

Polvere di stelle

The Italian platform for data-sharing and data-preserving of modern and ancient astronomical resources

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Abstract. *Polvere di stelle* (Stardust) is the web portal of the National Institute for Astrophysics (INAF) dedicated to the Italian astronomical libraries, archives and museums. It offers different tools and databases created to support astronomical research and increase the value of one of the richest astronomical heritages in the world.

In a single virtual space one can find useful tools for sharing digital resources and other services for current research. Besides the OPAC, consisting of bibliographic data of ancient and modern books and serials, the portal offers to astronomers, scholars, students, amateur astronomers and historians of science the possibility to search at the same time other databases: manuscripts, instruments, archival documents and biographies of astronomers. Furthermore, a digital showcase of rare books plays a relevant role in the portal.

This paper illustrates the ongoing developments and perspectives of *Polvere di stelle*.

1 The project

The project *Polvere di stelle* (Stardust) was conceived for the International Year of Astronomy 2009. It originated from the growing interest in historical archives that has engaged the archivists and librarians of Italian observatories in the last 30 years. It can also be considered the final and public result of the *Specola 2000* project [1]. *Polvere di Stelle* has increased the knowledge of the historical legacy of Italian astronomy, presenting in a complete and homogeneous way the treasures hidden in the folders of the Italian astronomical archives.

The first release of this portal was presented at the LISA VI conference held in Pune in 2010 [2]. *Polvere di Stelle* was the stargate to access twelve historical archives, to consult a first nucleus of data stored in a homemade database, and to browse a wide gallery of the most important documents. In the same year INAF published an elegant booklet to present and describe its fonds, series and documents [3]. In addition, a video presentation was published on the web and on social media, showing the

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Stardust pearls held by the historical archives of Italian observatories and sometimes hidden in old folders or inside ordinary documents¹.

1.1 The databases

The project had a turning point in 2013, when INAF decided to create a web platform to host the cultural heritage held by some of the oldest scientific institutes in Italy, as the astronomical observatories are. INAF in 2010 had already acquired two professional databases for all the twelve observatories.

Bibliowin is the web-based interface to catalogue books and journals, both modern and old, in accordance with the International Standards. The application program, ASP based, allows the shared and derived cataloguing, and is provided with tools for library circulation and management.

SicapWeb is the web interface of a MS SQL Server and MSDE database. It includes six cataloguing modules for different kinds of historical holdings. The module for manuscripts follows the standards approved by the Standing Committees of the IFLA Section on Cataloguing and the IFLA Section on Rare Books and Manuscripts. The inventory module for the archival documents complies with the ISAD(G) General International Standard Archival Description and ISAAR (CPF) International Standard Archival Authority Record for Corporate Bodies, Persons and Families. The modules for the scientific and technological instruments, the artworks such as the painting of father Piazzzi (see fig. 5), the astronomical plates and photographs are defined in accordance with the rules of the Italian Minister of Culture. Finally, the last module is structured to record the biographies of Italian astronomers.

A new release of the web portal was realized in 2014 and was presented at the LISA VII conference held in Naples (see fig.1). *Polvere di stelle* is reachable at the web address www.beniculturali.inaf.it.

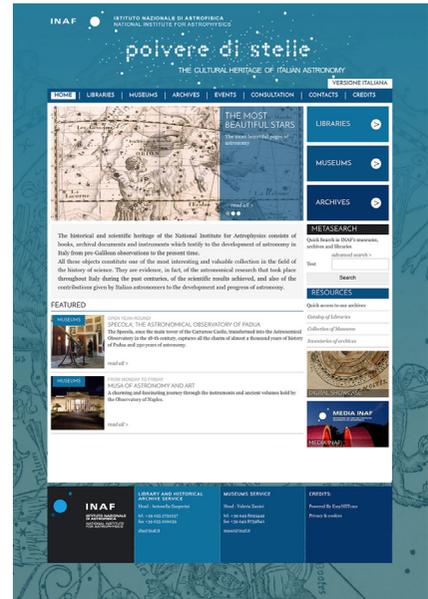


Fig. 1. The home page of *Polvere di stelle*.

