Format of the session

on lattice optimisation
for stochastic cooling

5 short (5 min.) “warm up talks”,
40 min. of general discussion

D. Möhl :	Introduction
J. Wei:	Lattices for collection and cooling
Y. Senichev:	Lattices for COSY and HESR
A. Dolinskii:	Collector and Accumulator for FAIR
V. Nagaslaev:	Fermilab Antiproton Accumulator
ALL :	Discussion

Introduction to the session on lattice optimisation for stochastic cooling

D. Möhl

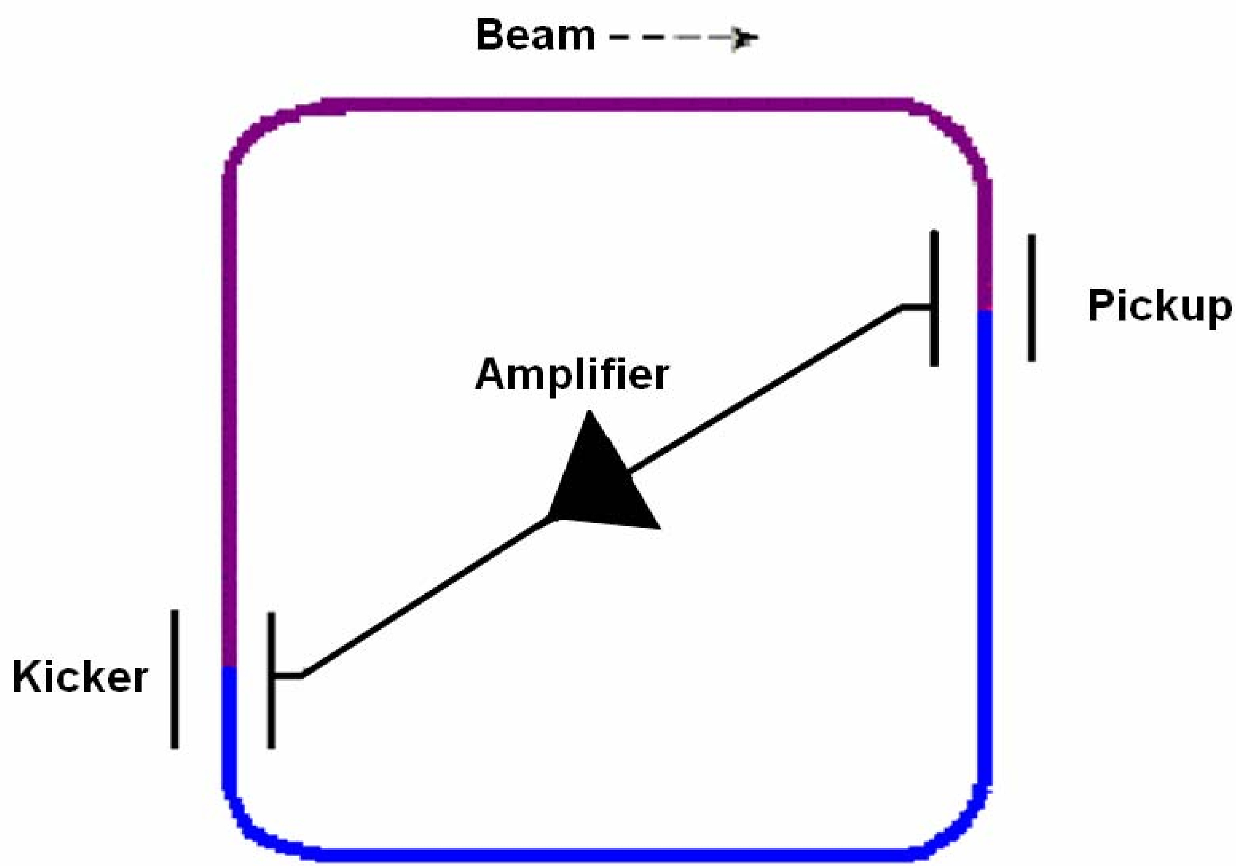
A 'split ring'… why?

