

COSY injection beam studies

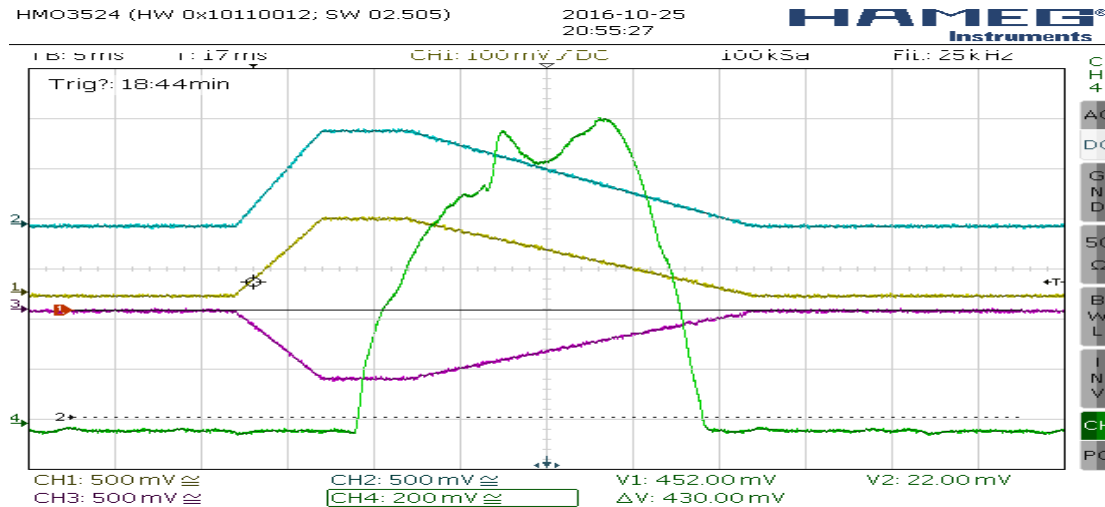
BL/HS/YS

Bernd Lorentz, FZJ

Introduction

Injection: Stripping Injection of H^- -Ions

@0 sec: Injection pulse of 20 ms, three 'bumper' (fast horizontal correction dipoles) moving injected beam off the stripping foil onto the COSY orbit



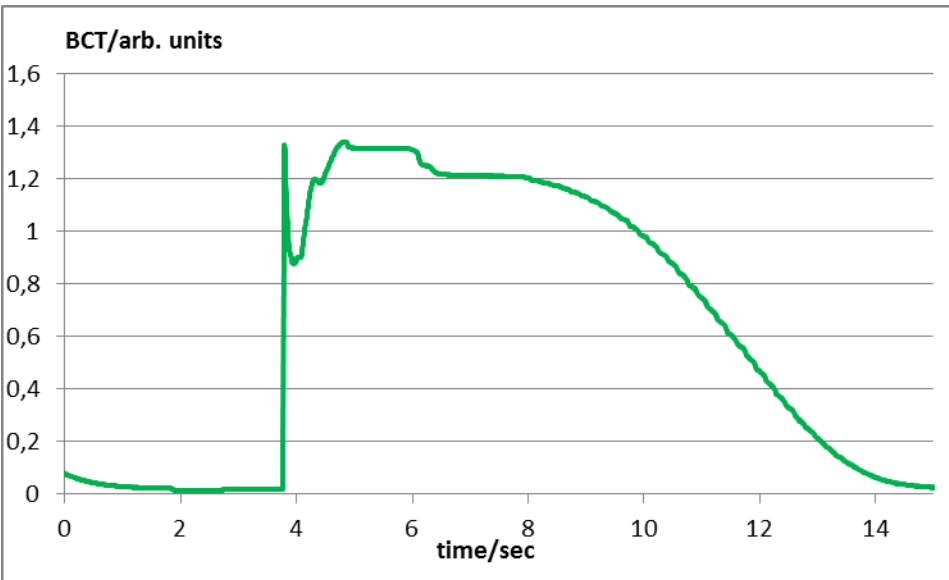
Injection: Stripping Injection of H^- -Ions

