IPAC21

TUPAB220

Longitudinal Dynamics with Harmonic Cavities under the Over-stretching Conditions

Jingye Xu[1,2], Haisheng Xu[1]

1. Institute of High Energy Physics, Chinese Academy of Sciences, Beijing China
2. University of the Chinese Academy of Sciences, Beijing, China

中国科学院高能物理研究所
Institute of High Energy Physics
Chinese Academy of Sciences

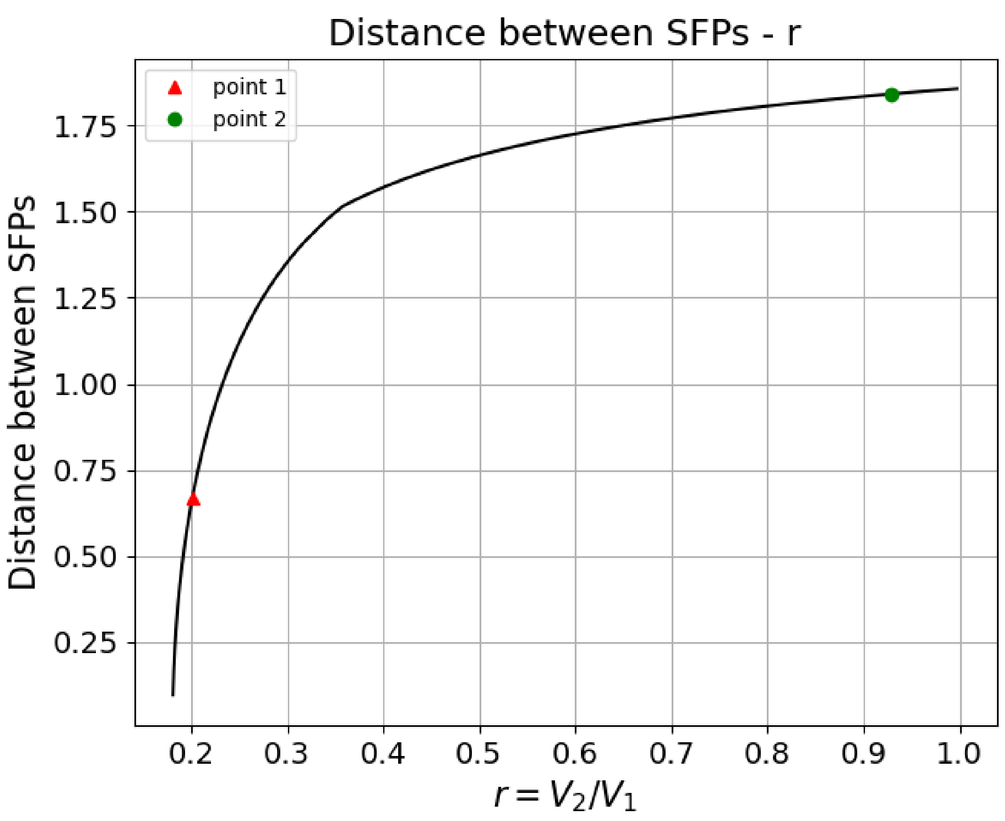
Abstract:

Harmonic cavities(HCs) are widely used to lengthen the bunches, mainly for increasing the Touschek lifetime or for suppressing the coupled-bunch instabilities in electron rings. There have been quite many studies on the beam dynamics with the consideration of HCs. We revisited the basic longitudinal beam dynamics with HCs. We successfully separated two peaks of longitudinal beam density of a over-stretching bunch from $267\mathrm{ps} \sim 1.77\mathrm{ns}$.

