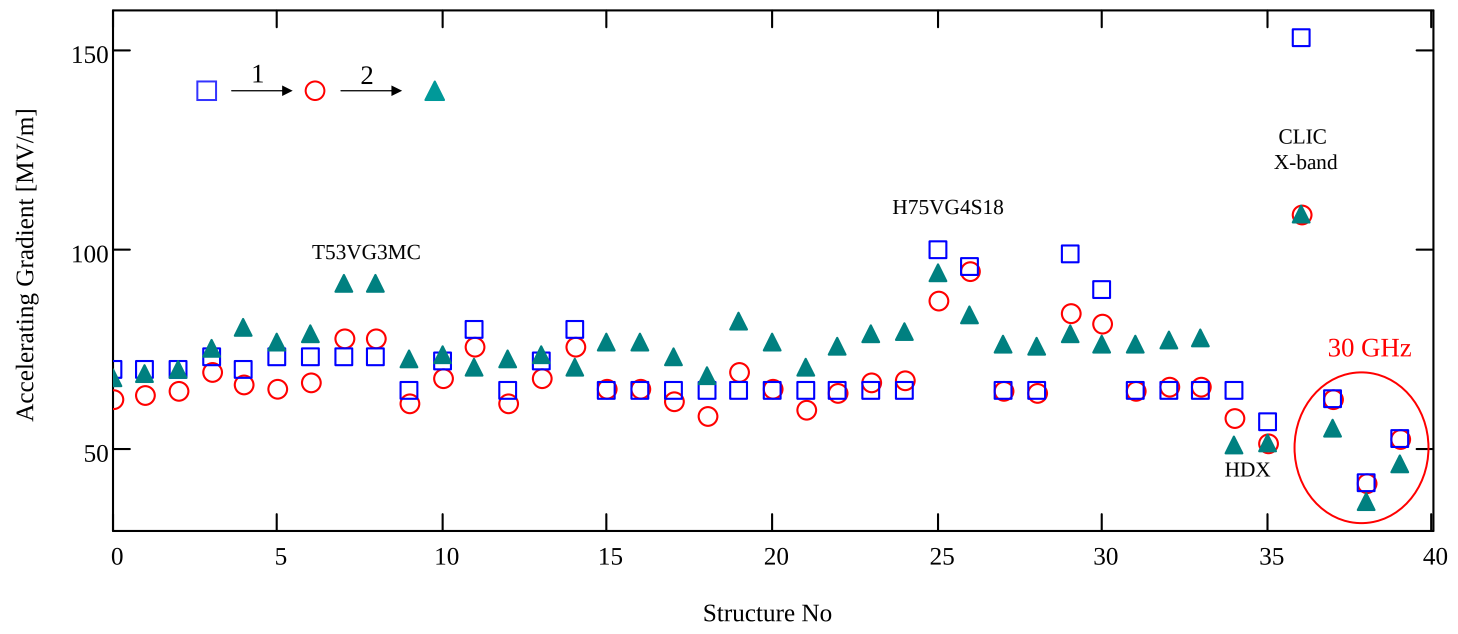
Analysis of available data on measured X-band and 30 GHz accelerating structures

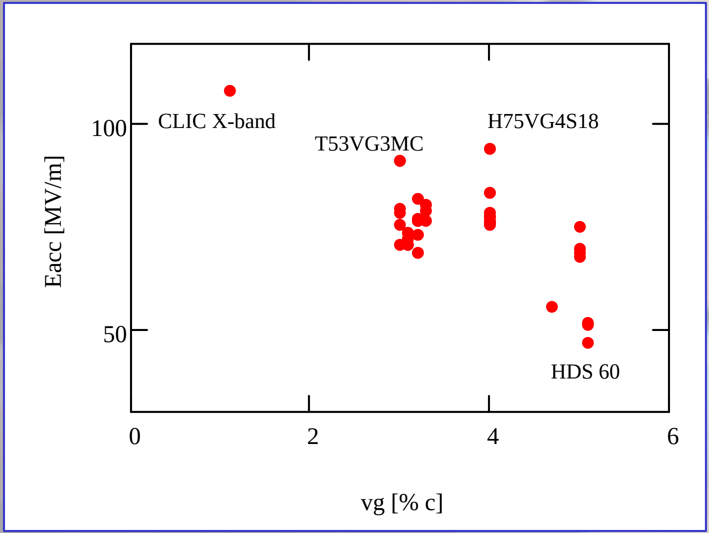
For the moment, use only copper accelerating structures (no PETS, No other materials)

