



Data at the Speed of Extreme Materials Discovery *an HTMDEC Data Handling and Management Seedling*

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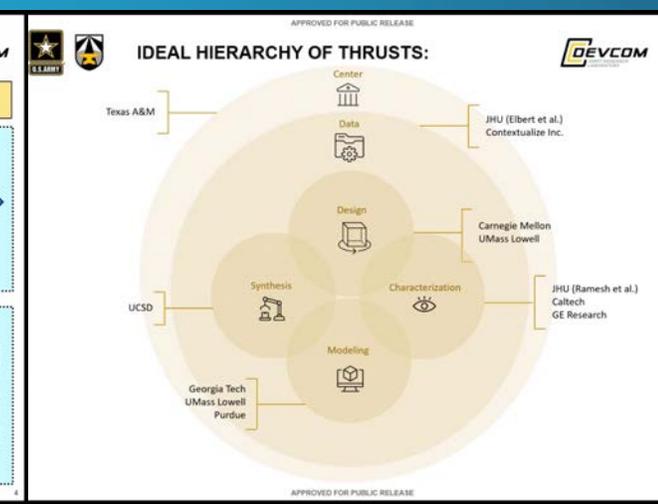
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Mission: *“Provide data at speed by connecting program data from edge-to-cloud to empower transparent, translatable research and expand the impact of program data beyond the life of the project”*

Data Goals:

- Optimize value
- Extend impact
- Empower science
- FAIR Data Legacy



HEMI

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Team Approach



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Three Fundamental Data Areas

“data informed research flow”

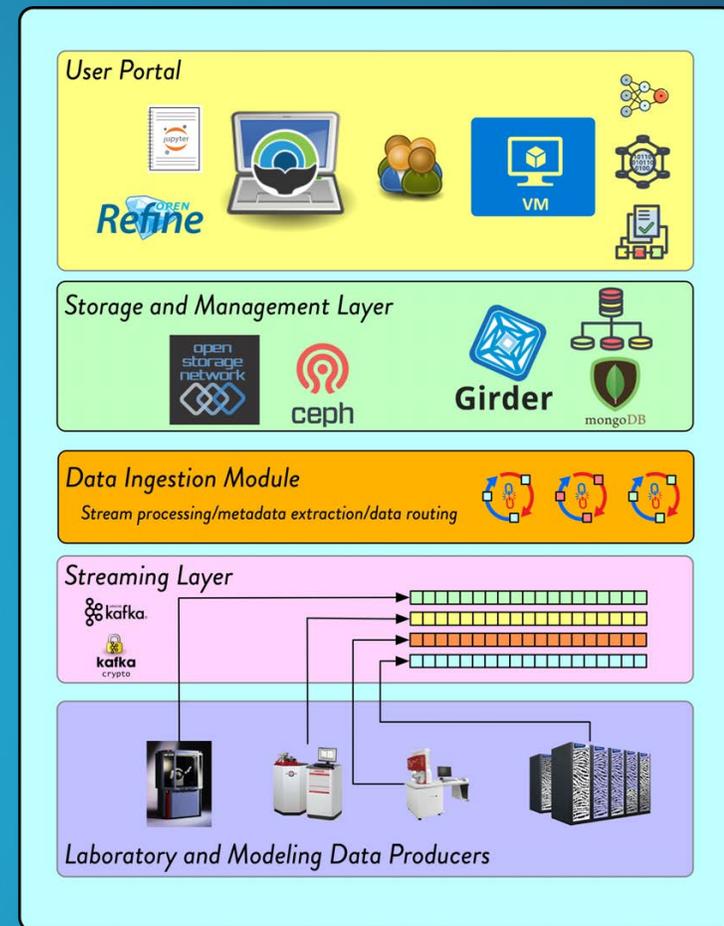
Innovative Data Infrastructure

- Automated Streaming Data Capture (OpenMSIStream)
- Transparent/Reproducible Data Analysis (WholeTale)

Collaboratively Developed Semantics

- Unified Sample System
- Graphical Data Model

Unified Data Annotation for ML



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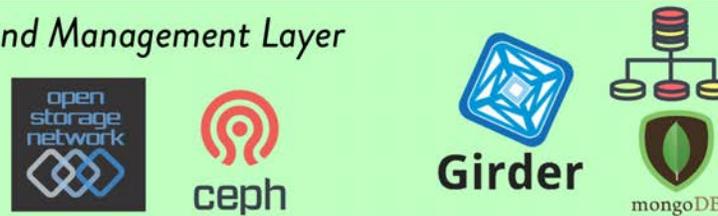
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Infrastructure

