*Update on the*

# Material Assay Database

James Loach *Shanghai Jiao Tong University*
Jodi Cooley *Southern Methodist University*

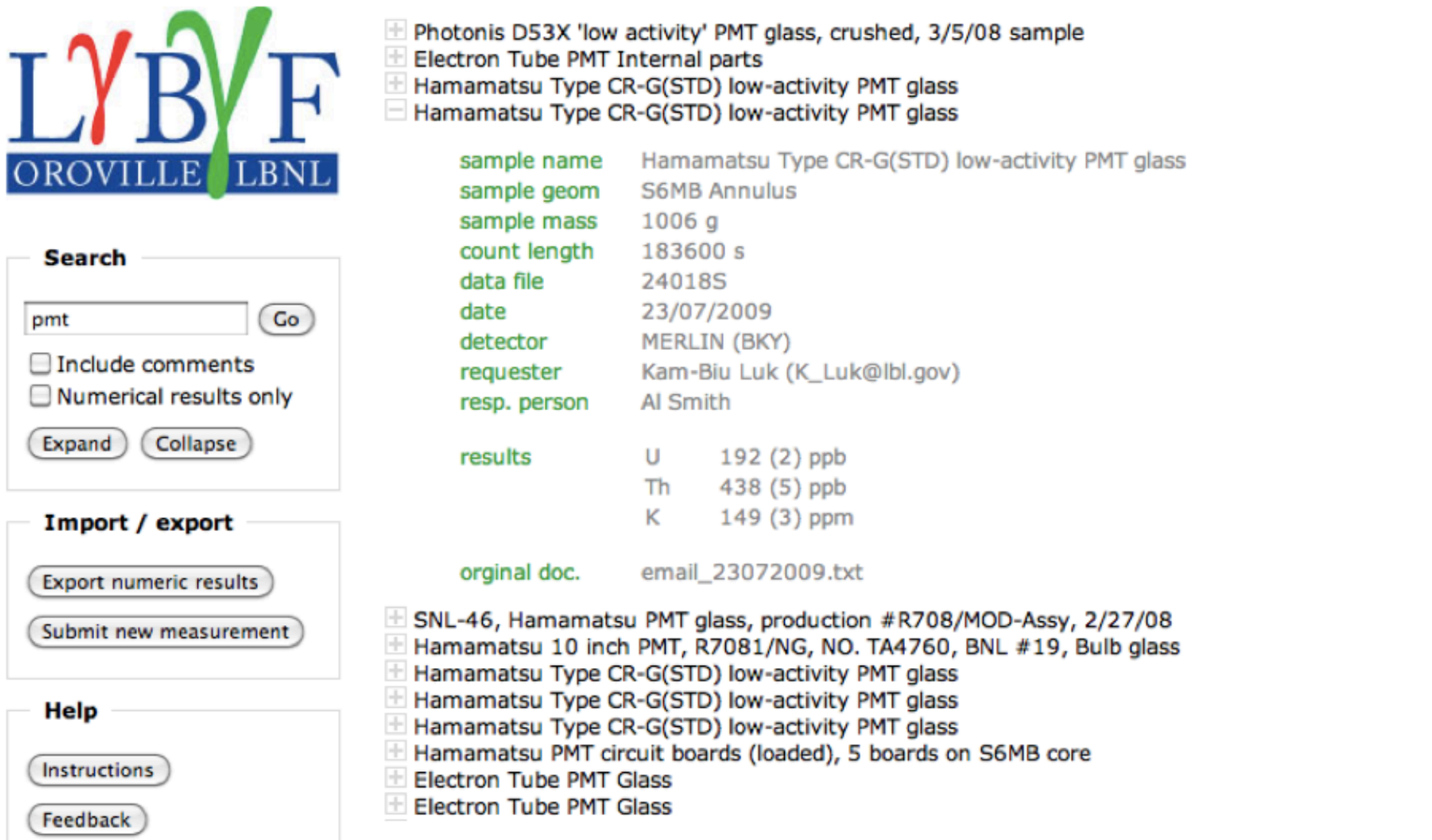
radiopurity.org

*AARM Collaboration Meeting, SLAC, January 2013*

# History

## 2010 LRT conference in Sudbury

- Proposal : *A Material Assay Database for the Low-Background Physics Community*
- Demonstration application for the LBNL LBF



# History

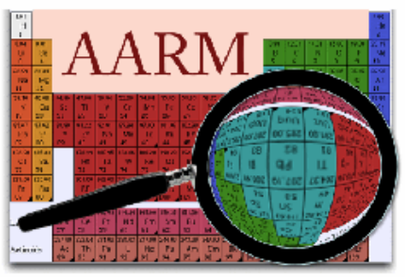
## 2010 LRT conference in Sudbury

- Proposal : *A Material Assay Database for the Low-Background Physics Community*
- Demonstration application for the LBNL LBF

## 2012 Formation of active collaboration

- Association with AARM (funded by the National Science Foundation)
- Association with SMU

  ( **Jodi Cooley** with undergrads Adler, Bruemmer & Wise )
- Contributions from **Adam Cox** ( KIT ) and others
- Complete revision of data specification & software




SMU

SHANGHAI JIAO TONG UNIVERSITY 1896

BERKELEY LAB

# History

## 2010 LRT conference in Sudbury

- Proposal : *A Material Assay Database for the Low-Background Physics Community*
- Demonstration application for the LBNL LBF

## 2012 Formation of active collaboration

- Association with AARM (funded by the National Science Foundation)
- Association with SMU

  ( **Jodi Cooley** with undergrads Adler, Bruemmer & Wise )
- Contributions from **Adam Cox** ( KIT ) and others
- Complete revision of data specification & software

