System Galactica for solving problems of interaction according to the laws of Newton and Coulomb

Joseph J. Smulsky,
doctor of physical-mathematical sciences,
professor of theoretical and applied mechanics
Russian Federal Research Centre,
Tyumen Scientific Centre, SB RAS
Institute of Earth's Cryosphere

It is invitation for free to use software named Galactica. The Galactica system was created to solve problems of N bodies with the forces of their gravitational interaction according to Newton's law or with the forces of electrostatic interaction according to Coulomb's law. It is based on the method of solving differential equations with high accuracy. For example, the accuracy of the Galactica system when considering the dynamics of the Solar System is 1000 times greater than the method used by NASA.

The Galactica system can be used to study the dynamics and evolution of the bodies of the Solar System, to calculate the motion of spacecrafts and probs, to simulate such star associations as globular star clusters and galaxies, to create models of atoms and molecules, and also to calculate various interactions in the microworld. The Galactica system should become a standard for use in physics and astrophysics.

A description of a part of the solved problems of gravitational interaction is available at the following link:
http://dx.doi.org/10.5539/apr.v4n2p110.

Galactica system manual is available at:
http://www.ikz.ru/~smulski/GalactcW/GalDiscrE.pdf.

Galactica system, including executable program modules, is available at:
http://www.ikz.ru/~smulski/GalactcW.

Additional information and examples of solved problems using the Galactica system are given in References.

The description of the Galactica system for gravitational interactions was published in [10], for the Coulomb interactions in [16].

Gravitational problems solved using the Galactica system were published in [1] - [7], [8] - [13], [18] - [24]. Coulomb interactions were published in [14] - [17], the Earth's rotational motion problem were published in [8], [21], [24].

The evolution of the Solar system over 100 million years was published in [2], [4], [11], [23] - [24].

The change in angular momentum in the Solar System and the accuracy of the Galactica system are in [19], [23].

The final solution to the problem of the perihelion of Mercury was published in [7], [23].

The movement of asteroids and the transformation of asteroids into satellites of the Earth are considered in [5], [6], [11], [12], [23].

The optimal motion of a spacecraft was published in [3], [23]. This work is important for future space missions.

The interaction of bodies in various stellar structures, including exact solutions of N-body problems, was published in [1], [13], [18], [20], [22], [23].

Creation of new planets in the Solar system was published in [22], [23].

The dynamics and evolution of the rotational motion of the Earth was published in [8], [21], [24].

Exact solutions of the interaction of N charged particles located axisymmetrically in a plane, and their evolution, were published in [14] - [15].

The interaction and evolution of multilayer structures on a plane, consisting of charged particles, was published in [17].

There are presentations of a report on the Galactica system at an exhibition in Spain on YouTyube in the form of a video: https://youtu.be/uDc-DmTCcZk and in the form of a presentation: https://youtu.be/Z17B3F4oPEI.

There is a presentation of 2 books in 2018 [23] - [24] into https://youtu.be/O57VuriOEJ4. The presentation describes the results of the Galactica system and there is a visualization of N-body interactions.

What knowledge should a Galactica user have?

Problems, that are at the forefront of science, can be solved with the help of the Galactica system. In my published works, all the questions of mechanics, mathematics and physics, which are necessary for solving any interaction problem in the surrounding world, are explained simply, unequivocally and without involving abstract concepts.

The user of the Galactica system must have knowledge in the scope of higher education in mechanics, physics, mathematics and programming. Additional knowledge the user will receive from reading my works on the topic of interest to him.

Therefore, students and even advanced senior pupils with the help of their physics and mathematics teachers can solve problems using the Galactica system.

What works with the system Galactica can perform novice researchers?

Senior pupils can perform work that they will then submit to the Olympiads and contests.

Students and graduate students can solve problems for their term papers and dissertations.

Interested parties may contact Leonid J. Smulsky, representative of the author, **for further information:** LSmulsky@mail.ru.

References

1. Smulsky J.J. 2003. Axisymmetrical problem of gravitational interaction of N-bodies. *Mathematical modelling*. Vol. 15, No 5, Pp. 27-36. (In Russian) http://www.ikz.ru/~smulski/smul1/Russian1/IntSunSyst/Osvnb4.doc.

2. Grebenikov E.A., Smulsky J.J. 2007. Evolution of the Mars Orbit on Time Span in Hundred Millions Years / Reports on Applied Mathematics. Russian Academy of Sciences: A.A. Dorodnicyn Computing Center. Moscow. 63 p. (In Russian) http://www.ikz.ru/~smulski/Papers/EvMa100m4t2.pdf.

3. Smulsky J.J. 2008. Optimization of Passive Orbit with the Use of Gravity Maneuver. *Cosmic Research, Vol.* 46, No. 5, pp. 456–464. http://dx.doi.org/10.1134/S0010952508050122. http://www.ikz.ru/~smulski/Papers/COSR456.PDF.

4. Melnikov V.P. & Smulsky J.J. 2009. Astronomical theory of ice ages: New approximations. Solutions and challenges. Novosibirsk: Academic Publishing House. http://www.ikz.ru/~smulski/Papers/AsThAnE.pdf.

5. Smulsky J.J., Smulsky Ya.J. 2010. Evolution of Apophis Orbit for 1000 Years and New Space Targets // "Protecting the Earth Against Collisions with Asteroids and Comet Nuclei" - Proceedings of the International Conference "Asteroid-Comet Hazard-2009", Eds.: A. Finkelstein, W. Huebner, V. Shor. - Saint-Petersburg: "Nauka". Pp. 390-395. http://www.ikz.ru/~smulski/Papers/EvlAp3Ec.pdf.