User Portal



Storage and Management Layer

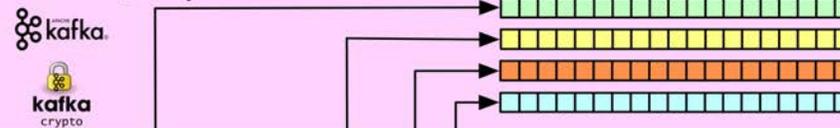


Data Ingestion Module

Stream processing/metadata extraction/data routing



Streaming Layer

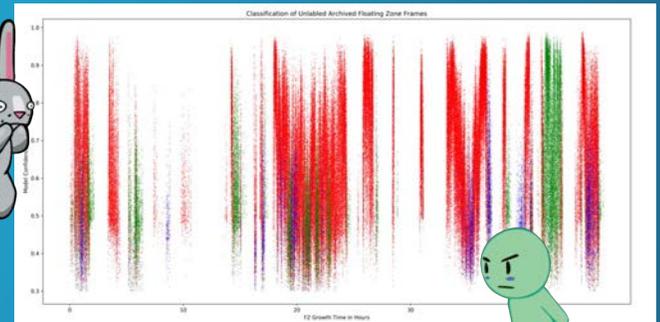
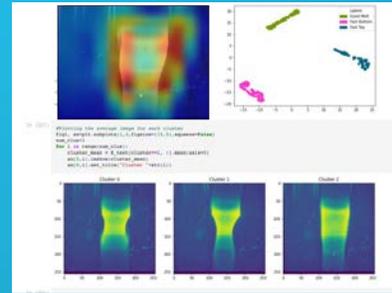
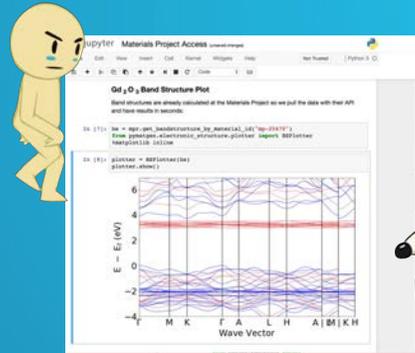
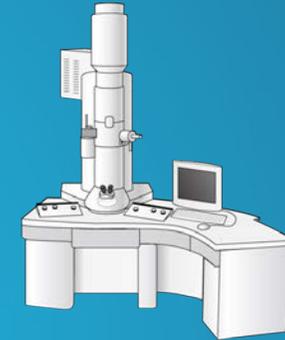
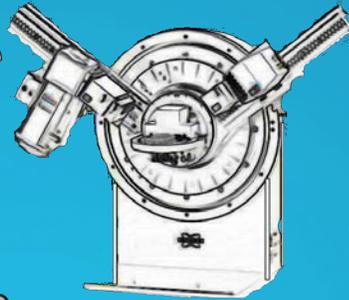
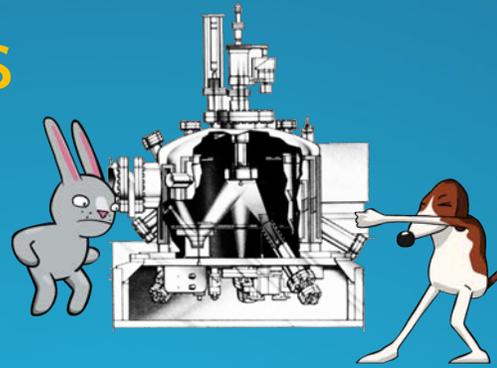


Laboratory and Modeling Data Producers



Diverse Capabilities and Needs

Equipment
People
Ideas



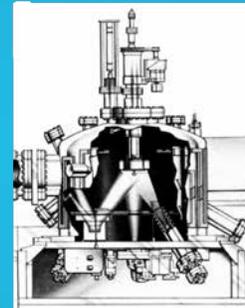
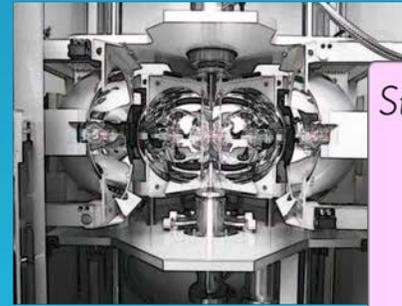
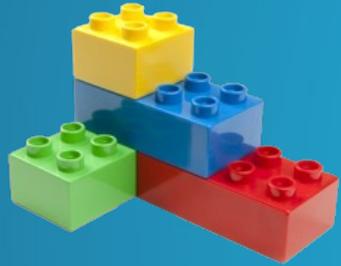
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Streaming Backbone

