BESSY

Berliner Elektronenspeicherring-Gesellschaft
für Synchrotronstrahlung m.b.H.

# IOT Charakterization at BESSY (➔ HZB)

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Agenda:

- BESSY + HMI ➔ HZB
- MLS in Operation
- Bessy Transmitter
- IOT Tubes
- Measurements

Leibniz Gemeinschaft

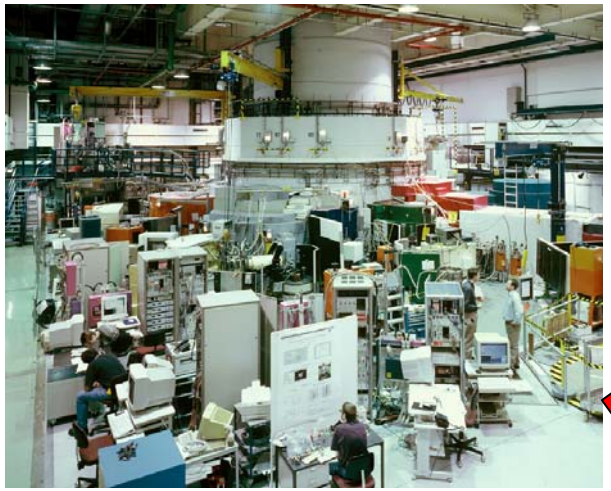
# HMI + BESSY ➔ HZB

HELMHOLTZ ZENTRUM BERLIN für Materialien und Energie

hmi

BESSY

**1.1.2009 BESSY and HMI merge to HZB**




Experimental hall of BER II reactor

Experimental hall of BESSY II

# MLS in Operation

EU cavity at the MLS storage ring

360° view of the MLS storage ring

**Meterology Light Source in user operation since April 2008**

- Injection energy: 100 MeV
- Energy: 600 MeV
- Circumference: 48 m
- Current: 100 (200 ) mA
- Transmitter: 80 kW
- Cavity: EU Cavity

# BESSY Transmitter

- Stability requirements of the transmitters for the FEL (now ERL) project
  - Phase noise < 0.1 deg
  - Amplitude noise < 10e-3
- BESSY transmitter development with FUG (Rosenheim, Germany)
  ➔Results see last year
- Different IOT tubes tested at BESSY
  - CPI  30 kW 1300 MHz (prototype)
  - CPI  80 kW  500 MHz (two tubes) (at MLS storage ring)
  - E2V 20 kW 1300 MHz
  - Thales 1300 MHz will follow soon

