

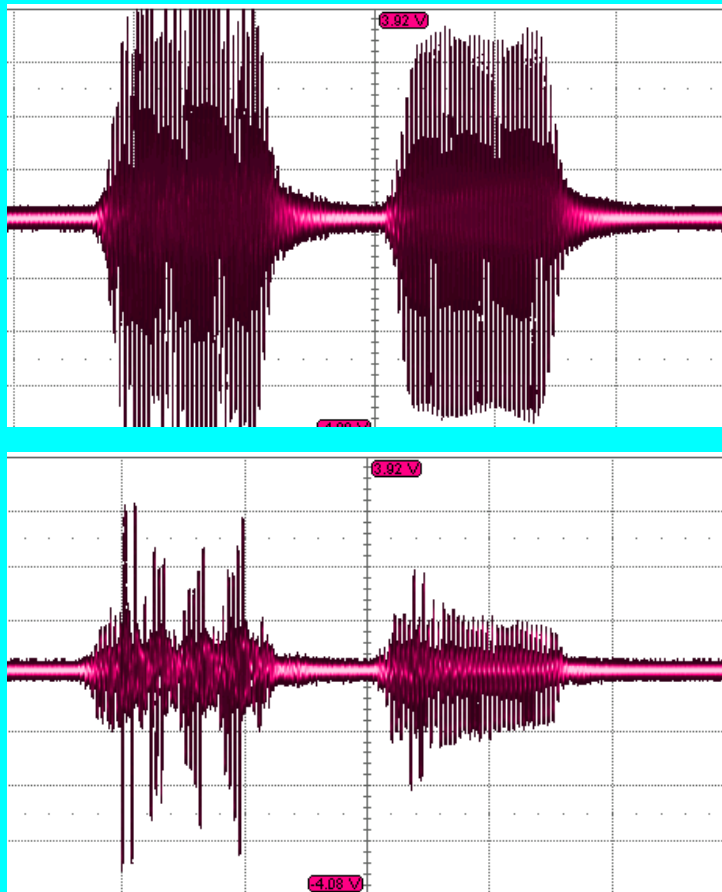


**Forschungszentrum Karlsruhe**  
in der Helmholtz-Gemeinschaft

# A Vertical Multi-Bunch Feedback System for ANKA

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## Motivation



Increased Current

Beam excites Wake Fields or/  
Higher Order Modes (HOM)