## 2013 LRT conference at Gran Sasso

- Launch of public version

# Design Principles

A permenant solution that is a pleasure to use

## Open, convenient software

- Open source NoSQL engine **CouchDB**

## Data flexibility

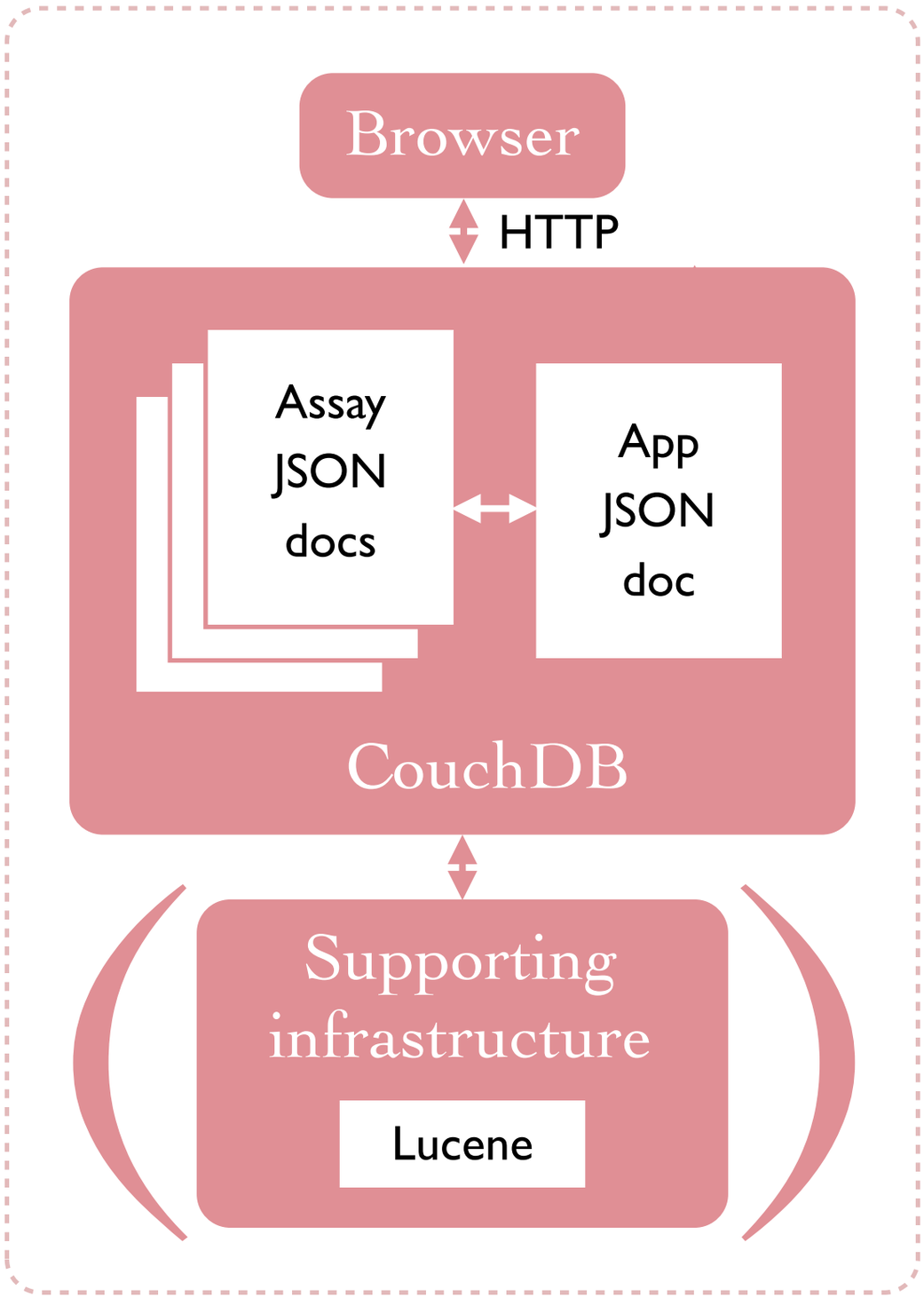
- Loose data structure
- Portable data

## Usage flexibility

- Interface diversity
- Community repositories
- Collaboration/institutional repositories
- Personal copies

