Analysis of baked cavities

- Based on the paper of J. Hao et al., SRF 2003

- Practical approach to quantify the bake effect

- cavity results:
    - $E_{acc,max}$, $Q_0(E_{acc,max})$
    - E_{acc}@ (Po=(100W/9*n)) (normalisation to cell number) , E_{acc}@ $Q_0 = 10^{10}$

- analysed preparation + test parameters:
    - BCP / EP / "mixed states"
    - before vs. after bake
    - temperature in 3 groups: (100 - 120)/ (120 – 130)/(130 – 140) °C
    - He bath temperature of rf test (not complete)
  neglected:
    - duration of bake, residual resistance, effect of warm-up above T_c

Results

- Concentration on EP cavity results ~ 30-40 cavities
  (for few BCP cavities no improvement of Eacc, but cure of Q-slope)

- Results not fully actualized

- Gain of Eacc after bake: typically 3-4 MV/m with large scatter

- average gradient after EP + bake: ~>35 MV/m

- Dependance on bake temperature:|
  - no influence on E_{acc}
  - influence on $E_{acc}(P=100W/9*n)$???
  - critical parameter $Q_0(E_{acc,max})$:
  bake temperature around 130C better than lower temperature
  (factor of 2 in $Q_0(E_{acc,max})$)

Analysis of baked cavities: $E_{acc,max}$

- EP-cavities: average of E_{acc} :   32,1 MV/m $\Rightarrow$ 35,3 MV/m
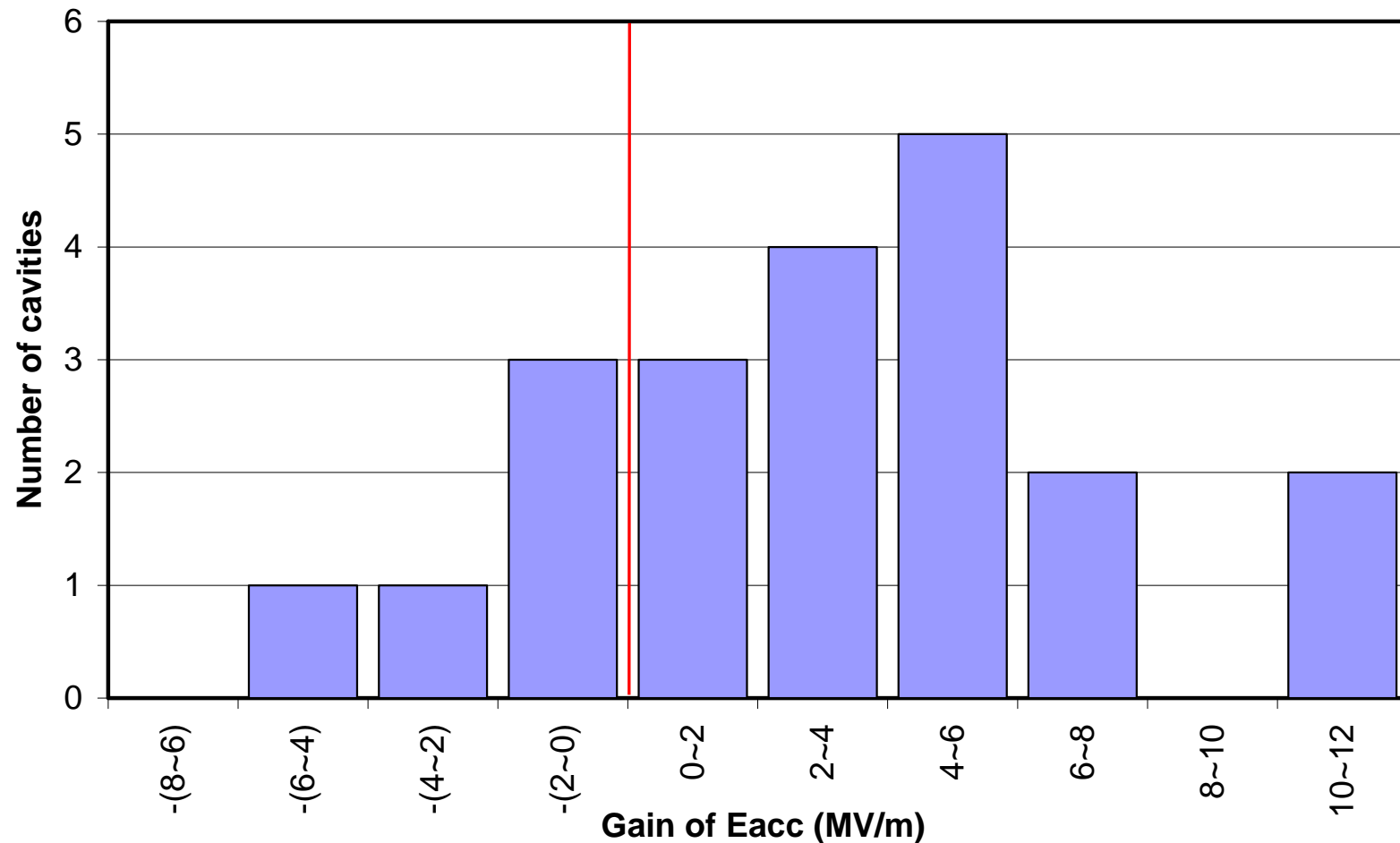

