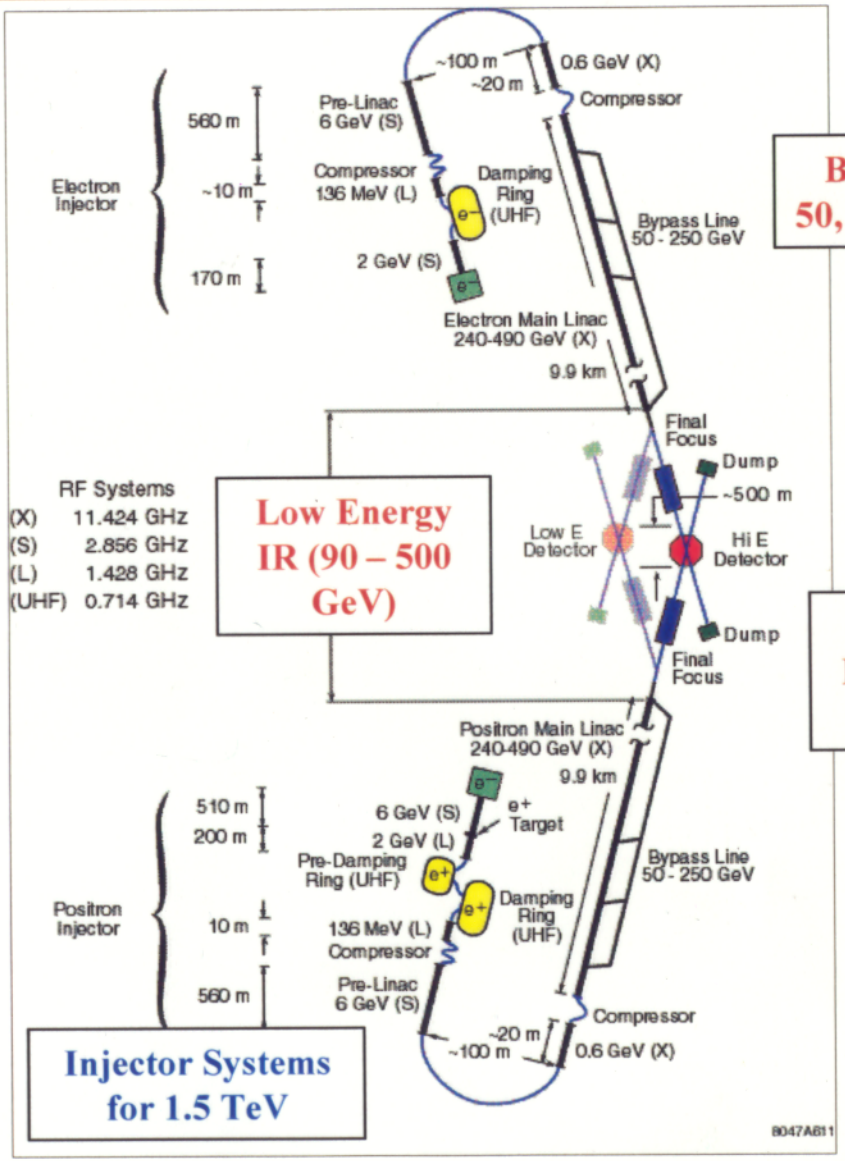
NLC at Snowmass 2001



Bypass Lines
50, 175, 250 GeV

Length for
500 GeV/beam

30 km

Low Energy
IR (90 – 500
GeV)

High Energy
IR (250 GeV to
multi-TeV)

Injector Systems
for 1.5 TeV

Tom Markiewicz

NLC - The Next Linear Collider Project

e-e- Switchover in the NLC Linac

R.S. Larsen-1999

The basic technical requirements are:

- Add a new polarized e- source
- Bypass the positron target
- Reverse all magnets where e-will travel through e+ sections *in the same direction*
- Fully automate or semi-automate electromagnetic polarity reversal
- Re-match phase at injection to the e+ main linac.

To be practical the conversion must:

- Add only modest initial capital cost
- Be accomplished quickly
- Reconfigure quickly back to normal operation.

