Dark current based resonance temperature measurement

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PITZ physics seminar
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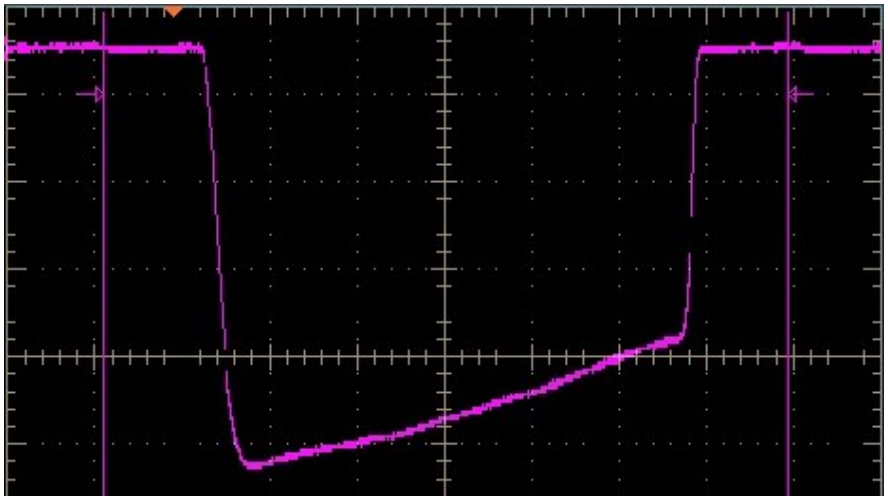
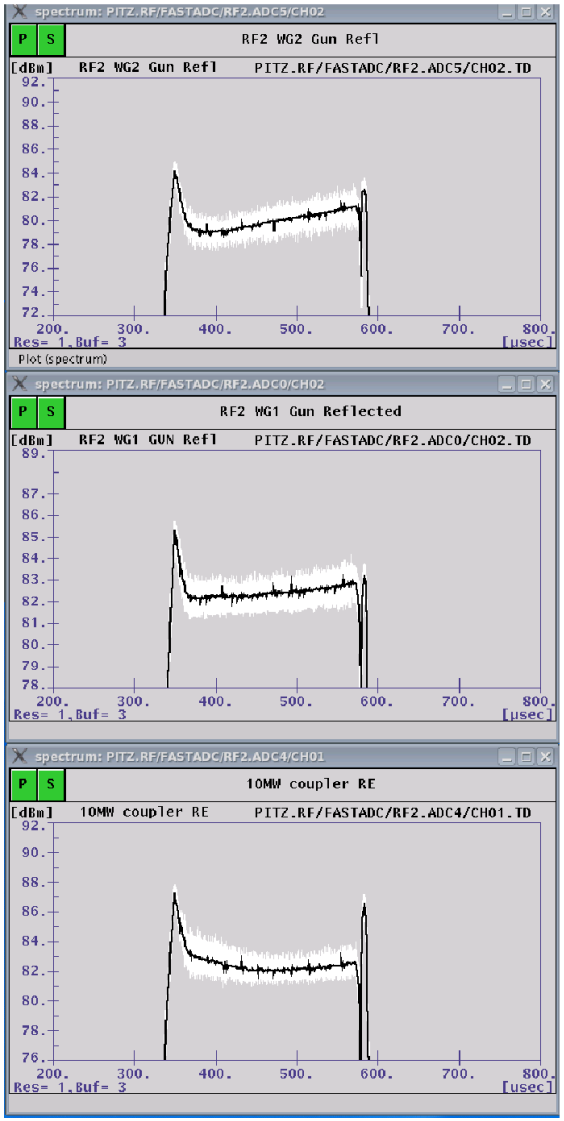
DESY

Motivation

Difference in determination of resonance temperature basing on reflected power spectra slopes from 2x5MW and 10MW couplers.

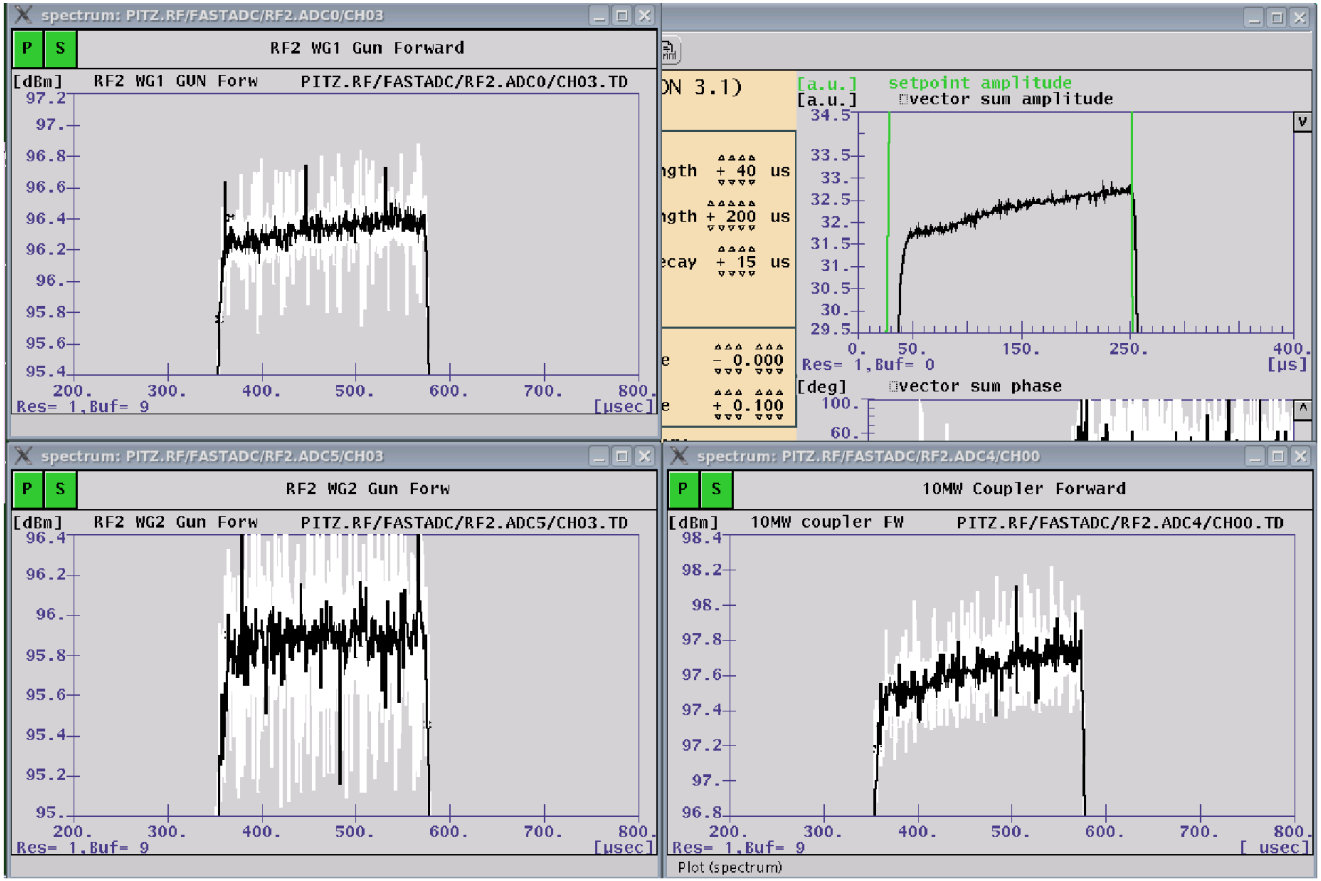
Dark current is a direct image of the power in the gun within the RF pulse length