2 The rare and valuable heritage of Italian astronomy

The historical and scientific heritage of Italian astronomy consists of manuscripts, ancient books, scientific instruments, archival documents, artworks, astronomical plates and photographs which prove the important developments of astronomy in Italy, from the pre-Galilean observations to the present time. Held in twelve astronomical observatories, all these objects are one of the most outstanding and valuable collections for the history of science worldwide.

2.1 Rare books

The Italian observatories hold more than 7000 rare books (from 1470 to 1830), including 19 incunabola and 551 cinquecentine, together with 30 manuscripts. Some of these books represent true cultural milestones: the works of Galileo, Copernicus, Ptolemy, Kepler and Newton (often first editions), are considered the symbols of the scientific revolution and have cleared the way for modern science.

¹The video was published on different web sites, i.e. www.youtube.com/watch?v=4MCleV7PxA.

Besides their importance for the history of Western culture, these books are also interesting for their fine and precious illustrations. The amazing star atlases of Hevelius, Doppelmayr, Flamsteed and Bode, or the cometographies and selenographies of Northern European astronomers, published in the 16th and 17th centuries, reveal a variety of details, illustrated with painstaking care in works of rare beauty that merge art, mythology and science. The oldest document held by the National Institute of Astrophysics is a manuscript preserved in the Library of the Copernican Museum in Roma, that dates back to the end of 1300 (see fig. 2). It is a collection of medieval astronomical texts, probably the most popular essays of that period.

2.2 Museum collections

The ancient astronomical instruments collection of the Italian observatories counts over 1200 items, from the 11th century to the first half of 1900. Exhibited in 13 museums, it mainly consists of quadrants, telescopes, theodolites, clocks, stopwatches, globes (see fig. 3), mathematical and meteorological instruments. Among the most precious pieces, the museum collections hold an Arabic astrolabe dated back to the year 1090, one of the biggest telescope mirrors made by William Herschel, the telescope used by Schiaparelli to describe the surface of Mars, and the instruments manufactured and used by the Italian astronomers to realize a "new science", astrophysics.

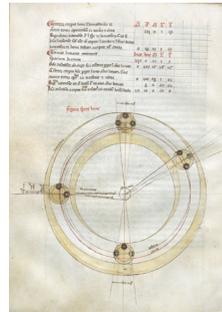


Fig. 2. *Theorica planetarum* by J. de Sacrobosco (14th century).



Fig. 3. The celestial globe by G. Roll and J. Reinhold, 1589.

2.3 Historical archives

The historical archives of the astronomical observatories preserve the documents of some of the oldest scientific institutions in our country.

Our archives keep records from countless nights spent at the telescope, beautiful sketches of solar phenomena (see fig. 4), nebulae, comets and planets, drawn during the observations under an astronomical dome, letters revealing the history some scientific discoveries, journey logbooks, maps, bills and meteorological observations as a continuum line throughout the centuries. A cultural legacy consisting of over 3 million documents and including 122 series of archival fonds of various astronomers especially.

2.4 Astronomy and astronomers in artworks, biographies, and photographs

Besides being the oldest scientific institutes in Italy, the observatories have also had cultural leadership at large. Many of them were installed in antique buildings, such as the medieval tower of Ezzelino da Romano in Padova, the royal Norman Palace in Palermo or the Brera Palace in Milano [1]. Therefore the Italian astronomical observatories preserve valuable artworks as frescoes, sculptures, paintings and honor medals. A catalogue of these kinds of objects still has to be completed: some hundred pieces of art can be roughly counted at a first estimate.

For what concerns astronomical plates and photographs, the Italian observatories own solar and lunar eclipses photos, such as the plates realized by father Angelo Secchi during some astronomical expeditions in the second half of 19th century, and images of historical and social events, like the pictures of the participants at the First International Astronomical Union Congress in 1922 [4]. So far, two collections of drawings and plates of solar observations have been recorded and scanned: the 2516 sketches of the Sun realized from 1865 to 1925 at the Catania Observatory, and the 5250 CaIIK and 6941 H α spectroheliograms acquired during 5042 observing days at the Arcetri solar tower from 1926 to 1974 [5]. In next future these records and their digital copies will be uploaded in *SicapWeb*.

In 1997 the Italian Astronomical Society published a book with 277 biography records of Italian astronomers from the Unity (1861) to the present [6]. The astronomers who worked in the Italian observatories were clearly many more, so the next goal will be adding the biographic profiles of Italian astronomers in *SicapWeb*.

