

# The Cost of Astronomy

## - publishing fees in astronomy: Case of Denmark

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### Background: What is the cost of free access = Open Access?

In March 2016 The New York Times wrote that "Journal publishers collectively earned 10 billion USD last year, much of it from research libraries, which pay annual subscription fees ranging from 2,000 to 35,000 USD per title if they don't buy subscriptions of bundled titles, which cost millions. The largest companies, like Elsevier, Taylor & Francis, Springer and Wiley, typically have profit margins of over 30 percent" (Murphy 2016).

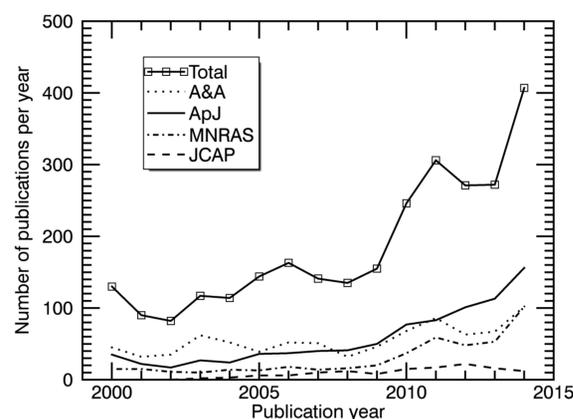
In the same article, Peter Suber, the director of Harvard's Office of Scholarly Communication was quoted saying that "the prices have been rising twice as fast as the price of health care over the past 20 years, so there's a real scandal there to be exposed". One solution, Suber was quoted saying, "was to persuade researchers to publish in Open Access journals like those under the umbrella of the Public Library of Science, or PLOS, co-founded by Dr. Eisen at Berkeley. But that financial model requires authors to pay a processing charge that can run anywhere from 1,500 to 3,000 USD per article so the publisher can recoup its costs."

In 2014 The Wellcome Trust published details of how much the research foundation spent on Open Access publishing during 2012-2013 in an attempt to make the debate around the costs of open access publishing more evidence-based: The Wellcome Trust spent approximately 3.9 million GBP on APCs for 2126 articles in the year 2012-13. Overall, the average APC for publication in hybrid journals is 2,727 USD (Björk & Solomon 2014).

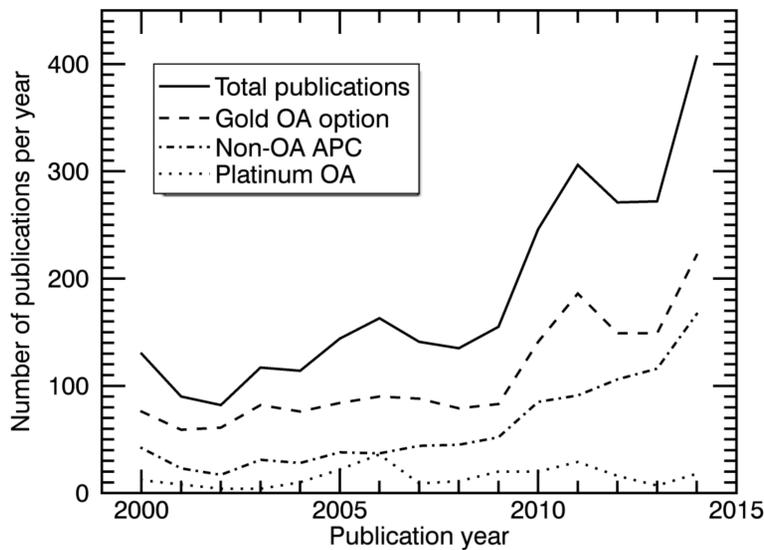
A study that is in a way a supplementary to that of Björk & Solomon (2014) was presented by Gray (2015) to show that the APCs paid to publish Open Access content, and the indirect costs of handling Open Access mandates costs may be unexpectedly high for individual institutions: the study added an estimate for the other publication charges currently paid by research institutions, a significant element which has been neglected by recent studies. When page and color charges are included, the total cost to institutions as of 2013-2014 is around 18.5 % over and above the cost of journal subscriptions—11 % from APCs, 5.5 % from indirect costs, and 2 % from other publication charges. For the Great Britain as a whole, this represents a total cost of publication around 213 million GBP against a conservatively estimated journal spend of 180 million GBP, with non-Open Access APCs representing around 3.6 million GBP (Gray 2015).

Recently, the Max Planck Digital Library White Paper on Open Access by Schimmer et al. (2015) makes the case for a large-scale transformation of the current scholarly publishing system to an Open Access model. The White Paper advocates that there need to be "a shared understanding that the money currently locked in the journal subscription system must be withdrawn and re-purposed for open access publishing services".

