Characterization of x-ray microcalorimeters for Constellation-X

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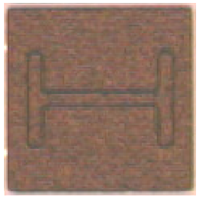
J. Sadleir

R vs T curves

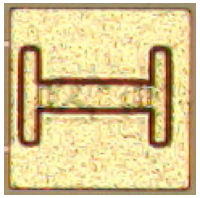
"The 2.5 eV device" in Simon's talk

"Vacuum-gap" device with H-stem

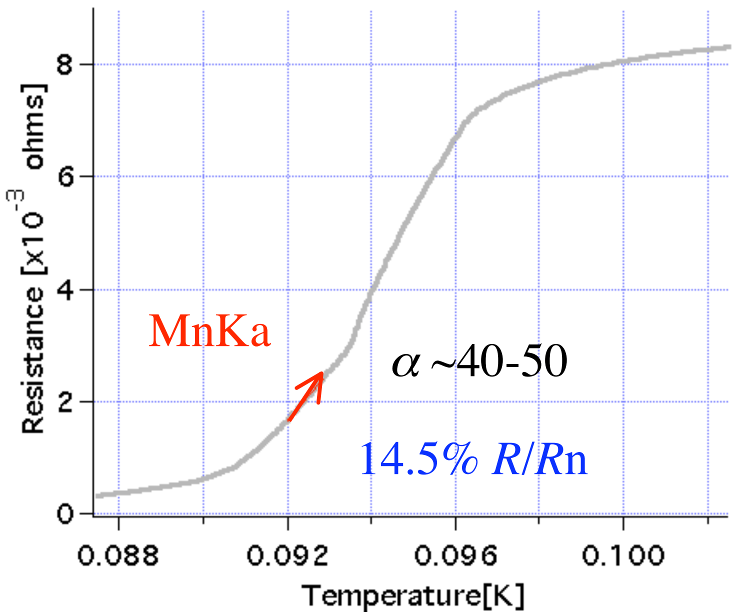


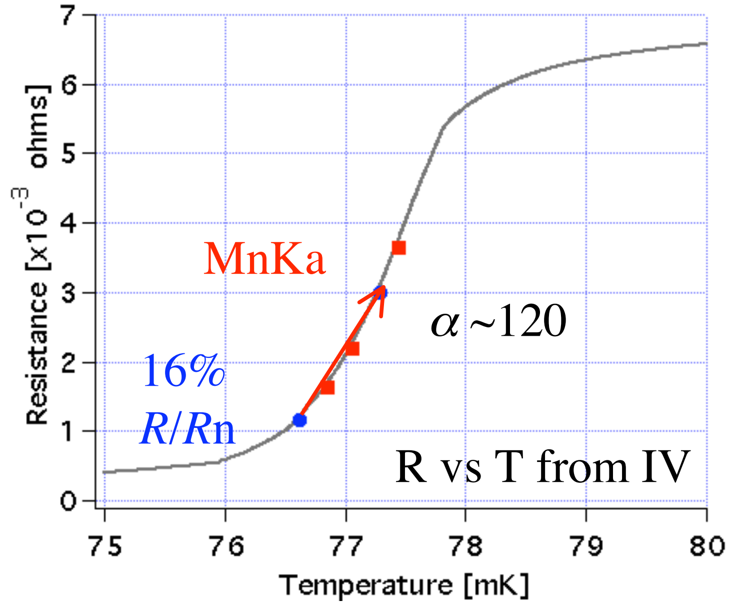
Evapolated Bi/Au absorber
3-stripes zebra
C = 1.24 pJ/K @Tc
Tc = 94 mK, α ~40-50

"Vacuum-gap" device with H-stem

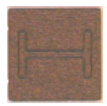


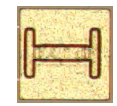
Electroplated Au absorber
3-stripes zebra
C = 1.46 pJ/K (1.93)
Tc = 78 mK, α ~120