@ 50 ms: adiabatic capture of the stored beam

@ 100 ms: start of acceleration

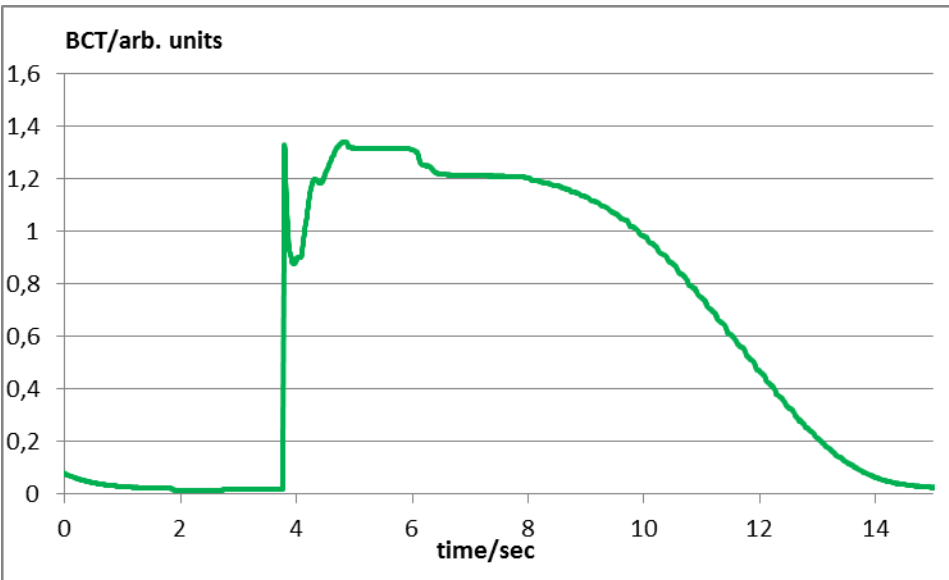
Motivation

Typical: bunching losses during capture process for uncooled beam approx. 50 %



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possible reasons:

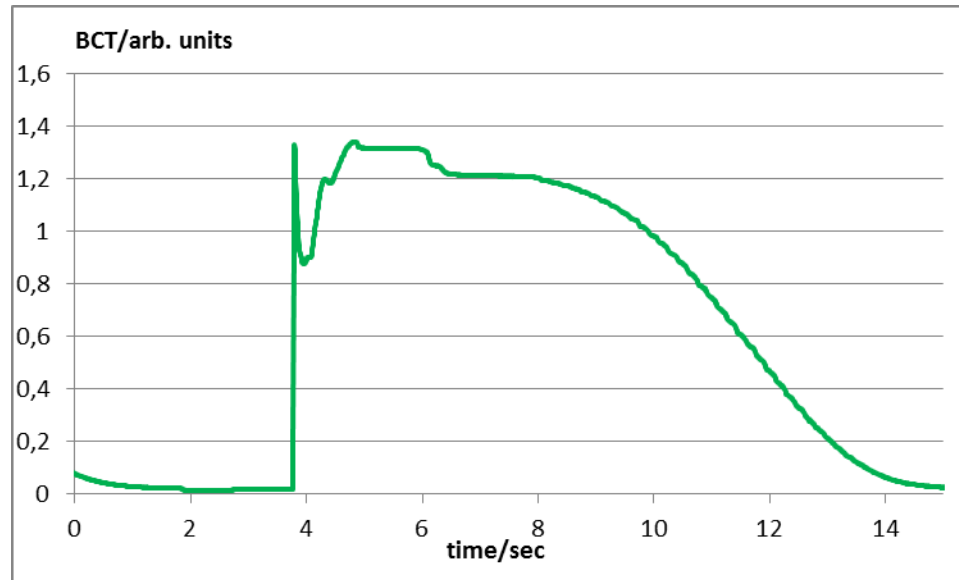
- problem of adiabatic bunching
- momentum spread
- emittance (hor. or vert. ?)
- orbit
- any property of beam optics (tunes, chromaticities, large dispersion at wrong places (e.g. cavity), spread of these (e.g. tune spread))

...

=> dedicated time for study foreseen

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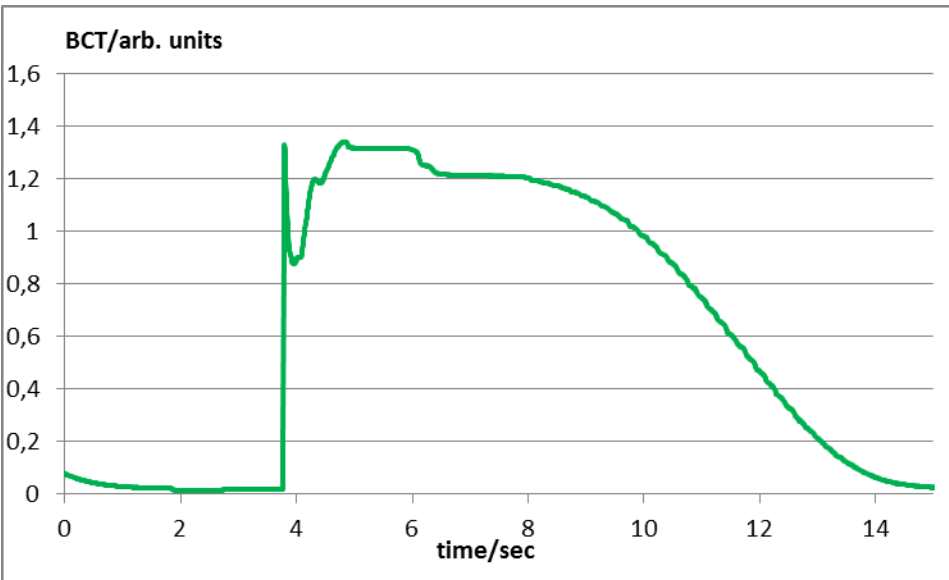
Unfortunately:

- CBAC4 recommended beam time, but it was not scheduled so far
- One week of user beam time was cancelled, and we planned to study this, but in parallel preparing extraction for new user irradiation experiment
=> the time was used up for preparing extraction

only some qualitative results as of now: I will present the study plan

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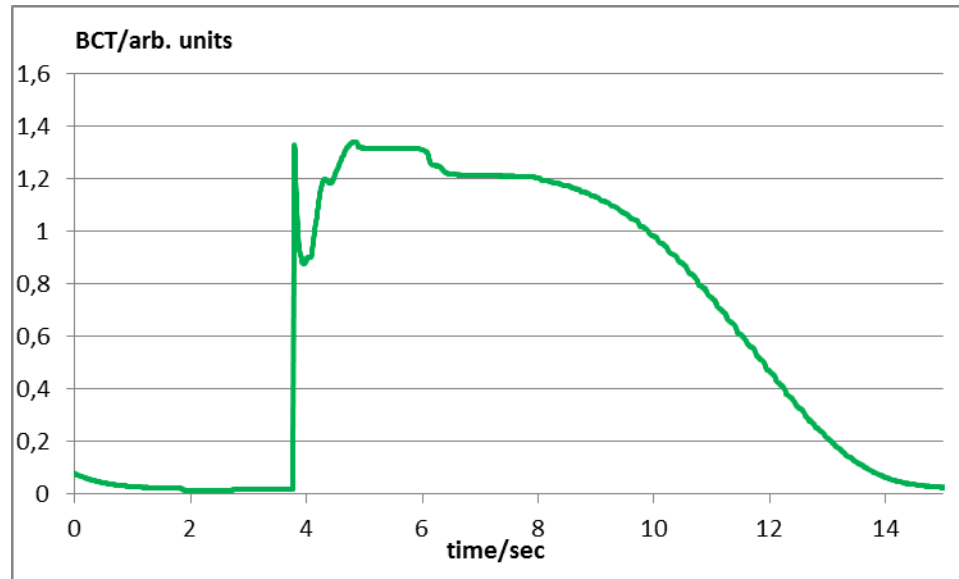
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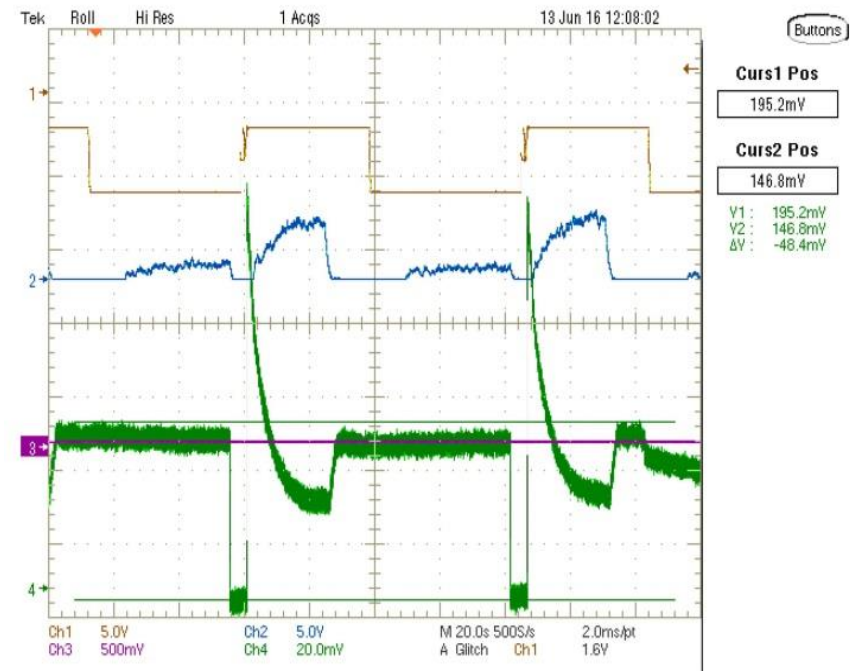
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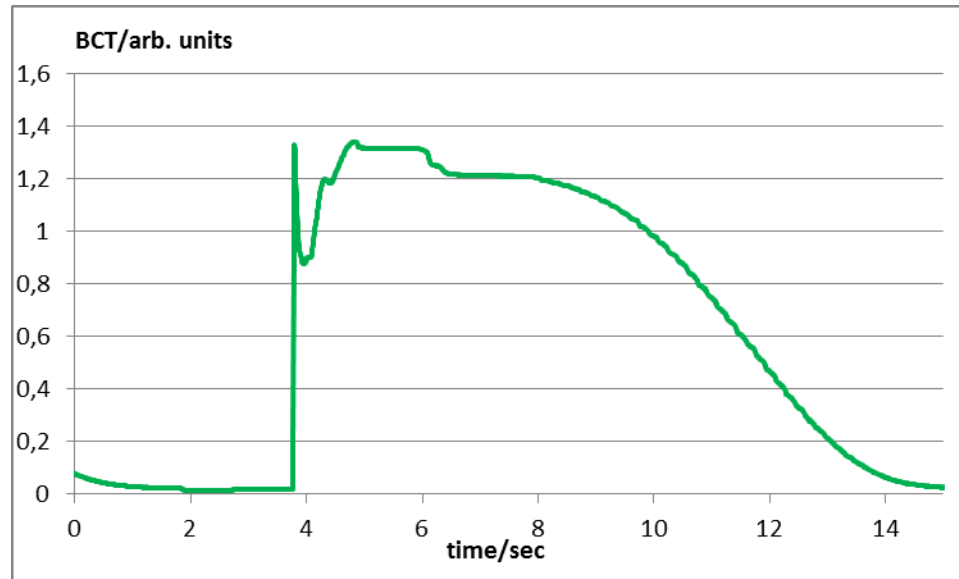


