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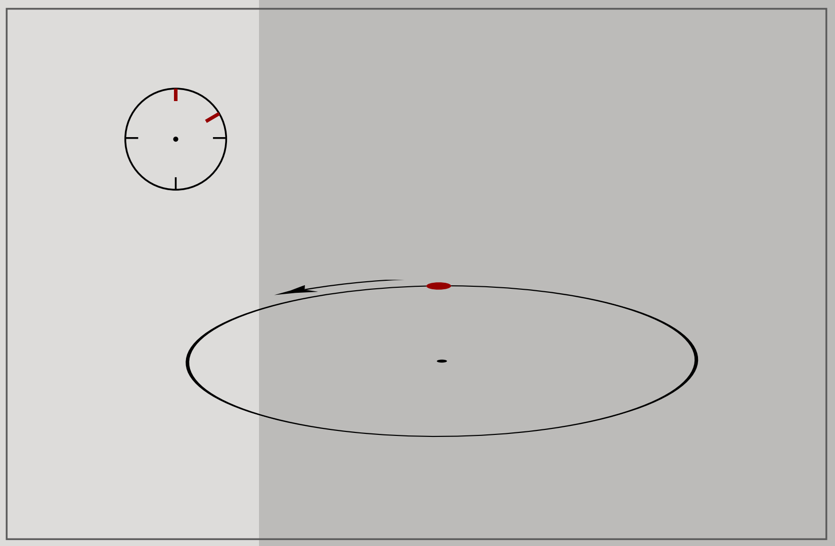
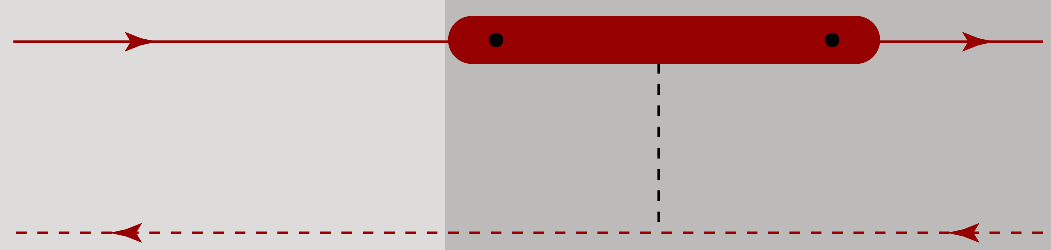
field theory approach to the standard map

Brunel, Dec. 18, 2009

Alexander Altland & Chushun Tian, Cologne University



- review: quasiclassical approach to nonlinear dynamics
- standard map
- field theory of the standard map



- **Eilenberger equation** (Eilenberger 68, Larkin & Ovchinikov 68)

  first order nonlinear evolution equation in phase space. Describes evolution of quasiclassical Green function $\hat{G}$ [redacted] along phase space trajectories. Sucessfully applied mostly to problems of superconductivity.

ballistic sigma model (Eilenberger 68; Altshuler et al. 95; Khmelnitskii & Muzykhantskii, 95)

Variational principle behind the Eilenberger equation. Allied to the nonlinear sigma model of disordered systems. Native version plagued by problems (no quantum interference, ‘mode locking problem’, ‘zero mode’ problem, repetition problem ...)

Hamilton function

$$S[T] = i \int_\Gamma d^{2f-1}x \, \mathrm{tr}\left(T \star \Lambda \{H, T\} + \omega \Lambda T \Lambda \star T^{-1} \right)$$

Moyal pr.