# BESSY Transmitters

CPI IOT 500 MHz 80 kW

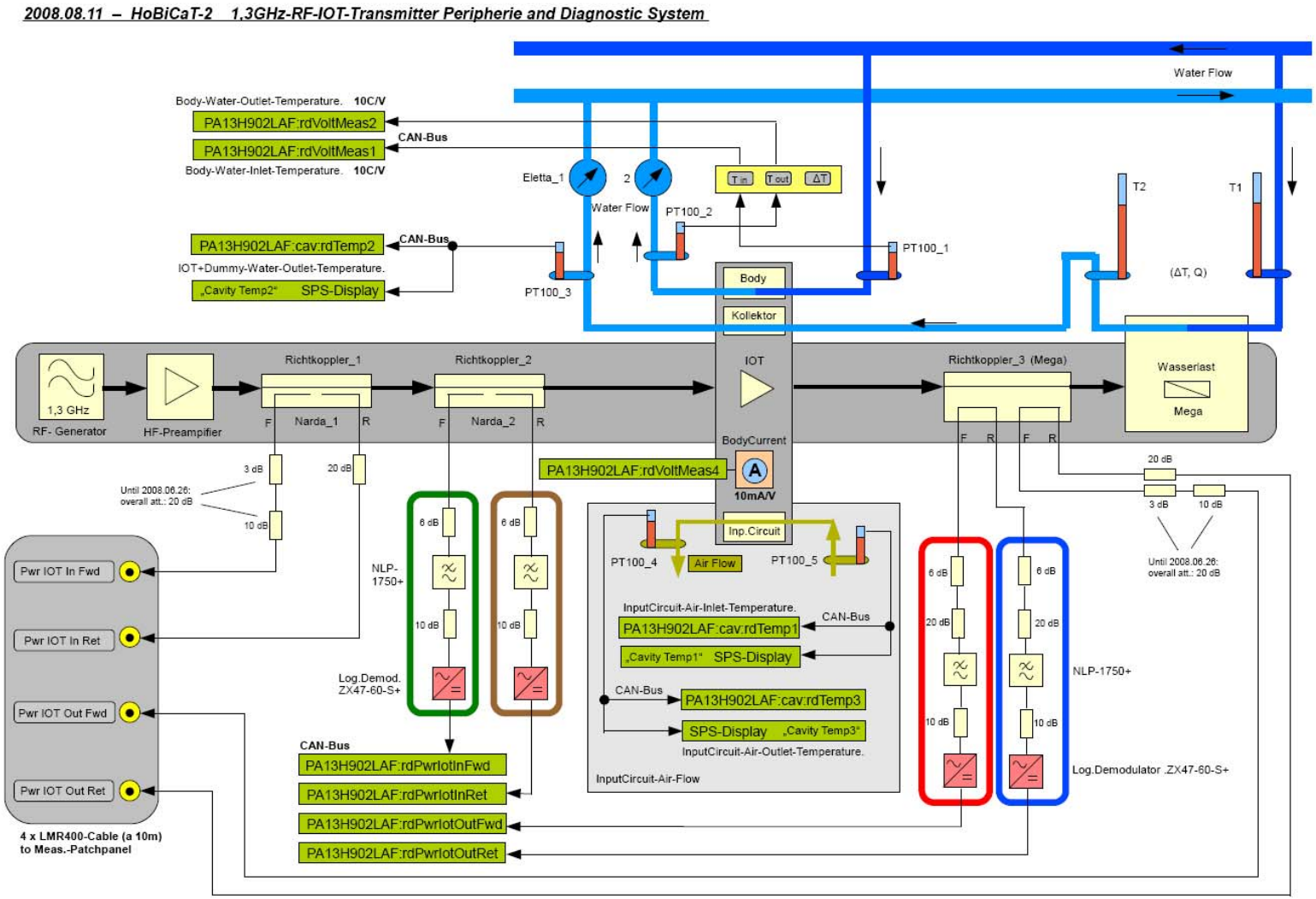
E2V IOT 1.3 GHz 20 kW

CPI IOT 1.3 GHz 30 kW Prototype

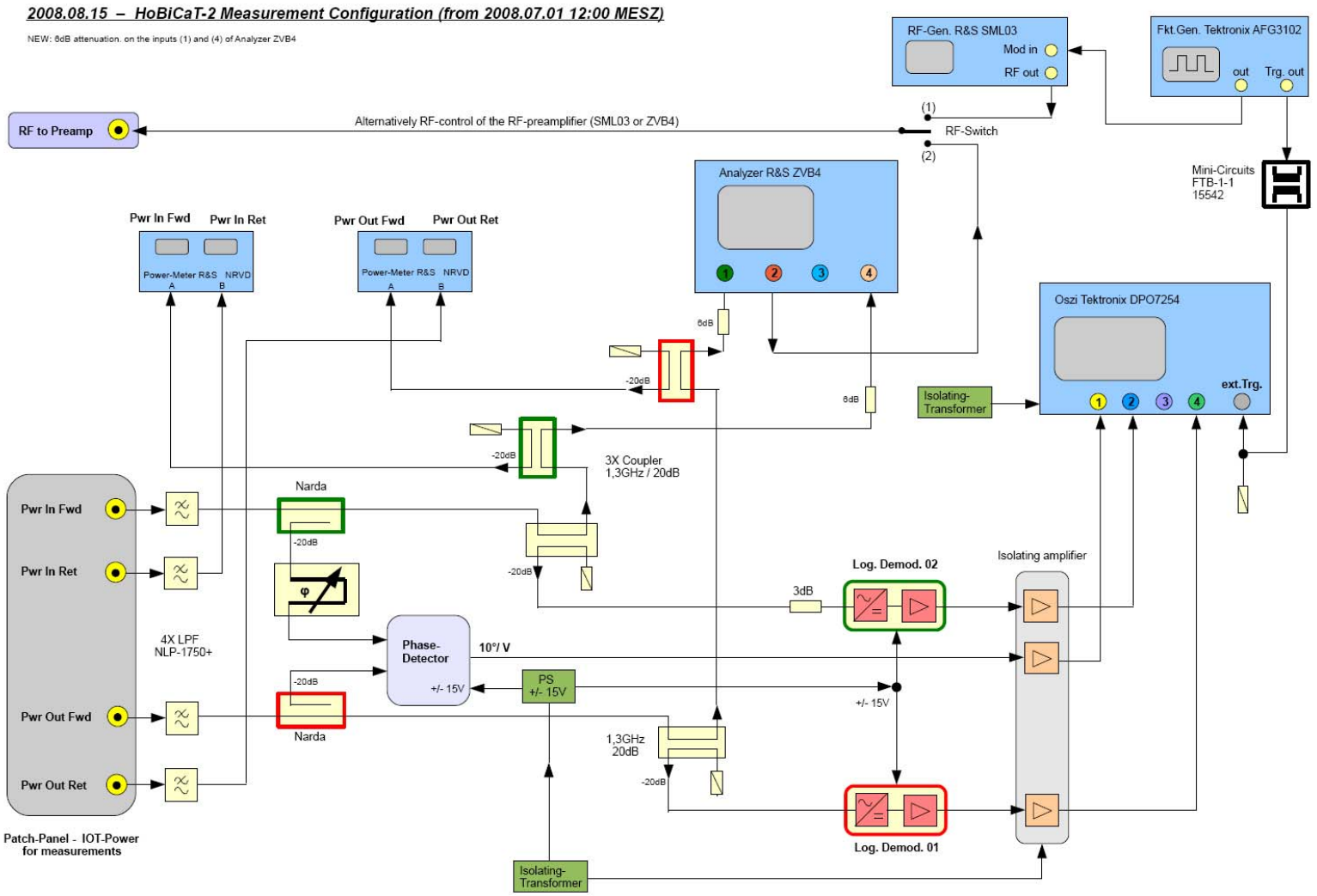

500 MHz 80 kW transmitter at the MLS

1.3 GHz 30 kW transmitter at HoBiCaT

