Schrödinger on Phaidra: Introduction and searching aid

The Austrian Central Library for Physics in Vienna holds the most comprehensive collection of documents regarding the work and life of Austrian Nobel prize laureate (1933) Erwin Schrödinger (1887-1961) who was among the most influential theoretical physicists of the first half of the 20th century. The respective holdings consist of about 2,000 items (mostly notebooks, research and teaching files, letters, manuscripts, drafts, photographs, press clippings and memorabilia) which have been almost completely digitized and are freely available for research online via the institutional repository of Vienna University, *Phaidra*. This paper gives a brief overview of the respective collections (including their indexing and digitization status), and then goes into more detail about searching for digitized source materials on Schrödinger via the *Phaidra repository*.[1]

Large parts of our extensive collections regarding life and work of Austrian Nobel Price laureate Erwin Schrödinger have been digitized and are freely accessible via the Phaidra-Repository.

Schrödinger sources available at the Central Library for Physics:

Holdings, indexing and digitization-status

Collections available in digital format

The main part of Schrödinger's scientific legacy has been microfilmed for Thomas Kuhn's "Sources for History of Quantum Physics Project"[2] and was subsequently transferred to our library in 1963. The respective files (including letters and other writings on wave mechanics) have been digitized in full and are freely accessible via the Phaidra repository. It should be noted that we have also digitized several documents Kuhn did not microfilm for reasons of cost and capacity.

By now, seven Schrödinger-related collections are available in digital format including Schrödinger's personal papers in science.

Further collections related to Schrödinger's life and work (mostly built up by friends and relatives of Erwin and Annemarie Schrödinger) were acquired in later years and have also been digitized in full. These include the Andreas-Krafack-Collection (comprising documents from Schrödinger's family on the maternal side), the Bianchi-Collection (Johanna Bianchi, née Krauss, was temporarily engaged with Schrödinger in his youth and remained a correspondence partner until old age) and the collections of Irmgard Bertel and Maria Bertel (Irmgard was a sister of Schrödinger's wife Annemarie; Maria was Annemarie's sister-in-law.) Digitization furthermore includes a mixed lot of Schrödinger documents donated to the library as single items (e.g. lecture notes taken by former students) and Schrödinger papers found within other archival collections of the Austrian Central Library for Physics.

A list of all digitized collections on Phaidra relating to Schrödinger can be found below. There is also a list on single document level.

[1] This paper refers to the digital provision and indexing of documents from the Schrödinger collections of the Central Library for Physics. Please note that Phaidra repository also contains numerous objects from other sources to which the information given in this paper may not apply.

[2] See https://www.amphilsoc.org/guides/ahqp/. All online-resources were accessed 2022-08-04.

Collections not digitized yet

The Central Library for Physics also holds Schrödinger's offprint-collection (including papers written by Schrödinger as well as papers by other scientists collected by Schrödinger), a vast collection of copies from other archives concerning Schrödinger's life and work and a collection of documentary material (research literature, daily press, articles from popular magazines…) These collections have not been digitized yet but are partly indexed in our internal archival catalogue and can largely be used on site. If necessary, we can research these materials for you and provide you with copies. For this purpose, please contact us via sammlungphysik.ub@univie.ac.at.

A small part of our relevant holdings, including Schrödinger's offprint-collection, has not been digitized yet. You can use this material on site or send us a request.

Note that parts of Schrödinger's written legacy are kept by his descendants or are held by other archives such as the Brenner-Archiv-Innsbruck.

Further Material regarding Schrödinger

Further information on Schrödinger, including a web exhibition and a comprehensive bibliography of Schrödinger's writings, can be found on our homepage. The exhibition catalog "Erwin Schrödinger 1887-1961: Documents, Material and Pictures" is freely available via Phaidra in English and German language and can also be ordered from us in printed format. Research literature on Schrödinger (especially books) can be found using our library catalogue u:search.

