Optical Matching Device

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Positron source collaboration meeting

Daresbury

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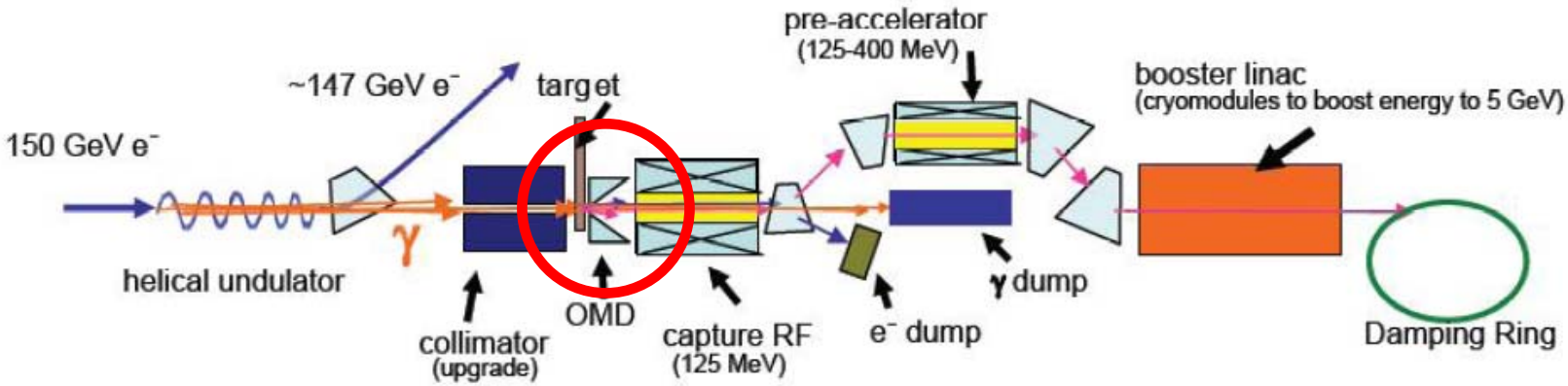
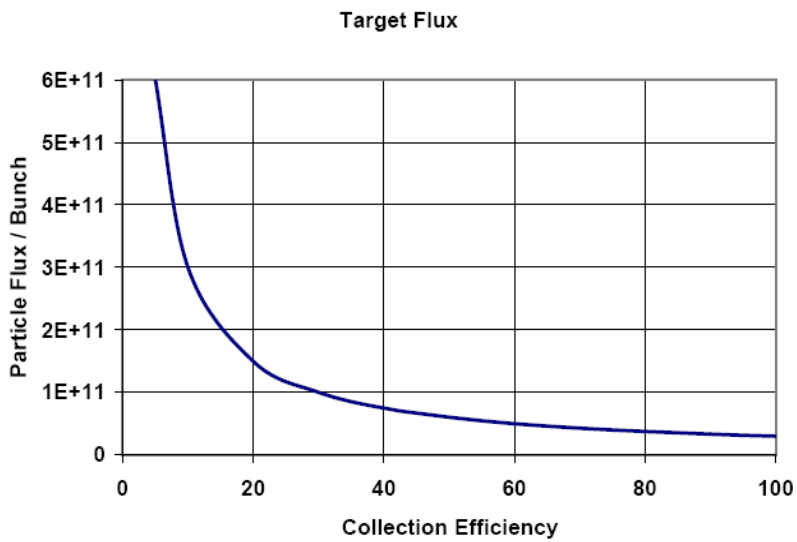
Optical Matching Device



- What is it?
  - **Point to parallel magnetic focusing optic after the target**
- Why is it important?
  - **Improves capture efficiency reduces photon flux required**
    - Shorter wiggler
    - Lower heat load in target
    - Smaller dumps
    - Less radiation



