August 17, 2016

SCHOOL *of* MATHEMATICS

Professor Yannick Giraud-Héraud
Director of the "Physics of the Universe" doctoral school
Université Paris Diderot, Case courier 7008
75205 Paris Cedex 13
France

The University of Edinburgh
James Clerk Maxwell Building
The King's Buildings
Peter Guthrie Tait Road
Mayfield Road
Edinburgh EH9 3JZ

Fax (0131) 650 6553
Telex 727442 (UNIVED G)
Telephone (0131) 650 5060
http://www.maths.ed.ac.uk

Dear Professor Yannick Giraud-Héraud,

it is my pleasure to report on the thesis manuscript of M. Ileyk El Mellah entitled "Wind Accretion Onto Compact Objects", which I received both in electronic format and as a paper copy directly from the candidate. The nearly complete paper version reached me by courier middle of July, the final electronic version approximately one week later.

The manuscript consists of a typeset bound document of 200 pages, containing several main sections (details see below) as well as "remerciements" and "avant-propos", an introduction, a conclusion, several appendices and a bibliography. This structure follows a standard format which is acceptable internationally. The only part which is not present would be a short abstract summarising the whole work; probably is it not required at your institution.

The language of this work is best described as "very flowery", with extensive use of vocabulary and expressions not normally found in works of mathematical and astrophysical literature. It does render the reading of this manuscript more interesting than the usually much more terse scientific texts. However in some instances it detracts from the subject matter at hand. Similarly, the presence of ample footnotes also distract from the reading flow somewhat. All the above are minor points of personal preference and on the whole the subject matter is clearly presented. Full details of typographical errors, grammatical mistakes, lax or inappropriate expressions are listed separately to this report, in an Appendix.

The artwork and figures embedded within the main text are of good quality, with only few exceptions. They clearly explain specific concepts, show examples of astrophysical objects and their geometry, represent obtained results in detail and sketch particularly intricate points. The figures are well embedded in the main text and correctly referred to. Although most annotations are legible, some were too small on the printed copy and I had to refer to the electronic version to enlarge the font or plot. Overall the artwork is acceptable for this thesis.

With approximately 300 entries the bibliography is ample and appropriate for such a piece of work. M. El Mellah refers to the work of other authors where it is appropriate to delineate what was done previously by others and what is his own original work. On occasion (e.g. in Chapter 7) it would be helpful to write more specifically what are classic results and which results are new from the candidate's own original work.

The contents of the thesis is split into three main sections. The first introduces a specific subset of astrophysical objects as well as the numerical representation of concepts of physics. The second covers the theory of Bondi-Hoyle-Lyttleton accretion, both analytically as well as numerically. The third section deals with wind accretion in persistent supergiant X-ray binaries, so has to first introduce the concepts of wind accretion and X-ray binaries and then combine the two.

I have attached a separate Appendix, in which you will find mostly minor points which would benefit from some additional explanations, as well as suggestions for expanding upon detailed or intricate conceptual points. I would like to highlight a few of my comments. The candidate has obviously run many simulations but has shown the results only in graphical form. He could show off his work better by also producing tables listing all the models, their initial conditions and summary results. I would have also liked to see more detailed explanations of the numerics and in this context also some critical review, e.g. of possible alternatives (variable split time stepping) or possible bugs (memory leaks).

All of the comments for explanatory additions of conceptual points which I made in the Appendix are optional. However, since most are fairly easy to implement, I suggest that the candidate does so for the final version of his thesis. All the language corrections will improve the style of the manuscript and I strongly suggest that the candidate implements them.

Large parts of the manuscript reviews and explains other people's work and results, but the thesis also contains big sections of original work by the candidate and presents interesting results. This combination of review work and original work is completely normal for a doctoral thesis at any major international institution. The degree of originality of the results and their importance on the international stage is beyond doubt, as evidenced by the published papers and the ones submitted and in preparation.

In summary, I am happy to report that this thesis is in a state which is acceptable for presentation and defence. I look forward to meeting both you and the candidate M. El Mellah in person at the viva.

Yours sincerely,

Dr. Maximilian Ruffert