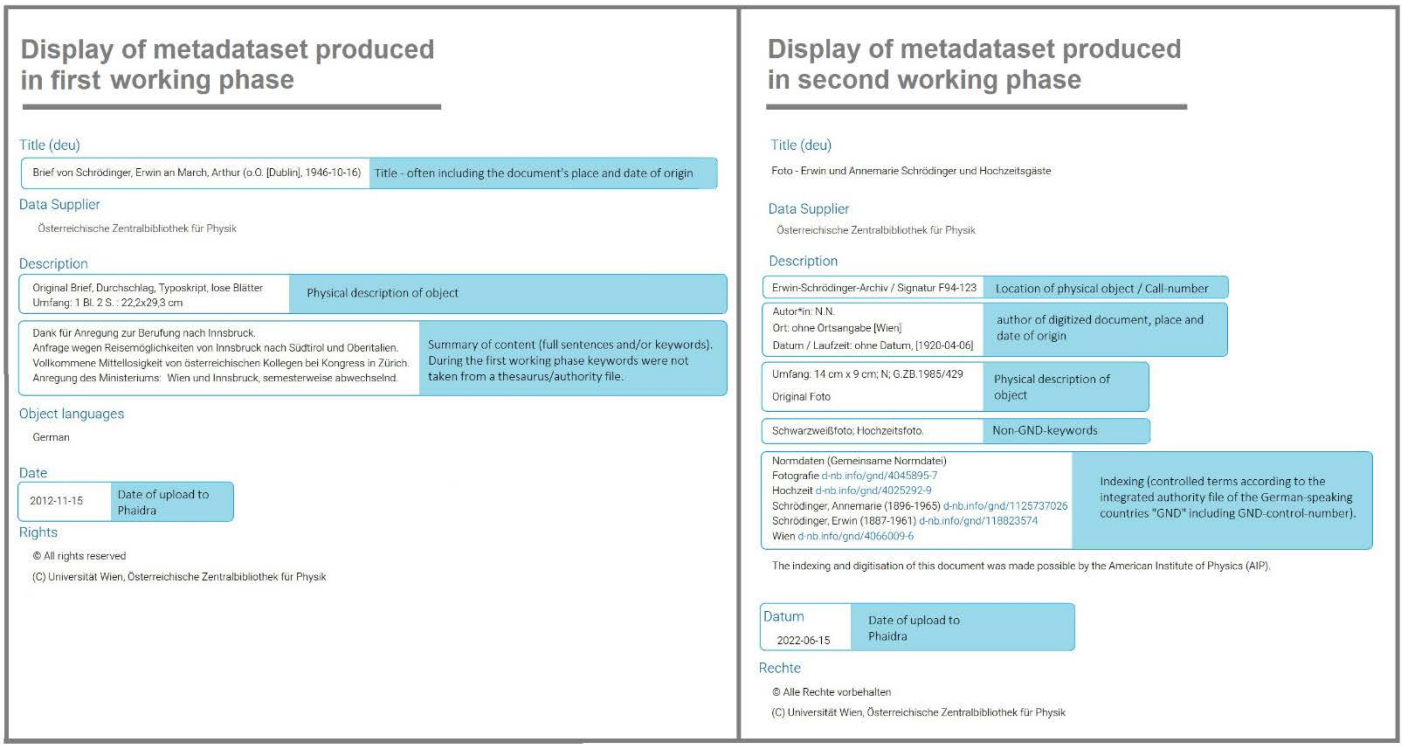
Further material including a comprehensive bibliography of Schrödinger's writings, can be found on our homepage.

Metadata and Indexing

Digitization of the Schrödinger-material comprised two phases. During the first phase (2012), a large part of the papers, which had come to the library in 1963, was digitized. The respective metadata sets were taken from our internal archival catalogue. They include a physical description of the digitized item, a summary of its content in full sentences and/or several subject headings, which were not taken from a subject authority file. Important places and personal names to occur in the documents have been indexed as well, but their notations have not been standardized either. Therefore, when searching, one has to consider synonyms and different spellings, including spelling variants of personal names and places.

Because during the first phase of work no thesaurus was used for indexing the digital documents, synonyms and variant spellings should be included in your search.

