

# DMAMC tasks supported by SNL

Belkis Cabrera-Palmer  
Sandia National Laboratories

T&E program Review, Albuquerque  
2019/07/23



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# SNL-supported DMAMC tasks



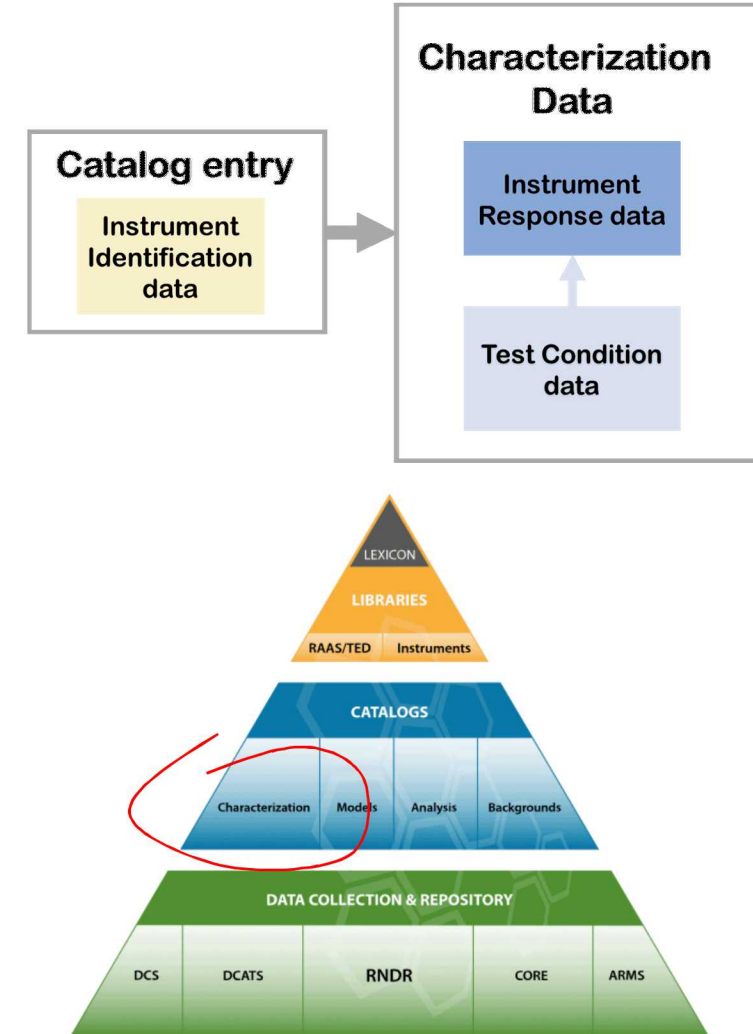
- Data Mining, Analysis and Modeling Cell (DMAMC) Management Integrated Product Team (IPT) member.
  - Sandia POC: Belkis Cabrera-Palmer
- For Analysis IPT:
  - Member of the SME working group (currently inactive)
- For Library IPT:
  - Lead the Characterization Catalog working group (also an Analysis IPT task)
  - Execute the design and development of the Characterization Catalog Web Application.
- Available to respond to stakeholder inquiries and requests for peer-review
- Proposals for long/short-term studies: goals, task breakdown and cost estimate.

# Instrument Characterization Catalog “CharCat”

**Definition:** Online catalog containing containing characterization data of radiation detection instruments used and tested at CWMD test events.

The catalog contents are specific to each detector unit identified by serial number, and will include characterization data pertaining to Normalization Test Ground Truth detectors, Reference detectors and SUTs, collected during CWMD test events and projects, including legacy DNDO test events and projects.

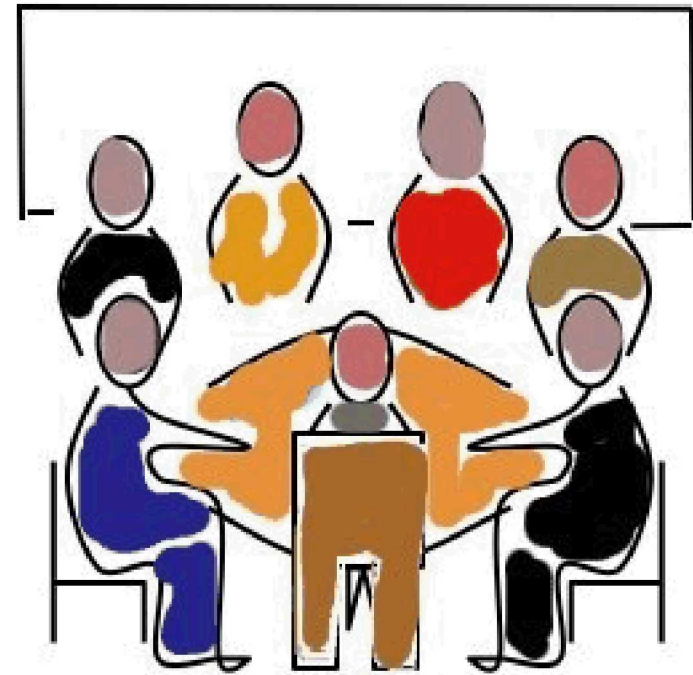
As such, this catalog aims to support test scientists and analysts at CWMD and CWMD partner organizations.



