Probing the use of stable islands as performance boosters for lepton rings and FCC-ee

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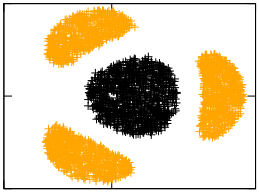
Study of transverse beam manipulations exploiting nonlinear effects

Stable resonant islands can be generated in the horizontal phase space to split or manipulate transverse properties of beams

Hadron rings: Hamiltonian dynamics $\leftrightarrow$ area-preserving maps

$$\mathcal{H} = \omega J + \frac{\Omega_2}{2} J^2 + \varepsilon J^{\ell/2} \cos(\ell\theta)$$

$$\begin{pmatrix} x_{n+1} \\ p_{n+1} \end{pmatrix} = R(\omega) \begin{pmatrix} x_n \\ p_n + x_n^2 + \varepsilon f(x_n) \end{pmatrix}$$



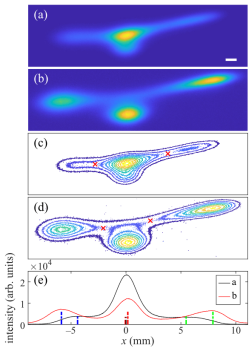
Trapping due to adiabatic parameter variation

Lepton rings: energy damping and quantum fluctuations

$$\begin{pmatrix} x_{n+1} \\ p_{n+1} \end{pmatrix} = R(\omega) \begin{pmatrix} x_n \\ (1-\gamma)p_n + x_n^2 + \xi_n \end{pmatrix}$$

Treat damping as adiabatic energy change; damping & fluctuation $\rightarrow$ equilibrium emittance in islands

Islands have been observed experimentally in synchrotron light sources



(from [5])

We would like to establish a comprehensive theoretical analysis of the nonlinear manipulations for lepton rings

Possible application: top-up in FCC-ee?

References

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