March 7, 2024

Bradlee Rothwell
HPC Website Developer
and System Administrator

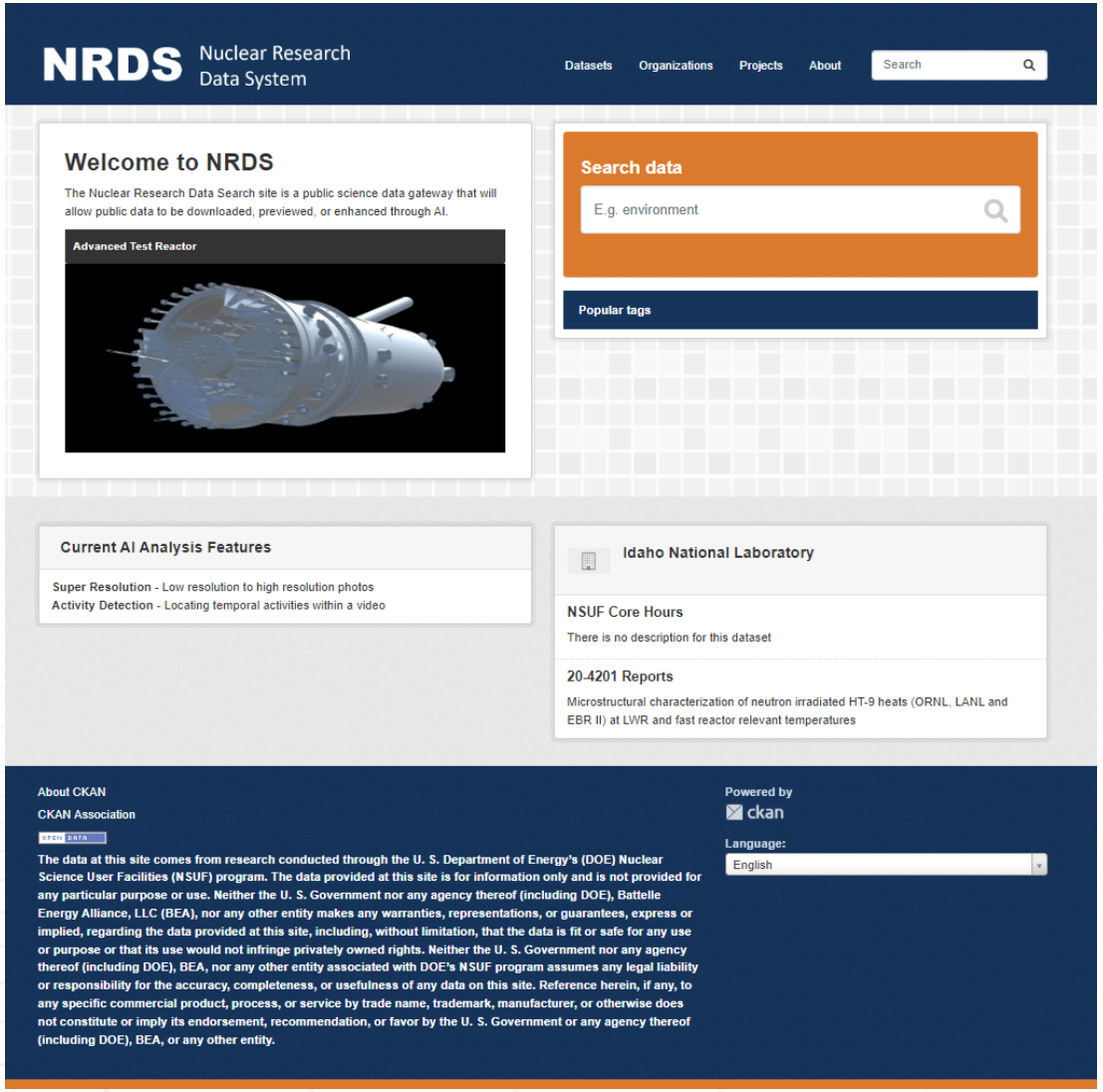
Overview of the Nuclear Research Data System (NRDS)

INL/CON-24-76522

Nuclear Science User Facilities

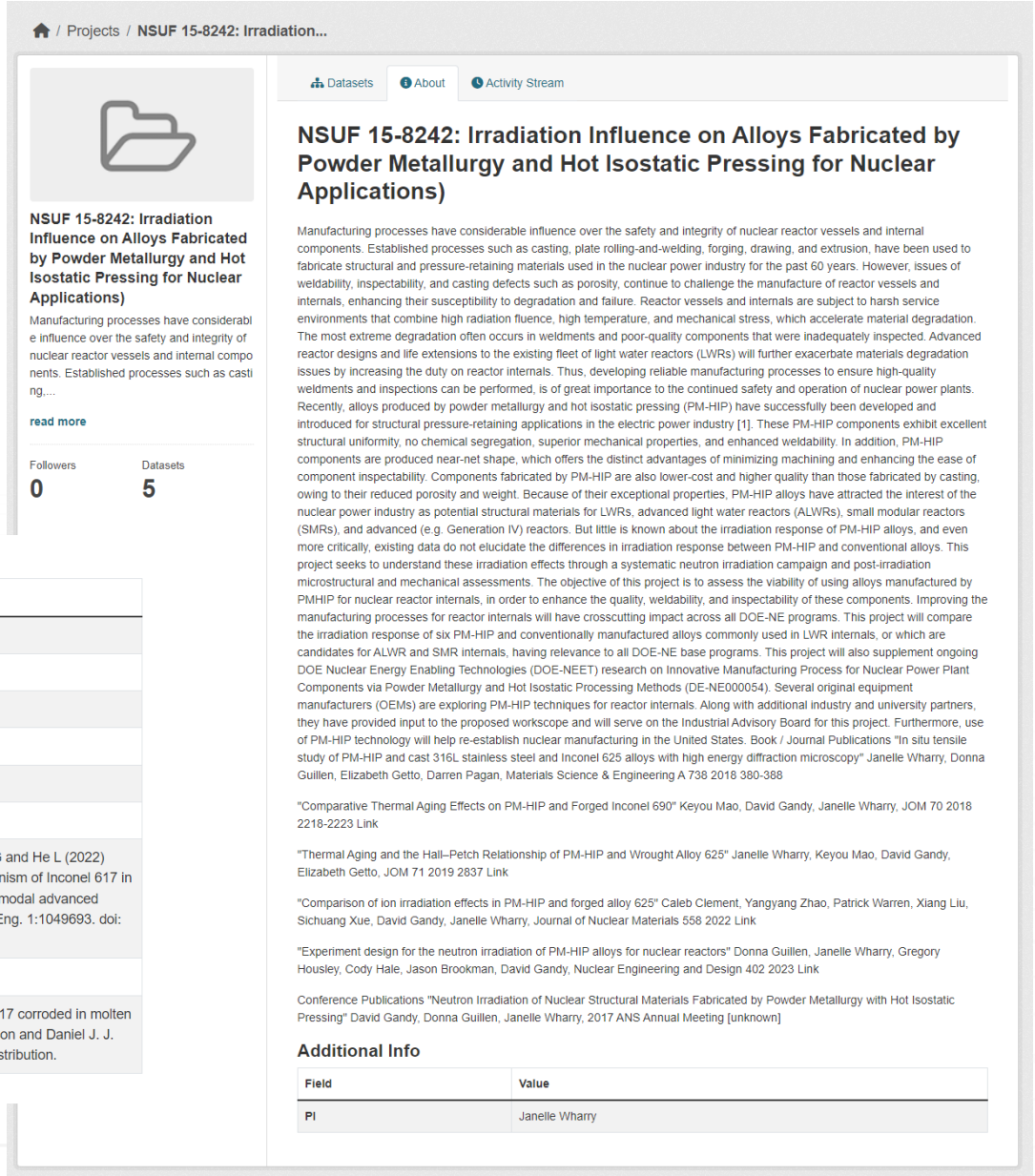
What is NRDS?

- Place for data to be:
  - Publicly available
  - FpAIRe
    - Findability
    - Peekable
    - Accessibility
    - Interoperable
      - Stored close to HPC systems
    - Reusable
    - Extensible
- Funded by the Nuclear Science User Facilities



NRDS

- License
- Type of data
- Author
- OSTI Link
- DOI Link



Projects / NSUF 15-8242: Irradiation...

Datasets | About | Activity Stream

NSUF 15-8242: Irradiation Influence on Alloys Fabricated by Powder Metallurgy and Hot Isostatic Pressing for Nuclear Applications)

Manufacturing processes have considerabl e influence over the safety and integrity of nuclear reactor vessels and internal compo nents. Established processes such as casti ng,...

read more

Followers 0

Datasets 5

NSUF 15-8242: Irradiation Influence on Alloys Fabricated by Powder Metallurgy and Hot Isostatic Pressing for Nuclear Applications)

