RF Calculation (updates)

- Previous RF calculations for 5 cases: (J.G./W.C.)
  - 240 GeV/s, 3 x 10^{13}
  - 305 GeV/s, 3 x 10^{13}
  - 240 GeV/s, 6 x 10^{13}
    (assuming successful 12-batch slip stacking or barrier RF stacking)
  - 305 GeV/s, 6 x 10^{13}
    (ditto)
  - 305 GeV/s, 1.5 x 10^{14}
    (goal of a 2-MW MI in the Proton Driver era, documented in TM-2169)
- New calculations:
  - 260 GeV/s, 3.3 x 10^{13}
  - 260 GeV/s, 4 x 10^{13}
  - 280 GeV/s, 3.3 x 10^{13}
  - 280 GeV/s, 4 x 10^{13}

Bucket Size

- Operation requirements: (per I.K.)
  - **17 cavities**, each 240 kV for a total of 4.08 MV (but only 1.1 MV @inj)
  - **Bucket size ≥ 0.6 eV-s**
  - **Beam intensity: 3.3 x 10^{13} and 4.0 x 10^{13}**
- At injection:
  - Define $k \equiv \gamma/\gamma_t$ $\gamma_t = 21.6$
  - E = 8 GeV, γ = 9.526, k = 0.441
  - V(rf) = 1.1 MV, stationary bucket = **0.83 eV-s (inj)**

