

REPORT
FELLOWSHIP POSDOC2/CIMA2023
MAY TO OCTOBER 2024
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Since May 2024, I have been a PostDoc at the University of Évora, under the supervision of Professor Pedro Macias Marques. In this report, I briefly describe my activities since the start of the postdoc.

Once I joined the department, I immediately found a very welcoming and positive environment and atmosphere.

Together with Professor P. Macias Marques we wrote a joint paper on the v -number of powers of sums of homogeneous ideals [5] and we are currently working on the Lefschetz properties, and in particular on the Weddle locus of six points in general position in three-dimensional projective space. Furthermore, related to this topic, I attended, together with Prof P. Macias Marques, a preparatory school and a conference about the Lefschetz properties. The school took place during 5-11 of May in Kraków. Professor P. Macias Marques was one of the teachers. The conference took place during 23-29 of June, again in Kraków.

More recently, I gave a PhD course for the department of Mathematics and Statistics of Évora, titled *Toric ideals in Commutative Algebra and Combinatorics*.

Currently, I am visiting Prof Tim Römer and Prof Somayeh Moradi, at the University of Osnabrück, with financial support from Indam, in the months of October and November. With them, I have written a joint paper regarding the component-wise linearity of symbolic powers of edge ideals [10]. Moreover, with Prof S. Moradi, we also wrote another joint paper in which we consider monomial ideals having the property that all their matching powers are Cohen-Macaulay [9].

Since the beginning of the postdoc until now, I have written alone and in collaboration 15 papers, which are listed below. Besides the papers mentioned before [5, 9, 10], I had collaborative researches with my former advisor, Prof M. Crupi [1, 11], with Prof C.B. Miranda-Neto and his PhD student D. Queiroz [6], and with Prof A.A. Qureshi [14], among others.

A special mention must be made regarding the three papers [7, 12, 13]. Earlier this year, on April 23th my other former advisor and maestro, Professor Jürgen Herzog, passed away. Professor Herzog, at the age of 82, was still very active and one of the leading figures in Commutative Algebra worldwide. His passing left an huge void in me, and Professor Pedro Macias Marques has been exceptional in understanding my times of need and supporting me.

In the paper [7], I investigate a conjecture about the canonical trace of Cohen-Macaulay algebra of codimension two, which Prof Herzog posed to me during some conversations. The paper [13], which we are currently finalizing with Prof S. Moradi, titled *Remembering Jürgen Herzog*, will be a commemorative paper celebrating and highlighting the huge impact that Prof Herzog had on Commutative Algebra, and will contain a really long and (hopefully) comprehensive list of the problems and conjectures due to him. Finally, the paper [12] is an attempt to complete the last unfinished paper of Professor Herzog. The topic regards the so-called cotangent functors, their vanishing, and the property of being a complete intersection.

Overall, this postdoc has been very productive thus far, important for my personal growth both as a scholar and as a person, and it helped me enhance my career.

List of the papers written during the postdoc:

- (1) Marilena Crupi and **Antonino Ficarra**. *Cohen–Macaulayness of vertex splittable monomial ideals*, Mathematics 2024, 12(6), 912;
- (2) **Antonino Ficarra**. *Dao numbers and the asymptotic behaviour of fullness*, (2024), preprint <https://arxiv.org/abs/2402.05555>.
- (3) **Antonino Ficarra** and Emanuele Sgroi. *Asymptotic behaviour of integer programming and the v -function of a graded filtration*. (2024), preprint <https://arxiv.org/abs/2403.08435>.
- (4) Nursel Erey and **Antonino Ficarra**. *Forests whose matching powers are linear*, (2024), preprint <https://arxiv.org/abs/2403.17797>.
- (5) **Antonino Ficarra** and Pedro Macias Marques. *The v -function of powers of sums of ideals*, (2024), preprint <https://arxiv.org/abs/2405.16882>.
- (6) **Antonino Ficarra**, Cleto B. Miranda-Neto and Douglas Queiroz. *Bounds on Dao numbers and applications to regular local rings*, (2024), preprint arxiv.org/abs/2405.10192.
- (7) **Antonino Ficarra**. *The canonical trace of Cohen-Macaulay algebras of codimension 2*, (2024), preprint <https://arxiv.org/abs/2406.07517>.
- (8) **Antonino Ficarra**. *A new proof of the Herzog-Hibi-Zheng theorem*, (2024), preprint <https://arxiv.org/abs/2409.15853>.
- (9) **Antonino Ficarra** and Somayeh Moradi. *Monomial ideals whose all matching powers are Cohen-Macaulay*, (2024), preprint <https://arxiv.org/abs/2410.01666>.
- (10) **Antonino Ficarra**, Somayeh Moradi and Tim Römer. *Componentwise linear symbolic powers of edge ideals and Minh’s conjecture*, (2024), preprint.
- (11) Marilena Crupi and **Antonino Ficarra**. *Generalizing blocking semiovals in finite projective planes*, (2024), preprint.
- (12) **Antonino Ficarra**. *Cotangent functors and Herzog last theorem*, (2024), preprint.
- (13) **Antonino Ficarra** and Somayeh Moradi. *Remembering Jürgen Herzog*, (2024), preprint.
- (14) **Antonino Ficarra** and Ayesha Asloob Qureshi. *The homological shift algebra of a monomial ideal*, (2024), preprint.
- (15) **Antonino Ficarra** and Seyed Amin Seyed Fakhari. *The normalized depth function of edge ideals*, (2024), preprint.

Évora, 23rd October 2024
Antonino Ficarra