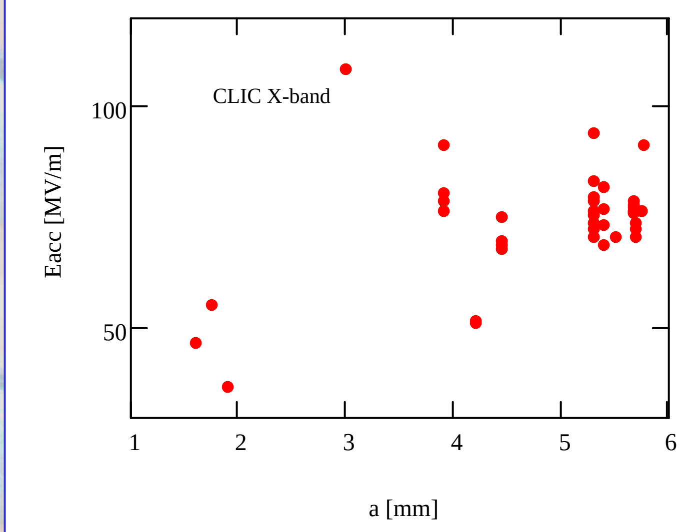
Normalization of measured gradient

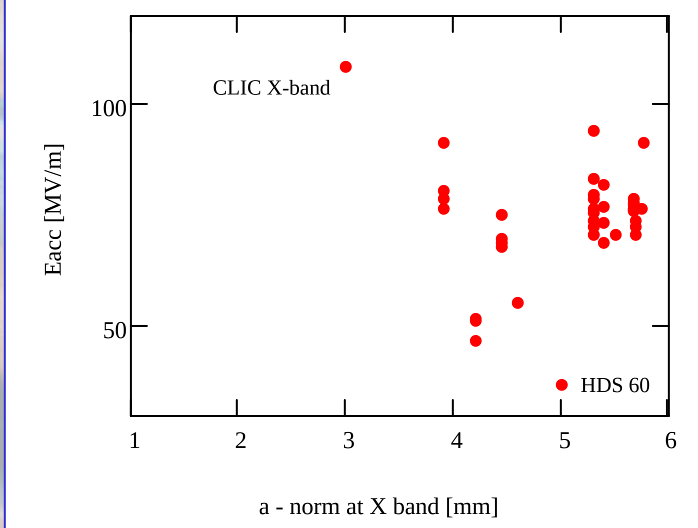
1. Normalize to 10-6 (assume "typical" copper slope, relative)
2. Normalize to pulse length (use 150 ns as "standard")