A number of options have been considered

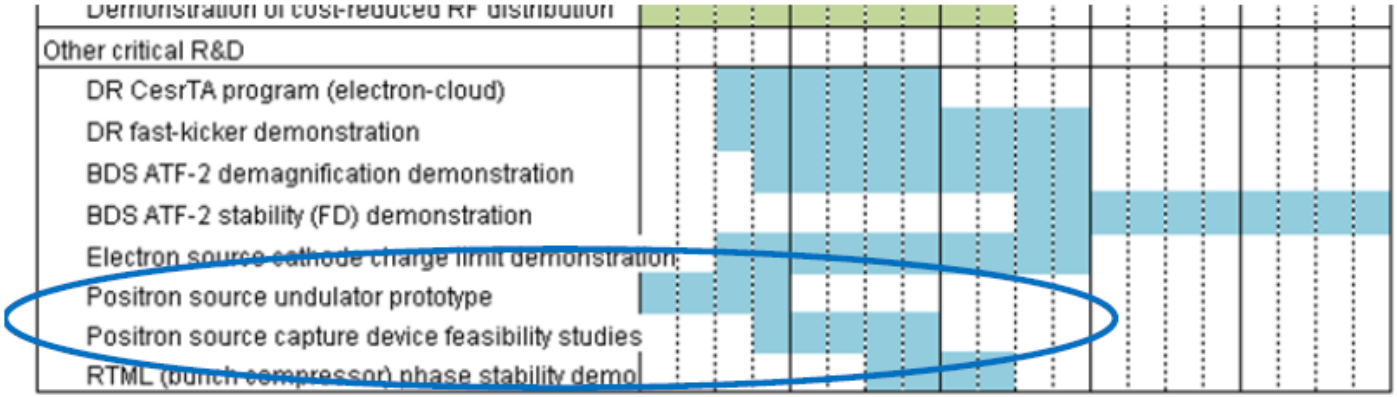
- The capture efficiency for the options have been simulated by SLAC/ANL/Cornell
  - **Capture efficiency varies between 10% and 30%**
- What are the options?
  - **Nothing**
  - **¼ wave solenoid**
  - **Pulsed flux concentrator**
  - **Immersed SC solenoid**
  - **Lithium lens**

OMD		Capture efficiency
Immersed target (6T-0.5T in 20 cm)	**Eddy current show-stopper**	~30%
Non-immersed target (0-6T in 2cm, 6T-0.5T 20cm)	**RDR baseline**	~21%
Quarter wave transformer (1T, 2cm)	**Proposed new baseline**	~15%
0.5T Back ground solenoid only		~10%
Lithium lens		~29% **(~40%*)**