Gain to be expected.

A 'split ring'…how?

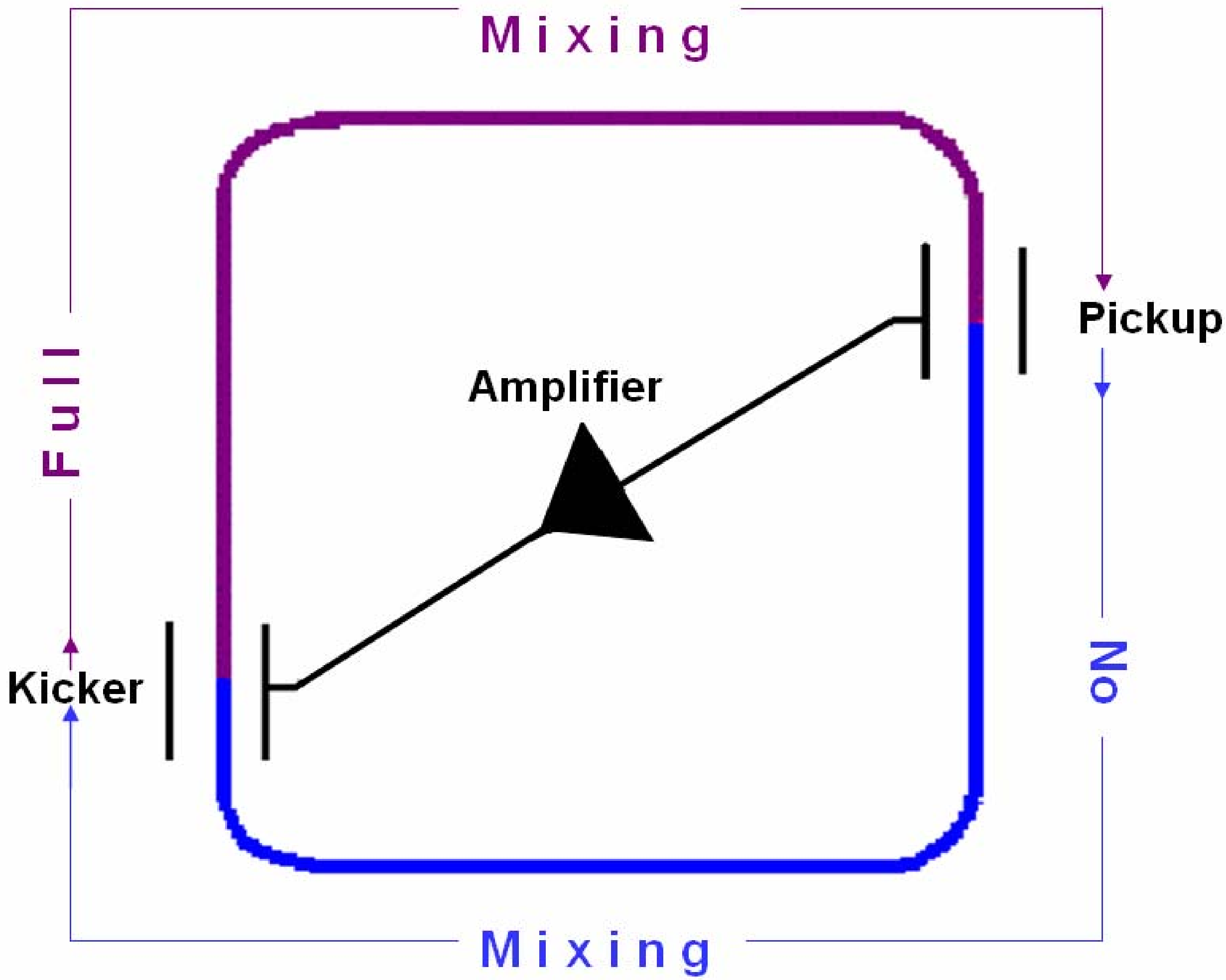
Price to be paid.