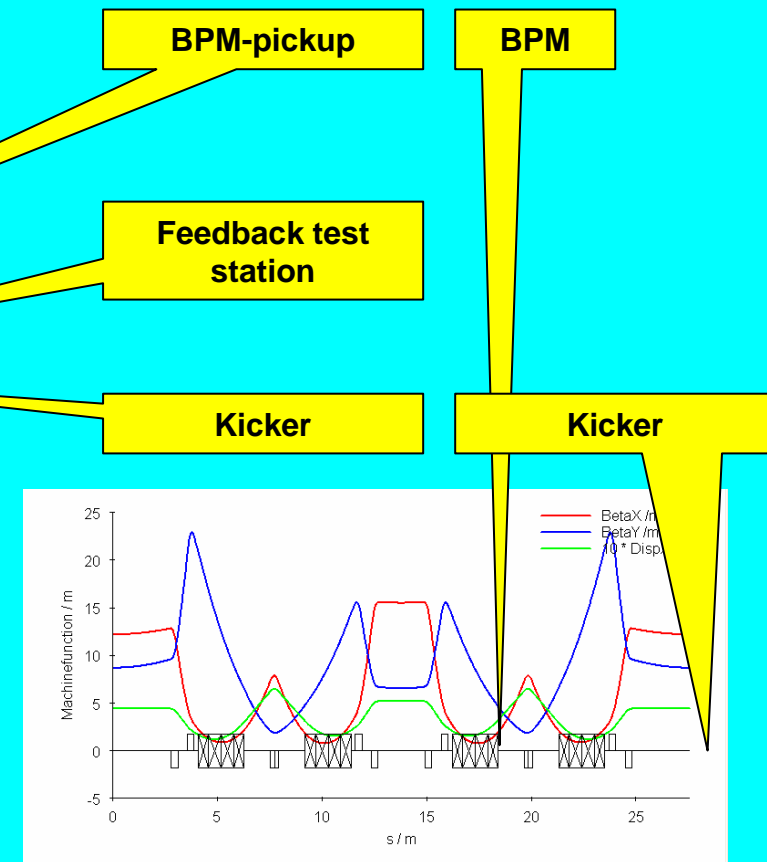
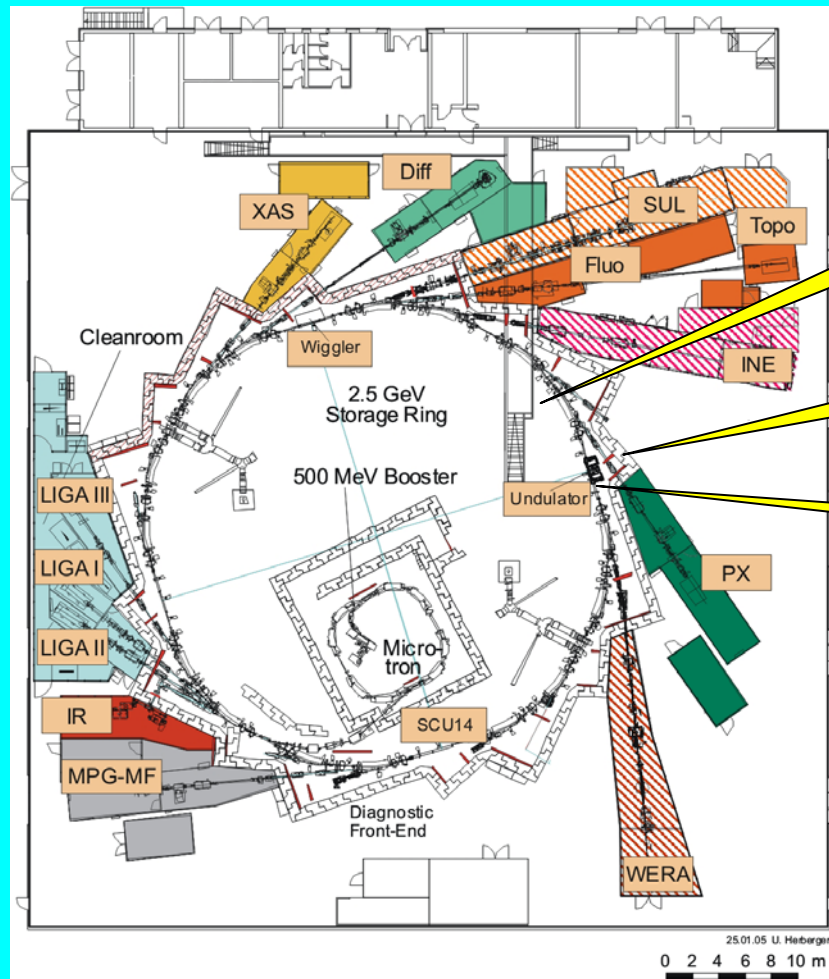
Those lead to beam instabilities

Betatron oscillations with (partial or  
total) beam loss

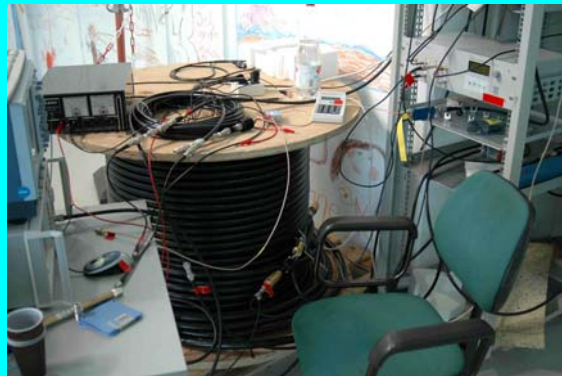
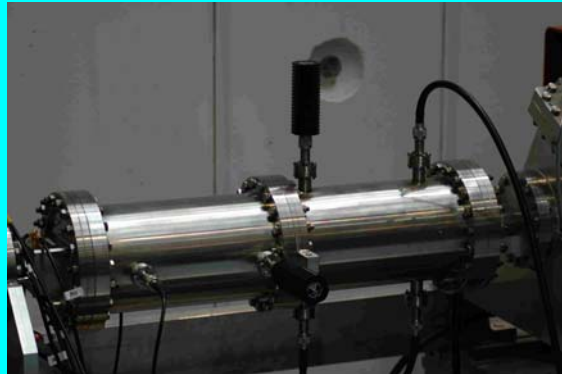
Cure: Feedback System