Manufacturing processes have considerable influence over the safety and integrity of nuclear reactor vessels and internal components. Established processes such as casting, plate rolling-and-welding, forging, drawing, and extrusion, have been used to fabricate structural and pressure-retaining materials used in the nuclear power industry for the past 60 years. However, issues of weldability, inspectability, and casting defects such as porosity, continue to challenge the manufacture of reactor vessels and internals, enhancing their susceptibility to degradation and failure. Reactor vessels and internals are subject to harsh service environments that combine high radiation fluence, high temperature, and mechanical stress, which accelerate material degradation. The most extreme degradation often occurs in weldments and poor-quality components that were inadequately inspected. Advanced reactor designs and life extensions to the existing fleet of light water reactors (LWRs) will further exacerbate materials degradation issues by increasing the duty on reactor internals. Thus, developing reliable manufacturing processes to ensure high-quality weldments and inspections can be performed, is of great importance to the continued safety and operation of nuclear power plants. Recently, alloys produced by powder metallurgy and hot isostatic pressing (PM-HIP) have successfully been developed and introduced for structural pressure-retaining applications in the electric power industry [1]. These PM-HIP components exhibit excellent structural uniformity, no chemical segregation, superior mechanical properties, and enhanced weldability. In addition, PM-HIP components are produced near-net shape, which offers the distinct advantages of minimizing machining and enhancing the ease of component inspectability. Components fabricated by PM-HIP are also lower-cost and higher quality than those fabricated by casting, owing to their reduced porosity and weight. Because of their exceptional properties, PM-HIP alloys have attracted the interest of the nuclear power industry as potential structural materials for LWRs, advanced light water reactors (ALWRs), small modular reactors (SMRs), and advanced (e.g. Generation IV) reactors. But little is known about the irradiation response of PM-HIP alloys, and even more critically, existing data do not elucidate the differences in irradiation response between PM-HIP and conventional alloys. This project seeks to understand these irradiation effects through a systematic neutron irradiation campaign and post-irradiation microstructural and mechanical assessments. The objective of this project is to assess the viability of using alloys manufactured by PMHIP for nuclear reactor internals, in order to enhance the quality, weldability, and inspectability of these components. Improving the manufacturing processes for reactor internals will have crosscutting impact across all DOE-NE programs. This project will compare the irradiation response of six PM-HIP and conventionally manufactured alloys commonly used in LWR internals, or which are candidates for ALWR and SMR internals, having relevance to all DOE-NE base programs. This project will also supplement ongoing DOE Nuclear Energy Enabling Technologies (DOE-NEET) research on Innovative Manufacturing Process for Nuclear Power Plant Components via Powder Metallurgy and Hot Isostatic Processing Methods (DE-NE000054). Several original equipment manufacturers (OEMs) are exploring PM-HIP techniques for reactor internals. Along with additional industry and university partners, they have provided input to the proposed workscope and will serve on the Industrial Advisory Board for this project. Furthermore, use of PM-HIP technology will help re-establish nuclear manufacturing in the United States. Book / Journal Publications "In situ tensile study of PM-HIP and cast 316L stainless steel and Inconel 625 alloys with high energy diffraction microscopy" Janelle Wharry, Donna Guillen, Elizabeth Getto, Darren Pagan, Materials Science & Engineering A 738 2018 380-388

"Comparative Thermal Aging Effects on PM-HIP and Forged Inconel 690" Keyou Mao, David Gandy, Janelle Wharry, JOM 70 2018 2218-2223 Link

"Thermal Aging and the Hall–Petch Relationship of PM-HIP and Wrought Alloy 625" Janelle Wharry, Keyou Mao, David Gandy, Elizabeth Getto, JOM 71 2019 2837 Link

"Comparison of ion irradiation effects in PM-HIP and forged alloy 625" Caleb Clement, Yangyang Zhao, Patrick Warren, Xiang Liu, Sichuang Xue, David Gandy, Janelle Wharry, Journal of Nuclear Materials 558 2022 Link

"Experiment design for the neutron irradiation of PM-HIP alloys for nuclear reactors" Donna Guillen, Janelle Wharry, Gregory Housley, Cody Hale, Jason Brookman, David Gandy, Nuclear Engineering and Design 402 2023 Link

Conference Publications "Neutron Irradiation of Nuclear Structural Materials Fabricated by Powder Metallurgy with Hot Isostatic Pressing" David Gandy, Donna Guillen, Janelle Wharry, 2017 ANS Annual Meeting [unknown]

Additional Info

Field	Value
PI	Janelle Wharry

Additional Info

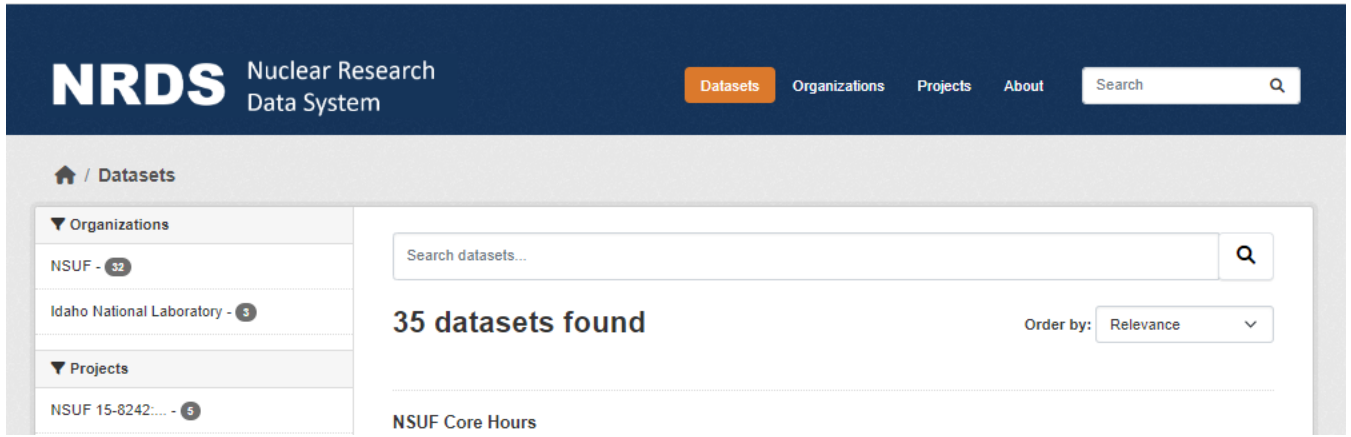
Field	Value
Author	Trishelle Copeland-Johnson
Last Updated	February 27, 2024, 2:04 PM (UTC-07:00)
Created	February 7, 2024, 10:31 AM (UTC-07:00)
OSTI	
DOI Link	https://doi.org/10.48806/2287679
Instrument	FEI G4 Helios Hydra Plasma-FIB
Publication	Copeland-Johnson TM, Murray DJ, Cao G and He L (2022) Assessing the interfacial corrosion mechanism of Inconel 617 in chloride molten salt corrosion using multi-modal advanced characterization techniques. Front. Nucl. Eng. 1:1049693. doi: 10.3389/fnuen.2022.1049693
Slice Offset	100 nm
Statement of Credit	"Focused ion beam tomography of Alloy 617 corroded in molten chloride salt" by Trishelle Copeland-Johnson and Daniel J. J. Murray is licensed under CC BY 4.0 for distribution.