# CharCat Working Group

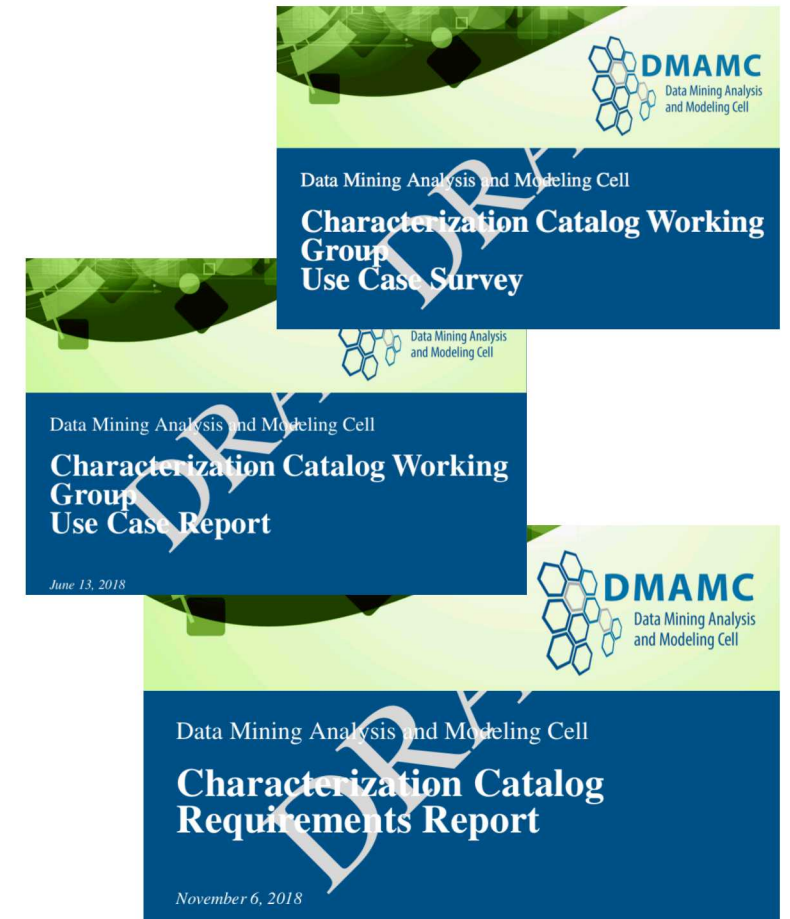
## Members:

1. CWMD: Daniel Weidinger
2. NIST: Miles McCord
3. NRL: Lee Mitchell
4. PNNL: Emily Mace, Gariann Gelston, Heather Orr, Juan Barajas
5. SNL (lead): Development Team of 3 staff and 5 student interns



# CharCat WG FY18 tasks

- Use Case survey:
  - 8 written responses
  - 9 phone interviews
  - 1 CWMD Brown Bag
- Use Case Report submitted on June 2018.
- Requirements Report submitted on November 2018.
- CharCat prototype development (SNL).





