STRABOEXPERIMENTAL

USER GUIDE

September 3, 2025

Contents

1 Introduction **2**
- 1.1 What is StraboSpot . . . 2
- 1.2 How StraboSpot is Organized . . . 2
- 1.3 About This Manual . . . 3
- 1.4 StraboExperimental Introduction . . . 3
- 1.5 The StraboExperimental Philosophy . . . 4
- 1.6 A Metadata Standard for Experimental Data . . . 4

2 The StraboExperimental Prototype **4**
- 2.1 Description of Data . . . 5
- 2.2 StraboExperimental and LAPS Interoperability . . . 5

3 The Landing Page **5**
- 3.1 Start a New Project . . . 6
- 3.2 Continue Project . . . 7
- 3.3 Search Database . . . 7
- 3.4 Apparatus Repository . . . 8
  - 3.4.1 Facility . . . 8
  - 3.4.2 Apparatus . . . 9

4 Add Experiment **9**
- 4.1 Digital Data Acquisition (DAQ) . . . 10
- 4.2 Sample Information . . . 10
- 4.3 Experimental Setup and Protocol . . . 11
- 4.4 Experimental Data . . . 14
  - 4.4.1 Structured Data Types . . . 14
  - 4.4.2 Data Header Nomenclature . . . 14

5 JSON Import and Export **15**

1 Introduction

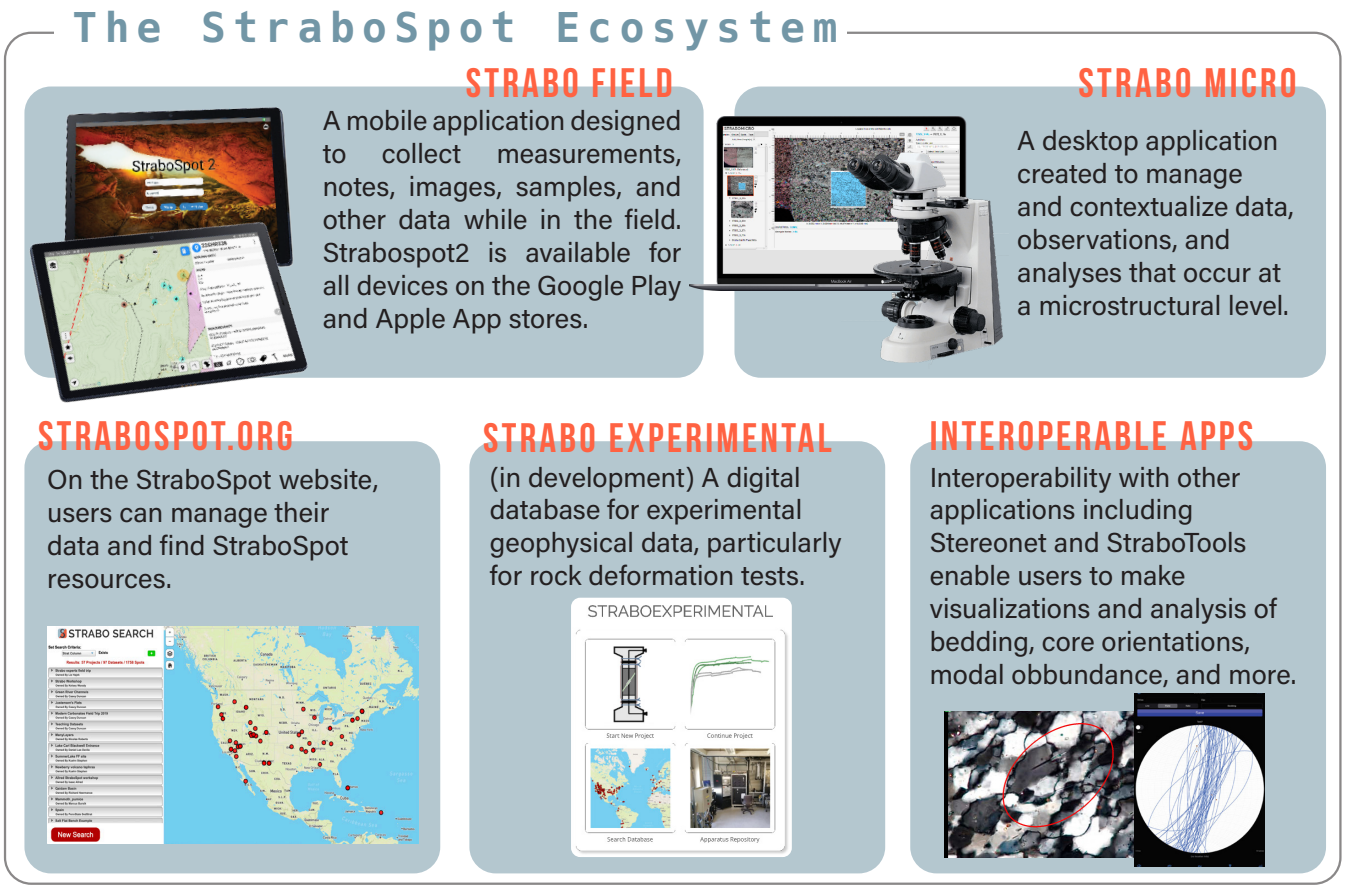
1.1 What is StraboSpot

The StraboSpot ecosystem is a network of interconnected applications and software designed to facilitate the collection, management, integration, and sharing of field and laboratory data in the Geologic Sciences. The goal of StraboSpot is to make these data consistent with FAIR (Findable, Accessible, Interoperable, and Reusable) principles and to integrate multidisciplinary field and laboratory geologic data types into one shared data system. Through community input and development, StraboSpot now incorporates structural geology, petrology, sedimentology, and tephra volcanology workflows. The use of controlled vocabularies developed by these communities promotes the standardization of data collection and increases the findability of data.

StraboSpot not only provides a shared data repository, but also the tools to collect and manage data and images. The data system uses the concept of spots, observations that apply over a specified spatial dimension, to nests observations from the regional to microscopic scale and to group data and images as chosen by the user (see below). This approach allows users to connect geologically complex relationships throughout their workflow.

1.2 How StraboSpot is Organized

A Spot is the basic element of data collection. It is an observation, relation, analysis, age, or anything that the geologist determines. Spots are fully hierarchical in that a Spots can contain Spots that contain Spots....



Datasets are the next organizational unit. Datasets contain Spots, and for most workers, will correspond to a map area, restricted location, outcrop, or thin section.

A Project in Strabo contains Datasets and Spots. A Project holds Datasets and is made up of a single, or multiple Datasets. The Project contains all the Datasets, vocabulary and custom features associated with the Datasets.

The User Account is the largest element. It allows the User to manage all Projects and Datasets. This management is somewhat limited on the Mobile app, but is fully supported on the Online version (strabospot.org).