The holdings of Italian astronomical observatories catalogued and/or recorded in INAF databases are listed in Table 1.

3 The web portal framework

The contents and the services offered by *Polvere di Stelle* are available to every user: astronomers, students, historical researchers, amateurs. A general introduction presents the three different thematic areas constituting the web platform. It describes activities and projects, offers access to catalogues and tools, and provides tips.

The actual structure of the portal is the result of a long-time cooperation among Italian astronomical observatories in the library, archives and museum areas.

From 1995 till 2010 every astronomical library had a local catalogue and used the CUBAI², a multiOPAC which made a simultaneous search on all databases [7]. In 2010 was acquired *Bibliowin*, where all the various catalogues have merged in an unified database and OPAC for all INAF libraries. Now INAF librarians are working to normalize records and authority files.

In 2001 astronomical libraries decided to participate to ACNP (Italian Union Catalogue of Serials) [8] and to create a national catalogue of astronomical journals (Astronomical ACNP)³.

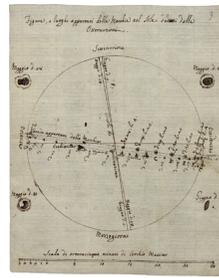


Fig. 4. Figures and sites of sunspots deduced from observations, 1703.



Fig. 5. The astronomer Piazzi by C. Angelini, abt. 1825.

Table 1. Items recorded in the databases until June 2017.

Records	#
Manuscripts	19
Ancient books	6674
Modern books	75574
Serials	206
Journals	2570
Museum instruments	545
Artworks	66
Archival records	6334
Biographies of astronomers	58
Authors and craftsmen indexes	974

²CUBAI is the acronym of *Catalogo Unico delle Biblioteche Astronomiche Italiane* (Unified Catalogue of Italian Astronomical Libraries).

³The catalogue can be searched at the following address: acnpsearch.unibo.it/custom/astro

A similar cooperation path was followed by the historical archivists working in the astronomical observatories, who realised *Specola 2000*. The aim of this project was the preservation, reorder, and inventory of the ancient astronomical documentation [9]. The rearrangement activities and the digital inventories, realized with this project, allowed the retrieval of outstanding documental sources, crucial to the understanding of the evolution of scientific thought and the reconstruction of the Italian "scientific politics" starting from the 18th century.

The project "Astrum 2009", a temporary exhibition realized at the Vatican Museums during the International Year of Astronomy 2009, was the first result of a national collaboration among observatories in the museum areas. This circumstance highlighted the local astronomical collections and how they could be considered as a part of a unique national museum of instruments illustrating the developing of Italian astronomy [10].

Now *Polvere di stelle* is the web portal of:

■ 13 libraries

of the twelve Italian astronomical Observatories and the library of the *Fundación Galileo Galilei*, which operates the TNG (*Telescopio Nazionale Galilei*) at Los Roches de los Muchachos in La Palma island. Each single library section presents the institute, staff, opening hours, local services, rules, and historical notes;

■ 12 historical archives

kept in the observatories, including the one owned by the Department of Physics and Astronomy of Bologna *Alma Mater Studiorum*⁴. Besides information on staff and schedules, every archives describes how it was formed, its structure, and the sorting and inventory status of documents. Moreover, one can find the complete tree structure of every archives. In some cases, such as in Torino and Milano, more than a single archives are kept and presented;

■ 10 museums

or scientific collections of nine Italian observatories and "La Specola" Museum owned by Bologna University. To complete the framework, still lack the pages of the instrument collections of Cagliari and Trieste observatories. In addition to general information, opening hours, contact and staff, some museums' web pages show peculiar aspects of exhibits such as historical notes, a virtual tour, and detailed descriptions of domes or gardens.

3.1 The queries and the records

Beyond presenting library catalogs, archives inventories, and museum collections, and providing historical descriptions for different kinds of items, *Polvere di Stelle* offers a double way to search the databases: a specific form and a simultaneous form. The specific form has different types of queries: simple, advanced, by list, by collapsing (in archives case). The simultaneous search performs a query in the two databases and in all kinds of materials: books, archival documents, manuscripts, artworks, scientific instruments, photographs, and astronomers' biographies records.

