WHAT CAN WE IMPROVE in HOM MEASUREMENTS with MODULATED BEAM?

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Reminder of principle
Past problems
What could we do?

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**Basic principle**

Excite mode when: \[ \omega_{\text{mod}} = |\omega_i - m \cdot \omega_b| \leq \omega_b/2: \]

\[
\Delta x'_{\text{res max}} = c \frac{e}{E} \delta x_0 \left( q_0 \frac{\omega_b}{2\pi} \right) \frac{\lambda}{\omega_i} \left( \frac{\left( \frac{R}{Q} \right) Q}{l} \right)
\]

**Assumptions:**
- steady state: bunch train length \( \gg \tau = 2Q/\omega \)
- exactly on resonance
- horizontal polarization

**Requirements:**
- low energy
- large beam offset
- high average current
- high modulation amplitude
- long bunch train \( \Rightarrow \) reach steady state
- high bunch frequency \( \Rightarrow \) avoid resonance overlap
- low frequency step \( \Rightarrow \) not to miss high-Q modes
Problems in the last measurements

- many quadrupole modes excited much stronger than dipole ones
- instabilities of the beam (position, charge, etc.)
- calibration
- instrumentation limitation

- time and men power
- too much automatization?
What can we improve?

• We need more information!
  ➢ polarization ✓
  ➢ vertical plane
  ➢ check mode character

  ➢ increase BPM resolution

• Possible changes:
  ➢ reduce beam deflection ⇒ avoid quadrupole modes
    • but we lose sensitivity; which can be regained by:
  ➢ increase current
  ➢ increase bunch frequency
  ➢ more sensitive BPMs

• Make complementary measurements (e.g. use two BPMs)

• It needs lots of time! But we have fewer cavities and HOM couplers and a bit more experience
What can we improve? (2)

- Measure \( R/Q \) with BPM
  - HOM couplers
    - no superimposed resonances, as seen at BPM
    - need calibration of cables at higher frequencies

- Will be better prepared
  - know more problems
  - use RF measurements of HOMs \( \rightarrow \) dipoles + quadrupoles?
    (+ monopoles)
5th Dipole Passband Trapped Mode

Prediction for: $f = 3068 \text{ MHz}$, $R/Q = 1.1 \Omega/\text{cm}^2$, $Q = 3.4 \times 10^7$ in cavity C7, as a function of the modulation frequency.