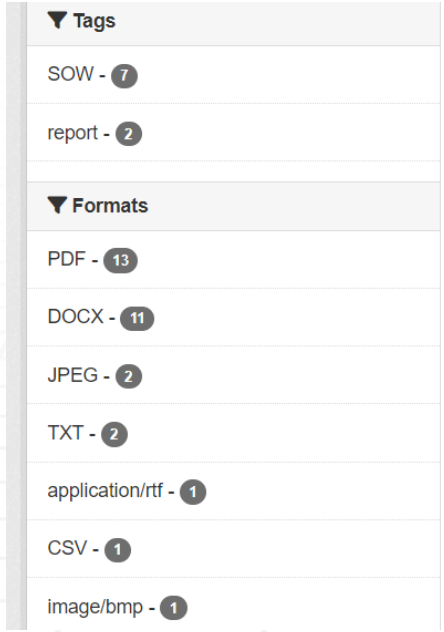
FpAIRe Data

- Findability
- Peekable
- Accessibility
- Interoperable
- Reusable
- Extensible

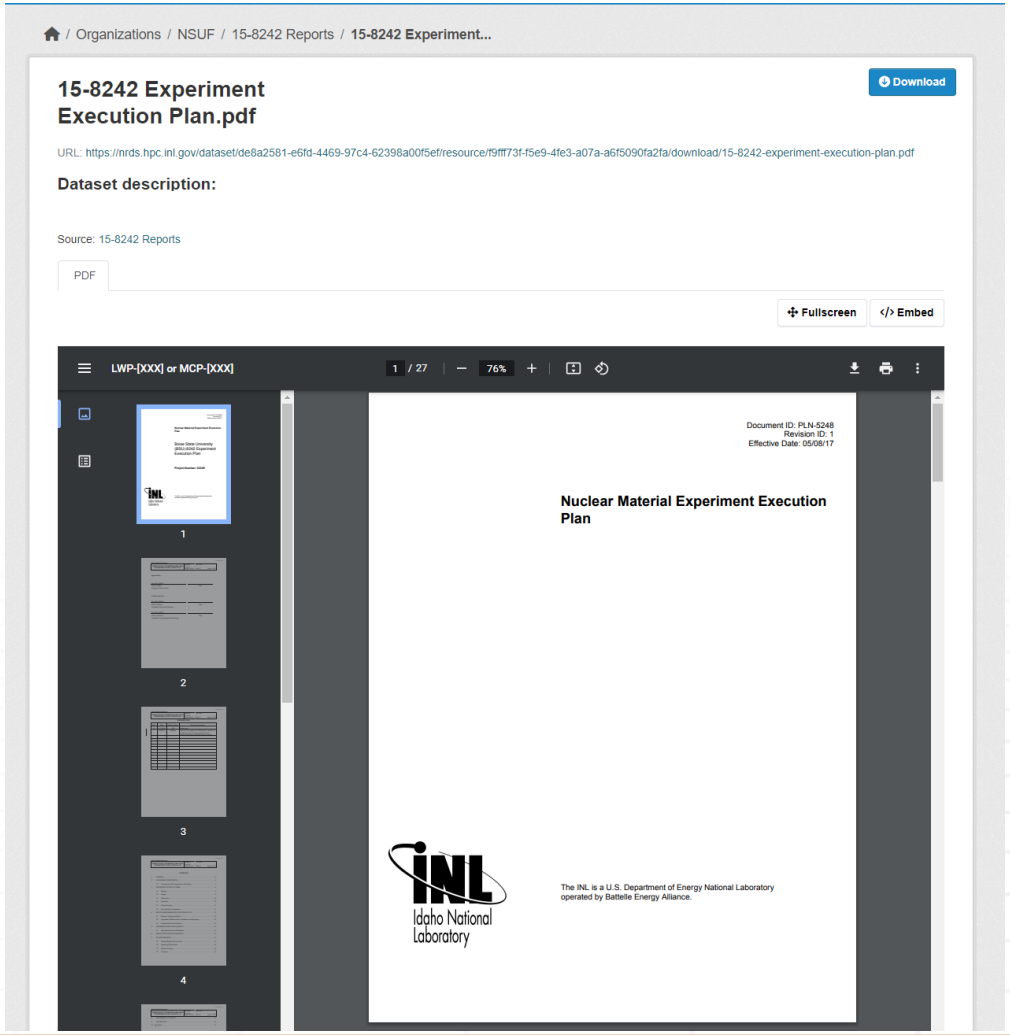
Findability

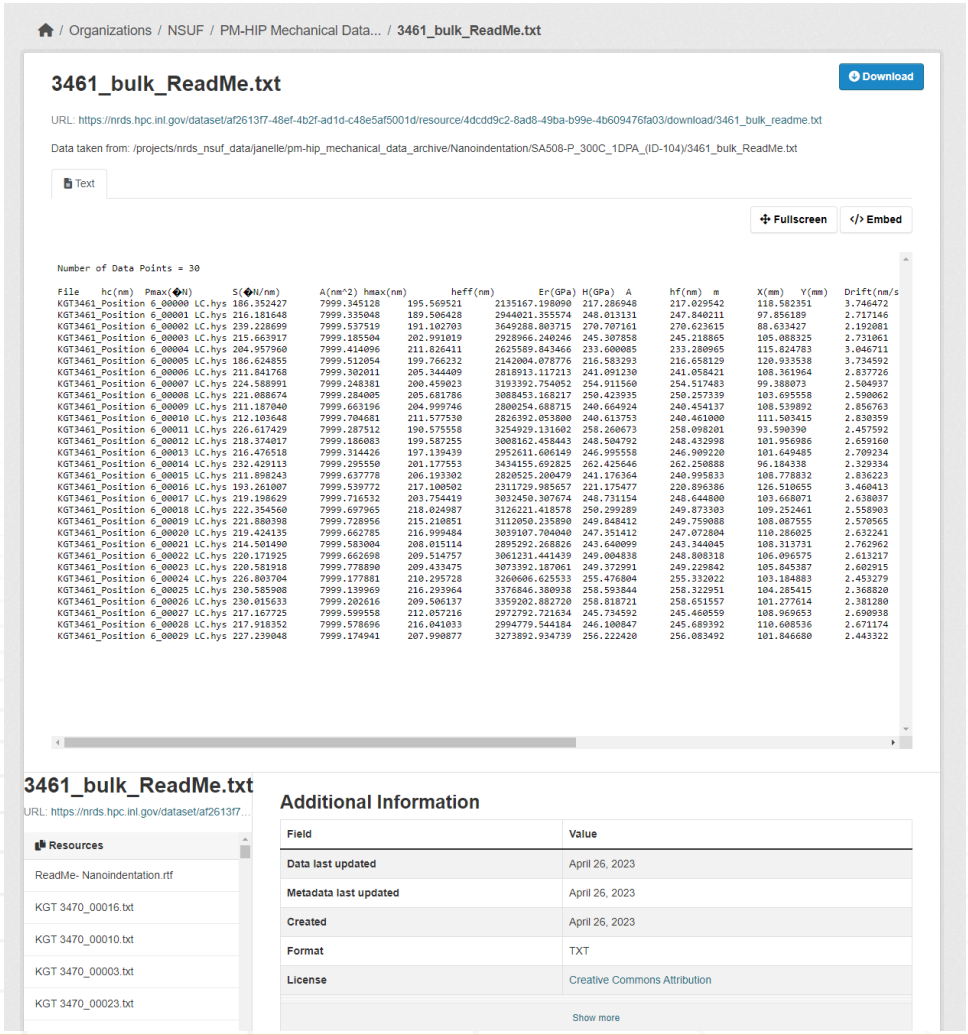
- Search features
- DOI Link
- Organized by projects
- Tags
- OSTI Link