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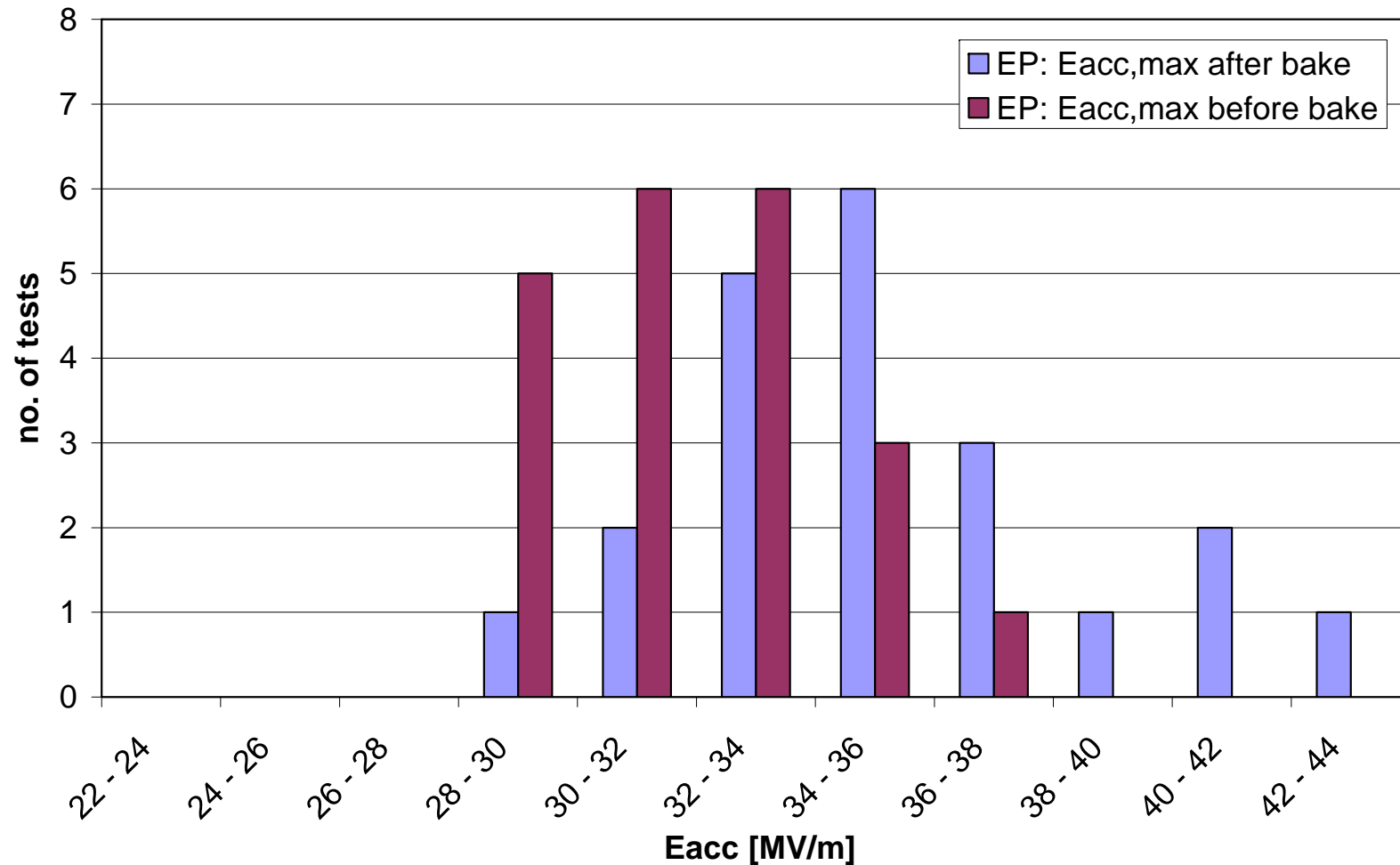
Analysis of baked cavities: $E_{acc,max}$