Lattice Parameters:

Parameters	Symbols	Values and Units
Circumference	C	1360.4 m
Beam Energy	E_0	6 GeV
Harmonic Number	h_1	756
Higher Harmonic Number	h_2	2268
Momentum Compaction Factor	α_c	1.561e-5
Radiation Energy Loss per Turn	U_0	2.887 MeV
RMS of momentum deviation rate	σ_δ	1.061e-3

Distance of SFPs V.S. $r = V_2/V_1$



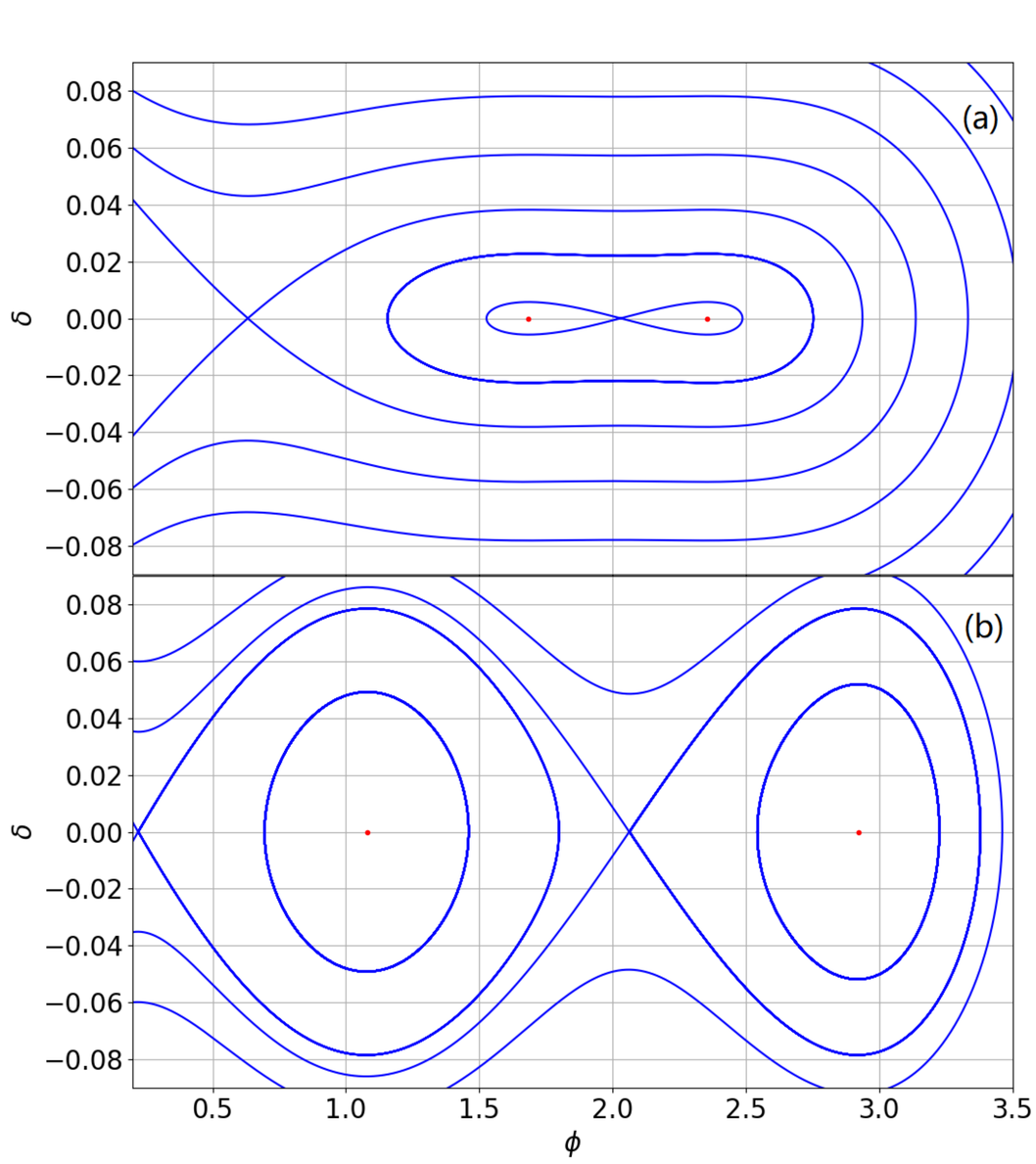
- Point 1:
  - V_1: 3.644 MV;
  - V_2: 0.733 MV;
  - ϕ_{1s}: 0.632;
- Point 2:
  - V_1: 3.644 MV;
  - V_2: 3.385 MV;
  - ϕ_{2s}: 0.221;