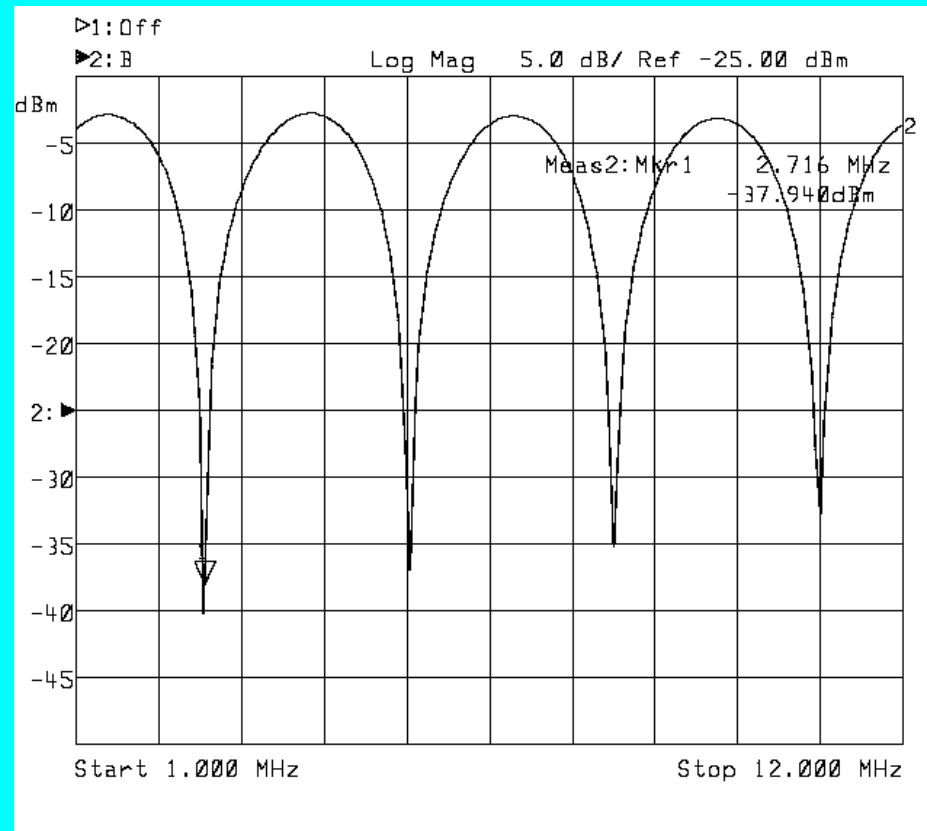
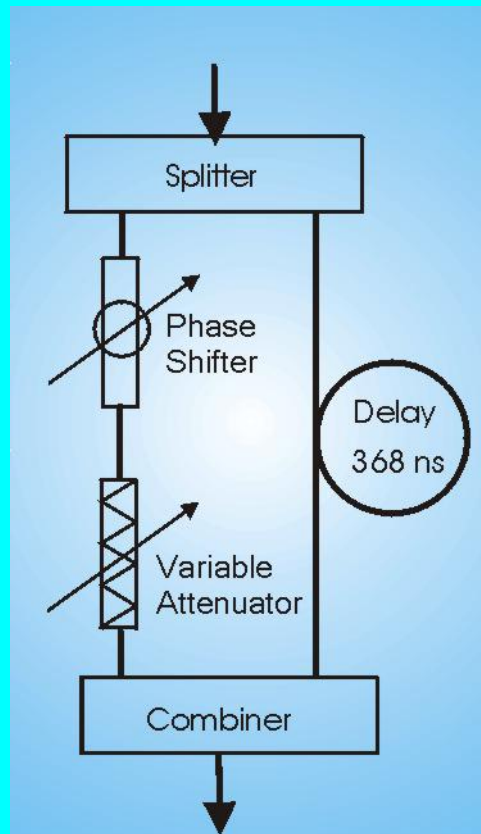
## ANKA-Ring