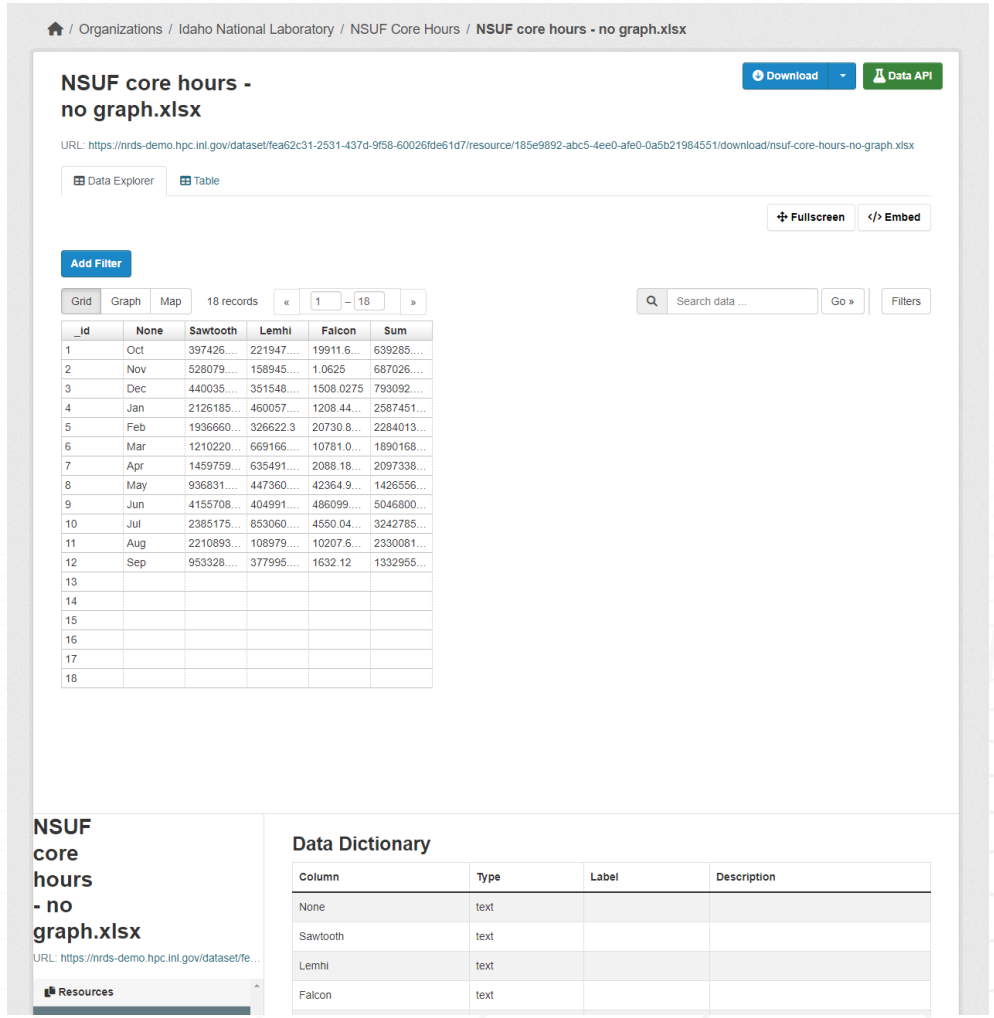


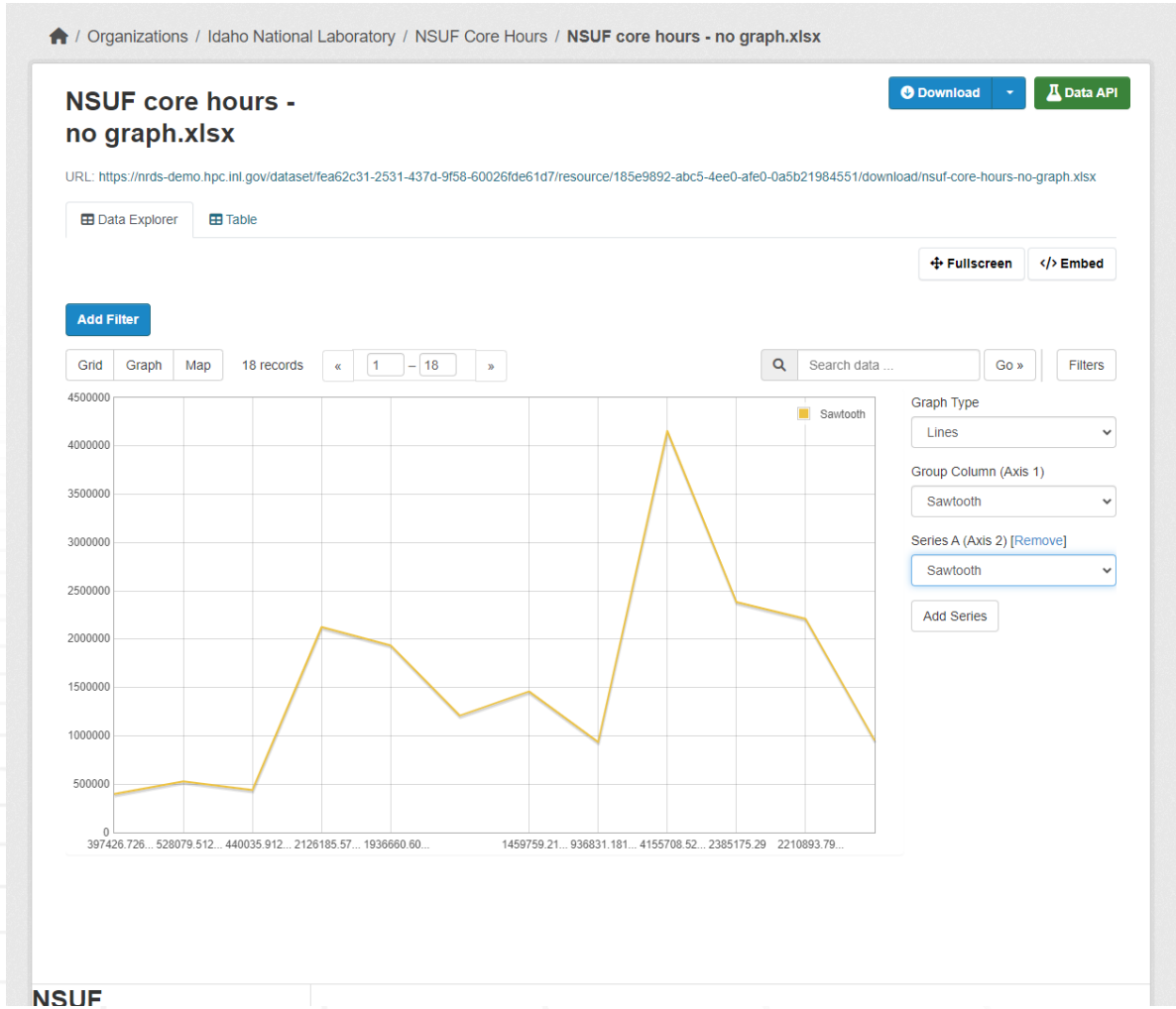
Peekable


/ Organizations / NSUF / 15-8242 Reports / 15-8242 Experiment...
15-8242 Experiment Execution Plan.pdf
Download
URL: https://nrds.hpc.inl.gov/dataset/de8a2581-e6fd-4469-97c4-62398a00f5ef/resource/f9fff73f-f5e9-4fe3-a07a-a6f5090fa2fa/download/15-8242-experiment-execution-plan.pdf
Dataset description:
Source: 15-8242 Reports
PDF
Fullscreen
Embed
LWP-[XXX] or MCP-[XXX]
1 / 27
76%
Document ID: PLN-5248
Revision ID: 1
Effective Date: 05/08/17
Nuclear Material Experiment Execution Plan
Idaho National Laboratory
The INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance.


/ Organizations / NSUF / PM-HIP Mechanical Data... / 3461_bulk_ReadMe.txt
3461_bulk_ReadMe.txt
Download
URL: https://nrds.hpc.inl.gov/dataset/af2613f7-48ef-4b2f-ad1d-c48e5af5001d/resource/4dcdd9c2-8ad8-49ba-b99e-4b609476fa03/download/3461_bulk_readme.txt
Data taken from: /projects/nrds_nsuf_data/janelle/pm-hip_mechanical_data_archive/Nanoindentation/SA508-P_300C_1DPA_(ID-104)/3461_bulk_ReadMe.txt
Text
Fullscreen
Embed
Number of Data Points = 30
File hc(nm) Pmax(μN) S(μN/nm) A(nm^2) hmax(nm) heff(nm) Er(GPa) H(GPa) A hf(nm) m X(mm) Y(mm) Drift(nm/s
KGT3461_Position 6_00000 LC.hys 186.352427 7999.345128 195.569521 2135167.198090 217.286948 217.029542 118.582351 3.746472
KGT3461_Position 6_00001 LC.hys 216.181648 7999.335048 189.506428 2944021.355574 248.013131 247.840211 97.856189 2.717146
KGT3461_Position 6_00002 LC.hys 239.228699 7999.537519 191.102703 3649288.803715 270.707161 270.623615 88.633427 2.192081
KGT3461_Position 6_00003 LC.hys 215.663917 7999.185504 202.991019 2928966.240246 245.307858 245.218865 105.088325 2.731061
KGT3461_Position 6_00004 LC.hys 204.957960 7999.414096 211.826411 2625589.843466 233.600085 233.280965 115.824783 3.046711
KGT3461_Position 6_00005 LC.hys 186.624855 7999.512054 199.766232 2142004.078776 216.583293 216.658129 120.933538 3.734592
KGT3461_Position 6_00006 LC.hys 211.841768 7999.302011 205.344409 2818913.117213 241.091230 241.058421 108.361964 2.837726
KGT3461_Position 6_00007 LC.hys 224.588991 7999.248381 200.459023 3193392.754052 254.911560 254.517483 99.388073 2.504937
KGT3461_Position 6_00008 LC.hys 221.088674 7999.284005 205.681786 3088453.168217 250.423935 250.257339 103.695558 2.590062
KGT3461_Position 6_00009 LC.hys 211.187040 7999.663196 204.999746 2800254.688715 240.664924 240.454137 108.539892 2.856763
KGT3461_Position 6_00010 LC.hys 212.103648 7999.704681 211.577530 2826392.053800 240.613753 240.461000 111.503415 2.830359
KGT3461_Position 6_00011 LC.hys 226.617429 7999.287512 190.575558 3254929.131602 258.260673 258.098201 93.590390 2.457592
KGT3461_Position 6_00012 LC.hys 218.374017 7999.186083 199.587255 3008162.458443 248.504792 248.432998 101.956986 2.659160
KGT3461_Position 6_00013 LC.hys 216.476518 7999.314426 197.139439 2952611.606149 246.995558 246.909220 101.649485 2.709234
KGT3461_Position 6_00014 LC.hys 232.429113 7999.295550 201.177553 3434155.692825 262.425646 262.250888 96.184338 2.329334
KGT3461_Position 6_00015 LC.hys 211.898243 7999.637778 206.193302 2820525.200479 241.176364 240.995833 108.778832 2.836223
KGT3461_Position 6_00016 LC.hys 193.261007 7999.539772 217.100502 2311729.985657 221.175477 220.896386 126.510655 3.460413
KGT3461_Position 6_00017 LC.hys 219.198629 7999.716532 203.754419 3032450.307674 248.731154 248.644800 103.668071 2.638037
KGT3461_Position 6_00018 LC.hys 222.354560 7999.697965 218.024987 3126221.418578 250.299289 249.873303 109.252461 2.558903
KGT3461_Position 6_00019 LC.hys 221.880398 7999.728956 215.210851 3112050.235890 249.848412 249.759088 108.087555 2.570565
KGT3461_Position 6_00020 LC.hys 219.424135 7999.662785 216.999484 3039107.704040 247.351412 247.072804 110.286025 2.632241
KGT3461_Position 6_00021 LC.hys 214.501490 7999.583004 208.015114 2895292.268826 243.640099 243.344045 108.313731 2.762962
KGT3461_Position 6_00022 LC.hys 220.171925 7999.662698 209.514757 3061231.441439 249.004838 248.808318 106.096575 2.613217
KGT3461_Position 6_00023 LC.hys 220.581918 7999.778890 209.433475 3073392.187061 249.372991 249.229842 105.845387 2.602915
KGT3461_Position 6_00024 LC.hys 226.803704 7999.177881 210.295728 3260606.625533 255.476804 255.332022 103.184883 2.453279
KGT3461_Position 6_00025 LC.hys 230.585908 7999.139969 216.293964 3376846.380938 258.593844 258.322951 104.285415 2.368820
KGT3461_Position 6_00026 LC.hys 230.015633 7999.202616 209.506137 3359202.882720 258.818721 258.651557 101.277614 2.381280
KGT3461_Position 6_00027 LC.hys 217.167725 7999.599558 212.057216 2972792.721634 245.734592 245.460559 108.969653 2.690938
KGT3461_Position 6_00028 LC.hys 217.918352 7999.578696 216.041033 2994779.544184 246.100847 245.689392 110.608536 2.671174
KGT3461_Position 6_00029 LC.hys 227.239048 7999.174941 207.990877 3273892.934739 256.222420 256.083492 101.846680 2.443322
3461_bulk_ReadMe.txt
URL: https://nrds.hpc.inl.gov/dataset/af2613f7...
Resources
ReadMe- Nanoindentation.rtf
KGT 3470_00016.txt
KGT 3470_00010.txt
KGT 3470_00003.txt
KGT 3470_00023.txt
Additional Information
Field
Value
Data last updated
April 26, 2023
Metadata last updated
April 26, 2023
Created
April 26, 2023
Format
TXT
License
Creative Commons Attribution
Show more