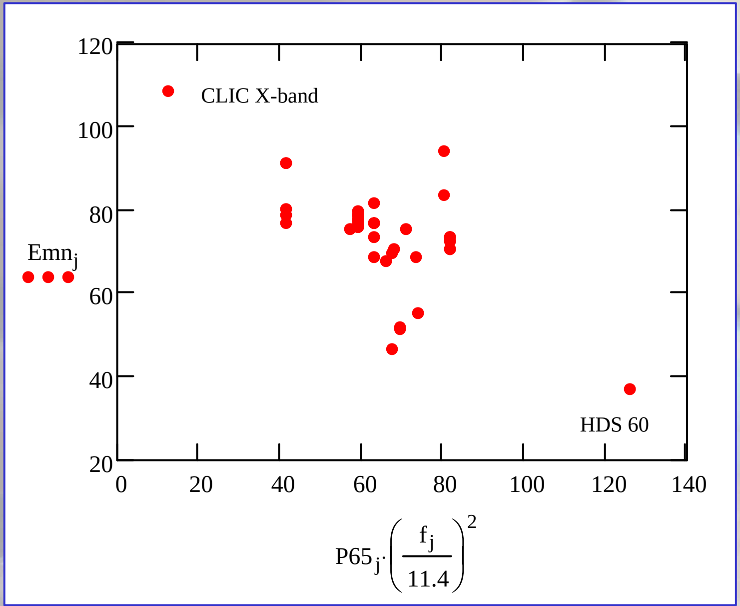
Correlation plots

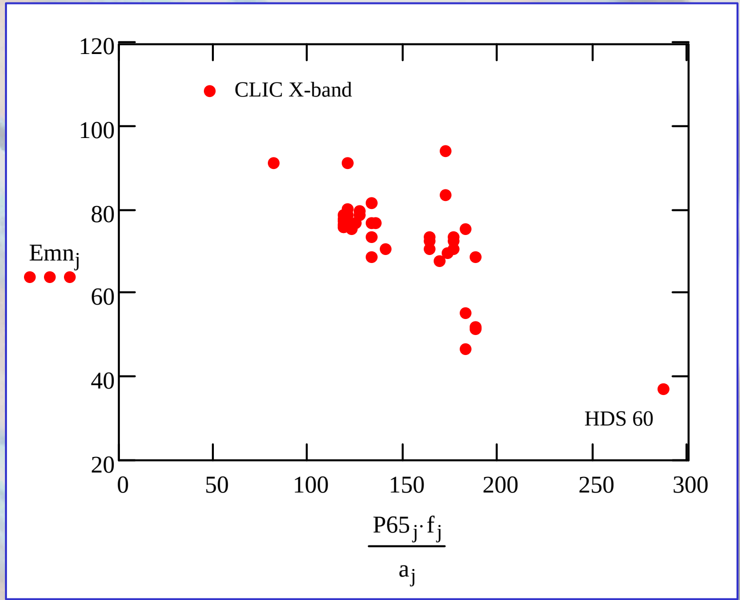






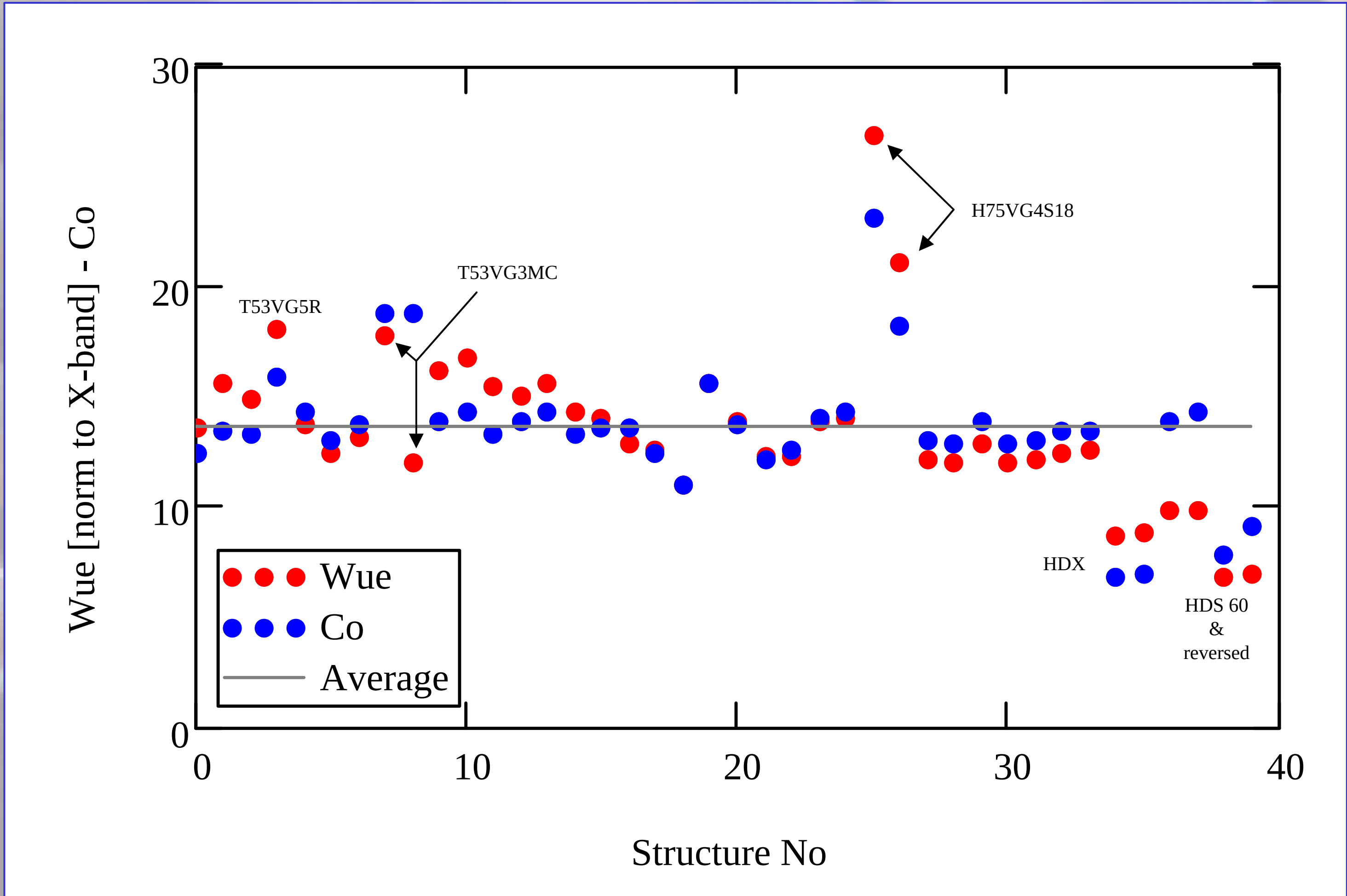