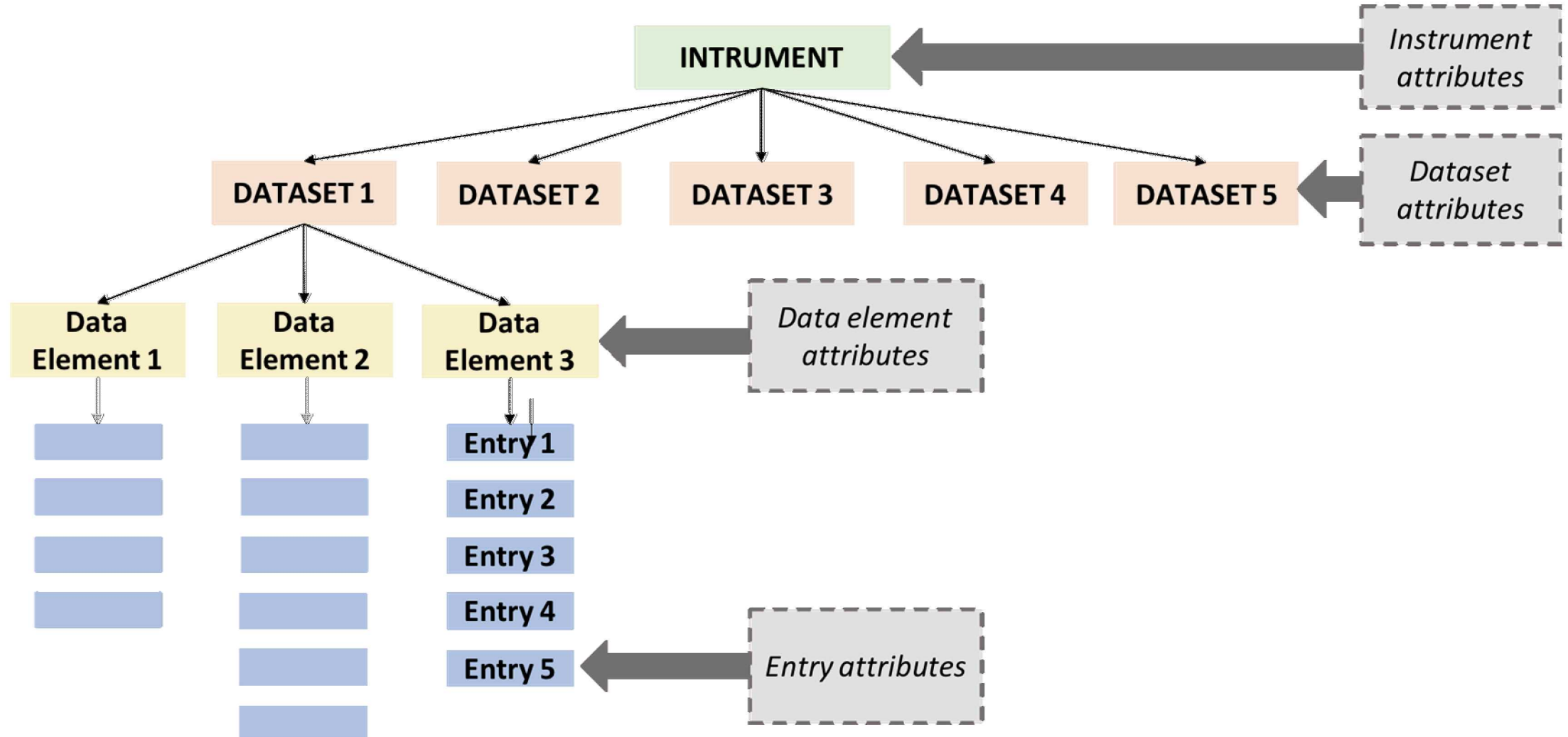
# SNL CharCat FY19 Development Team

Full App development activities started on end of January 2019

1. Belkis Cabrera-Palmer (PI)
2. Matthew Wong
3. Charlie Gieseler
4. Kousuke Tachida
5. Justin Cheon
6. Arthur Zhang (2019 summer)
7. Boris Kudryavtsev (2019 summer)
8. Marton Demeter (2019 summer)

