Characterization Catalog Web Application

Creating an Online Catalog for Radiation Detector Characterization Data

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Intern:

Kousuke Tachida | Computer Science | Rensselaer Polytechnic Institute 2020

Mentors:

Matthew Wong | 8754 | R&D S&E | Computer Science
Belkis Cabrera-Palmer | 8647 | R&D S&E | Physics

What is the Characterization Catalog?

- Web application that catalogs detector information and characterization data for individual detector units
- Characterization data consists of detector response data for each test and corresponding test conditions
- Part of a larger organization known as DMAMC (Data Mining, Analysis, and Modeling Cell) managed by the CWMD (Countering Weapons of Mass Destruction) office of the DHS (Department of Homeland Security)

ORTEC Micro-Detective Radiation Detector
Image from ortec-online.com

DMAMC Data Mining Analysis and Modeling Cell
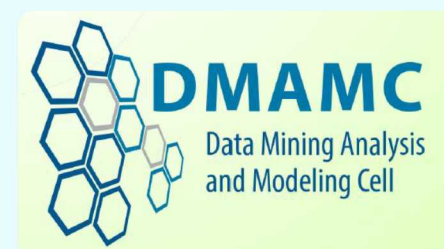
Why is the Characterization Catalog important?

Main Goals:
- Support test scientists and analysts at CWMD and CWMD partner organizations by organizing and providing data
- Enable the formulation of quantitative and conclusive outcomes
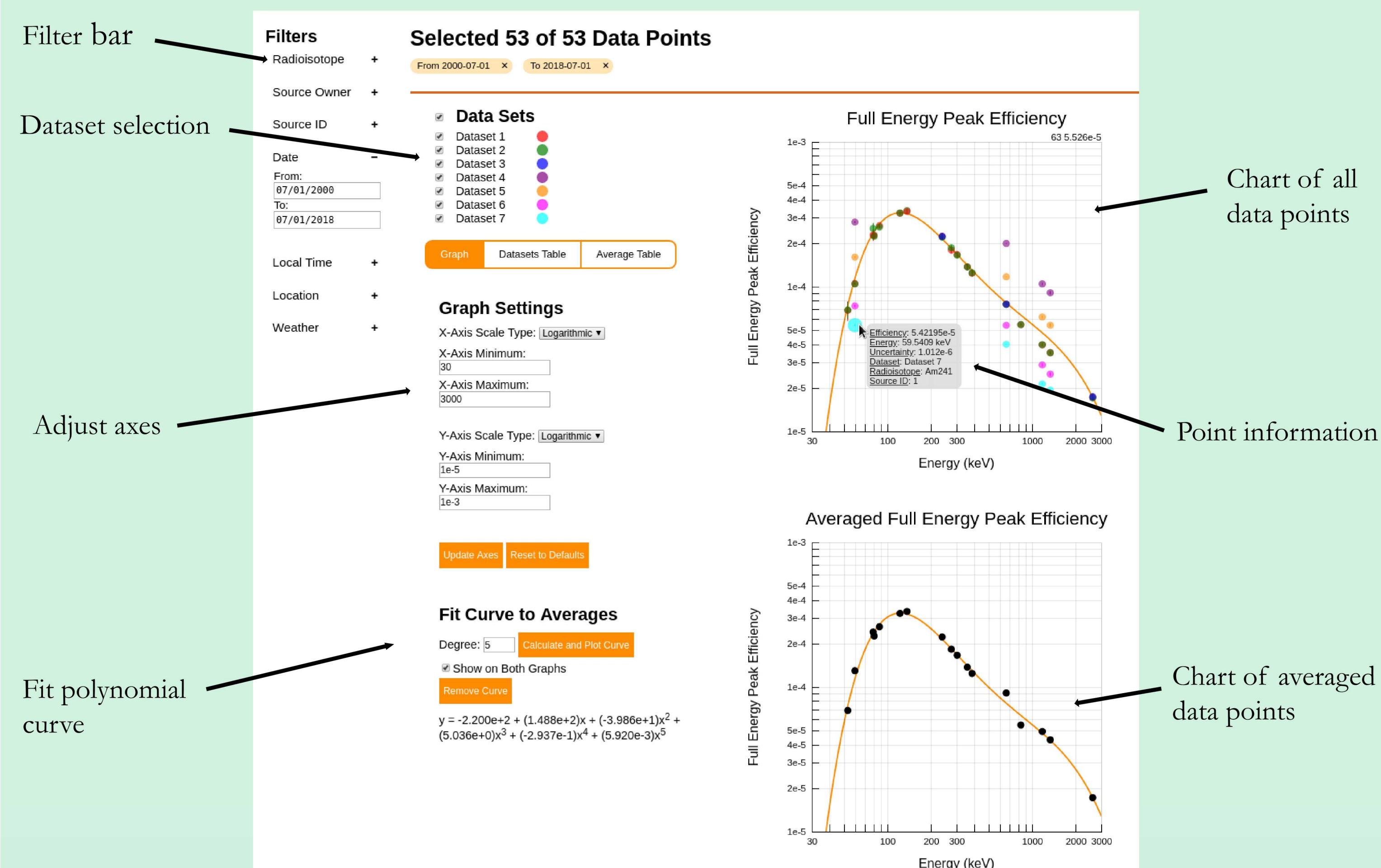
Use Cases:
- Support test planning, execution, and post-test analysis
- Evaluate and compare instrument performance
- Support instrument management