The remaining material was digitized and indexed in depth during a second phase (2021/22) as part of a project funded by the American Institute of Physics (AIP). From this point on, indexing largely followed the rules set up by the national libraries of the German speaking countries for the cataloguing of manuscripts and autographs ("RNAB"). Subject headings, places, persons and institutions were captured as controlled terms. The integrated authority file of the German-speaking countries "GND" was used as a thesaurus. Personal names that were not listed in the GND yet were consistently captured in the form "last name, first name". Several documents were additionally given short summaries in full sentences and further non-GND keywords. The following figure shows how the metadata sets are displayed in Phaidra.



During both phases indexing and digitization was largely carried out on the single document level. However, documents of similar content forming a single file unit physically were occasionally combined in a shared digital copy (e.g. photos located in the same album). In those cases, information on the individual items is given in list-form as part of the metadata record.

The documents were uploaded to “Phaidra” the University of Vienna's repository for the long-term preservation of digital objects.[3] Run by the University Library, Phaidra is used by various organizational units of Vienna University to store or make accessible digital objects. Thus, Phaidra covers a wide range of digital objects whereof those from our Schrödinger-collections only make up a small fraction. For this reason, one has to limit the search using a suitable request (see below).

[3] See https://datamanagement.univie.ac.at/ueber-phaidra-services/.

Finding Schrödinger-papers via Phaidra: Tips for searching

Phaidra currently provides a simple search only which appears when one calls up the Phaidra-webpage (https://phaidra.univie.ac.at/).

Search terms must be translated to German

Only the metadata sets are searched, not the full texts of the digitized documents

The search should be restricted using the term "Schrödinger"

Keep in mind that no full text search within the digitized documents will be performed. Only the respective metadata sets will be searched. Your search will necesarilly comprise the entire metadata set whereas a restriction to a certain field – such as the document title or the author field – is currently not possible. Please also note that the indexing language for all Schrödinger-items is German and that therfore search terms have to be translated to German first.

Without further restriction, all objects stored in Phaidra will be included in your search. An easy way to limit the search to the documents related to Schrödinger is to include the word "Schrödinger".

Although there is only a single input field, complex search queries can be built up using search operators. The most helpful operators Phaidra can process are listed below.[4]

Since Phaidra can process the most common search operators, including the Boolean Operators, complex search queries can be built up.

AND	&&	Both terms on either side of the operator must be present for a match. Is used automatically when several search terms are typed in without being linked by a specific operator.	Schrödinger AND Planck finds only documents with both Schrödinger and Planck in the respective metadata set.
NOT	!	The following term must not occur for a match. Instead of the exclamation mark also the minus symbol - can be used.	Schrödinger NOT Planck finds documents in whose metadata set Schrödinger occurs, but not Planck.
OR		Requires either term (or both terms) to be present for a match.	Schrödinger OR Planck finds all documents in whose metadata set Schrödinger occurs, Planck occurs or in which both occur.
Phrase search	""	The phrase between the quotes is searched for in the exact form specified.	"schreibt Schrödinger an Planck" finds only documents whose metadata set includes the exact phrase "schreibt Schrödinger an Planck"
Wildcard	?	Replaces one character within the search string.	Te?t finds documents in whose metadata set occurs Text or Test
truncation	*	Serves as a placeholder for zero or more sequential characters within a search string. Can be placed at any position.	Berufung* finds documents in whose metadata sets occurs Berufung, Berufungsverhandlung, Berufungszusage etc.
Proximity	~	Looks for terms that are within a specific distance from one another. To perform a proximity search enter the search terms in quotation marks, then the tilde and a numerical value.	"Schrödinger Planck" ~3 finds documents in whose metadata set the words Schrödinger and Planck occur and are not more than 3 words apart.