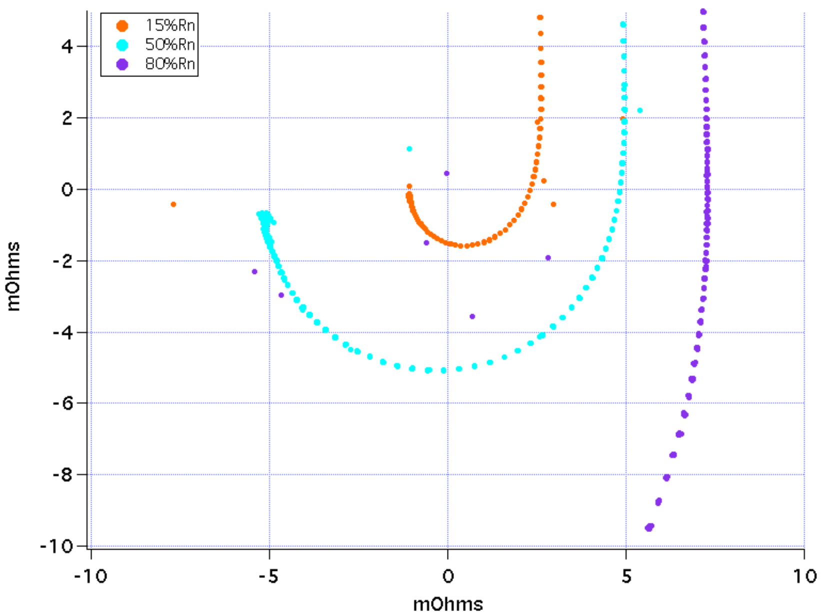


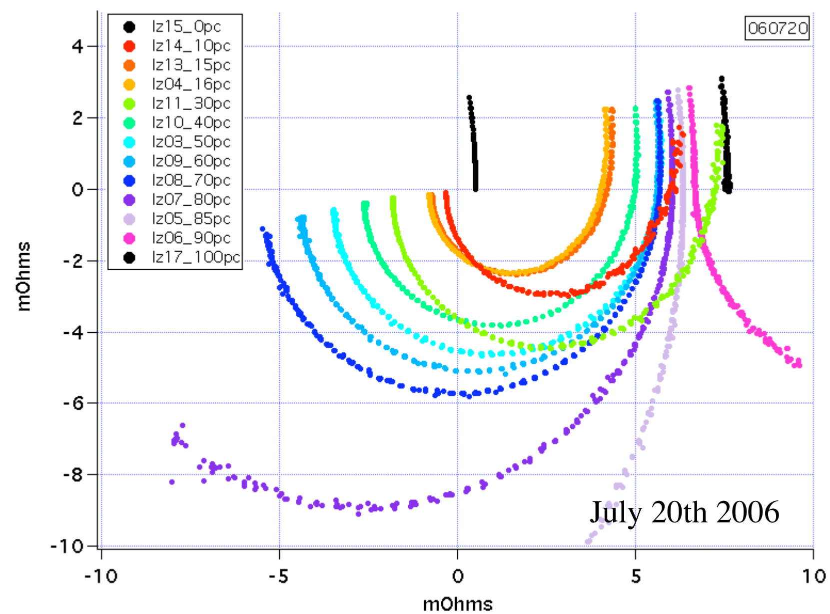


Impedance fit



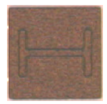


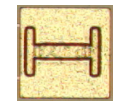


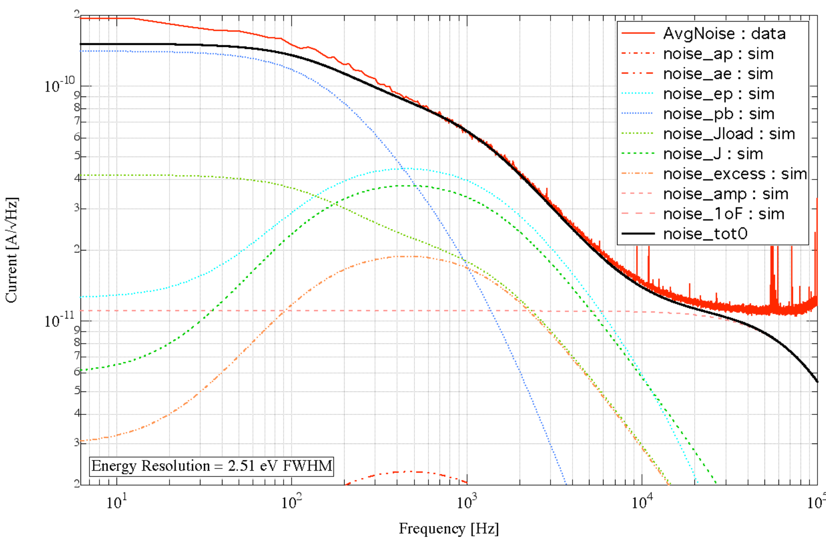


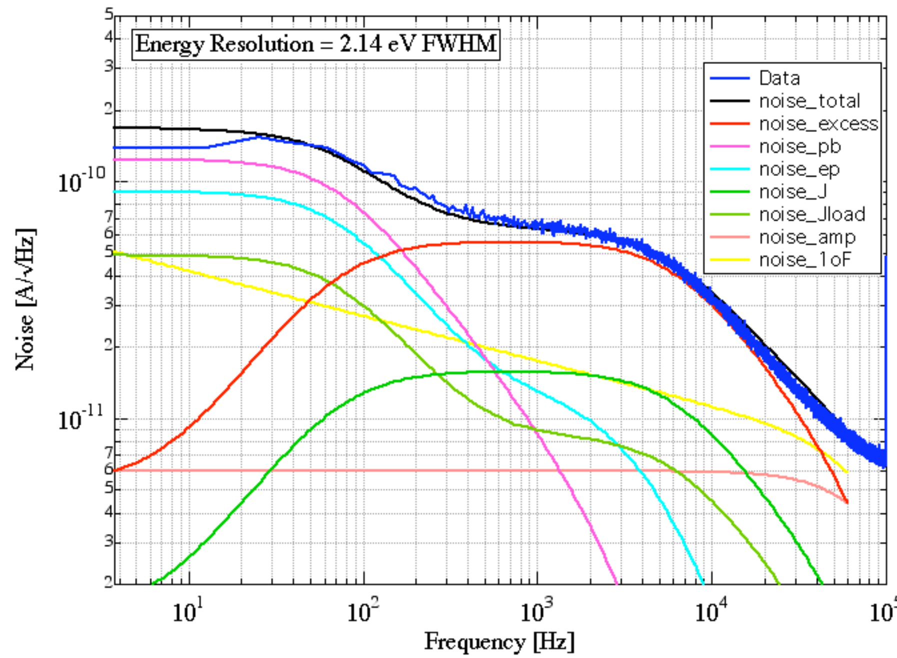
We model Z curves at each bias point varying α and β
With G obtained from IV curves and C from theoretical values.

Noise spetra: data vs simulation



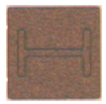


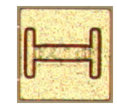


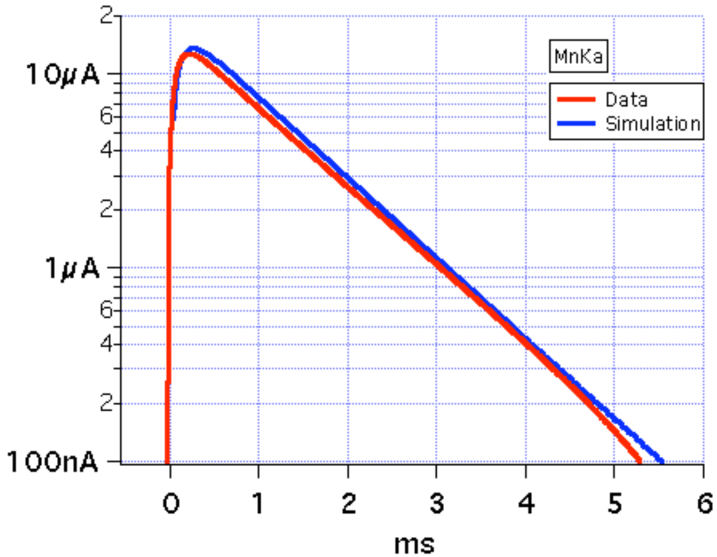


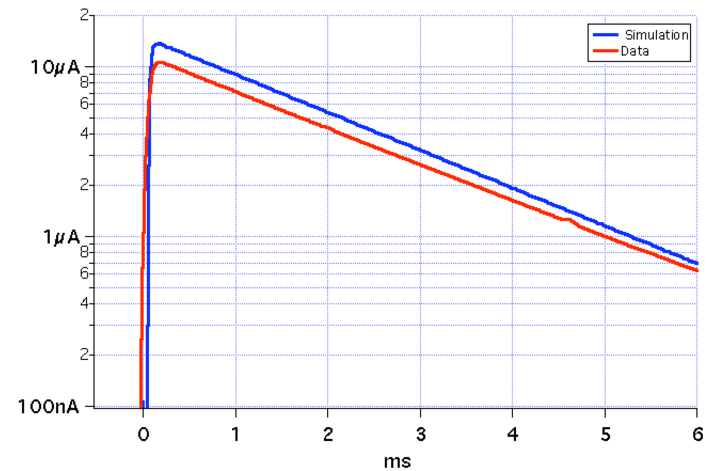
We successfully modeled noise the spectra by parameters from the *Z* cuve fit by varying ratio between excess noise / Johnson noise.
Predicted energy resolutions of 2.5 eV and 2.3 eV respectively are roughly consistent with their baseline energy resolution.