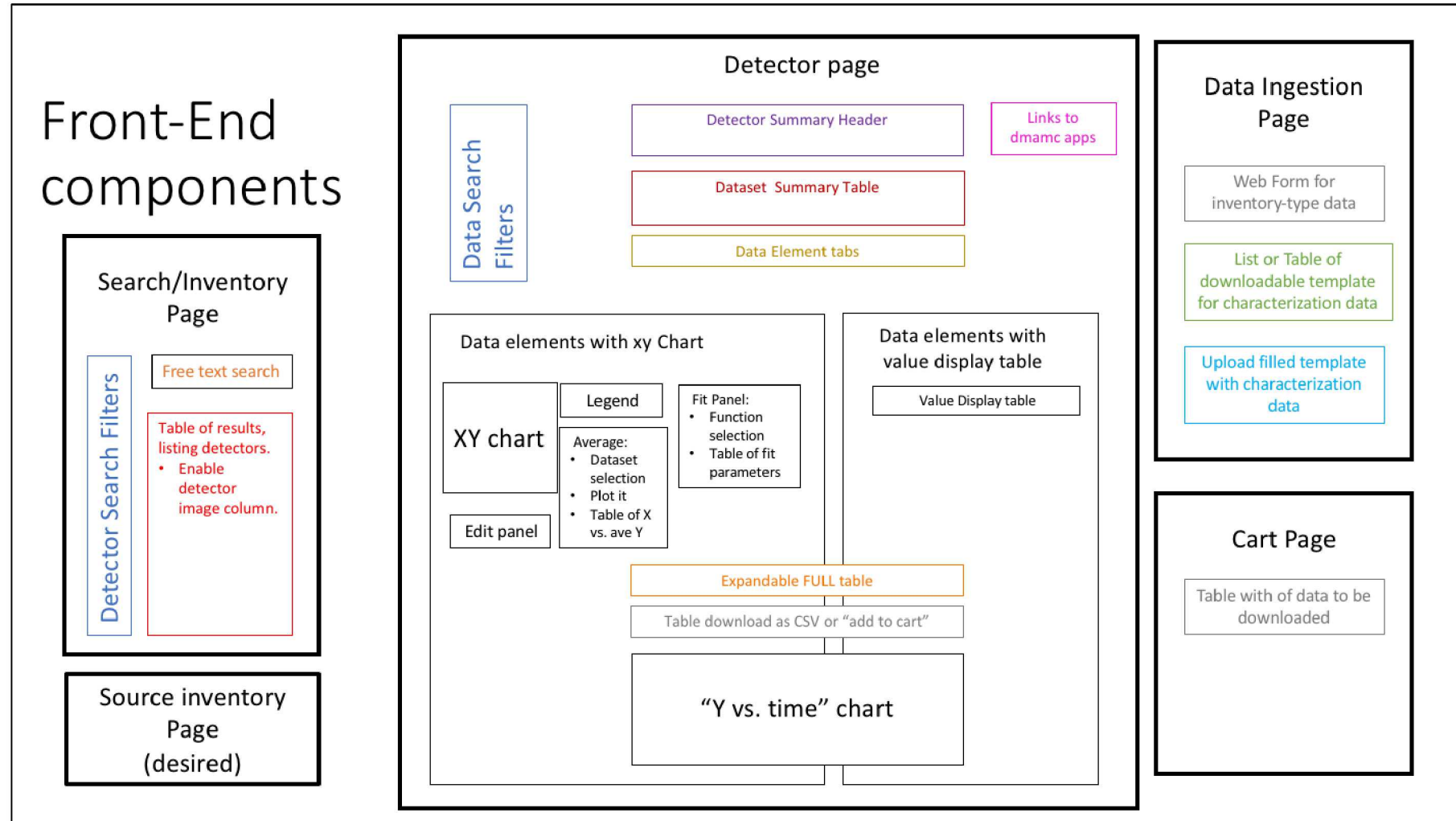


# CharCat Data Organization



# CharCat Front-End Design

- Implemented so far:
  - Search/Inventory page
  - Detector pages (mostly done)
- Currently working on the Data ingestion page
- Will not be done in FY19:
  - Source Inventory page and
  - Cart Page (though data will be downloadable as independent CSV files.)

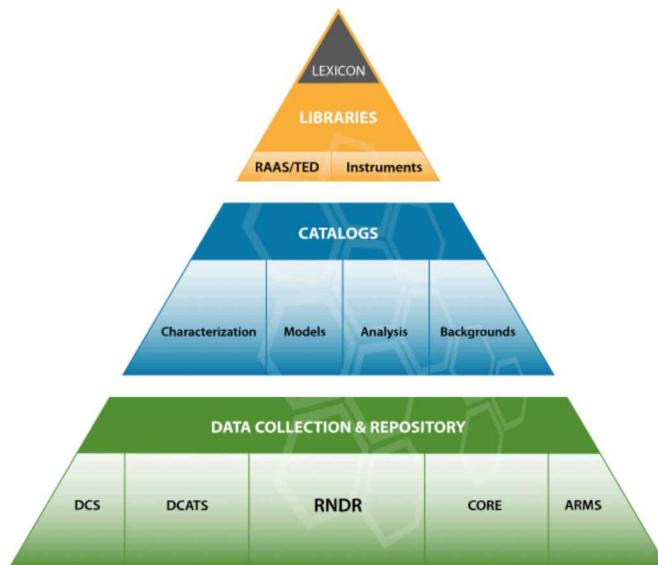
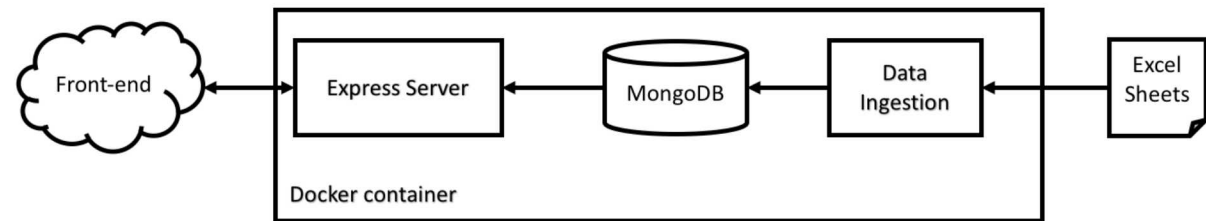




# CharCat Back-End and Deployment Design

- Most back-end components have been implemented.
- Focus on ingesting data provided by test scientists via excel file templates

## Back-End Components



## Also working on:

- Implement cybersecurity and data protection
  - Improve security between the char-cat server and MongoDB
  - Implement OAUTH for common login into DMAMC portal
- Implement linkages to other DMAMC online tools (RNDR, RAAS, Instrument Library, ModCat)
- Understanding requirements for future deployment in AWS (potentially)

# T&E week CharCat live demo

- During development, CharCat has been deployed in a SNL externally facing server at <https://hekili.ca.sandia.gov/dmamc/>
- CharCat WG members have got accounts and are able to provide regular and direct feedback on newly developed features.
- PNNL's Richard Pagh (LIPT lead) to deliver “live” demo at 2019 T&E week by logging in to CharCat.
- Next slides: screen shots of the actual CharCat Web App, highlighting implemented functionality as on July 16, 2018.

Inventory search enabled by by free text typing and by filters.