1.3 About This Manual

This manual describes the basic functionality and features of StraboExperimental. It is based on the prototype version as published and initially presented at AGU 2023. The manual will be continuously updated to accommodate future changes in the site repository. LAPS StraboExperimental is a project partly funded by NSF (Award 1948453) and is supported by the Experimental Geophysics Community.

1.4 StraboExperimental Introduction

StraboExperimental Overview

StraboExperimental is a digital database designed to manage and archive experimental geophysical data, with a particular focus on rock deformation experiments. In its envisioned final form, StraboExperimental will serve as a critical component of the broader Strabo System, enabling seamless integration across experimental, microstructural, and field data.

Projects entered through StraboExperimental can be linked to datasets within the larger Strabo ecosystem, including microstructural imagery from the *StraboMicro* application and geologic field data collected using *StraboMobile*. The platform is built to offer experimentalists a comprehensive, intuitive, and extensible environment for managing, storing, and sharing experimental results.

Key Features and Benefits

- **Open-source, publicly funded, and free to use**
- **Comprehensive metadata capture**, including apparatus configuration, operating procedures, sensor details, sample properties, and more
- **Public apparatus repository** to encourage reproducibility and collaboration
- **Granular access control**, allowing users to manage visibility and permissions for datasets
- **Advanced search and presentation tools** to explore and visualize data effectively
- **Full metadata import/export** in standardized JSON format
- **Reusable templates** for efficient and consistent data entry
- **Public REST API** for automated access and integration with external tools

1.5 The StraboExperimental Philosophy

The primary objective of this project is to establish a practical and flexible standard for documenting experimental geophysical data. This includes implementing the standard within an accessible online digital repository and developing tools that enable researchers to apply these standards efficiently in laboratory settings.

While experimental datasets can vary greatly in complexity and volume, StraboExperimental is designed to support a wide range of use cases—from highly detailed, multi-parameter experiments to simple, single-variable tests—making it a valuable tool for researchers across disciplines and levels of expertise.

1.6 A Metadata Standard for Experimental Data

Experimental data is rarely self-explanatory. As both experiments and modeling techniques become increasingly intricate, the role of contextual information—metadata—becomes critical for interpreting results accurately.

A well-defined and comprehensive set of metadata serves multiple purposes. It can be used to assess the quality and reliability of an experiment or to determine its relevance to a theoretical framework. Metadata can help explain unexpected outcomes and is essential for enabling others to find, reproduce, and build upon prior work. Public access to both data and metadata allows for direct comparison across laboratories, thereby improving reproducibility and data quality. It also fosters transparency, facilitates downstream data processing, and supports long-term data preservation.

Despite its importance, experimental geophysics currently lacks a standardized approach for storing data and metadata. Most laboratories rely on proprietary workflows and internal conventions for data collection and storage. When publishing results, researchers are typically responsible for uploading their data and metadata—often in ad hoc digital formats—to public repositories. Without a consistent structure, this process is frequently inefficient, error-prone, and time-consuming.

Establishing a community-driven metadata standard is therefore essential to streamline data management, promote interoperability, and enhance the scientific value of experimental geophysical research.

2 The StraboExperimental Prototype

In recent years, the Strabo Team has synthesized key components from a variety of experimental workflows and parameters to develop a structured schema for data entry and storage. Particular emphasis was placed on ease of use and compatibility with existing public repositories, drawing on the experiences and needs of the experimental geophysics community.

The underlying schema of the StraboExperimental database reflects a typical workflow for a single experimental test. It follows a logical sequence—from equipment selection and sample preparation to experimental procedures and data collection—ensuring that all relevant parameters are documented and stored in a consistent and organized manner. While only a minimal set of metadata fields is required, users are encouraged to include additional contextual information as needed.

A central goal of the prototype is to reduce data fragmentation within projects. Although entering metadata for each experiment may initially seem repetitive, storing data and metadata together is essential for long-term usability, data discoverability, and compatibility with emerging tools such as machine learning models. Importantly, the storage overhead for complete metadata is negligible (typically less than 1 MB) compared to most experimental datasets (e.g., images or data files).

To streamline data entry, the web application offers reusable templates and the ability to import/export metadata from prior datasets. This functionality is especially beneficial for projects involving a series of experiments conducted under similar conditions. Metadata can be exported and imported as human-readable JSON files, allowing integration with existing lab workflows and enabling template sharing across research groups and institutions.

2.1 Description of Data

The data structure used in StraboExperimental and LAPS defines a standardized set of metadata required to document geophysical rock deformation experiments. All data are organized within **projects**, each identified by a name and description. A project may contain one or more **experiments**, with each experiment encompassing all necessary information for others to interpret the results, including equipment, setup, and procedures.

Each experiment is structured into thematic sections (schemata):

1. Facility and Experimental Apparatus
2. Digital Data Acquisition (DAQ)
3. Sample Information
4. Experimental Setup
5. Data

2.2 StraboExperimental and LAPS Interoperability

Recognizing the need to manage and store data locally, LAPS tools allow for offline data preparation. It presents a simple and exemplary workflow that may be employed to guarantee that data and metadata can later be seamlessly published to StraboExperimental. LAPS makes use of the JupyterLab environment and Python.

3 The Landing Page

StraboExperimental is accessible at `https://strabospot.org/experimental/`. To use the platform, users must create an account by providing their name, address, and institutional affiliation. Please contact the Strabo site administrator for access or account support.

Upon logging in, users are directed to the main **Projects Landing Page**, which includes the following sections:

