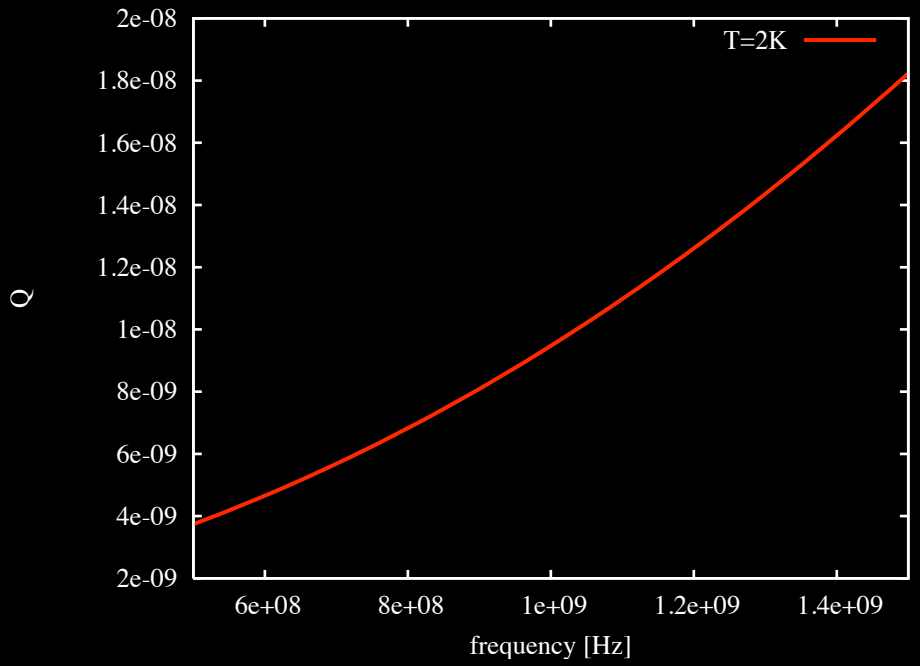
notes on: Q=f(T,f,B)

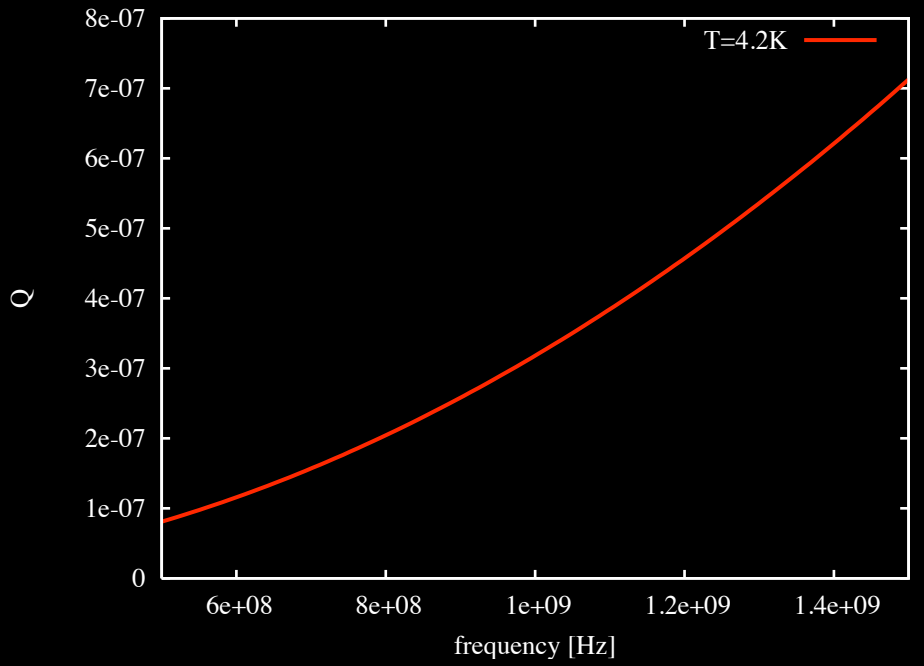
F. Gerigk, M. Schuh, W. Weingarten

SPL steering group meeting, 11 July 2008

standard approach

$$
\begin{aligned}
R_{surf.} &= R_{BCS} + R_H \\
R_{BCS} &= 2 \cdot 10^{-4} \left(\frac{f}{1.5 \cdot 10^9} \right)^2 \frac{\exp(-17.67/T)}{T} \\
R_H &= 9.5 \cdot 10^{-12} H_{ex,static} \sqrt{f} \\
Q &= \frac{G}{R_{BCS} + R_H} \\
G &\approx 280\,\Omega \quad \text{for } \beta{=}1 \text{ elliptical cavity}
\end{aligned}
$$





"Notes on Q=f(f,T,B)", SPL steering group, 11 July 2008, F. Gerigk

standard approach:

$$\text{at } 2\text{K}: \quad \frac{Q(704\,\text{MHz})}{Q(1408\,\text{MHz})} = 2.9$$

$$\text{at } 4.2\text{K}: \quad \frac{Q(704\,\text{MHz})}{Q(1408\,\text{MHz})} = 4$$

the numbers will probably change when we consider $R_s = f(B)$,
... still under study ...

"Notes on Q=f(f,T,B)", SPL steering group, 11 July 2008, F. Gerigk

impact on power consumption

assuming the same Q_0 at both frequencies:

HPSPL: I_b=40 mA, t_P=0.4 ms, 50 Hz, 5 GeV, 4 MW	**704 MHz**	**1408 MHz**
P_{el} (RF + cryo 2K/4.5K)	24.2 MW + 3.8/8.4	16.2 MW +2.6/3.6
P_{cryo} @2 K (eq.@4.5 K)	1.7 (5.1) kW	0.92 (2.8) kW
P_{cryo} @4.5 K	12.7 kW	4.7 kW

assuming scaled Q_0 values for 1408 MHz:

HPSPL: I_b=40 mA, t_P=0.4 ms, 50 Hz, 5 GeV, 4 MW	**704 MHz**	**1408 MHz**
P_{el} (RF + cryo 2K/4.5K)	24.2 MW + 3.8/8.4	16.2 MW +4.0/11.1
P_{cryo} @2 K (eq.@4.5 K)	1.7 (5.1) kW	1.7 (5.3) kW
P_{cryo} @4.5 K	12.7 kW	17.2 kW

"Notes on Q=f(f,T,B)", SPL steering group, 11 July 2008, F. Gerigk

impact on power consumption

- approximately the same cryo-power consumption at 2K,
- 35% higher cryo-power needs for 1408 MHz at 4.2 K,
- it remains ~20-40% higher electrical power consumption for 704 MHz, driven by the RF system,
- need to understand of field dependence on Q!

"Notes on Q=f(f,T,B)", SPL steering group, 11 July 2008, F. Gerigk