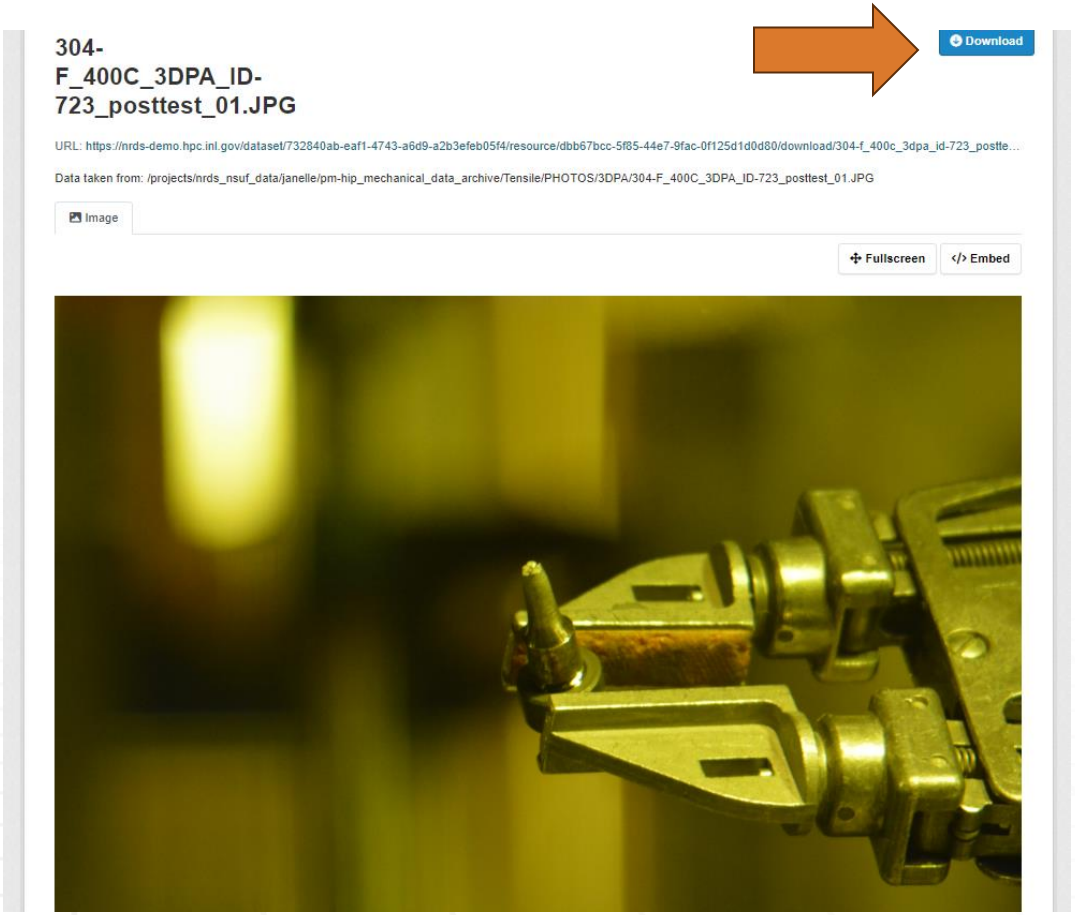
Peekable


Organizations / Idaho National Laboratory / NSUF Core Hours / NSUF core hours - no graph.xlsx
NSUF core hours - no graph.xlsx
Download
Data API
URL: https://nrds-demo.hpc.inl.gov/dataset/fea62c31-2531-437d-9f58-60026fde61d7/resource/185e9892-abc5-4ee0-afe0-0a5b21984551/download/nsuf-core-hours-no-graph.xlsx
Data Explorer
Table
Fullscreen
Embed
Add Filter
Grid
Graph
Map
18 records
Search data ...
Go »
Filters
_id None Sawtooth Lemhi Falcon Sum
1 Oct 397426.... 221947.... 19911.6... 639285....
2 Nov 528079.... 158945.... 1.0625 687026....
3 Dec 440035.... 351548.... 1508.0275 793092....
4 Jan 2126185... 460057.... 1208.44... 2587451...
5 Feb 1936660... 326622.3 20730.8... 2284013...
6 Mar 1210220... 669166.... 10781.0... 1890168...
7 Apr 1459759... 635491.... 2088.18... 2097338...
8 May 936831.... 447360.... 42364.9... 1426556...
9 Jun 4155708... 404991.... 486099.... 5046800...
10 Jul 2385175... 853060.... 4550.04... 3242785...
11 Aug 2210893... 108979.... 10207.6... 2330081...
12 Sep 953328.... 377995.... 1632.12 1332955...
13
14
15
16
17
18
NSUF core hours - no graph.xlsx
URL: https://nrds-demo.hpc.inl.gov/dataset/fe...
Resources
Data Dictionary
Column Type Label Description
None text
Sawtooth text
Lemhi text
Falcon text


Organizations / Idaho National Laboratory / NSUF Core Hours / NSUF core hours - no graph.xlsx
NSUF core hours - no graph.xlsx
Download
Data API
URL: https://nrds-demo.hpc.inl.gov/dataset/fea62c31-2531-437d-9f58-60026fde61d7/resource/185e9892-abc5-4ee0-afe0-0a5b21984551/download/nsuf-core-hours-no-graph.xlsx
Data Explorer
Table
Fullscreen
Embed
Add Filter
Grid
Graph
Map
18 records
Search data ...
Go »
Filters
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
Sawtooth
397426.726... 528079.512... 440035.912... 2126185.57... 1936660.60...
1459759.21... 936831.181... 4155708.52... 2385175.29 2210893.79...
Graph Type
Lines
Group Column (Axis 1)
Sawtooth
Series A (Axis 2) [Remove]
Sawtooth
Add Series
NSUF

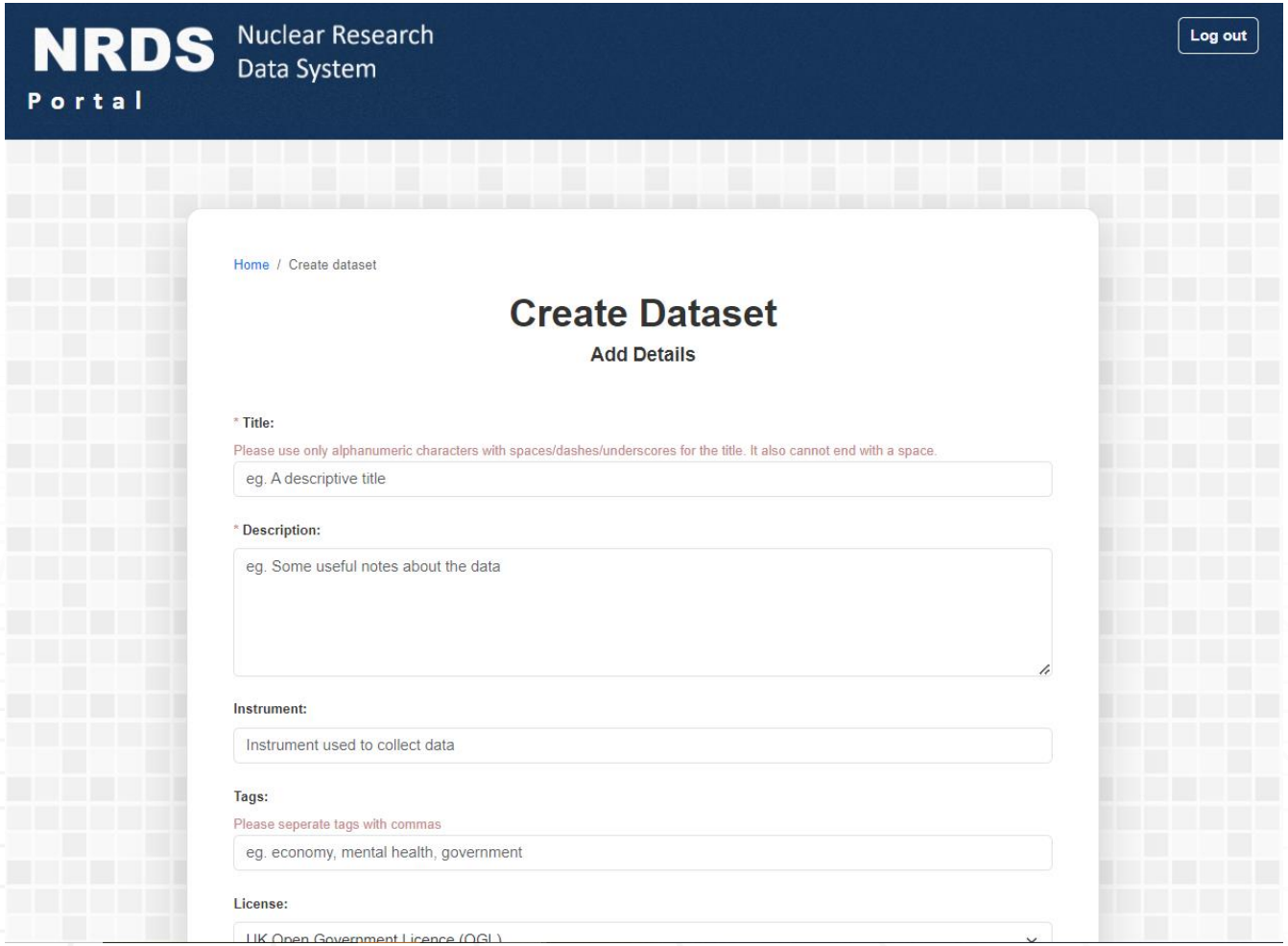
Accessibility

- Anyone can view data
- No password required
- DOIs created upon upload
- Creative Commons Attribution
  - Open sourced, publicly available data