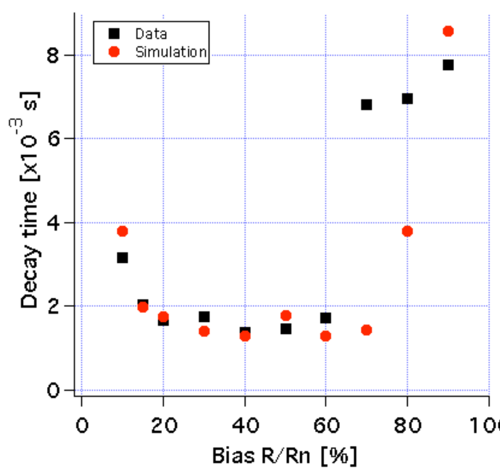
Average pulses: data vs simulation

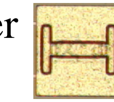




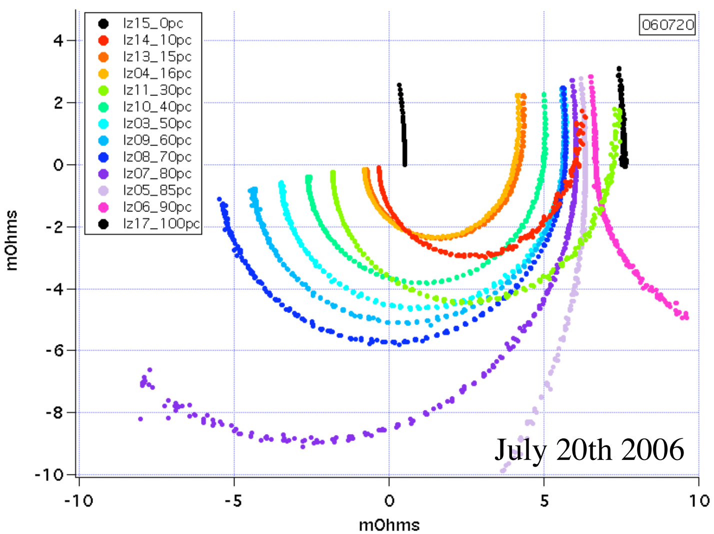


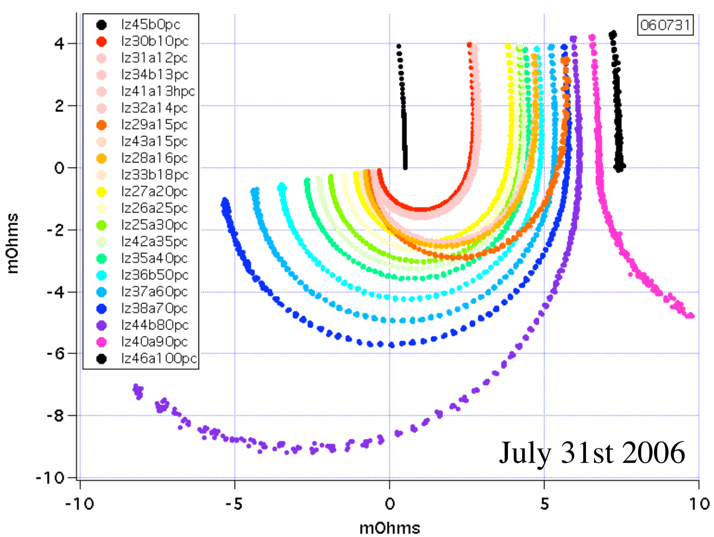




Electroplated Au absorber
H-stem 

Alpha and beta estimation by impedance fit



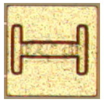


To study structure of $R(T,I)$ plane,
- Impedance measurements
- Noise measurements

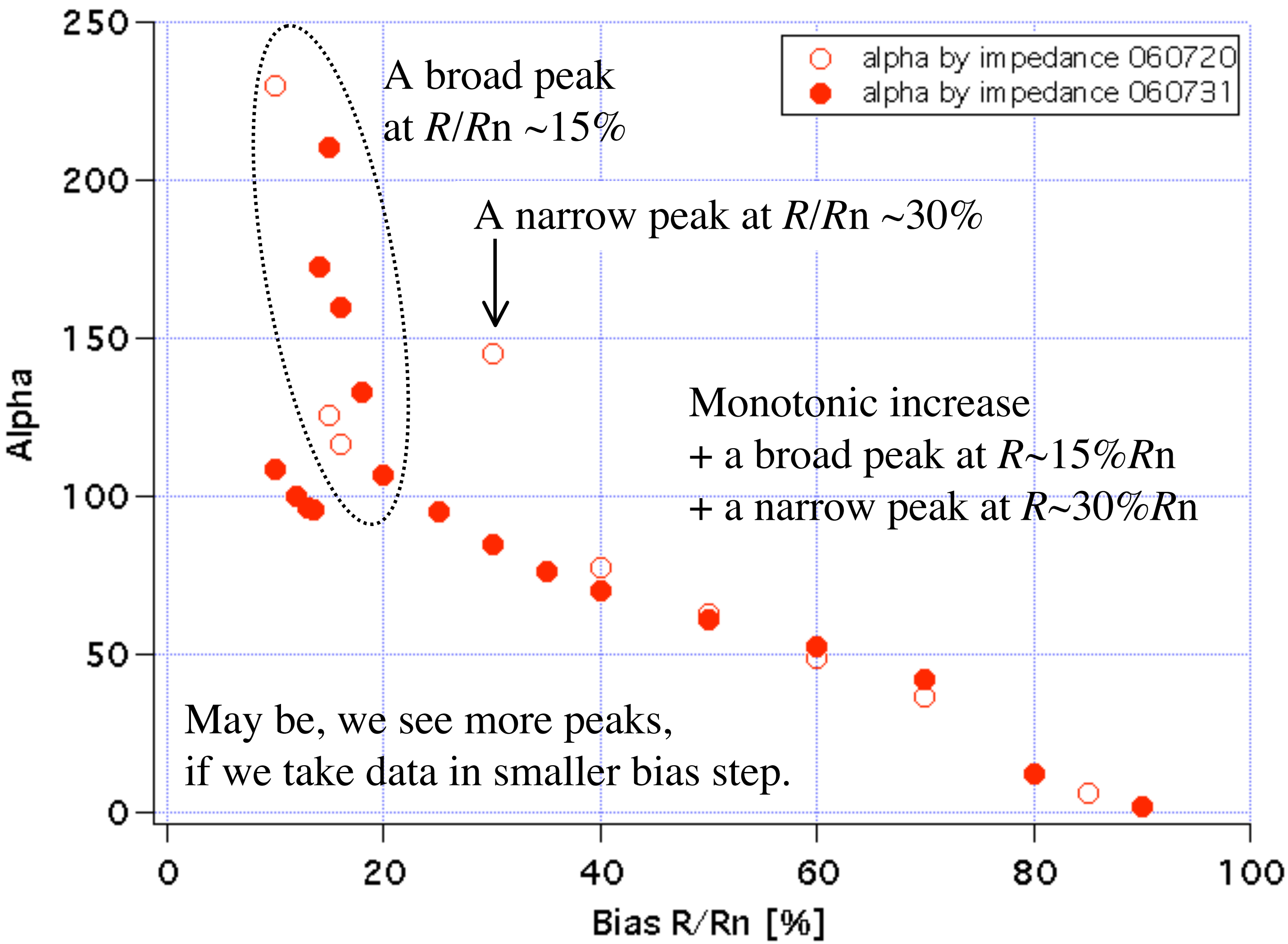
through the transition.

Impedance measurements are very sensitive to study fine structure in the transition. E.g., the two sets of curves may have a slightly different external magnetic field, that can cause the difference between Z curves.