The mixing dilemma



No mixing desired PU to kicker, full mixing desired kicker to PU.

The mixing dilemma



This requires a 'split ring' with different properties in the blue and red part

Advantages

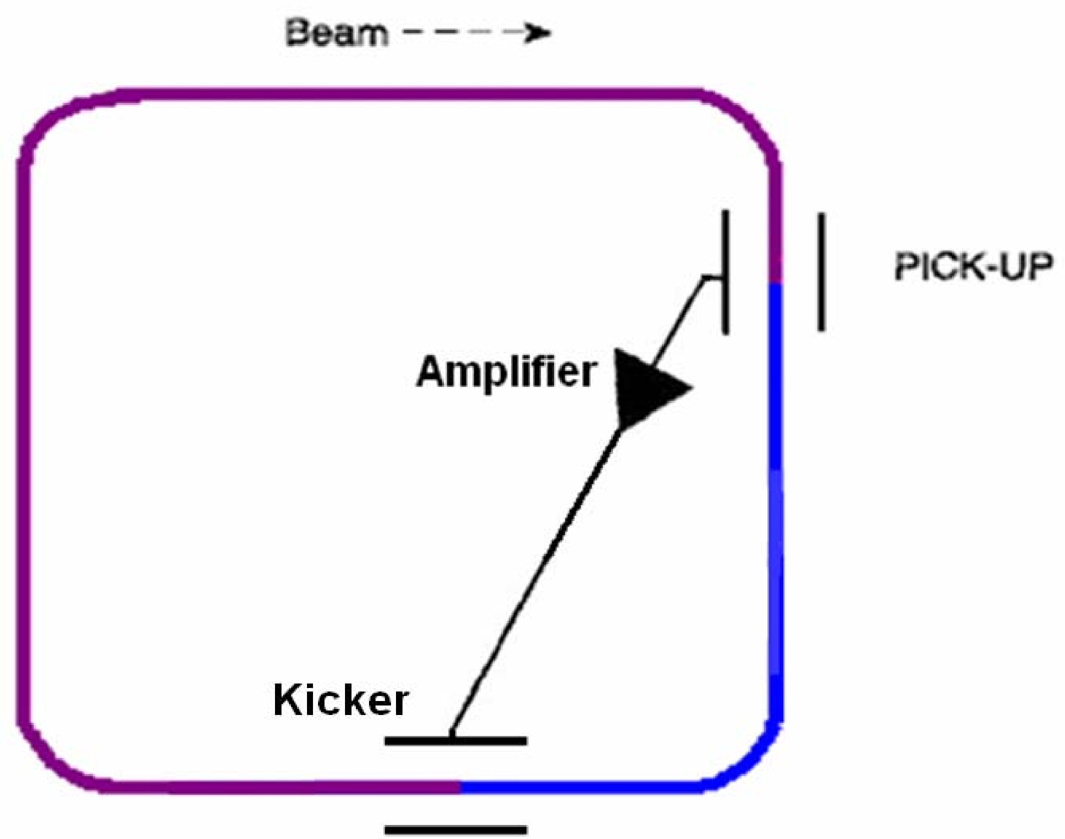
The potential gain with an 'optimum mixing lattice' is:

-- a factor of three to six in cooling speed --

This concerns transverse cooling and longitudinal cooling by the Palmer and local time of flight methods but not the filter method.

It assumes a diagonal cooling path and negligible system noise
For a distance PU to K shorter than K to PU and also with poor signal to noise ratio, the gain is less pronounced.

Shorter path PU to kicker



For a distance PU to K shorter than K to PU and also with poor signal to noise ratio, the gain is less pronounced.