- Automate Data Flow
- Modular and Scalable
- Flexible Loose Coupling



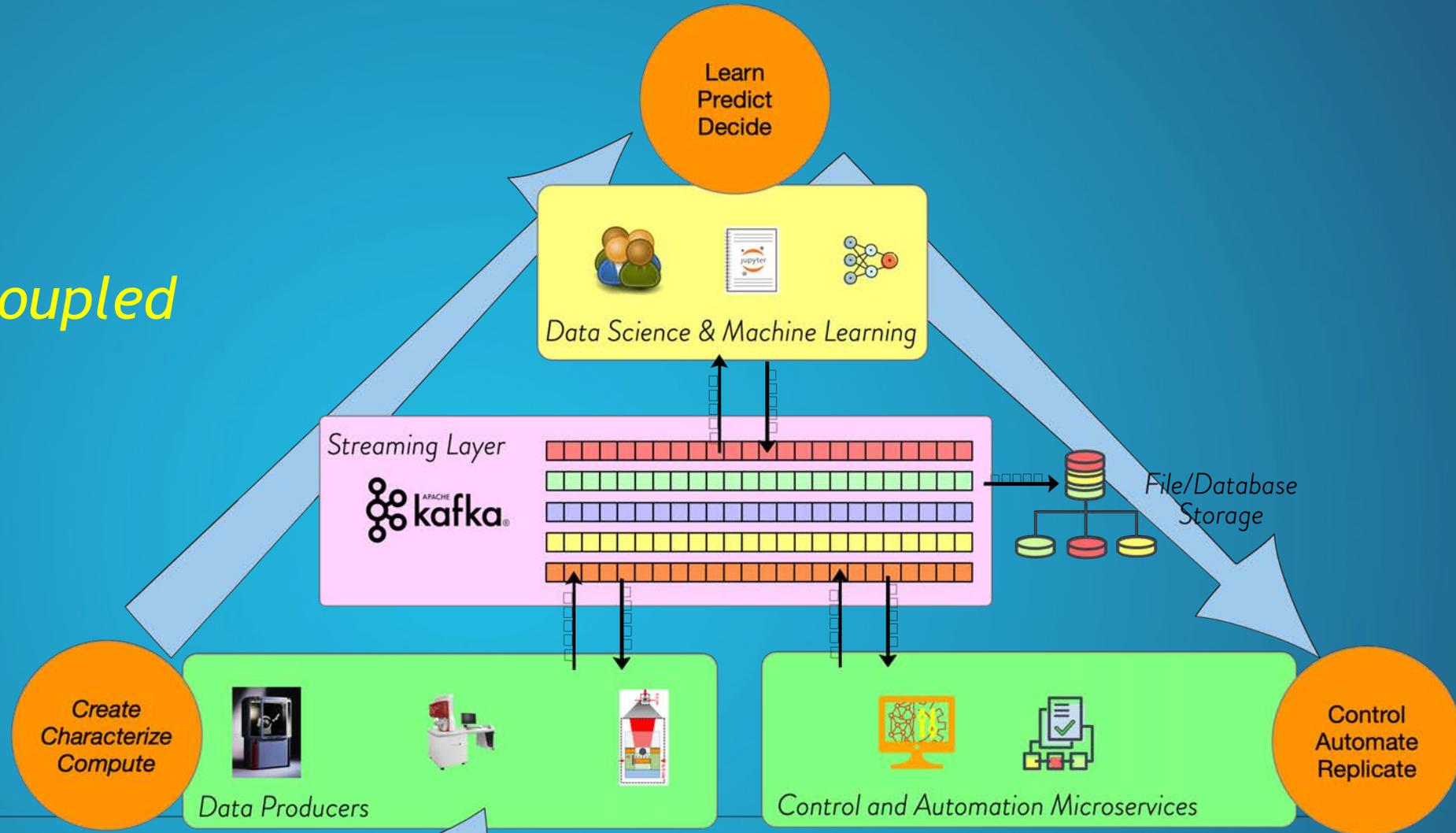
Seamlessly close the design loop for users



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Streaming Closes the Design Loop