These use cases were identified through a survey taken by test scientists and working group members.

What organizations are involved in development?

- SNL (Lead) — Sandia National Laboratories
- DHS-CWMD
- LLNL — Lawrence Livermore National Laboratory
- NIST — National Institute of Standards and Technology, U.S. Department of Commerce
- NRL — U.S. NAVAL RESEARCH LABORATORY
- PNNL — Pacific Northwest NATIONAL LABORATORY

My Tasks:

- Decide which technologies to work with
- Design and develop the Characterization Catalog from scratch
- Add features and adjust prototype based on feedback

Technologies Used:

Front-end

HTML, CSS, JavaScript

D3.js (JavaScript Library) — Data-Driven Documents
- Used for making charts and plotting data
- Low abstraction level allows for more customizability and features

jQuery (JavaScript Library)
- Used for manipulating the DOM and AJAX requests
- Allows easy handling of user events and interactions

Requests data through AJAX → ← Returns data as JSON

Symfony 3.4 (PHP framework)
- Simple and flexible PHP framework
- Used in backend: controlling routing, API routes, and more
- Also used by PNNL for another web application in DMAMC

Query database with SQL → ← Returns result of query

MariaDB (SQL Database)
- Open-source SQL database
- Used for storing data in several relational tables

Back-end

Characterization Data Chart View:

- Filter bar
- Dataset selection
- Adjust axes
- Fit polynomial curve

Filters — Selected 53 of 53 Data Points
Radioisotope +   From 2000-07-01 ×   To 2018-07-01 ×
Source Owner +
Source ID +
Date –
From: 07/01/2000
To: 07/01/2018
Local Time +
Location +
Weather +

Data Sets
Dataset 1
Dataset 2
Dataset 3
Dataset 4
Dataset 5
Dataset 6
Dataset 7

Graph | Datasets Table | Average Table

Graph Settings
X-Axis Scale Type: Logarithmic
X-Axis Minimum: 30
X-Axis Maximum: 3000
Y-Axis Scale Type: Logarithmic
Y-Axis Minimum: 1e-5
Y-Axis Maximum: 1e3

Update Axes | Reset to Defaults

Fit Curve to Averages
Degree: 5   Calculate and Plot Curve
Show on Both Graphs
Remove Curve

Full Energy Peak Efficiency
63 5.526e-5

Efficiency: 5.421195e-5
Energy: 59.5409 keV
Uncertainty: 1.012e-6
Dataset: Dataset 7
Radioisotope: Am241
Source ID: 1

Chart of all data points

Point information

$y = -2.200e+2 + (1.488e+2)x + (-3.986e+1)x^2 + (5.036e+0)x^3 + (-2.937e-1)x^4 + (5.920e-3)x^5$