# Structure

All communication
with CouchDB
via HTTP
*'built for the web'*




Web application
stored within the
CouchDB itself

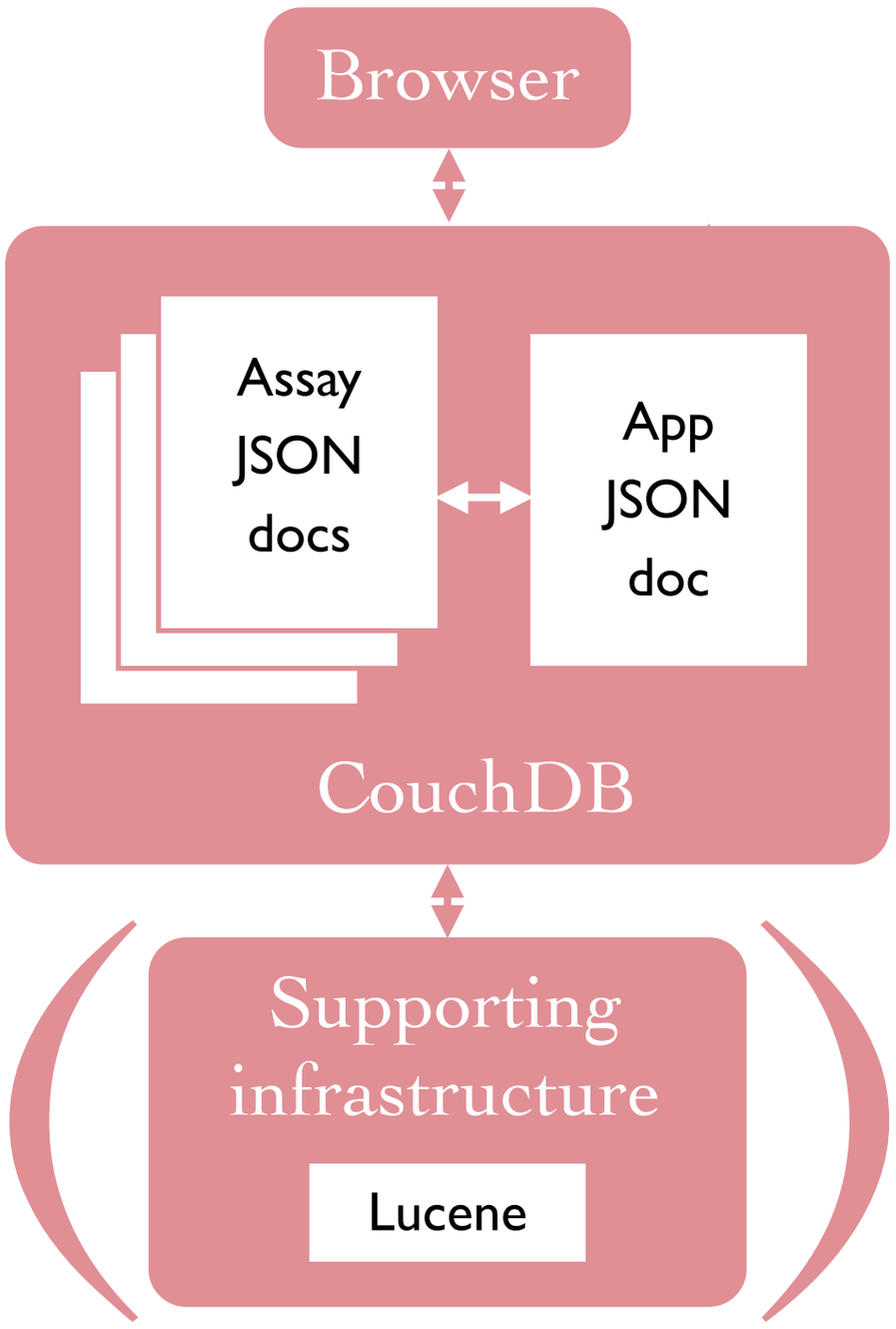
Pure AJAX
client-side
HTML/JavaScript

Lucene provides
powerful search

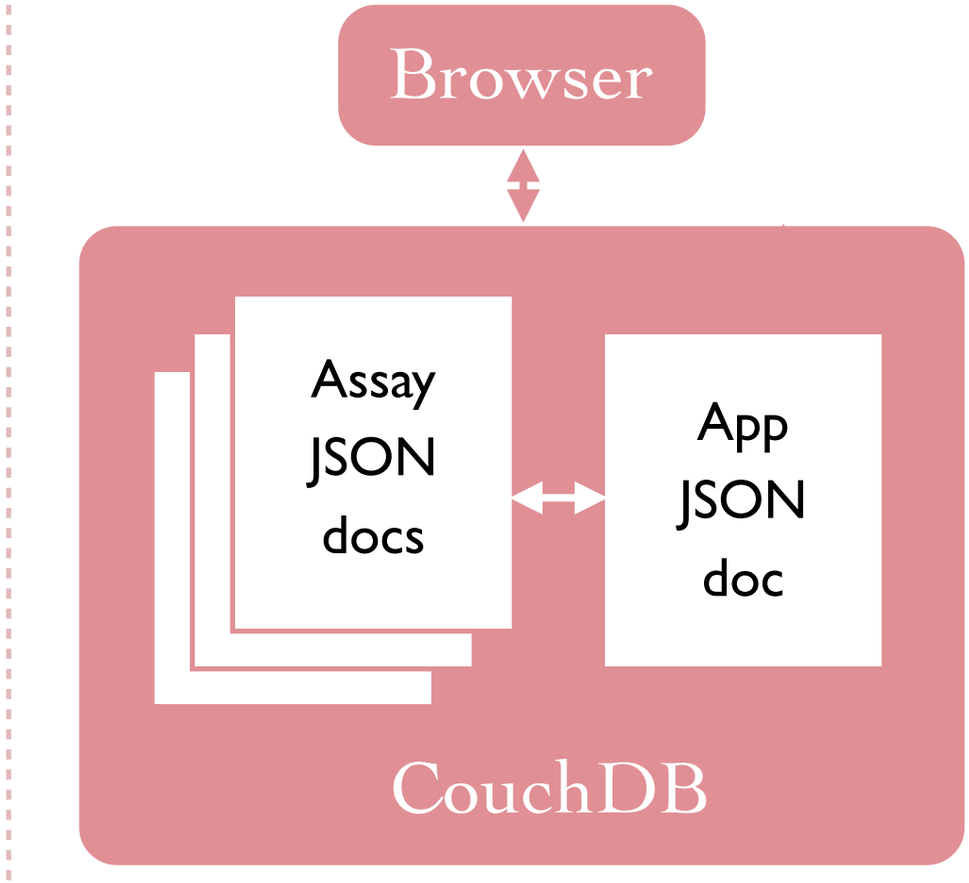
# Structure

Server

Laptop

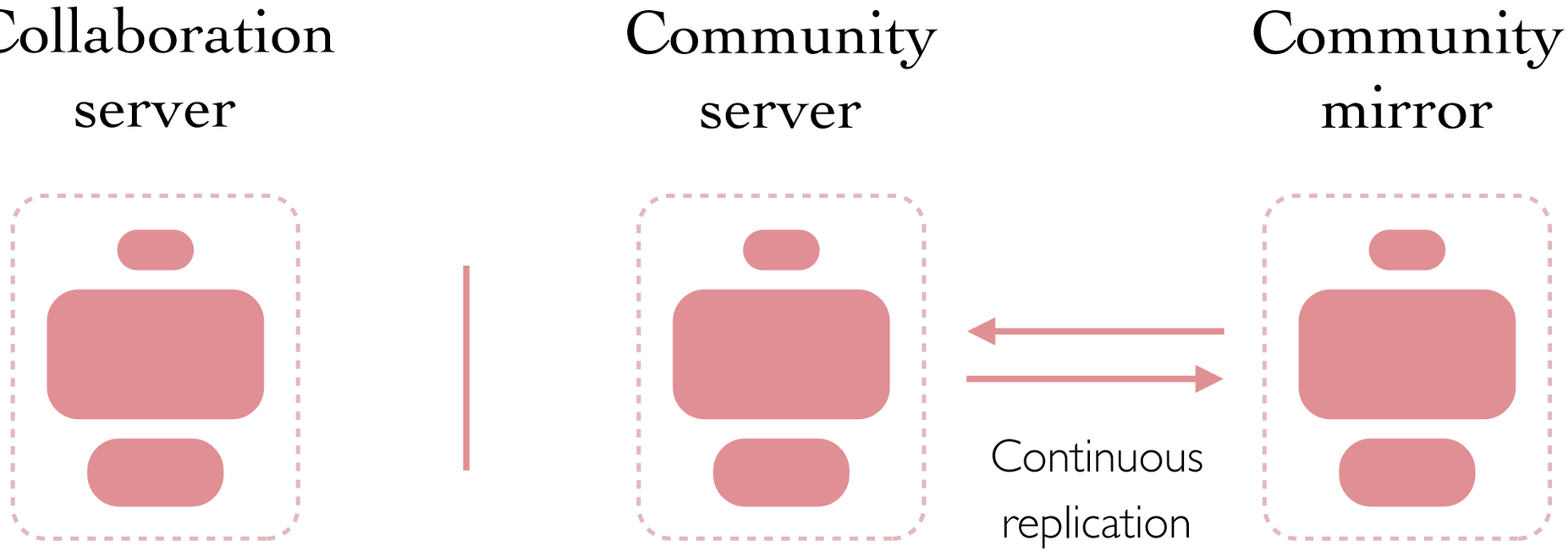



CouchDB **replicates** trivially



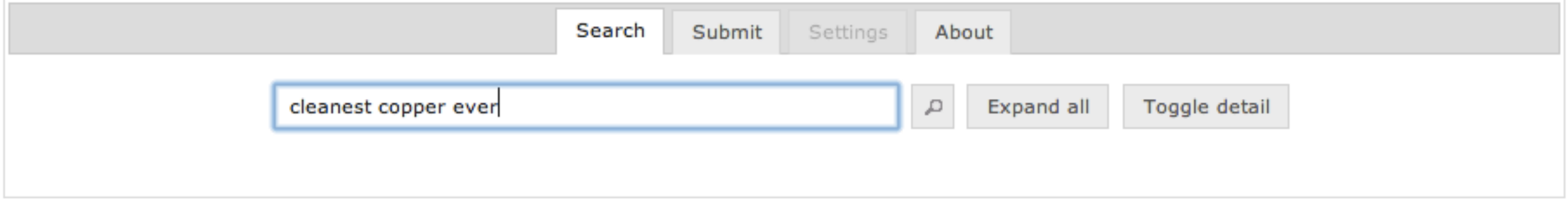

A laptop replication will loose the powerful search

# Structure

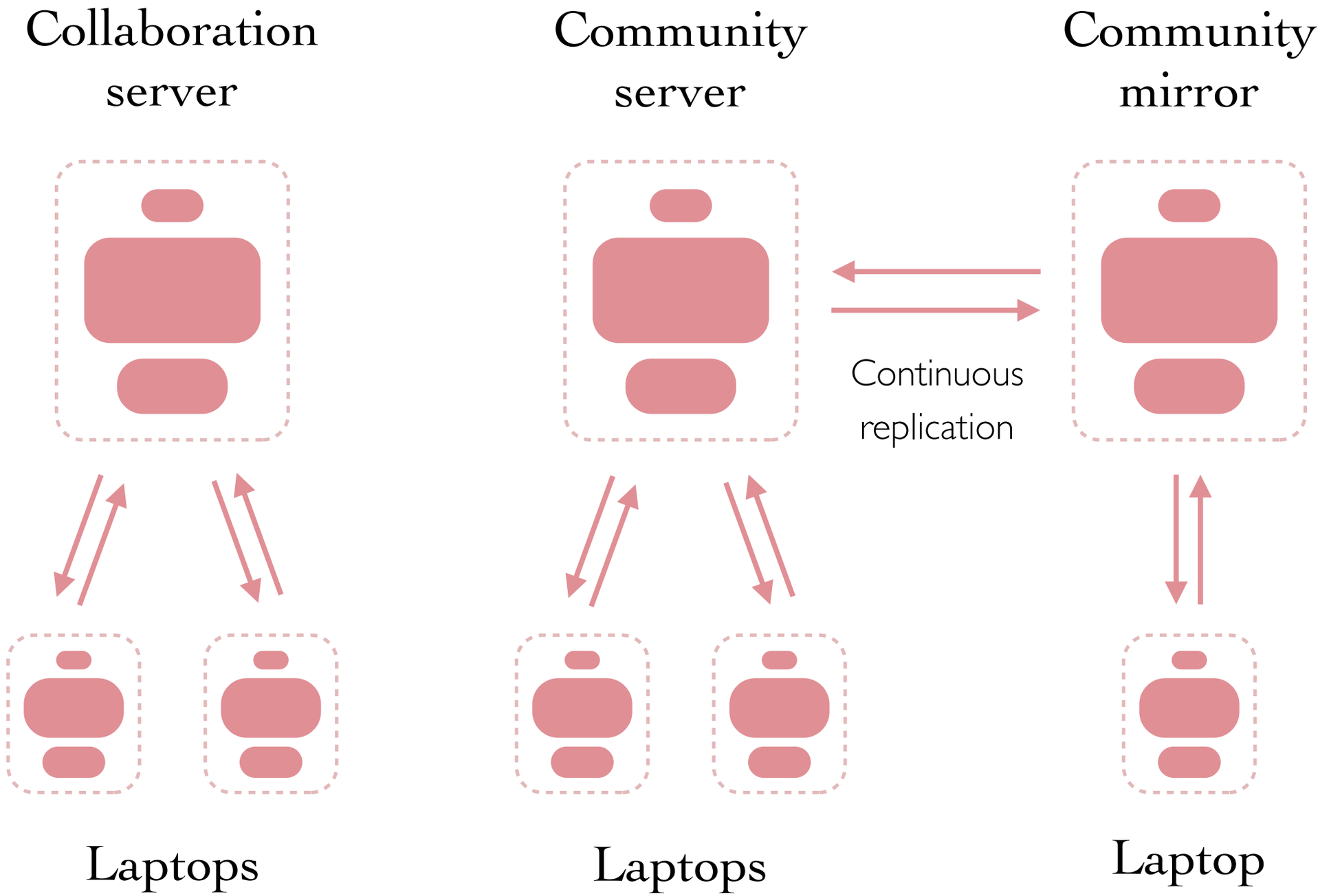



**MAJORANA**

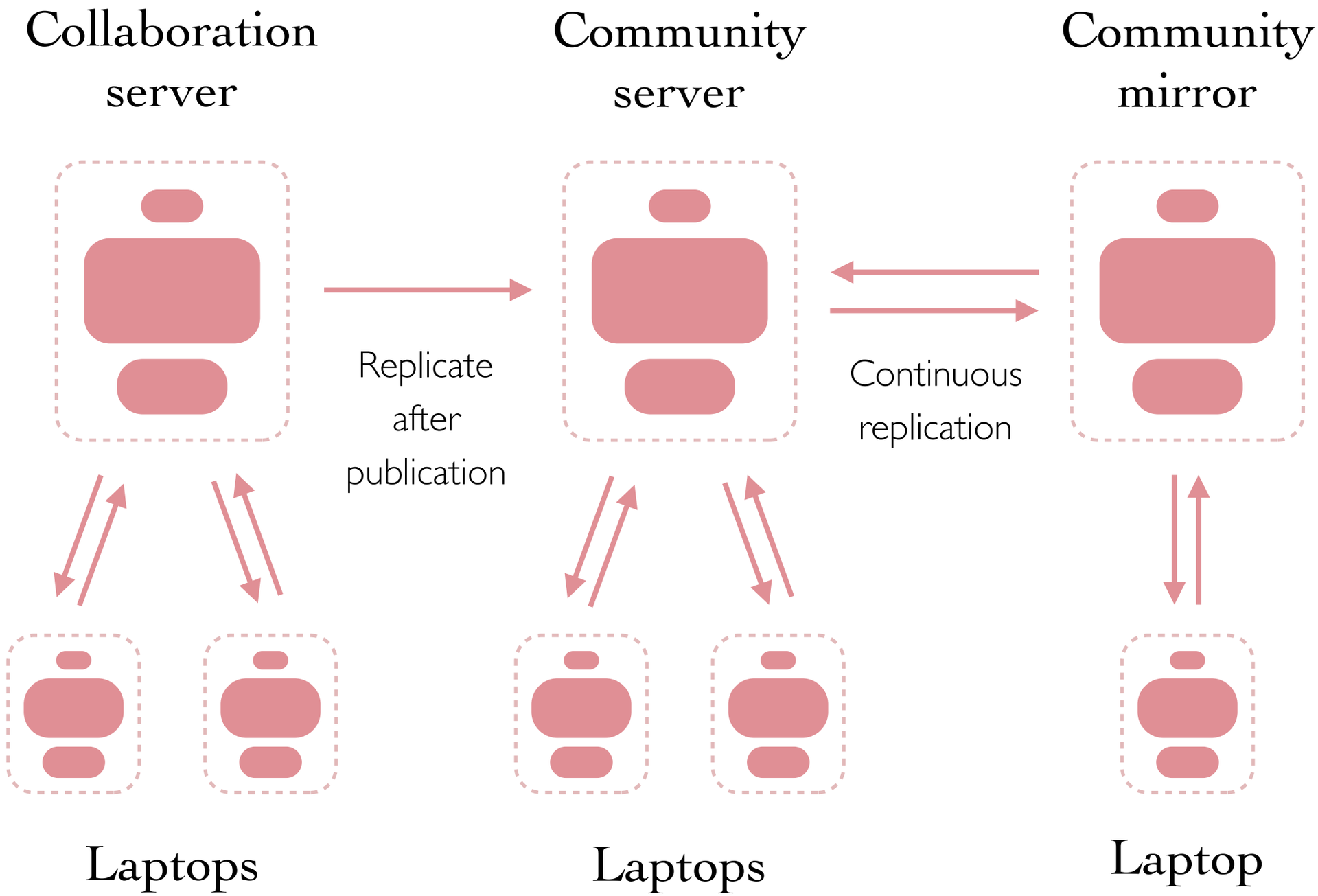
Material Assay Database



# Structure


Collaboration server
Community server
Community mirror
Continuous replication
Laptops
Laptops
Laptop

# Structure


Collaboration server
Community server
Community mirror
Replicate after publication
Continuous replication
Laptops
Laptops
Laptop

# Data format

## Sample

The thing that is being counted

Name | Description | Source | Owner | ID

## Measurement

The measurement and its results