Lattice Design

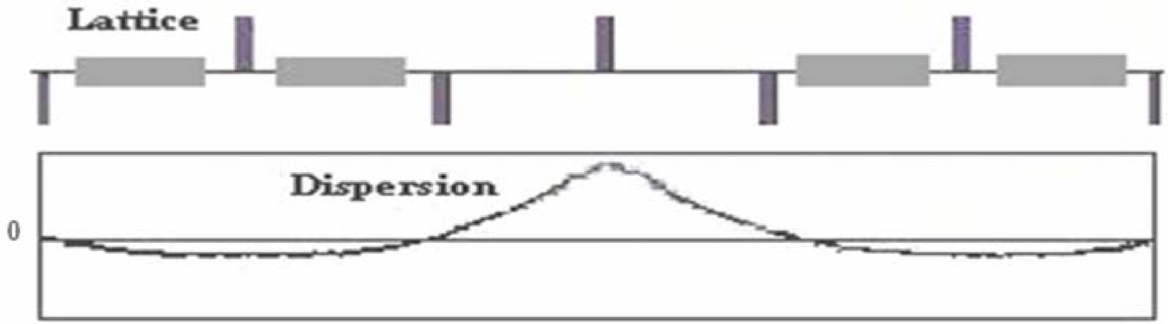
The optimum mixing lattice can be built from Flexible Momentum Compaction ('FMC') modules.

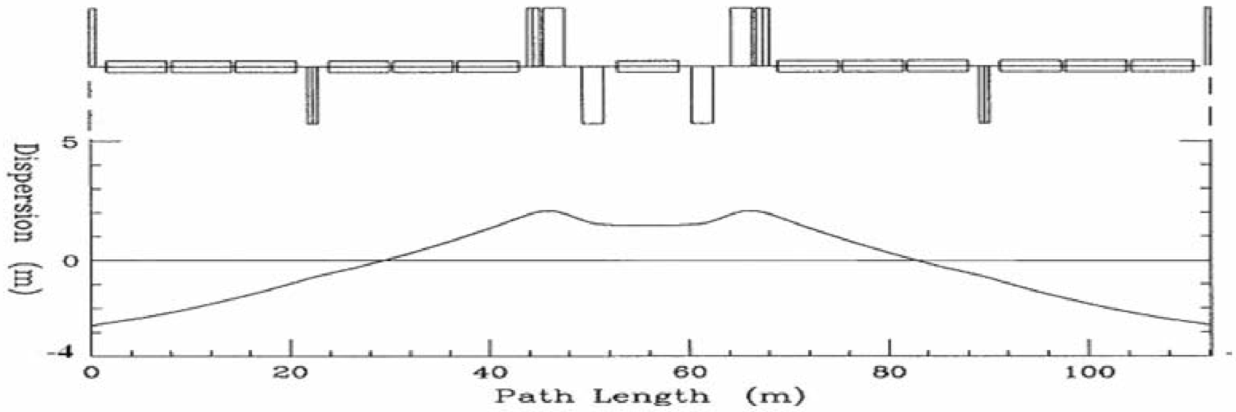
A long list of references exists concerning the design of ('FMC') modules suited for this purpose.

The low mixing section (PU to kicker) needs low momentum compaction modules ($\alpha_p = \gamma^{-2}$ → $\eta = 0$).

The strong mixing section (kicker to PU) needs large momentum compaction modules (preferably negative α_p) → η large.

