**Why Nb$_3$Sn?**
Currently Niobium is used in modern accelerators and is reaching its fundamental limit. Nb alone has a high quality factor ($Q_0$); Nb$_3$Sn has a higher critical temperature (~18 K, whereas Nb has a $T_c$ of ~9 K) -- so it has an even higher $Q_0$. Nb$_3$Sn performs just as well, if not better, at the natural boiling point of liquid helium (4 K) as opposed to Nb cooled to 2 K. Also, Nb$_3$Sn has a higher superheating field, which allows for higher accelerating gradients.

**Coating the Cavity**
After loading samples of tin and placing the standard niobium cavity within the furnace, it is placed under vacuum and heated up to 1300 ºC so that tin vapors coat the interior of the cavity.

**Temperature Mapping**
Once coated, the cavity is submerged in liquid helium and $Q_0$ as a function of the accelerating field is found. 38 boards each holding 17 resistors are placed on the cavity -- the 646 resistors give a full temperature profile of the cavity during operation.

**Result**
The cavity tested in July 2013 marked a breakthrough for the Nb$_3$Sn program -- it outperformed previous cavities of its type, which were produced by other labs in the 1980s. This allows for multiple new applications within the field!

**Data Analysis**
In the case of Wuppertal’s Cavity, it was thought that the reason for the $Q_0$-slope was strictly a fundamental occurrence. This breakthrough test shows that the reason for the degradation is in fact not fundamental! The first cavity manufactured at Cornell also showed a similar result to Wuppertal. In an attempt to try to further understand the $Q_0$-slope, the $\Delta T$ data was examined. The heating before and during the $Q_0$-slope was compared to see if any trends could be found. The deviation of the other points from the trend was measured, providing the normalized residual:

\[
NR = \frac{\Delta y_1}{y_1} + \frac{\Delta y_2}{y_2} + \frac{\Delta y_3}{y_3} + \ldots + \frac{\Delta y_n}{y_n}
\]

The normalized residual was plotted against the maximum heating for each resistor in a given field. Unfortunately, no trend was found within the results. Further investigations are ongoing.

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