Measurement flow, conditions

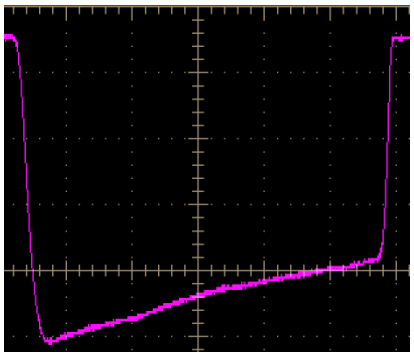
Gun is set to 200 us RF pulse length
Peak power is 7.8 MW around the resonance
Default settings for LLRF correction of the forward power is used



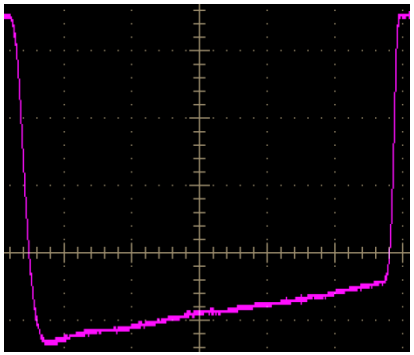
Measurement flow, first measurement

Single shot dark current was measured for different gun temperatures

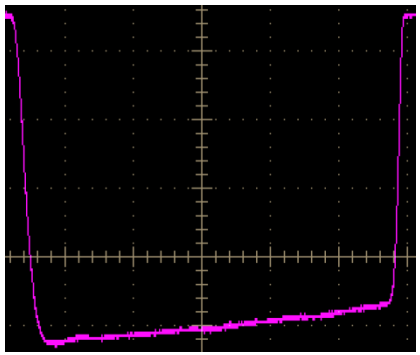
72.45, p2p = 471.2 uA



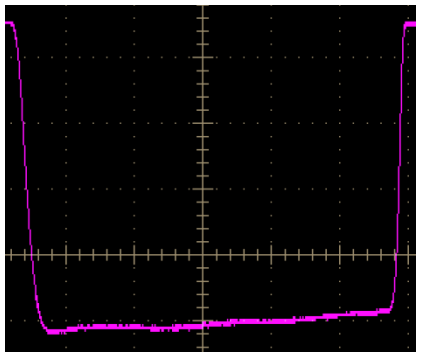
72.35, p2p = 491.6 uA



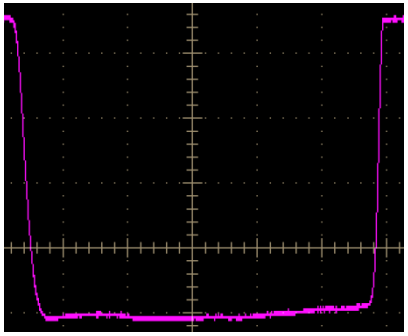
72.25, p2p = 485.6 uA



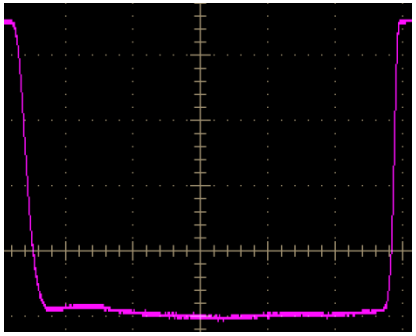