Examples of FMC modules



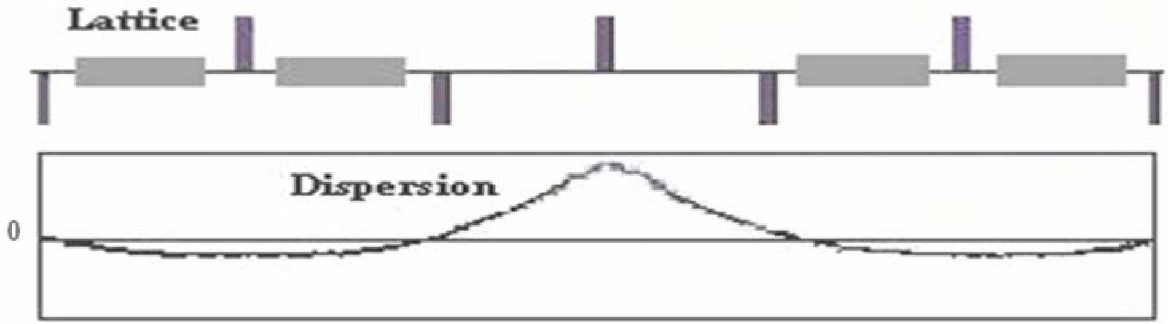


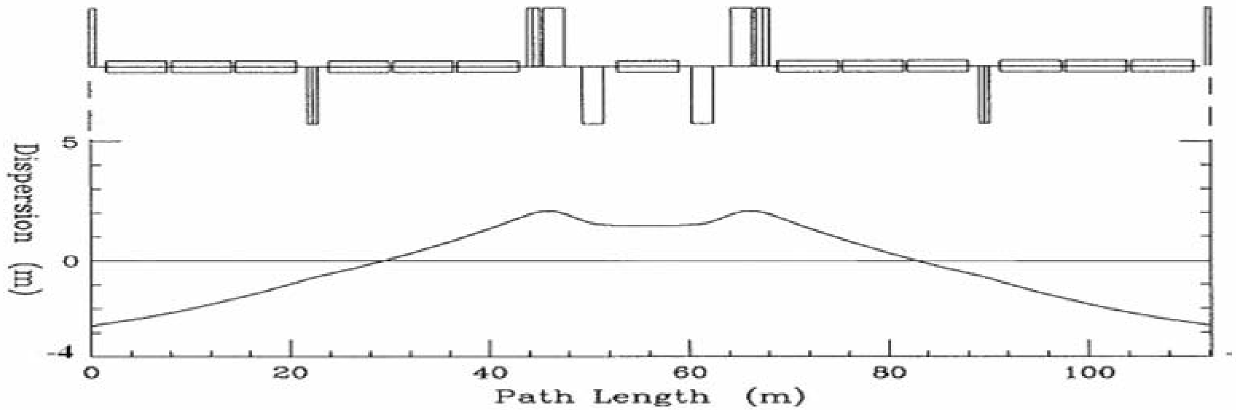
Disadvantages

The optimum mixing lattice is more complex and more expensive than a simple FODO structure

- Needs more quadrupoles and esp. more quad. families
- The simple structure has reduced acceptance (increased maxima of lattice functions)
- Periodicity 1 → many systematic resonances
- Many pieces of straight section and low betas at places where one cannot always use them
- Influence of η_{ring} on RF quantities ($U \propto \eta$ …)

More quadrupoles for the FMC modules





Features that turn out to be of no great disadvantage

Collective instabilities and dynamic aperture do not seem to be of special concern

The η entering into the 'Keil-Schnell-Boussard' criterion

is the 'full turn' $\eta_{ring} = \frac{L_{pk}}{C}\eta_{pk} + \frac{L_{kp}}{C}\eta_{kp}$. For large η_{kp} this, and hence the tolerable impedances, are large

S.Y. Lee et al. conclude, that the dynamical aperture in the advanced FMC-modules can be at least as large as that of regular FODO cells

Conclusion

1. The potential gain with an 'optimum mixing lattice' is a factor of three to six in cooling speed.

2. The optimum mixing lattice can be built from Flexible Momentum Compaction ('FMC') modules.

3. The optimum mixing lattice is more complex and more expensive than a simple FODO structure.

Test in COSY???

Some simple relations

$$\frac{\Delta T_{1,2}}{T_{1,2}} = \eta_{1,2} \frac{\Delta p}{p}$$

Time of flight spread

point '1' to '2'

$$\eta_{1,2} = \alpha_{1,2} - 1/\gamma^2$$

Local 'off momentum factor'

$$\alpha_{1,2} = \frac{1}{L_{1,2}} \int_{'1'}^{'2'} \frac{D}{\rho} ds$$

Local momentum compaction factor

$$\eta_{ring} = \frac{L_{pk}}{C} \eta_{pk} + \frac{L_{kp}}{C} \eta_{kp}$$

Addition theorem