[4] The search in Phaidra is based on "The Extended DisMax Query Parser" by Apache Solr. Detailed technical information can be found here: https://lucene.apache.org/solr/guide/6_6/the-extended-dismax-query-parser.html

One can combine several operators and use brackets to structure complex queries. Thereby the use of brackets is analogous to their use in mathematics:

Note that the letters ü ä ö and ß have been captured as such, but can be replaced as follows without affecting the search result (even when using phrase-search):

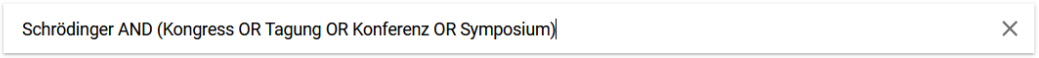
The umlauts (ü, ö, ä) and ß can be replaced without affecting the search result.

ü	ue	Künstler = Kuenstler
ö	oe	Österreich = Oesterreich
ä	ae	Porträt = Portraet
ß	ss	Straße = Strasse

Thus, one does not necessarily need a German-language keyboard or a special character editor to search.

Online dictionaries such as Leo can help to translate key words into German. In addition, the freely accessible online version of the integrated authority file of the German-speaking countries "GND" can also be used to find suitable German-language search terms (see below for more details). As during the first phase of work neither form of vocabulary control was applied, synonyms and variant spellings should be included in the search. Applicable synonyms might be found with the help of Openthesaurus or similar tools and can be linked within your search query using the OR-operator; e.g.

One can find suitable German-language search terms and their synonyms with the help of online dictionaries (Leo, Openthesaurus…).



When searching for persons, it is recommended to use the family name only and to include name variations in the search.

As mentioned above, several documents have short, full-sentence summaries within their metadata records which might be quite valuable for searching. However, within these summaries words are very likely to occur in conjugated or declined forms. It is therefore recommended to search for the root of a keyword only and to make use of truncation.

When searching for a specific string that contains hyphens or special characters, it is recommended to enclose the searched string in quotation marks (phrase search). This applies in particular to the search for call numbers [e.g. "B33-(56)-10"] and exact dates [e.g. "1928-04-14"].

As far as the Schrödinger-Documents are concerned, we do not recommended to use the filters on the right to limit the number of search results, as the assignment

Include variations of personal names in your search

Use truncation to incorporate various word forms

Call numbers and exact dates are best searched for "as phrases"

of document types is not always accurate for technical reasons. It is more advisable to limit the number of hits by specifying the search query.

The digitized Schrödinger-collections contain a considerable amount of photographs including complete albums. The photographs are labeled „Originalfotografie“, „Originalfoto“, „Foto“ oder „Fotografie“, the albums are labled “Fotoalbum”.

An appropriate search query to display all photos included in the digitized Schrödinger-collections is