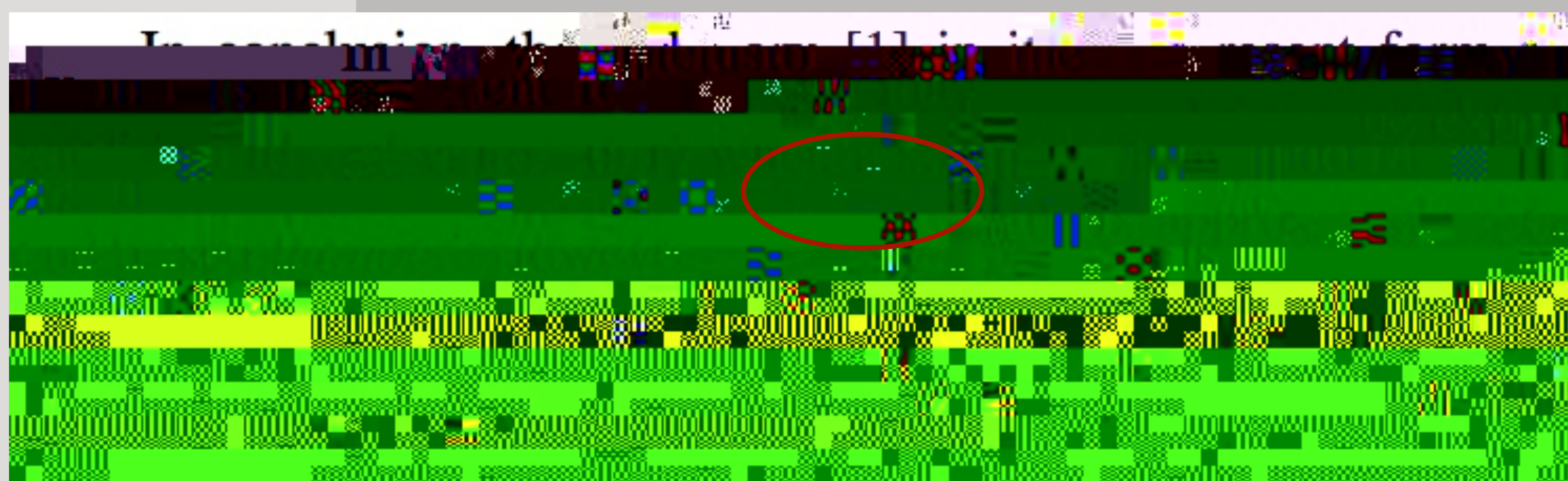
energy argument

integral over energy shell

quasiclassical approach: historical review

sigma model approach to standard map (Zirnbauer, a.a., 1996)

less mathematical difficulties. Successful