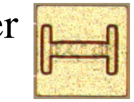
Electroplated Au absorber
H-stem



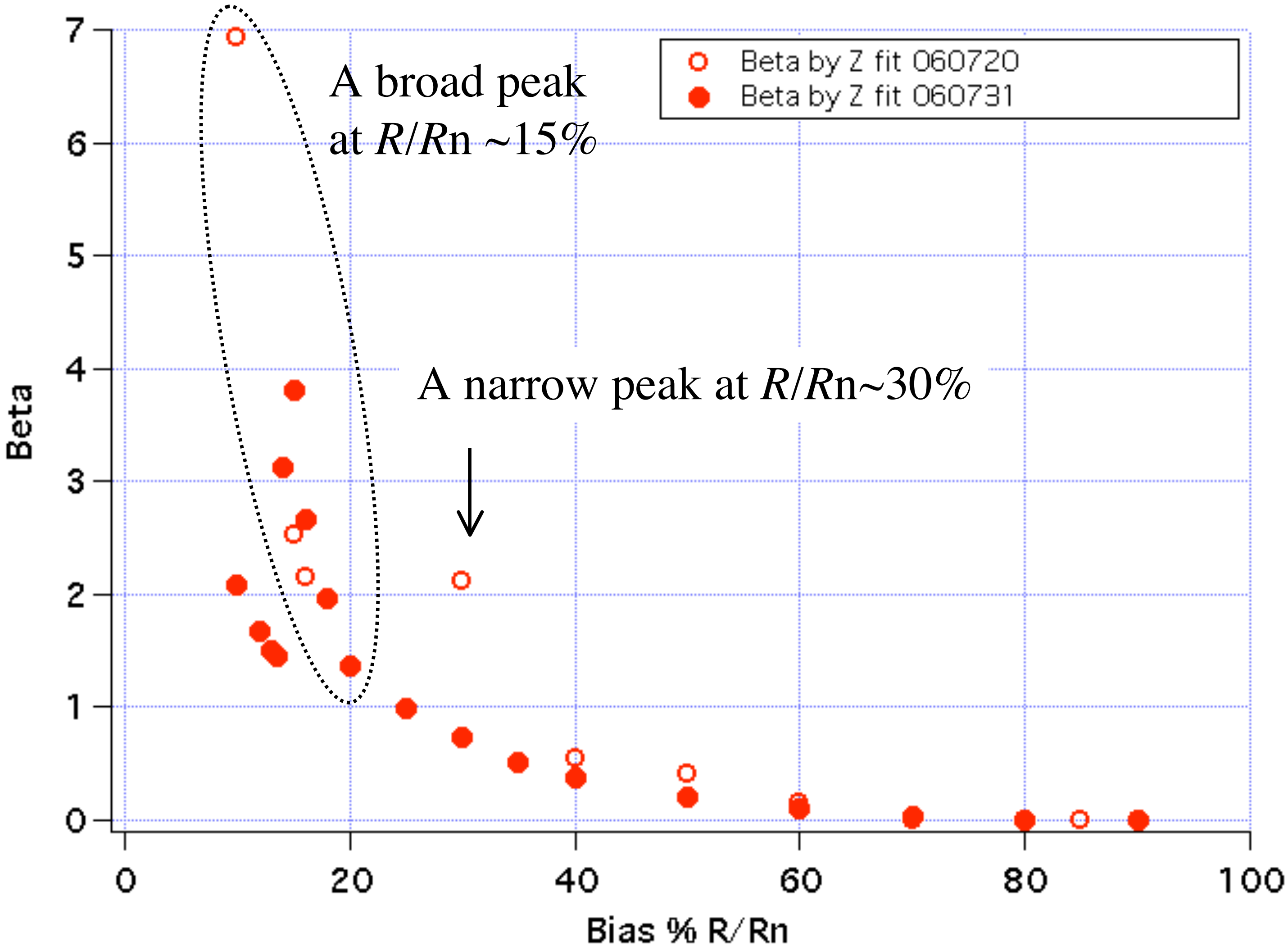
Alpha vs bias by *Z* curve fit



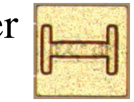
Electroplated Au absorber
H-stem



Beta vs bias by *Z* curve fit



Electroplated Au absorber
H-stem

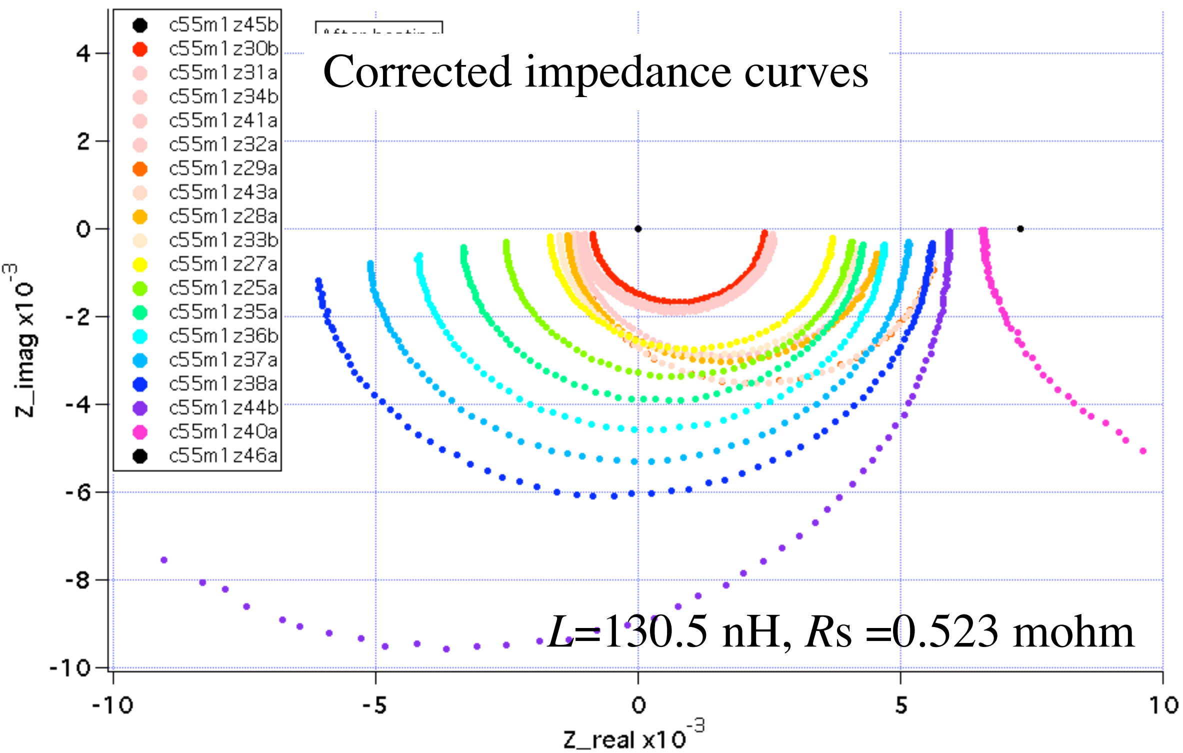


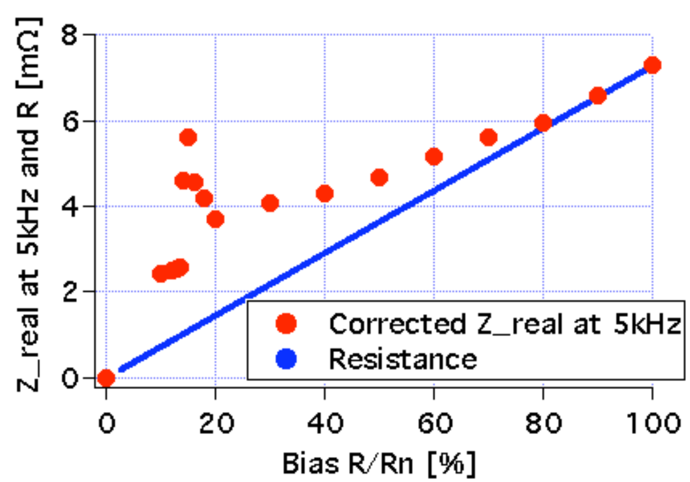
Another method: β from Z_{real} at high-frequency

At f = inf.,
$Z_{real} = R\,(1+\beta)$, i.e. $\beta = (Z_{real}/R) - 1$

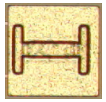
L, L_p and C in circuit distort the Z curves at high frequency.
Take whole Z curves at R/Rn = 0% and 100% to correct the result.

Detail were given in Mark's talk.

