Optical Matching Device

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Positron source collaboration meeting

DESY / Zeuthen

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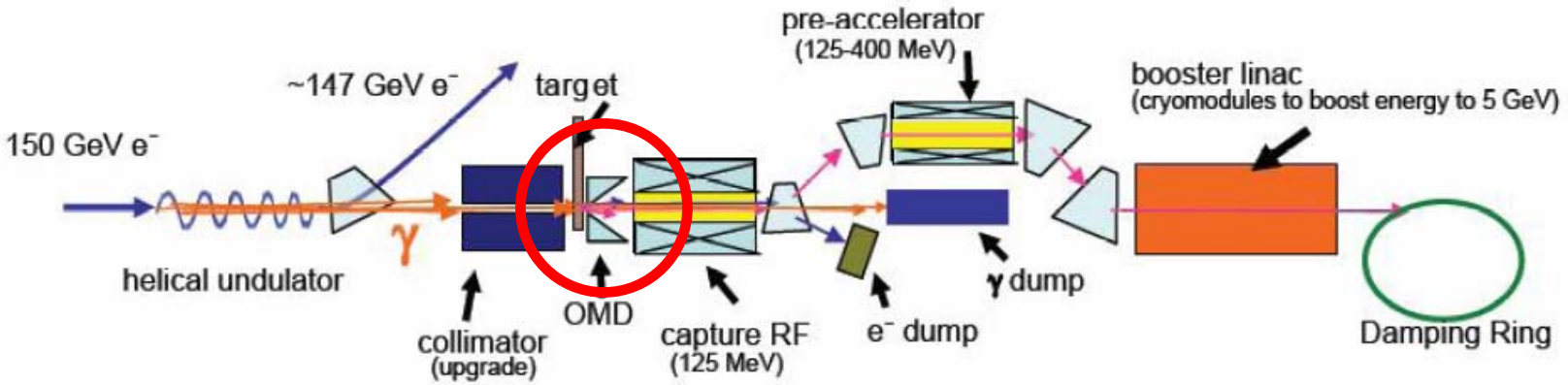
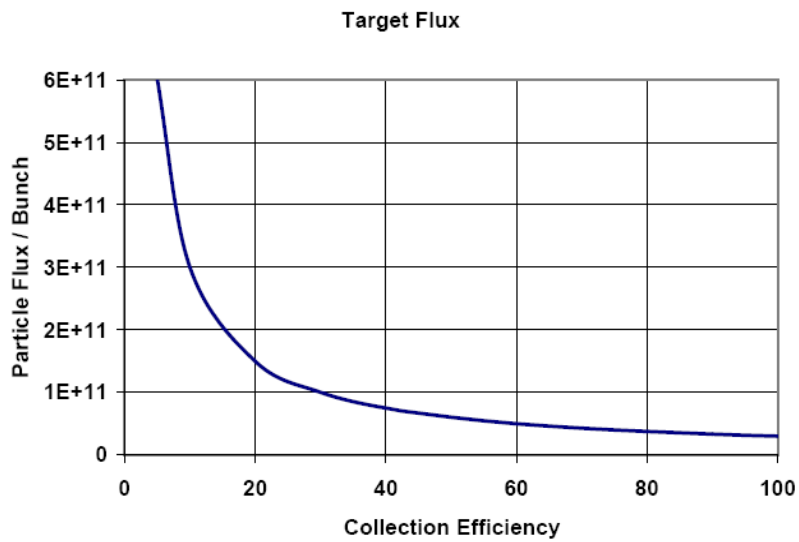
Optical Matching Device



- 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 EDR baseline**	~15%
0.5T Back ground solenoid only		~10%
Lithium lens		~29% **(~40%*)**

W. Liu

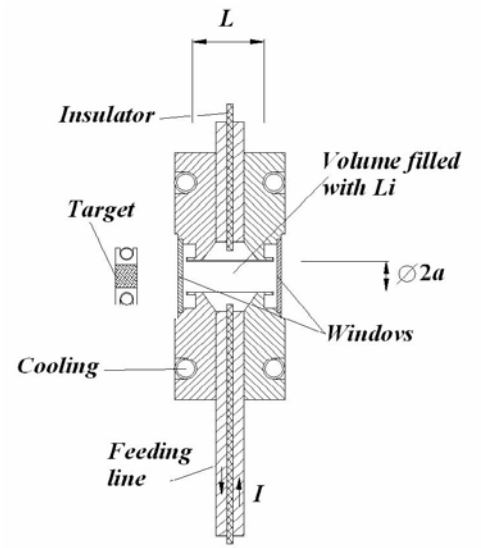
*** K=0.36 undulator**

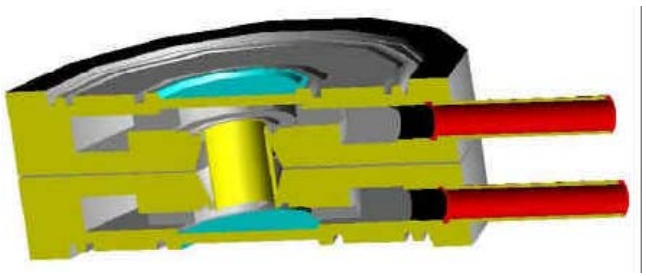
Planned work for this year

- Mikhailichenko to submit report on Lithium lens design
  - **Submitted, CBN 08-1**