Assumptions:

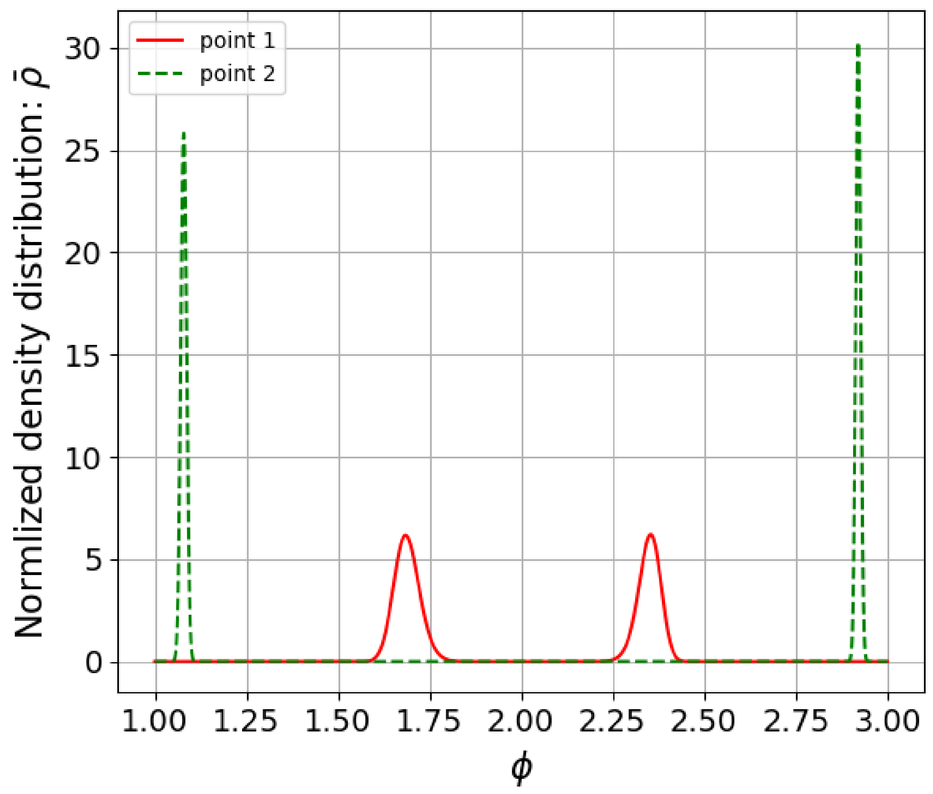
- Two sub-buckets were same bucket height.
- Ignore quantum excitation and impedance.

Corresponding Hamiltonian Torus:

(a) Two sub-buckets are in a larger bucket.
(b) Two sub-buckets cannot be in the same bucket.



Normalized Density Distribution



- **RED**: Normalized density distribution for point 1 assuming a continuous density distribution.
- **GREEN**:Normalized density distribution for point 2 assuming two sub-buckets have equal charges, for discontinuous distribution at this condition. Two peak density can be adjusted by injecting different charges into two sub-buckets.

Conclusions

- The distance between two density peaks of a over-stretching bunch can range from $0.28 \sim 1.85\mathrm{rad}(267\mathrm{ps} \sim 1.77\mathrm{ns})$.

* Work supported by National Natural Science Foundation of China (No. 11805217 and No. 11775239), NKPSTRD (2016YFA0402001)