72.15, p2p = 478.2 uA

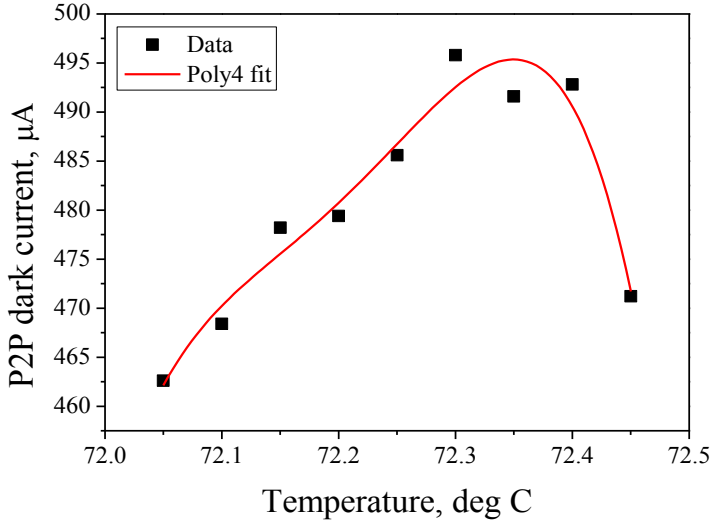


72.10, p2p = 468.4 uA

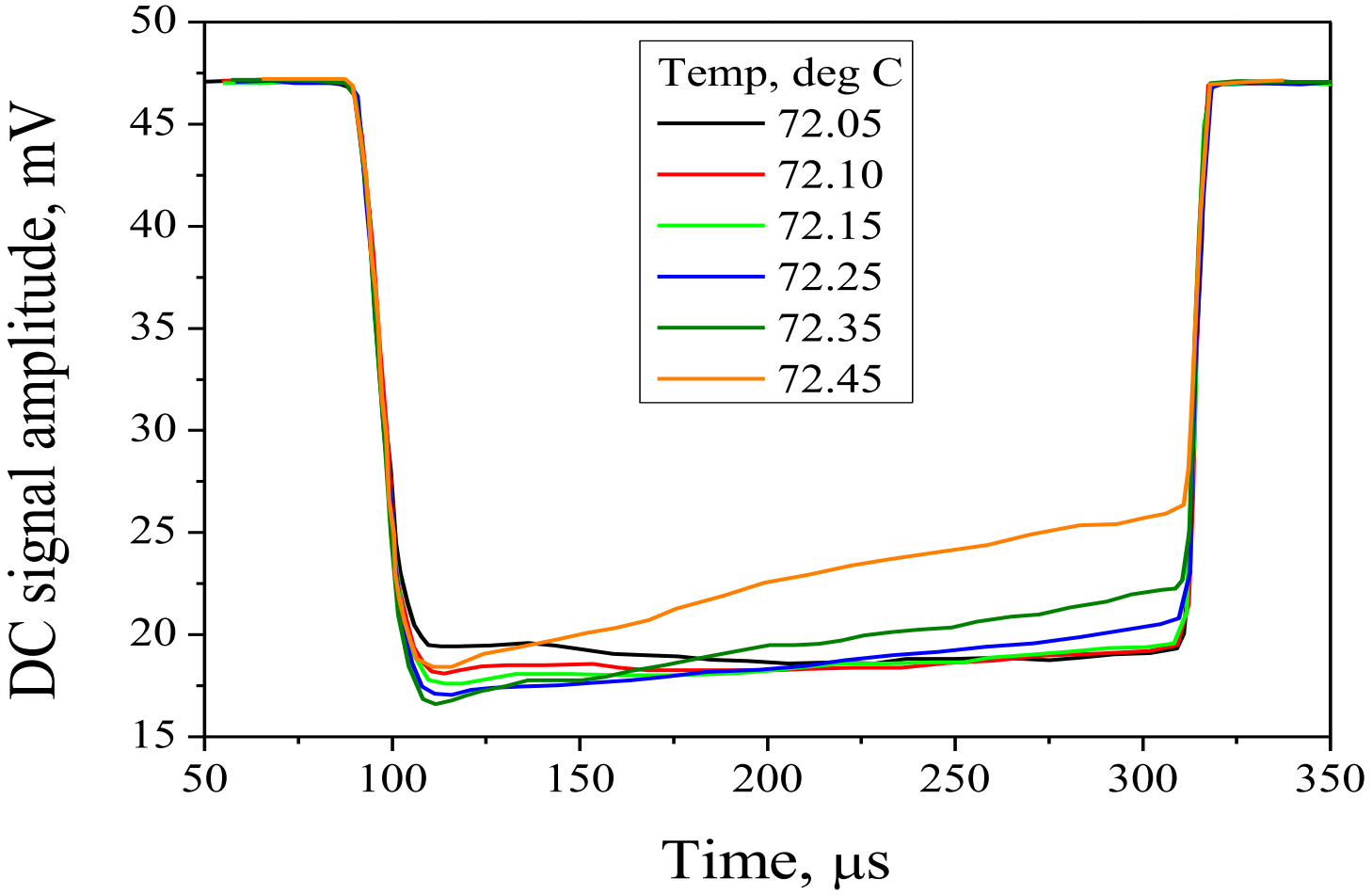


72.05, p2p = 462.6 uA



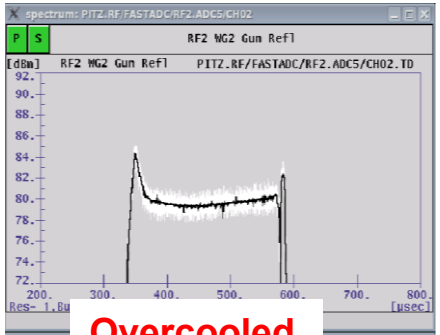
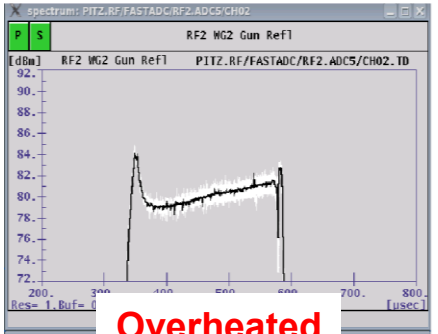
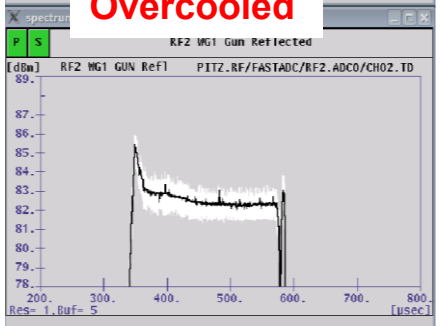
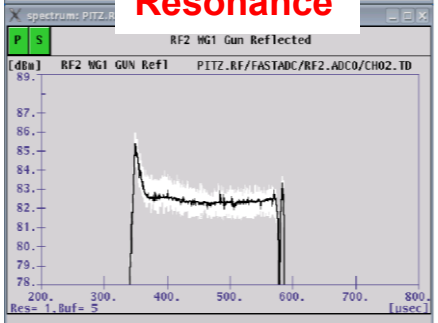
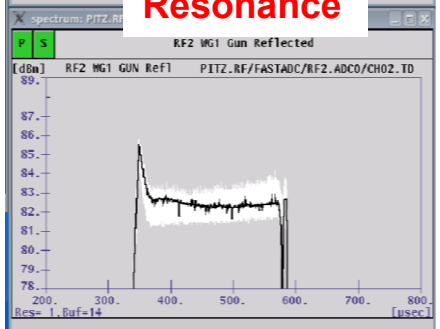
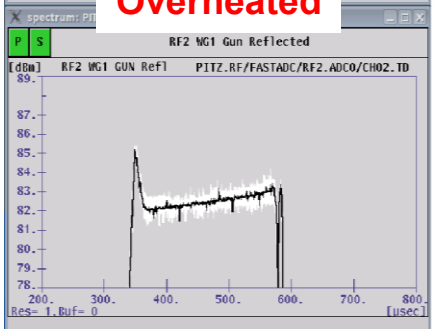
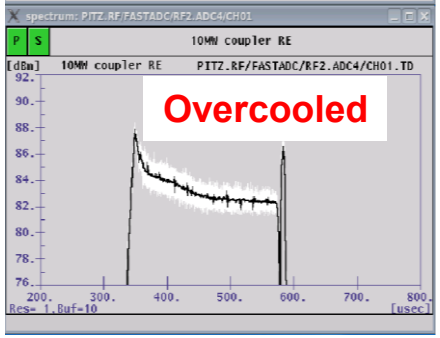
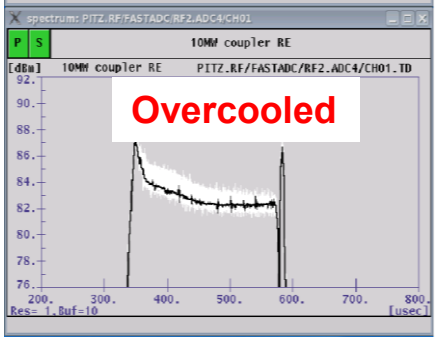
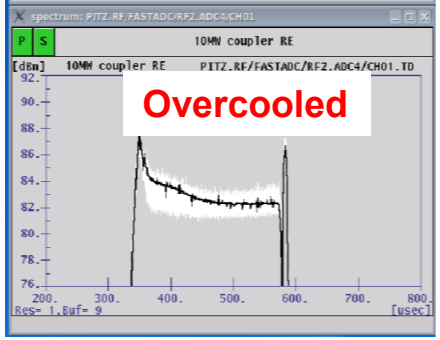
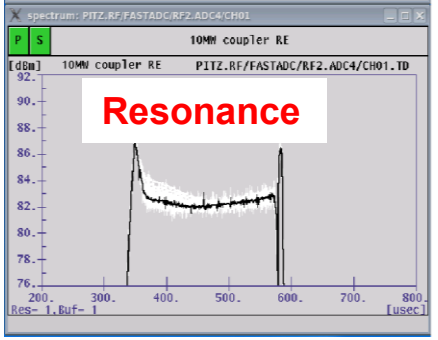