electron cooled beam
no capture losses



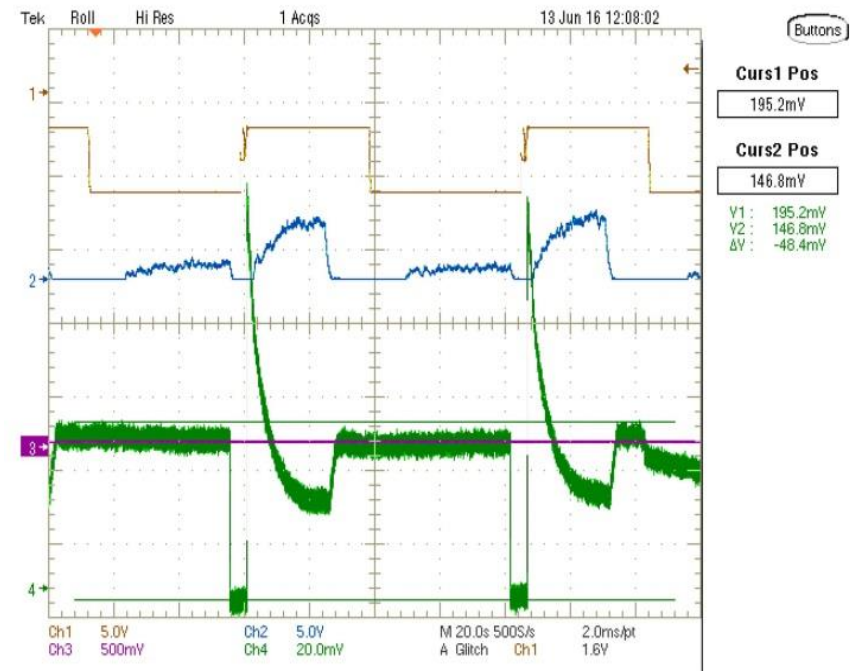
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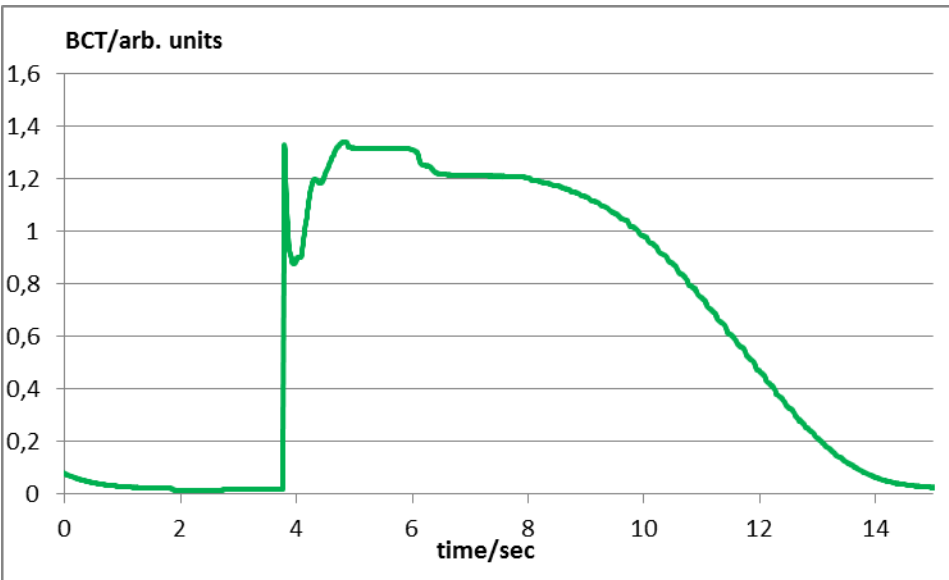
Bunching process is okay
(simulations of bunching by Hans and Yuri also show no reason for losses, adiabaticity condition is not so strong and should be fulfilled for our typical cavity amplitude turn on)