- Conceptual design of ¼ wave solenoid
- Flux concentrator engineering
  - **No funding**

Detailed Lithium lens design exists

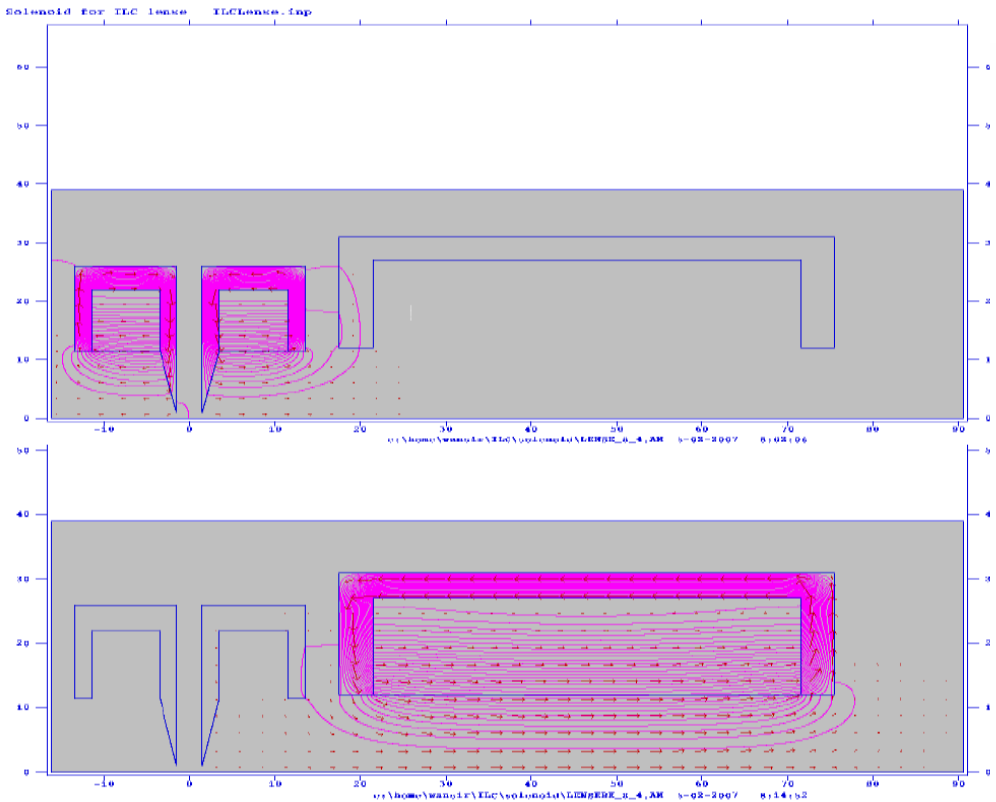


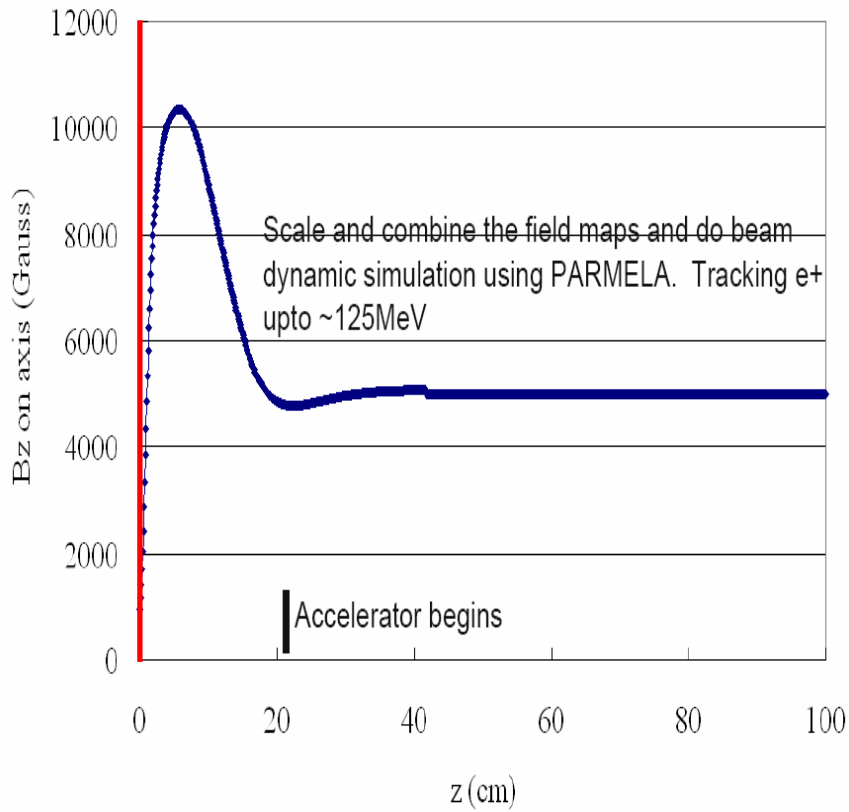


Mikhailichenko CBN 08-1