- **Start a New Project**
- **Continue Project**

- **Search Database**
- **Apparatus Repository**

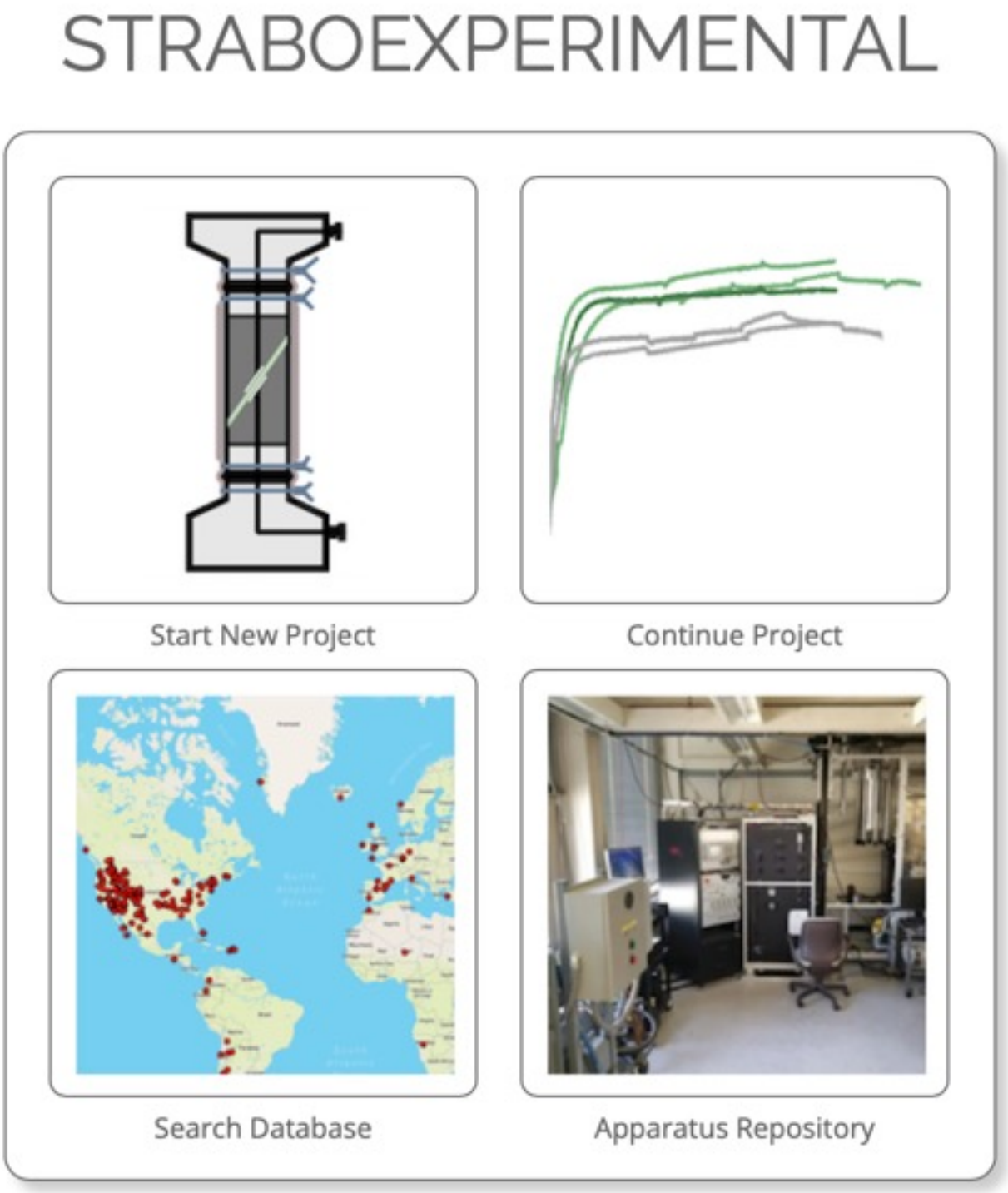


Figure 1: StraboExperimental Landing Page

3.1 Start a New Project

Creating a new experimental project is the first step in the StraboExperimental workflow. Projects serve as containers for individual experiments. A new project can be initiated from the landing page or via the Project Management interface.

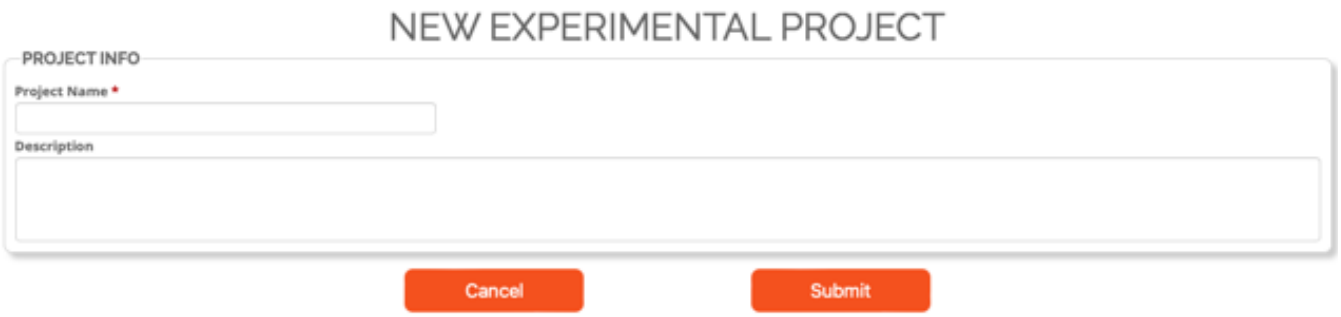


Figure 2: Creating a New Experimental Project

The only required field is the **project name**. Once saved, the project will appear in the user's project list. Users can create and manage multiple projects.

3.2 Continue Project

This section lists all existing projects and their associated experiments, accessible only to the registered user unless explicitly made public. Each project entry includes the Experiment ID, Apparatus Type, and recorded metadata sections. New projects can also be added directly from this page.

Available options per project include:

- **New Experiment** – Add a new experiment with full metadata
- **Delete** – Permanently delete the project and all associated experiments
- **JSON** – View or download the full project metadata as a JSON file
- **Plot Data** – Filter and visualize time series data
- **Public** – Toggle project visibility (private/public)

Once an experiment is created, users can **view**, **edit**, **delete**, or **download** its metadata. Note: currently, only metadata is downloadable; associated files are referenced by their server ID. Full data download functionality will be added in a future release.

3.3 Search Database

The **Search Database** button redirects to `https://strabospot.org/fullsearch/`, which allows users to search all public projects across StraboSpot, including field, microstructural, and experimental datasets.

The search supports keyword-based queries and allows multiple terms to refine results. Users can view search results in list or map view (for georeferenced field projects) and sort by creation date, last update, number of spots, or number of images. Filters are available by project type (field, micro, experimental).

For experimental datasets, clicking **View** opens the project viewer, where users can explore metadata, uploaded files, and associated images.