# Instrument Characterization Catalog

## Inventory

X CLEAR FILTERS

Detector Class ▾

Detector Type ▾

Detector Subtype ^

- High  
☐ sensitivity ion chamber
- ☐ BF3
- ☐ Coaxial HPGe
- ☐ He3
- ☒ HPGe
- ☐ Nal

Manufacturer ^

- ☐ Reuter Stokes
- ☐ LANL
- ☒ ORTEC
- Health  
☐ Physics Instruments
- ☐ Ortec

Detector Use ▾

Owner ▾

SAVE CSV

Search

<input type="checkbox"/>	Serial Number	Description	Use	Owner	Location	Number of Available Characterizations	Last Characterization	Test Participation	Last Test Participation	Last Known Operat
<input type="checkbox"/>	<a href="#">51-TP50885A</a>	Name: GEM100P4-108-HE-S Manufacturer: ORTEC Model: GEM100P4-108-HE-S Type: Gamma / Coaxial HPGe Class: Spectrometer	---	NRL	---	1	---	---	---	---
<input type="checkbox"/>	<a href="#">50-TP50751A</a>	Name: GEM100P4-108-HE-S Manufacturer: ORTEC Model: GEM100P4-108-HE-S Type: Gamma / Coaxial HPGe Class: Spectrometer	---	NRL	---	1	---	---	---	---
<input type="checkbox"/>	<a href="#">51-TP32852A</a>	Name: GEM100P4-108-HE-S Manufacturer: ORTEC Model: GEM100P4-108-HE-S Type: Gamma / Coaxial HPGe Class: Spectrometer	---	NRL	---	1	---	---	---	---
<input type="checkbox"/>	<a href="#">121457818</a>	Name: IDM-200 Manufacturer: ORTEC Model: IDM-200 Type: Gamma / HPGe Class: Spectrometer	Reference Detector	ORNL	---	---	---	5	Test name: RASE handheld Date: 2015-11-01T07:00:00.000Z	---
<input type="checkbox"/>	<a href="#">52-TP51027A</a>	Name: GEM100P4-108-HE-S Manufacturer: ORTEC Model: GEM100P4-108-HE-S Type: Gamma / Coaxial HPGe Class: Spectrometer	---	NRL	---	1	---	---	---	---
<input type="checkbox"/>	<a href="#">52-TP50986A</a>	Name: GEM100P4-108-HE-S Manufacturer: ORTEC Model: GEM100P4-108-HE-S Type: Gamma / Coaxial HPGe Class: Spectrometer	---	NRL	---	1	---	---	---	---
<input type="checkbox"/>		Name: Micro-Detective HPGe Manufacturer: ORTEC								



- Hovering over cell opens tool-tip with date of last update and person
- Enabled CSV file download of the whole table

## Inventory

X CLEAR FILTERS

Search

<input type="checkbox"/>	Serial Number	Description	Use	Owner	Location	Number of Available Characterizations	Last Characterization	Test Participation	Last Test
<input type="checkbox"/>	<a href="#">10000254</a>	Name: Reuter Stokes Ion Chamber Manufacturer: Reuter Stokes Model: RS-S131-200-ER0000 Type: gamma / High sensitivity ion chamber Class: Health Physics Cooler Run hours: not applicable	Measure background at test events	ORNL	Current location: ORNL Regular location: ORNL	---	---	5	Test name: Date: 197
<input type="checkbox"/>	1	Name: BF3 NRDS neutron detector Manufacturer: LANL Model: NRDS Type: Neutron / BF3 Class: Coarse Neutron Spectrometer Cooler Run hours: not applicable	Normlization Test Ground Truth; Reference Detector	LANL	Current location: not available Regular location: LANL	1	Date: 2012 Scientist: Travis Grove, Cheslan Simpson Scientist institution: LANL	Lots	Test name: Date: 197
<input type="checkbox"/>	2	Name: BF3 NRDS neutron detector Manufacturer: LANL Model: NRDS Type: Neutron / BF3 Class: Coarse Neutron Spectrometer Cooler Run hours: not applicable	Normlization Test Ground Truth; Reference Detector	LANL	Current location: not available Regular location: LANL	1	Date: 2012 Scientist: Travis Grove, Cheslan Simpson Scientist institution: LANL	Lots	Test name: Date: 197
<input type="checkbox"/>	<a href="#">51-TP50885A</a>	Name: GEM100P4-108-HE-S Manufacturer: ORTEC Model: GEM100P4-108-HE-S Type: Gamma / Coaxial HPGe Class: Spectrometer	---	NRL	---	1	---	---	---
<input type="checkbox"/>	<a href="#">585216</a>	Name: Meridian Neutron Survey Meter Manufacturer: Health Physics Instruments Model: 5085 Type: Neutron / He3 Class: Health Physics Cooler Run hours: not applicable	Normlization Test Ground Truth	CWMD	---	---	---	---	---
<input type="checkbox"/>		Name: NRDS neutron detector Manufacturer: Model: Type: Class: Cooler Run hours: not applicable							