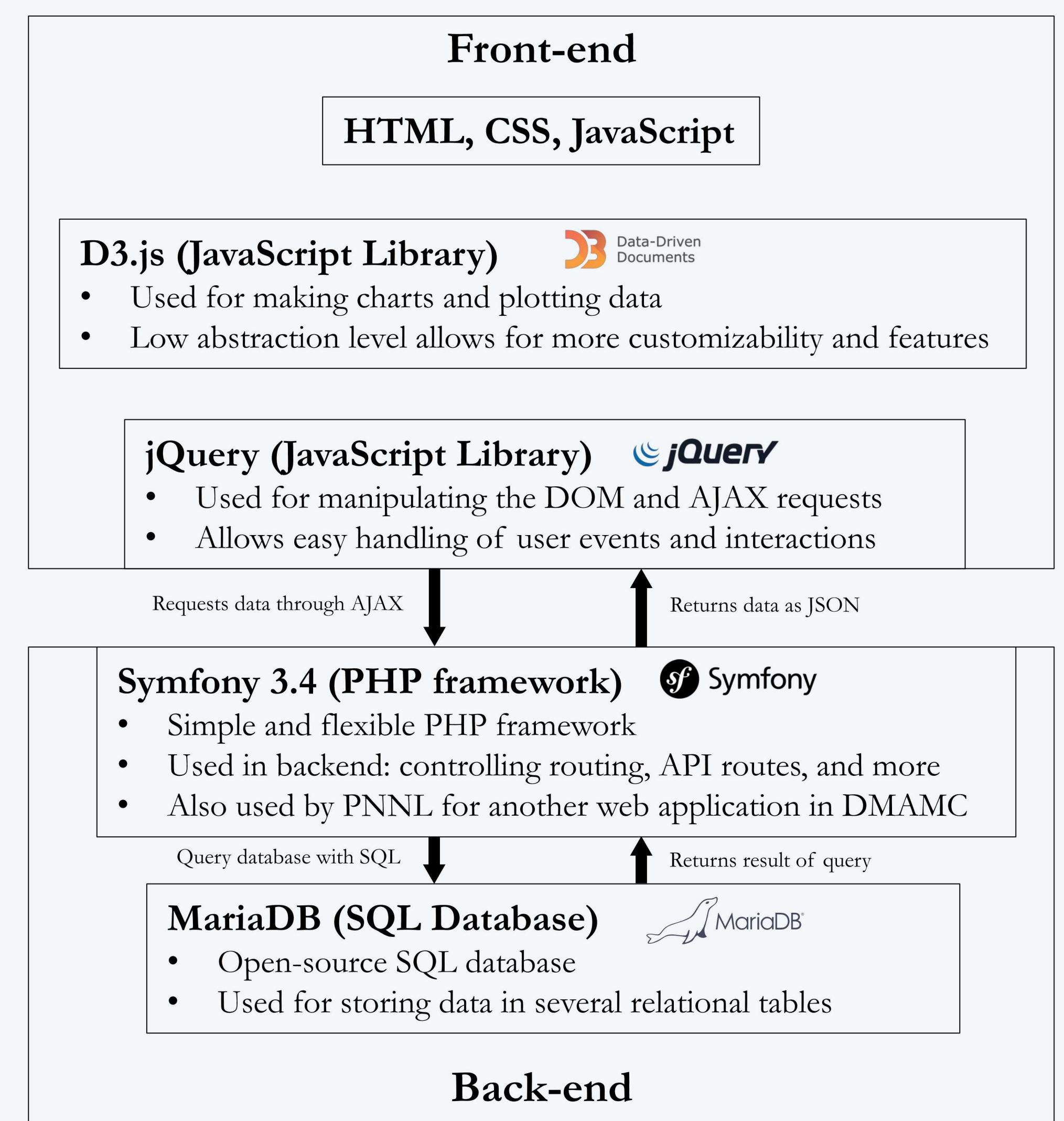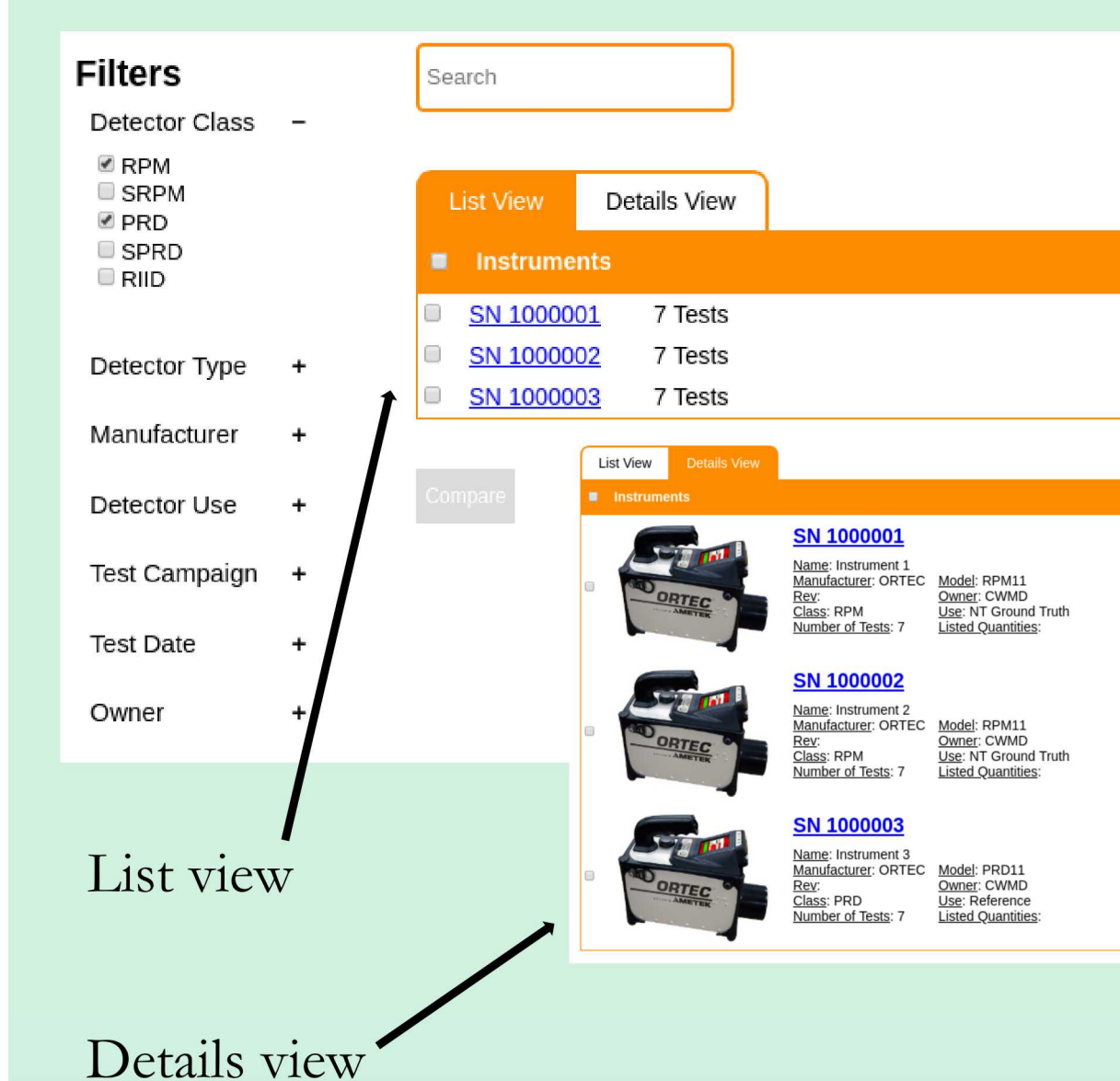**Averaged Full Energy Peak Efficiency**

