The beam position sensitivities (vertical and horizontal) are determined by the equation:

\[ x = K_x(x,y)U, \quad y = K_y(x,y) V \]

**Geometry Parameters**

Most important points in design of button BPM are button and vacuum chamber geometries.
- Vacuum chamber
- Button:
  - Diameter (d)
  - Thickness (t)
- Gap (g)

**Induced Charge calculation**

We derive induced charge \( Q_i \) by using Green’s theorem and numerical solution of Laplace’s equation in a two dimension region \( \Omega \) closed by the boundary \( \Gamma \), containing the charge density \( p(x,y) \). The charged particle is moved vertical and horizontally inside a ±1 mm range. Hence numerical solution represents matrix equation:

\[ [G] F + B = 0 \]

where \( F \) is the unknown column vector whose elements are the induced charge density on each boundary element (considering 720 small elements). LU decomposition method has been implemented in C# code to calculate the numerical solution. It has best time-consuming (about 7 seconds).

**Output Curves**

- The beam position sensitivities (vertical and horizontal) are determined by difference over sum (\( \Delta/\Sigma \) ) method
- Intrinsic resolution from the ratio of signal to thermal noise

**REFERENCES**


[3] F.E. Black et al., *This is a Very Interesting Book* (New York: Knopf, 2007), 52