 SAVE CSV



# Instrument Characterization Catalog

## Inventory



### Micro-Detective HPGe, SN 103217545

Use: Normalization Test Ground Truth  
Manufacturer: ORTEC  
Model: HPRDS3  
Revision: 5085  
Class: Spectrometer  
Type: Gamma  
Owner: CWMD

[Report errors in data](#)

#### DMAMC Linkages

	Backgrounds Catalog
	Report Analysis and Archive System (RAAS)
	Instrument Library
	Modcat
	Lexicon
	Characterization Catalog
	RNRD

- Click on an inventory detector opens the unit's characterization data page, showing:
  - Header with general detector information
  - Linkage to other DMAMC catalogs with related data
  - Table of available Characterization datasets
- Linkage to other DMAMC catalogs:
  - Instrument library with general detector specifications
  - ModCat if there is an existing model
  - RNRD for raw data
  - RAAS for related documents and reports
- User can select which dataset to inspect.
- Dataset table can be downloaded as csv file

#### Characterization Datasets

<input checked="" type="checkbox"/>	Dataset Name	Measured data elements	Start Date	End Date	Measurement Location	Test Scientist Institution	Measurement Purpose	Test Event
<input checked="" type="checkbox"/>	2016/07/28, Routine	Absolute Peak Efficiency	7/28/2016	7/29/2016	NIST	NIST	Routine characterization	---
<input checked="" type="checkbox"/>	2016/08/01, pre-ERNIE	Absolute Peak Efficiency	8/1/2016	8/1/2016	NIST	NIST	Normalization Test, ERNIE	2016/08/10 ERNIE
<input checked="" type="checkbox"/>	2016/08/15, post-ERNIE	Absolute Peak Efficiency	8/15/2016	8/15/2016	NIST	NIST	Normalization Test, ERNIE	2016/08/10 ERNIE
<input checked="" type="checkbox"/>	2016/07/29, Routine background	Background spectrum	7/29/2016	7/29/2016	NIST	NIST	Routine characterization	---
<input checked="" type="checkbox"/>	2016/08/02, pre-ERNIE background	Background spectrum	8/2/2016	8/2/2016	NIST	NIST	Normalization Test, ERNIE	2016/08/10 ERNIE
<input checked="" type="checkbox"/>	2016/08/15, post-ERNIE background	Background spectrum	8/15/2016	8/15/2016	Virginia International Gateway (VIG) Port of Virginia	NIST	Normalization Test, ERNIE	2016/08/10 ERNIE
<input checked="" type="checkbox"/>	2016/07/28, Routine 1	Absolute Peak Efficiency	2/6/2017	2/6/2017	NIST	NIST	Routine characterization	---



- The displayed data elements depend on the dataset. In this example, all the selected datasets report Absolute Peak Efficiency.
- Plot displaying Efficiency vs. Energy values of all selected datasets
- User can further select which dataset to plot.
- Plot formatting: zoom in and out, display x and y grid, display error bars, draw connecting line.

Test Case Filters

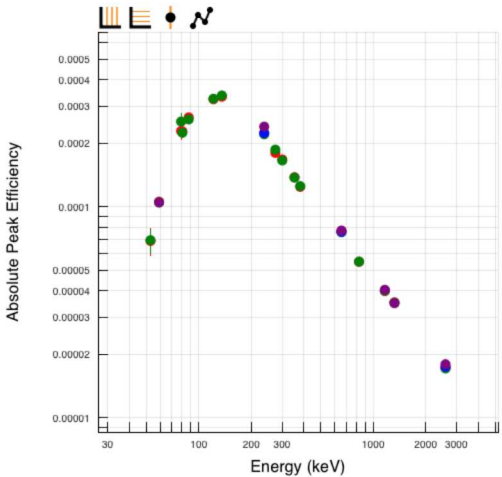
Test Event	▼
Dataset Date	▼
Radionuclide	▼
Source ID	▼
Location	▼
Weather	▼
Distance	▼

Measured Data Elements

Absolute Peak Efficiency

Absolute peak efficiency ( $\epsilon_{abs\ peak}$ ):

Number of pulses recorded within the full energy peak area of the spectrum divided by the number of radiation quanta emitted by the source.



Fit Panel

Type:  $p_0 + \dots + p_n x^n$  Distance: All

X Axis: Log Y Axis: Log

Degree: 5

UPDATE

FIT

RESET

☐ Average of selected datasets

☒ Data Legend

☒ 2016/07/28, Routine

☒ 2016/08/01, pre-ERNIE

☒ 2016/08/15, post-ERNIE

☒ 2016/07/28, Routine 1

Marker

●

●

●

●

Source Detector distance (cm)

50

50

50

50

- Fit panel with several available functions
- Fit selected datasets
- Table displaying fit coefficient values and errors.
- Evaluated fit function also plotted.
- Axis can be fitted in log or linear scale.
- User gets a warning when fitting datasets with different detector-source distance (important for Absolute Peak efficiency data).

