Capture Linac Solenoids

Jim Clarke
ASTeC & Cockcroft Institute
Daresbury Laboratory

ILC Positron Source Collaboration Meeting
29 – 31 October 2008
The Cockcroft Institute, Daresbury Laboratory

Linac Capture Solenoids

- Present RDR design has 0.5T solenoids along the length of the NC linacs after the positron target
- Modelling has suggested that higher solenoidal magnetic fields along the linacs would increase the positron capture

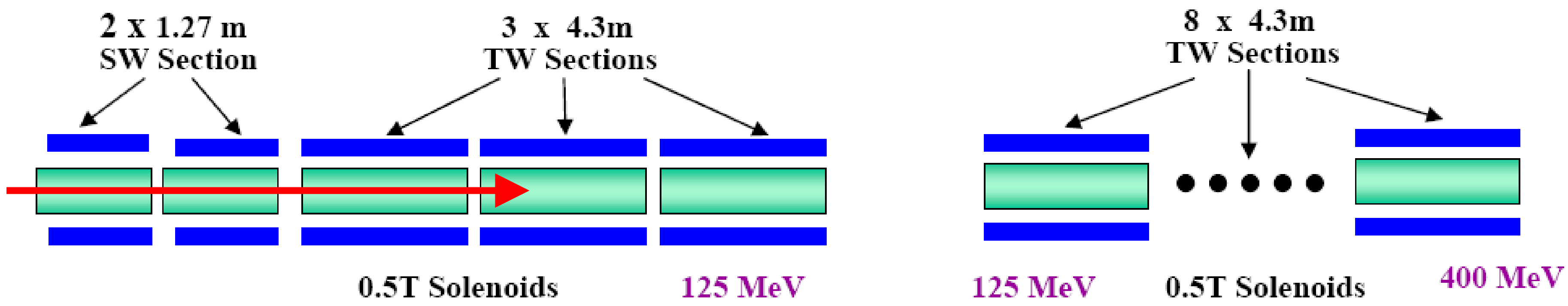
- An initial assessment has been made of what might be feasible
  - ➔ DC Magnet
  - ➔ Fast Pulsed Magnet
  - ➔ Slow Pulsed Magnet

RDR Solenoids

- RDR uses 0.5T DC magnets

- Length = 1.3m for SW linacs
- Bore = 36cm diameter

- Length = 4.3m for TW linacs
- Bore = 31cm diameter
- This is the most demanding magnet and this is the one that has been studied



- Reasonable limit is **~0.5 T**

Field (T)	Conductor Size (cm)	Number of Turns	Current (A)	Average Power (kW)
0.5	1 x 1	4300 (10 layers)	527	362
0.5	2 x 2	1075	2107	353
0.5	5 x 5	172	13169	300
1.0	1 x 1	4300	1054	1448
0.5	1 x 1	6450 (15 layers)	351	272

Fast Pulsed Solenoids

- Keep PSU voltage <2kV
- Voltage scales with inductance and dI/dt
- Inductance scales with N^2
- Linear Ramp of I in 4ms, 1ms flat top, 4ms fall time
- Reasonable limit is **~1 T**
- PSU very challenging but splitting magnet into sections could help

Field (T)	Conductor Size (cm)	Number of Turns	Current (A)	Average Power (kW)
0.5	2.5 x 2.5	172	13169	26
1.0	5 x 2.5	86	52674	96

Slow Pulsed Solenoids

- Keep PSU voltage <2kV
- Linear Ramp of I in 50ms, 1ms flat top, 50ms fall time
- Reasonable limit is **~1 T**
- PSU challenging but splitting magnet into sections could help

Field (T)	Conductor Size (cm)	Number of Turns	Current (A)	Average Power (kW)
0.5	2 x 2	1075	2107	90
1.0	2 x 2	1075	4214	360

Recommendations

- The long 4.3m solenoids in the TW sections presently operate at 0.5T
- Changing to a pulsed magnet will allow this field to be increased to ~1T
- The power supply will not be trivial so the overall benefit needs to be carefully assessed and proven
- The short 1.3m solenoids in the SW sections presently operate at 0.5T
- Similar studies suggest that these could operate at **~1.5T** in pulsed mode
- Does the focussing field need to remain constant from 0 to 400MeV?
- Can we have highest fields at low energy and reduce field as positron energy increases?