

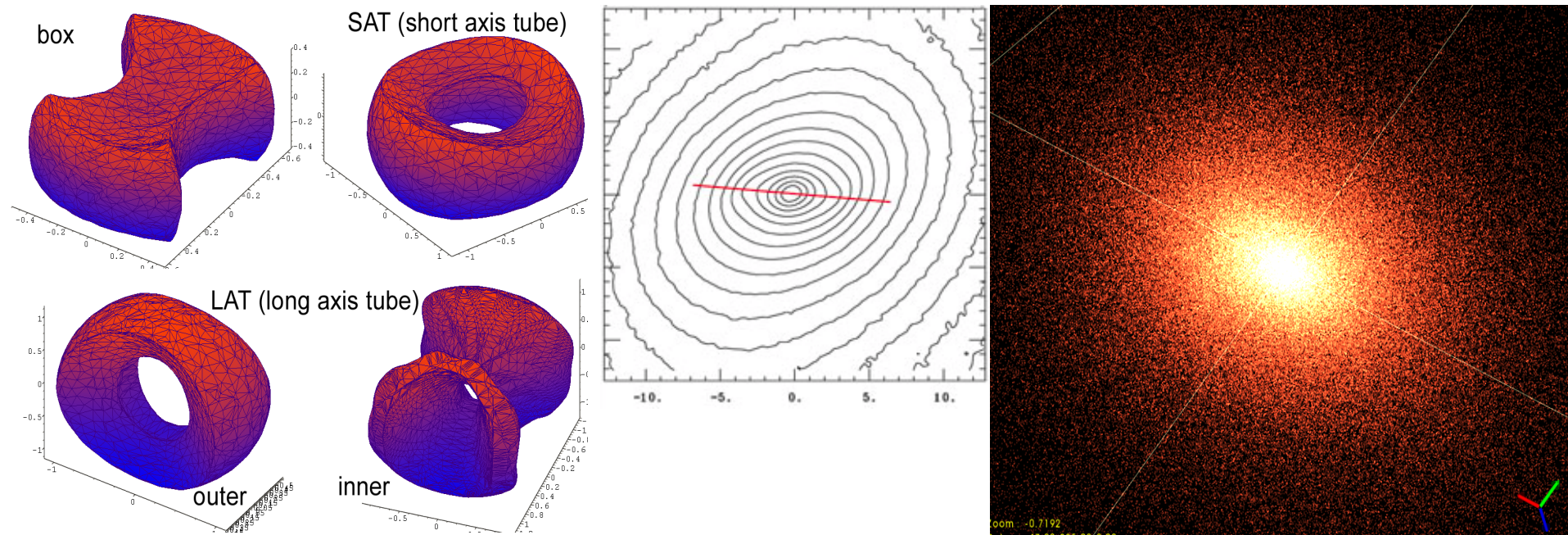


Orbit analysis and Schwarzschild modelling of triaxial galaxies

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