

JUAS 2020 – RF Exercise

$$\mu = \mu_0 \mu_r$$

$$\mu_0 = 4\pi \cdot 10^{-7} \text{ Vs/(Am)}$$

$$c = 2.998 \cdot 10^8 \text{ m/s}$$

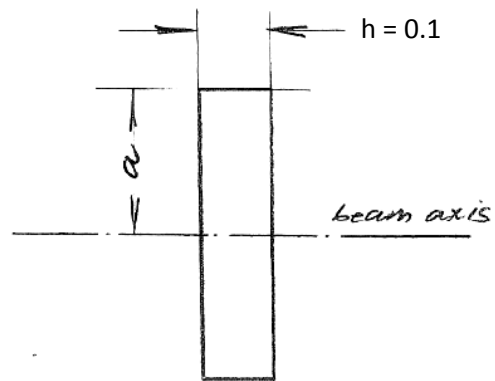
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Design of a pillbox cavity

Problem: Design a simple cavity of the “Pillbox” type with the following parameters:

- Frequency : $f = 299.98 \text{ MHz}$ ($\lambda = 1.00 \text{ m}$)
- Wall material : Copper (equivalent skin depth $\delta = 3.8 \mu$)
- Axial length : $h = 0.1$

It is assumed that the diameter of the vacuum chamber (beam hole) can be neglected so that all analytical formulae describing a pillbox cavity are applicable.



Questions:

A1.- Find from analytical formulae

- cavity radius a ,
- cavity quality factor Q ,
- “geometry factor” also known as “characteristic impedance” r/Q .

Is the cavity completely determined?

A2.- Find the equivalent circuit of the intrinsic cavity.

A3.- Find the 3-dB bandwidth of the intrinsic cavity.

A4.- Calculate the necessary RF power for a gap voltage of $U = 100 \text{ kV}$

A5.- The cavity shall be fed by an amplifier designed for a load impedance of 50Ω .

Determine

- the peak voltage at the cavity input,
- the necessary transformer ratio k of the input coupler.