

Instructor: B. Khesin

**Course MAT461
Spring 2023
“Hamiltonian Mechanics”**

Mini-paper topics:

[The project is to write a mini-paper based on 2-3 sources/papers (not Wiki!). Start by reading the article *How to write mathematics* by P.R. Halmos, Enseignement Math. (2) 16 (1970), 123-152. Follow its advice.]

1. Billiards in quadrics.
2. Elastic collisions and π .
3. Elastic collisions and negative masses.
4. Cycloids and terrestrial brachistochrones.
5. Exciting examples of the Noether theorem in mechanics.
6. Integrable cases of a heavy top.
7. Stability of rotations of the 4-dimensional Euler top.
8. Integrability of an n -dimensional Euler top.
9. Stability of rotations of an n -dimensional Euler top and parabolic diagrams.
10. Proof of the Darboux theorem for a contact 1-form.
11. The Kirchhoff equations of point vortices.
12. Integrable cases of point vortices on the plane, sphere and torus.
13. Dynamics of point vortices on the Möbius band.
14. Dynamics of point vortices on a strip.
15. The 3-body problem and the Poincaré paper.
16. Unbounded motions in the 3-body problem.
17. Euler’s elastic problem.
18. Golfer’s dilemma: a ball in a vertical tube.
19. Parking of a car with a trailer.
20. Exciting applications of the Benford law.
21. Subtleties and recent results in Newton’s minimal resistance problem.
22. Poincaré’s last theorem and Arnold’s conjectures.
23. Applications of Arnold’s conjectures in mechanics.

*Choose your topic by Mar. 21 the latest, turn in the minipaper (4-5pp) by Apr. 11.
(Topics outside of the list are also possible: please, discuss with the instructor.)*