Institution | Technique | Date | Requestor | Practitioner | Description

Results

| | | | |
|---|---|---|---|
| Isotope | Value | Error | Unit |
| Isotope | Limit | c.l. | Unit |
| Isotope | Range | c.l. | Unit |
| ... | | | |

## Data source

Where the data came from

Who entered it

Reference | Data entry person | Notes

## General

Group | Specification

The concept is expressed in the schema

# Data format

```
{
   "type":          "measurement",

   "grouping":      "Experiment name or similar",

   "sample":        {...},
   "measurement":   {...},
   "data_source":   {...},

   "specification": "X.XX"

}
```

## Sample

```
"sample": {

   "name":           "Short description",
   "description":    "Detailed description",
   "id":             "Identification number",
   "source":         "Where it came from",

   "owner":
      {
         "name":         "Who owns it",
         "contact":      "Institution or email/postal address"
      }

}
```

## Data source

```
"data_source": {

   "reference":      "Where the data came from",
   "input":
      {
         "name":         "Who created this document,
         "contact":      "Institution or email/postal address",
         "date":         []
      },

   "notes":          "Comments on/issues with data entry"

}
```

## Measurement

```
"measurement": {

   "institution":    "Where the count was done",
   "technique":      "The technique that was used",

   "date":           [],

   "requestor":
      {
         "name":         "Who managed the measurement",
         "contact":      "Institution or email/postal address"
      },

   "practitioner":
      {
         "name":         "Who did the measurement",
         "contact":      "Institution or email/postal address"
      },

   "description":    "Detailed multi-line description of
                      the procedure and results",

   "results":
      [
         {
            "isotope":     "II-AAA or II or description",
            "type":        "measurement or limit or range",
            "value":       [],
            "unit":        "Unit"
         },
         ...
      ]
}
```