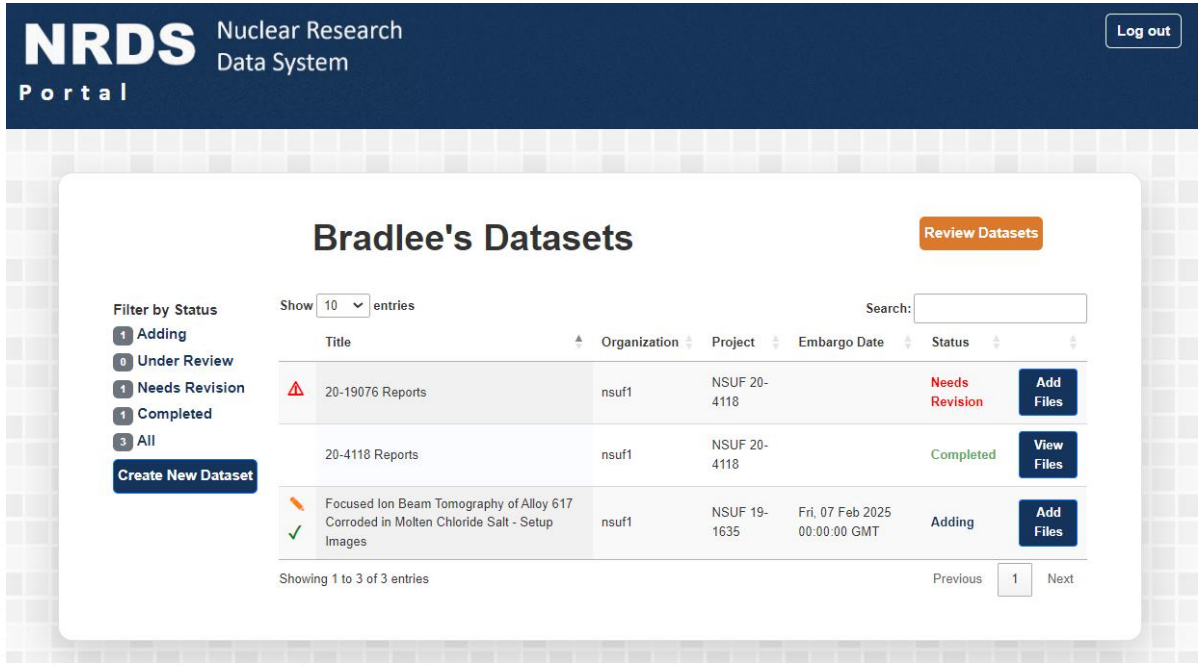
Enhancing Interoperability

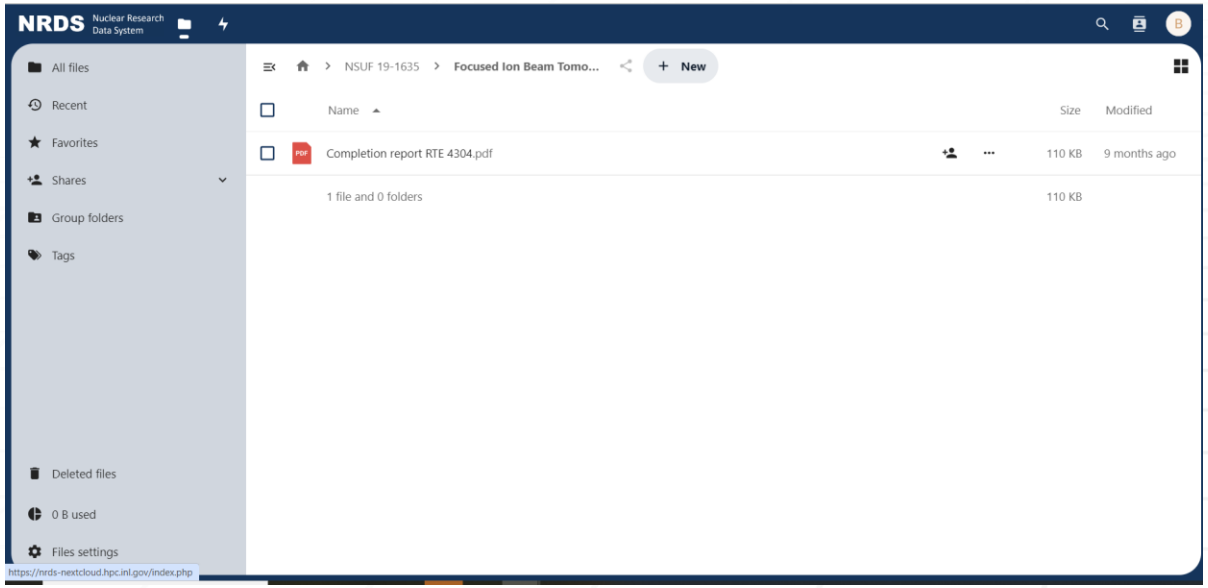
- Any researcher within the project can upload data
- Enforced embargo dates



Interoperable - Portal

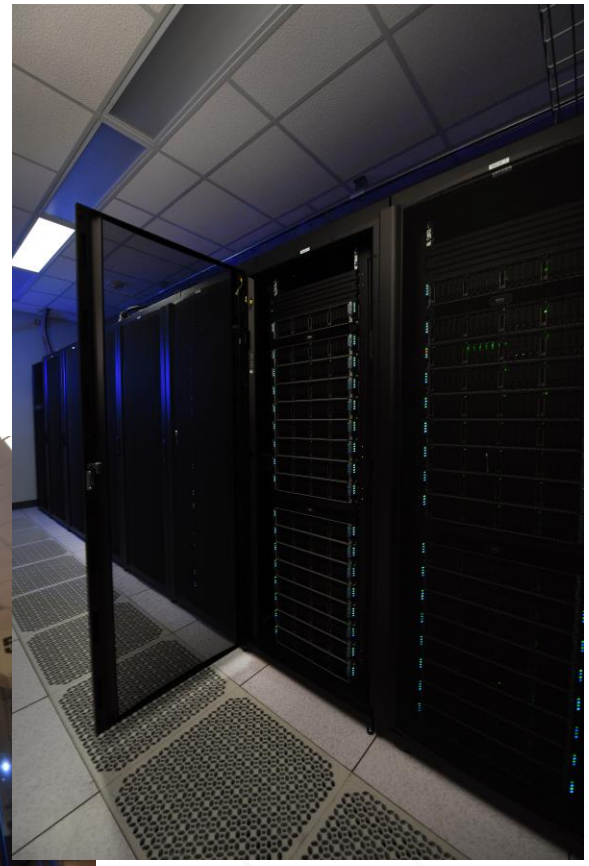
- Allows drop and drag of files
- Collaboration among others in project
- PI approval required before public release





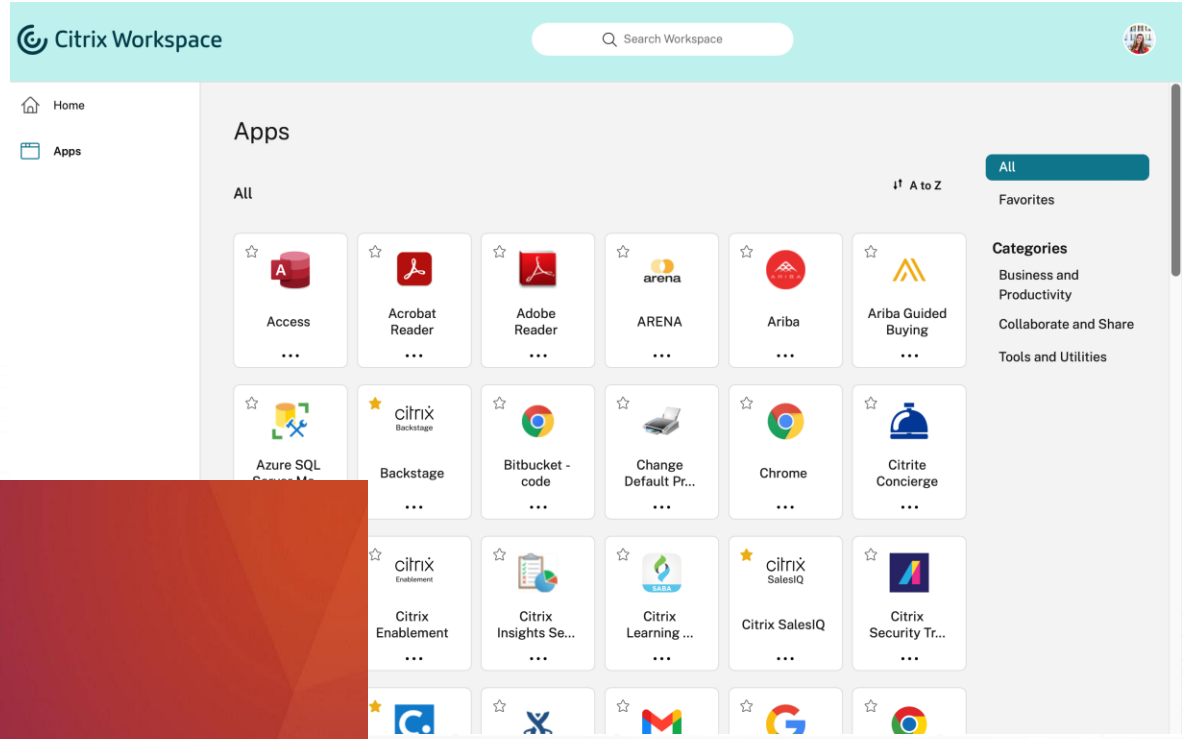
Interoperable - Close to the HPC Systems

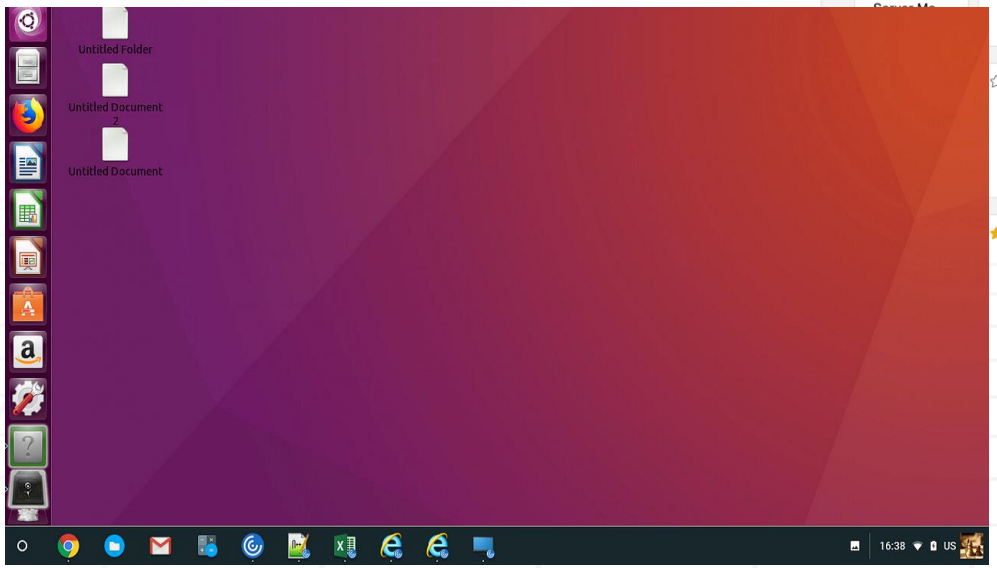
- Anyone can make use of the data on HPC systems
  - Co-located on HPC Systems
    - Reduced data movement