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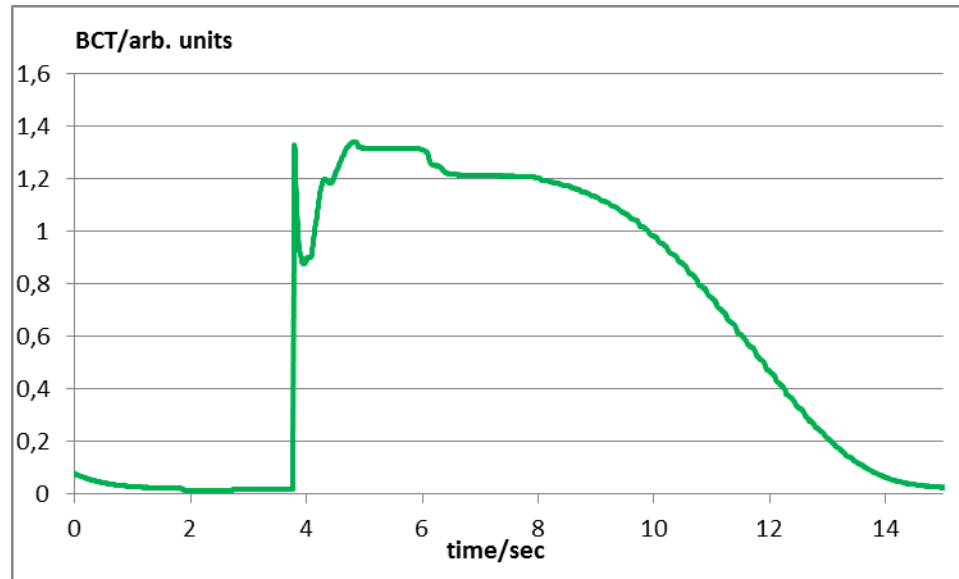
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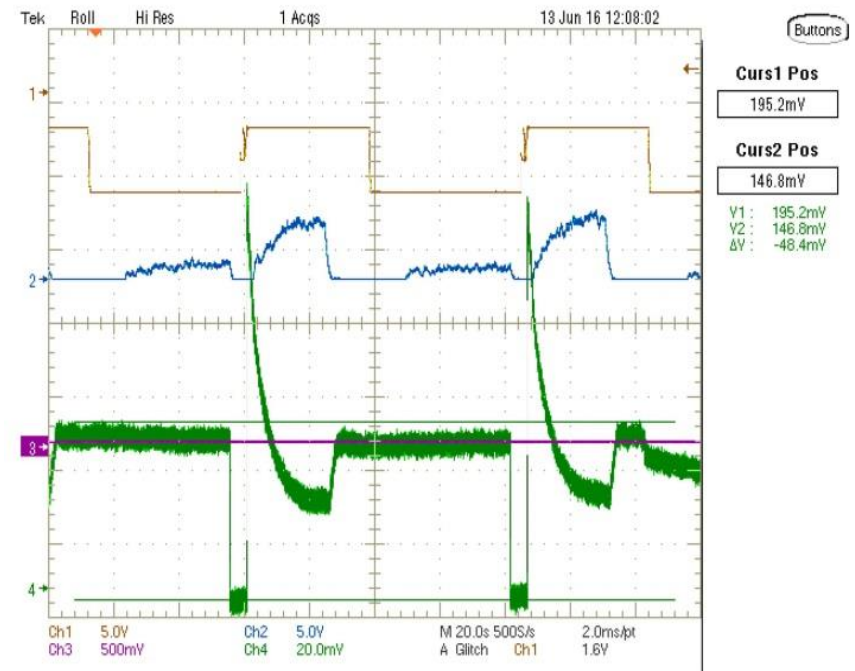
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another study topic:
losses during e-cooling at injection energy

Plan

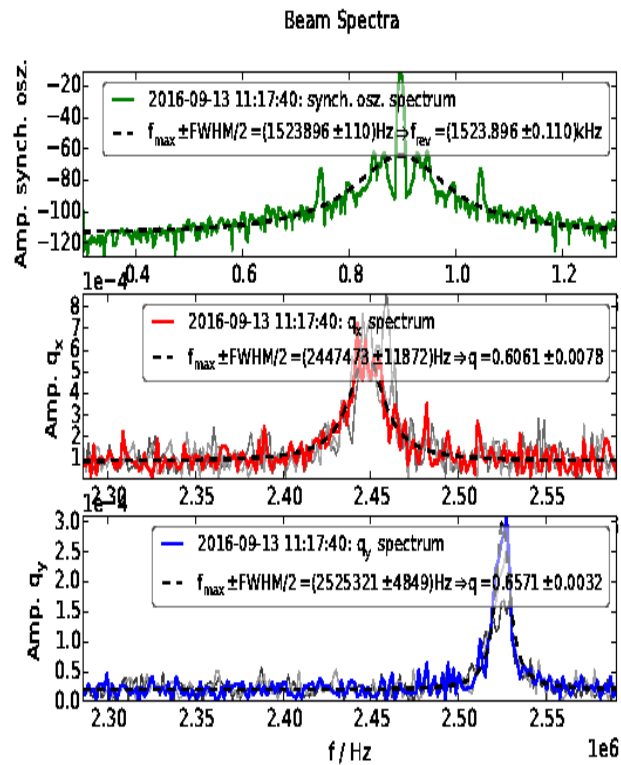
- No bunching loss for cooled beam, start with this setup

advantages:

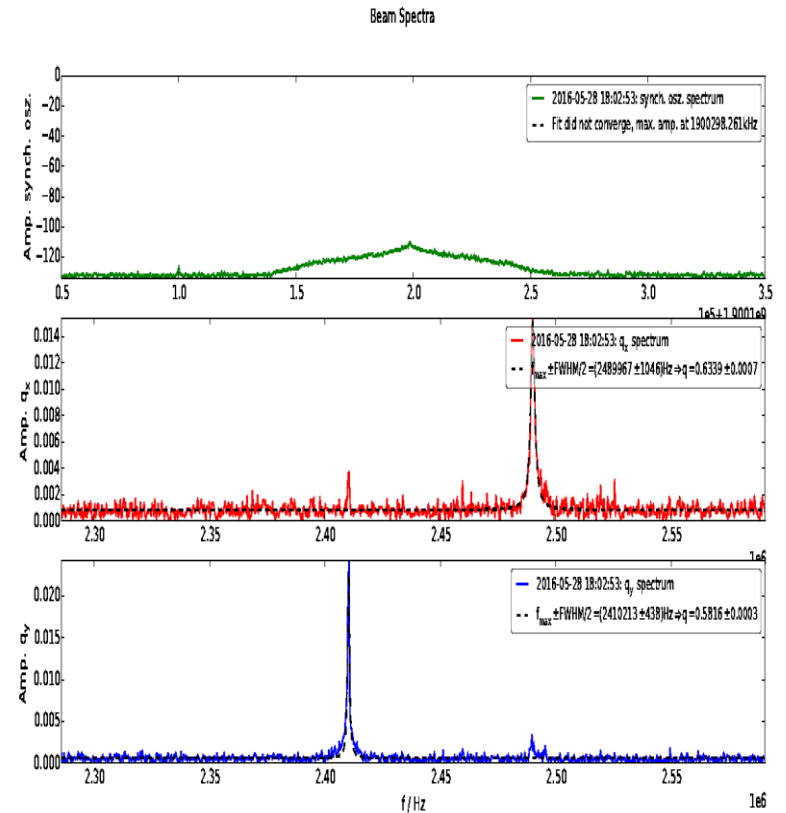
- control of momentum spread, hor. and vert. emittance independently (white noise on stripline)
- ‚pencil beam‘ allows good control/measurement of beam parameters

