

# Wires in accelerators

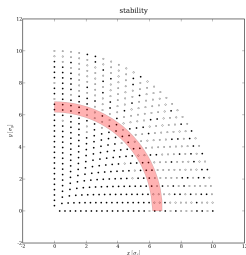
LHC, RHIC

Ulrich Dorda

ABP/LCU meeting

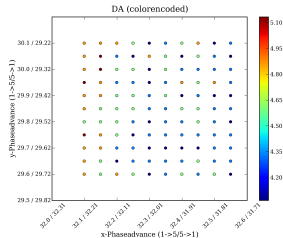
# BBTrack: Simulation Model and my Definition of the DA

- ▶ Weak-strong
- ▶ Linear Transfer matrices between nonlinear elements (this time no triplet errors included)
- ▶ Off momentum particles are tracked for 300.000 turns
- ▶ Lyapunov exponent used to detect Chaos.
- ▶ Particles are launched on a grid in the  $x$ - $y$  plane
- ▶ DA  $\approx$  Amplitude where a given percentage of particles are unstable



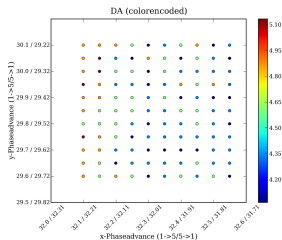
# Phase-advance scan, IP1 & IP5

## IP1 & IP5 ,nominal

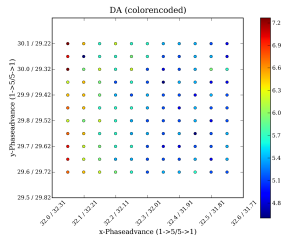


# Phase-advance scan, IP1 & IP5

## IP1 & IP5 ,nominal

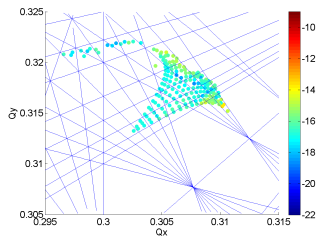


## IP1 & IP5, pacman

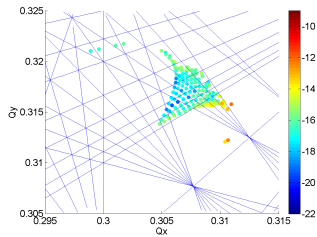


# Two tune diffusion footprints, IP1 & IP5

nominal, higher DA

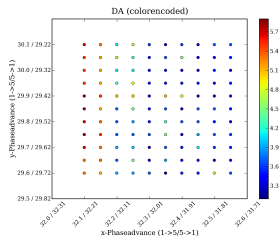


nominal, lower DA



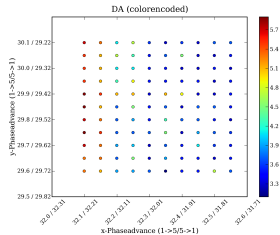
# Phase-advance scan, all IP & Wire

all IP, nominal

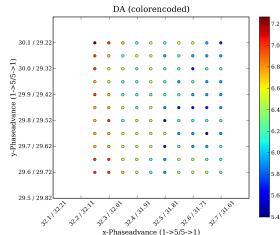


# Phase-advance scan, all IP & Wire

all IP, nominal

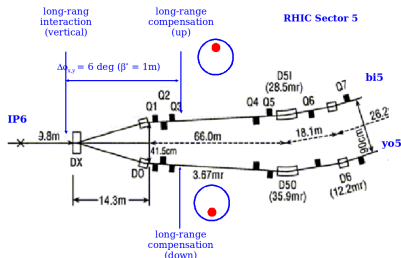


IP1 & IP5, wire



# RHIC: Wire excitation

- ▶  $l = 2.5\text{m}$ , vertically movable, max:  $125\text{Am}$ ,
- ▶ unfortunately: asymmetrical  $\beta$ -function (1:3)
- ▶  $\gamma_{inj} = 12$ ,  $\gamma_{top} = 108$
- ▶  $\sigma_{y,inj} = 2.16\text{mm}$ ,  $\sigma_{y,top} = 2.33\text{mm}$
- ▶ In case of an upgrade (more bunches) it will also suffer from LRBB
- ▶ test for wire compensator/ effect of LR on the beam





# RHIC: Experiments so far (W. Fischer)

## 2006

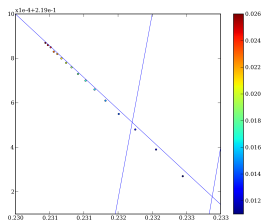
- ▶ Protons
- ▶ LRBB experiments (1 LR at IP or at  $s=10\text{m}$ )
- ▶ Injection: clear results (although not tune compensated....)
- ▶ Top: data doubtful/inconsistent.
- ▶ Simulation: all lattice 6-poles required to reproduce case at injection