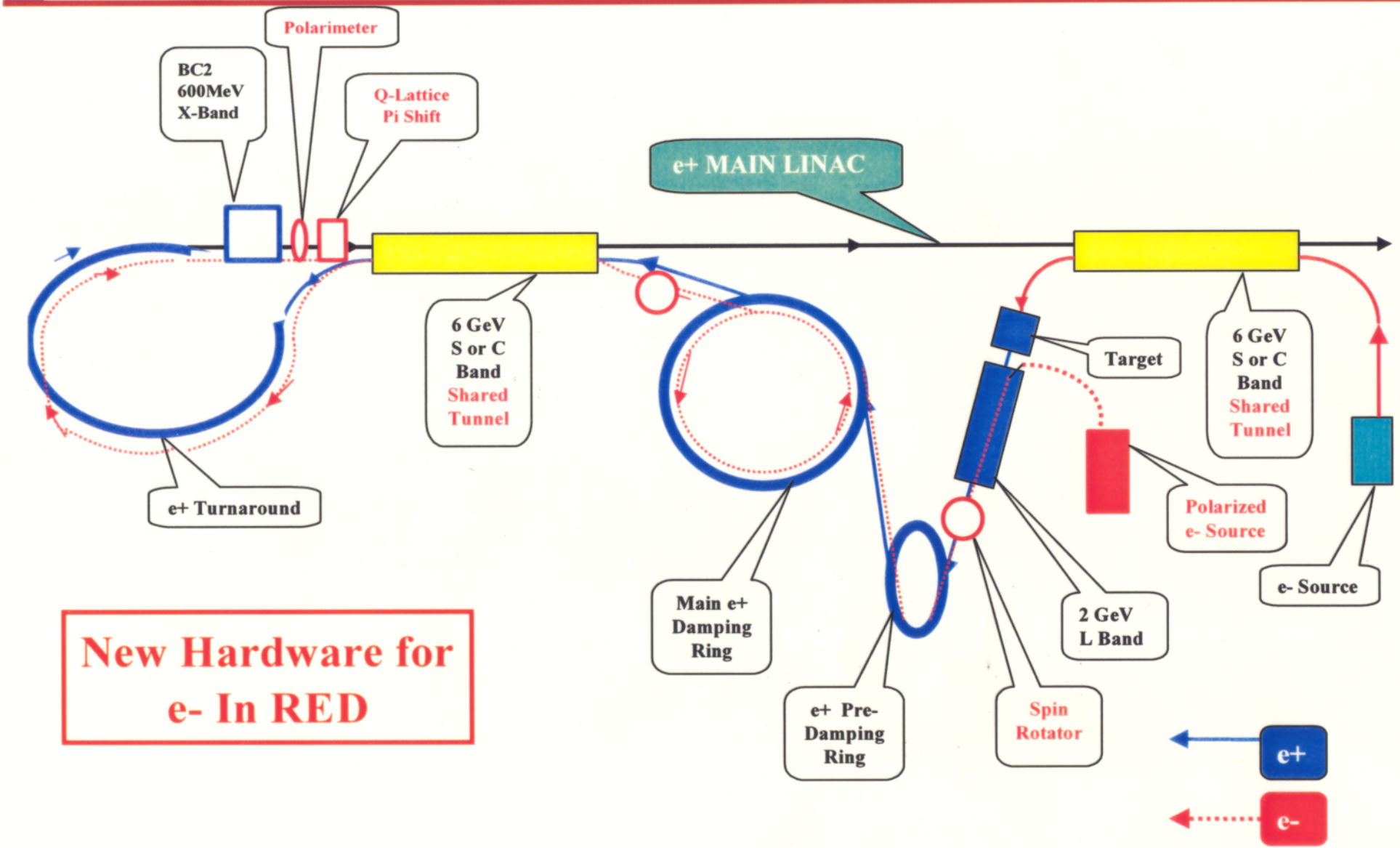
Most problems in Positron Source Area:

Magnet Type	PSOURCE	PBOOST	PPL	PLTR	PPDR	PXFER	PDR	PBC1	PBC2	TOTALS
Bends	6			13	18	2	36	26	188	289
Quads	46	123	91	36	78	4	136	95	263	872
Sextupoles			15		48		120		136	319
Corr./Trims	40	312		20		4		20		396
Septa					2		4			6
Kickers					6		6	1		13
Spin Rotators						2				2
Wigglers					8		20			28
										0
Totals	92	435	106	69	160	12	322	142	587	1925

NLC - The Next Linear Collider Project

Polarity Reversal Model

Same Tunnels, Same Magnets



New Hardware for e- In RED

Polarity Reversal Mode

Description:

- New e- Source installed near e+ vault bypasses target.
- Injects into 2 GeV pre-accelerator.
- New Spin Rotator and Polarimeter are added.
- Magnets reversed in ½ the PDR, the Main DR, Turnaround and all injection and extraction lines.
- New Q Lattice π Shift after Turnaround.

Advantages:

- Only tunneling required is for Polarized e- Source vault and transport line.
- Re-uses all e+ beamline components.

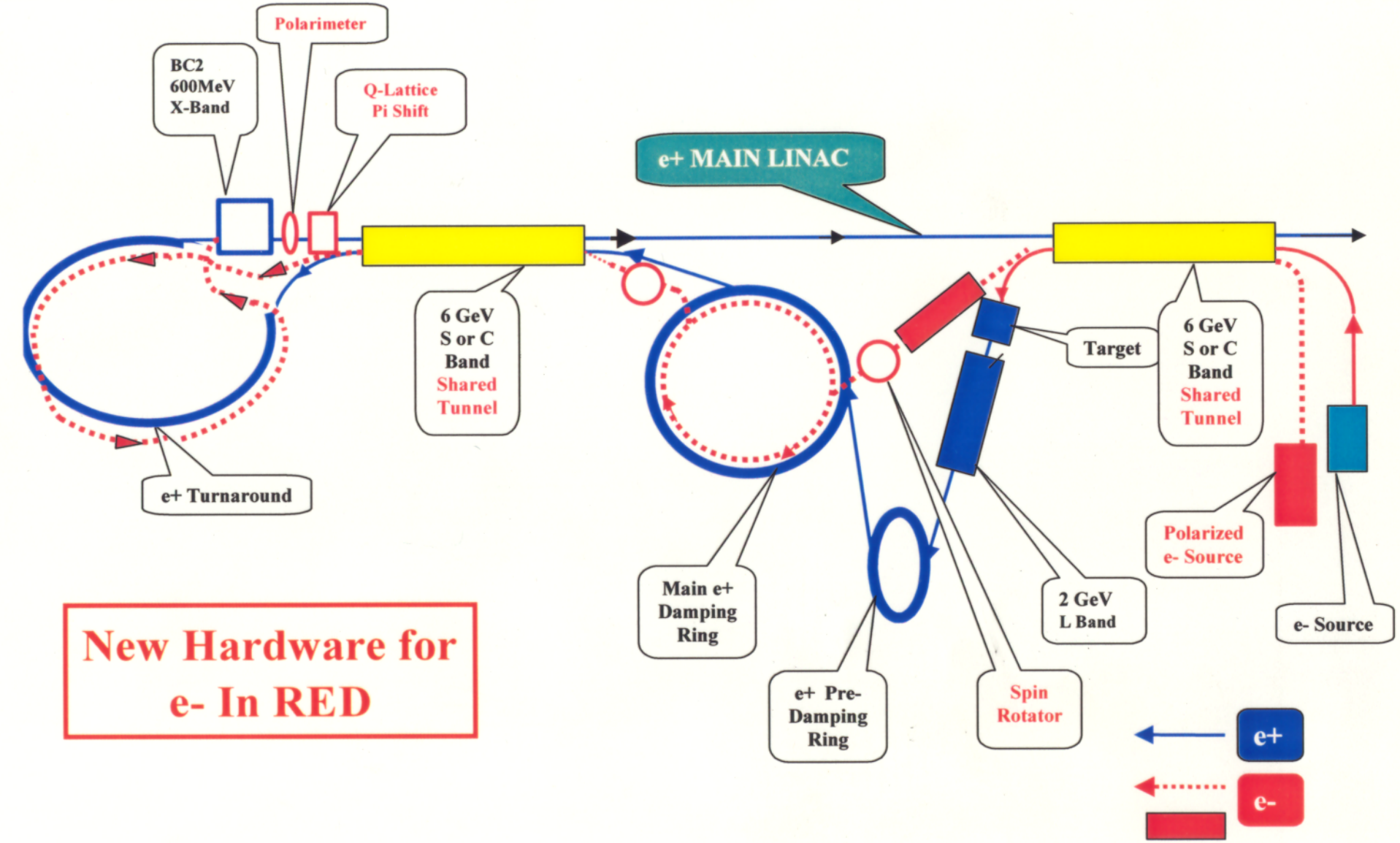
Disadvantages:

- Requires automated reversing switches for all electromagnets.
- Requires complicated magnet design and mechanics to rapidly reverse permanent magnets. Wrenches may be only solution in some cases. Must reverse without breaking vacuum.
- Re-standardization of magnets and subsequent tuning will be time-consuming.
- Re-start could take several shifts.

NLC - The Next Linear Collider Project

Direction Reversal Model

New Tunnels, Same Magnets



New Hardware for e- In RED

Direction Reversal Model

Description:

- A new Polarized e- Source is located near the e+ Source.
- Beam is extracted from the first linac at 2 GeV.
- A new tunnel and transport line injects beam into the Main DR in reverse direction.
- A new Spin Rotator and Polarimeter are added.
- A new extraction line is added for the reversed beam out of the MDR.
- Beam is injected into the Turnaround in the reverse direction.
- Reverse Polarity fast Kickers are added (not shown).
- Launch into Q Lattice π Shift after Turnaround.

Advantages:

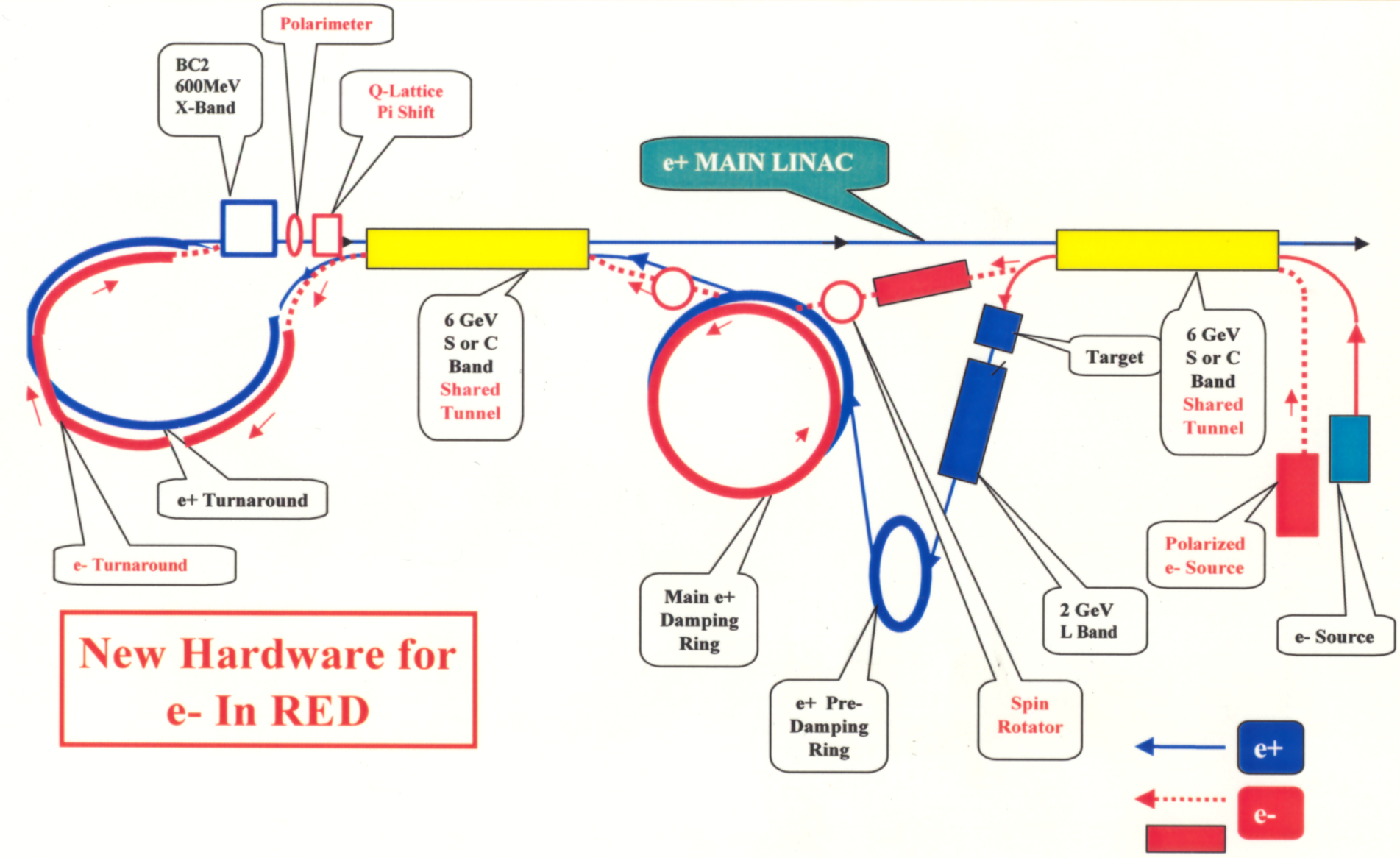
- Avoids polarity reversals of all magnets in MDR and Turnaround.
- Avoids PDR bypass entirely.
- Avoids problems associated with juxtaposition of electromagnets and permanent magnets.
- Switchover essentially automated and quick.