Measurement flow, summary of first measurement



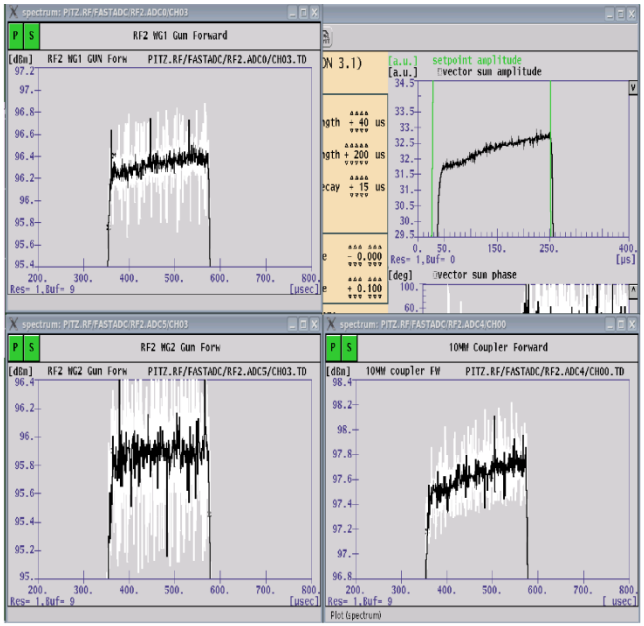
Resonance at 72.1-72.15 deg C

Measurement flow, summary of first measurement

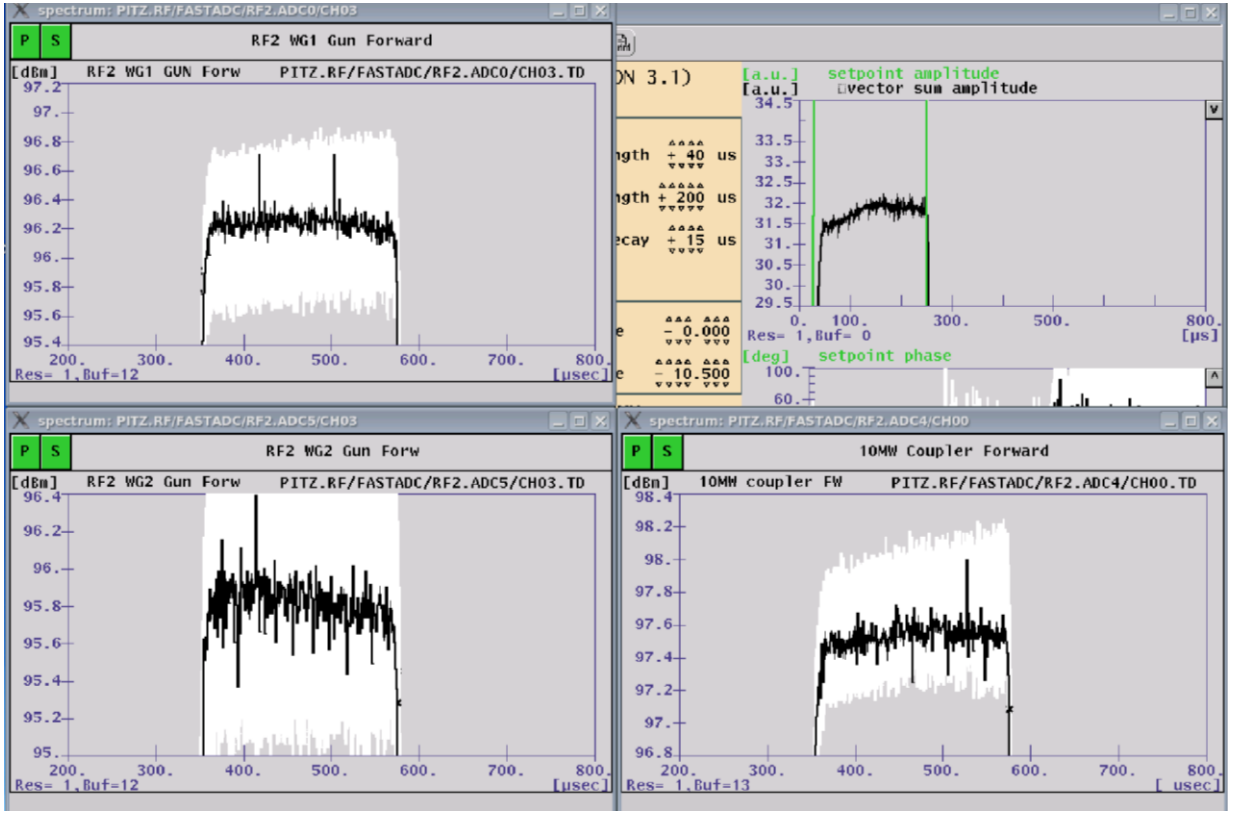
72.05 deg C	72.10 deg C	72.15 deg C	72.20 deg C
			