# IOT Transmitter Measurement Peripherie

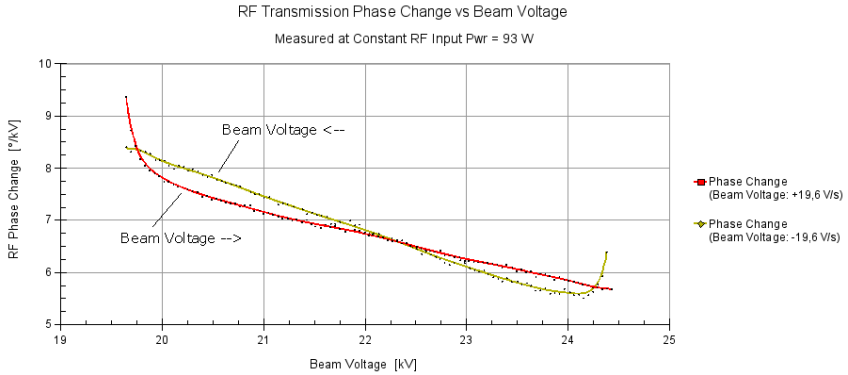


# Measurement Setup

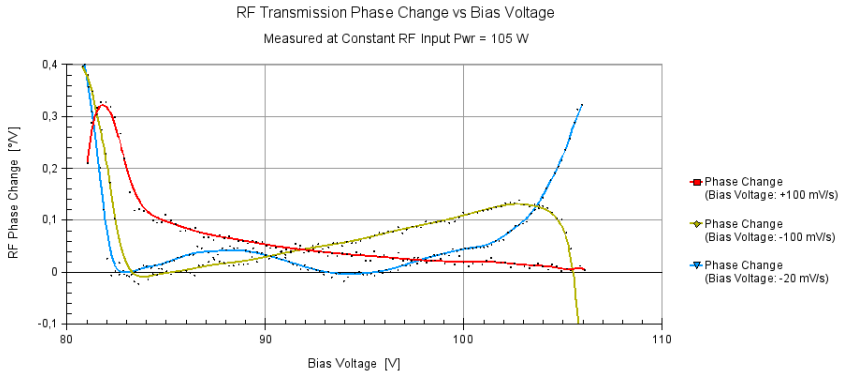



Measurements performed by H.G. Hoberg and A. Heugel

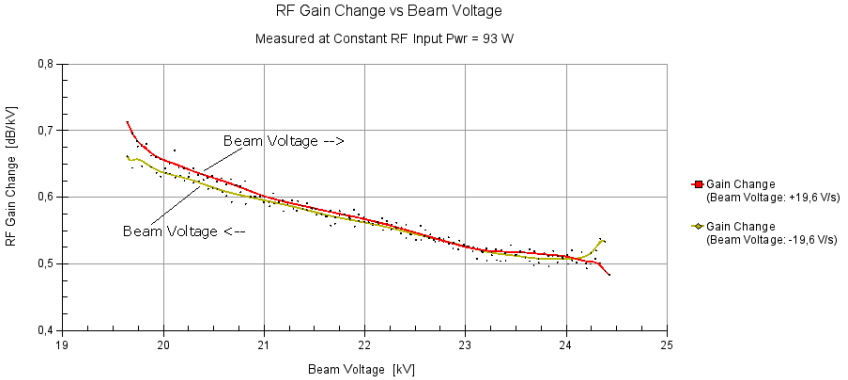
# Gain -- RF Power -- Phase



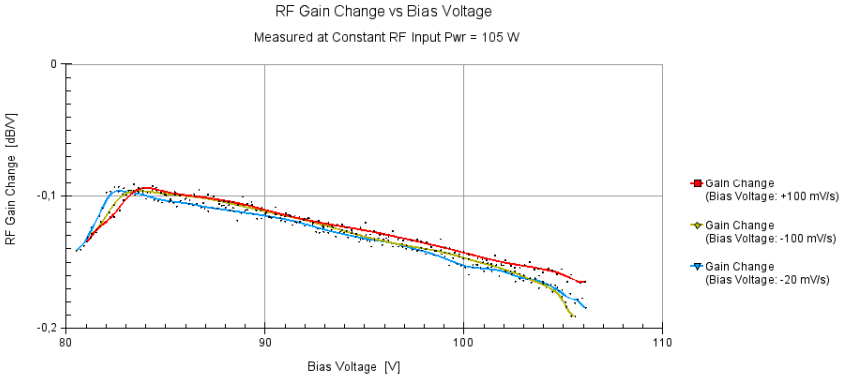

Phase change versus beam voltage
Red increasing voltage, green falling




Phase change versus bias voltage
Red increasing voltage, green falling, blue slow increasing