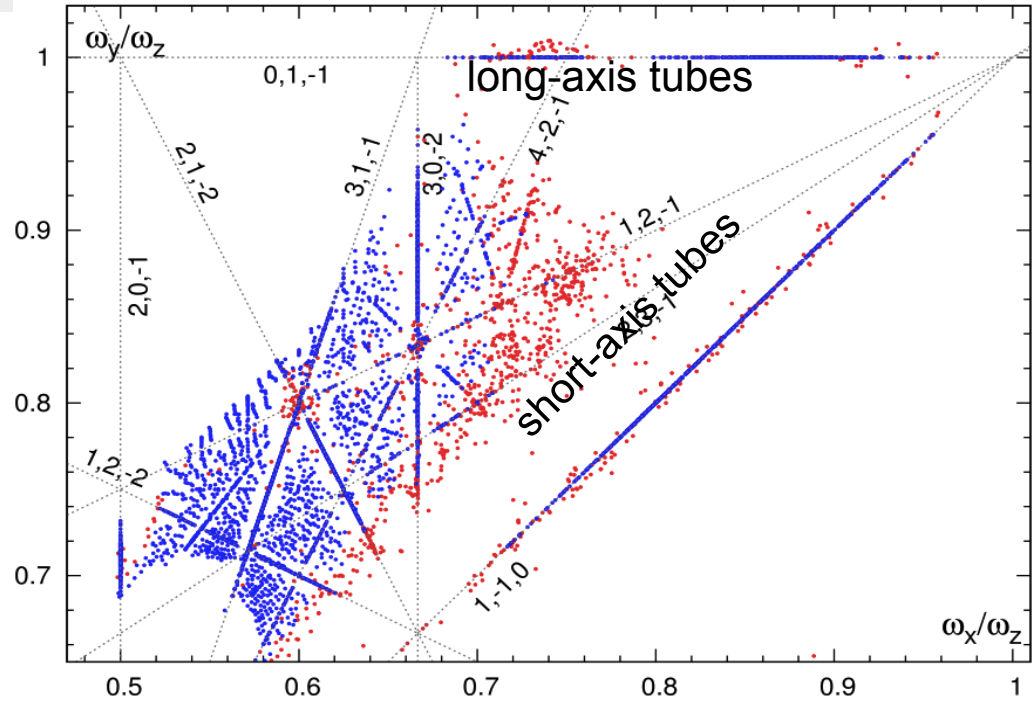
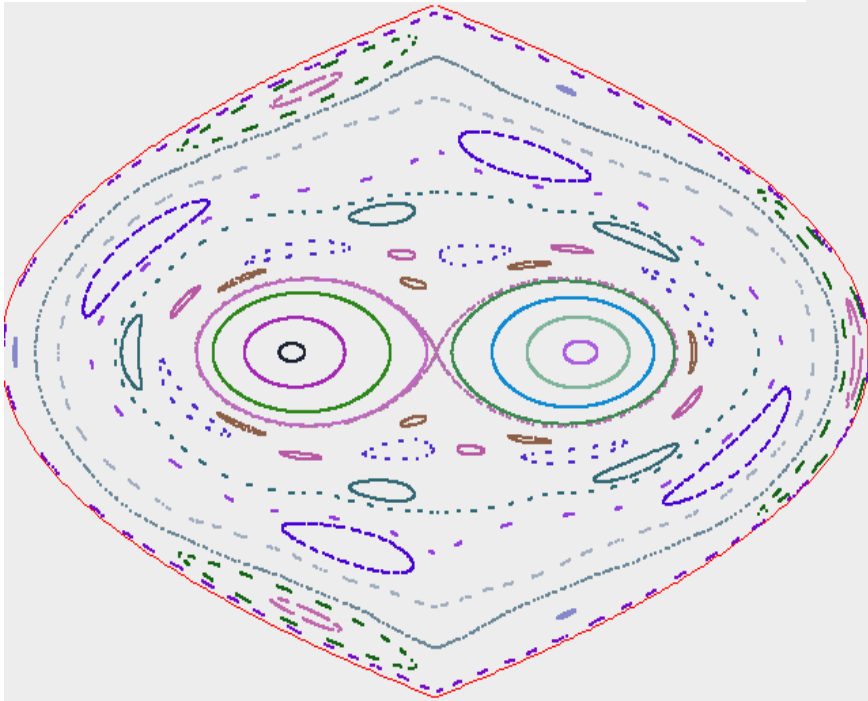
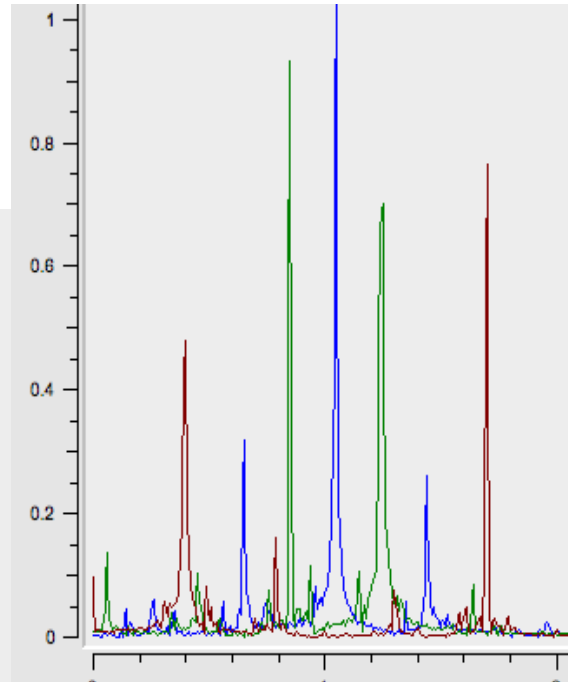
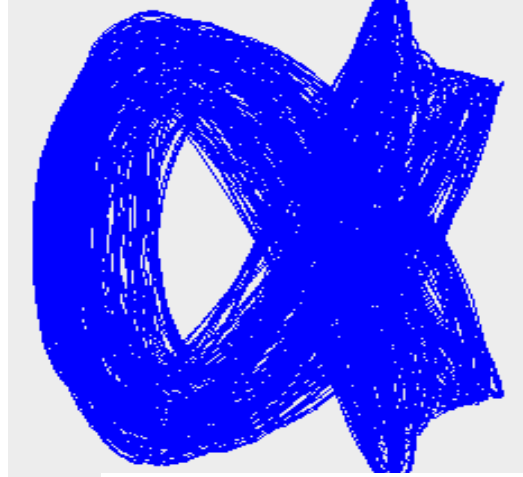
Triaxial galaxies