# Data format

```
"date":      [],
```

Can be **single**- or **double**-valued

**YYYY-MM-DD** or **YYYY-MM** or **YYYY**

```
"results":
   [
      {
         "isotope":     "II-AAA or II or description",
         "type":        "measurement or limit or range",
         "value":       [],
         "unit":        "Unit"
      },
      ...
]
```

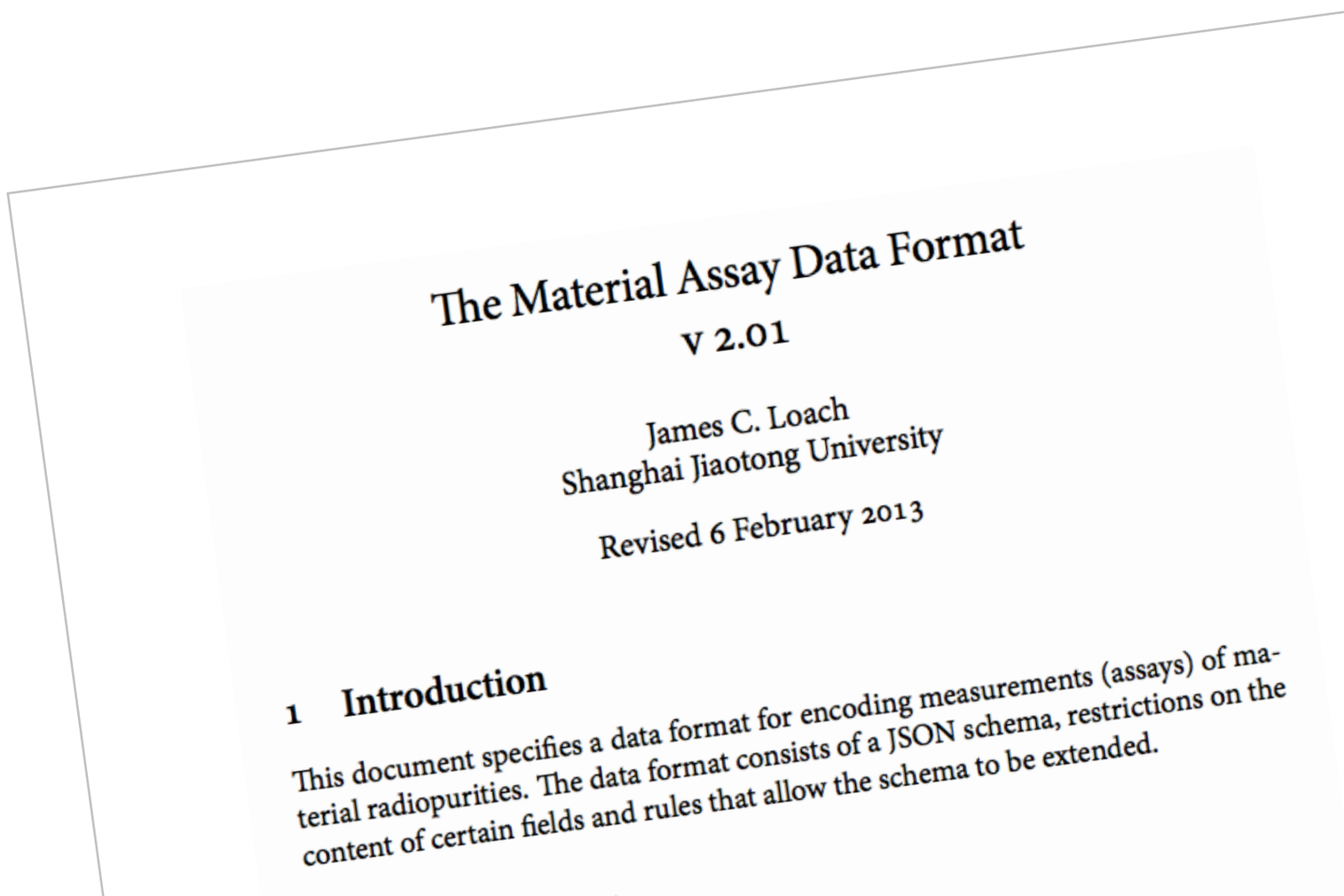
| type | value | Description |
|---|---|---|
| measurement | [0] | measurement with no error |
| | [0,0] | measurement with symmetric error |
| | [0,0,0] | measurement with asymmetric error (+, -) |
| range | [0,0] | range (lower, upper) |
| | [0,0,0] | range with confidence level |
| limit | [0] | limit |
| | [0,0] | limit with confidence level |

# Extendability

```
"user":
   [
      {
         "name":                 "Short description",
         "description":          "Detailed description",
         "type":                 "measurement or limit
                                    or range or string",
         "value":                [] or "",
         "unit":                 "Associated unit"
      },
      ...
]
```

All the details
are written down

Find the document
in the repository



The Material Assay Data Format

v 2.01

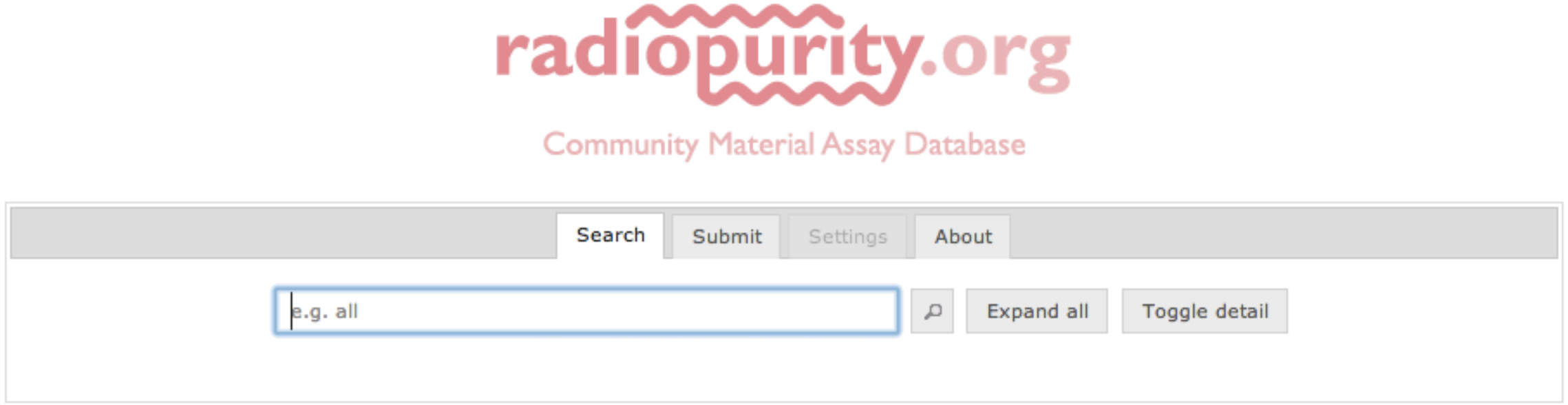
James C. Loach
Shanghai Jiaotong University

