

Post Doctoral Position : 24 months – 2018/2020

**PSL : IRIS-SDSS
MOKOSMO**

**3D Monge Kantorovich numerical models in Cosmology: Optimal Transport,
Algorithmic on Massively Parallel Computers and Numerical Cosmology**
Contact : jean-david.benamou@inria.fr et jean-michel.alimi@obspm.fr

A two-year contract is open in the MOKAPLAN team of INRIA Paris (<https://team.inria.fr/mokaplan/>) in collaboration with the DEUS project (www.deus-consortium.org) of the Universe and Theories Laboratory at Paris Observatory. The scientific objective of the post-doc contract is to test a model for reconstructing mass fluctuations of the primordial universe from the numerical data generated in the framework of the DEUS project. Applications can then be adapted and applied to observational data from major mapping projects of our universe (Euclid (sci.esa.int/euclid/), SDSS (www.sdss.org)...). This reconstruction model is based on Optimal Mass Transport, it was introduced in the 2000s. However, at this time, it could not be used on massive data set, the available algorithms (Bertsekas auction algorithms) being essentially cubic cost. Recent progress in Optimal Transport, developed in the team, has made it possible to develop several linear cost algorithms in dimension 3. The reconstruction of primordial mass fluctuations with several tens of millions of particles is now easily achievable in a few minutes on sequential computers. But to process large amounts of data like those available in the DEUS project, with several hundred billion (8192^3) particles, it is essential to distribute memory and computations on a large number of processors. The project therefore plans to develop parallel versions of existing algorithms that scale to distributed memory machines. Several algorithmic options have been considered: Entropy/Sinkhorn Regularization, Semi-discrete Monge-Ampere Approach and Multi-scale Algorithm.

The post-doc will work on the algorithmic aspects, the implementation and the optimization on machine massively parallel of the models of reconstruction developed in the team, in interaction with J.-D. Benamou and L. Martinet (PhD) from MOKAPLAN-INRIA team on the aspects directly related to Optimal Transport and with J.-M. Alimi of the LUTH-Paris Observatory and in charge of the DEUS project on the numerical cosmology aspects. The post doc project is part of a larger project on the scientific application of reconstruction algorithms in numerical and observational cosmology. This project includes Y. Brenier (Department of Mathematics ENS-ULM, Q. Mérigot (Department of Mathematics, University Paris South), B. Levy (INRIA, Nancy), R. Mohayaee (IAP, Paris) and V. Reverdy (Department of Astronomy, and NCSA, University of Illinois at Urbana-Champaign, USA).

The ideal applicant will demonstrate: (1) good coding skills, (2) an understanding of the latest advances in parallel computation for nonlinear equations, and (3) a successful publication record. Very important is the candidate's experience with numerical algorithms and willingness to learn new applications. The post doc position is located at INRIA-Paris (Paris 75012) and partially at the Laboratory Univers and Theories at the Observatory of Paris-

Meudon (Meudon 92190). INRIA is located in the center of Paris, it can be easily reached by public transport from all points of the Ile de France.

To apply, simply send a CV, a list of publications, and a report on your research activities to jean-david.benamou@inria.fr and jean-michel.alimi@obspm.fr as well as 3 letters of recommendations. Any application received before September 15, 2018, will receive full attention, applications will however be accepted until the position is filled.

The position is scheduled to start before the end of 2018. Any questions about this announcement can be sent to Jean-David Benamou (jean-david.benamou@inria.fr) or Jean-Michel Alimi (jean-michel.alimi@obspm.fr).

The position includes the usual social coverages to the French administration.