- 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?

Quarter Wave Transform



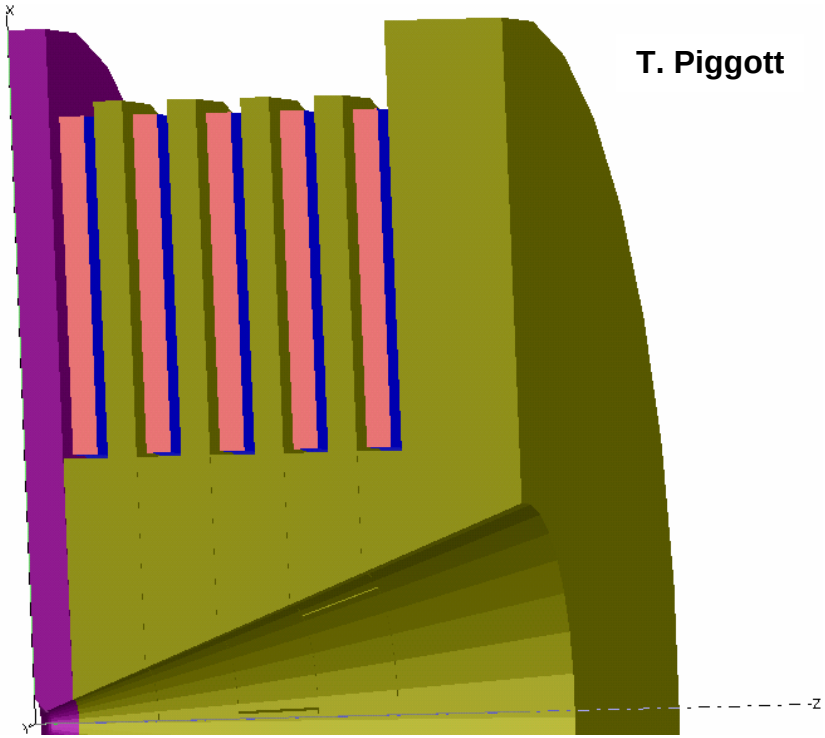


W. Liu

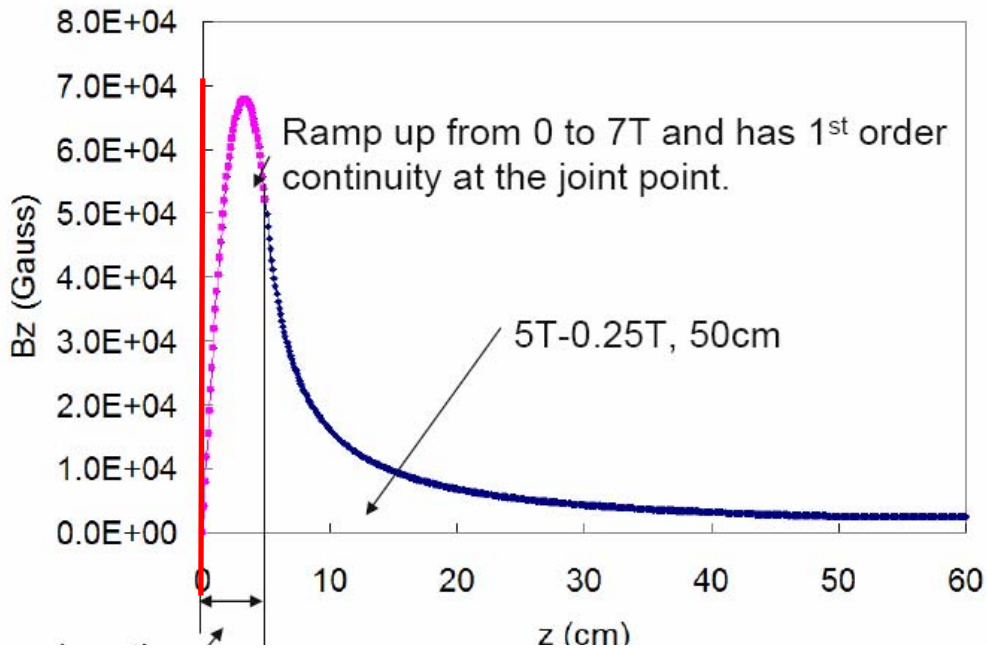
- Low magnetic field at target
- Lower capture efficiency, 15%