Chart of averaged data points

- Data points can be filtered through various filters in the filter bar or checking datasets on or off
- The chart is made in D3.js with adjustable axes bounds and scale types, data point information on hover, and polynomial curve fitting
- Also able to view data in table format, and able to download data as a csv file

Feature: D3.js Quadtree for Better Point Hovering
The quadtree will recursively subdivide a two-dimensional space into quadrants until each point belongs to its own cell. Whenever the user's cursor moves, the nearest point is found efficiently with the quadtree and more information about that data point is shown. Since data-points can be very close together, the quadtree also allows for easier and smoother selection compared to normal hover behavior.

Search View:

Filters
Detector Class –
RPM
SRPM
PRD
SPRD
RIID
Detector Type +
Manufacturer +
Detector Use +
Test Campaign +
Test Date +
Owner +

Search

List View | Details View
Instruments
SN 1000001   7 Tests
SN 1000002   7 Tests
SN 1000003   7 Tests

List View | Details View
SN 1000001
SN 1000002
SN 1000003

- List view
- Details view

- Search text input and filter bar allow for quick filtering
- User can choose between list view with hovering for more information or details view
- Able to select a single instrument to view its data or select multiple instruments to compare

Future Work:

- Continue adding/modifying functionality, features, and design
- Implement user authentication with OAuth and Symfony
- Deploy to web server
- Possibly start using React + Redux JavaScript libraries

Sandia National Laboratories