Gaufriau et al. (2016) conducted an analysis showing that the funds spent on journal licenses by universities in Denmark is sufficient to pay for the number of publications from the same universities should they be subjected to an APC. In accordance with the Max Planck Digital Library White Paper, the authors found that the average cost per publication of 3,600 Euro in Denmark is only a little lower than a similar calculation by Schimmer et al. (2015) yielding a global level cost per publication of 3,800 Euro (Gaufriau et al. 2016).



Journal	Number of publications	Average annual number of publications
Proceedings of the International Astronomical Union	44	42
Astronomische Nachrichten	31	33
Astronomical Journal	27	19
Astrophysical Journal, Supplement Series	20	40
Monthly Notices of the Royal Astronomical Society: Letters	19	27
Icarus	11	24
International Journal of Modern Physics A	11	19
Space Science Reviews	10	7
Annales Geophysicae	9	12
Planetary and Space Science	9	19
Publications of the Astronomical Society of the Pacific	9	11
Proceedings of the International Astronomical Congress, IAC	9	21
Experimental Astronomy	8	18
Solar Physics	8	11
Modern Physics Letters A	8	11
Nuovo Cimento della Società Italiana di Fisica C	7	8
Revista Mexicana de Astronomía y Astrofísica: Serie de Conferencias	7	14
Memorie della Società Astronomica Italiana, Supplementi - Journal of the Italian Astronomical Society, Supplement	6	7
International Journal of Modern Physics D	5	10
Physics of the Earth and Planetary Interiors	5	6
51st International Astronomical Congress 2010, IAC 2010	5	9
Publication of the Astronomical Society of Japan	4	4
12th Marcel Grossmann Meeting on Recent Dev. in Theoretical and Experimental General Relativity, Astrophysics and Relativistic Field Theories - Proc. of the MG 2009 Meeting on General Relativity	4	4
Applied Computational Electromagnetics Society Journal	3	6
Astronomy and Astrophysics Review	3	3
Astronomy and Geophysics	3	3
Astrophysics and Space Science	3	4
Astronomy Reports	2	1
Astroparticle Physics	2	2
Journal for the History of Astronomy	2	2
Annual Review of Earth and Planetary Sciences	1	1
Acta Astronomica	1	1
Celestial Mechanics and Dynamical Astronomy	1	1
Publications of the Astronomical Society of Australia	1	1
Baltic Astronomy	1	1
Astrophysics and Space Sciences Transactions	1	1
Chinese Physics C	1	1
Gravitation and Cosmology	1	1
Research in Astronomy and Astrophysics	1	1
Astrophysical Bulletin	1	3
Advances in Astronomy	1	2
Physics of the Dark Universe	1	1
Proceedings of the 14th International Conference on Elementary Particle Physics: Particle Physics at the Year of Astronomy - Dedicated to the Late Academician Alexey Sissakian	1	1
Astroparticle, Particle, Space Physics and Detectors for Physics Applications - Proceedings of the 13th ICATPP Conference	1	1
Proceedings of the 15th Meeting on QFT and Lorentz Symmetry, CPT 2010	1	1
Astrophysics and Space Science Proceedings	1	1



Journal	Average annual number of publications
Astronomy and Astrophysics	55.5
Astronomical Journal	3.1
Annales Geophysicae	2.7
Astrophysical Journal*	57.3
Astronomische Nachrichten	3.8
Experimental Astronomy	1.1
Proceedings of the International Astronomical Union	6.6
ICARUS Journal	1.1
International Journal of Modern Physics A-D	7.5
Journal of Cosmology and Astroparticle Physics	8.6
Monthly Notices of the Royal Astronomical Society*	29.7
Publication of the Astronomical Society of Japan	0.5
Publications of the Astronomical Society of the Pacific	1.1
Physics of the Earth and Planetary Interiors	1.3
Planetary and Space Science	1.8
Solar Physics	2.2
Space Science Reviews	1.1

### Data and method: Danish astronomy as a case

To investigate the cost of scholarly publishing on an even finer scale – and to include all direct publication costs, as argued by e.g. Gray (2015), I use astronomy and astrophysics in Denmark as a case. It can be argued that astronomy and astrophysics in several ways is both a traditional field of science with root back to the origin of the scientific method and beyond, but also a first-mover e.g. with respect to adopting Open Science practices including Open Access all the way back to the birth of the Internet. Thanks to arXiv.org, within the field of astronomy and astrophysics Open Access has generally been achieved through Green Open Access self-archiving.