Correlation plots



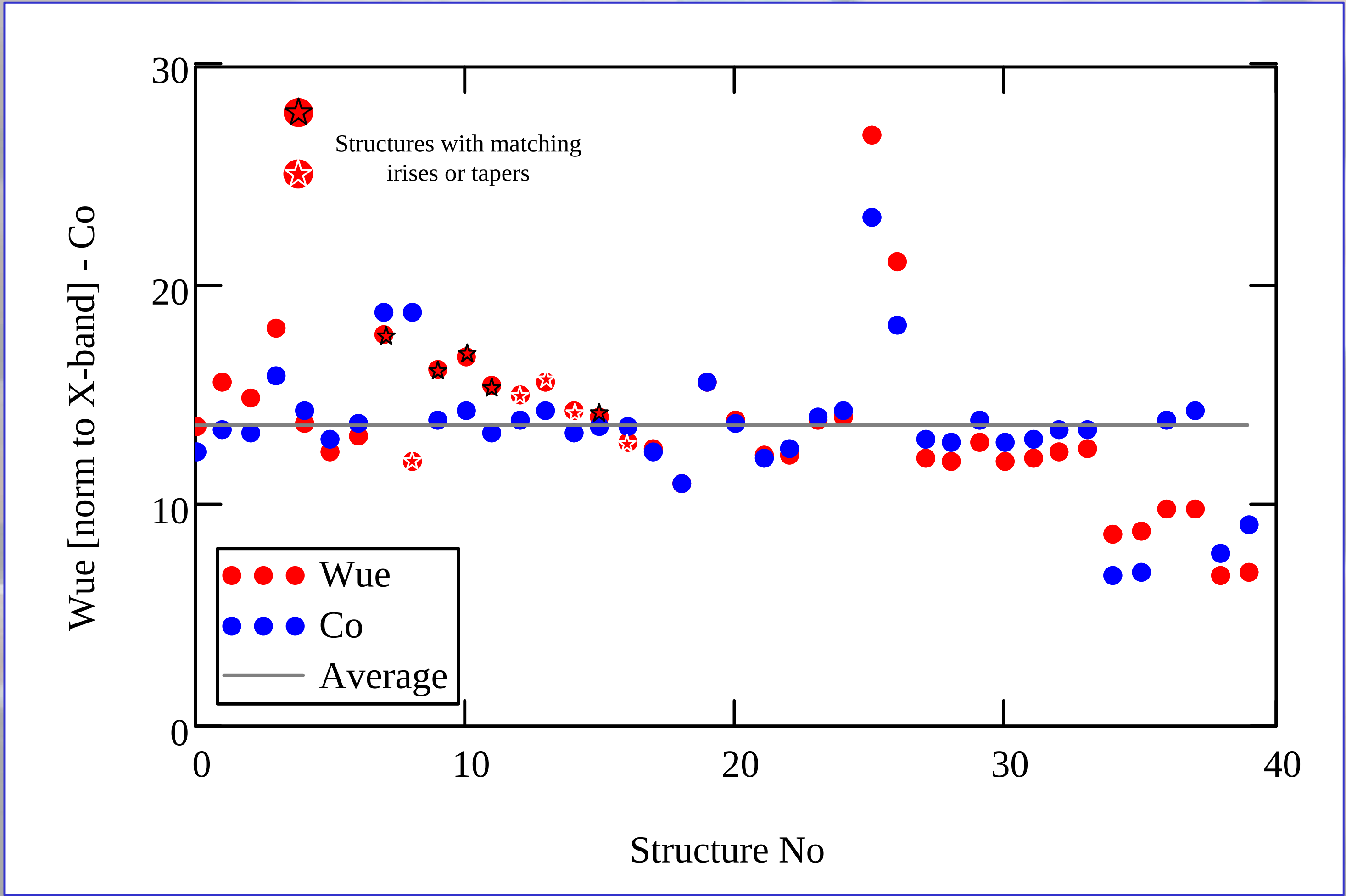


Wuenshes & Corsinis

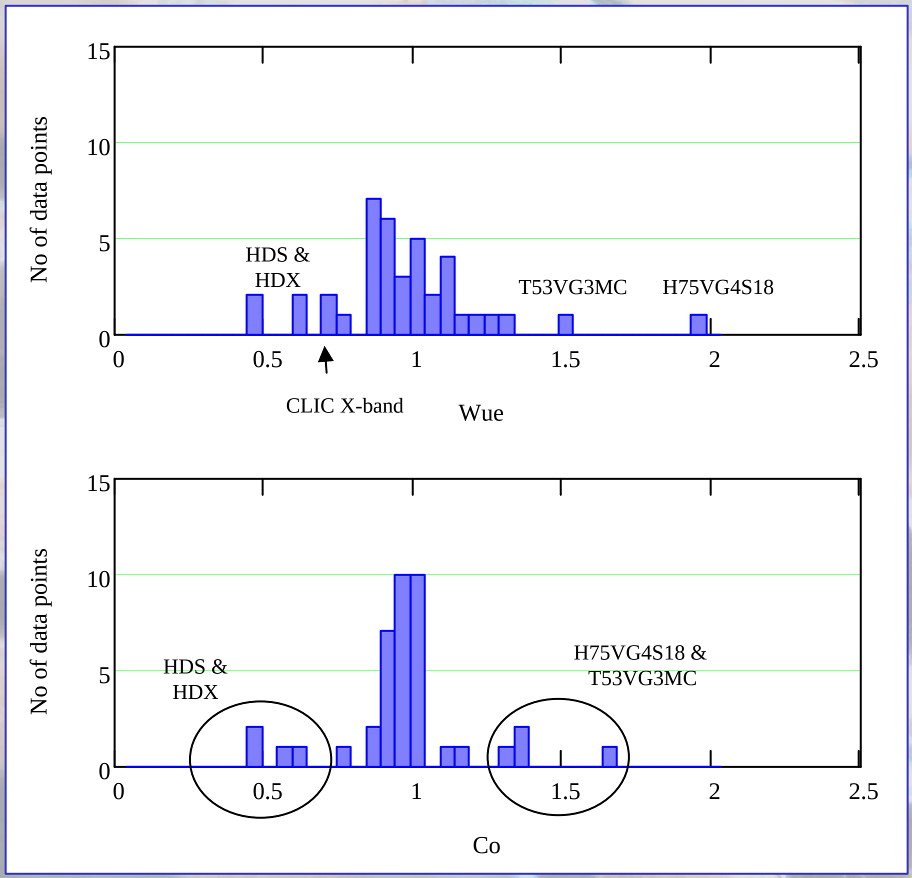
$$Co = \frac{(E_{acc})^2 \cdot (v_g)^{0.1} \cdot (f)^{1.5} \cdot (P65)^{0.5}}{\left(\frac{\phi \cdot \sin(\phi) + 2 \cdot v_g \cdot \cos(\phi)}{\sin(\phi)}\right)^{0.1}}$$