Overcooled	Resonance	Resonance	Overheated
			
			
Overcooled	Overcooled	Overcooled	Resonance

Measurement flow, second measurement

First measurement



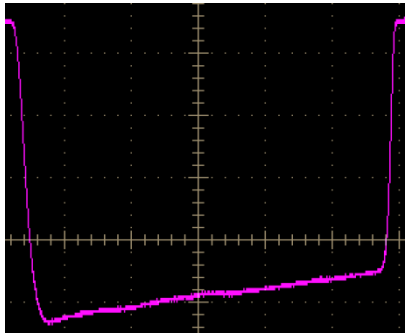
Corrected slopes for second measurement



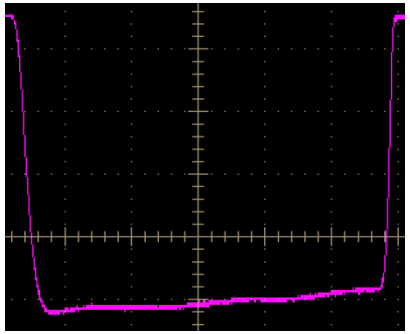
Measurement flow, second measurement

First measurement, initial RF slopes

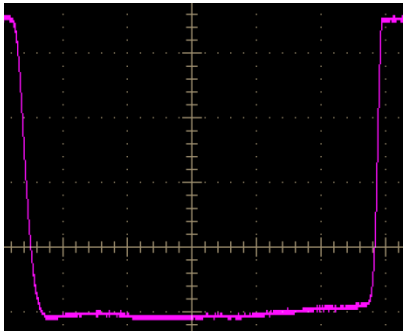
72.3, p2p = 495.8 uA



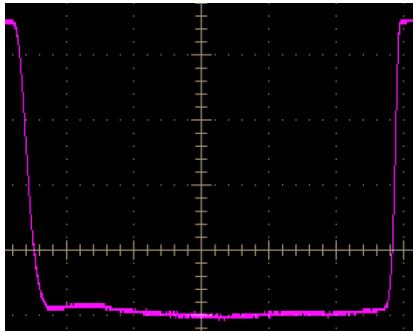
72.2, p2p = 479.4 uA



72.10, p2p = 468.4 uA

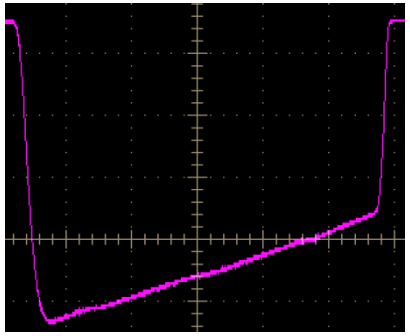