Tune measurements

uncooled



cooled



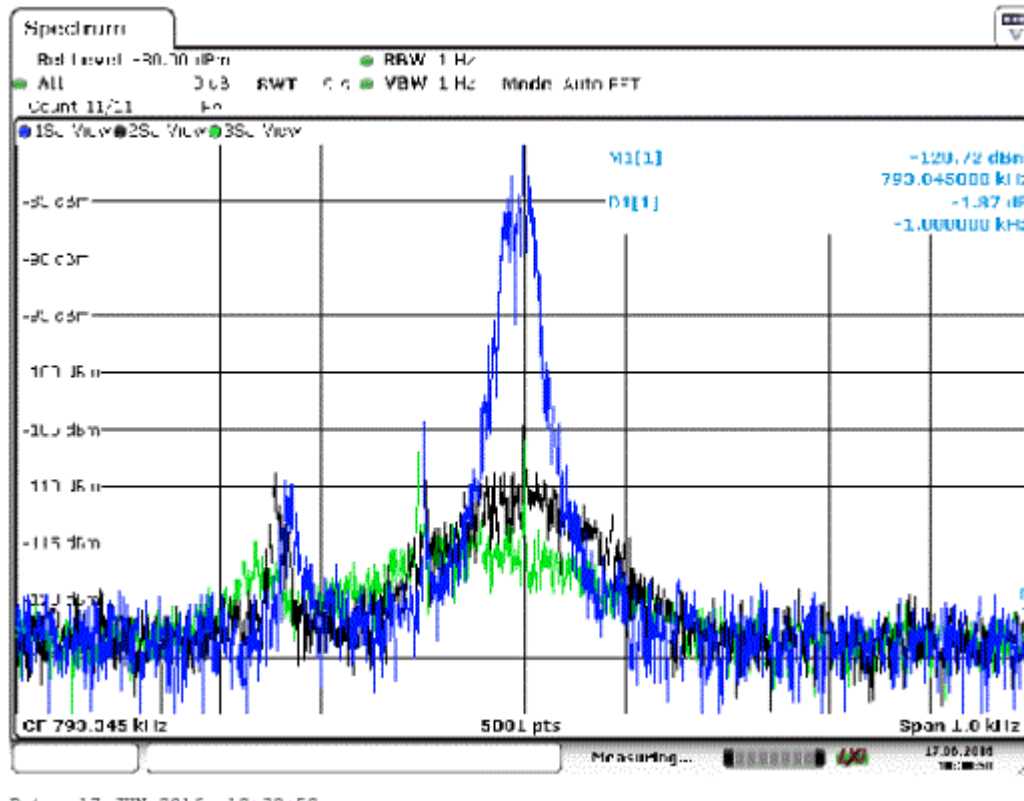
Schottky spectra

Blue cooled

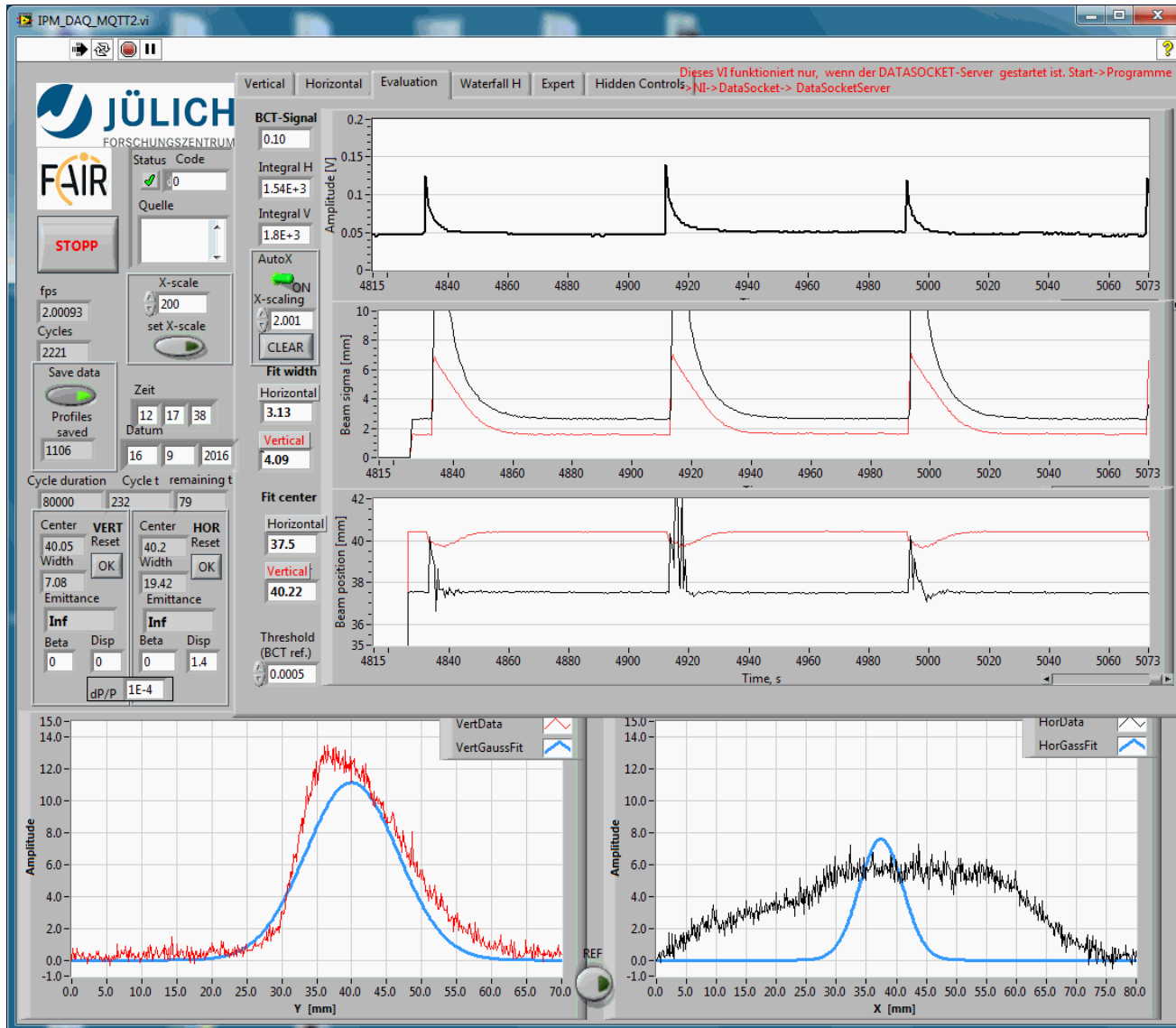
Cooling of after 60 sec

Black after 100 sec

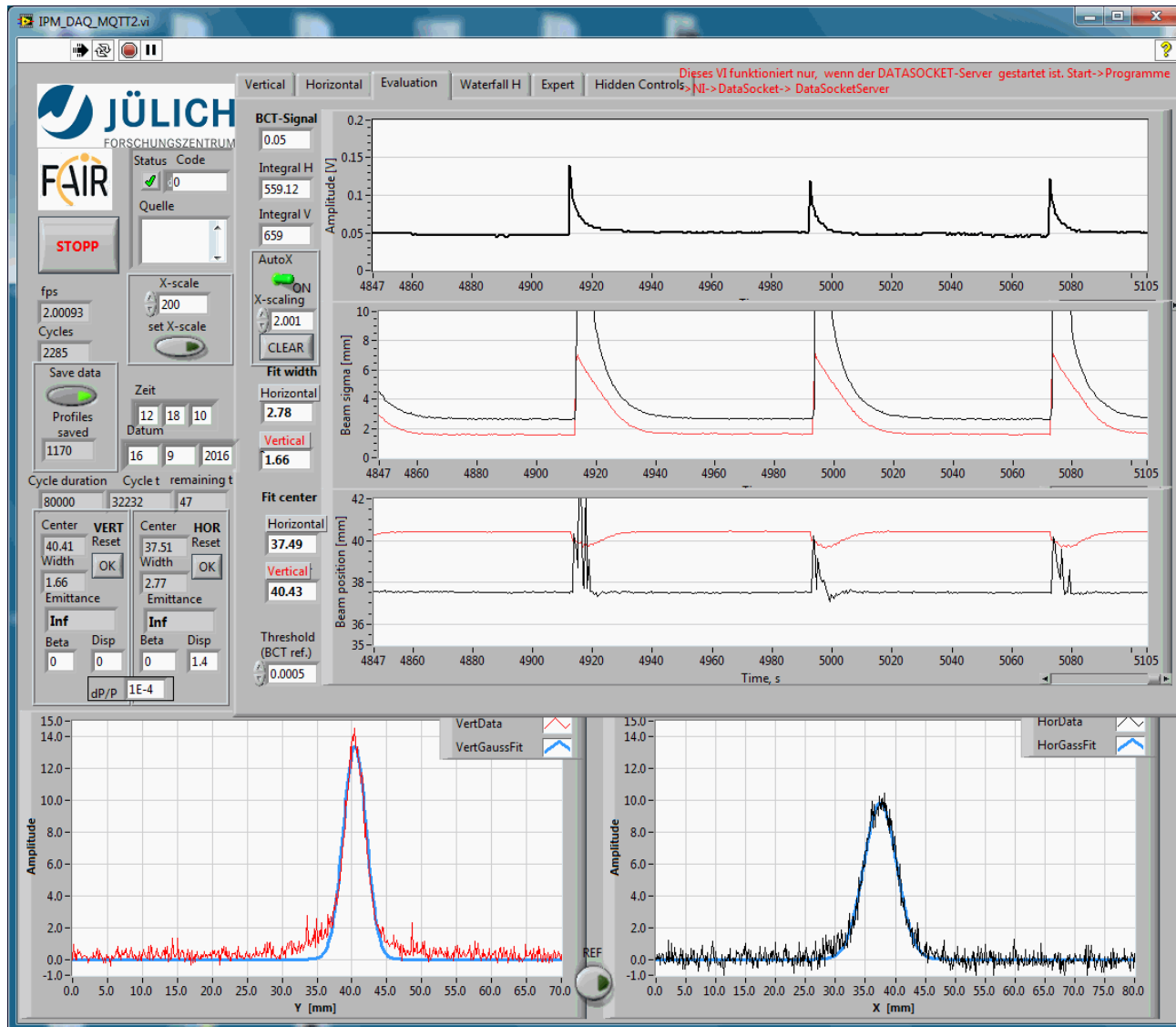
Green after 300 sec



IPM uncooled



IPM cooled



Plan

- No bunching loss for cooled beam, start with this setup

advantages:

- control of momentum spread, hor. and vert. emittance independently (white noise on stripline)
- ‚pencil beam‘ allows good control/measurement of beam parameters

disadvantage:

- Changed beam optics (e.g. phase space coupling through uncompensated solenoid fields, tune change through solenoids)
- orbit distortion by cooler toroids (reduced transverse acceptance)

!!! Uncooled no control of momentum spread and emittance !!!

Plan

- Prerequisites: careful adjustment of beam conditions
 - verify closure of injection bump
 - orbit correction (automized orbit response measurement)
 - tune scanning for best bunching
 - calibration of cavity amplitude (synchr. Frequency)
 - measurement of momentum spread and acceptance (schottky) and emittances (IPM)

Summary

Detailed study planned for early 2017 (pending CBAC#5, Dec. 2016 and scheduling)

Two weeks recommended by CBAC#4 but not scheduled (request included loco measurements and study of e-cooling losses)