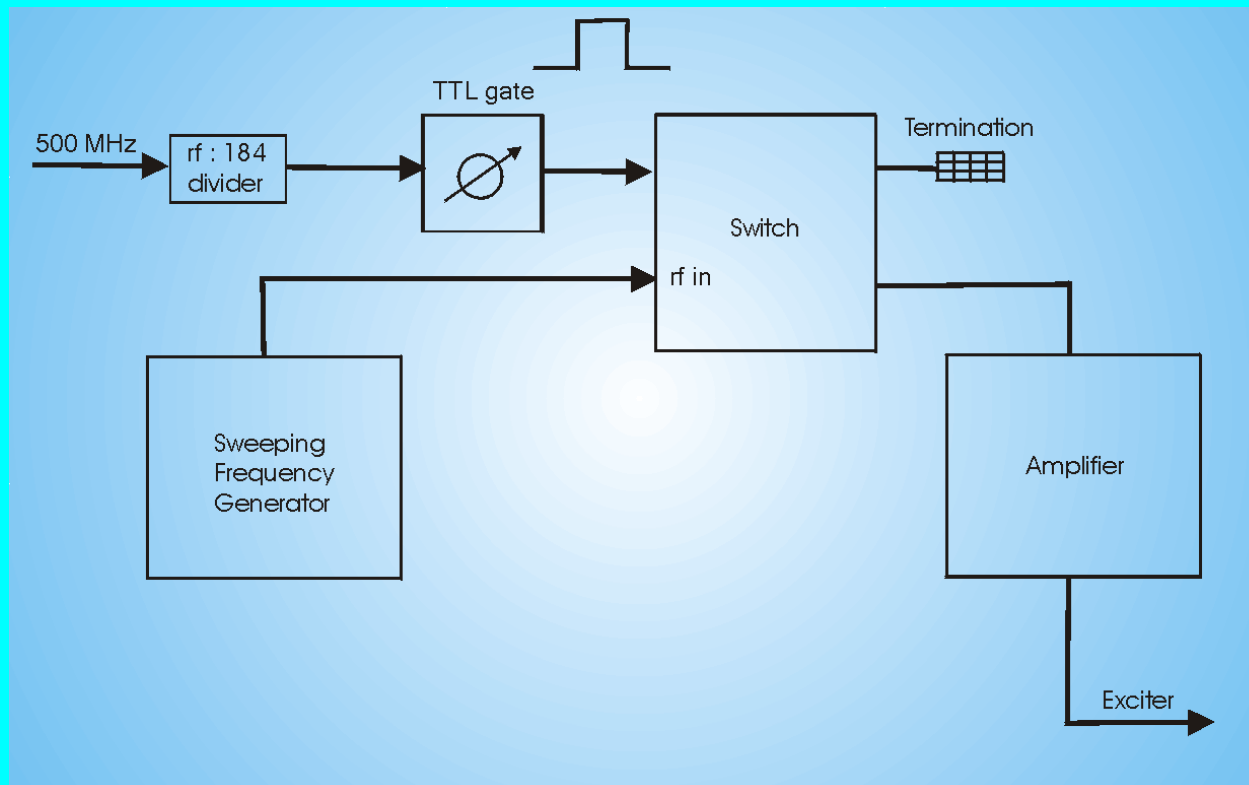
## RF Kicker and Overall View



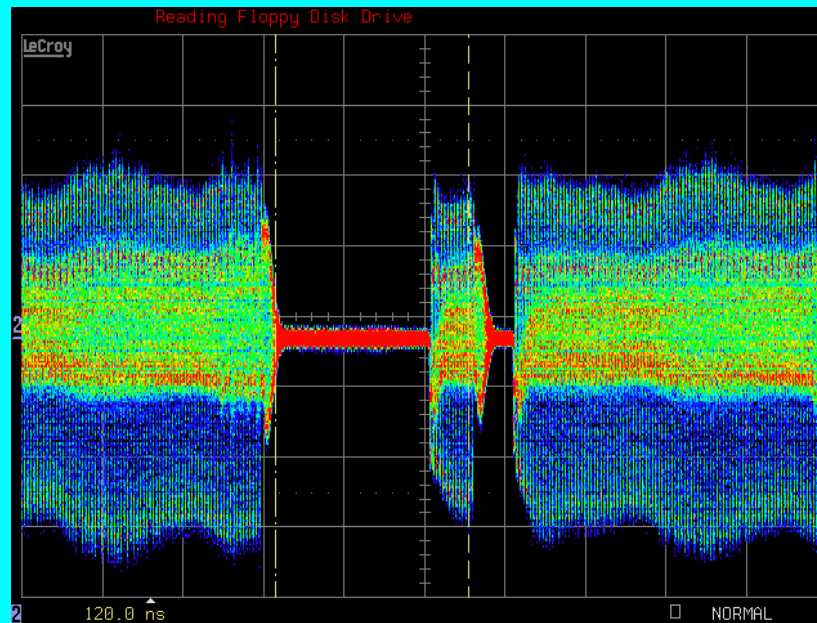
## Transfer Function of the reject Notch-Filter