Revised 6 February 2013

1 Introduction

This document specifies a data format for encoding measurements (assays) of material radiopurities. The data format consists of a JSON schema, restrictions on the content of certain fields and rules that allow the schema to be extended.

# User interface



# Output

radiopurity.org

Community Material Assay Database

Search | Submit | Settings | About

all | Expand all | Toggle detail

| | | | |
|---|---|---|---|
| + | 0vBB Experiment | **Plombum, VG2 lead** | Th-232 3.2 - 4.2 ppb U-238 < 30 ppb ... |
| + | 0vBB Experiment | **Plombum, VG2 lead** | Th-232 < 13.2 ppb U-238 < 20 ppb ... |
| + | 0vBB Experiment | **Plombum, VG3 lead (extra special)** | |
| + | 0vBB Experiment | **Plombum, VG2 lead** | Th-232 < 3.3 ppb U-238 < 19 ppb ... |
| + | 0vBB Experiment | **Plombum, VG2 lead** | Th-232 3.2 - 4.2 ppb U-238 30 ppb ... |

Persephone

Supported by AARM, LBNL, SMU, SJTU & others

# Output

radiopurity.org

Community Material Assay Database

Search | Submit | Settings | About

all | Expand all | Toggle detail

| | | | | |
|---|---|---|---|---|
| – | 0vBB Experiment | **Plombum, VG2 lead** | | Th-232 3.2 - 4.2 ppb U-238 < 30 ppb ... |
| | Sample | Description | Plombum, VG2 lead, lot #D9119 | |
| | Measurement | Results | Th-232 | 3.2-4.2 ppb |
| | | | U-238 < | 30 ppb |
| | | | K | 170 (10) ppt |
| + | 0vBB Experiment | **Plombum, VG2 lead** | | Th-232 < 13.2 ppb U-238 < 20 ppb ... |
| + | 0vBB Experiment | **Plombum, VG3 lead (extra special)** | | |
| + | 0vBB Experiment | **Plombum, VG2 lead** | | Th-232 < 3.3 ppb U-238 < 19 ppb ... |
| + | 0vBB Experiment | **Plombum, VG2 lead** | | Th-232 3.2 - 4.2 ppb U-238 30 ppb ... |

Persephone

Supported by AARM, LBNL, SMU, SJTU & others

# Output

radiopurity.org

Community Material Assay Database

Search | Submit | Settings | About

all | Expand all | Toggle detail

0vBB Experiment **Plombum, VG2 lead** Th-232 3.2 - 4.2 ppb U-238 < 30 ppb ...

| | | | |
|---|---|---|---|
| Sample | Name | Plombum, VG2 lead | |
| | Description | Plombum, VG2 lead, lot #D9119 | |
| | ID | Pb-001 | |
| | Source | Plombum FL | |
| | Owner | Alice Professor, A University alice@university.edu | |
| Measurement | Results | Th-232 | 3.2-4.2 ppb |
| | | U-238 < | 30 ppb |
| | | K | 170 (10) ppt |
| | Institution | Low-background Facility | |
| | Technique | Gamma | |
| | Date | 2000-01-02 | |
| | Requestor | Alice Professor, A University alice@university.edu | |
| | Practitioner | Bob Technician bob@lowbackground.edu | |
| | Description | Standard gamma count of the whole brick. | |
| Data | Reference | 0vBB-EXP-0001 (Technical report) | |
| | Data entry | Eve Undergraduate eve@university.edu on 2010-01-01 spec v2.01 | |
| | Notes | There seems to be a typo in the results list in the report. Interperate U-239 as U-238. | |

0vBB Experiment **Plombum, VG2 lead** Th-232 < 13.2 ppb U-238 < 20 ppb ...

0vBB Experiment **Plombum, VG3 lead (extra special)**

0vBB Experiment **Plombum, VG2 lead** Th-232 < 3.3 ppb U-238 < 19 ppb ...

0vBB Experiment **Plombum, VG2 lead** Th-232 3.2 - 4.2 ppb U-238 30 ppb ...

# Output

radiopurity.org

Community Material Assay Database

Search | Submit | Settings | About

all | Expand all | Toggle detail

0vBB Experiment **Plombum, VG2 lead** Th-232 3.2 - 4.2 ppb U-238 < 30 ppb ...

| | | | |
|---|---|---|---|
| Sample | Name | Plombum, VG2 lead | |
| | Description | Plombum, VG2 lead, lot #D9119 | |
| | ID | Pb-001 | |
| | Source | Plombum FL | |
| | Owner | Alice Professor, A University alice@university.edu | |
| Measurement | Results | Th-232 | 3.2-4.2 ppb |
| | | U-238 < | 30 ppb |
| | | K | 170 (10) ppt |
| | Institution | Low-background Facil... | |
| | Technique | Gamm... | |
| | Date | | |

| Sample Name | Sample Source | Institution | Technique | K-isotype | Th-isotype | U-isotype |
|---|---|---|---|---|---|---|
| Norddeutsche Affinerie, NSOV copper | Norddeutsche Affinerie | Shiva Inc. | GD-MS | 0.4 | 5 | 5 |
| Norddeutsche Affinerie, NSOV copper | Norddeutsche Affinerie | | Gamma | 120 | 35 | 63 |
| Norddeutsche Affinerie OFRP copper | Norddeutsche Affinerie | | ICP-MS | 55 | 2.4 | 2.9 |
| Norddeutsche Affinerie OFRP copper | Norddeutsche Affinerie | | ICP-MS | 50 | 2.4 | 2.9 |
| Norddeutsche Affinerie OFRP copper | Norddeutsche Affinerie | | ICP-MS | 0 | 3.1 | 3.8 |
| Valcool VNT 700 metal | Norddeutsche Affinerie | | ICP-MS | 0 | 9.8 | 10.2 |
| ...mixture | Norddeutsche Affinerie | | Gamma (above ground) | 38000 | 10000 | 3700 |
| | Norddeutsche Affinerie | | Gamma (above ground) | 44000 | 1800 | 3800 |