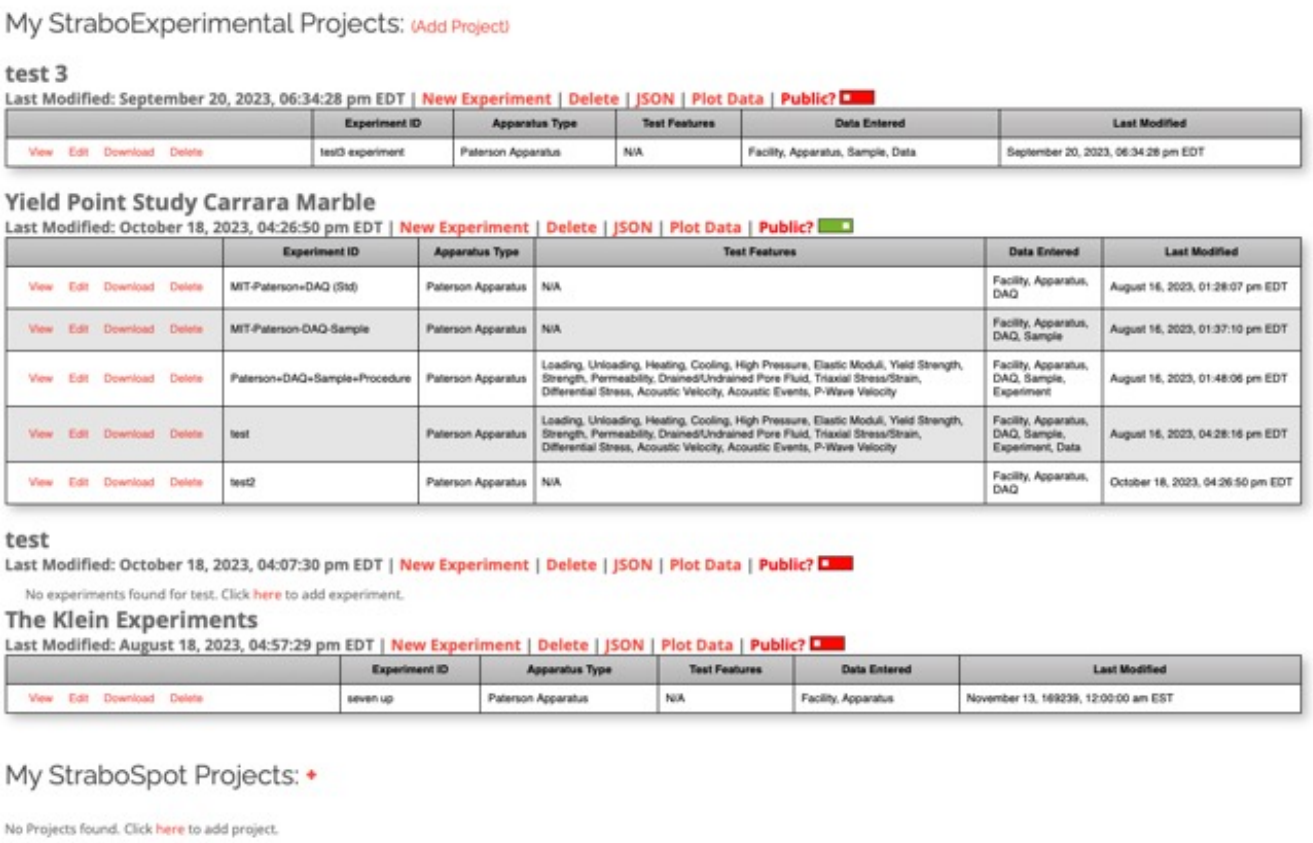


Figure 3: Project Management Interface

3.4 Apparatus Repository

The **Apparatus Repository** provides a publicly accessible directory of experimental equipment used in rock physics. Maintained collaboratively by facility and laboratory managers, this repository allows registered lab managers to add and update their own equipment listings.

The repository benefits both equipment providers and external researchers seeking laboratory access. It also supports broader community engagement and may guide equipment design through access to technical specifications and documentation.

Apparatus listings are grouped by facility and display the name and type of each device. While lab managers can add, edit, or delete equipment entries, general users may only browse the directory. Search functionality based on apparatus specifications will be introduced in a future update.

3.4.1 Facility

To begin contributing, lab managers must first create a facility entry, providing the facility name (e.g., laboratory or research group), facility type, and institutional affiliation. Additional fields (e.g., contact name, email) are optional but recommended. Multiple facilities under one institution are supported.

3.4.2 Apparatus

Each facility can list one or more apparatuses. Descriptions should be clear, concise, and free of proprietary details. To add new equipment, click **Add Apparatus** within the facility page.

Required fields include:

- **Name*** – Equipment name
- **Type*** – Category or classification of the apparatus

Optional fields allow users to specify equipment capabilities and modifications. The **Parameters** section includes technical limits (e.g., pressure, temperature, stress, dimensions), helping users locate equipment suited for specific experimental conditions.

Supporting documents—such as manuals, schematics, and photos—may be uploaded. If available in the public domain, design drawings are also welcome.

4 Add Experiment

The second step in the StraboExperimental Workflow is to add an experiment to a project. This page provides access to all core functionality and metadata for a specific experiment. Users can enter data through multiple methods:

Figure 4: Add Experiment Interface

Data Import Options

Load All Data from Previous Experiment: This is the fastest way to replicate a dataset. Selecting this option opens a list of all projects and experiments in the user's database. The selected experiment's data and metadata will be duplicated under the current project. *Note:* Data files will retain references to their original paths. Update these references as needed.

Load All Data from JSON File: To provide greater flexibility, users may import metadata from a local JSON file. If editing the file, ensure compliance with the schema structure. You may download an existing dataset to use as a template. Only metadata is uploaded—no data files. Existing references to server files will only work if proper access permissions exist.

Metadata Sections:

- Facility Information
- Apparatus Information
- Digital Data Acquisition (DAQ)
- Sample Information
- Experimental Setup and Procedure
- Data

Each section can be populated individually using data from a previous experiment or via JSON import. Facility and Apparatus Information can also be imported from the public Apparatus Repository. Any changes made here will not alter repository records.

4.1 Digital Data Acquisition (DAQ)

DAQ details are optional and mainly intended for laboratory managers or advanced users. While DAQ is typically tied to the apparatus, external devices or unique configurations may vary by experiment.

A **DAQ Group** describes a complete measurement system, including all sensors and actuators. A group name and DAQ type are required.

Each DAQ group includes one or more **DAQ Devices**. Devices contain:

- Sensors/Actuators (Channels)
- Channel Headers and Specifiers (Units, location, etc.)
- Electrical and signal processing settings (range, gain, filters)
- Calibration templates (input/output data, date)

The header list is under development and subject to change. Users can attach documents describing DAQ configurations in detail.

4.2 Sample Information

All sample properties are entered in the Sample Form. A unique combination of **Sample Name***, **IGSN**, **ID***, and **Description** is required. Parent sample IDs may also be added to document sample lineage.

Material Section: Covers all physical sample properties except geometry and preparation, which are recorded in the Experimental Setup. Material types (e.g., rock types, minerals) are listed for convenience. Future versions aim to integrate standard geological databases.

Mineralogy: Allows entry of phase composition, grain size, and fractional abundance.

