

**Programme for Research-Development-Innovation for
*Space Technology and Advanced Research - STAR***

***Computational methods in
scientific investigation of space***
COMISIS

Radu Constantinescu – University of Craiova
Dumitru Vulcanov – West University of Timisoara

Romanian Space Week , 12-16 May 2014, Bucharest, Romania

- **Coordinating organization:**

WEST UNIVERSITY TIMISOARA

- **Project manager:**

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- **Partner organizations:**

P1: UNIVERSITY OF CRAIOVA

P2: "BABES-BOLIAI" UNIVERSITY CLUJ-NAPOCA

- **Partners team leaders:**

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SHORT DESCRIPTION OF THE PROJECT:

The project proposes a joint research program having the following main directions:

- Providing an entire computer library devoted to numerical, symbolic computation and algebraic programming methods in space science areas as numerical relativity, nonlinear flow equations and other applications.
- Analytical and numerical models for remote solar and space plasma diagnostics.
- Semi-analytical methods in studying the stability of constrained space flight dynamics.

PROJECT GOAL:

Producing high-level scientific results and output increasing the international recognition and relevance of the Romanian science.

OBJECTIVES:

- Identifying possible effects of different cosmological models on the astrophysical measurements in space missions (satellites and planetary movement in the solar system, supernovae, etc.)
- Complementing and validating the proposed methods of solar and space plasma diagnostics by novel observations and corresponding data assimilation procedures.
- Refinement of reconnection models based on stochastic behavior of magnetic fields and applications to astrophysical events, like the intraday variability observed in the spectra of accretion disks of AGNs (Active Galactic Nuclei).
- Extension of the Draper Semi-analytical Satellite Theory (DSST) in studying the stability of spacecraft orbits.
- Development of specific application of the stability theory in the study of turbulent atmospheric phenomena.

ESTIMATED RESULTS:

- The major results of the project will consist in technical reports, collection of libraries with computer software (including user guides) as well as scientific papers published in main flow journals and/or communicated in international conferences.
- On the educational side: informal sessions and workshops, multidisciplinary training of high-level specialists.
- The social and educational impact of the project will be assured by a series of public conferences and events organized within COMISIS.

HUMAN RESOURCES INVOLVED:

CO: 3 experienced researchers + 1 PhD student

P1: 6 experienced researchers+ 2 PhD students

P2: 2 experienced researchers+ 1 PhD student+1Master student

START DATE OF THE PROJECT / END DATE OF THE PROJECT:

November 2013 / November 2016

WORK PLAN OF THE PROJECT

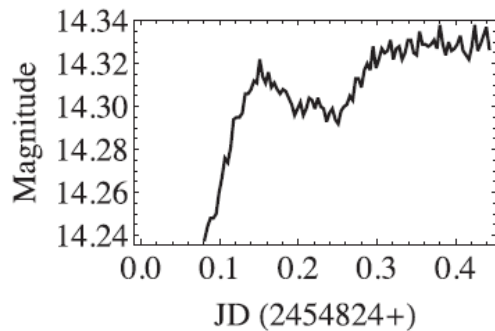
WP no.	Work package title	Involved partners	Start month	End month
1	Computer library devoted to numerical, symbolic computation and algebraic programming methods in space science	CO, P1, P2	4	34
2	Analytical and numerical models for remote solar and space plasma diagnostics.	CO, P1, P2	6	34
3	Semi-analytical methods in studying the stability of constrained space flight dynamics.	CO, P1, P2	15	34
4	Dissemination, communication, training and education	CO, P1, P2	6	30
5	Management / administration	CO, P1, P2	1	36

