Absolute charge radius of radioactive silver from muonic x-ray spectroscopy

A Data Management Plan created using DMPonline.be

Creator: Marie Deseyn

Affiliation: KU Leuven (KUL)

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Project abstract:

Muons are intriguing probes to study nuclear structure, as muonic atoms are more sensitive to finite size effects of the nucleus than regular atoms. By using muonic x-ray spectroscopy, the nuclear charge radius can be extracted much more precise than the state-of-the-art methods. Since the muX method has reduced the required target quantity to 5 µg, the spectroscopy is promising for long-lived radioactive nuclei.
An element for which nuclear radius determination is essential is silver (Ag), as the number of neutrons in the isotopic chain spans from 45 to 86. Indicating that both 50 and 82 are accessible magic neutron numbers. Ag is also an interesting isotope for the study of nucleosynthesis and odd decay properties.

Nuclear charge radii measurements are available from laser spectroscopy for exotic nuclei. But, the conversion from the laser spectroscopy results towards nuclear charge radii involves mass and field shift factors. The latter two are often extracted from large scale atomic calculations, which carry large systematic errors. To reduce these systematic errors, the King plot method can be used, where 3 experimental absolute charge radii are needed (for example extracted from muonic atoms). That way, the mass and field shift factors are obtained and existing Ag laser spectroscopy results can be reviewed. Hence, nuclear structure models can be refined to better understand the nature of nuclei. It requires investigation of 108mAg, which has only recently become possible.

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Application DMP

Questionnaire

Describe the datatypes (surveys, sequences, manuscripts, objects …) the research will collect and/or generate and /or (re)use. (use up to 700 characters)

First, the primary datatypes will be discussed: the first datatype is the 108mAg samples, the second type consists of the measurement data in the form of event-by-event ASCII or binary files with an approximate size of up to 5Tb per experiment. The latter is rather large, due to the fact that germanium detectors have a limited timing resolution, which is improved by storing part of the waveform and determine the event time in the post analysis. Moreover, online logbooks will be present as primary datatypes.
Secondary data: formatted data files with energy and time information in ROOT format (few GB), figures and data tables from the output of the data analysis.

Specify in which way the following provisions are in place in order to preserve the data during and at least 5 years after the end of the research? Motivate your answer. (use up to 700 characters)

For the 108mAg samples, a lead safe is present for storage at KU Leuven. For measurements at CERN, the metadata for the production conditions are stored in TIMBER, the online logbooks are also kept on independent servers. The raw PSI data are backed up in PSI in DORA-PSI. Moreover, the raw, secondary and tertiary data are stored on the KU Leuven cluster, featuring a multi-location back up and guaranteed curation over 5 years beyond the end of the project.

What’s the reason why you wish to deviate from the principle of preservation of data and of the minimum preservation term of 5 years? (max. 700 characters)

NA

Are there issues concerning research data indicated in the ethics questionnaire of this application form? Which specific security measures do those data require? (use up to 700 characters)

NA

Which other issues related to the data management are relevant to mention? (use up to 700 characters)

NA

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FWO DMP (Flemish Standard DMP)

1. Research Data Summary

List and describe all datasets or research materials that you plan to generate/collect or reuse during your research project. For each dataset or data type (observational, experimental etc.), provide a short name & description (sufficient for yourself to know what data it is about), indicate whether the data are newly generated/collected or reused, digital or physical, also indicate the type of the data (the kind of content), its technical format (file extension), and an estimate of the upper limit of the volume of the data.