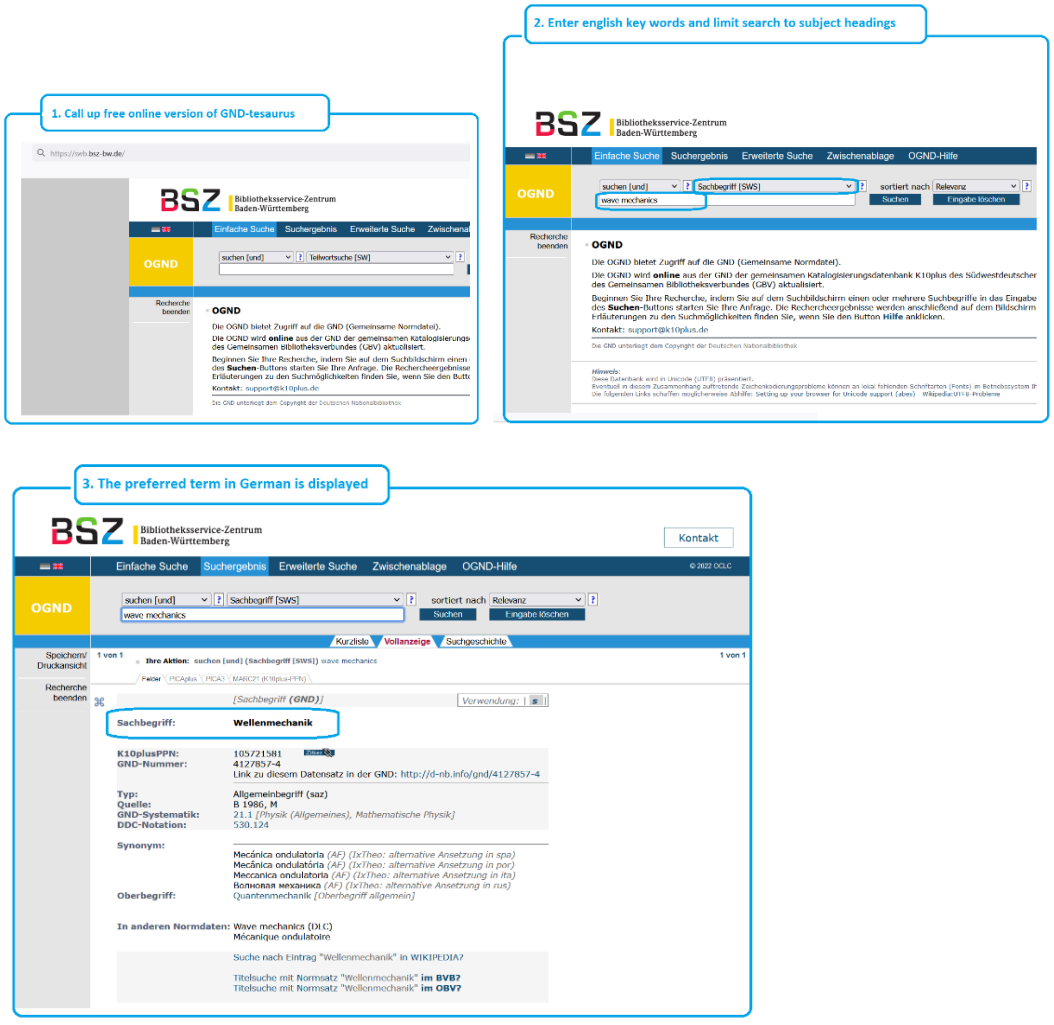
schrödinger AND (*photo* OR *foto*)

Using the query schrödinger AND (*photo* OR *foto*)

all photos from the digitized collections on Schrödinger can be found.

During the second working phase (when 800 out of about 2,000 documents were processed) controlled terms according to the integrated authority file of the German-speaking countries “GND” were used for indexing. With the help of the freely accessible online-version of the GND one can easily identify the preferred terms which can be used for the search in Phaidra. Because the GND has partly been translated to English also english keywords can be used to search for the respective german subject heading. In order to keep the number of results manageable, it is highly recommendable to limit your GND-search to “Geografikum als Schlagwort” (when searching for a place), “Person” or “Person als Schlagwort” (when searching for a person) or “Sachschlagwort” when searching for a factual matter of interest (e.g. wave mechanics; quantum physics).

To find suitable search terms, the thesaurus used for indexing during the second phase of work can be retrieved.



Collections and Browsing

All Schrödinger objects are grouped into virtual collections which also enables browsing.

Objects in Phaidra are grouped into virtual collections. In the case of Schrödinger they reflect the common provenance of objects. For example, all documents donated to the Central Library for Physics by Andreas Krafack in 2017 have been digitized and form a separate collection in Phaidra (as their physical counterparts do in the real world.)

It should, however, be noted that the order *within* a collection in Phaidra does not necessarily reflect the order *within* the respective physical collection.

The table below gives an overview of the pertinent collections in Phaidra with regard to Schrödinger.

Collection	# Items	Phaidra	Indexing using controlled terms / subject headings from GND-authority file
Personal Papers (Nachlass Schrödinger)	1100	o:143722	No
Documents relating to wave-mechanics	98	o:1539262	Yes
Krafack-Collection (documents from Schrödinger's youth and family history)	287	o:1417266	Yes
Schrödinger-Papers / Maria-Bertel-Collection	56	o:1417268	Yes
Schrödinger-Papers / Irgmard-Bertel-Collection	163	o:1539259	Yes
Schrödinger-Papers / Bianchi-Collection	59	o:1539260	Yes
Single items and Schrödinger papers from various collections	114	o:1422954	Yes

The collections listed in the table *mainly* contain material on Schrödinger's life and work. Other collections available on Phaidra that may only sporadically contain material related to Schrödinger are the Personal papers of Hans Thirring (partly digitized) and the Audio collection of the central library of physics (partly digitized). The latter contains many eyewitness interviews with Austrian scientists including some of Schrödinger's friends and colleagues.