- **EP-cavities: influence of bake temperature**
  average gain of E_{acc} after (100 - 110)°C: 31,9 MV/m $\Rightarrow$ 35,5 MV/m
  average gain of E_{acc} after (120 - 130)°C: 32,6 MV/m $\Rightarrow$ 34,9 MV/m
  $\Rightarrow$ no difference between (100 - 110)°C vs. (120 - 130) °C

- **EP-cavities: general**
  high scatter of $E_{acc,max}$:   29 MV/m to 44 MV/m
  high scatter of gain: -5 MV/m to 12 MV/m
  (experimental problems, cavity close to quench limit, not FE limited)

- **BCP-cavities: general** (only 5 tests available)
  average gain of E_{acc} 30 MV/m $\Rightarrow$ 29,6 MV/m
  $\Rightarrow$ no improvement !!

- **EP-cavities** preliminary: add. 2nd bake gives no improvement (3 tests)

Analysis of baked cavities: $E_{acc,max}$
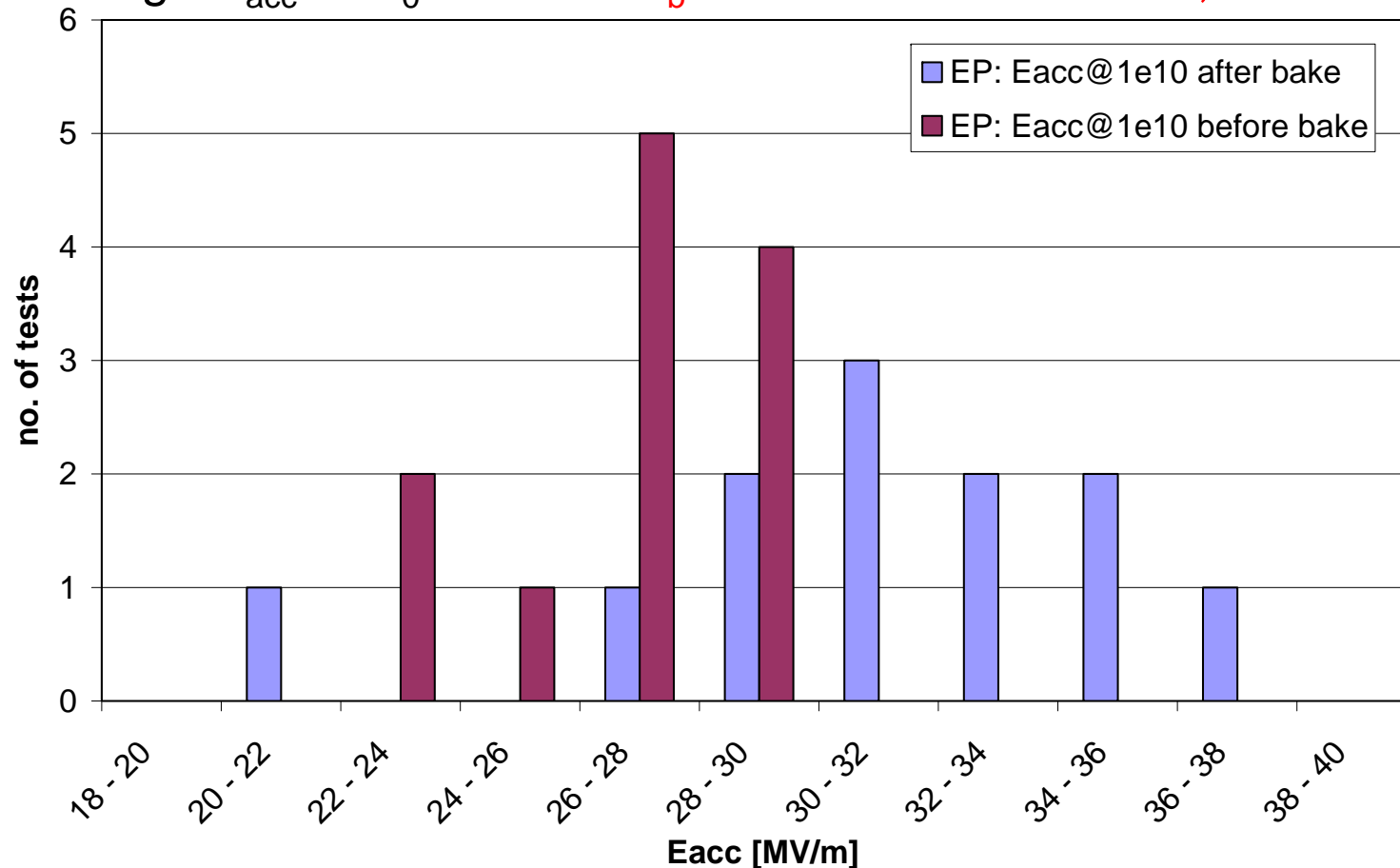
- EP-cavities: average gain of E_{acc} after bake: 3,2 MV/m