- A rather general family: elliptical and barred spiral galaxies, N-body models...
- Rich dynamics (no conservation of angular momentum, resonant & chaotic orbits)
- Flexible representation of 3d density/potential in terms of basis-set or spline spherical-harmonic expansion



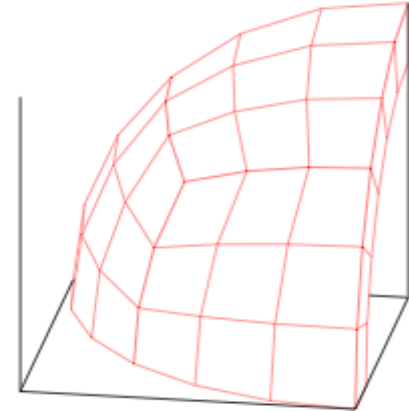
Orbit analysis

- Frequency analysis
- Lyapunov exponents
- Poincare surface of section
- Frequency map



Schwarzschild modelling

- A trial potential is chosen and a library of orbits is numerically computed in this potential, with their densities and kinematic information stored for each orbit on some grid
- Each orbit is assigned a weight in such a way as to satisfy self-consistency of density/potential pair and to minimize the difference of kinematic information with observables
- Repeated for another choice of potential, find best-fit parameters of mass model



EXISTING IMPLEMENTATIONS

- Various choices of geometry (spherical, axisymmetric, triaxial, +figure rotation)
- Observations in the form of surface brightness + long-slit or integral-field spectroscopy
- Kinematic information: line-of-sight velocity distribution or its moments (integrated), radial velocities and/or proper motions for individual stars (discrete)
- Various approaches to regularization, parameter search, likelihood estimate...