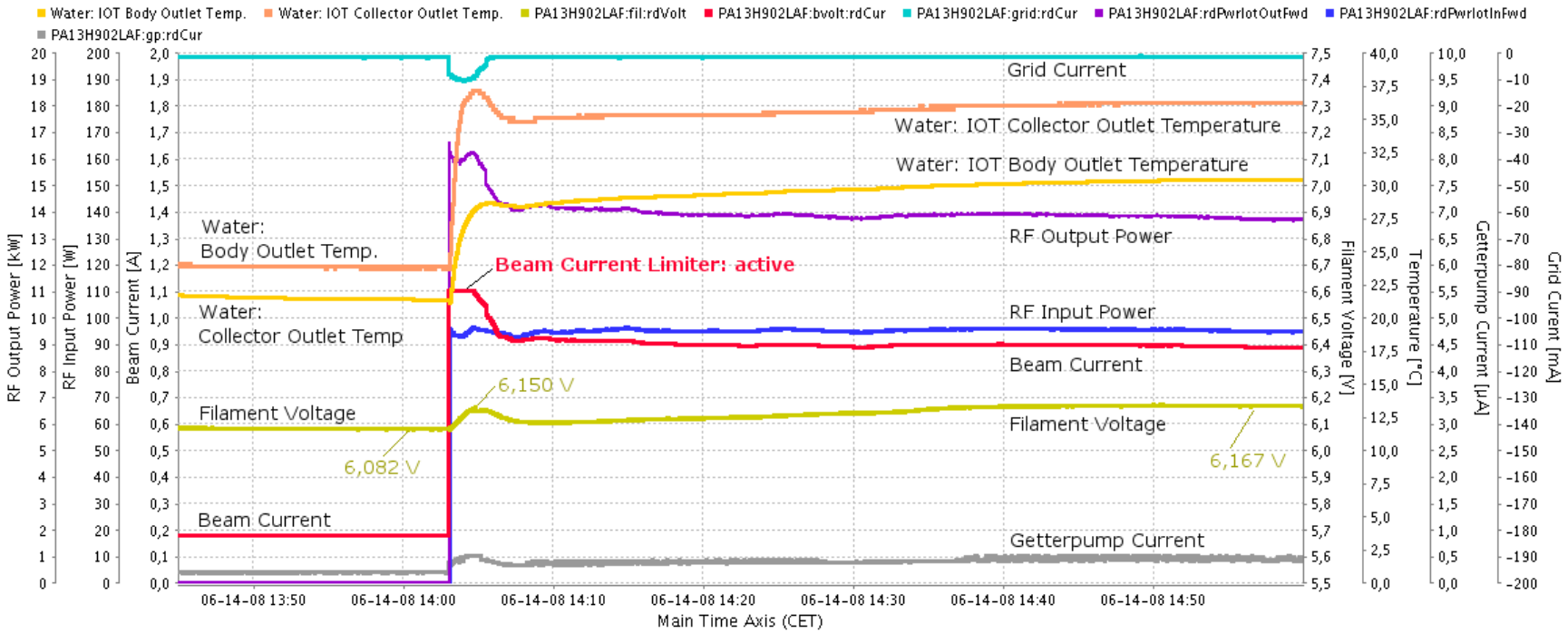



Gain change versus beam voltage
Red increasing voltage, green falling



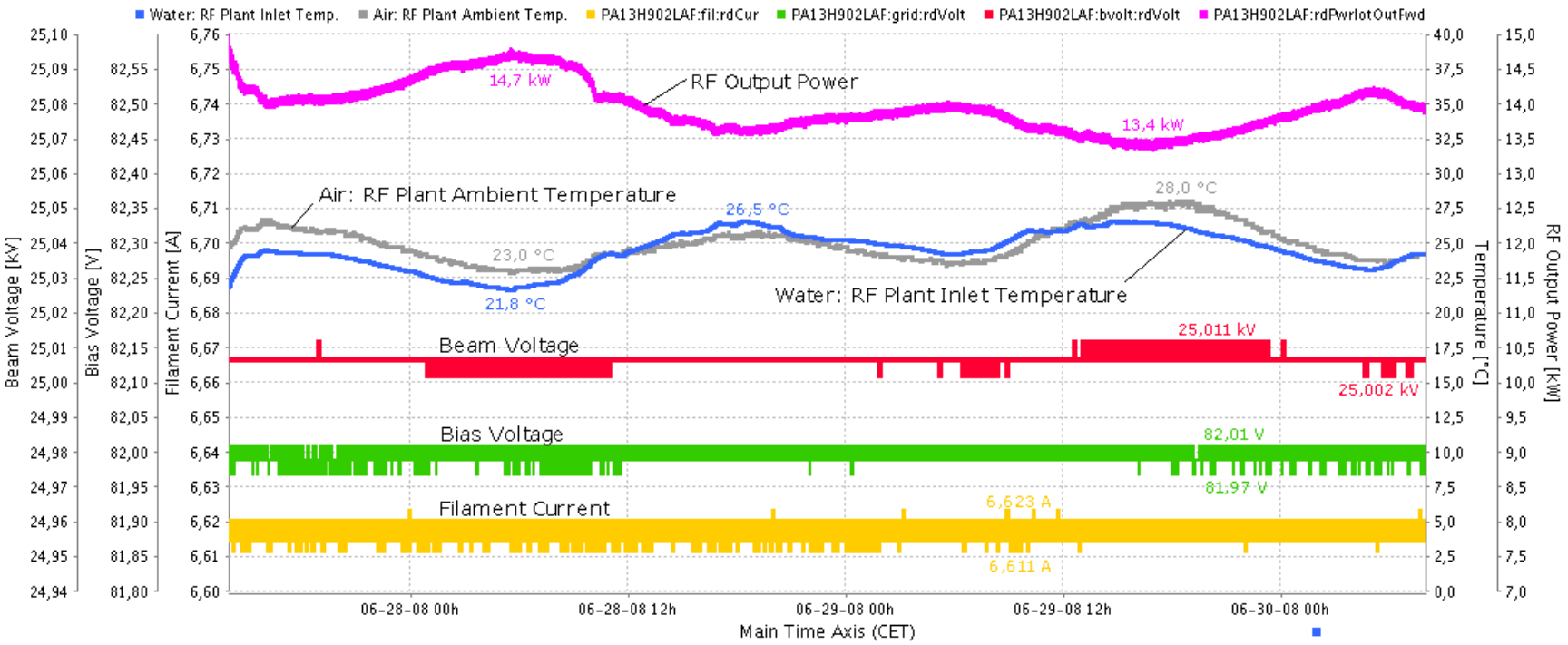

Gain change versus bias voltage
Red increasing voltage, green falling, blue slow increasing