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

Pulsed Flux Concentrator



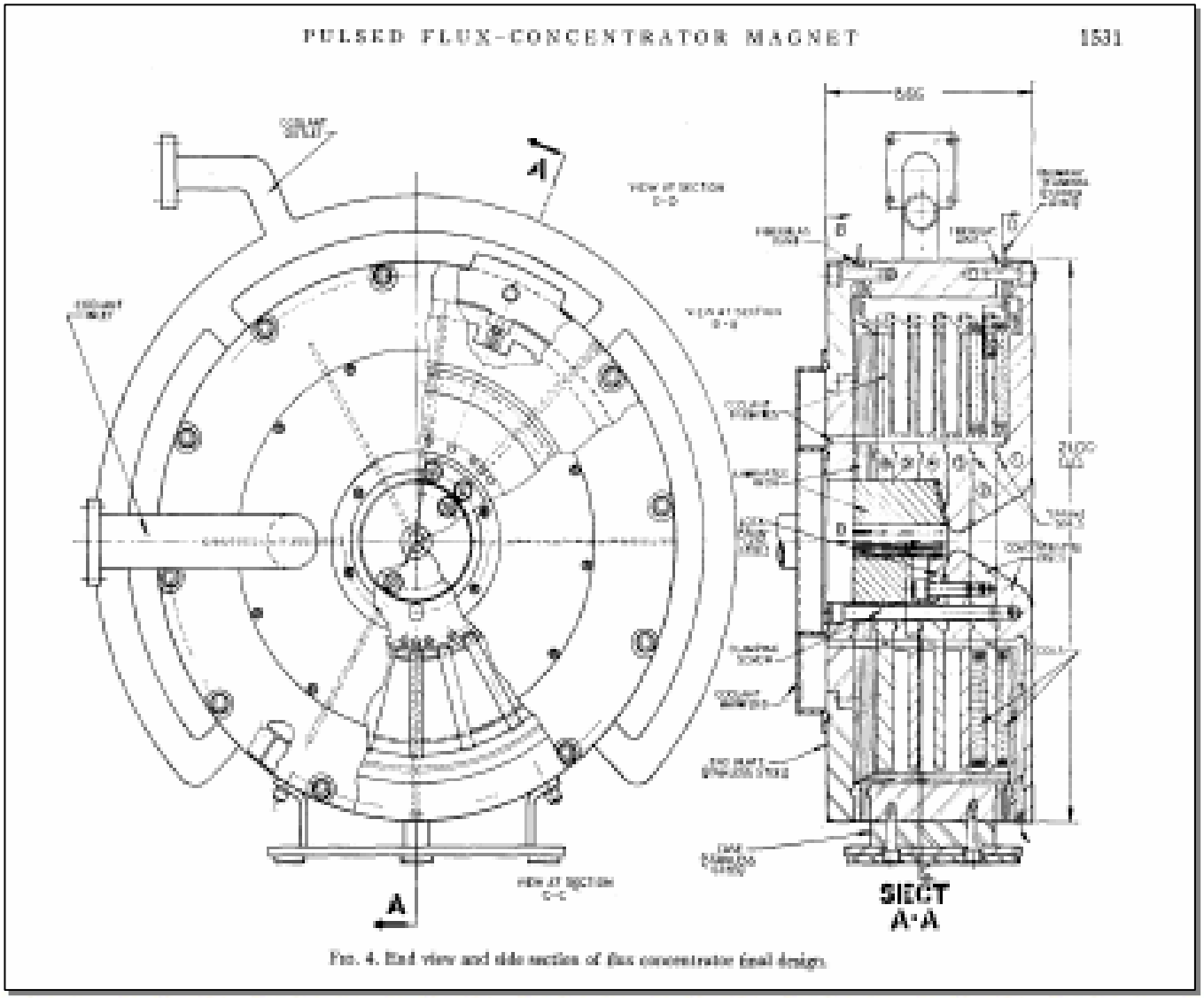
T. Piggott



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

Status

- We want as much capture efficiency as is realistically possible
  - **Cost reduction in the undulator**
  - **Reduced radiation backgrounds**

- High field at the target seems ruled out
  - **Some work on non-conductive materials has been done**
- Flux concentrator seems to be a challenging engineering problem
- The ¼ wave solenoid seems realizable and appropriate for the baseline

- Lithium lens detailed design exists
  - **Some work on survivability in the beam remains**