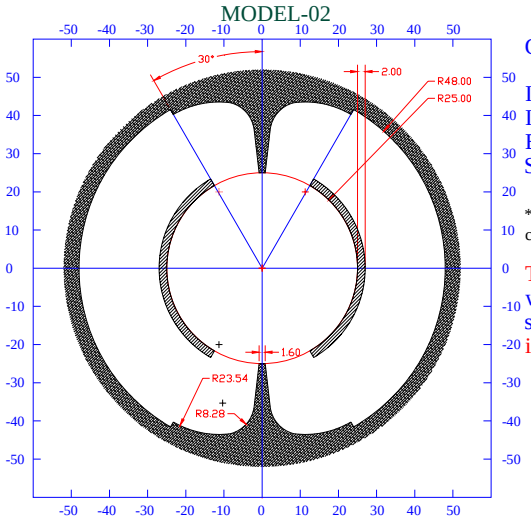
VMI (Visalia, CA) is working with Dr. Kardo-Sysoev to develop the required solid state (DSRD) structure

# Plan for the ILC DR Injection/Extraction Kicker

# R&D Plan for the ILC DR Kicker




Proposed Cross Section for the ILC DR Kicker




Geometry:

Inner Housing Diameter is 96 mm *)
Inner Electrode Diameter is 50 mm
Electrode Thickness is 2 mm
Swept Electrode Angle is 120 Deg

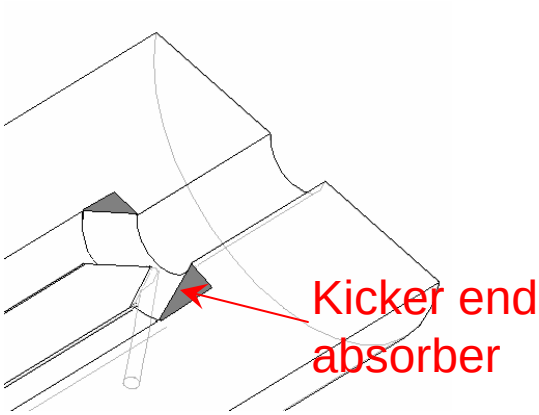
*) Standard tube OD=4" with wall thickness 0.125" could be used for a mockup

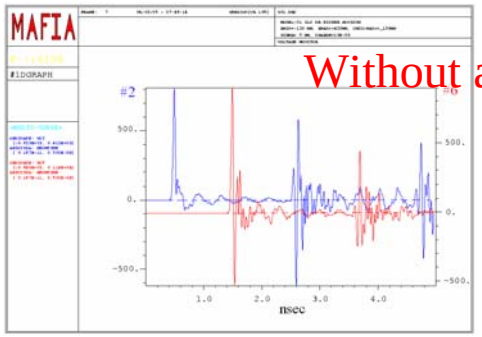
Two Ground Fenders with the 60 Deg swept angle and shaped such a way that the differential impedance does not change

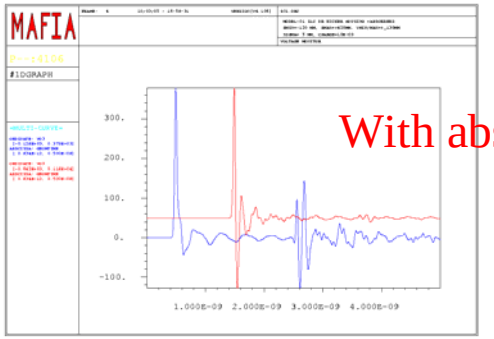
Major proposed kicker components are:

- a regular kicker part,
- two matched tapered regions,
- grounded fenders,
- constant impedance feedthrough

# R&D Plan for the ILC DR Kicker (cont.)




Preliminary kicker structure simulation shows that HOM power may be effectively suppressed by placing absorbers in the kicker end