# Switch On Drifts



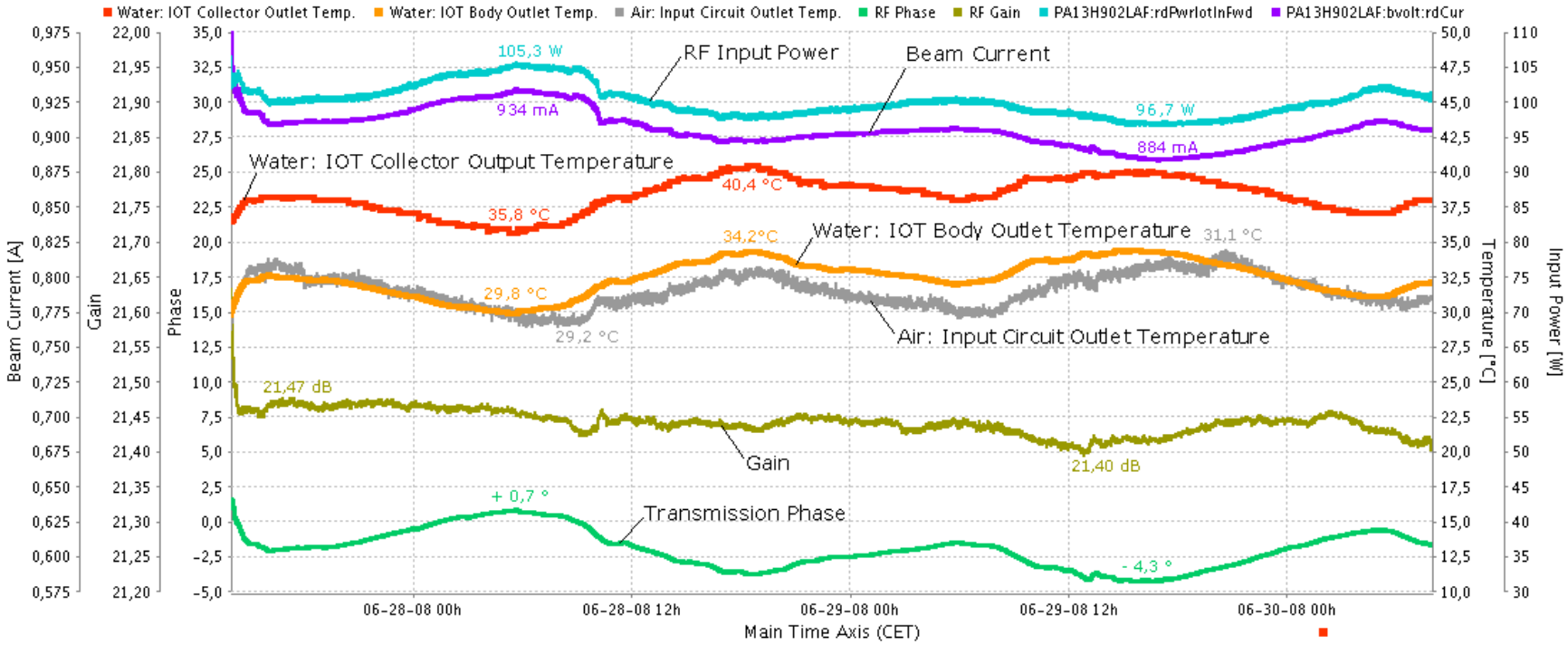

Switch on characteristics 0→ 14 kW of E2V tube (~1 hour): In first 3 minutes there is an overshoot in output power and beam current (limiter active). After this time only small and slow drifts.

# Long Term Stability




Long term stability (2.5 days): Output power varies with water and air temperature (see next foil master clock)

# Long Term Stability

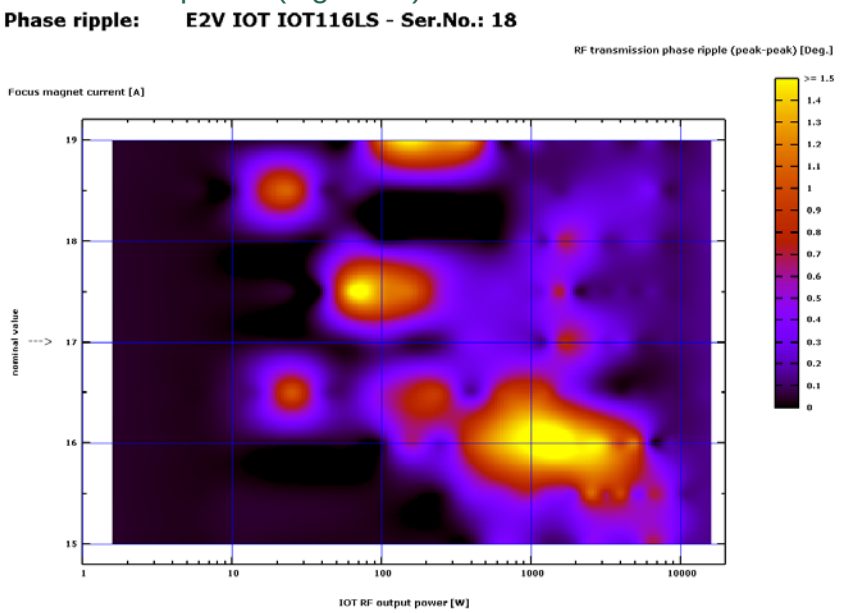



Long term stability (2.5 days): Master clock is not stable in temperature, gain is stable

phase varies 5° with input power (~10%)