## Knock-Out Generator



## Gap Produced by Knock-Out Generator

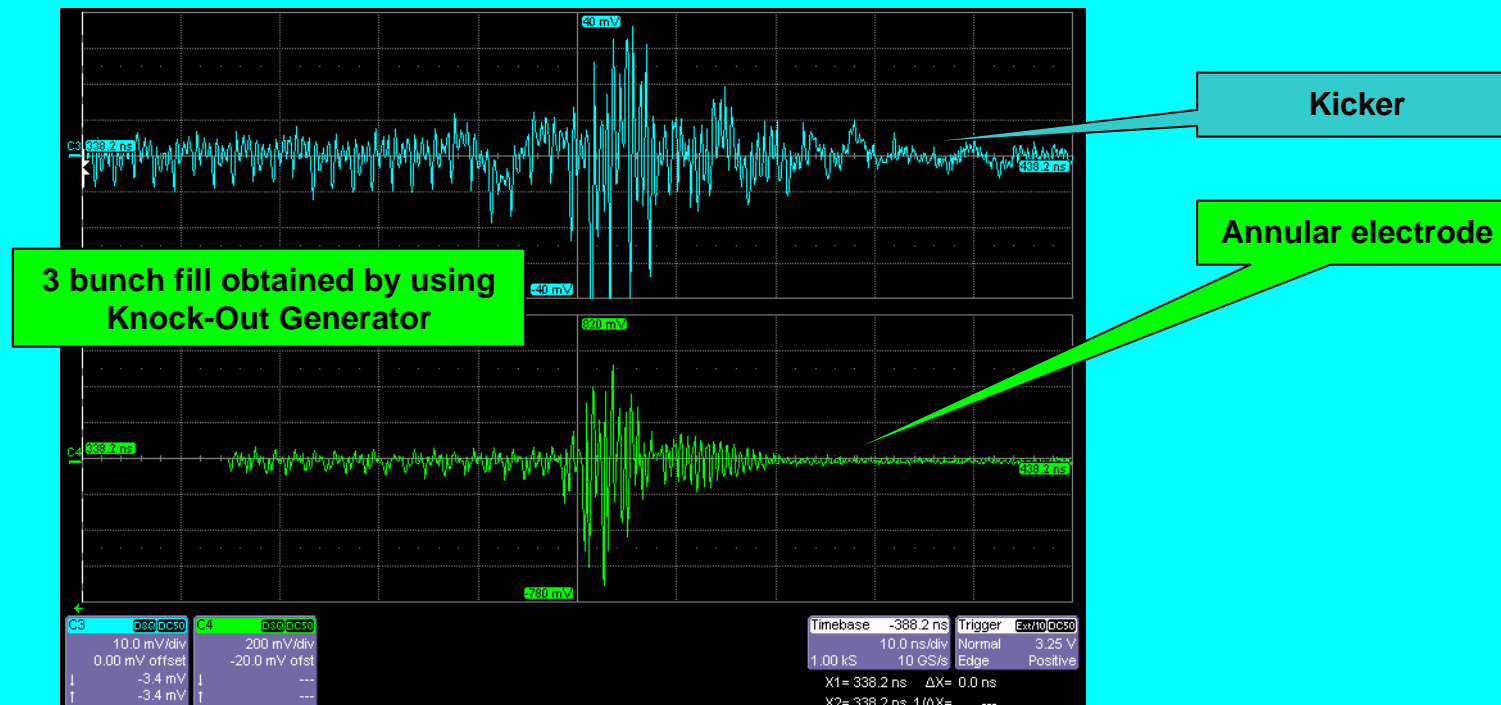


The gap length can be adjusted by the length of the TTL-gate pulse.