Loosely Coupled



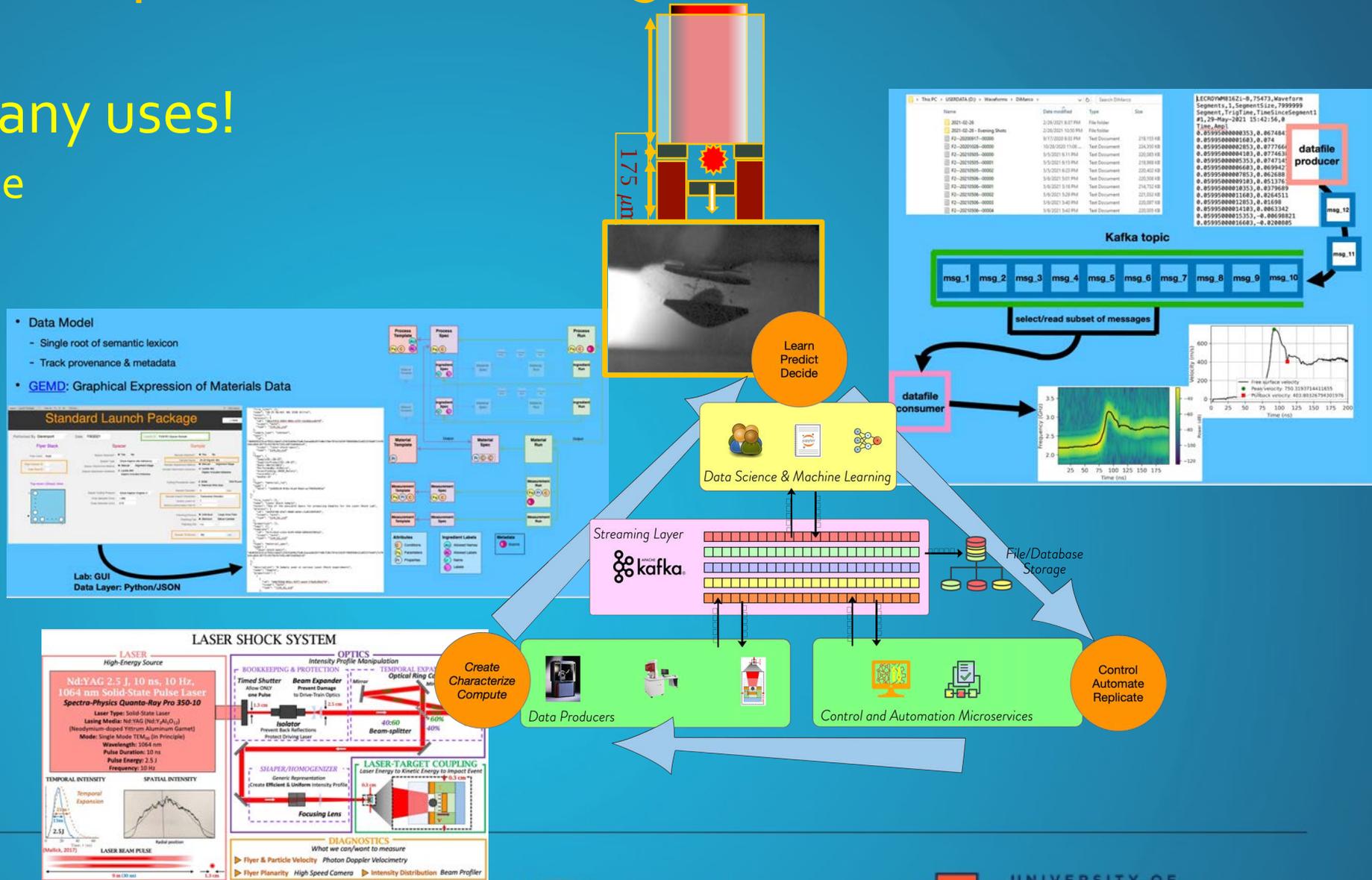
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Connect the Design Loop to Decision Making

One stream — Many uses!

Consume to storage
Process data



Data Model

- Single root of semantic lexicon
- Track provenance & metadata

GEMD: Graphical Expression of Materials Data

Standard Launch Package

Lab GUI
Data Layer: Python/JSON

LASER SHOCK SYSTEM

LASER High-Energy Source
Nd:YAG 2.5 J, 10 ns, 10 Hz, 1064 nm Solid-State Pulse Laser
Spectra-Physics Quanta-Ray Pro 350-10
Laser Type: Solid-State Laser
Lasing Media: Nd:YAG (Nd₃Y₂Al₃O₁₂)
(Neodymium-doped Yttrium Aluminum Garnet)
Mode: Single Mode TEM₀₀ (in Principle)
Wavelength: 1064 nm
Pulse Duration: 10 ns
Pulse Energy: 2.5 J
Frequency: 10 Hz

OPTICS Intensity Profile Manipulation
BOOKKEEPING & PROTECTION
Timed Shutter
Beam Expander
Isolator
SHAPER/HOMOGENIZER
Focusing Lens
LASER-TARGET COUPLING
Laser Energy to Kinetic Energy to Impact Event