Phaidra-Icon for collections

To get to the level of a specific collection, enter the collection name in the Phaidra search field. Collections are marked with a separate icon in the hit display. Each collection contains a brief summary, usually also in English. By clicking on "Browse this collection", one will see the objects belonging to the respective collection. Browsing is recommended to get a first overview of the available material of less extensive collections.

Like single objects, collections in Phaidra have a permanently stable electronic address that can be used for citation.

If you call up Phaidra and enter a search query, all collections will be searched. To limit your search to a single collection, first call up the collection in question (e.g. "Krafack Collection"); then enter the collection using the “Browse the collection”-button and then enter the search query.

One can restrict a search to a specific collection. For this first call up the collection in question and then enter the search query.

Frequently used abbreviations

Data generated during the first phase of work frequently includes abbreviations, especially within the physical description of the digitized items. During the second phase of work, the use of abbreviations was largely avoided, in order to increase readability for non-German-speaking users. The following is a list of the most common abbreviations to occur in the metadata-sets of the Schrödinger collections on Phaidra:

During the first phase of work, abbreviations were frequently used which you will find resolved and translated here.

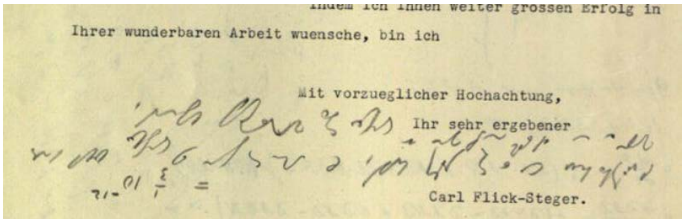
A.S.	Annemarie Schrödinger	Annemarie Schrödinger
allg.	allgemein	general/generally
Anm.	Anmerkung	note
Bd.	Band	volume
betr.	betreffend	concerning
Bl.	Blatt	sheet / leaf
bzw.	beziehungsweise	and ... respectively
cm	Zentimeter	centimeter; 1 inch = 2,54 cm
d.h.	das heißt	that is
Dr.	Doktor	doctor / PhD
E.S.	Erwin Schrödinger	Erwin Schrödinger
Entw.	Entwurf	draft
Ex.	Exemplar	copy
Exz.	Exzerpt	exzerpt
Fig.	Figur	figure
geb.	geboren	born
gedr.	gedruckt	printed
gem.	gemeinsam	jointly
Ges.	Gesellschaft	society
gest.	gestorben	died
H.	Heft	booklet, brochure, notebook
hrsg.	herausgegeben	edited (by)
Hrsg.	Herausgeber	editor
I. phys. Inst.	1. Physikalisches Institut	1st physics departement
Irl.	Irland	Ireland
Kop.	Kopie	copy
l.Bl.	lose Blätter	loose sheets
m.	mit	with
m.Kuv.	mit Kuvert	with envelope
mathemat.	mathematisch	mathematical
Nr.	Nummer	number
Ö	Österreich	Austria

o.D.	ohne Datum	no date
o.J.	ohne Jahr	no year
o.O.	ohne Ort	no place stated
or.	original	original
phys.	physikalisch	physical
Rev.	Review	review
S.	Seite	page
s/w	schwarz-weiß	black and white / monochrome
Sign.	Signatur	call number
sign.	signiert	signed
SS	Sommersemester	summer term
St.-Übertragung	Stenografie-Übertragung	transription from shorthand
Stenogr.	Stenografie	shorthand
stenogr.	stenografiert	written in shorthand
u.a.	unter anderem, und andere	amongst others
Univ.	Universität	university
usw.	und so weiter	et cetera
verh.	verheiratet/e	married
versch.	verschieden/e	various
vgl.	vergleiche	confer
vorm.	vormals	formerly
WS	Wintersemester	winter term

