Visualizing higher-dimensional systems — classical and quantum

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As the simplest example of higher-dimensional systems with a mixed phase space we consider 4D maps. The global structure of regular tori is visualized using 3D phase-space slices [1, 7]. By this we explain the more general hierarchy in 4D maps [2] and organization in terms of bifurcations of families of 1D tori [3]. An important application is to achieve an understanding of the mechanism of power-law trapping in higher-dimensional systems [4].

Quantum mechanically, the Husimi representation restricted to the 3D phase-space slice allows for comparing regular and chaotic eigenstates with classical structures to investigate the semiclassical eigenfunction hypothesis [1]. For the case of fully chaotic systems we briefly discuss spectral statistics [5] and entanglement [6].

[1] *Visualization and comparison of classical structures and quantum states of four-dimensional maps*,
M. Richter, S. Lange, A. Bäcker, and R. Ketzmerick,
Phys. Rev. E **89**, 022902 (2014).

[2] *Global structure of regular tori in a generic* 4D *symplectic map*,
S. Lange, M. Richter, F. Onken, A. Bäcker, and R. Ketzmerick,
Chaos **24**, 024409 (2014).

[3] *Bifurcations of families of 1D-tori in 4D symplectic maps*
F. Onken, S. Lange, R. Ketzmerick, and A. Bäcker,
Chaos **26**, 063124 (2016).

[4] *What is the mechanism of power-law distributed Poincaré recurrences in higher-dimensional systems?*
S. Lange, A. Bäcker, and R. Ketzmerick,
arXiv:1609.07977.

[5] *Universal scaling of spectral fluctuation transitions for interacting chaotic systems*,
S. C. L. Srivastava, S. Tomsovic, A. Lakshminarayan, R. Ketzmerick, and A. Bäcker,
Phys. Rev. Lett. **116**, 054101 (2016).

[6] *Entanglement and localization transitions in eigenstates of interacting chaotic systems*,
A. Lakshminarayan, S. C. L. Srivastava, R. Ketzmerick, A. Bäcker, and S. Tomsovic
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[7] For videos of 3D phase space slices see:
`http://www.comp-phys.tu-dresden.de/supp/`