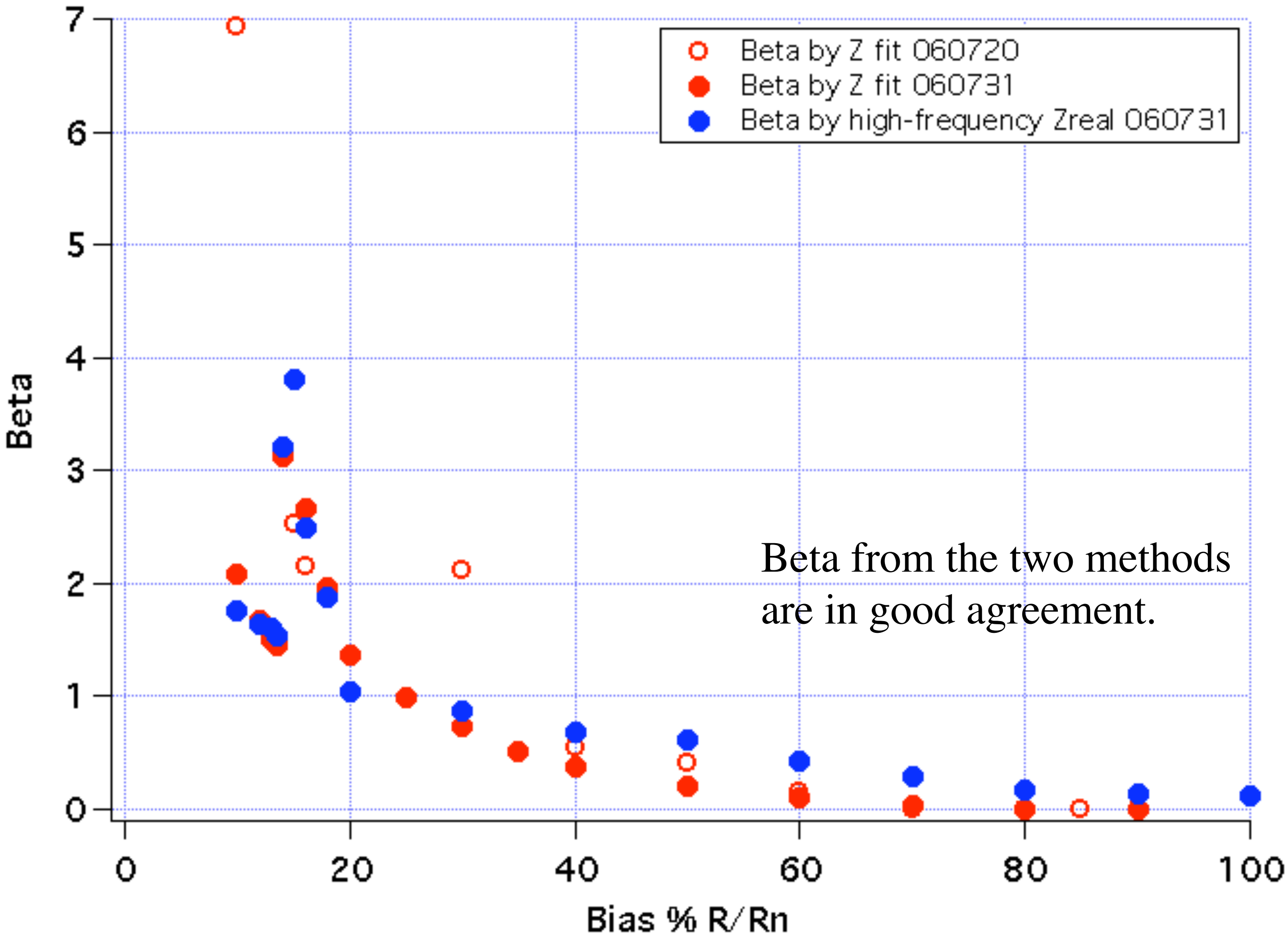




Electroplated Au absorber
H-stem

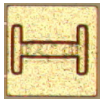


Beta vs bias by high-frequency Z_{real}

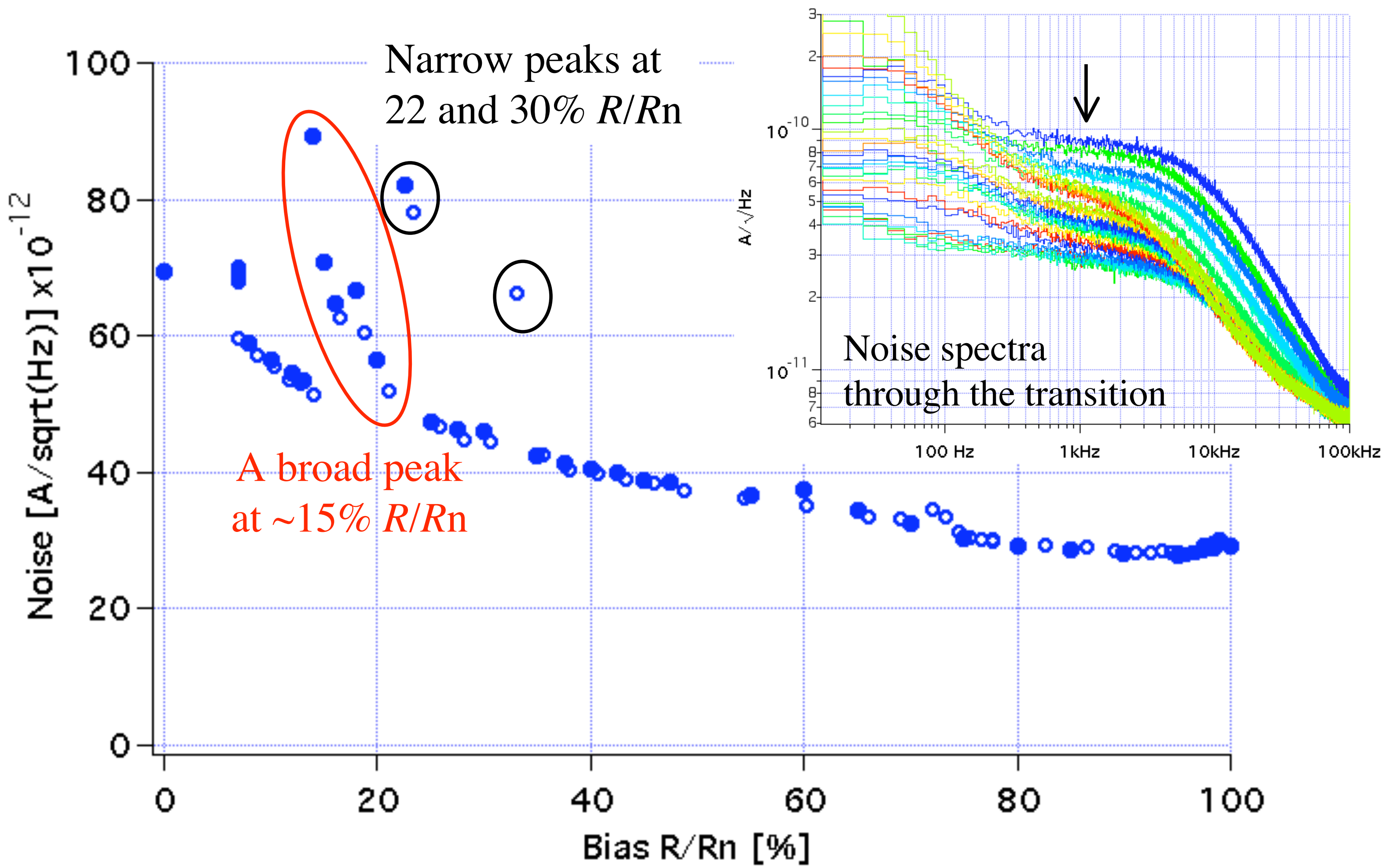


Beta from the two methods are in good agreement.