# R&D Plan for the ILC DR Kicker (cont.)

## Subjects for R&D studies are:

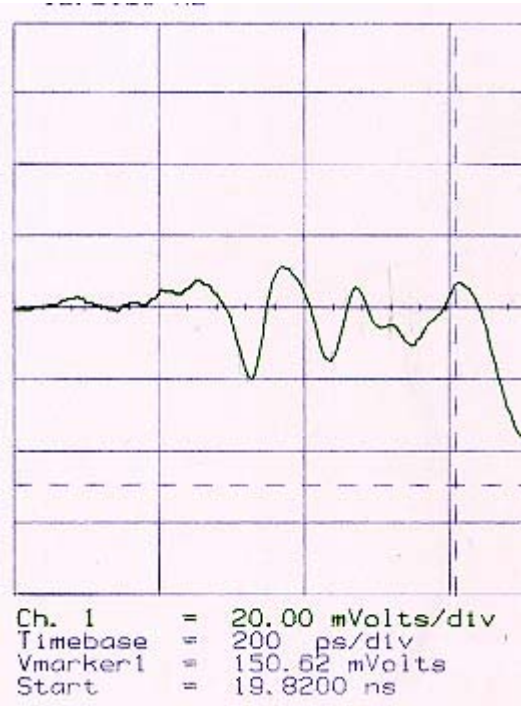
1. Let us assume that the proposed cross section of the regular part of the kicker is acceptable. A field distribution with ~5% homogeneity in the 10 mm x 10 mm aperture has been obtained. This result was obtained for the kicker structure without ground fenders. The item for study: what is the field distribution in the kicker structure with ground fenders?
2. Two tapered kicker ends will increase the axial length of the kicker. Actually the axial kicker length should be as short as possible. The next item is a question: what would be a minimal length for the transition part of the kicker structure?
3. Ground fenders improve the matching between Odd and Even modes. How much is the beam impedance reduced with the ground fenders? I would like to compare two models and to optimize the fender shape.

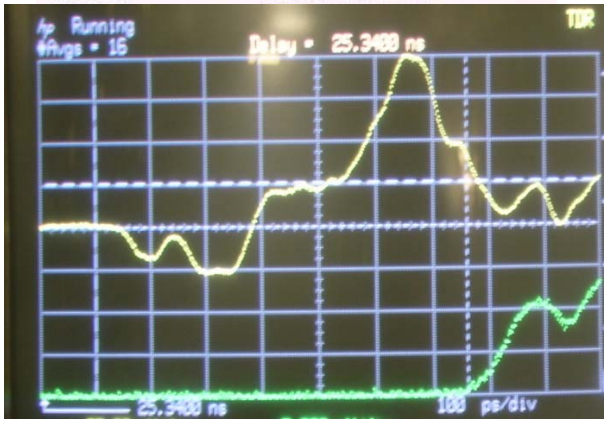
# R&D Plan for the ILC DR Kicker (cont.)

## Subjects for R&D studies are:

4. What is the specification for the HOM power absorbers (resistivity, optimal geometry, power loading, etc.)?
5. The surface of the kicker electrodes are often blacked to improve the heat emissivity. On the other hand, to minimize HOM dissipation, the electrodes must be made from a high conductive material. What is better to black or not to black the kicker electrodes? Is there any optimum for the black thickness?
6. Several DR fill pattern scenarios are discussed. Analyze of dissipated HOM power and energy balance for different fill patterns are necessary.
7. Thermal design of the kicker structure

# R&D Plan for the ILC DR Kicker (cont.)




## Subjects for R&D studies are:

8. The HV feedthrough is an important part of the kicker. We are not aware of feedthroughs with bandwidths sufficient for ILC DR kicker. For example, the pictures show the TDR results for the TFB PEP-II and KEK ATF DR kickers. The broadband impedance perturbation in the feedthrough region is ~10 Ohm. As a result, there are reflections when HOM power propagates thorough.

Design and manufacture of the necessary feedthroughs are needed.

# R&D Plan for the ILC DR Kicker (cont.)

## Subjects for R&D studies are:

9. Once a prototype kicker is available, it would be interesting to study the structure with beam; to measure a short and broadband beam impedance: frequency and time domain measurements. We are not aware of any experimental data relevant to this issue.

10. We recommend study of the behavior of the kicker structure for multi bunch operation mode. The preliminary simulations shows that kickers will introduce the longitudinal momentum into the bunch train. Of course, this momentum may be compensated by the longitudinal feedback system. The question is how much is this longitudinal momentum and its time structure?

# R&D Plan for the ILC DR Kicker (cont.)

The proposed sequence and the thoroughness of the work will depend upon the time and financial recourses that available for these studies.

The preliminary kicker design was developed under internal funding from the SLAC Klystron & Microwave Dept. The time and financial resources have been provided mostly by this department. Alternative funding will be required to continue this work to meet future goals. Furthermore the pursuit of this activity at SLAC deserves to be formalized

# Acknowledgements


- Work is supported partly by Department of Energy contracts DE–AC02–76SF00515
- The author thanks Dr. C. Burkhart for making this presentation on his behalf to the ILC DR Kicker working group

- We would welcome comments and suggestions from the participants (krasnykh@slac.stanford.edu)