# Master on Numerical Methods in Engineering

ACCEPTANCE OF INTERNSHIP WORK PLAN

Name of the student	JONATAN MARTIN RODRIGUEZ

Company/Institution/ Department	INSTITUTE OF SPACE SCIENCES
Name of the external supervisor	DIEGO F. TORRES
Start and end dates	17 MAYO -- 9 AGOSTO 2016
Total number of hours	450

Topic:
Main tasks:

The aim of the internship will be to study and being able to run the most advanced magneto-hydrodynamic code available.

The code is called PLUTO. The following description is adapted from the webpage of the code.

PLUTO is a freely-distributed software for the numerical solution of mixed hyperbolic/parabolic systems of partial differential equations (conservation laws) targeting high Mach number flows in astrophysical fluid dynamics.

The code is designed with a modular and flexible structure whereby different numerical algorithms can be separately combined to solve systems of conservation laws using the finite volume or finite difference approach based on Godunov-type schemes.

Equations are discretized and solved on a structured mesh that can be either static or adaptive. The AMR interface relies on the Chombo library for parallel calculations over block-structured, adaptively refined grids.

The code is written in the C programming language while the AMR interface also requires also C++ and Fortran.

PLUTO is a highly portable software and can run from a single workstation up to
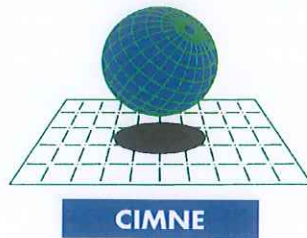
several thousands processors using the Message Passing Interface (MPI) to achieve highly scalable parallel performance.

The software is developed at the Dipartimento di Fisica, Torino University in a joint collaboration with INAF, Osservatorio Astronomico di Torino and the SCAI Department of CINECA.

PLUTO is distributed freely under the GNU general public license

The success point of the internship is then to
1) Install, understand the basics, and run the code
2) Compute examples of shocks (e.g. ,a simple non-relativistic strong shock) and a pulsar wind nebula (at least in 1D, with the intention of reaching the full 3D simulation).
3) Document all the process to facilitate other's continuance into this line of research.

References:

"PLUTO: A Numerical Code for Computational Astrophysics"
Mignone et al.,
The Astrophysical Journal Supplement Series, Volume 170, Issue 1, pp. 228-242
[External link: http://adsabs.harvard.edu/abs/2007ApJS..170..228M]

"The PLUTO Code for Adaptive Mesh Computations in Astrophysical Fluid Dynamics"
Mignone et al,
The Astrophysical Journal Supplement, Volume 198, Issue 1, article id. 7, 31 pp. (2012)
[External link: http://adsabs.harvard.edu/abs/2012ApJS..198....7M]

Additional remarks:

Any change in the information contained in the internship agreement must be authorized by the local master coordinator.

Date: 02 / 05 / 16

Student's signature   Ext. Supervisor   Antonia Larese