A first look to a 3 km DR

M. Biagini, INFN/LNF

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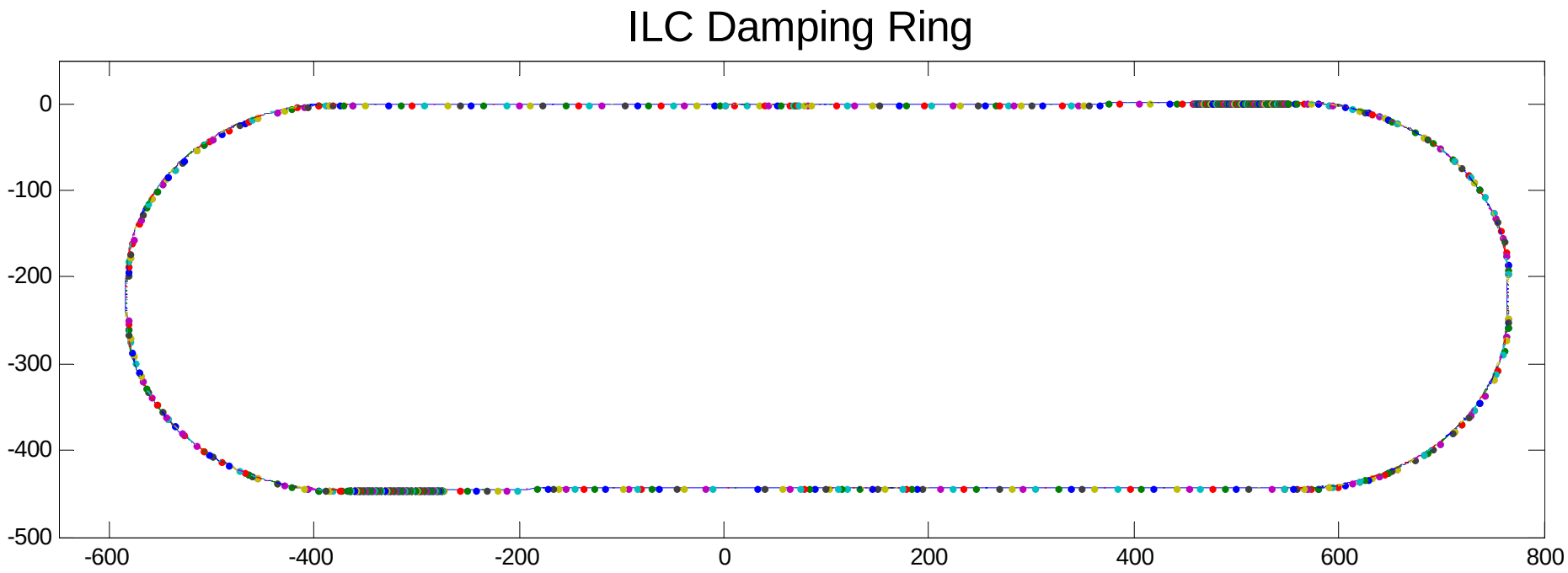
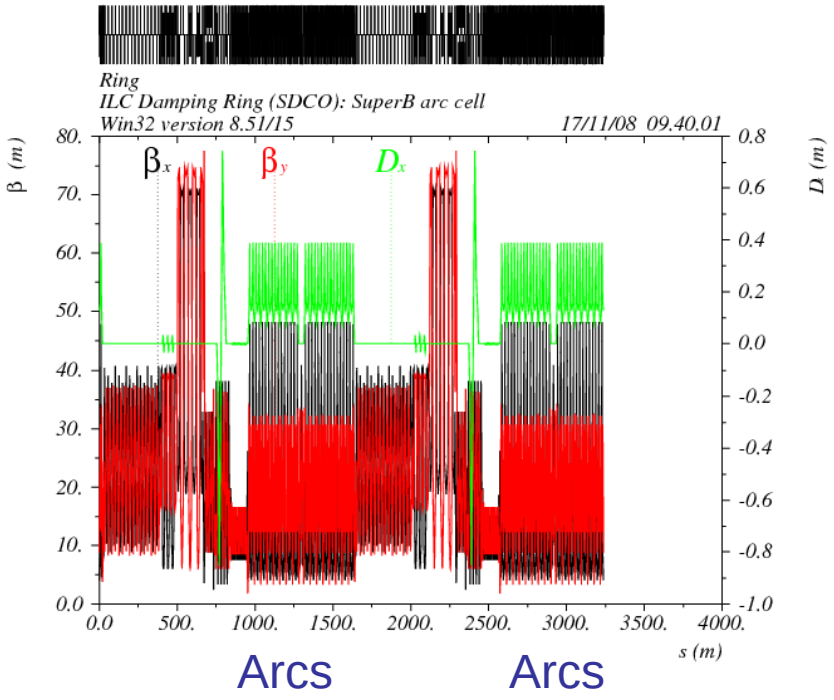
Outlook