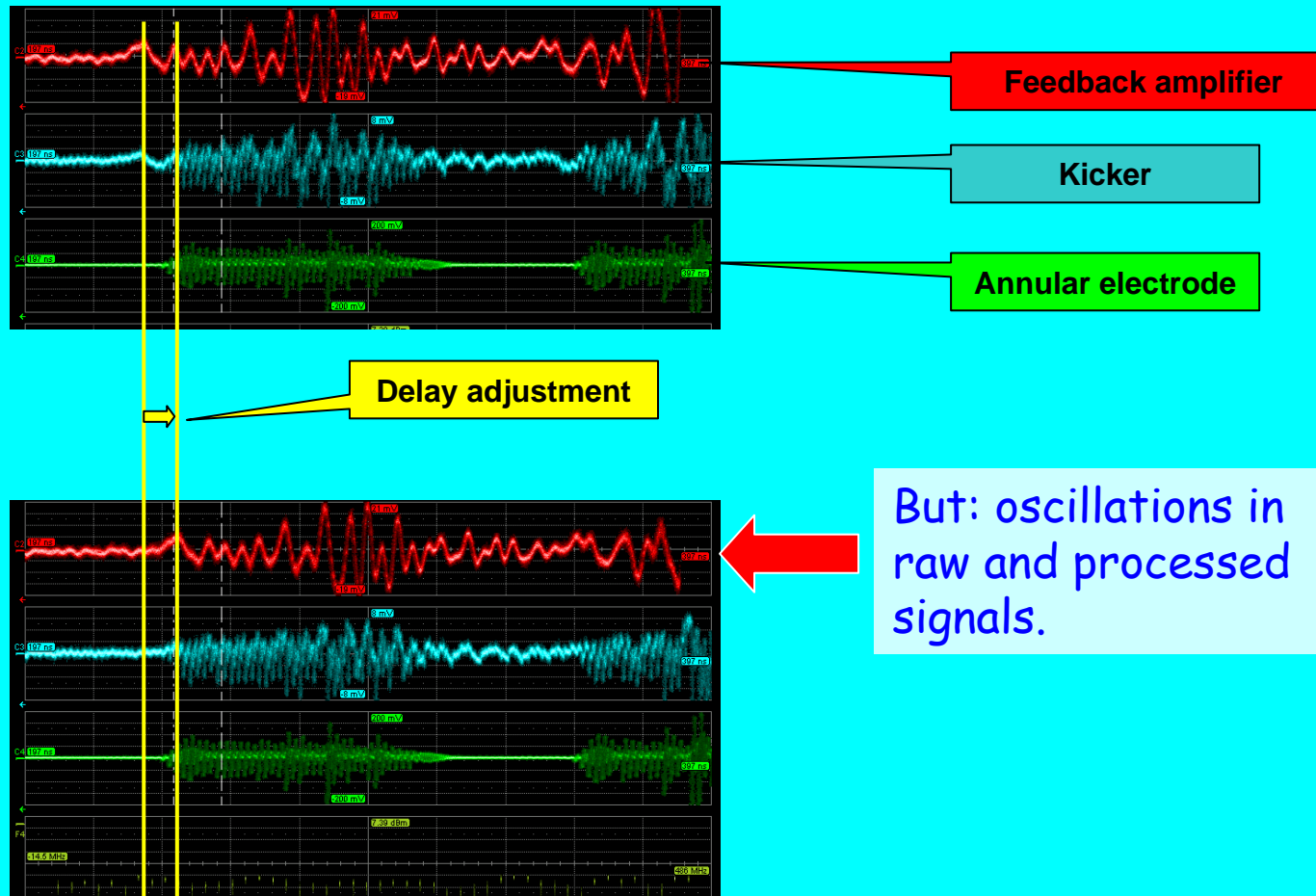


## Feedback Timing

Single bunch mode is presently not available at ANKA



## Feedback Timing



## Feedback Phase and Gain Adjustment

Gain is beam current dependent.

Gain and phase are operation-mode dependent (optic, energy).

Phase and gain adjustment was done empirically by searching for the best beam stabilizing condition, when instabilities were provoked by reducing chromaticity.