6. Smulsky J.J., Smulsky Ya.J. 2010. Orbit Evolution of Apophis and its Transformation into the Earth's Satellite // Proceedings of the Natural Philosophy Alliance. 17th Annual Conference 23-26 June, 2010, at Long Beach, CA, USA. Vol. 7. Published by NPA, Ltd. Mt. Airy, MD, USA. Pp. 569-578. http://www.ikz.ru/~smulski/Papers/AstApophsE4c.pdf.

7. Smulsky J.J. 2011. New Components of the Mercury's Perihelion Precession. *Natural Science, Vol.* 3, No.4, pp. 268-274. https://www.scirp.org/journal/PaperInformation.aspx?PaperID=4679.

8. Smulsky J.J. 2011. The Influence of the Planets, Sun and Moon on the Evolution of the Earth's Axis. *International Journal of Astronomy and Astrophysics*, *Vol.* 1, Issue 3, 117-134. http://dx.doi.org/10.4236/ijaa.2011.13017.

9. Smulsky J.J. 2012. Galactica software for solving gravitational interaction problems. *Applied Physics Research*. 4(2), pp. 110-123. http://dx.doi.org/10.5539/apr.v4n2p110.

10. Smulsky J.J. 2012. The System of Free Access Galactica to Compute Interactions of N-Bodies. *I. J. Modern Education and Computer Science*, 11, 1-20. http://dx.doi.org/10.5815/ijmecs.2012.11.01

11. Smulsky J.J. & Smulsky Ya.J. 2012. Dynamic Problems of the Planets and Asteroids, and Their Discussion. *Intern. Journal of Astronomy and Astrophysics*. Vol. 2, No. 3, pp. 129-155. http://dx.doi.org/10.4236/ijaa.2012.23018.

12. Smulsky J.J. & Smulsky Ya.J. 2012. Asteroids Apophis and 1950 DA: 1000 Years Orbit Evolution and Possible Use. In: *Horizons in Earth Science Research*, Vol. 6, Benjamin Veress and Jozsi Szigethy (editors), Nova Science Publishers, USA, pp. 63-97. https://www.novapublishers.com/catalog/index.php.

13. Smulsky J.J. 2013. *Multi-Layer Axisymmetric Rotating Structures*. Institute of Earth Cryosphere SB RAS, Tyumen. Deposited in VINITI 28.10.2013, No. 303-V2013, 27 p. http://www.ikz.ru/~smulski/Papers/OsMVStr.pdf. (In Russian).

14. Smulsky J.J. 2013. *The axisymmetric Coulomb interaction and orbital motion instability. Institute of Earth Cryosphere*, SB RAS. Tyumen. Deposited in VINITI 28.10.2013, No. 304-V2013, 30 p. http://www.ikz.ru/~smulski/Papers/KulInt2.pdf. (In Russian).

15. Smulsky J.J. 2014. Axisymmetric Coulomb Interaction and Research of Its Stability by System Galactica. *Open Access Library Journal*. 1 (e773), pp. 1 – 23. http://dx.doi.org/10.4236/oalib.1100773.

16. Smulsky J.J. 2014. Module of System Galactica with Coulomb's Interaction // I.J. Modern Education and Computer Science, Vol. 6, No. 12, p. 1-13. http://dx.doi.org/10.5815/ijmecs.2014.12.01.

17. Smulsky J.J. 2015. Multilayer Coulomb Structures: Mathematical Principia of Microcosm Mechanics. *Open Access Library Journal*, 2: e1661, 46 p. http://dx.doi.org/10.4236/oalib.1101661.

18. Smulsky J.J. 2015. Exact solution to the problem of *N* bodies forming a multi-layer rotating structure. *SpringerPlus*, 4:361, pp. 1-16. http://www.springerplus.com/content/4/1/361

19. Smul'skii I.I. and Krotov O.I. 2015. Change of Angular Momentum in the Dynamics of the Solar System. *Cosmic Research*, Vol. 53, No. 3, pp. 237-245. DOI: 10.1134/S0010952515020094. https://rd.springer.com/article/10.1134/S0010952515020094.

20. Smulsky J.J. 2016. *Distributed structures on the sphere*. Institute of the Earth Cryosphere SB RAS. Tyumen. Deposited in VINITI 22.08.2016, No. 112-V2016, 43 p. http://www.ikz.ru/~smulski/Papers/SphDsSt2.pdf. (In Russian).

21. Smulsky J.J. 2016. Fundamental Principles and Results of a New Astronomic Theory of Climate Change. *Advances in Astrophysics*. Vol. 1, No. 1, 1-21 http://www.isaacpub.org/Journal/AdAp.

22. Smulsky J.J. 2017. Advances in Mechanics and Outlook for Future Mankind Progress. *International Journal of Modern Education and Computer Science (IJMECS)*, Vol. 9, No. 1, pp.15-25. http://www.mecs-press.org/ijmecs/ijmecs-v9-n1/IJMECS-V9-N1-2.pdf.

23. Smulsky J.J. 2018. *Future Space Problems and Their Solutions*. Nova Science Publishers, New York, 269 p. ISBN: 978-1-53613-739-2. https://novapublishers.com/shop/future-space-problems-and-their-solution

24. Smulsky J.J. 2018. *New Astronomical Theory of Ice Ages*. "LAP LAMBERT Academic Publishing", Riga, Latvia. 132 c. ISBN 978-613-9-86853-7. https://www.lap-publishing.com/catalog/details//store/gb/book/978-613-9-86853-7/Новая-Астрономическая-теория. (In Russian).