Test Case Filters

Test Event

Dataset Date

Radionuclide

Source ID

Location

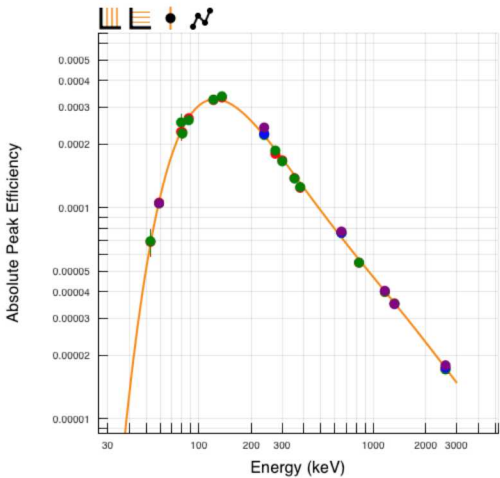
Weather

Distance

Measured Data Elements

Absolute Peak Efficiency

Absolute peak efficiency ( $\epsilon_{abs\ peak}$ ):  
Number of pulses recorded within the full energy peak area of the spectrum divided by the number of radiation quanta emitted by the source.



Fit Panel

Type:  $p_0 + \dots + p_n x^n$  Distance: A//

X Axis: Log Y Axis: Log

Degree: 5

UPDATE	FIT	RESET
Coefficients		
	Values	Errors
$p_0$	-121.21	1.410574e+1
$p_1$	203.5908	2.913759e+1
$p_2$	-138.4822	2.375327e+1
$p_3$	46.50743	9.551872e+0
$p_4$	-7.75336	1.894907e+0
$p_5$	0.5134636	1.483921e-1

☐ Average of selected datasets

<input checked="" type="checkbox"/> Data Legend	Marker	Source Detector distance (cm)
<input checked="" type="checkbox"/> 2016/07/28, Routine	●	50
<input checked="" type="checkbox"/> 2016/08/01, pre-ERNIE	●	50
<input checked="" type="checkbox"/> 2016/08/15, post-ERNIE	●	50
<input checked="" type="checkbox"/> 2016/07/28, Routine 1	●	50

Round values ☐

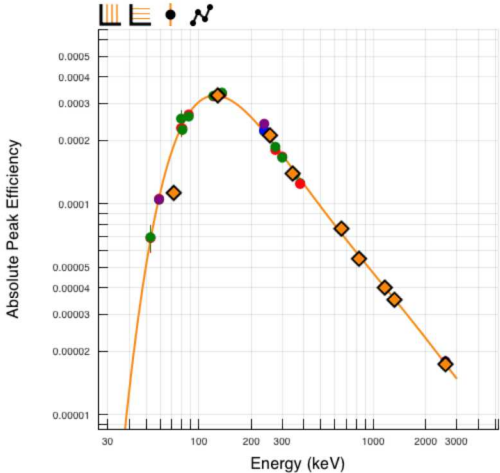
- Table displaying average of selected dataset
- Average values also display (orange diamonds with black border)
- If data errors are provided, they are considered in the average calculation.

Test Case Filters	
Test Event	▼
Dataset Date	▼
Radionuclide	▼
Source ID	▼
Location	▼
Weather	▼
Distance	▼

Measured Data Elements

Absolute Peak Efficiency

Absolute peak efficiency ( $\epsilon_{abs\ peak}$ ):  
Number of pulses recorded within the full energy peak area of the spectrum divided by the number of radiation quanta emitted by the source.



Fit Panel

Type:  $p_0 + \dots + p_n x^n$  Distance:  $A//$

X Axis: Log Y Axis: Log

Degree: 5

UPDATE	FIT	RESET
Coefficients		
Values		
Errors		
$p_0$	-121.21	1.410574e+1
$p_1$	203.5908	2.913759e+1
$p_2$	-138.4822	2.375327e+1
$p_3$	46.50743	9.551872e+0
$p_4$	-7.75336	1.894907e+0
$p_5$	0.5134636	1.483921e-1

Average of selected datasets

Energy (keV) <sup>†</sup>	Energy Error <sup>†</sup>	AbsolutePeakEfficiency (I)	AbsolutePeakEfficiency Error
72.26976	15.047779	0.000112	8.136e-7
129.267105	10.191466	0.000325	3.276e-6
257.51545	26.705231	0.00021	3.878e-6
347.570733	41.153487	0.000139	2.891e-6

<sup>†</sup> Individual measurement errors not used in calculation.

