

The SAO/NASA Astrophysics Data System: A Gateway to the Planetary Sciences Literature. Edwin A. Henneken, Alberto Accomazzi, Carolyn S. Grant, Michael J. Kurtz, Donna Thompson, Elizabeth Bohlen and Stephen S. Murray, Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA, ehenneken@cfa.harvard.edu.

Introduction: The SAO/NASA Astrophysics Data System (ADS) provides various free services for finding, accessing, and managing bibliographic data, including a basic search form, the myADS notification service [1], and private library capabilities [2], plus access to scanned pages of published articles. The ADS also provides powerful search capabilities, allowing users to find e.g. the most instructive or most important articles on a given subject [3]. For the Planetary Sciences, the citation statistics of the ADS have improved considerably with the inclusion of the references from Elsevier journals, including *Icarus*, *Planetary and Space Science*, and *Earth and Planetary Science Letters*.

Current Holdings: The ADS database contains over 7.4 million records, with over 1.5 million records in the Astronomy/Planetary Sciences database and over 4.7 million records in the Physics/Geophysics database. About 60% of all records have full abstracts, the rest are table of contents entries (titles and author lists only). About 2.6 million records have references, resulting in a total of 33 million resolved citations, i.e. citations to other records in the ADS. For 8 million records we have external links to the full article text. The coverage for the astronomy literature is better than 95% from publication year 1975. Before this year, we cover all major journals and many smaller ones. We have scans for 513,000 articles (3.8 million pages). Currently, we are rescanning the grayscale and color content of *The Astrophysical Journal*. The component of historical literature, including observatory reports, is growing. Currently we have 130 historical publications scanned from hardcopy and microfilm.

We get abstracts on a regular basis for most journals, either directly (via data feeds) or indirectly (via web harvesting) from the publisher or via our collaboration with CrossRef (a non-profit organization aiding the dissemination of metadata).

The ADS is synchronized with arXiv every night. For every e-print we attempt to extract the reference list. Once the e-print is published as an article, both records get merged.

Coverage of Planetary Sciences: We currently have about 78 journals covering the planetary and space sciences (*Advances in Space Research*, *Icarus*, *Solar Physics*, *Astrophysics & Space Science*, *JGRE*, *Meteoritics*, to name a few). Currently, this set of jour-

nals represents about 180,000 articles and 1.1 million references.

The planetary science content in the major astronomy journals has increased over time. In order to get a measurement for this content, we queried the ADS for a number of keywords in article titles. In 2007, about 14% of the articles in *The Astrophysical Journal* (including the Supplement), *Astronomy & Astrophysics* and *Monthly Notices of the RAS* were about a topic in the planetary sciences. This is roughly twice as much as in 1995.

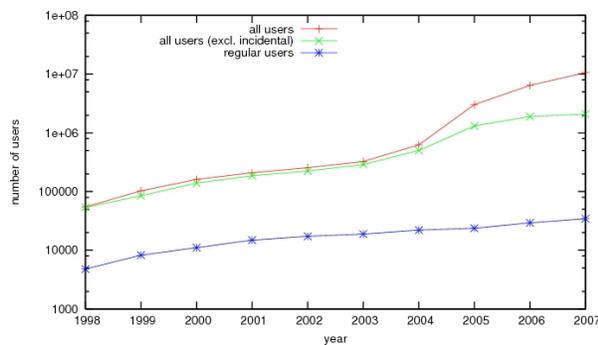
Submitting an e-print to arXiv before an article is published is still relatively uncommon in the planetary sciences. However, there is a growing trend. Just like we did for the main astronomy journals, we measured the planetary science content of arXiv. In 2007, 7% of the astronomy ("astro-ph") e-prints were on a topic in the planetary sciences, which is about 18 times as much as in 1995. Over 90% of this 7% were e-prints that appeared in one of the main astronomy journals. A small fraction of articles in the main planetary science journals were submitted to arXiv. In 2007, for example, 7% of the *Advances in Space Research* articles appeared as e-print, 41% of *Astrophysics & Space Science* articles, 9% of *Icarus* articles, 15% of *Solar Physics* articles and less than 1% of articles in *Earth & Planetary Science Letters*. These fractions for the main astronomy journals are well above 70%. The most important articles in the main astronomy journals all appeared as e-prints [4].

Usage Growth: Penetration into the Solar Physics, Planetary Sciences, and Geophysics community has increased with the inclusion of abstracts and references from AGU and EGU journals and references from the Elsevier planetary journals, notably *Icarus*. As a data point: comparing user access to *JGR* and *Icarus* records in Feb. 2004 and Feb 2008 shows an increase by a factor of 4.4; as a comparison, *Astrophysical Journal* access increases by "only" a factory of 1.8 during the same period.

The long-term and recent growth of ADS can be seen in the number of items downloaded per year (full-text papers, abstracts, citations, data, etc). In 1999 3.8 million items were downloaded, by 2003 this had grown to 9.6 million. All these were by "scientists." In 2007 "scientists" made 22 million downloads, while an additional 24 million came from the general public, via external search engines, mainly Google.

Among the more successful new services provided by ADS are the myADS-arXiv notification service, which now has over 6,000 subscribers. The introduction of user-managed private libraries has also proven to be popular new features, with over 12,000 users taking advantage of it.

Access Statistics: Up to the middle of 2004, the number of ADS users doubled on a bi-yearly basis. Since the ADS started to be indexed by general search engines, the number of incidental users has increased dramatically. However, the number of typical users (more than 10 visits per month) has continued to follow the same growth pattern. The figure below illustrates the growth in the number of ADS users over time. The (red) line marked '+' shows the total number of users. This includes incidental users who just look at an abstract. Excluding incidental users, the total number of users is shown by the (green) line marked with 'x' (these are users who request additional metadata and perform queries). Finally, the number of typical users is given by the (blue) line marked with '*'.



The total number of visits in the period of January and February of 2008 amounted to 5,941,983. The table below gives a breakdown per origin of these visits.

Origin	Number of visits
Main ADS site	2,620,868
Google	1,920,797
Google Scholar	315,864
Wikipedia	31,094
Astr. Pict. of the Day	23,742
arXiv	17,474
MSN	11,556
Yahoo	2,015
Ask.com	1,354

The median usage equals about 21 reads per month. This is an indication that all our frequent users on average use the ADS on a daily basis. Initially, this

meant that all professional astronomers use the ADS on a daily basis [5]. This is probably still true, but with the addition of a growing group of physicists and planetary scientists.

References:

- [1] Henneken, E.A. et al. (2007) *ASPC* 377, 106.
- [2] Eichhorn, G. et al. (2007), *LPSC XXXVIII*, 1240.
- [3] Accomazzi, A. et al. (2009) *AAS* 213, Abstract #47301.
- [4] Henneken et al. (2007), *J. Electr. Publ.* 9, 2.
- [5] Kurtz et al. (2003), *Library and Information Services in Astronomy IV (LISA IV)*, 223.

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