Documents written in Shorthand (Gabelsberger)

Part of the documents are written in Gabelsberger shorthand, a shorthand system no longer in use which is not identical with the later German standard shorthand (Deutsche Einheitskurzschrift). Manyt documents in question were transrcibed by Auguste Dick, a former employee of the Central Library for Physics. If a transcription is available, it is usually part of one and the same digital copy (preceding the original document or following it). If the transcription has to be searched for as an independent object in Phaidra, a respective note will be found in the metadatset of the document. Note that for several documents, however, no transcription is available at all.

Some of the documents were written in Gabelsberger shorthand, which is no longer in use today. In these cases, our digital copy often contains a transcription.



Two lines of handwritten notes by Schrödinger (Gabelsberger shorthand) on a letter from Carl Flick-Steger to Erwin Schrödinger, 1931-01-28. Österreichische Zentralbibliothek für Physik, Erwin-Schrödinger-Archiv, Signatur B33-390. DOI: 11353/10.260056 [Bottom left is a handwritten calculation.]

To read the Gabelsberg shorthand, knowledge of the German cursive is helpful but not sufficient. A recommended textbook on Gabelsberg shorthand in German language is

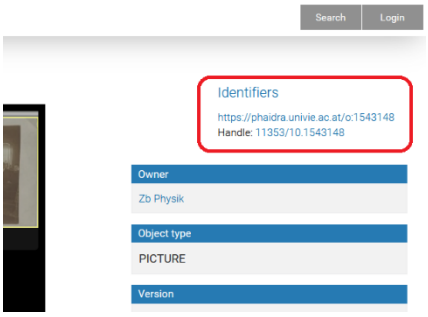
> Rosenberg, Heinrich: Lehr- und Lesebuch der kaufmännischen Stenographie (System Gabelsberger), für Handelsakademien, zweiklassige Handelsschulen und andere kommerzielle Lehranstalten, sowie zum Selbstunterrichte. Reichenberg 1900. (Fulltext on archive.org)

Date specifications

Note that the date given in the field “Datum” of the metadata record is the upload date, not the origin date of the respective document. However, the origin date was captured too if it was known and can be found as part of the document title or the document description field. The standardized date format is YYYY-MM-DD. If only the month is known, the form YYYY-MM is used. Dates added from the context are given in square brackets e.g. [1928-04-01] or [1918-02].

Mind the difference between upload date and origin date of the digitized item.

Citing the digitized objects



As all digitized items on Phaidra are provided with a stable link, they can be properly cited in any case of use.

In addition to the handle or DOI that can be found on the overview page of the respective object, we also recommend the following information from the metadata set to be included in the citation:[5]

For the citation of the digitized objects stable links (handle, DOI) are provided.

Author | Origin date (and, if applicable, the date of upload) | Location of the original document (i.e. Austrian Central Library for Physics / Erwin-Schrödinger-Archive, and, if applicable, call number[6])

If your intended use goes beyond the mere citation in a research or teaching-context, please contact us in advance.

[5] Further information on the citation of objects in Phaidra in German language can be found at https://datamanagement.univie.ac.at/fileadmin/user_upload/p_phaidraservice/Digitale_Objekte_zitieren.pdf

[6] When indicated in the metadata set; unfortunately during the first phase of work call numbers were not transferred to the respective Phaidra metadata sets. In these cases we recommend to use the stable link only.

Contact & Inquiries

If any questions occur, do not hesitate to get in touch with us.

Although a large part of the Schrödinger papers available at the Central Library for Physics has already been digitized, it may be worthwhile to send us an informal inquiry so that we can also research our non-digitized holdings for you. If further questions about the search for Schrödinger documents via Phaidra occur, we are also happy to help.

It is best so send us an email to sammlungphysik.ub@univie.ac.at

Further way of contact

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