✓	Data Legend	Marker	Source Detector distance (cm)
✓	2016/07/28, Routine	●	50
✓	2016/08/01, pre-ERNIE	●	50
✓	2016/08/15, post-ERNIE	●	50
✓	2016/07/28, Routine 1	●	50

- Test case filters to further select data
- Plot, average and fits are updated according to new selection
- Hovering over plotted data point shows tool-tip with test case data

Test Case Filters

Test Event

Dataset Date

Radionuclide

☐ Am241 (3)

☒ Ba133 (14)

☐ Cd-109 (2)

☐ Co57 (4)

☐ Co60 (6)

☐ Cs137 (4)

☐ Mn-54 (2)

☐ U232 (8)

Source ID

Location

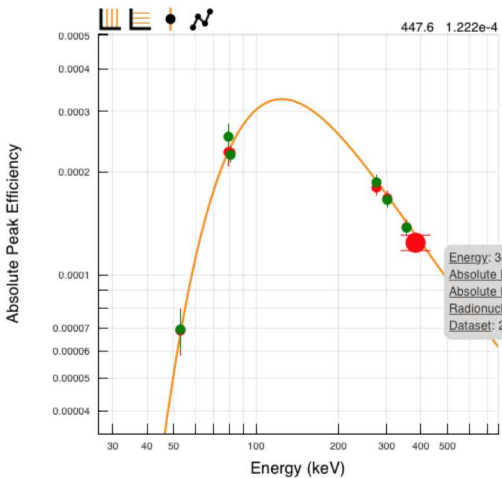
Weather

Distance

Measured Data Elements

Absolute Peak Efficiency

Absolute peak efficiency ( $\epsilon_{abs\ peak}$ ):  
Number of pulses recorded within the full energy peak area of the spectrum divided by the number of radiation quanta emitted by the source.



Fit Panel

Type:  $p_0 + \dots + p_n x^n$  Distance: All

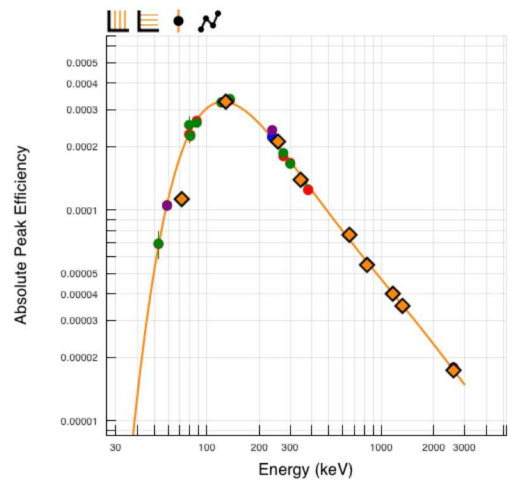
X Axis: Log Y Axis: Log

Degree: 5

UPDATE	FIT	RESET
Coefficients		
$p_0$	-121.21	1.410574e+1
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$p_5$	0.5134636	1.483921e-1

Average of selected datasets

<input checked="" type="checkbox"/> Data Legend	Marker	Source Detector distance (cm)
<input checked="" type="checkbox"/> 2016/07/28, Routine	●	50
<input checked="" type="checkbox"/> 2016/08/01, pre-ERNIE	●	50
<input checked="" type="checkbox"/> 2016/08/15, post-ERNIE	●	---
<input checked="" type="checkbox"/> 2016/07/28, Routine 1	●	---



Fit Panel

Type:  $p_0 + \dots + p_n x^n$  Distance:  $A//$

X Axis: Log Y Axis: Log

Degree: 5

UPDATE	FIT	RESET
Coefficients		
$p_0$	-121.21	1.410574e+1
$p_1$	203.5908	2.913759e+1
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Average of selected datasets

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<input checked="" type="checkbox"/> 2016/07/28, Routine	●	50
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<input checked="" type="checkbox"/> 2016/08/15, post-ERNIE	●	50
<input checked="" type="checkbox"/> 2016/07/28, Routine 1	●	50

Dataset	Energy	Absolute Peak Efficiency	Absolute Peak Efficiency Uncertainty	Source ID/Serial number	Radionuclide	Net Peak Counts	Net Peak Counts Uncertainty	Life
2016/07/28, Routine, Routine characterization	53.1622	0.000069	0.000011	133-A	Ba133	1029.04	149.2108	2
2016/07/28, Routine, Routine characterization	79.6142	0.000228	0.000021	133-A	Ba133	5141.88	105.922728	2
2016/07/28, Routine, Routine characterization	80.9979	0.000227	0.000012	133-A	Ba133	65162.36	273.681912	2
2016/07/28, Routine, Routine characterization	276.3989	0.000179	9.296e-6	133-A	Ba133	12099.33	130.672764	2
2016/07/28, Routine, Routine characterization	302.8508	0.000167	8.460e-6	133-A	Ba133	28938.77	173.63262	2
2016/07/28, Routine, Routine characterization	356.0129	0.000137	6.901e-6	133-A	Ba133	80939.31	283.287585	2
2016/07/28, Routine, Routine characterization	383.8485	0.000124	6.370e-6	133-A	Ba133	10509.42	107.196084	2





## Instrument Characterization Catalog

Inventory

Data Upload

Future work: Add page for data ingestion to enable test scientists :

- Submit new characterization data for existing instrument
- Add new instrument to inventory
- Update inventory data of existing instrument

This will be done via:

- Characterization data Excel templates
- Inventory data Web form

We hope to get lots of data!!!!

The CharCat philosophy is to only display data as reported and provided by the test scientists.