RESULTS

Scientific output – deliverables

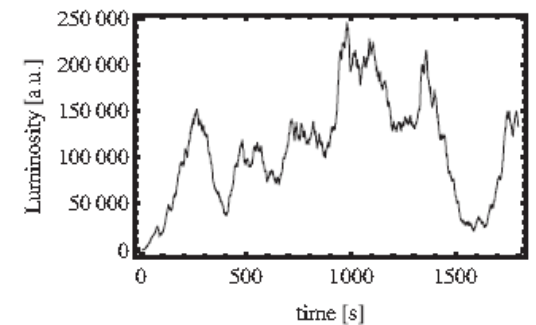
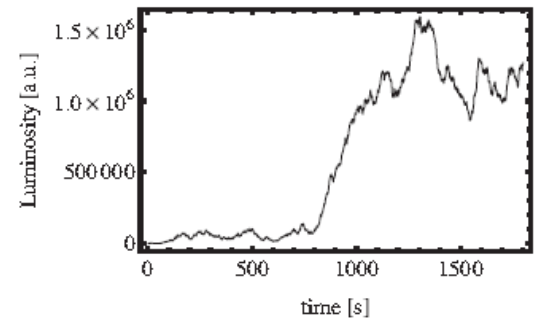
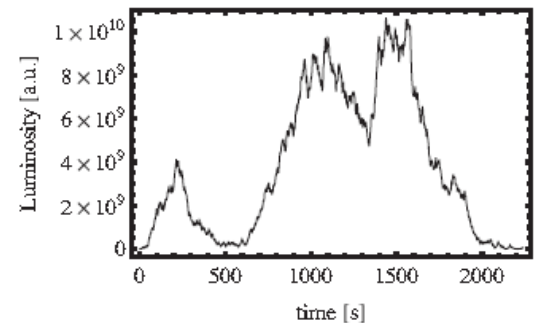
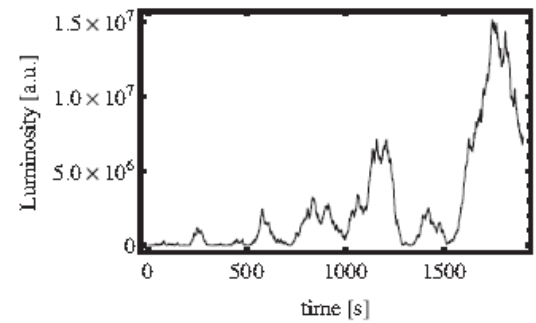
- C.A. Sporea - “Notes on $f(R)$ theories of gravity” - <http://arxiv.org/abs/1403.3852>
- I. Cotaescu - “Accelerated frames in de Sitter spacetime” – submitted to publication in a scientific journal. <http://arxiv.org/abs/1403.3074>
- G. Mocanu, N. Magyar, A. Marcu, - “Appearance of an accretion disc perturbed by fractional Brownian Motion density”, Monthly Notices of the Royal Astronomical Society, Volume 439, Issue 4, p.3790-3797, 2014. <http://adsabs.harvard.edu/abs/2014MNRAS.439.3790M>
- B. Danila, A.Marcu, G. Mocanu - “New statistical results on the optical IDV data of BL Lac S50716+714” submitted to Research in Astronomy and Astrophysics
- R. Cimpoiasu, R. Constantinescu – “Nonlinear self-adjointness and invariant solutions of a 2D Rossby wave equation”, Cent. Eur. J. Phys. 12(2), 2014, 81-89. DOI: 10.2478/s11534-014-0430-6
- R.Cimpoiasu – “Generalized conditional symmetries and related solutions of the Grad-Shafranov equation”, accepted for publication in *Physics of Plasmas*.

“Appearance of an accretion disc perturbed by fractional Brownian Motion density”, G. Mocanu, N. Magyar, A. Pardi, A. Marcu, **Monthly Notices of the Royal Astronomical Society**, 439(4), 3790-3797, 2014