W. Liu

*** K=0.36 undulator**

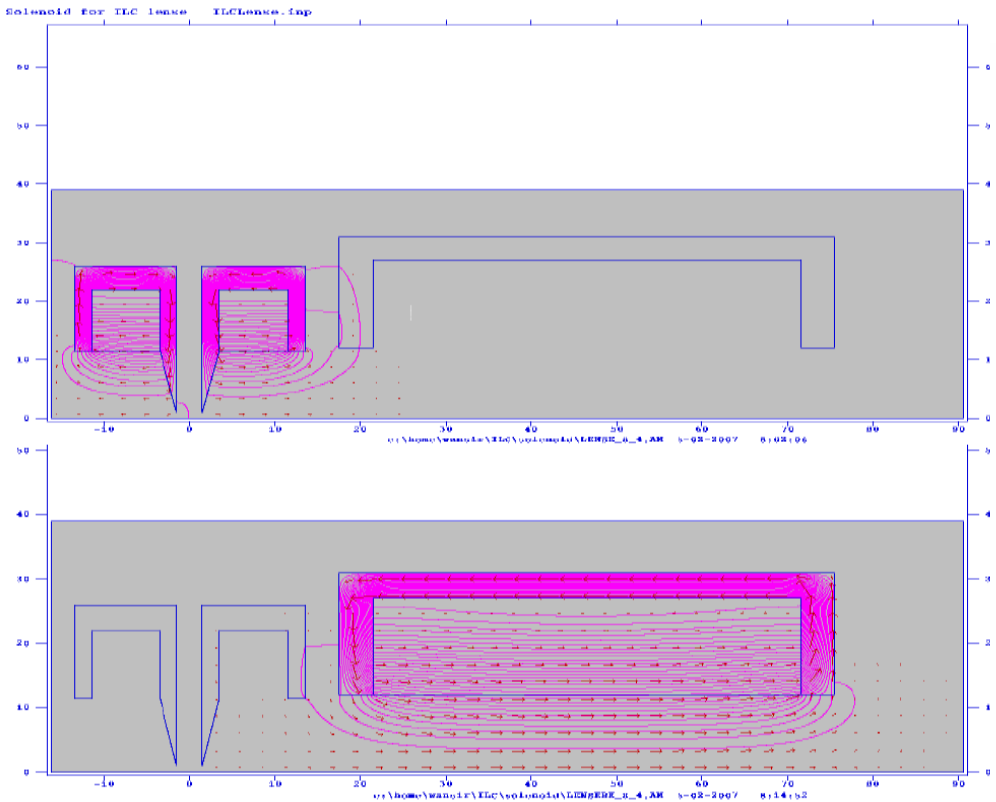
Technical Design Phase 1 R&D

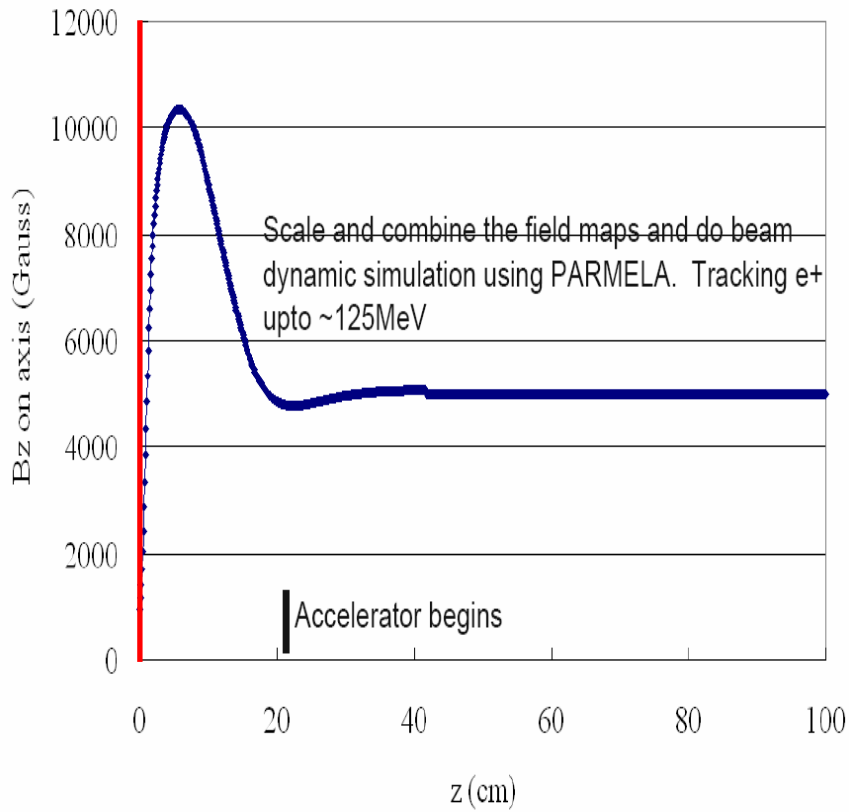


Walker

- ¼ wave solenoid
  - **Achievable**
  - **Need to quantify fringe field interaction with target**
- Lithium lens
  - **Specific design, Mikhailichenko CBN 08-1**
  - **Beam survivability issues need to be quantified**
- Flux concentrator
  - **Needs engineering studies and design**