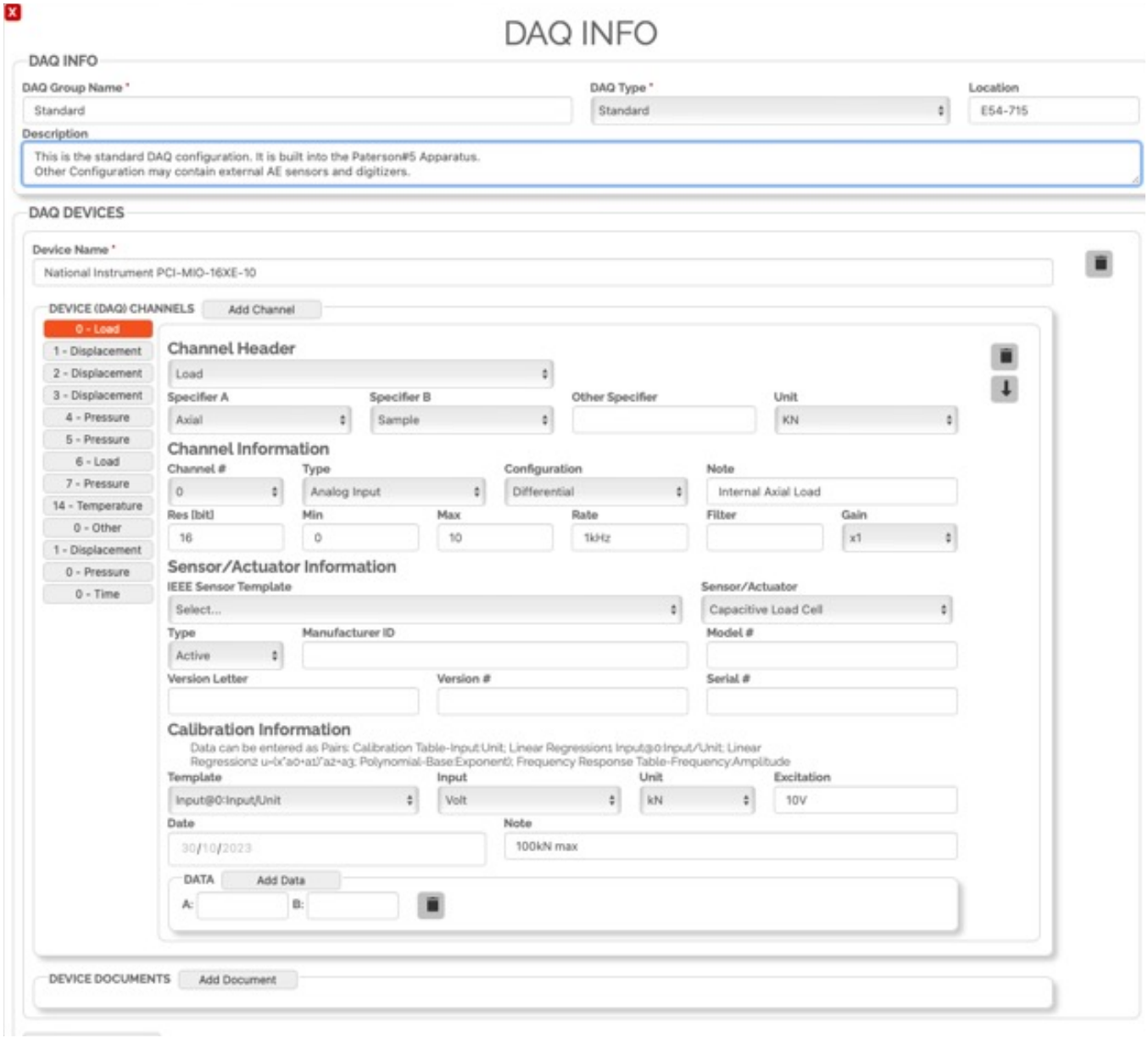


Figure 5: DAQ Group Interface

Provenance: Documents sample origin, including formation and stratigraphic details.

Texture: Describes features such as bedding, foliation, and faults. Supporting documents (e.g., images) are encouraged.

Sample Parameters: Includes weight, porosity, permeability, density, and other conditions (e.g., fluid saturation, prestress). Geometry is documented in the Experimental Setup.

4.3 Experimental Setup and Protocol

Users enter the experiment's title, ID, description, and start/end dates here. The associated project name is automatically retrieved via the API.

Test Features: Specify procedures performed during the test. These differ from Apparatus features and must be explicitly selected.

Author: Enter the name and email address of the responsible experimentalist.

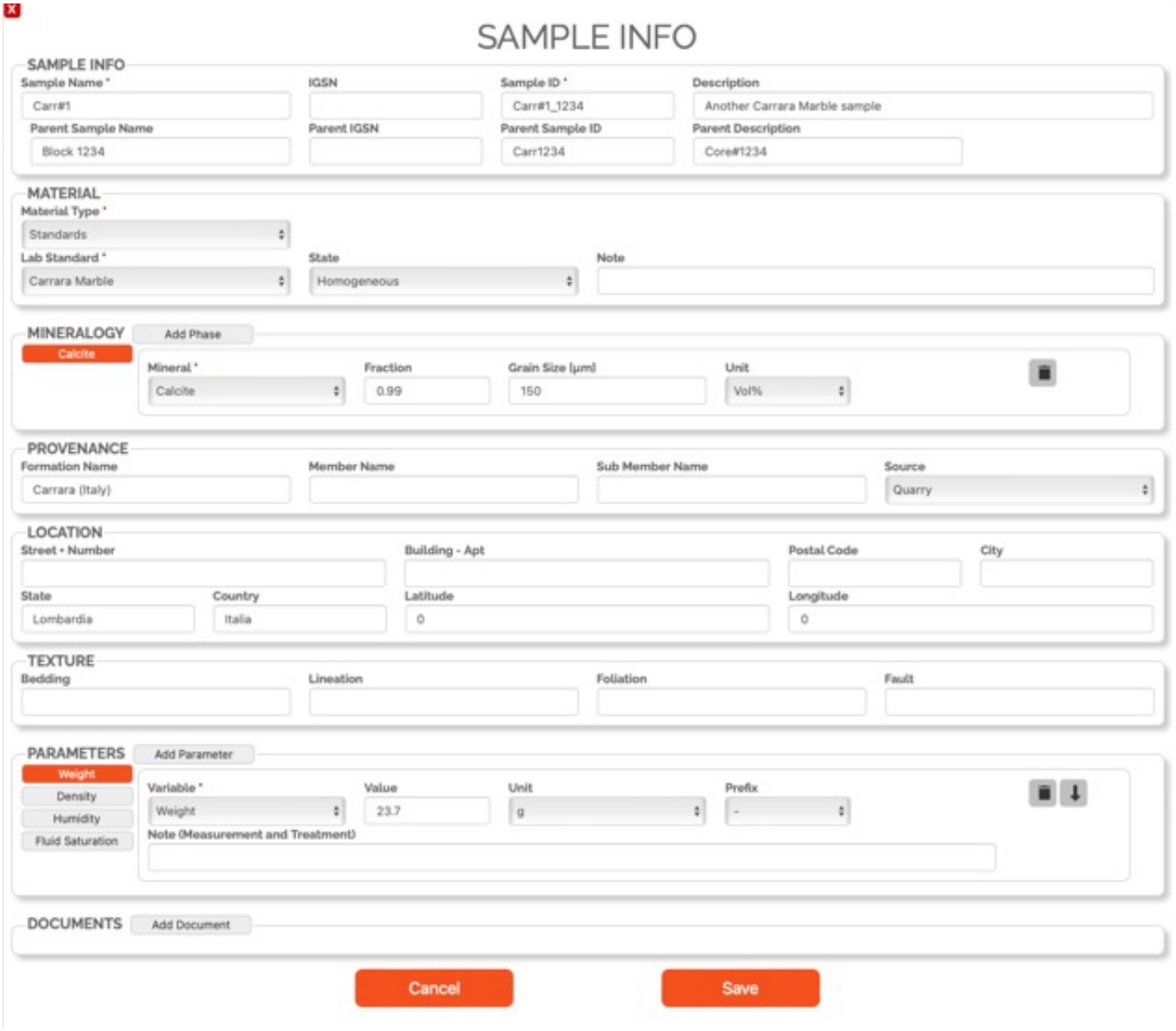


Figure 6: Sample Information Interface

Geometry: Define the physical arrangement of the sample and supporting components (jackets, spacers, blocks). Most common rock testing geometries (e.g., cylindrical, dog bone) are supported.