				Only for digital data	Only for digital data	Only for digital data	Only for physical data
Dataset Name	Description	New or reused	Digital or Physical	Digital Data Type	Digital Data format	Digital data volume (MB/GB/TB)	Physical volume
		Please choose from the following options: • Generate new data • Reuse existing data	*Please choose from the following options:* • Digital • Physical	*Please choose from the following options:* • Observational • Experimental • Compiled/aggregated data • Simulation data • Software • Other • NA	*Please choose from the following options:* • .por, .xml, .tab, .csv,.pdf, .txt, .rtf, .dwg, .gml, … • NA	*Please choose from the following options:* • <100MB • <1GB • <100GB • <1TB • <5TB • <10TB • <50TB • >50TB • NA	
Stable 107Ag	the stable 107 silver target to do muX on	New target that was bought in september 2023	Physical				600mg
Stable 109Ag	the stable 109 silver target to do muX on	New target that was bought in september 2023	Physical				500mg
test 110mAg target	the radioactive target produced by neutron irradiation of natural silver	Target produced in October 2023	Physical				~65kBq
test 110mAg separated	the radioactive target after separation performed at ISOLDE	Target to be produced at ISOLDE in November 2023	Physical				~400Bq spread over 4 glassy carbon foils
108mAg target	target to be produced at MARIA or BR2	New	Physical				not yet known
108mAg target separated	the radioactive target after separation performed at ISOLDE	New	Physical				not yet known
Stable silver muonic x-ray data - primary	data obtained after RefRad campaign of 2023b	New	Digital	Experimental	.mid.gz	<10TB	

Stable silver muonic x-ray data - secondary	data obtained after RefRad campaign of 2023b after analyzer	New	Digital	Experimental	.root		
Stable silver muonic x-ray data - tertiary	data obtained after RefRad campaign of 2023b in sorted trees	New	Digital	Experimental	.root		
silver muonic x-ray data - primary	data obtained after RefRad campaign of 2024/25	New	Digital	Experimental	.mid.gz	<10TB	
silver muonic x-ray data - secondary	data obtained after RefRad campaign of 2024/25 after analyzer	New	Digital	Experimental	.root		
silver muonic x-ray data - tertiary	data obtained after RefRad campaign of 2024/25in sorted trees	New	Digital	Experimental	.root		
self sputtering Ag	results of the self-sputtering simulations for Ag on Al/carbon	New	Digital	Simulated	.txt	<1GB	

If you reuse existing data, please specify the source, preferably by using a persistent identifier (e.g. DOI, Handle, URL etc.) per dataset or data type:

NA

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? Describe these issues in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Will you process personal data? If so, briefly describe the kind of personal data you will use in the comment section. Please refer to specific datasets or data types when appropriate.

- No

Does your work have potential for commercial valorization (e.g. tech transfer, for example spin-offs, commercial exploitation, …)? If so, please comment per dataset or data type where appropriate.

- No

Do existing 3rd party agreements restrict exploitation or dissemination of the data you (re)use (e.g. Material/Data transfer agreements/ research collaboration agreements)? If so, please explain in the comment section to what data they relate and what restrictions are in place.

- No

Are there any other legal issues, such as intellectual property rights and ownership, to be managed related to the data you (re)use? If so, please explain in the comment section to what data they relate and which restrictions will be asserted.

- No

2. Documentation and Metadata

Clearly describe what approach will be followed to capture the accompanying information necessary to keep data understandable and usable, for yourself and others, now and in the future (e.g., in terms of documentation levels and types required, procedures used, Electronic Lab Notebooks, README.txt files, Codebook.tsv etc. where this information is recorded).

At PSI as well as at CERN ISOLDE, a digital logbook is kept for the preparation of the experiment and the experiment itself, to note down important information that may be needed during the offline analysis. This will include information regarding
the setup (type and unique code of detectors used, other electronics used ...), the parameters used (voltages, filters, ...), and details for every collection (time of start/stop, isotope, beam current, proton current, foil used, ...). Every person involved in the experiment will have access to it through personal credentials.

Moreover, for the Reference Raddi experiments, the experimental conditions are saved for each run in an equipment.json file. Additionally, an analysis logbook will be created to keep track of the progress and of the procedures used during the offline analysis. Only people involved in the analysis will have access to this.

At CERN, TIMBER is used to store all parameters related to the experimental setup (eg. magnetic fields).

For the target production of the stable Ag, the specifications are kept in a .pdf file. Moreover an overview sheet will be made including all targets owned by the ReferenceRadii and their current location.

For the 110mAg test target, the production information at PSI will be documented.

For the 108mAg target, the production procedure at MARIA or BR2 will be documented.

Will a metadata standard be used to make it easier to find and reuse the data? If so, please specify (where appropriate per dataset or data type) which metadata standard will be used. If not, please specify (where appropriate per dataset or data type) which metadata will be created to make the data easier to find and reuse.