# Instabilities

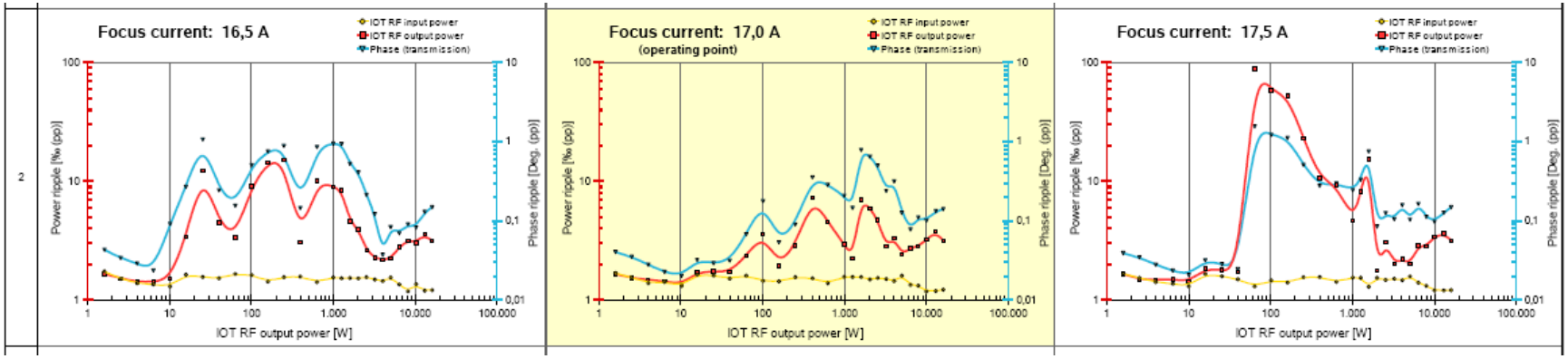
Instabilities of the phase in dependence of output power (log scale) and focus current.




Instabilities of the gain (output power, red) and phase noise (blue) in dependence of output power (log scale) and focus current.

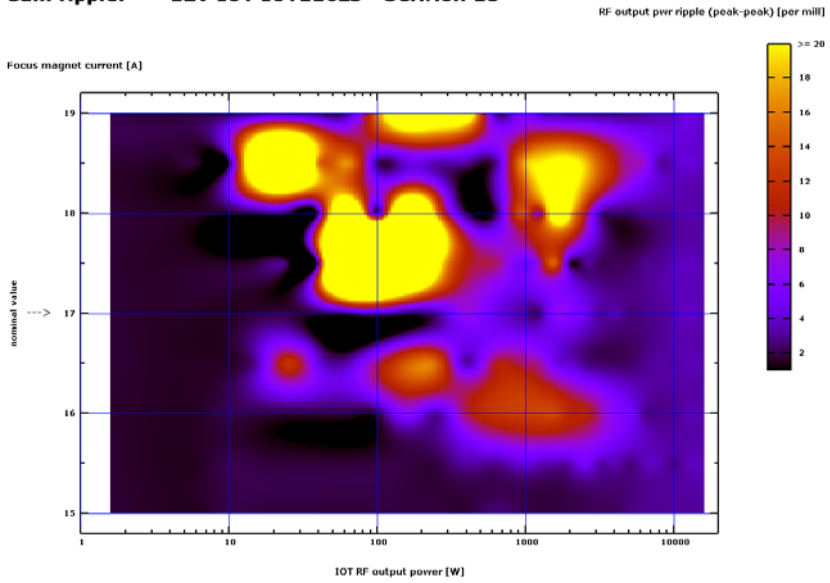
Amplitude instabilities are up to 1% range and phase instabilities 1° range.

The time constant of the instabilities is random about a few milliseconds.



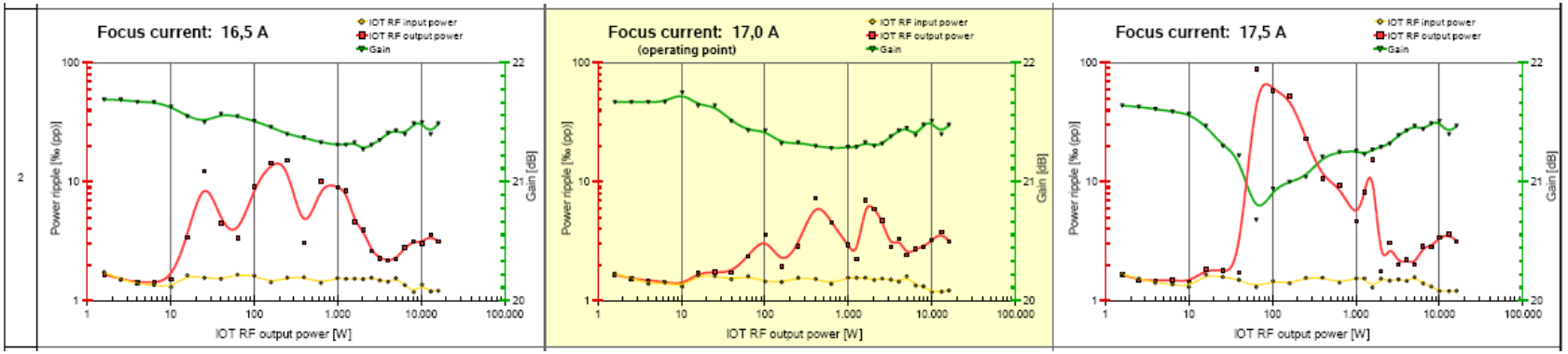
# Instabilities

Instabilities of the output power in dependence of output power (log scale) and focus current.