Protocol: A step-by-step sequence defining the test. Steps correspond to selected test features and include:

- Objective
- Description
- Parameters (e.g., Pressure, Temperature, Load)

Steps can be reordered to reflect the actual test sequence.

Documents: Upload any files supporting the setup or test objectives.

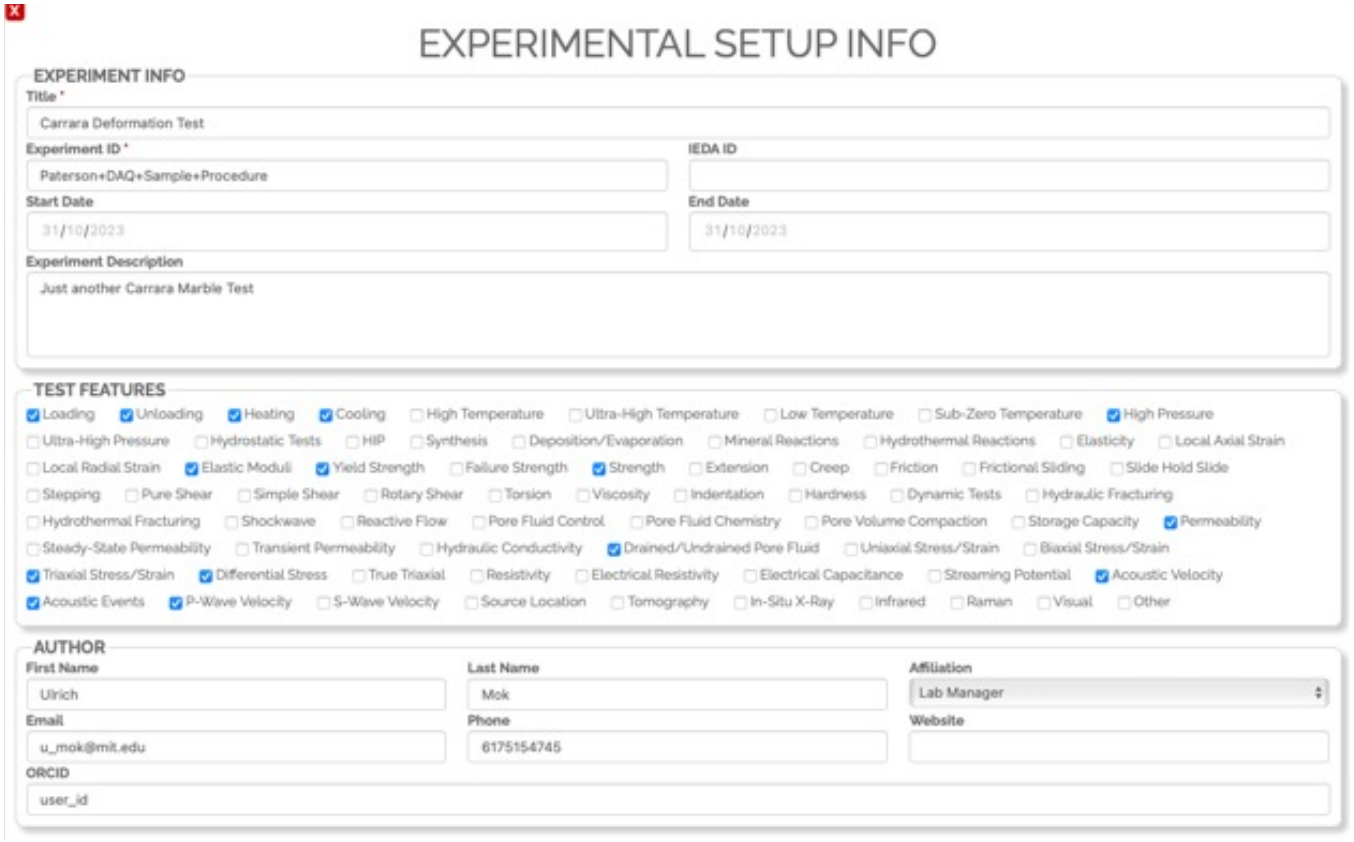


Figure 7: Experimental Setup Information

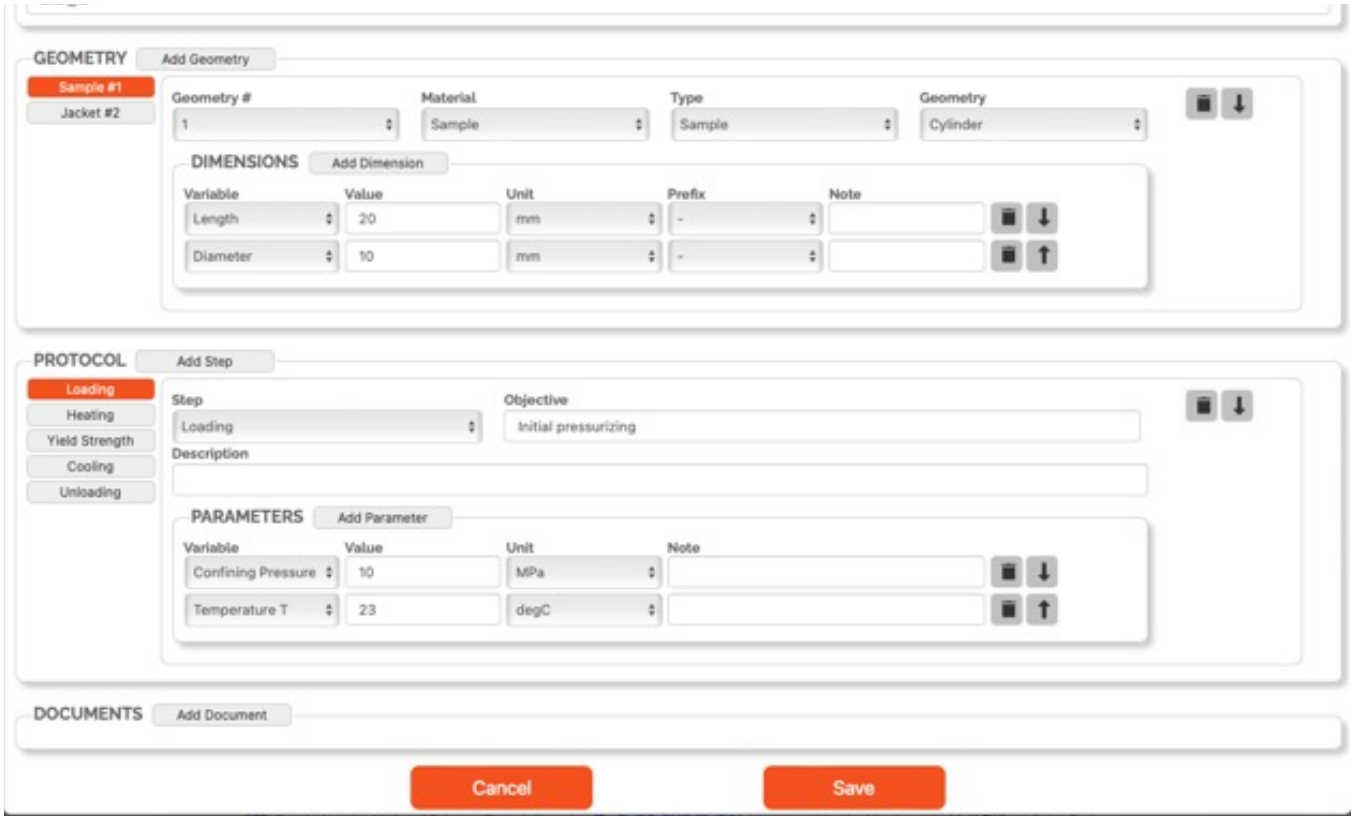


Figure 8: Sample and Assembly Geometry

4.4 Experimental Data

This section is for uploading all relevant experimental results, including pre- and post-test images, data files, and supporting documentation. Data is organized into **datasets**, each defined by:

- Data Type
- ID
- File Format
- Description
- Estimated Data Quality

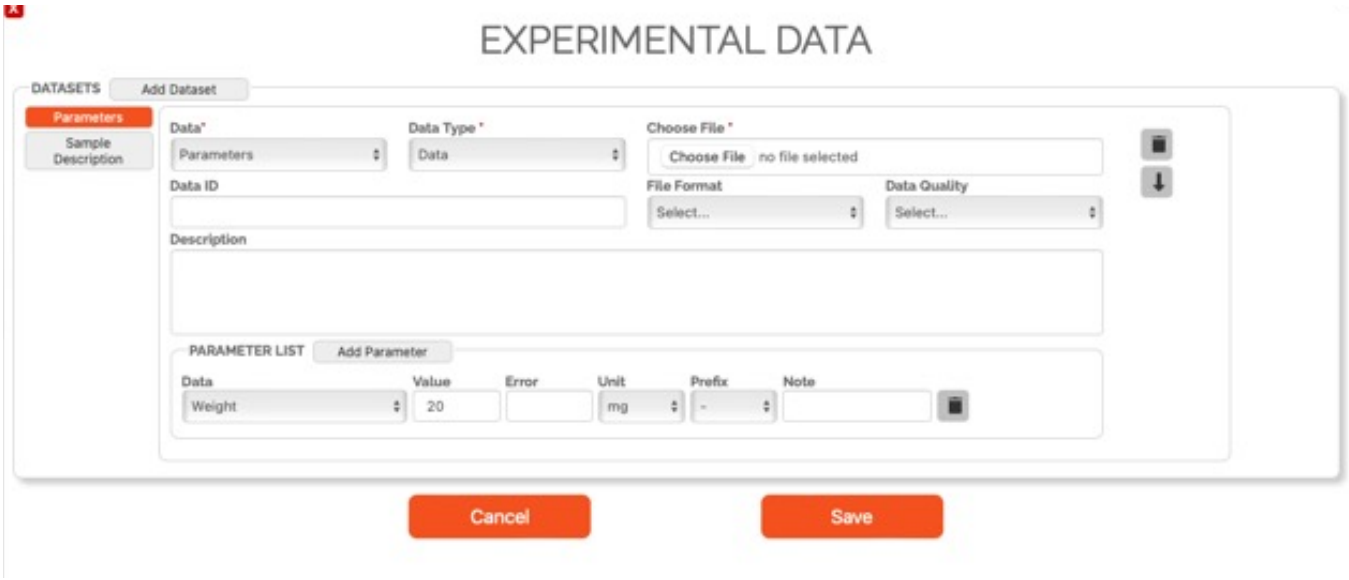


Figure 9: Experimental Data Upload Interface

4.4.1 Structured Data Types

Parameters: Manual entry of discrete measurements (e.g., sample length, permeability).

Pore Fluid: Define fluid phases with fractional composition and chemistry (ions, activity).

Time Series: Supports time-dependent measurements (e.g., pressure, strain, temperature). Files must be tabular text with column headers that match predefined formats.

4.4.2 Data Header Nomenclature

Each data column includes:

- **Main Header:** Type of measurement (e.g., Time, Pressure)
- **Specifier A:** Context (e.g., Sample, Room, Furnace)
- **Specifier B:** Location details (e.g., Top, Average)
- **Additional Descriptor:** Optional, for custom notes

Units follow SI conventions. Custom headers not listed can be added with descriptors.

5 JSON Import and Export