Disadvantages:

- Requires additional tunneling.
- Requires additional components for injection, extraction, kickers.

NLC - The Next Linear Collider Project

Independent Systems Model
Same Tunnels, New Magnets



Independent Systems Model

Description:

- Design Polarized e- Injection to be completely independent up to Main Linac.
- Add Spin Rotator, Polarimeter and Q Lattice π Shift
- Diagram shows shared or parallel housings but could be completely separated to eliminate interference during construction of second complex.
- Linacs are shared to reduce cost.
- Could couple upgrade with 2nd IR Detector.

Advantages:

- Systems switchover requires zero down time.
- Systems are always tuned.
- True parasitic running possible.
- Interleaved ML operation possible.
- More physics options available in one or both IR's.
- Initial civil work if on same side would be less costly.
- Construction at later date could be completely non-interfering.
- Flexibility of programming and operational non-interference is optimized.

Disadvantages:

- Additional capital cost would be significantly higher than other models.

Layout Conclusions

If we are serious about e-e- need to plan the additional beam transport systems from the beginning

The Independent System model is the ideal solution in the long run. It is more costly but operationally may recover the capital costs through significantly less downtime of the total physics program.

e+e- versus e-e- at the IP

Assume beam lines are taken care of

What else is there?

Interaction with detector's solenoid field

Crab Cavity Phasing

Possibly a Permanent Magnet final doublet for incoming beam

Beam-Beam interaction differences

- Luminosity
- → IP Backgrounds
- Pair monitor
- Beam-Beam deflection based feedback systems
- → Extraction line losses due to increased disruption

Concluding Remarks

There doesn't appear to be anything fundamental that would stop e-e- from being realized

Polarized e-e- running is assumed for $\gamma\gamma$ collider

Nonetheless it's not part of the baseline design as it's not going to sell the program to the community

The baseline crew is fully occupied

There's a lot that could be worked on to take the project from where it is now to the level where it is part of the baseline

Conceptual Engineering, Simulations, Accelerator Physics

Some group of advocates from the e-e- or $\gamma\gamma$ communities must give these problems the same level of thought that has taken $\gamma\gamma$ itself from a wild-eyed concept to the mass shell