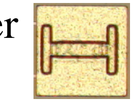
Electroplated Au absorber
H-stem



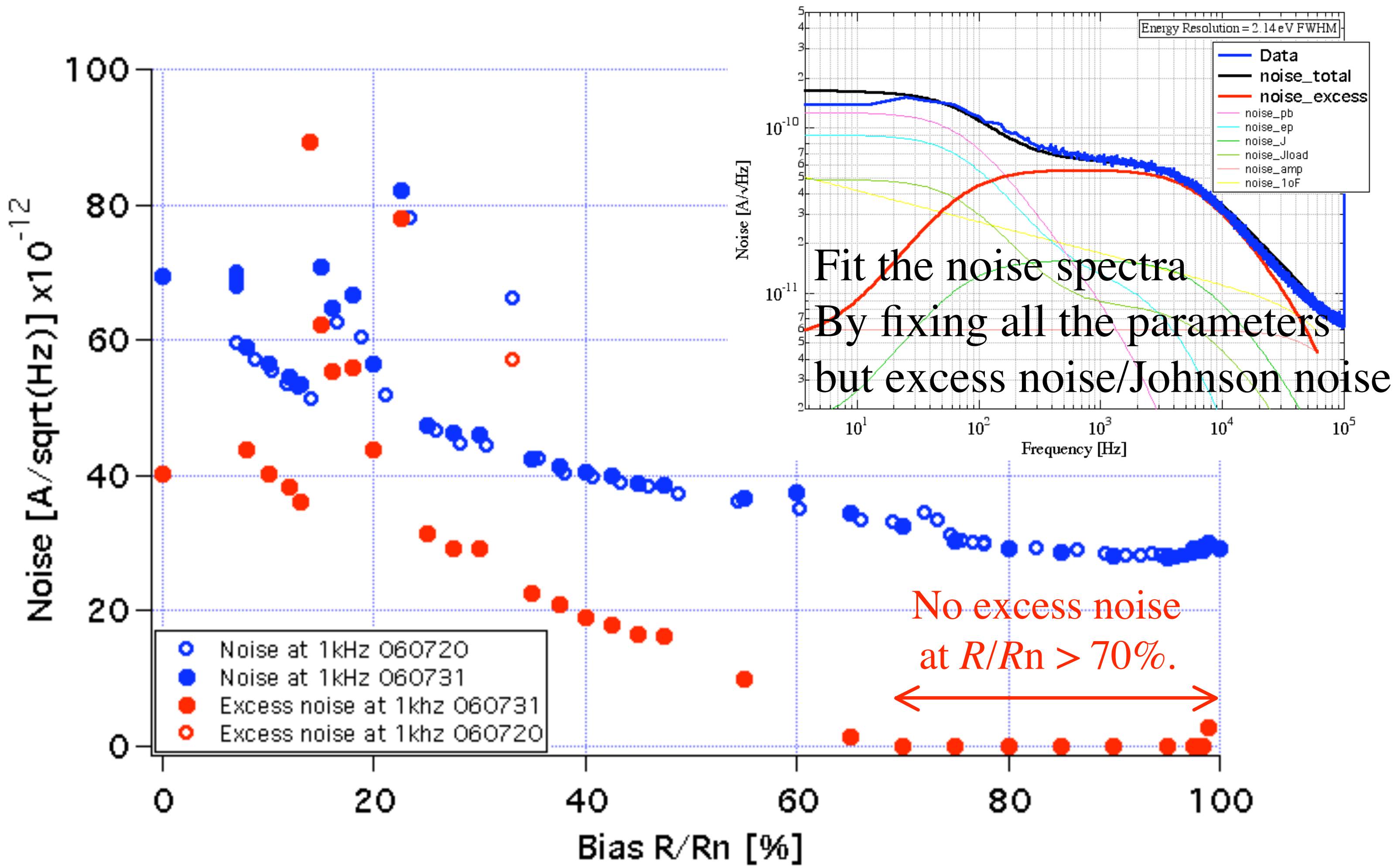
Noise at 1kHz



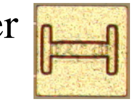
Electroplated Au absorber
H-stem



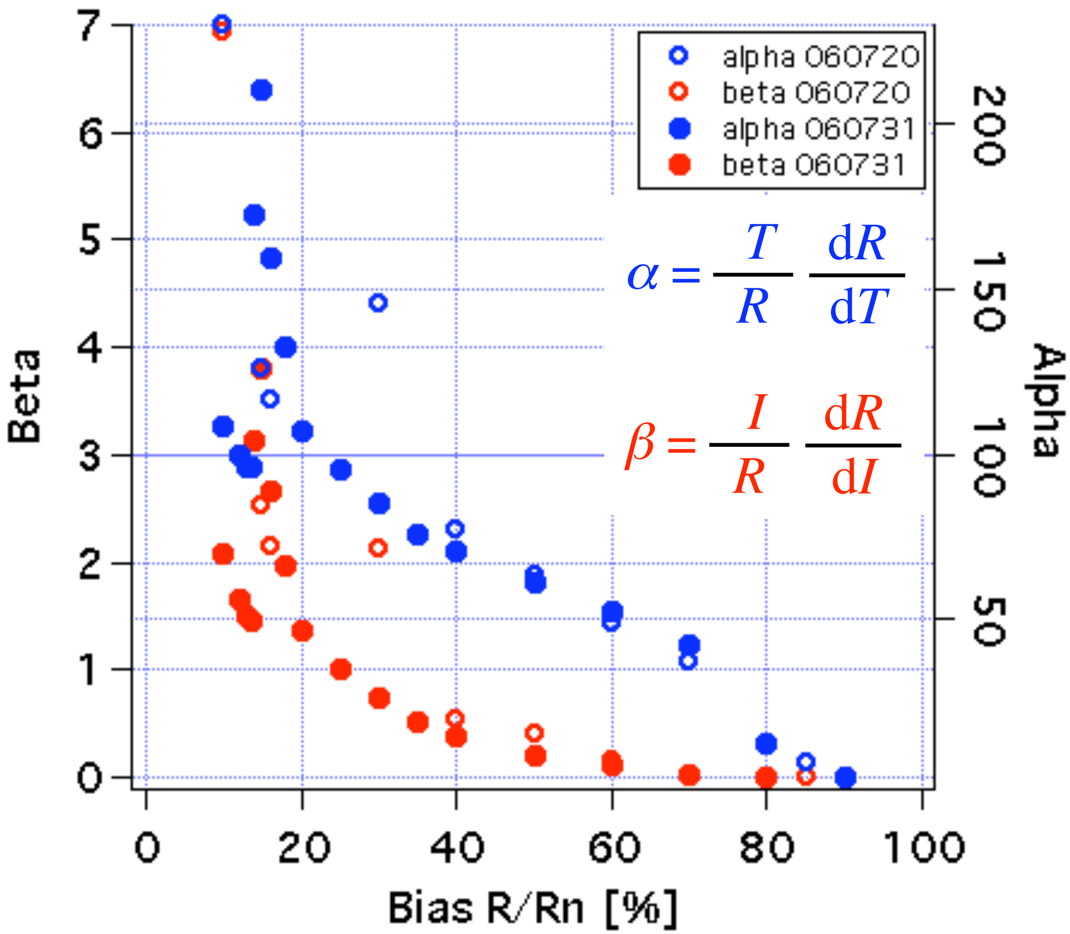
Excess noise at 1kHz vs bias



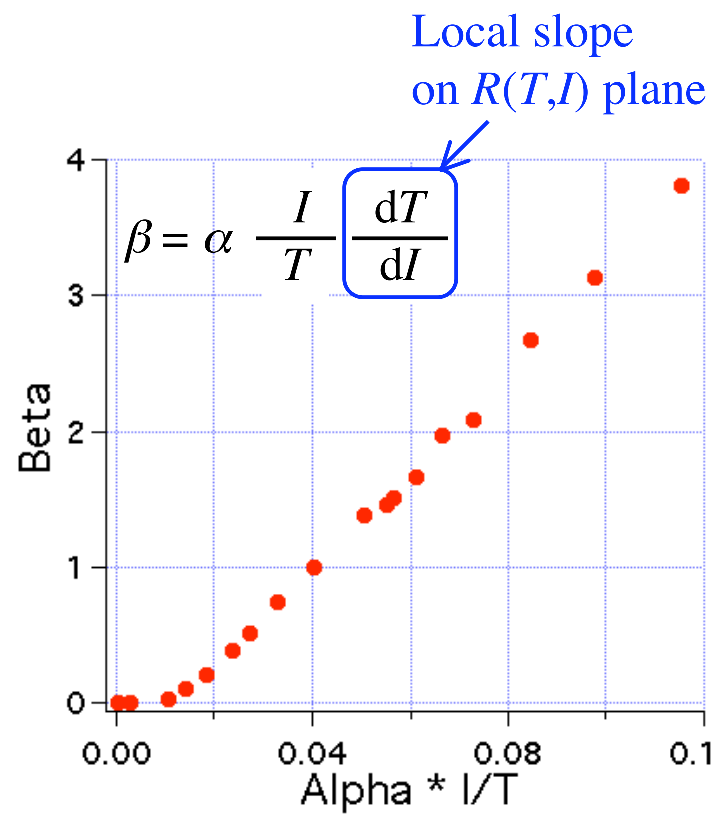
Electroplated Au absorber
H-stem



Comparison between α vs β

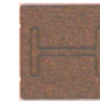


Alpha and beta have a similar trend.