StraboExperimental provides optional capabilities for importing and exporting experiment metadata using human-readable JSON files. These files follow the same schema used by the API, ensuring compatibility while offering a convenient format for users to view, edit, and reuse experimental data.

Overview

The JSON export includes all metadata entered through the web interface, organized hierarchically according to the predefined schema. Only valid JSON files that conform to this schema may be used for re-import. Users may modify these files using a text editor, provided the schema structure is preserved. Offline editing tools, including schema validation, will be available through LAPS in future versions.

Usage Options

Option 1: Download from the Project Page

Navigate to your **Project Page**, select an existing experiment, and click `Download`. This will export the experiment in JSON format. You can download experiments at any stage of the workflow and use the resulting file as a:

- Backup of the experiment
- Template for future experiments

Templates can include Apparatus, DAQ, Sample, and Test information. For repeated experiments, uploading a saved template and updating specific values (e.g., sample name, sensor calibration) greatly accelerates data entry.

Option 2: Download JSON from Experiment View

In the **Project Page**, click `View` on a selected experiment. A `Download Project JSON` button is available at the top-right corner of the page. This allows users to either download the full JSON or copy it to the clipboard for use elsewhere.

Best Practices

- Always validate your edited JSON files before upload.
- Use JSON templates to ensure consistency across similar experiments.
- Update references to data files or IDs when copying templates.