Some records, such as those of old books, show not only the bibliographic description of materials but also the specimen notes and the biographical notes of authors and printers.

The astronomers records contain links that launch queries on *Bibliowin* catalogue, ADS, and *Sicapweb*, thus producing a complete bibliography and a list of the cultural materials related to that person.

⁴An agreement signed in 2014 by INAF and Bologna University permits a complete collaboration to study and promote the ancient astronomical heritage of both institutions.

Other records, in particular those referring to instruments, documents, and astronomers, are structured so that one can launch a query by clicking on an icon. The query will show all records in the database having the same metadata in the same field (i.e. the institute preserving the item, persons cited in the document, category, authors and craftsmen, as shown in fig. 6).

All these useful interconnections permit to build some specific aspects of the history of astronomy, and to realize thematic pathways of important astronomical events, discoveries and instrument employments.

4 Leafing through rare books

A digital showcase plays a relevant role in *Polvere di Stelle*. With the same technology used to store and share astronomical data, the Italian data-center for Astronomical Archives (IA2), housed in the Astronomical Observatory of Trieste, has set up a platform to create a national repository for the digital copies of the ancient books [11]. IA2 is a national infrastructure based on the cloud paradigm, hosts data from the main ground-based Italian Telescopes and offers proprietary and public data access through user portals and Virtual Observatory (VO) services. All software tools are based on Open Source application and are developed in C++, Java and PHP.

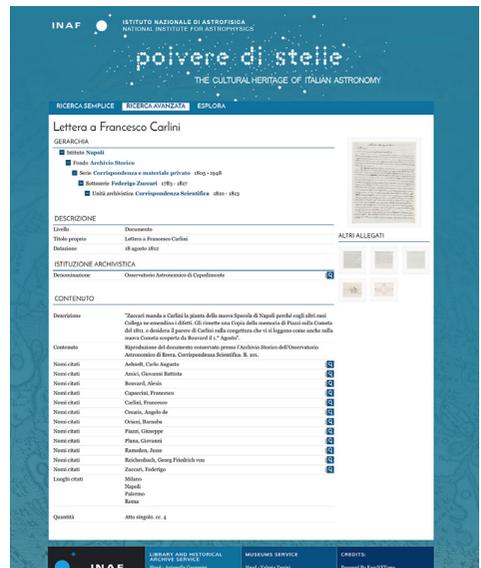


Fig. 6. An archival record on the OPAC.

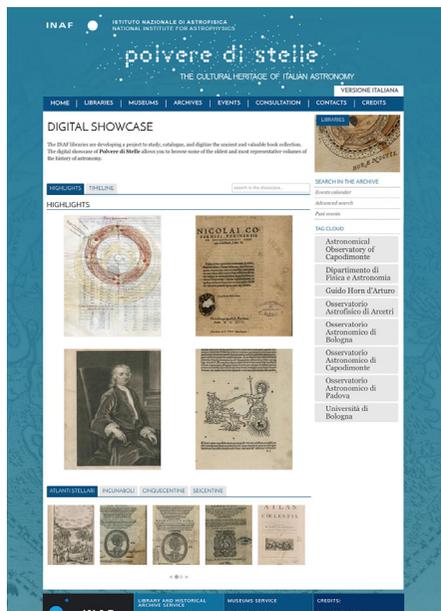


Fig. 7. The main page of the Digital Showcase.

Using this infrastructure, and in particular the data cloud storage, we have uploaded over 110,000 files of 324 ancient books, in different resolutions: the images at 150 DPI are used to publish the books on the web with a watermark on each page, while the 300 and 600 DPI images are used to keep a digital copy of each book [12].

At present, the digital showcase enables the reading, in a colour digital form and in very good resolution, of the rarest and valuable editions of the old book collection (in fig. 7 its main page). It presents some highlighted volumes and four tabs listing Stellar atlases, Incunabula, Cinquecentine and Seicentine.

Moreover the timeline allows users to surf all the digital copies uploaded in the repository and catalogued in Bibliowin. Until July 2014 there are digital volumes published from 1326 to 1842. In addition, a search field enables to select a specific digitized edition.