- Started from new DCO lattice
- Substituted FODO cells with *SuperB*-like arc cells, keeping untouched the DCO straights
- At present bends and quadrupoles lengths in the arc cells have not been changed from *SuperB*, 128 arc bends are 5.4 m long. This may be adjusted if required
- Lower emittance, same damping time, with half n. of wigglers of the 6 Km option

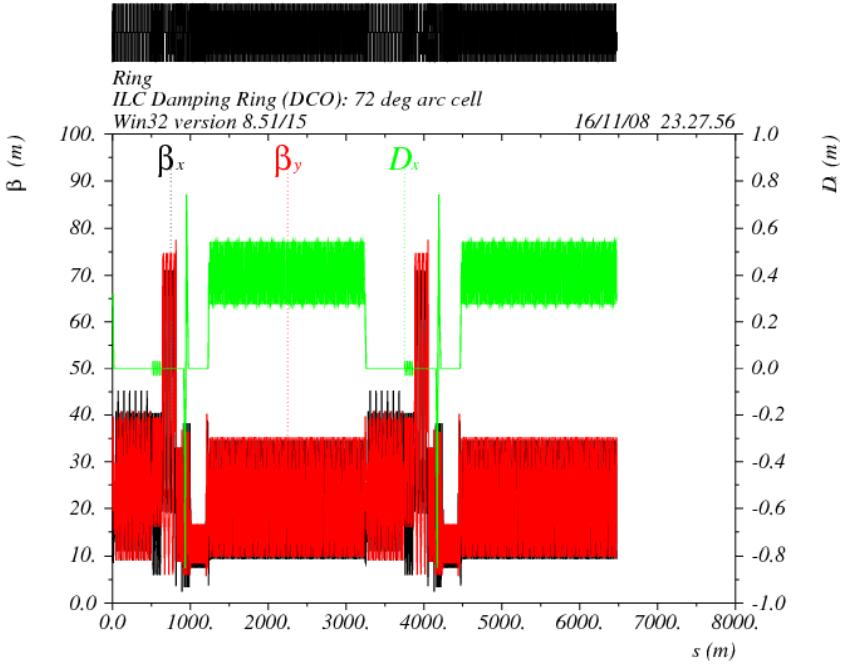
New 3Km layout



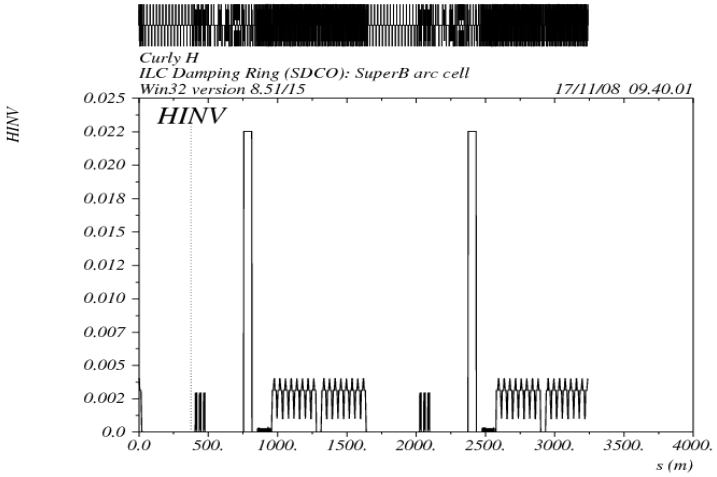
Ring



Arcs Arcs

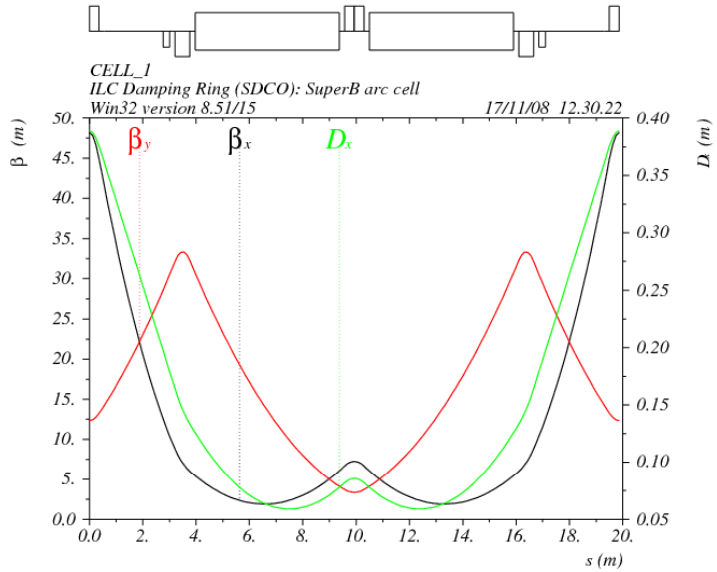


Original, 6Km



Curly H

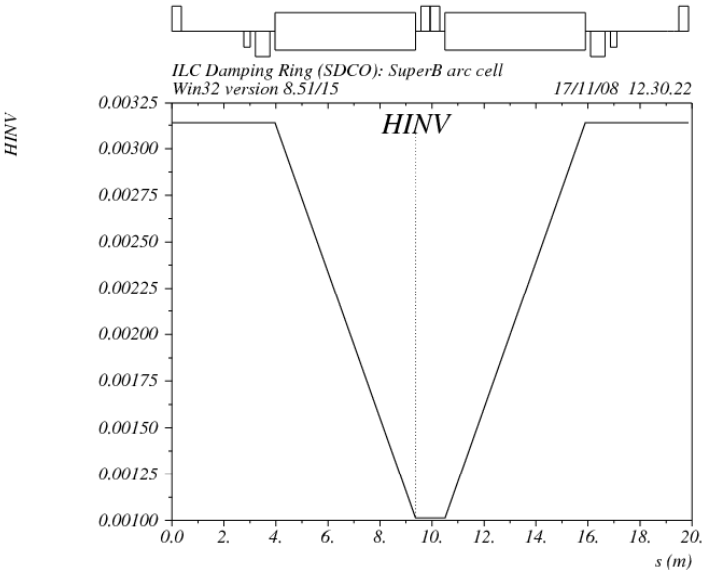
SuperB-like cells

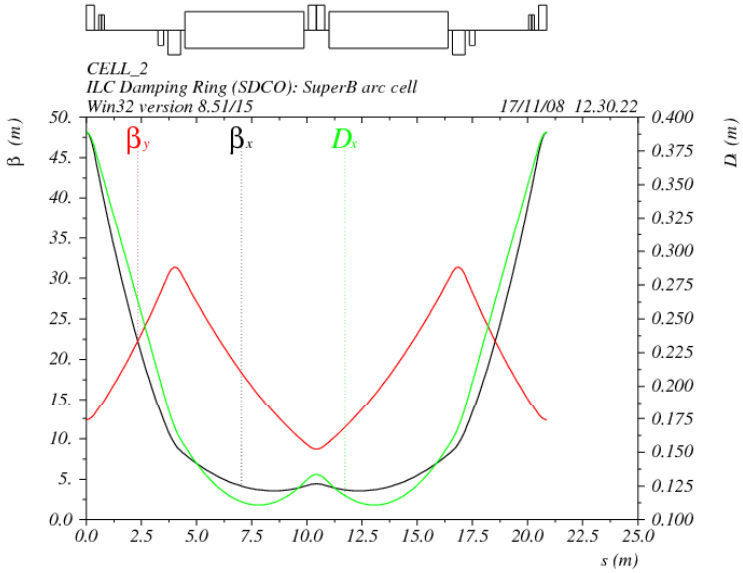


Cell #1

$\mu_x = 0.72$

$\mu_y = 0.27$