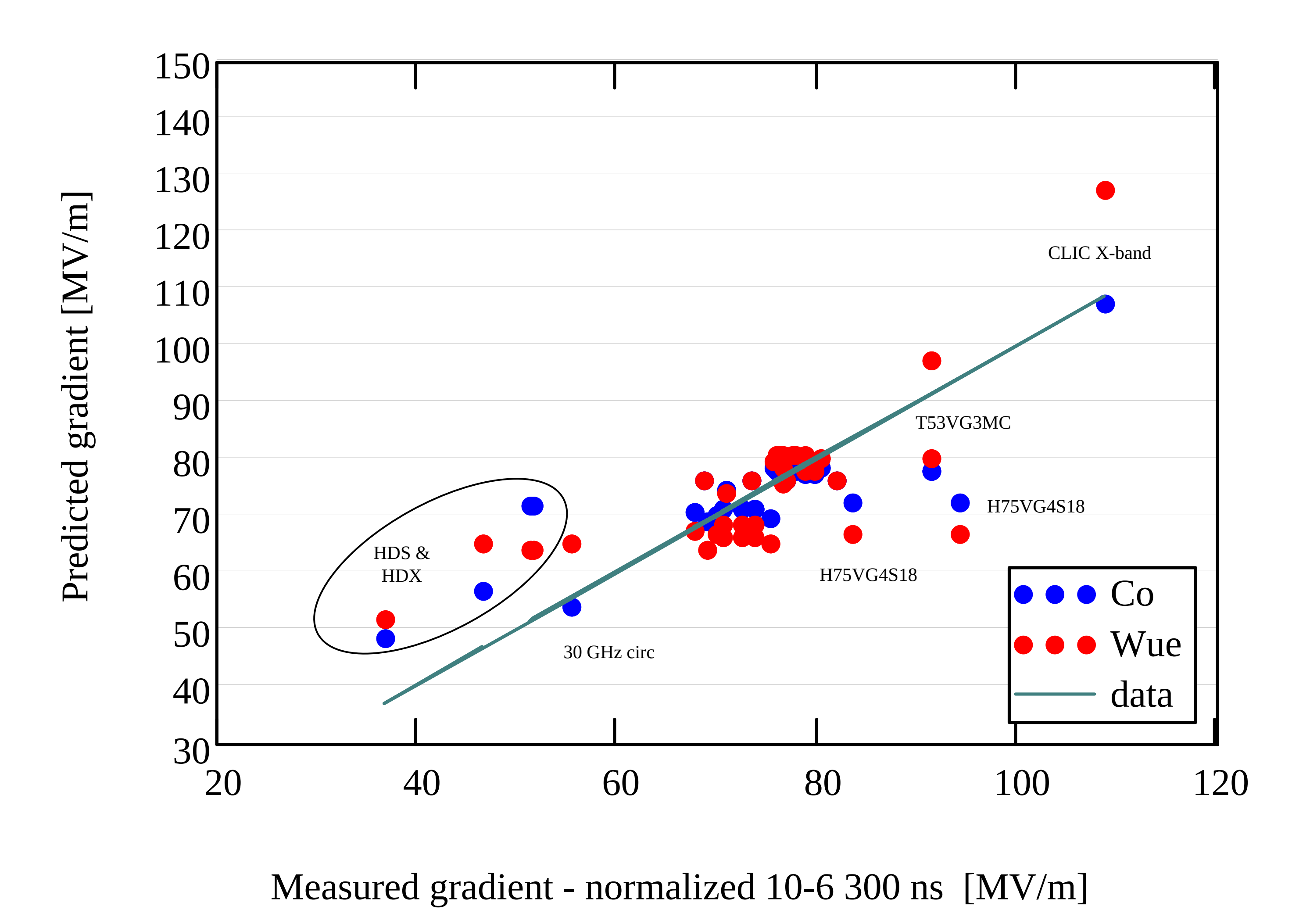
Wuenshes & Corsinis



Wuenshes & Corsinis



Wuenshes & Corsinis – predictive power



Chris' damage potential & scalings

Effective Impedance

$$Z_s \approx 2\frac{R/Q}{k\ \sin(\phi)} \approx \frac{R/Q}{v_g}\ \frac{\phi\sin(\phi) + 2\,v_g\cos(\phi)}{\sin(\phi)}$$

Power Absorbed in an Arc

$$Power_{abs} \approx 4\frac{R_{arc}}{Z_s}\ Power_{inc} \approx \frac{R_{arc}}{(R/Q)^2}\ \frac{v_g^2}{\omega/c}\ \frac{4\sin(\phi)\ \ Gradient^2}{\phi\sin(\phi) + 2\,v_g\cos(\phi)}$$

Different scaling – still miss R/Q data to test, but not very promising

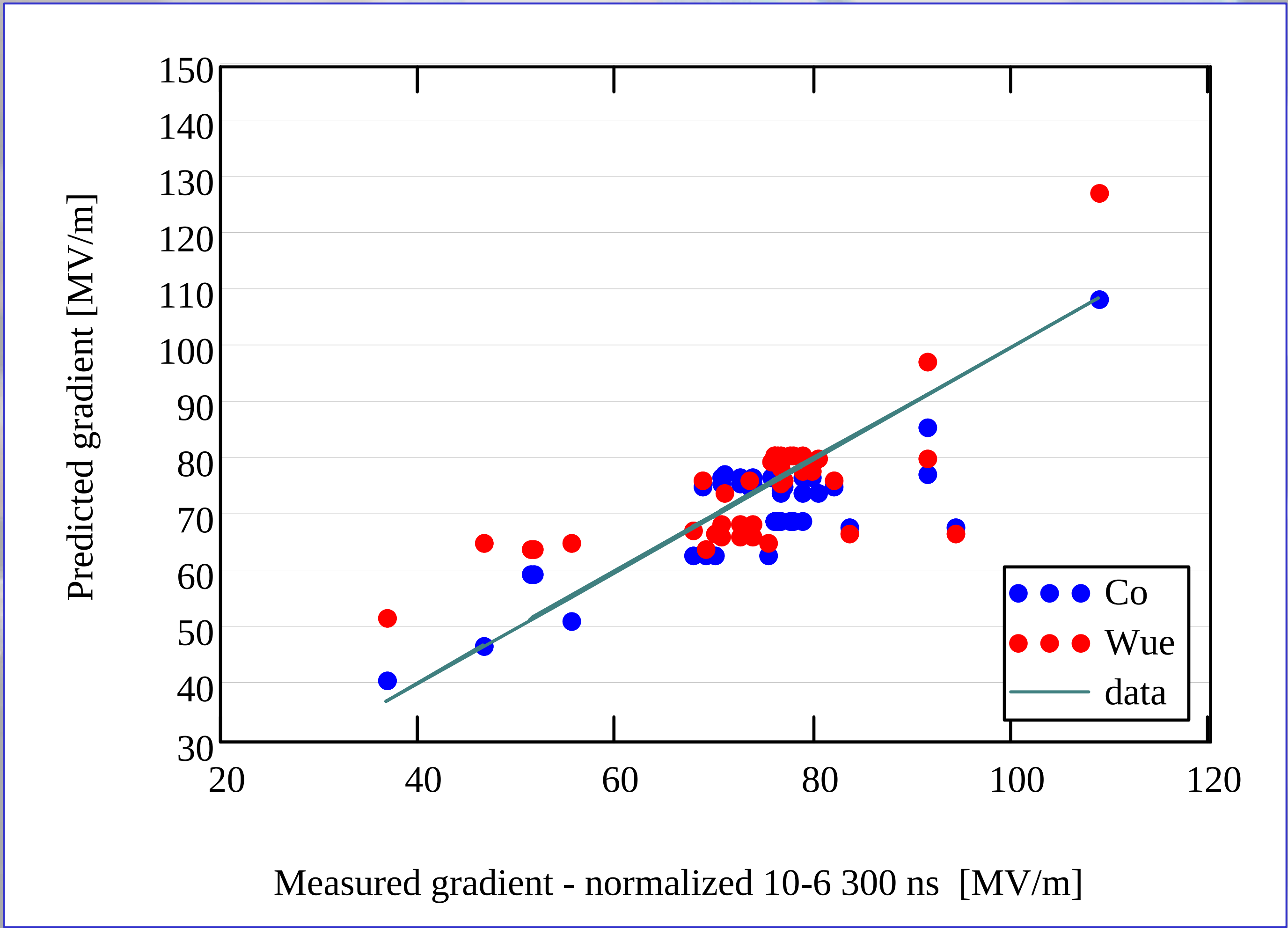
If Breakdown is Modeled as a Load Impedance,
Power Absorbed in the Load Scales as