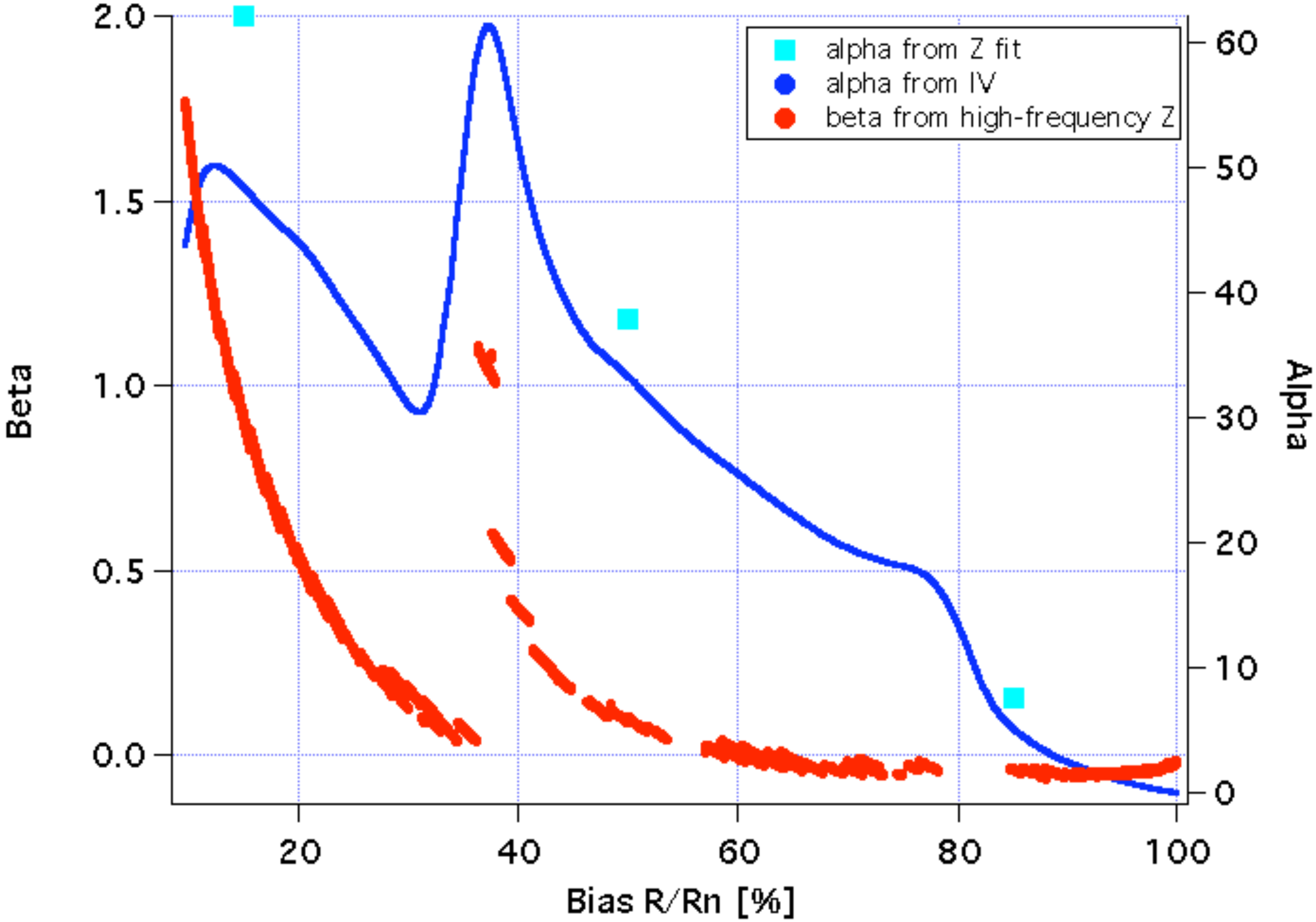


See Tali's talk.

Bi/Au absorber
H-stem

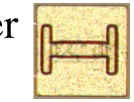


Another comparison between α and β

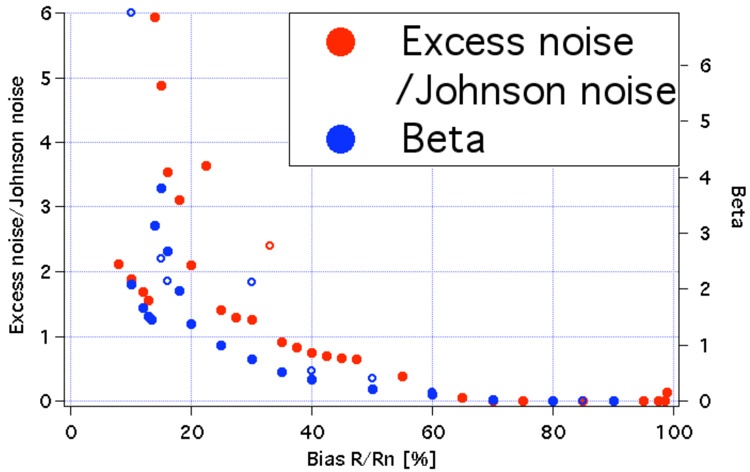


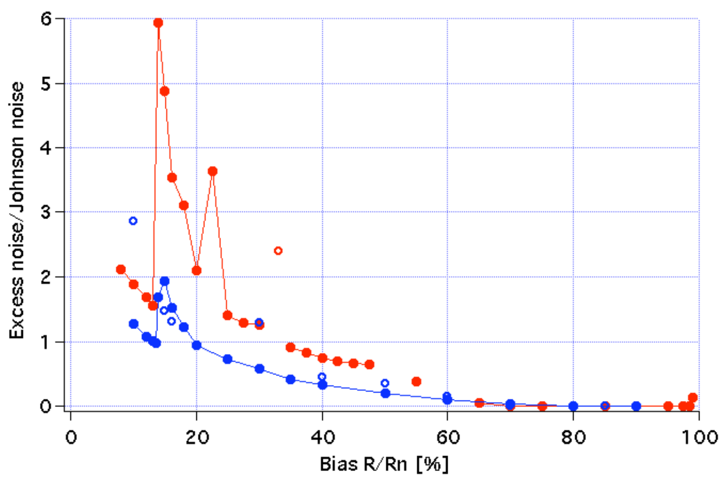
Again, alpha and beta have a similar trend.