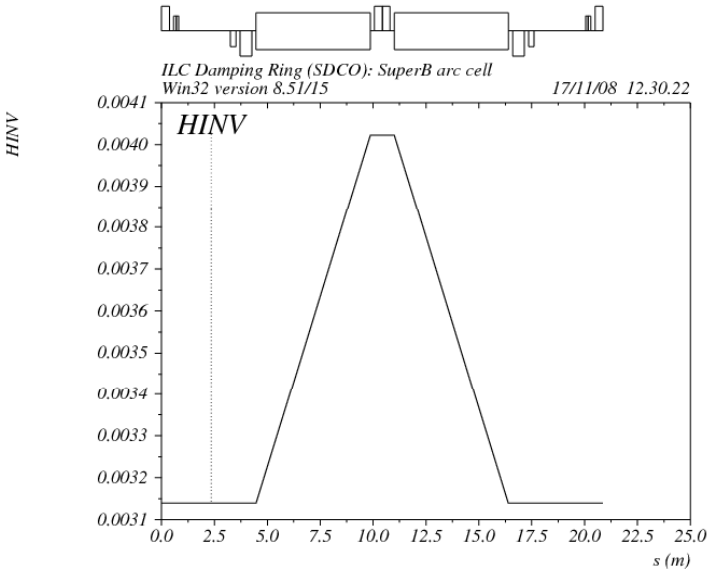




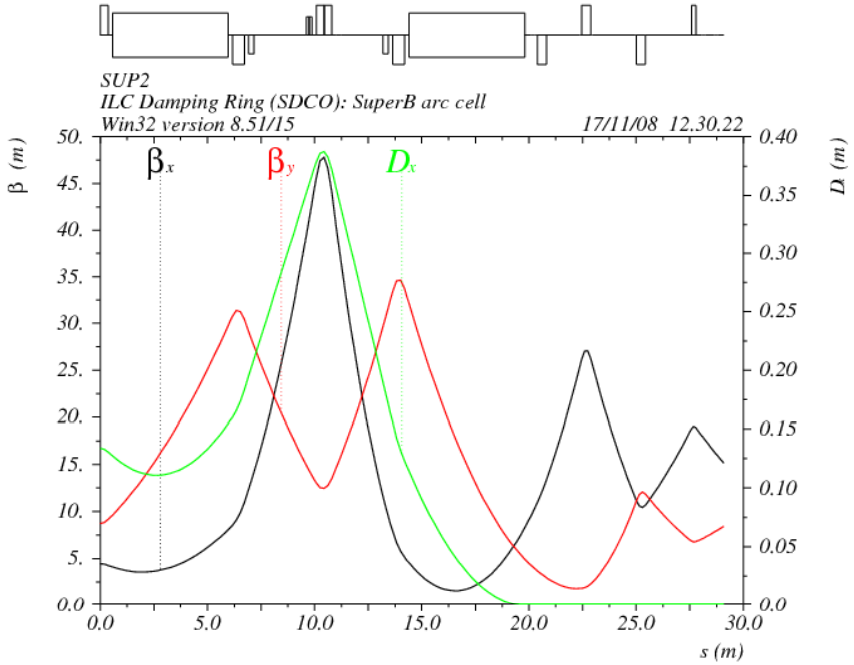
Cell #2

$\mu_x = 0.5$

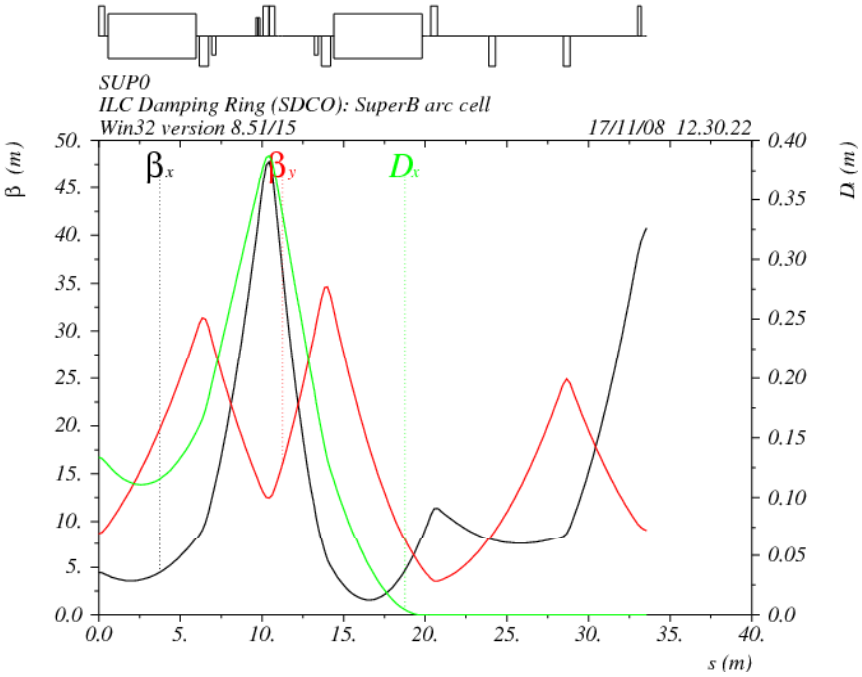
$\mu_y = 0.19$



Dispersion suppressors

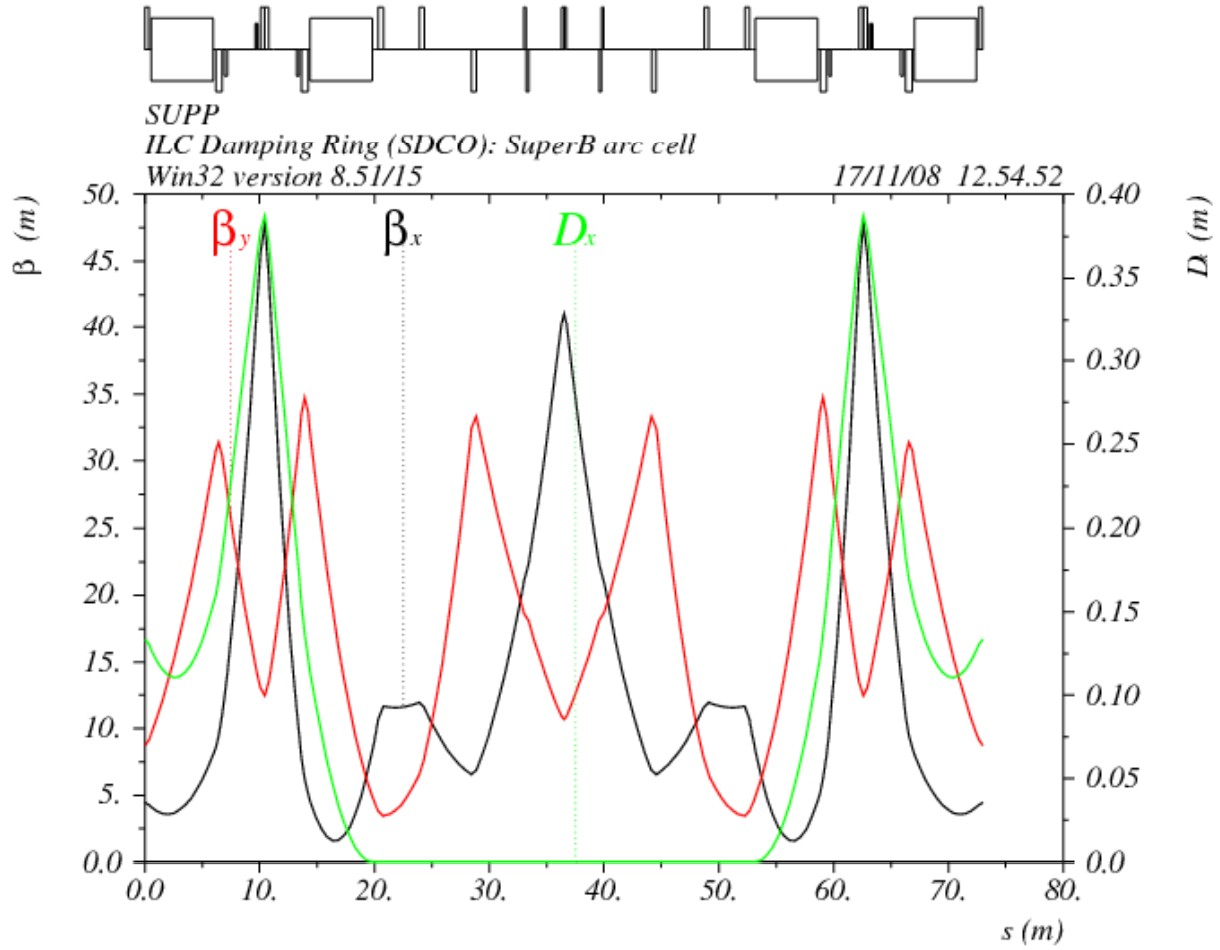


Matching to wiggler section



Matching to tune trombone section

Middle-arc section for phase tuning between sextupoles



Features

- Half DCO circumference
- Arcs contain alternating cells with different phase advances:
  - cell #1: L=20 m, $\mu_x = 0.72$, $\mu_y = 0.27$
  - cell #2: L=21 m, $\mu_x = 0.5$, $\mu_y = 0.2$
- Dispersion in cell lower wrt DCO → sextupoles less effective
- Emittance can be tuned by changing the x-phase advance/cell in cell#1