Quarter Wave Transform



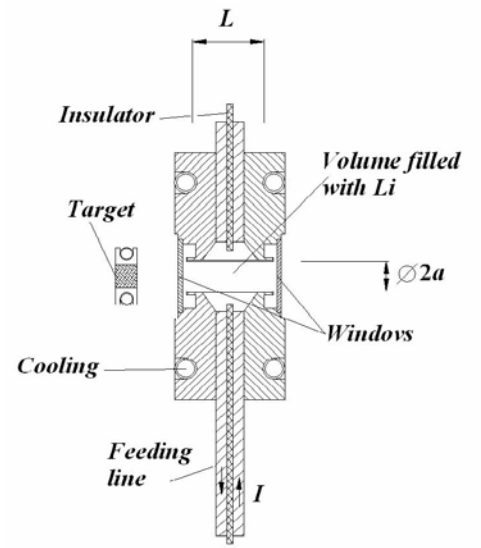


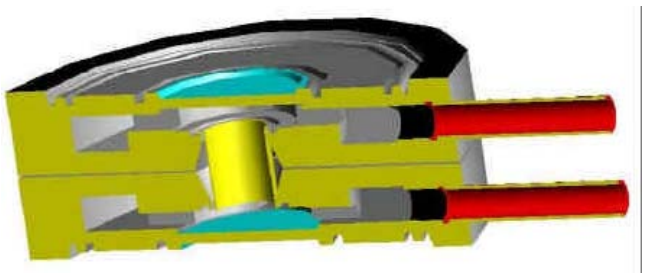
W. Liu

- Low magnetic field at target
- Lower capture efficiency, 15%

- Not an exotic device
- Needs magnet expert to make a design

Detailed Lithium lens design exists

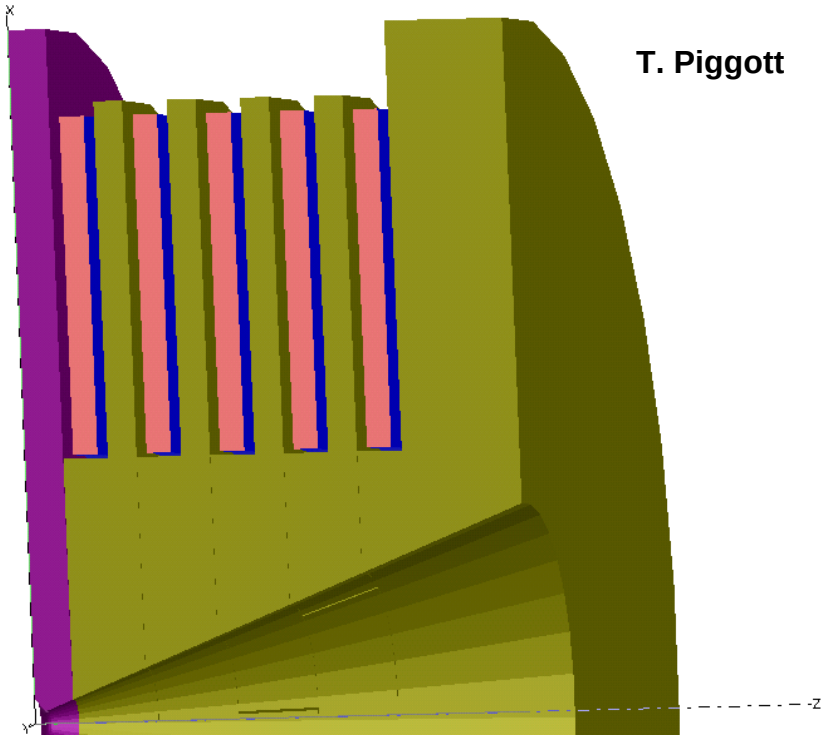




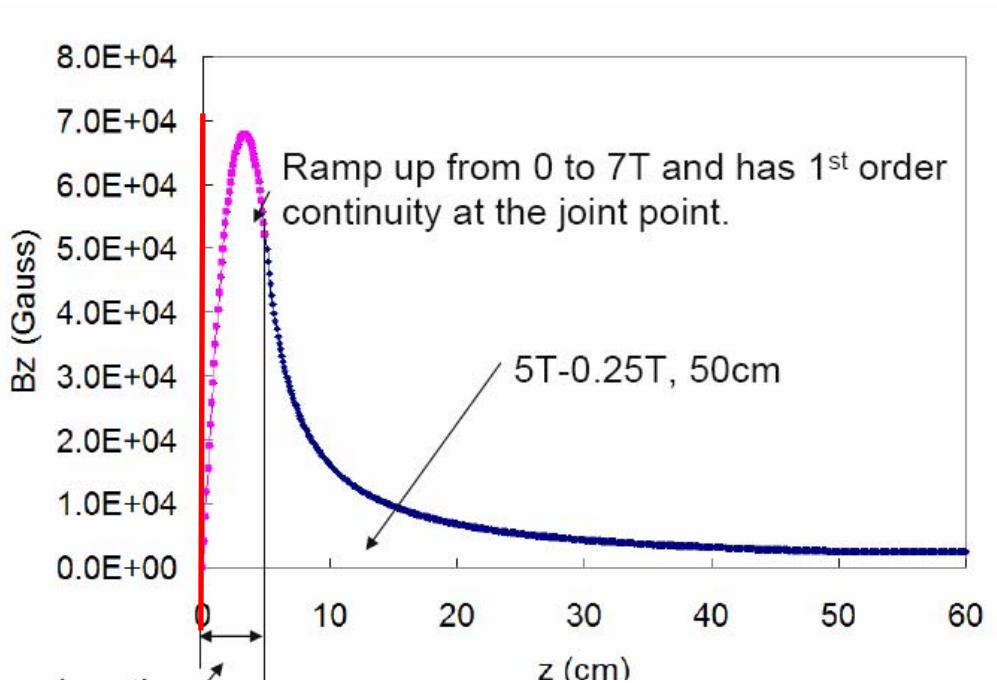
Mikhailichenko CBN 08-1

- Most mature OMD design we have
- Some engineering questions related to survivability:
  - **What is the radiation damage in the windows from photo-nuclear reactions?**
  - **What is the stress-strain in the windows from heating?**
  - **Does thermal cycling cause fatigue?**
  - **Is there cavitation in the liquid metal?**
    - If yes, will this erode the windows?