Analysis of baked cavities: $E_{acc}@Q_0=10^{10}$

- EP-cavities:

average $E_{acc}@ Q_0 = 10^{10}$ at $T_b = 2K$: 27 MV/m $\Rightarrow$ 31,1 MV/m

Analysis of baked cavities: $E_{acc}@Q_0=10^{10}$

- Only tests at $T_b = 2K$ taken into account !

- EP-cavities: influence of bake temperature
  average gain of E_{acc} after (100 - 110)°C: 25,9 MV/m $\Rightarrow$ 30,5 MV/m
  average gain of E_{acc} after (120 - 130)°C: 28,4 MV/m $\Rightarrow$ 31,6 MV/m
  $\Rightarrow$ no significant difference between (100 - 110)°C vs. (120 - 130) °C
         (limited statistics)

- EP-cavities: influence of Q-degradation due to multipacting
  high scatter of $E_{acc,max}$ and gain   (gain: -6 MV/m to 13 MV/m)

  $\Rightarrow$ multipacting leads to significant Q-degradation

- EP-cavities preliminary: add. 2nd bake gives no improvement (3 tests)

Analysis of baked cavities: $E_{acc}@Q_0=10^{10}$

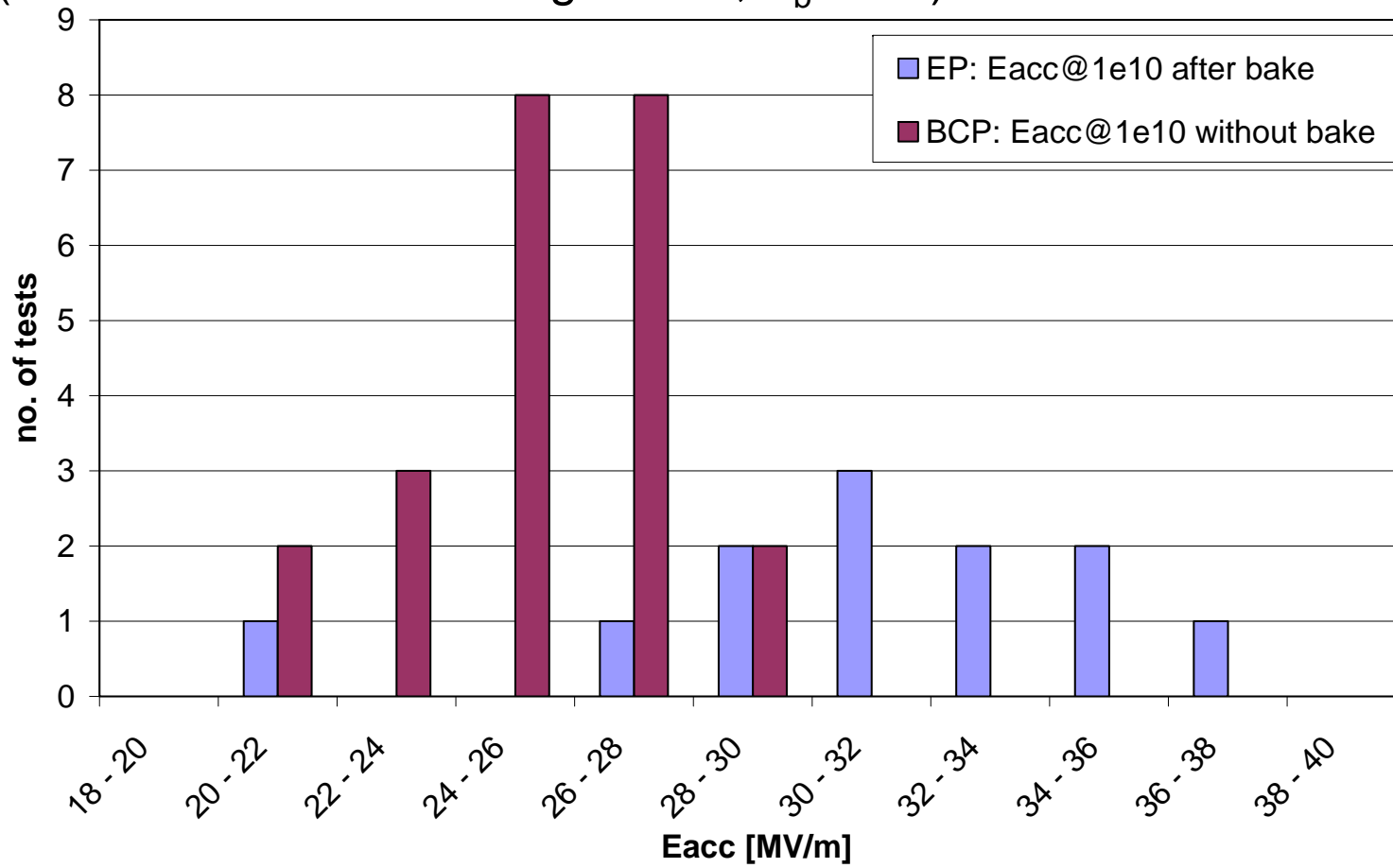- EP-cavities: gain of $E_{acc}@ Q_0 = 10^{10}$ after bake ($T_b = 2K$):   4,1 MV/m
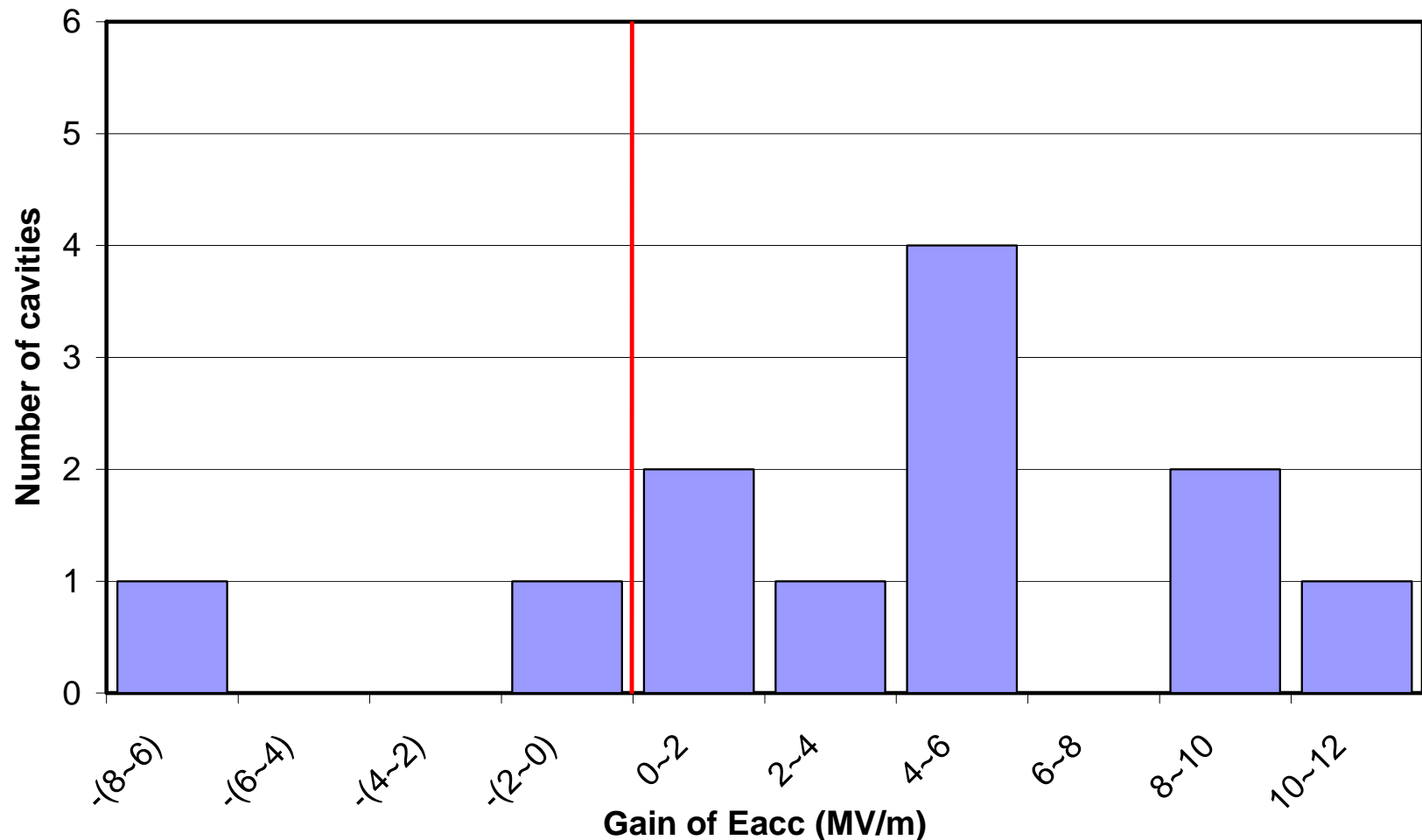
$E_{acc}@Q_0=10^{10}$: BCP vs. EP-cavities