72.05, p2p = 462.6 uA

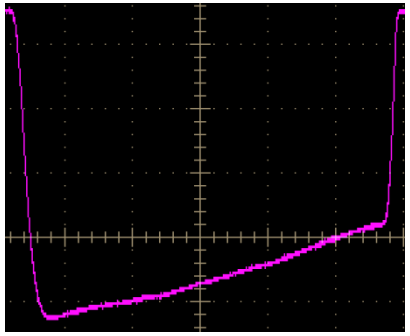


Second measurement, corrected RF slopes

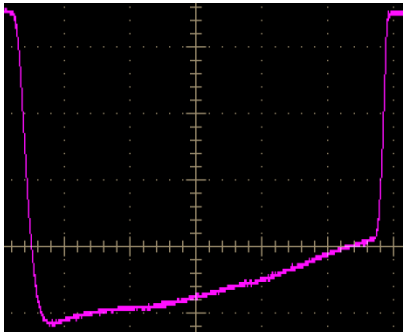
72.3, p2p = 495.2 uA



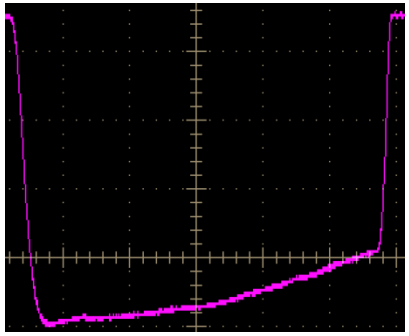
72.2, p2p = 482 uA



72.1, p2p = 473.2 uA



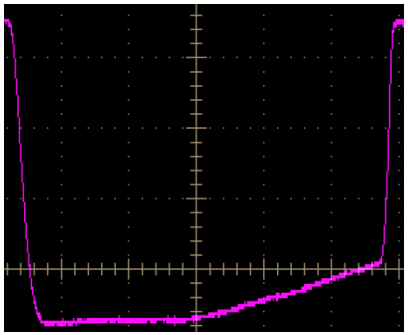
72.05, p2p = 459.2 uA



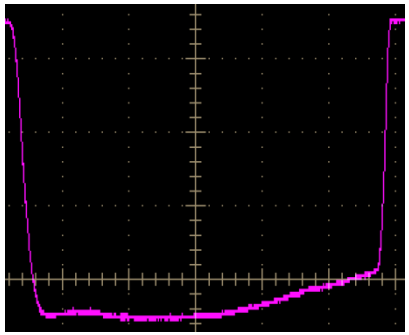
Measurement flow, second measurement

Second measurement, corrected RF slopes

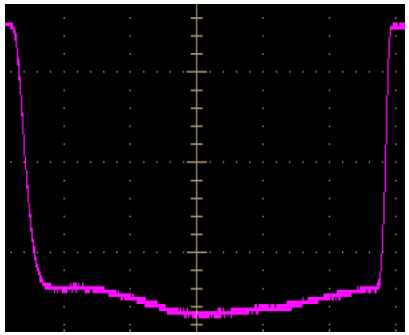
71.95, p2p = 444.2 uA

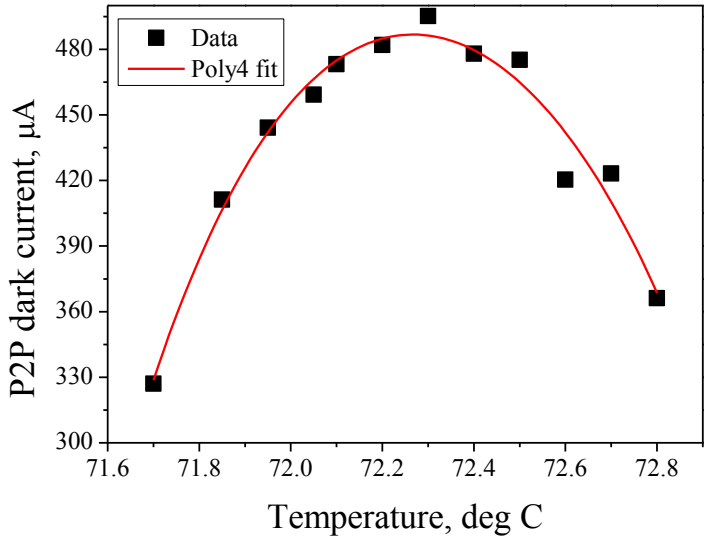