- No

3. Data storage & back-up during the research project

Where will the data be stored?

The PSI data is stored on the PSI DAQ PC, as well as backed up via DORA-PSI. Moreover, the raw, secondary and tertiary data are stored on the KU Leuven cluster that is
accessible to every member of the research group (in read-only mode).

The ISOLDE data is stored on the DFS (data file server).

Everything produced in the offline analysis will be kept on this same KU Leuven cluster.

How will the data be backed up?

The KU Leuven cluster features a multi-location back up, so all raw data and metadata will be stored and backed up automatically every week

on the cluster. Moreover, at PSI the data is backed up on DORA-PSI. Additionally, CERN's central servers are backed up automatically weekly.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely.
If no or insufficient storage or backup capacities are available, then explain how this will be taken care of.

- Yes

How will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

The access to the KU Leuven cluster repository of the research group is limited and the original data is in read-only mode, so that nobody can, even unintentionally, modify the raw data.

What are the expected costs for data storage and backup during the research project? How will these costs be covered?

The costs are covered by other activities

4. Data preservation after the end of the research project

Which data will be retained for at least five years (or longer, in agreement with other retention policies that are applicable) after the end of the project? In case some data cannot be preserved, clearly state the reasons for this (e.g. legal or contractual restrictions, storage/budget issues, institutional policies...).

The raw output data of the ReferenceRadii experiments as well as the output trees. The stable silver targets will be kept.
The results from the self-sputtering simulations will be kept as txt files as well as the input files used to generate these results.
However, 108mAg and 110mAg are radioactive and can therefore not be kept in a stable status (110mAg after 5 years: 100kBq -> 0.6366kBq; 108mAg after 5 years: 1MBq -> 0.9919MBq). Hence, the information regarding the production procedure will be kept as the sources themselves cannot be kept in spite of the best practices.
In that sense, the 110mAg separated source will be left at CERN so that other experiments can benefit from its ideal calibration properties.

Where will these data be archived (stored and curated for the long-term)?

The data will be stored on the IKS servers (with automatic back-up procedures) for at least 10 years, conform the KU Leuven RDM policy.

What are the expected costs for data preservation during the expected retention period? How will these costs be covered?

The costs are covered by other activities

5. Data sharing and reuse

Will the data (or part of the data) be made available for reuse after/during the project? In the comment section please explain per dataset or data type which data will be made available.

- Other, please specify:

Data will be made available on demand upon request to myself, my supervisor, or the head of the international collaboration. The complex

form of the data requires any user to be trained on its use, which is why the access is restricted to individual contacts only.

If access is restricted, please specify who will be able to access the data and under what conditions.

Everyone involved in the experiment and in the offline analysis as well as anyone starting working in the research group after the end of the project will have access to the data.

Are there any factors that restrict or prevent the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)? Please explain in the comment section per dataset or data type where appropriate.

- No

Where will the data be made available? If already known, please provide a repository per dataset or data type.

In the KU Leuven cluster in the dedicated folder for our research group.

When will the data be made available?

Data will be made available on demand upon request to myself, my supervisor, or the head of the international collaboration. The complex form of the data requires any user to be trained on its use, which is why the access is restricted to individual contacts only.

Which data usage licenses are you going to provide? If none, please explain why.

None, the data will only be shared with a limited number of people due to its complex nature.

Do you intend to add a PID/DOI/accession number to your dataset(s)? If already available, you have the option to provide it in the comment section.

- No

What are the expected costs for data sharing? How will these costs be covered?

There are no costs foreseen for the data sharing.

6. Responsibilities

Who will manage data documentation and metadata during the research project?

Marie Deseyn

Who will manage data storage and backup during the research project?

at PSI: Andreas Knecht; at IKS: N&S ICT team;

Who will manage data preservation and sharing?

Marie Deseyn

Who will update and implement this DMP?

Marie Deseyn

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GDPR

GDPR

Have you registered personal data processing activities for this project?

- Not applicable

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DPIA

DPIA

Have you performed a DPIA for the personal data processing activities for this project?

- Not applicable