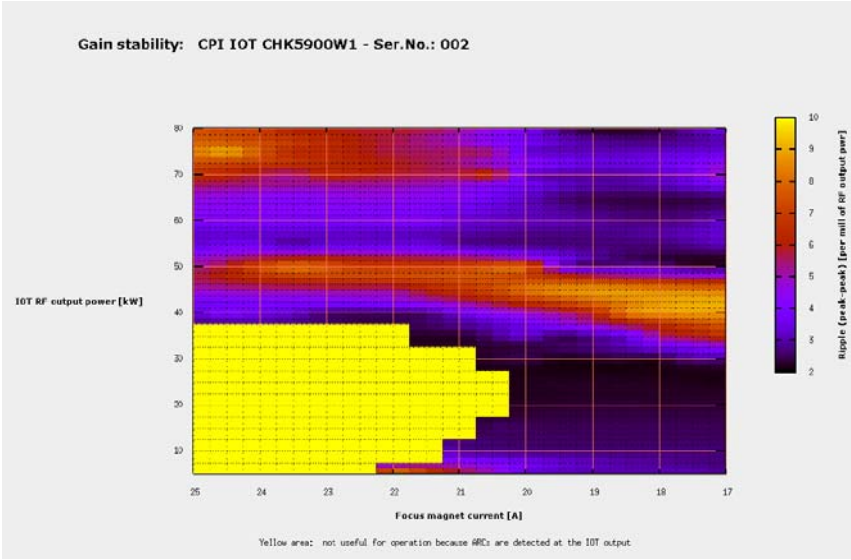


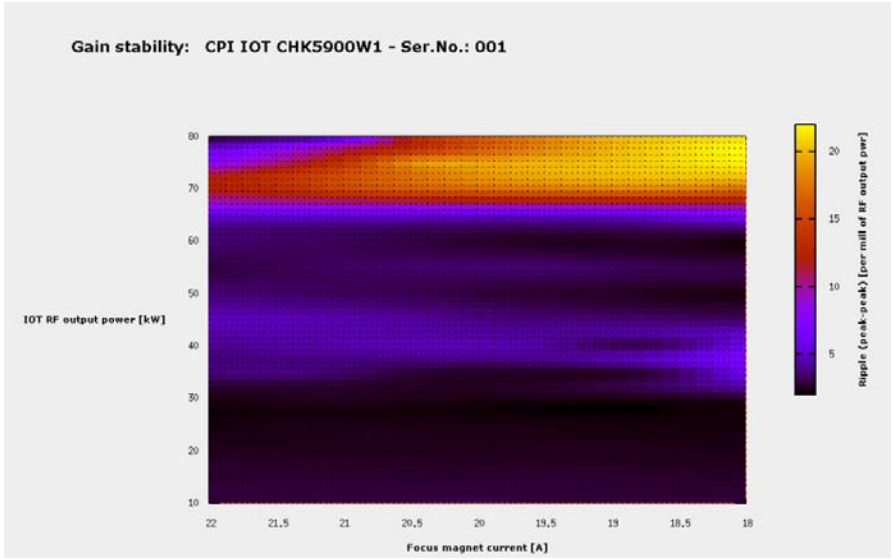

Instabilities of the gain (output power, red) and total gain Green) in dependence of output power (log scale) and focus current.

In the areas of high instability activities, the gain of the IOT drops. This is an indicator, that the beam current is involved (ions??).



# Instabilities




Two IOT CPI 500 MHz 80 kW

Left: No 002 from first production series

Right: No 001 is send back to factory because of the instabilities but damage on transport ➔ new rebuild with the knowledge of instability ➔ better performance

Arc area: reflected light from electron beam ??

# Summary

- New institute HZB was introduced
- New light source MLS in operation
- BESSY has developed a RF transmitter with high stability power supplies
- A setup to characterize the IOT performance in detail was shown
- Different IOT were characterized
  - Thermal drifts when switched on (similar to some klystron)
  - Long term performance is good
  - Instabilities in 1% AM and 1 deg phase range depending on focus current and power level
    - ➔ manufacturers are working on this item

➔ Annoucement: SRF09 conference at HZB/Rossendorf 20.-25.9.2009