Supplementary
interfaces being explored

Input

radiopurity.org

Community Material Assay Database

Search | Submit | Settings | About

Clear form | Check | Clear warnings | Submit

**Grouping/experiment** Majorana

**Sample**

Name: Corning ArF7980 fused silica — Short description

Description:

ID:

Source:

Owner: Name | Email or institution

User: +

**Measurement**

Institution:

Technique:

Date: yyyy-mm-dd or yyyy-mm or yyyy

Requestor: Name | Email or institution

Practitioner: Name | Email or institution

Input

radiopurity.org

Community Material Assay Database

Search | Submit | Settings | About

Clear form | Check | Clear warnings | Submit

**Grouping/experiment** Majorana

**Sample**

| | |
|---|---|
| Name | Corning ArF7980 fused silica |
| Description | Fused silica wafer, 3 mil thickness, 20/40 polished |
| ID | MJ0004-2a |
| Source | Mark Optics Inc. |
| Owner | Bob Smith / BobSmith@lbnl.gov |
| User | + |

**Measurement**

| | |
|---|---|
| Institution | LBNL |
| Technique | (Gamma, ICP-MS, NAA) — How the measurement was done |
| Date | |
| Requestor | |
| Practitioner | Name / Email or institution |

Input

**Measurement**

| | | |
|---|---|---|
| Institution | LBNL | |
| Technique | ICP-MS | |
| Date | 2008-03-01 | 2008-03-12 |
| Requestor | Senior Scientist | SScientist@lbl.gov |
| Practitioner | Al Smith | ARSmith@lbl.gov |
| Description | A detailed description. | |

Results: 238 | Meas. (error) | Value | Error | | Unit | + | −

- Am-238
- Cm-238
- Np-238
- Pu-238
- U-238

User

**Data source**

| | |
|---|---|
| Reference | |
| Input person | Name / Email or institution |
| Input date | yyyy-mm-dd |
| Notes | |
| User | + |

Input

**Measurement**

Institution: LBNL

Technique: ICP-MS

Date: 2008-03-01 — 2008-03-12

Requestor: Senior Scientist | SScientist@lbl.gov

Practitioner: Al Smith | ARSmith@lbl.gov

Description: A detailed description.

Results: U-238 | Meas. (error) | Value | Error | | Unit | + |

Isotope | Meas. | Value | Error | | Unit | + | −

- Meas.
- Meas. (error)
- Meas. (asym. error)
- Limit
- Limit (c.l.)
- Range
- Range (c.l.)

User: +

**Data source**

Reference

Input person: Name | institution

Input date: yyyy-mm-dd

Notes

User: +

Input

**Measurement**

| | | |
|---|---|---|
| Institution | LBNL | |
| Technique | ICP-MS | |
| Date | 2008-03-01 | 2008-03-12 |
| Requestor | Senior Scientist | SScientist@lbl.gov |
| Practitioner | Al Smith | ARSmith@lbl.gov |
| Description | A detailed description. | |

Results

| Isotope | Meas. (error) | Value | Error | | Unit |
|---|---|---|---|---|---|
| U-238 | Limit (c.l.) | Limit | c.l. | | Unit |

pct
ppm
ppb
ppt
ppq
mBq/kg
uBq/kg
nBq/kg

User +

**Data source**

| | |
|---|---|
| Reference | |
| Input person | Name / Email or institution |
| Input date | yyyy-mm-dd |
| Notes | |

User +

Input

**Measurement**

| | | | | | | |
|---|---|---|---|---|---|---|
| Institution | LBNL | | | | | |
| Technique | ICP-MS | | | | | |
| Date | 2008-03-01 | 2008-03-12 | | | | |
| Requestor | Senior Scientist | SScientist@lbl.gov | | | | |
| Practitioner | Al Smith | ARSmith@lbl.gov | | | | |
| Description | A detailed description. | | | | | |
| Results | U-238 | Limit (c.l.) | 100 | 95 | | ppb |
| | Th-232 | Meas. (error) | 50 | 10 | | ppt |
| User | | | | | | |
| | Name | Description | Value | Unit | | |

**Data source**

| | |
|---|---|
| Reference | |
| Input person | Name / Email or institution |
| Input date | yyyy-mm-dd |
| Notes | |
| User | |

# Data

Porting published data from :

| | |
|---|---|
| ILIAS | http://radiopurity.in2p3.fr/ |
| EXO | D.S. Leonard *et al.* (2008). |
| Borexino | C. Arpesella *et al.* (2002). |

~ 500 assays

Other suggestions welcome

We can help you port data from your collaboration!

# Work to be done

## Completion of editing functionality

## Interface refinements

- Automatic unit conversion
- Data export (to ROOT &c.)

# Points for discussion

Database hosting (commercial or by ourselves)

Interfacing with GEANT4 (necessary?)

# Collaboration

radiopurity.org

Community Material Assay Database

## Code repository / dev mailing list

https://github.com/nepahwin/**persephone**

radiopurity@googlegroups.com

## Domains

**radiopurity.org** radiopurity.com

radiopurity.net radiopurity.info

## Contributors

James Loach, SJTU

Jodi Cooley, SMU

Adam Cox, KIT

Keith Adler, SMU *

Matthew Bruemmer, SMU *

Ben Wise, SMU *

Alan Poon, LBNL

* student

## Collaborators welcome

james.loach@gmail.com · cooley@physics.smu.edu

Physics Department

# Shanghai Jiaotong University

# 上海交通大学