71.85, p2p = 411.2 uA

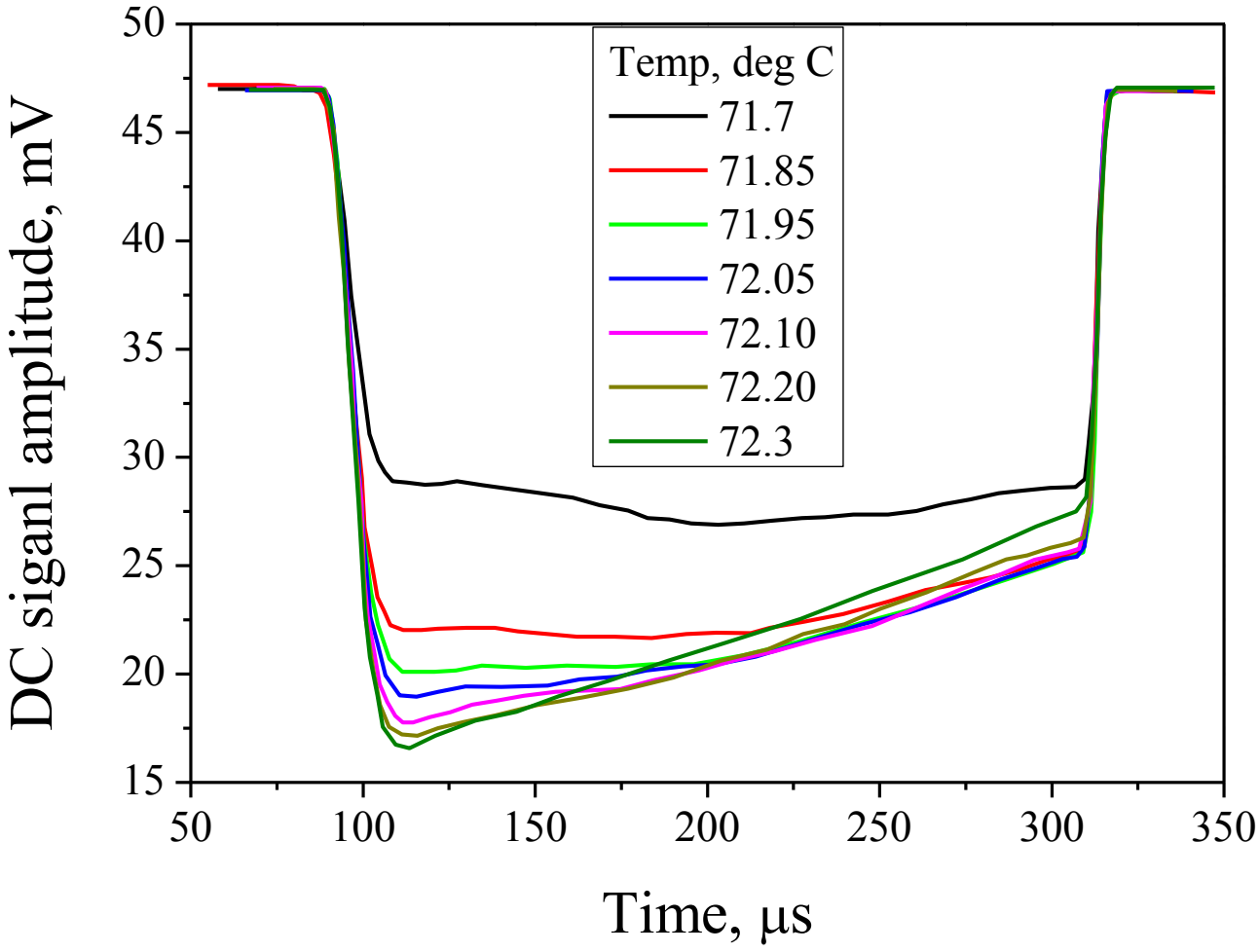


71.7, p2p = 327 uA

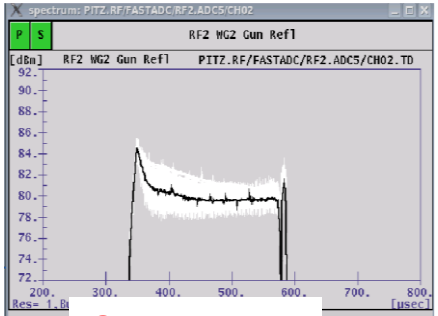
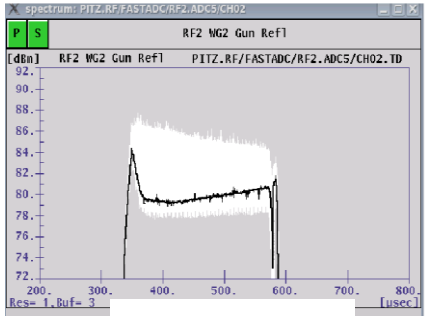
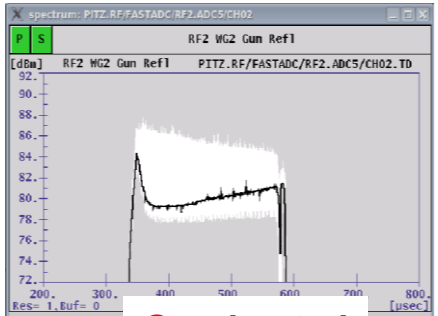
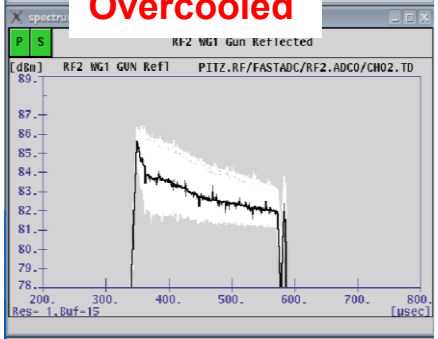
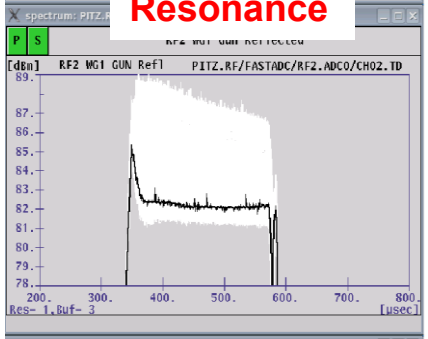
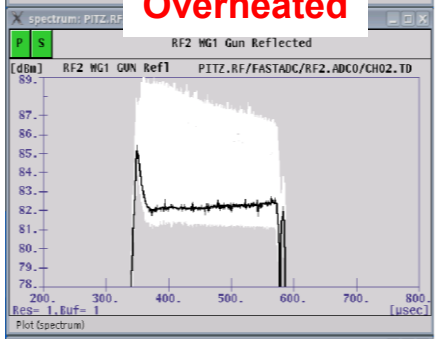
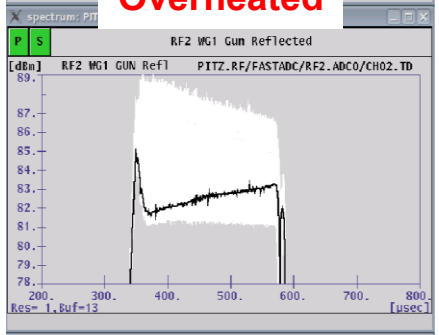
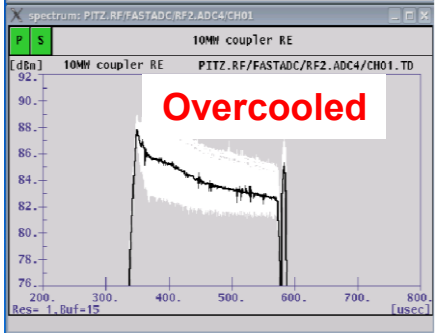
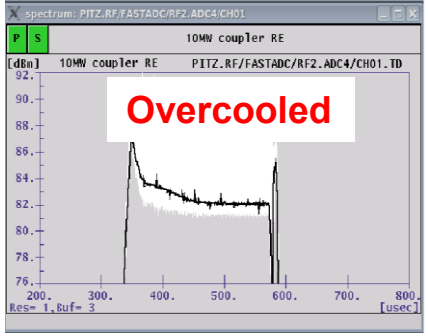
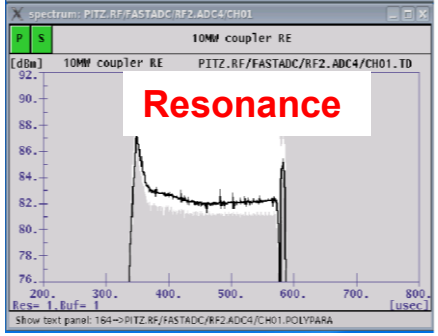
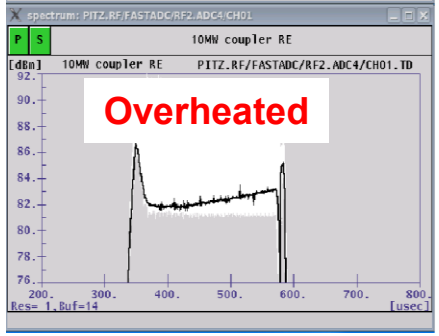