- Same is true for momentum compaction
- Increasing x-phase advance/cell may reduce dynamic aperture (to check)
- 1 RF cell (originally 2)
- 5 shorter "tune trombone" cells (originally 6)
- 11 wiggler sections (originally 22)
- 3 chicane sections (originally 4)

Magnet counts

Arc dipole length	**5.4 m**	**2.0 m**
Arc dipole field (2 types)	**0.178/0.243 T**	**0.273 T**
Number of arc dipoles	**128**	**192**
Number of 2 m dipoles	**4**	**8**
Number of 1 m dipoles (in chicanes)	**36**	**48**
Total number of quadrupoles	**502**	**690**
Maximum quadrupole gradient	**7.5 T/m**	**12.0 T/m**
Total number of sextupoles	**192**	**384**
Maximum sextupole gradient	**145 T/m^2**	**215 T/m^2**
Wiggler peak field	**1.6 T**	**1.6 T**
Wiggler period	**0.4 m**	**0.4 m**
Wiggler unit lenght	**2.45 m**	**2.45 m**
Wiggler total length	**107.8 m**	**215.6 m**

Parameters

Circumference (m)	3238.22	RF frequency (MHz)		650	
Energy (GeV)	5	RF voltage (MV)		7	
Bunch length (mm)	6	Harmonic number		14042	
Natural X chromaticity	-102	Natural Y chromaticity		-66	
X phase advance/cell#1	0.72	0.6	0.65	0.75	0.78
Normalized ε_x (μm)	3.4	4.3	3.5	3.9	5.5
Momentum compaction x10^{-4}	1.8	1.4	1.5	2.1	2.7
Transverse damping time (ms)	20.6	21	21	20.2	19.6
Max β_x in cell #1 (m)	50	80	60	45	45
Max D_x in cell #1 (m)	0.4	0.3	0.3	0.5	0.6

In red baseline parameters (see plots)

Issues and future work

- Chromaticity higher wrt DCO
- Sextupoles and chromatic properties (W functions) still to be optimized
- Less sextupoles available (less cells!) with lower dispersion and larger chromaticity
- DA still to be optimized (at present small)

Conclusions

- Using the DCO lattice straights a shorter layout (half) has been designed
- SuperB-like arc cells used (large x-phase advance/cell) instead of FODO cells
- Lower emittance, same damping time, has been achieved. Emittance tunable with x-phase advance/cell#1 (no change in bending angle)
- Momentum compaction also easily tunable, as for emittance, from 1.4 to 2.7
- Dynamic aperture still to be studied
- Seems worthwhile to pursue this study