$$\frac{v_g^2}{(R/Q)^2}\ \frac{\sin(\phi)}{\phi\sin(\phi) + 2\,v_g\cos(\phi)}\ Gradient^2$$

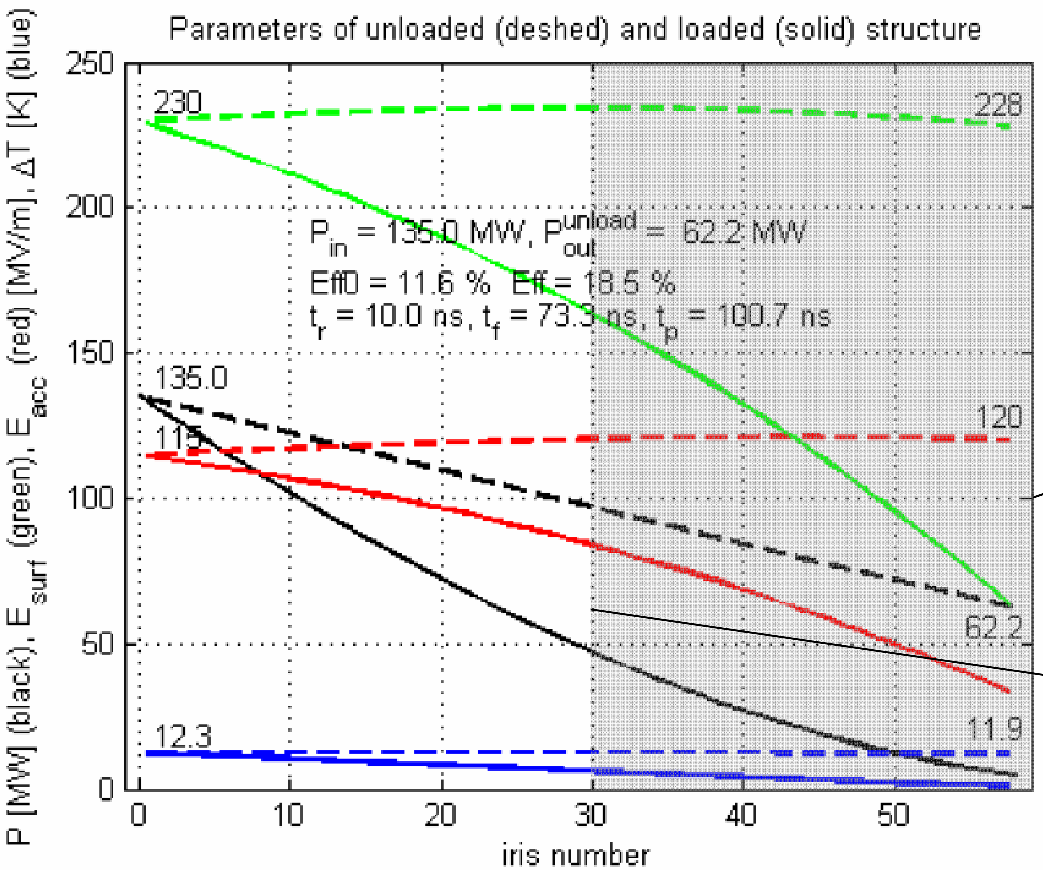
where v_g = Group Velocity/c, R = Shunt Impedance, Q = Quality Factor, ϕ = Phase Advance