Measurement flow, summary of second measurement



Measurement flow, summary of second measurement

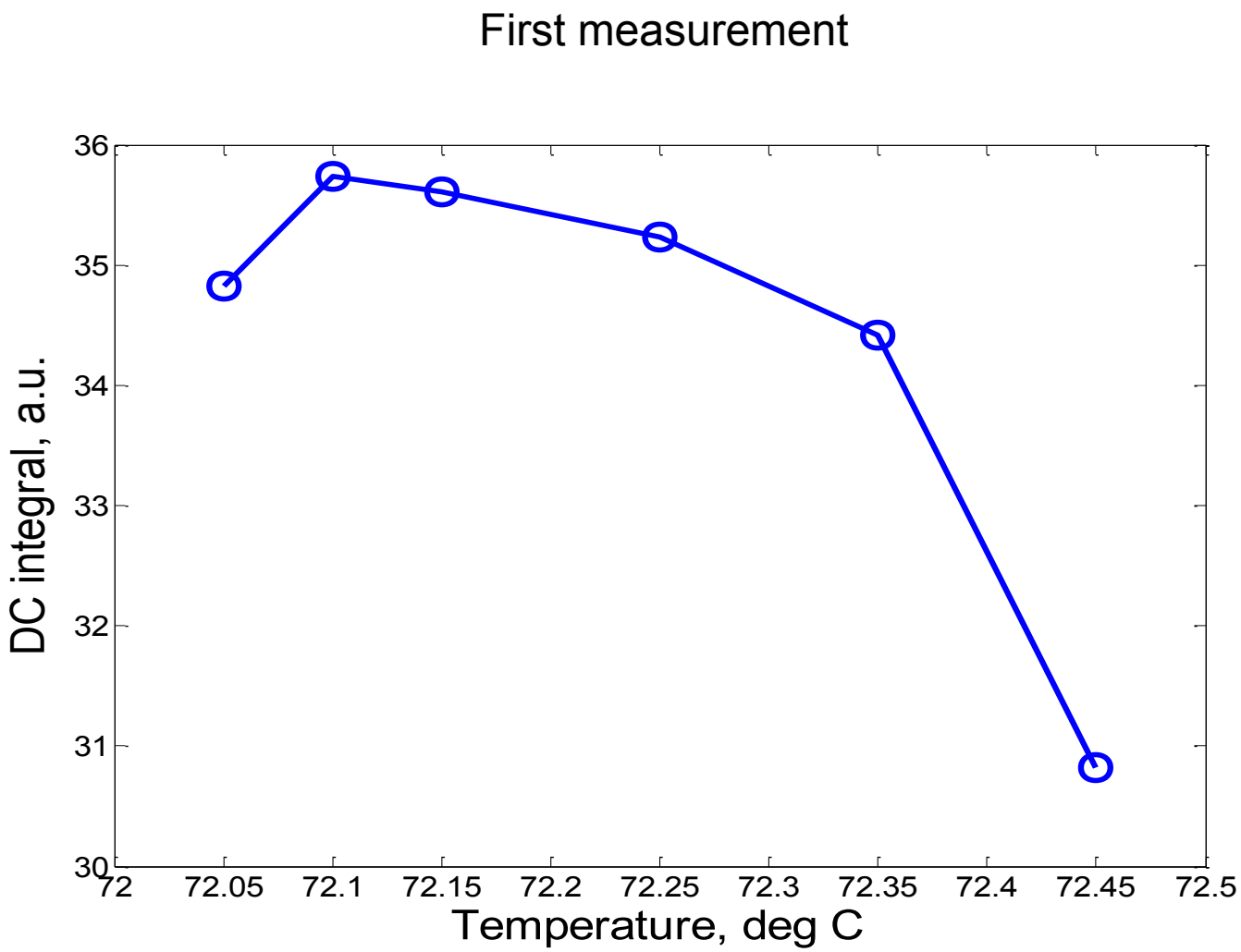
71.95 deg C	72.10 deg C	72.2 deg C	72.30 deg C
			
Overcooled	Resonance	Overheated	Overheated
			
			
Overcooled	Overcooled	Resonance	Overheated

Summary

- Second measurement with corrected RF slopes seems to be not reliable as correction has introduced some unexpected effects. Possible reason is to high power and consequently klystron working at saturation. Solution: repeat measurement with reduced peak power where RF correction works better.
- P2P DC measurement is not relevant for studies of resonant temperature. Integral over the DC signal has to be measured*.
- Statistical measurement is required.
- Measurements have to be repeated with uTCA system which seems to be more stable and reliable (pulse flatness looks better).

* Some information can be extracted from the measured data, see next slide

Dirty estimation of resonance temperature based on integral dark current



Dirty estimation of resonance temperature based on integral dark current