The JSON Import/Export functionality is a powerful tool for improving workflow efficiency, ensuring reproducibility, and enabling collaboration across research teams.

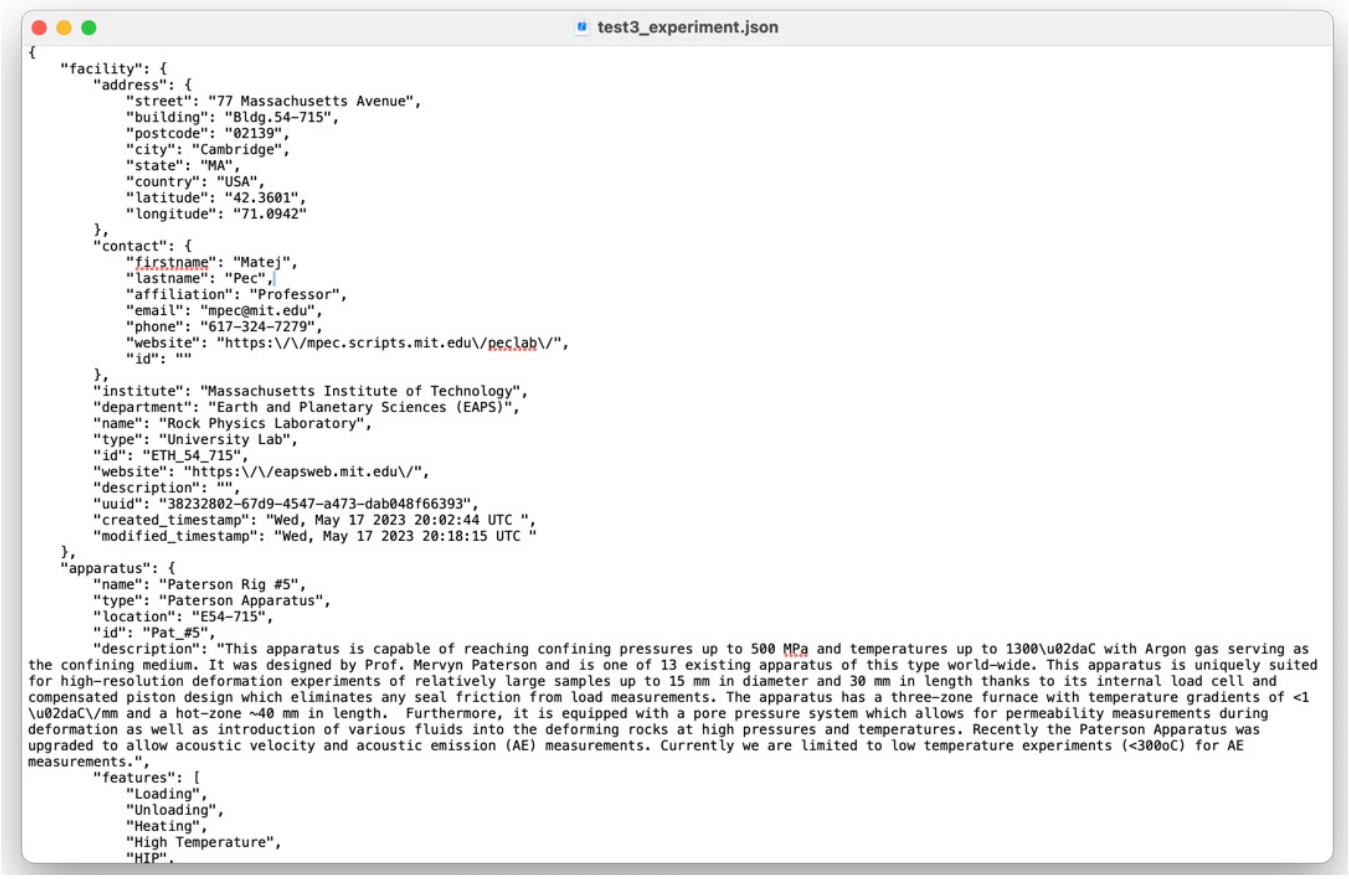


Figure 10: Export JSON from Project Page

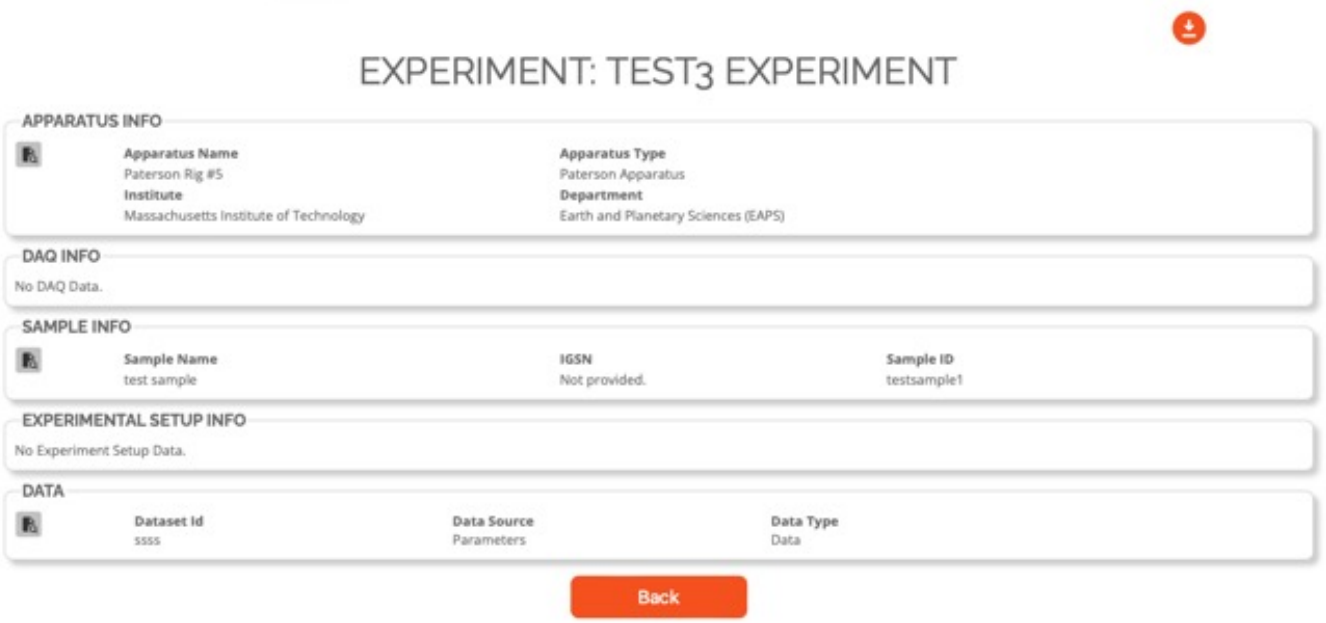


Figure 11: Download JSON Button in Experiment View

Figure 12: Download Options for JSON Export