The core journals of Danish astronomy are defined here by considering all astronomy "documents" with contributions from authors coming from Denmark during 2010–2014 according to Scopus (cf. the Table to the lower left), and selecting the set of journals with recurrent authorship, cf. Table above.

On the one hand, even though most core astronomy journals allow or even encourage self-archiving, some of them do in fact offer a Golden Open Access option corresponding to an APC. On the other hand, some core astronomy journals require APCs to be paid that are not related to Open Access. An example of the latter is *ApJ* from The American Astronomical Society, which is published by IOP Publishing.

Journal	Publisher	APC (Euro)	Gold OA	Green OA
Astronomy and Astrophysics, A&A	EDP		400	Yes
Astronomical Journal, AJ	IOP*	763		Yes
Astrophysical Journal, ApJ	IOP*	763		Yes
Journal of Cosmology and Astroparticle Physics, JCAP	IOP	1600	Yes	Yes
Monthly Notices of the Royal Astronomical Society, MNRAS	Oxford	2175	Yes	Yes
Publications of the Astronomical Society of the Pacific, PASP	Chicago**	1000		Yes
Solar Physics	Springer		2200	Yes

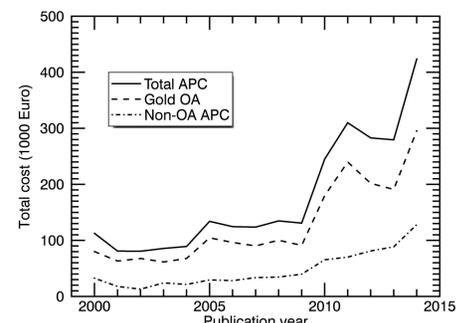
Article charges are calculated by The American Astronomical Society by counting units of information in the digital form that the author supplies called "digital quanta", i.e. units of information in digital form that can include words, figures, tables, digital-only components etc.

This way of calculating article charges makes the cost of an article a unique value, as opposed to the typical Open Access APC which is fixed for a particular journal or publisher. In order to get a handle on the typical article charge for a paper published in *ApJ* we calculated the average cost of publishing in this journal by the DARK Cosmology Center at University of Copenhagen during 2012 – 2015. These four years, scholars at DARK together with international colleagues published a substantial number of articles in *ApJ* and were billed by IOP for a total of 32 of these articles costing DARK all in a sum of 181,980 DKK. The average cost per article per year ranged between 5,033 and 9,100 DKK corresponding to an overall average of 763 Euro.

Example: of the 1030 articles with authors from Denmark published in The Astrophysical Journal during 1990-2016, 775 articles also have co-authors from the USA, 411 articles have co-authors from the UK, 327 have co-authors from Germany, 264 have co-authors from Italy, 206 have co-authors from France etc. (Scopus, March 2016).

## Summary

- This poster deals with the direct cost of publishing in Danish astronomy and astrophysics since 2000.
- This is work in progress – would you like to join?
- Subscription costs are not included (yet).
- The costs considered arise from *Article Processing Charges* related to page charges and Open Access charges.
- Potential publishing costs are calculated by using known APCs and publication counts from *Scopus*.
- Relevant astro journals are included by considering the publication output over a number of years.
- Publications with authors from Danish institutions are considered "Danish".
- The potential cost of publishing rises as the number of publications rises, correspondingly.
- The actual realized costs are unknown.
- Potential direct Golden Open Access costs and potential costs from page charges are comparable in magnitude. However,
- if realized, Gold Open Access would potentially make publishing in astronomy four times more expensive than the potential cost resulting from page charges.
- In future work, subscription costs should be included.



### Discussion and outlook

Non-Open Access or Toll Access publishing in astronomy and astrophysics is traditionally supplemented by Green Open Access through authors' self-archiving into the open repository arXiv.org at Cornell University Library. This method of achieving Open Access has been the *modus operandi* for astronomy and astrophysics even prior to the invention of the term Open Access around the millennium: arXiv.org has now been in operation for more than a quarter of a century.

The estimated (maximum) potential annual cost of APCs related either Golden Open Access publishing or traditional Toll Access publishing in astronomy and astrophysics – based on the publication record in Denmark during 15 years – are the same order of magnitude.

The potential cost of publishing in astronomy and astrophysics in Denmark is on the order of a several 100,000 Euros per year, including both Open Access and non-Open Access publishing.

Publishing in astronomy is of course funded in several different ways, e.g. through international collaboration, and potential costs – future or present – are not only realized in Denmark. However, it remains to be seen, if the current publishing system is sustainable in the Open Access era, and if the realization of increasing costs will quench the apparent growth of Danish astronomy as reflected by the publication output 2000ff. Additionally, the important factor of **subscription costs** needs to be included when assessing the evolution of the said economy!

### References

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