description of diffusion, quantum interference and localization in the QKR.



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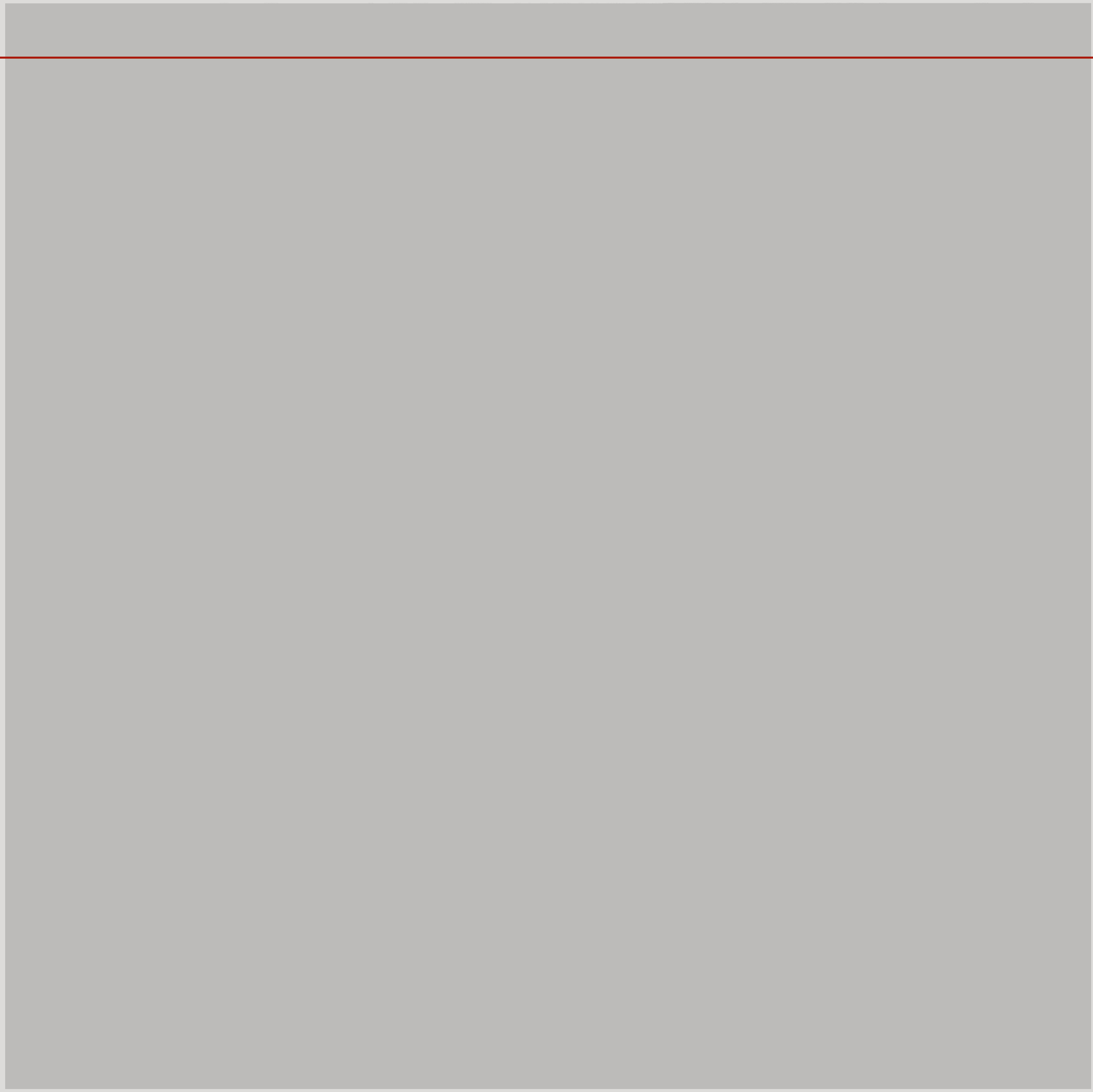
quasiclassical approach: historical review