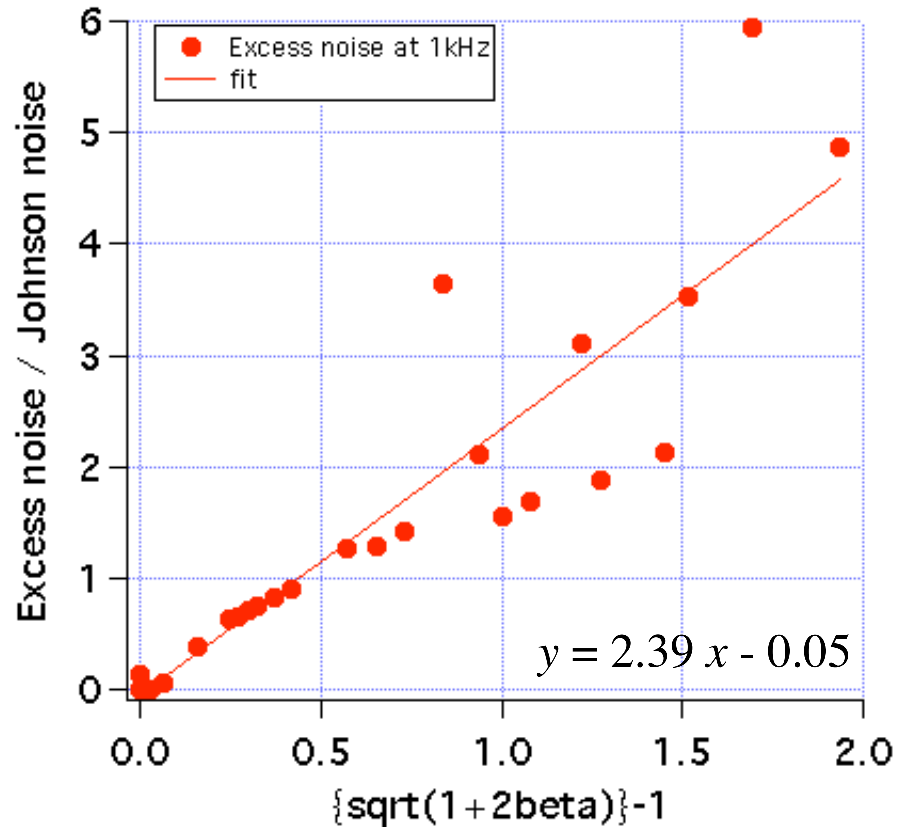
Electroplated Au absorber
H-stem



Excess noise due to beta

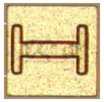




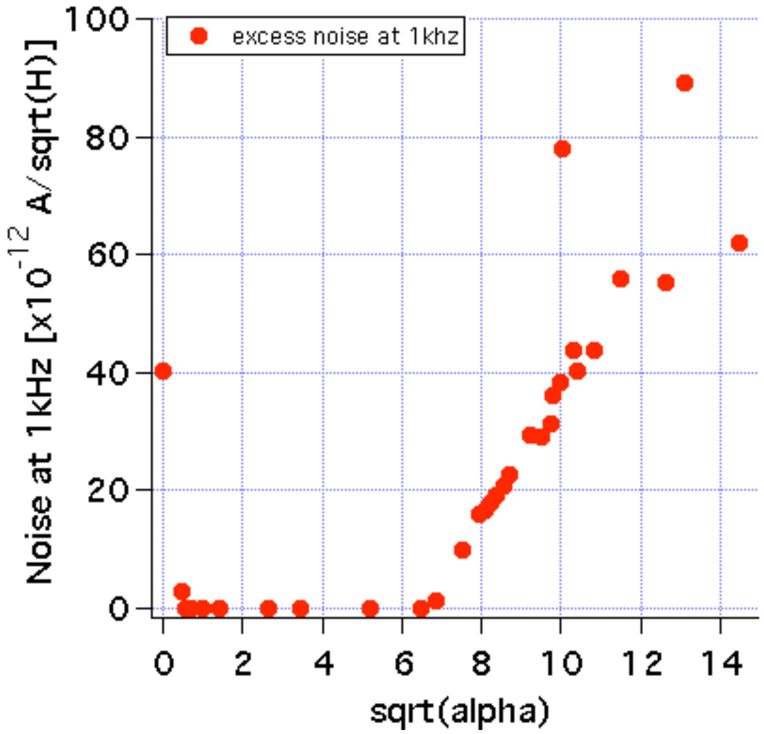


(Although it's far from equilibrium, *T*b=50 mK, *T*c=78 mK)

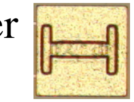
Electroplated Au absorber
H-stem



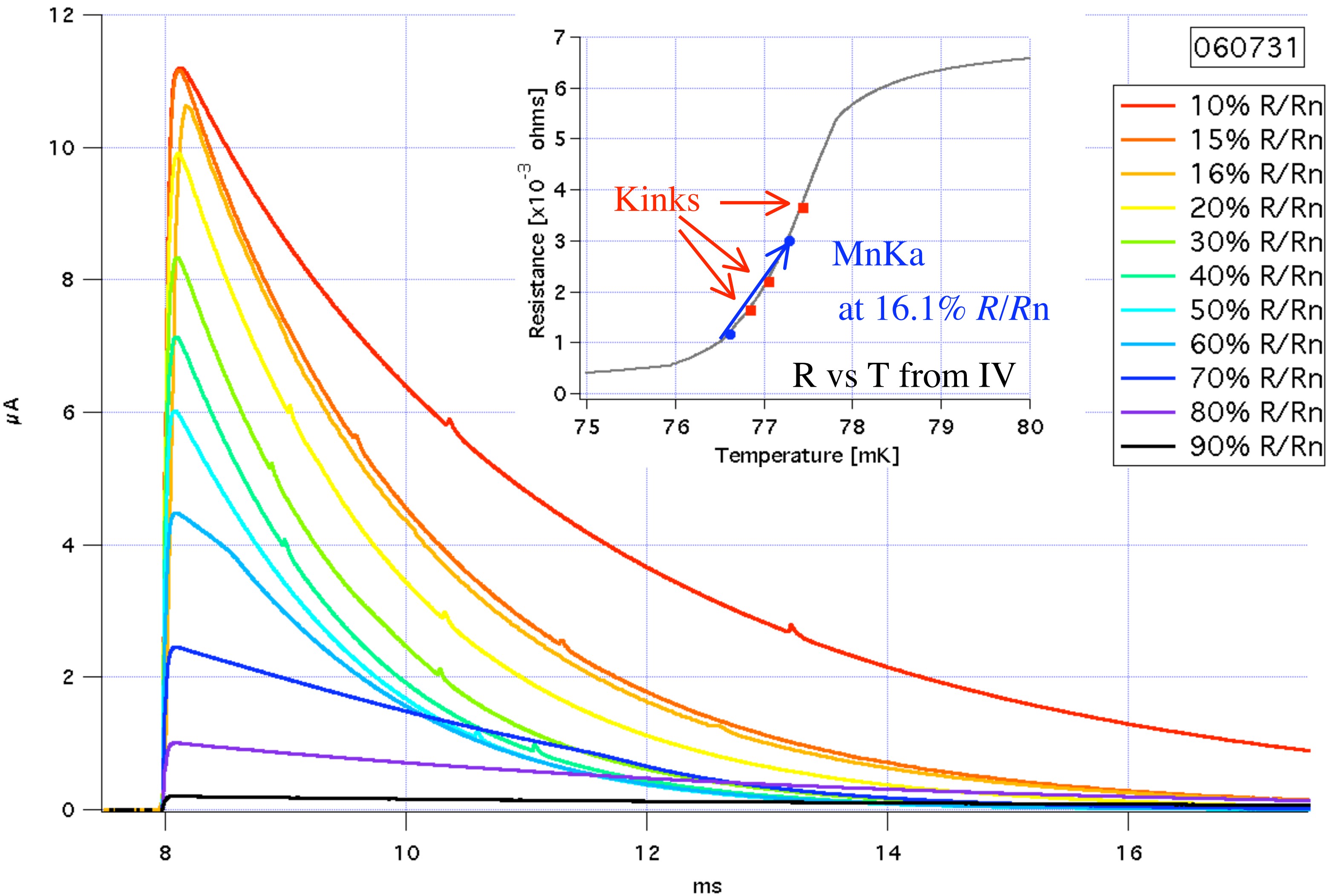
Excess noise vs alpha



Electroplated Au absorber
H-stem



Small kinks on pulses



Summary

- We successfully modeled our model IV, impedance, noise and pulse data.
- We investigated alpha, beta and noise distribution through transition, by impedance measurements and noise measurements.
- Alpha, beta and excess noise have a similar trend, including fine structures.
- Position of small kinks on pulses are in coincedence with kinks on the alpha, beta, and noise.