People can leaf through some wonderful volumes like the *Almagestum* by Claudius Tolomeus published in 1528, the *Cosmographiae vniuersalis* by Sebastian

Munster published in March 1572, and the *Tabule astronomice* by Alfonso X, King of Castile and Leon, printed in 1521. Some amazing stellar atlases have a special scientific and artistic relevance: the *Vranometria* by Johann Bayer, published in 1661, includes 51 engravings of detailed astronomical plates, and the *Atlas novus coelestis* by Johann Gabriel Doppelmaier, printed in 1742, presents 30 hand-coloured stellar maps and a marvelous "antiporta". The digital showcase, from where you can leaf the books, can be reached at www.beniculturali.inaf.it/eng/digital-showcase.

We have also defined a policy to upload the documents in the national repository of the digital copies of ancient cultural heritage. Each Observatory can create a main folder to preserve the high resolution copies and various sub-folders to upload the digital copies of each archival record (see fig. 6). A pilot project is in progress, and 31 folders have been uploaded in the repository at present.

In the last years, more than a half of the astronomical archives of Bologna University have also been digitized, and the digital copies will be soon available on the web. This work, combined with a reordering and rearrangements of both archival files and single sheets, allows archivists to recover many others series of documents and astronomical logbooks of observations, among the oldest observations ever realized in an observatory [13].

5 A place to offer utilities and to promote events

Polvere di stelle has a specific section, a launch window, to promote the events realized to valorize the cultural heritage and disseminate the astronomical knowledge for the general public and schools, even in a multidisciplinary approach.

This section is used to inform patrons about updates and new features supporting the scientific research: astronomers can find which journals, serials and digital libraries are available online, how to access to these resources with a remote connection, and how to use NILDE, the library services for document delivery.

A long series of cultural activities have been realized in the last years in the observatory libraries, archives and museums. To name but a few, we can cite the concerts organized at Arcetri Observatory where the "Albert Einstein piano" is placed in the library hall⁵, or the stage shows like *Settemillimetri di Universo* (Sevenmillimeters of Universe) conceived for the *Starlight* project⁶.

A special mention goes to a particular event that took place in January 2015. On the 70th anniversary from the liberation of Auschwitz concentration camp, some astronomy librarians, archivists, and historians organized the conference *Under the same sky?* in collaboration with the University of Bologna, the Jewish Community of Bologna, the Italian Astronomical Society and the "Primo Levi" University [14]. It was the first official commemoration of the six Jewish Italian astronomers Azeglio and Giulio Bemporad, Luigi Jacchia, Guido Horn d'Arturo, Tullio Levi-Civita and Bruno Rossi, who at the end of 1938 were dismissed from their jobs because of the racial laws⁷.

Finally, the portal offers the *Bibliography of Italian astronomical books for children*, a periodically updated selection of Italian astronomical books for children, dedicated to teachers, parents, public librarians, science communicators. This kind of bibliography is a unique tool ever made in the Italian scientific libraries [15].

⁵From 2016, the central hall of Arcetri library houses the piano that Albert Einstein gave to his sister Maja during her stay in Firenze. The piano has been the "star" of many of Arcetri library events.

⁶*Starlight* was a shared exhibition realized in five observatories in 2016 (Palermo, Napoli, Roma, Firenze and Padova). See the virtual tour at the following address: www.starlight.inaf.it

⁷In September-December 1938 the Fascist Government issued a series of provisions regulating the exclusion of foreign and Italian Jews from the school, the academia, politics, finances, professional world, and all sectors of public and private life.

6 Towards new challenges

Polvere di stelle is a platform to support current research and, at the same time, a web portal to enhance the Italian astronomical heritage. An interlinked web tool that looks to the present and includes the past, in the name of the historical and scientific knowledge considered as an "unicum". After three years since its first release, we are now working to implement new contents, to realize new projects and to publish a new layout for *Polvere di stelle*. The digitization of old books will also continue, and a new set of rare plates and great pages of astronomy will be soon available in the showcase.

INAF is also interested in new technologies. Through Turin Astrophysical Observatory, we are participating in a pilot project on Linked Open Data which is fully detailed in a poster presented at LISA VIII conference (see the related paper [16]).

Polvere di stelle is and will be even more a focal point supporting astronomical research with its information services, and preserving the great cultural heritage of astronomy which is "the most beautiful monument of the human mind" (Laplace).

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