Another Corsini definition

$$Co = \frac{\left[(E_{acc})^{2} \cdot (v_g)^{0.75} \cdot (\phi)^{0.1}\right]}{(a)^{0.5}}$$



…to cut or not to cut…



$\langle Ea \rangle$ = 80MV/m

Nb = 34

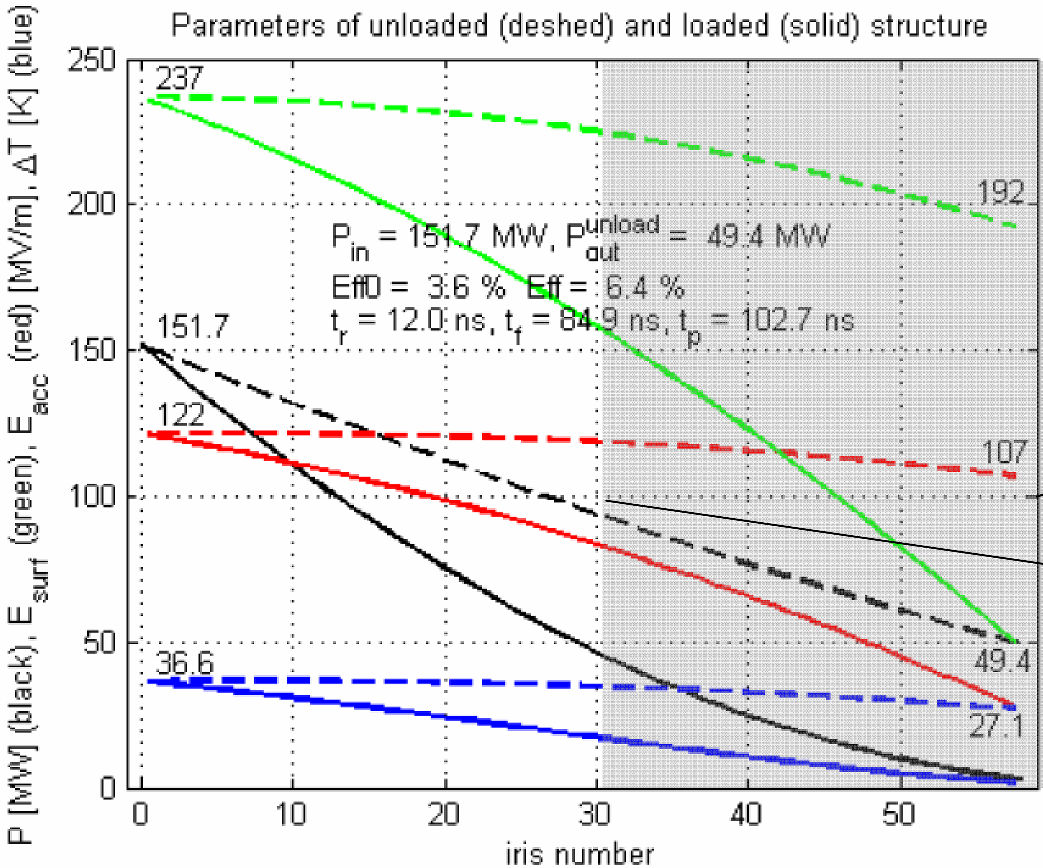
FoM_0=4.6

FoM =7.4

$$\frac{100.7-73.3-10}{100.7}\cdot\frac{135-11.9}{135}\cdot 0.735 = 0.116$$

$$\frac{100.7-\frac{73.3}{2}-10}{100.7}\cdot\frac{135-50}{135}\cdot 0.735 = 0.248$$

Structure is not damped but 6-rf-cycles bunch spacing is assumed



<Ea> = 80MV/m

Nb = 12

FoM_0=1.4

FoM =2.6

$$\frac{102.7-84.9-12}{102.7}\cdot\frac{151-27.1}{151}\cdot 0.75=0.035$$

$$\frac{102.7-\frac{84.9}{2}-12}{102.7}\cdot\frac{151-50}{151}\cdot 0.75=0.236$$