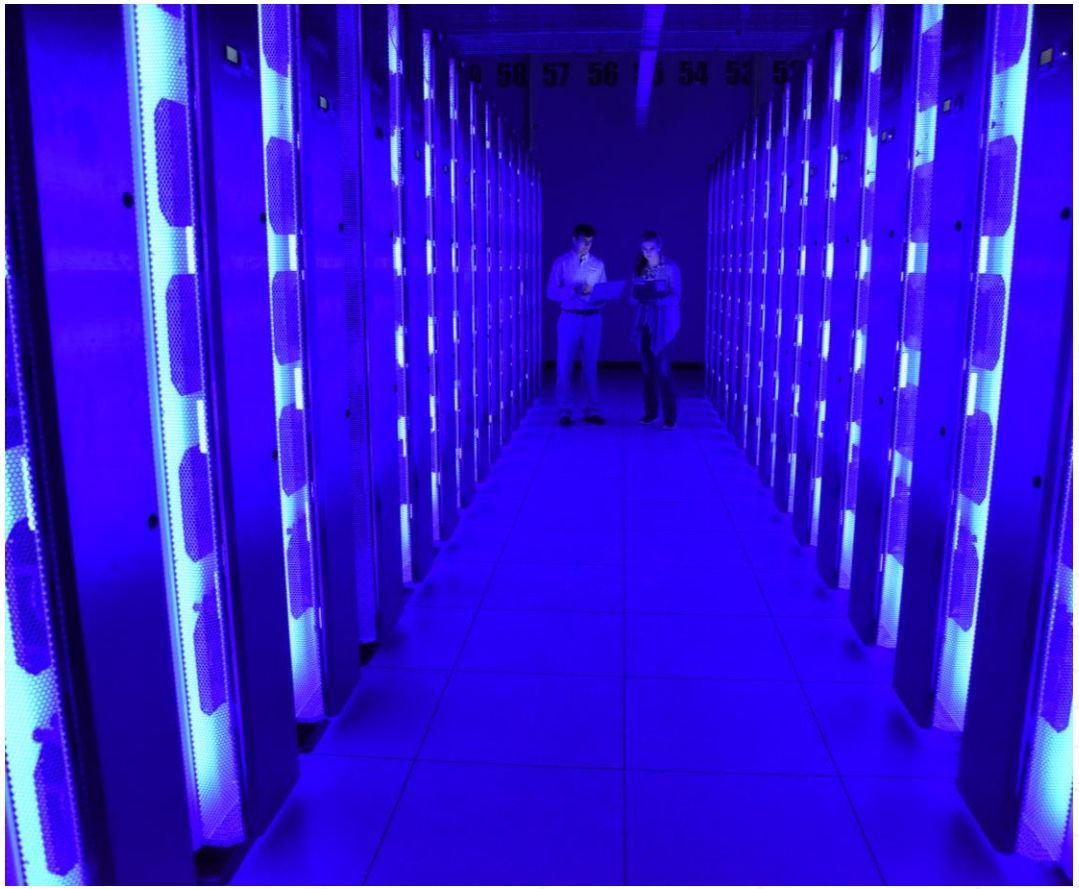
Interoperable - Citrix Hypervisor

- Allow for direct access to GPUs to run models on data
- Virtual Desktops
- Coming soon



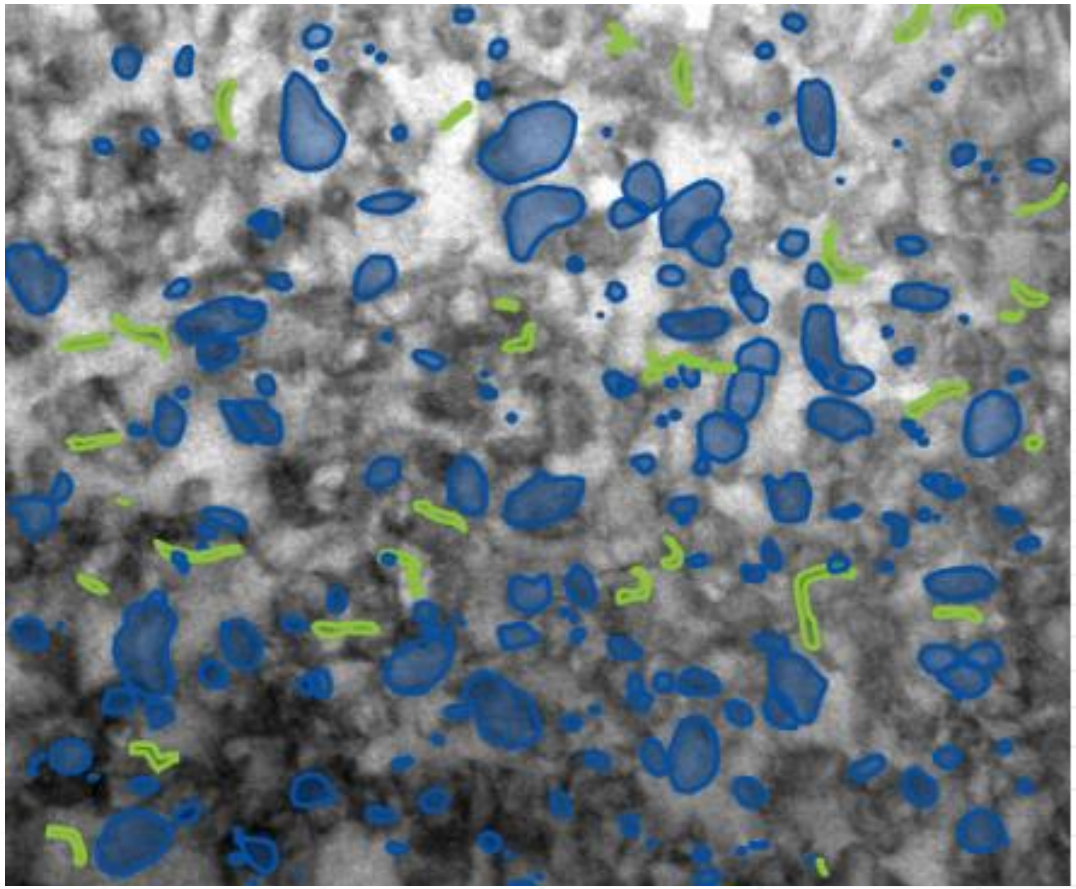


Reusable



- NRDS Storage will keep the data
  - 1.2 PB initially
- Stored in a non-proprietary format

Extensible



- Annotation will give data new life
  - AI Analysis
  - New discoveries

AI Analysis

- **Currently Available**
  - Super Resolution
  - Activity Detection
- **Coming Soon**
  - Anomaly Detection
  - Object Detection
  - Stitching

Super Resolution

Super Resolution

Low resolution to high resolution photo

Images will be deleted after one day of generation. Please make sure to download the image or else the image will have to be regenerated