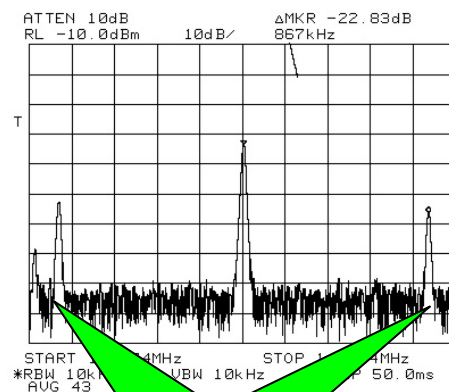
## Beam Profile and Frequency Spectrum

open TFB loop

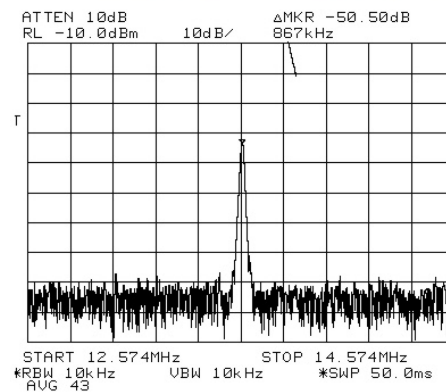
Closed TFB loop



Beam Profile



Sidebands

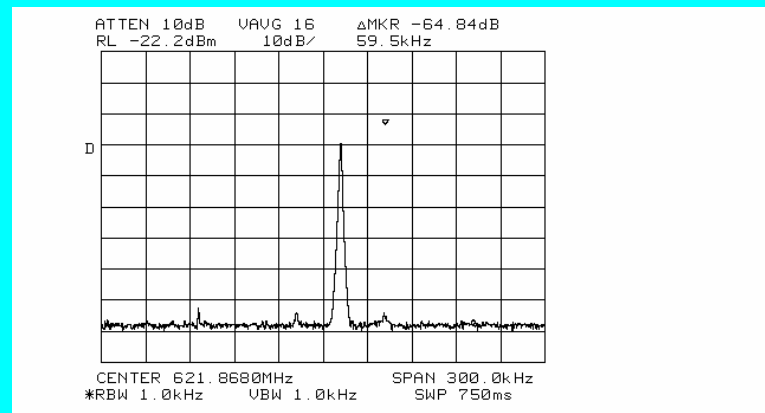
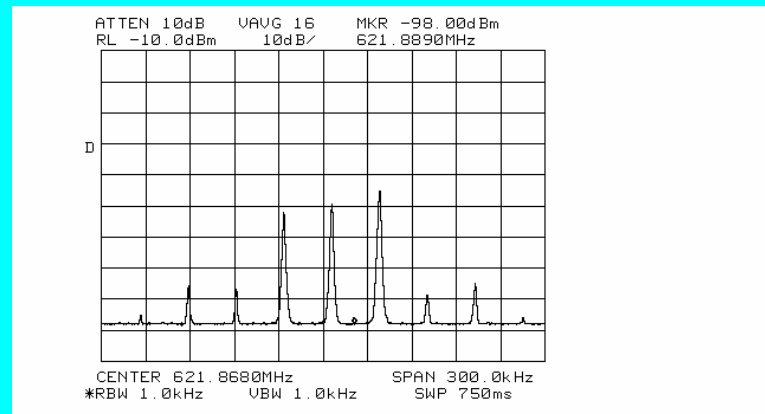
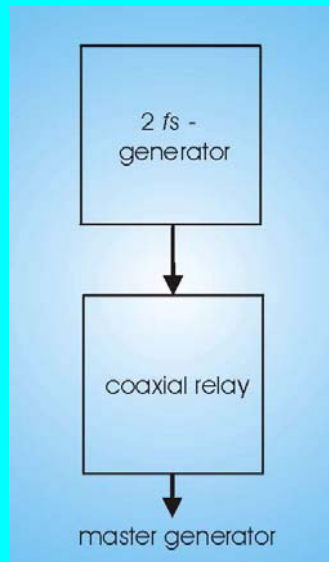