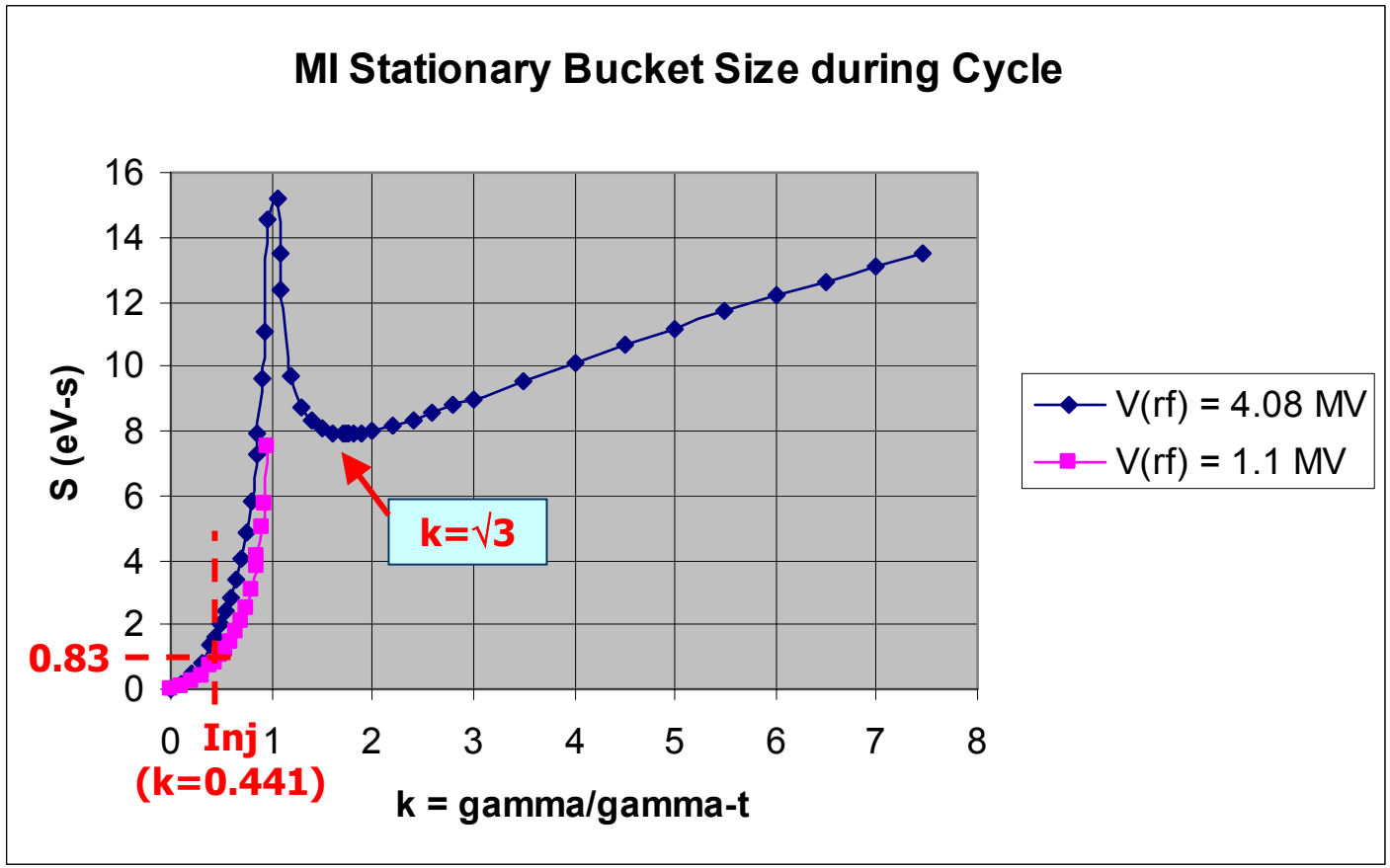
Minimum Bucket Size after Transition

k = √3 $\Rightarrow$ Minimum stationary bucket after transition

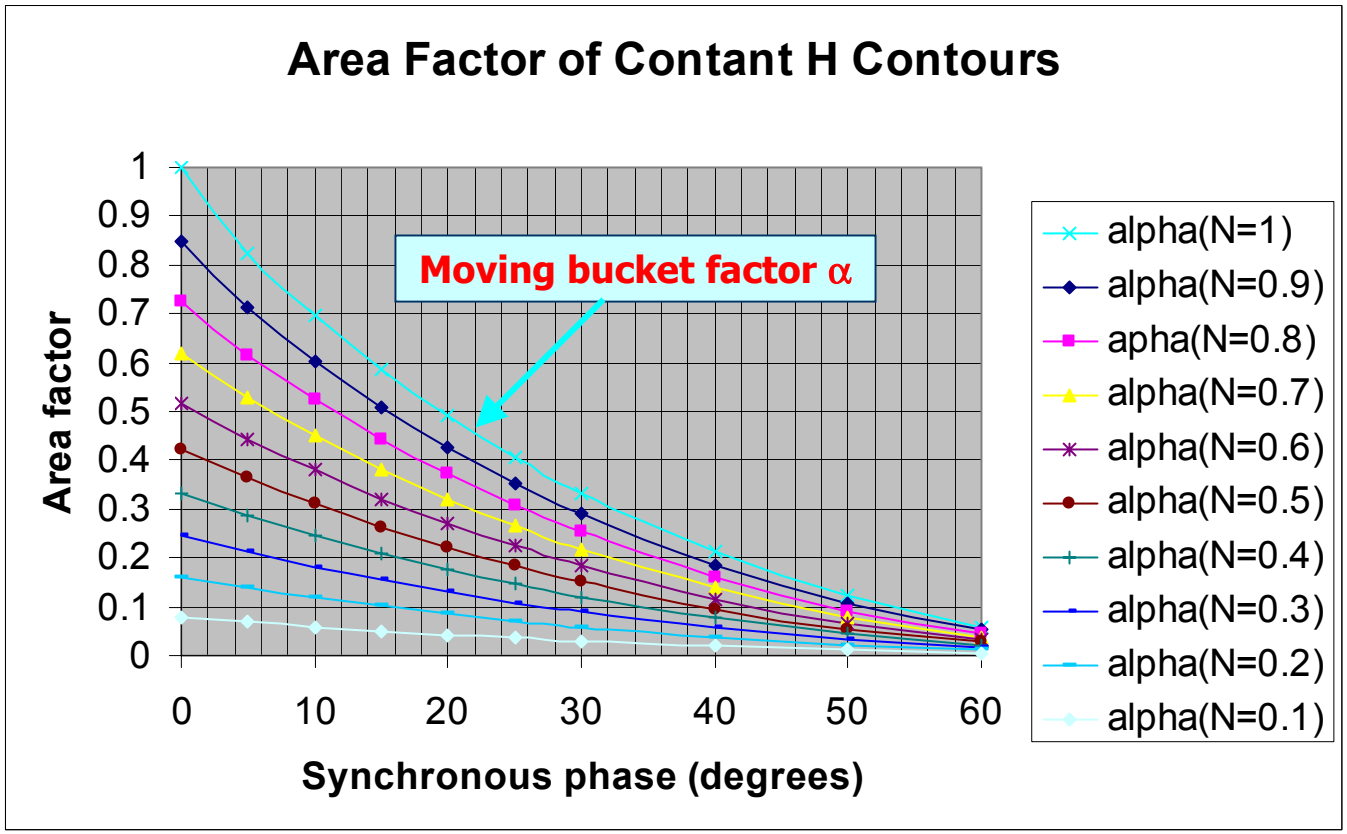
V(rf) = 4.08 MV, minimum stationary bucket = 7.9 eV-s

Ramp rate (GeV/s)	Accelerating voltage (MV/turn)	Synchronous phase φ	Moving bucket factor α	Moving bucket size (eV-s)
240	2.67	40.9	0.208	1.64
260	2.88	44.9	0.168	1.33
280	3.10	49.5	0.129	1.02
305	3.38	55.9	0.085	0.67

Stationary Bucket Size during Cycle



Moving bucket Factor



RF Power Calculation

- Cavity Q = 6500, R = 7.8 x 10^5 Ω, R/Q = 120 Ω
- **17 cavities**, each delivering 200 kW for a **total of 3.4 MW**
- **Wall loss**: V(gap) = 240 kV ⇒ P(wall) = **37 kW each**, or **total of 0.63 MW** for 17 cavities
- **Beam intensity: 3.3 x 10^{13} and 4.0 x 10^{13}**

Ramp rate (GeV/s)	Beam intensity	Power to the beam (MW)	Wall loss (MW)	Total power (MW)
240	3.3 x 10^{13}	1.27	0.63	1.90
240	4.0 x 10^{13}	1.54	0.63	2.17
260	3.3 x 10^{13}	1.37	0.63	2.00
260	4.0 x 10^{13}	1.66	0.63	2.29
280	3.3 x 10^{13}	1.48	0.63	2.11
280	4.0 x 10^{13}	1.79	0.63	2.42

2nd Type (High Intensity) Robinson Instability

- Power dissipation:
  - Anode power = 100 kW
  - Wall loss = 37 kW
  - Energy dissipation per cavity= 137 kW
  - Total dissipation of 17 cavities = **2.33 MW**
- Power delivered to the beam: (see previous table)
- Stability criterion:
  - Dissipation power > Power to the beam
  - **Satisfied in all the cases**.

Conclusion

No problem for fast ramp as far as the bucket size, RF power and beam stability are concerned.