Pulsed Flux Concentrator



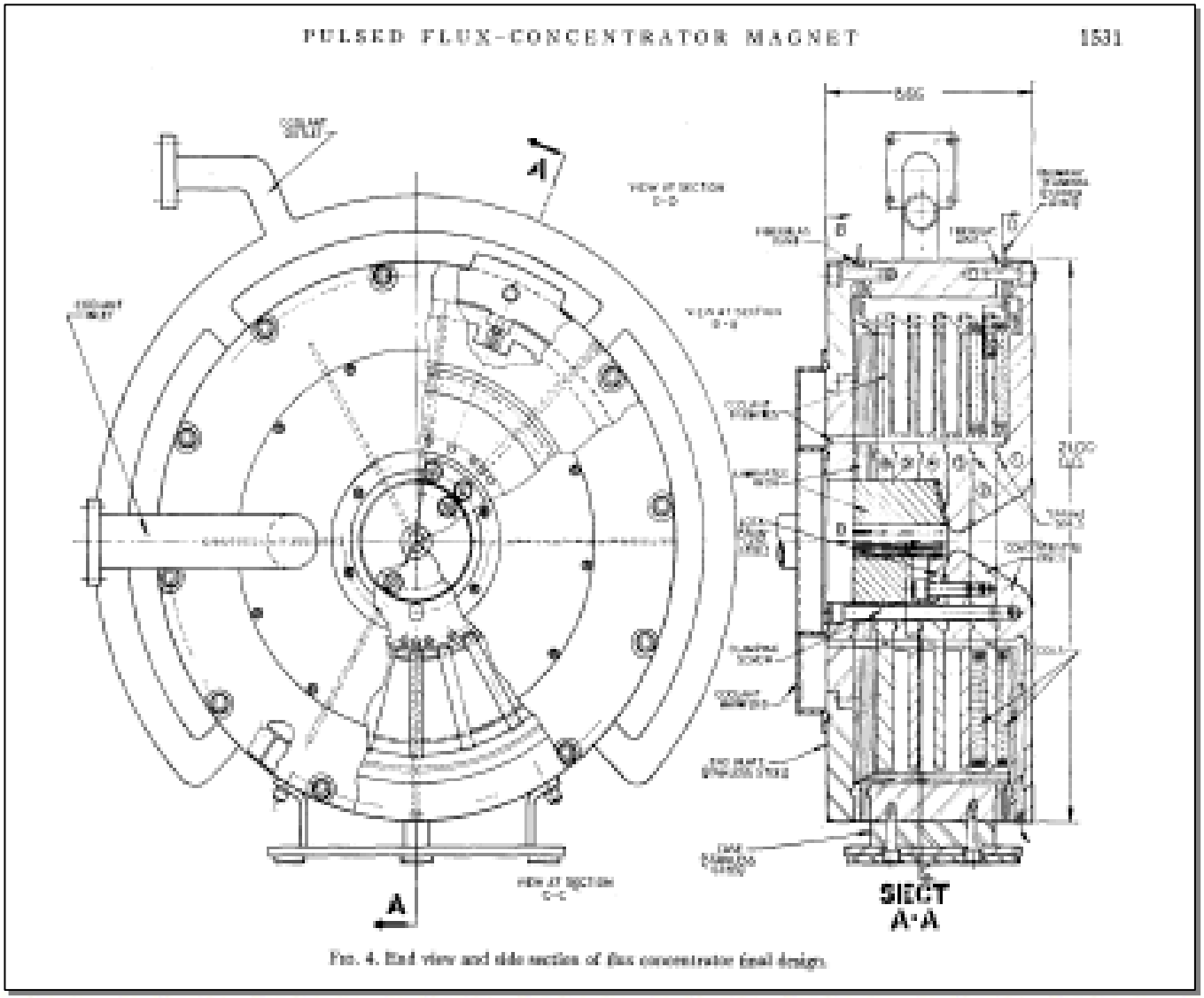
T. Piggott



W. Liu

- Reduces magnetic field at the target
  - **Reduced capture efficiency, 21%**
- Pulsed flux concentrator used for SLC positron target
  - **It is a large extrapolation from SLC to ILC**
  - **1μs -> 1ms pulse length**

Similar devices have been created before



- Brechna, et al.
  - **1965**
  - **Hyperon experiment**
- Very preliminary ANL and LLNL simulations do not indicate showstoppers
- No one has stepped up to claim this is “doable”