universality from sigma model (Müller, Micklitz, a.a., 2006)

Connections to semiclassical analysis ('Sieber-Richter') established on

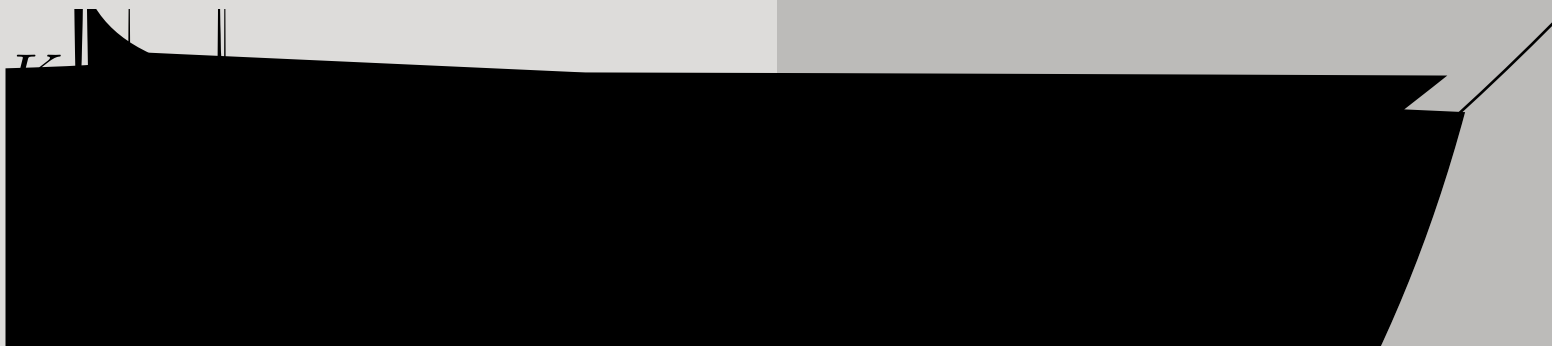


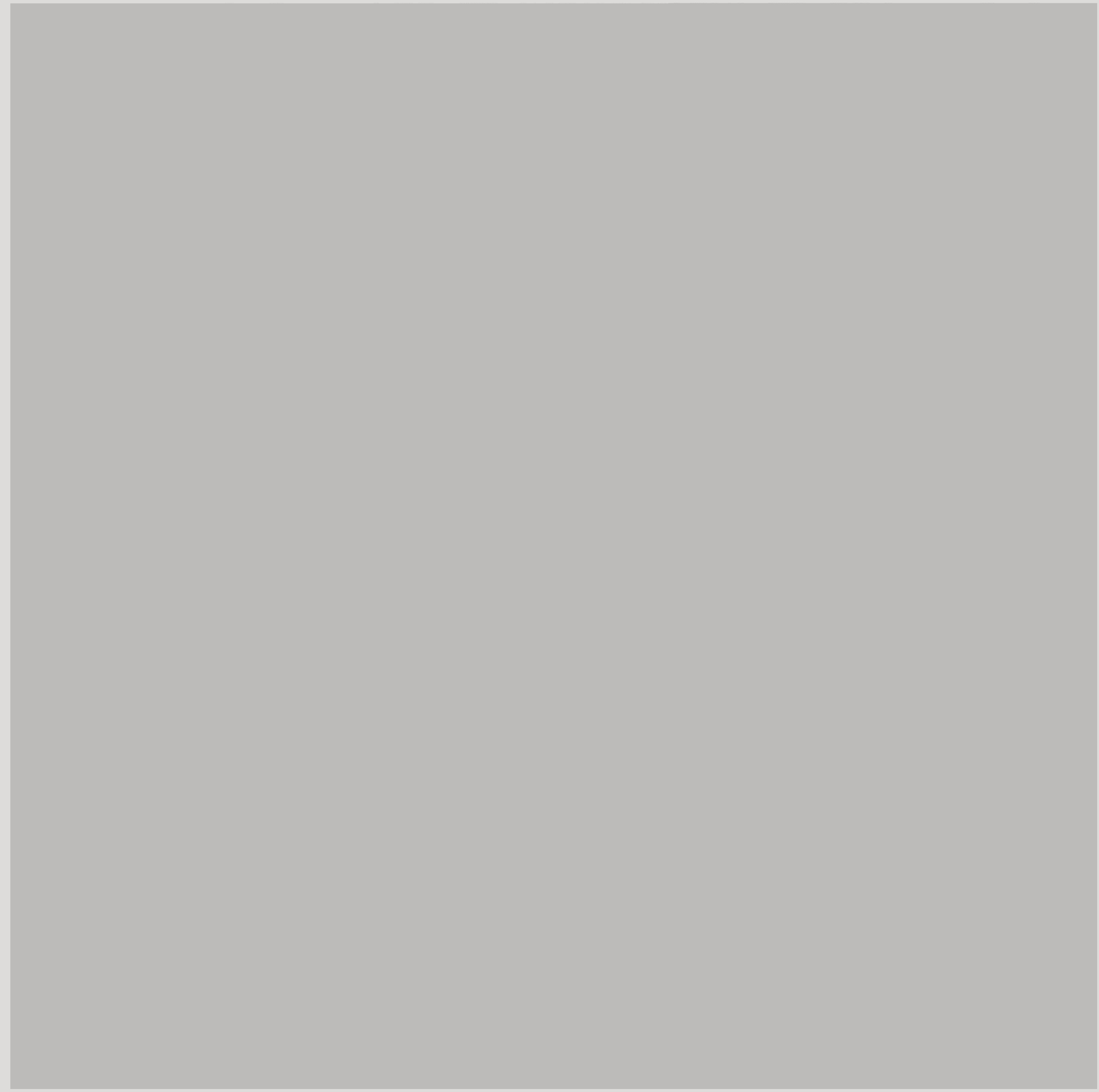
quasiclassical approach: historical review

standard map: phenomenology

standard map

- Rechester-White (1980) corrections ($1/K$ corrections to diffusion constant)
-
- accelerator modes, regular islands at special values of K (Karney, 1983)





summary

- quasiclassical methods can be powerful alternative to semiclassics
- often implemented in field theoretical framework
- good in non-perturbative settings (localization, gap formation, non-perturbative correlations)
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