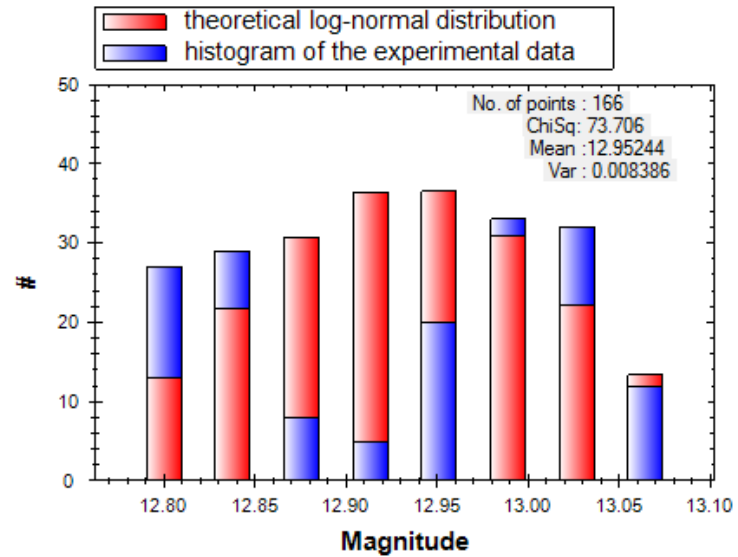
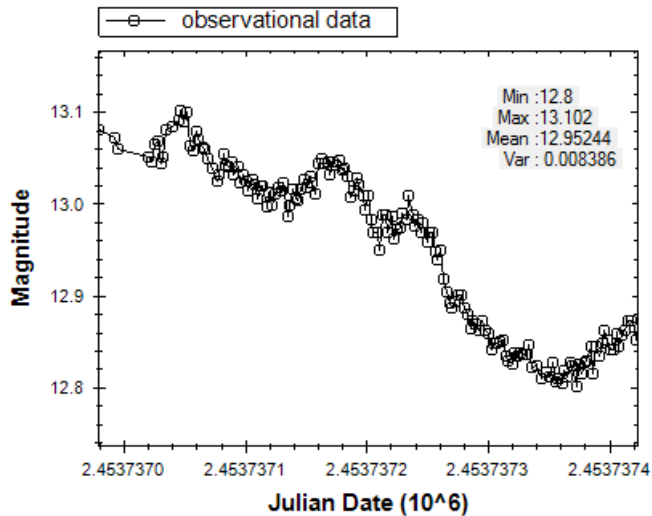
Observational data of AGN BL Lac S5 0716+714

Simulated light curves with a newly proposed model including fractal perturbations in the quantities of the disk



This work was supported by a grant of the Romanian National Authority of Scientific Research, Program for research – Space Technology and Advanced Research – STAR, project number 72/29.11.2013.

“New statistical results on the optical IDV data of BL Lac S5 0716+714”, B. Danila,
A. Marcu, G. Mocanu, submitted to **Research in Astronomy and Astrophysics**



New type of analysis to investigate if the fast variability in the optical emission of *BL Lac S5 0716+714* comes from the accretion disk

Acknowledgements This work was supported by a grant of the Romanian National Authority of Scientific Research, Program for research - Space Technology and Advanced Research - STAR, project number

72/29.11.2013.

PROJECT'S CONTRIBUTION TO THE GOAL OF THE STAR PROGRAMME

- The research approach of the whole project start from TRL 1 and end to TRL 4.
- All the three major research themes will start from identifying general principle which can be applied in space science and will allow their validation in laboratory conditions.

CONTEXT AND CONTRIBUTION TO ESA PROGRAMMES

COMISIS Project is fitting with the strategy, objectives and ESA programs related with Space Science trying to answer to question as:

- How did our Earth, our Solar System and the Universe evolve?
- How Sun generate its Plasma?
- Is Chaos handling our Universe?

Solar plasma - increasingly important object of ESA studies.

ESA space missions provide data which can be used in our analysis on alternative cosmological and astrophysical models.

DISSEMINATION

- Two public conferences in preparation :
 - Cluj Academic Days, 29-30.05.2014, A.Marcu, G. Mocanu, N. Magyar, S. Ontanu, The titles of the works to be presented: “Statistical results on observed optical Intra-Day Variability of BL Lac S5 0716+714”, “Numerical simulations of transverse coronal loop oscillations in cooling plasma”, “GPU-enabled simulations of stellar clustering with cold dark matter and scalar field dark matter”,
 - Intergalactic Matters, 16-20.06.2014, Intergalactic Matters, A.Marcu, G. Mocanu, <http://www.mpiahd.mpg.de/homes/igm14/>.
- Special seminars (Partially ionized plasmas) 2-3.05.2014 Ballai I. from Sheffield University, UK
3 public conferences (D. Vulcanov, I. Cotaescu, M. Lungu) given during Open Doors Days at the Physics Faculty – CO UVT, see at www.physics.uvt.ro/portideschise/
- Special seminar during the 8-th Erwin Schrodinger lectures at Timisoara with a talk given by P.G.O. Freund: “On the strength of interactions”
http://www.physics.uvt.ro/~vulcan/SCHRODINGER/Schrodinger_seminar.htm
- Building the web page of the project (see COMISIS.physics.uvt.ro)

CONCLUSIONS:

- **We are confident in the force of the consortium**
- **The activity is in line with the WorkPlan.**
- **ROSA is an excellent contractual authority.**

THANK YOU !