No sidebands detected

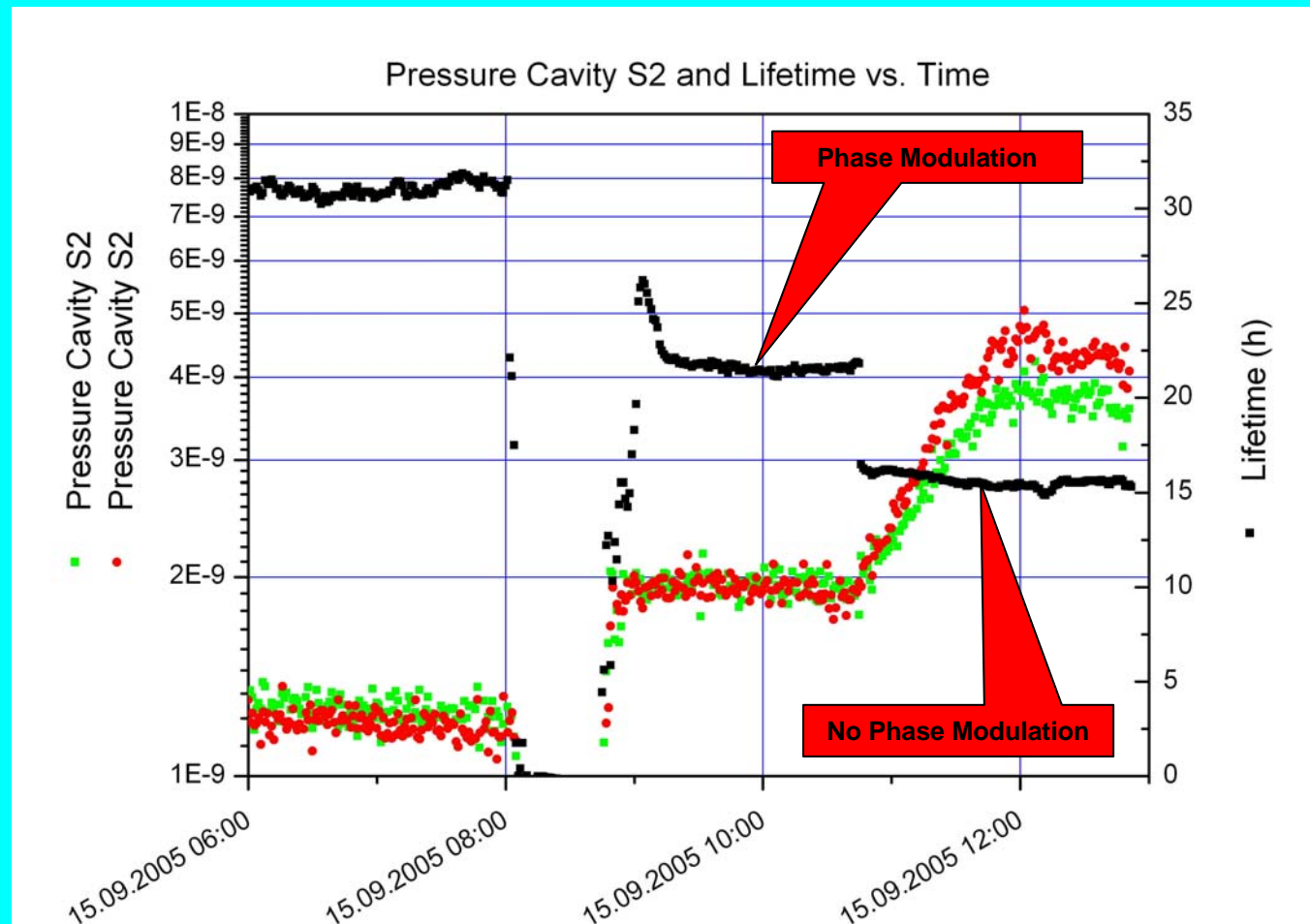
Frequency spectrum

## Phase Modulation

Phase Modulation at  $2f_s$   
may increase the beam  
lifetime and can ease  
coupled bunch instabilities.



## Modulation and Beam Lifetime



## Summary and Outlook

Successful operation of TFS was demonstrated.

The TFS has been implemented and tested under standard user operation conditions.

Further studies of instabilities and cures are mandatory.

Continuous adapting of the TFS parameters is required.

Integration of TFS into the control system is necessary.

TFS is tricky, unpredictable and continuously absorbing