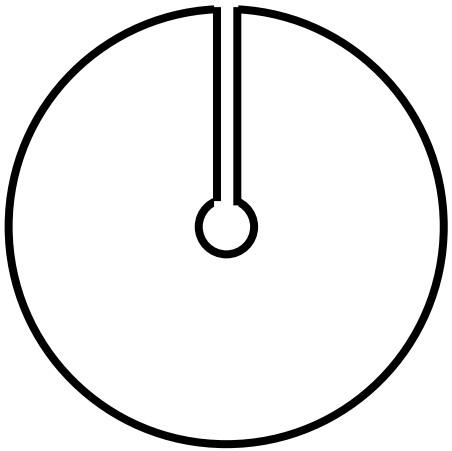
ILC parameters are close to Brechna

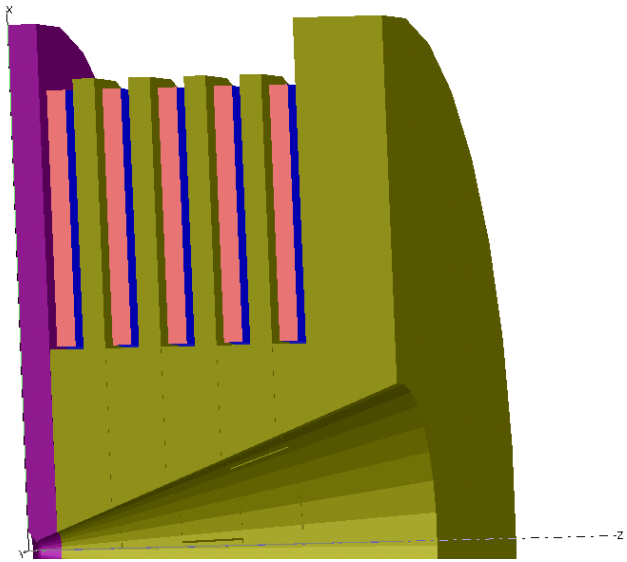
Parameter	Brechna	ILC	Units
Field Strength	10	7	T
Pulse Length	40	1	ms
Repetition Rate	1/3	5	Hz

J. Sheppard

- Extrapolation from Brechna to ILC is not large
  - **Lower field**
  - **Lower pulse length**
  - **Pulse length x repetition rate is similar**
- Requires significant design and prototyping effort

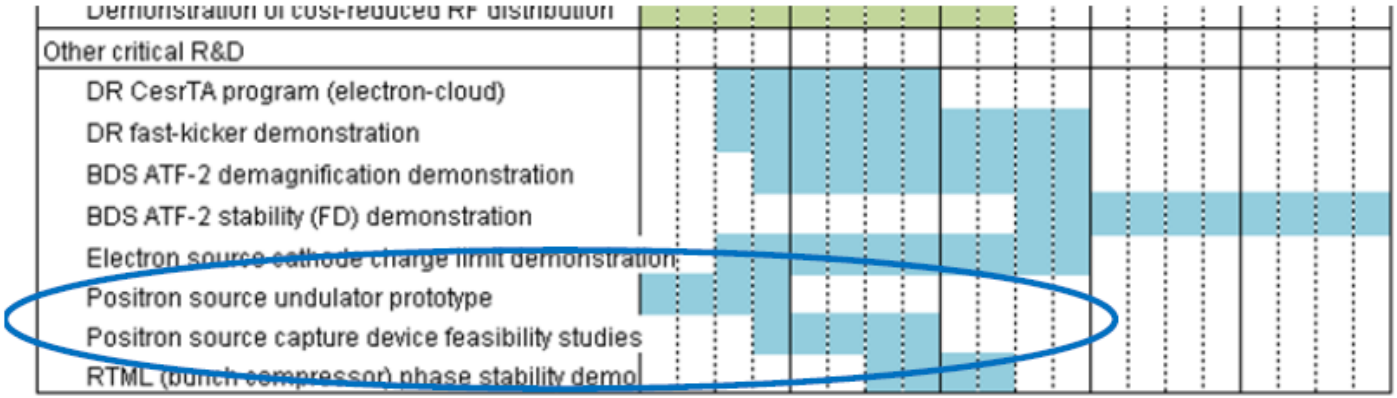
Proposed flux concentrator studies in 2009 at LLNL





- Simulation studies
  - **Currents, heating and interactions**
  - **Cooling of the plates**
  - **Forces and shocks**
  - **Specify the drive current necessary for the device**
- Straw man design of an inductive modulator to drive the device and maintain a constant field for the 1ms pulse

Phase 1 decision schedule



Walker

- Goal is to have R&D questions on the OMD answered by end calendar 2009 so that downselect can occur?
- New baseline in 2010?