## 2006

- ▶ Gold
- ▶ 2 different wire currents
- ▶ beam-wire distance scans
- ▶ Not tune compensated  $\Rightarrow$  one needs to be careful in drawing conclusions (hope to change that once I am there; )

# Tune shift due to wire

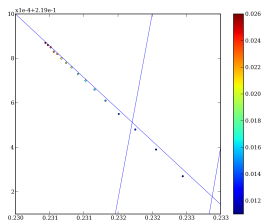
12.5Am



$m = -10, n = 6, p = -1$

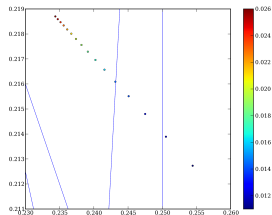
# Tune shift due to wire

12.5Am



$m = -10, n = 6, p = -1$

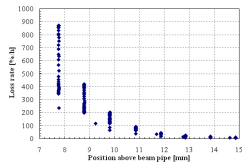
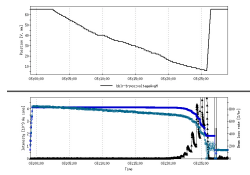
125Am



$m = 4, n = 0, p = 1$   
or  $m = 5, n = -1, p = 1$

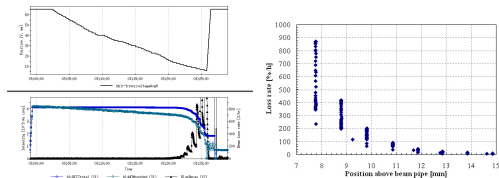
# Experimental results (W.Fischer)

12.5Am

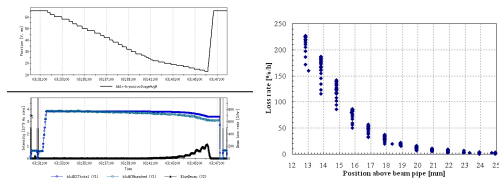


# Experimental results (W.Fischer)

## 12.5Am

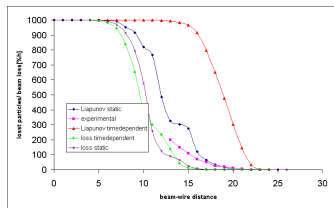


## 125Am

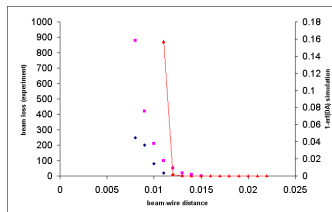


# RHIC: Simulation I

## Gaussian bunch, 125Am



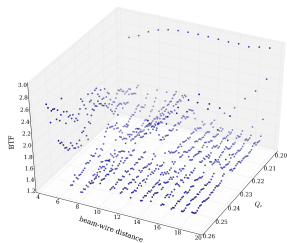
## DA, 12.5Am



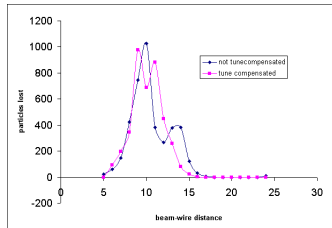
Slopes are only a matter of scaling!

# RHIC: Simulation II, 125Am

## BTF

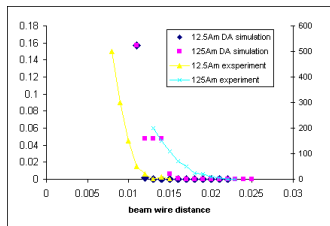


## Time dependent

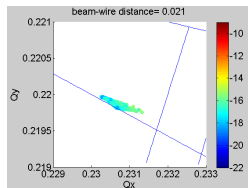
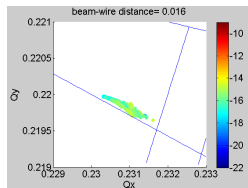
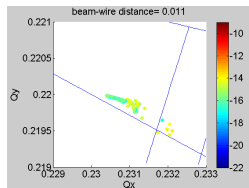


# RHIC: Simulation III

All



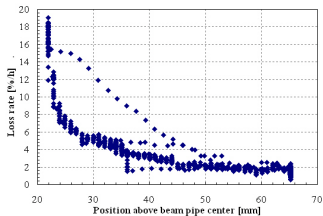
12.5Am





# RHIC: Top and Conclusions

- ▶ Hysteresis - cross resonances again after having diffused particles?
- ▶ Diffusion time to slow?
- ▶ Duration within simulation scope (currently running)
- ▶ First simulations not as accurate



## Conclusions

- ▶ Injection well reproduced
- ▶ First simulations at top energy are not as close. (not sensitive enough, Triplet error?)
- ▶ Hope for (tune-) compensated experiment
- ▶ Hope for wire & HO (tune footprint folding)