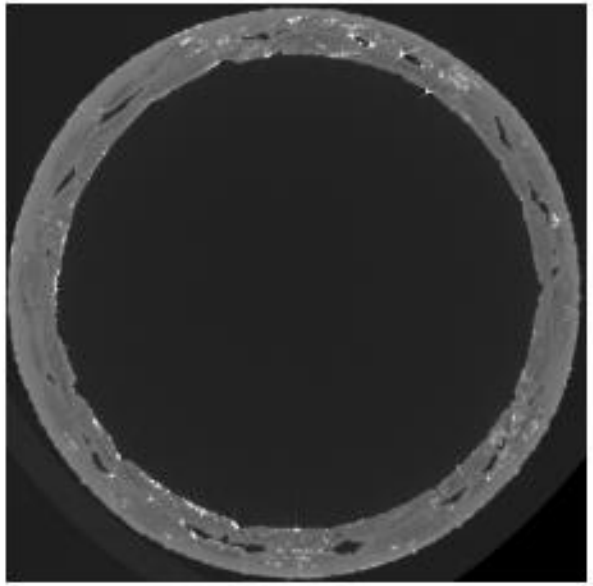
Upscale

Sharpen

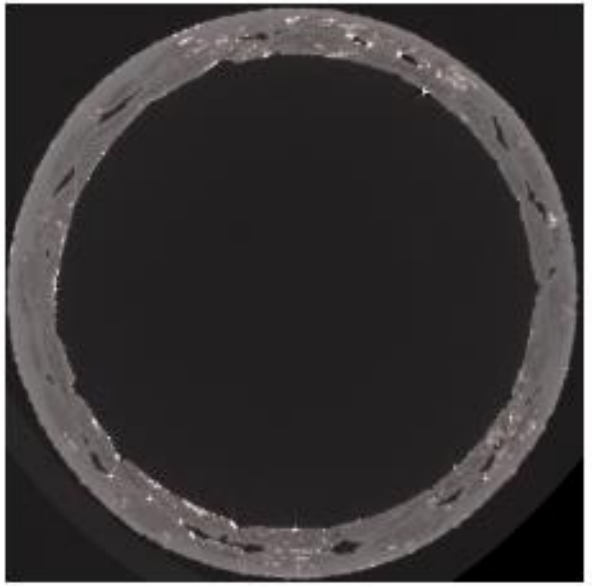
Compare Images

rot0625_low_res.png

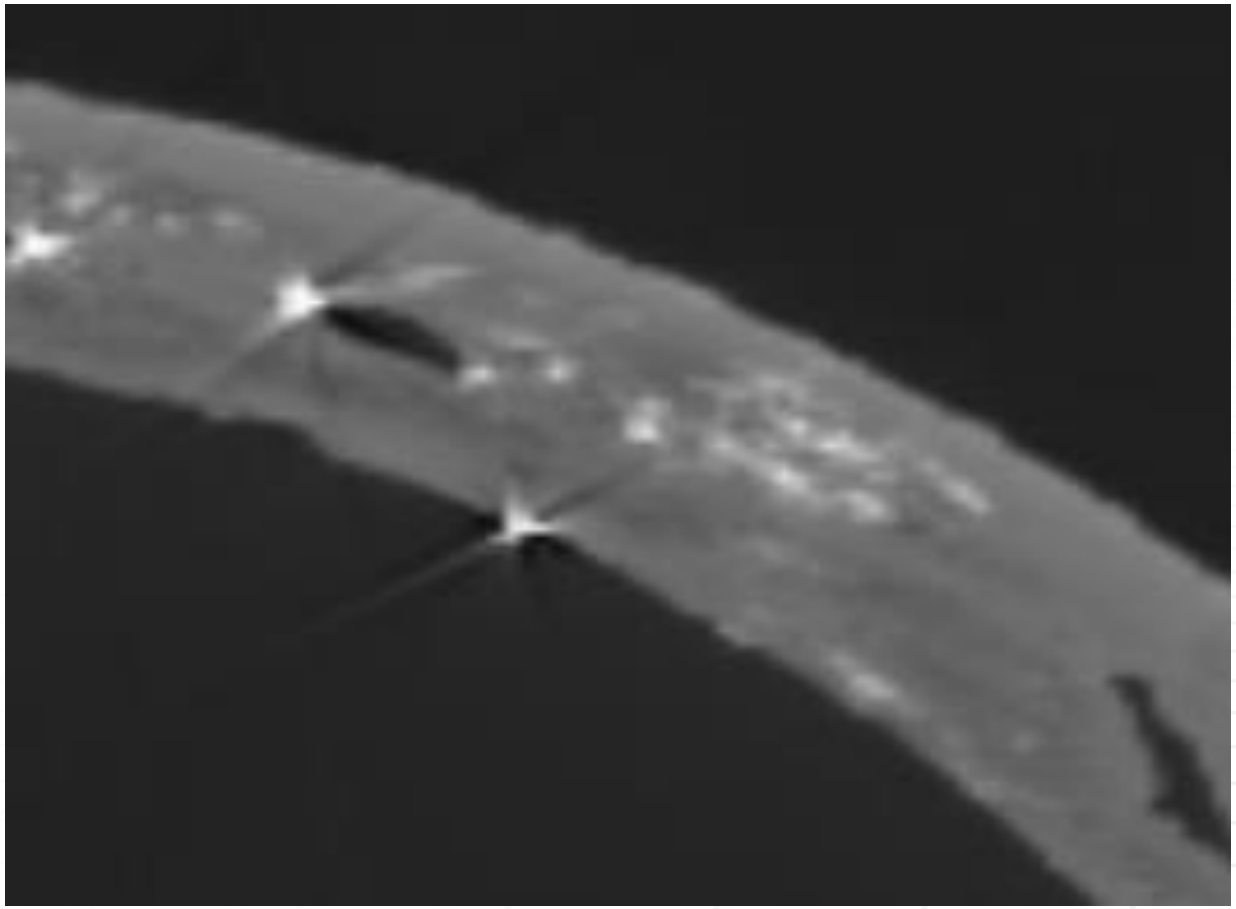
Original ▼

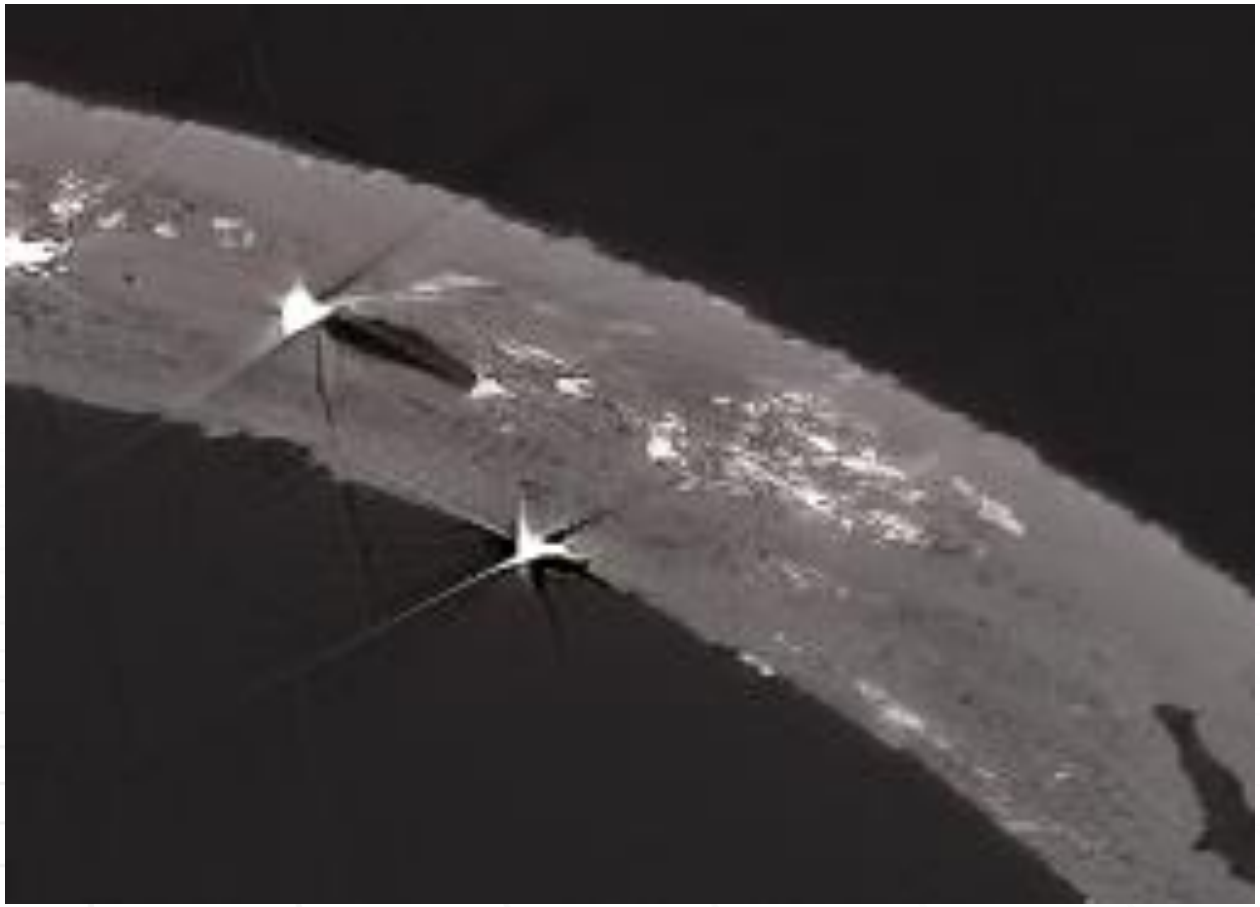


Upscaled ▼



Super Resolution





Activity Detection

Activity Detection

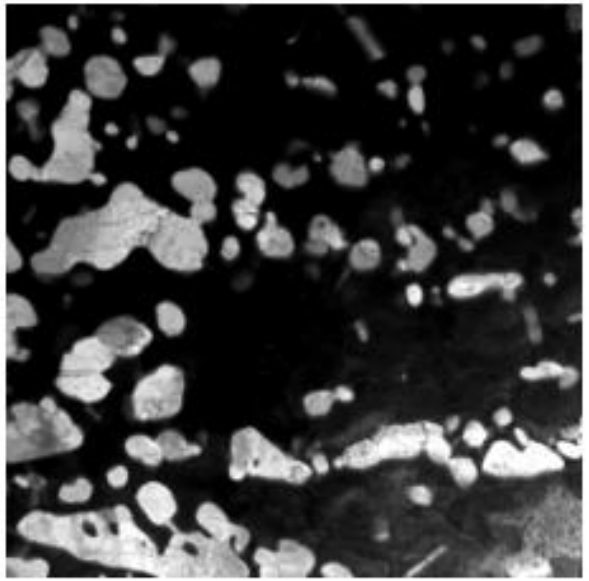
Activity is marked based on the previous 25 frames of a video

Images will be deleted after one day of generation. Please make sure to download the image or else the image will have to be regenerated

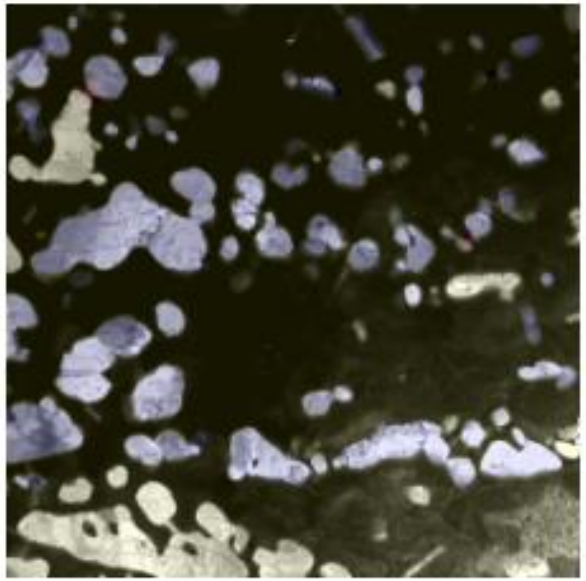
Detect

Compare Images

Original



Activity



NRDS

- Site that is a public science data gateway that will allow public data to be downloaded, previewed, or enhanced through AI
- FpAIRe data
  - Proprietary data
  - Embargo dates
- Data collection efforts are on going

https://nrds.inl.gov/

Questions?

Bradlee.Rothwell@inl.gov
Matthew.Sgambati@inl.gov
Matthew.Anderson2@inl.gov