Schwarzschild modelling in SMILE

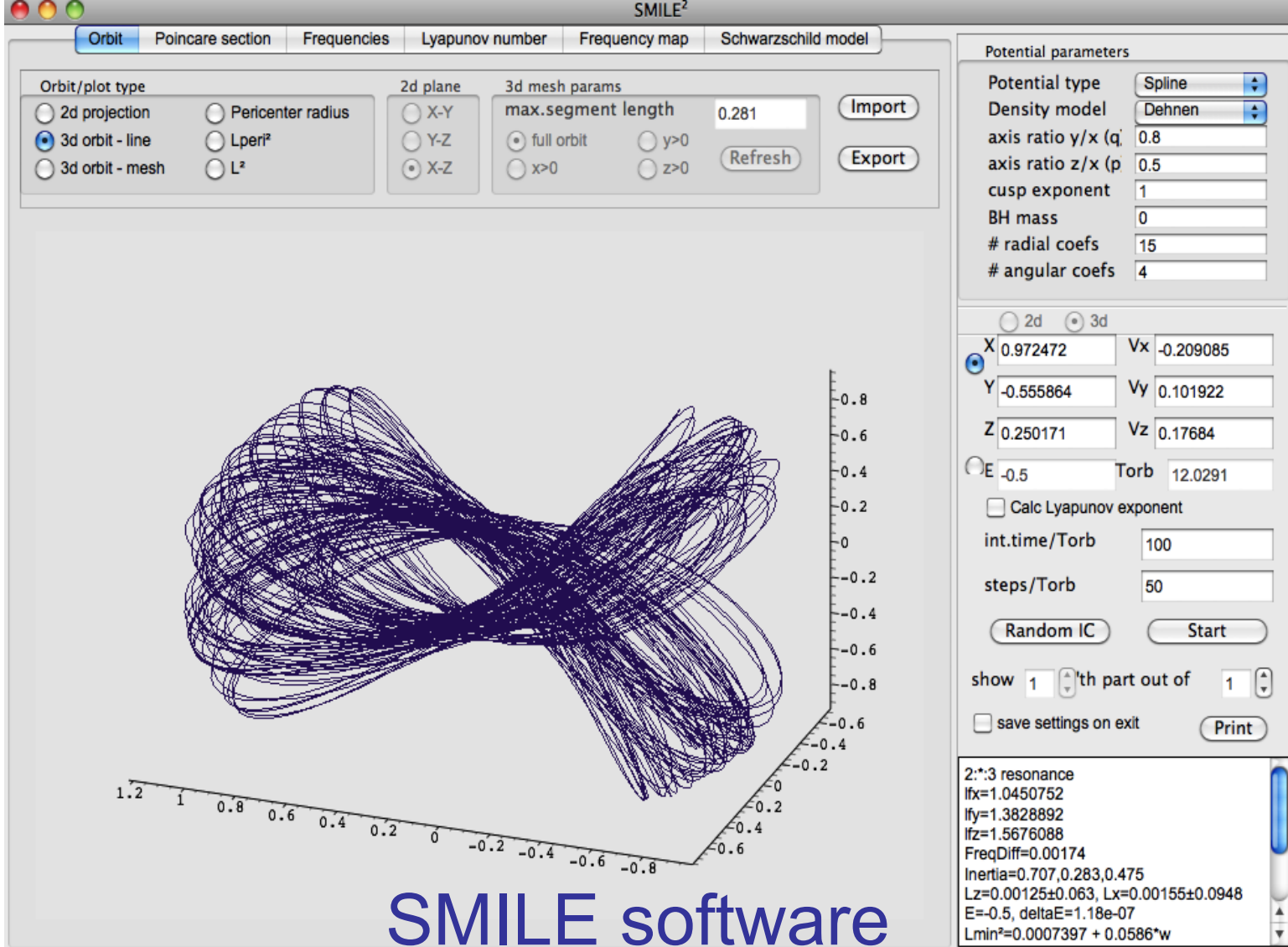
- Standard grid-based method and two additional variants, using spherical-harmonic expansion of 3d density
- Random sampling of initial conditions in phase space
- Several variants of orbit weight regularization

LIMITATIONS:

- No support for figure rotation, not adapted to spiral galaxies
- So far only suitable for 'theoretical' usage (creating models with predefined density profiles, no observational constraints in terms of kinematics)

FUTURE DEVELOPMENT PLANS for observational modelling:

- Unified approach for modelling discrete/binning/continuous data
- Marginalization of likelihood over hidden parameters (i.e. orbit weights)
- Several approaches to multidimensional parameter search (nested grid search, MCMC, particle swarm, ...); more prudence about confidence intervals



SMILE software

- Educational and practical applications for galactic dynamics
- The only SM code which is publicly available (<http://td.lpi.ru/~eugvas/smile/>)
- Observational extension under development