- Standard treatment BCP-cavities without bake vs. baked EP-cavities (mix of nine-cells and single-cells; T_b = 2K):

$E_{acc}@Q_0=10^{10}$: BCP vs. EP-cavities

- Standard treatment BCP-cavities without bake:

  $E_{acc}@ \; Q_0 = 10^{10}$: 25,5 MV/m

- Baked EP-cavities:

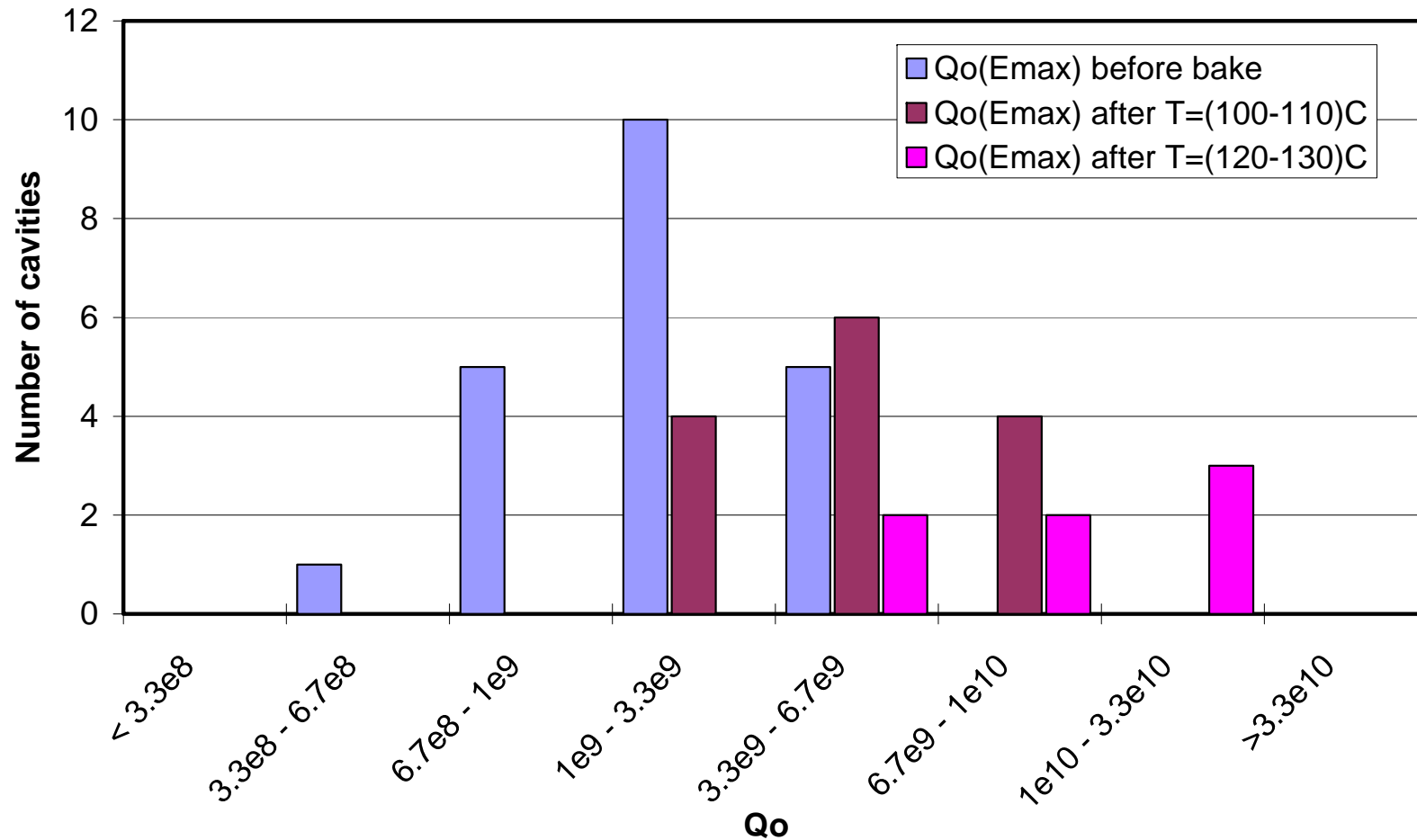 $E_{acc}@ \; Q_0 = 10^{10}$: 31,1 MV/m

  $\Rightarrow$ gain of 5,7 MV/m due to EP + bake

- remarks:

  - mix of nine-cells and single-cells at T_b = 2K
  - BCP-results show narrow distribution
  - EP-results show broad scattering (MP effect)
  - (BCP cavities show no (few) multipacting $\Rightarrow$ no Q-degradation)

Analysis of baked cavities: $Q_0(E_{acc})$

- EP-cavities: higher $Q_0(E_{acc,max})$ at T_{bake} = (120 - 130) °C

Analysis of baked cavities: $Q_0(E_{acc})$

- EP-cavities:

  $Q_0(E_{acc,max})$ at T_{bake} = (100 - 110) °C: $5.4 \cdot 10^9$ (14 tests)

  $Q_0(E_{acc,max})$ at T_{bake} = (120 - 130) °C: $9.0 \cdot 10^9$ (7 tests)

  $\Rightarrow$ significant improvement by enhanced bake temperature

- BCP-cavities:

  only some tests show improved $Q_0(E_{acc,max})$