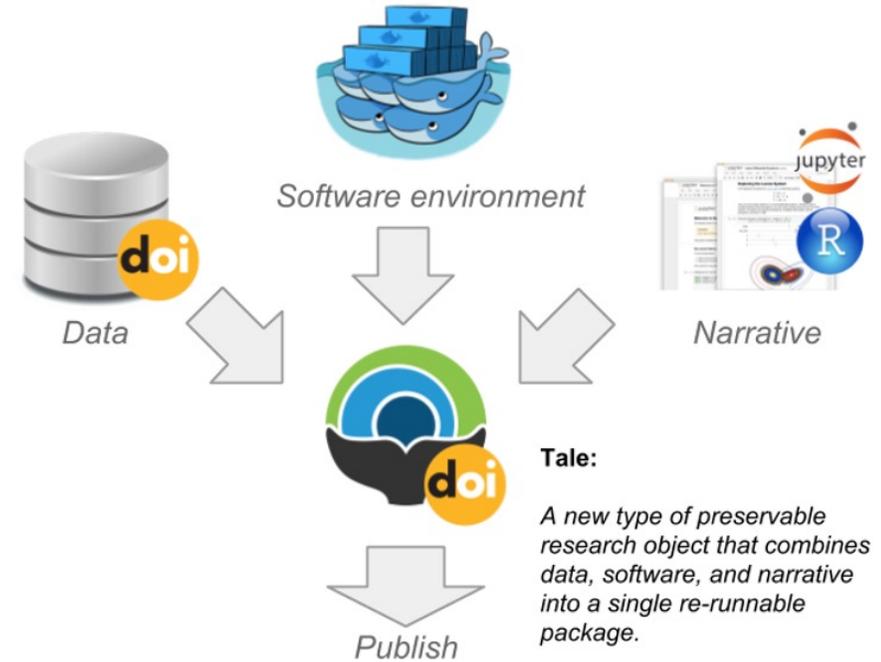
DIAGNOSTICS
What we can't want to measure
Flyer & Particle Velocity Photon Doppler Velocimetry
Flyer Planarity High Speed Camera Intensity Distribution Beam Profiler





What is a "Tale"?

- A tale is a type of preservable research object that combines data, software, and narrative into a single re-runnable package





Whole Tale Dashboard (dashboard)

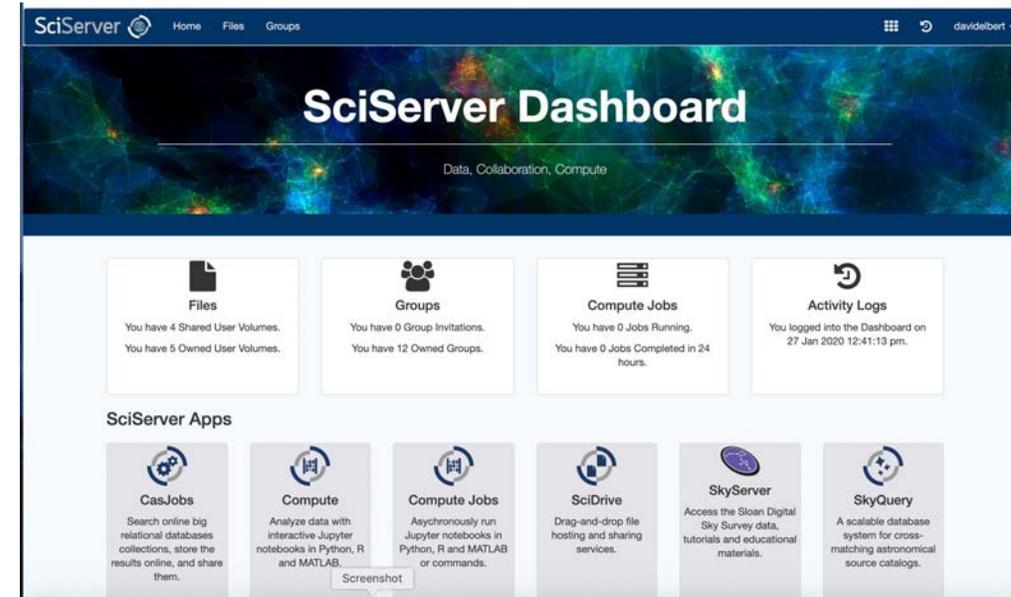
- Users interactively launch and share Tales
- Reference interface for Whole Tale API
- Component-centric model
- Reactive design using Semantic UI

© WholeTale (Build: 4f619f6) Report a problem
This material is based upon work supported by the National Science Foundation under Grant No. OAC-1541450.



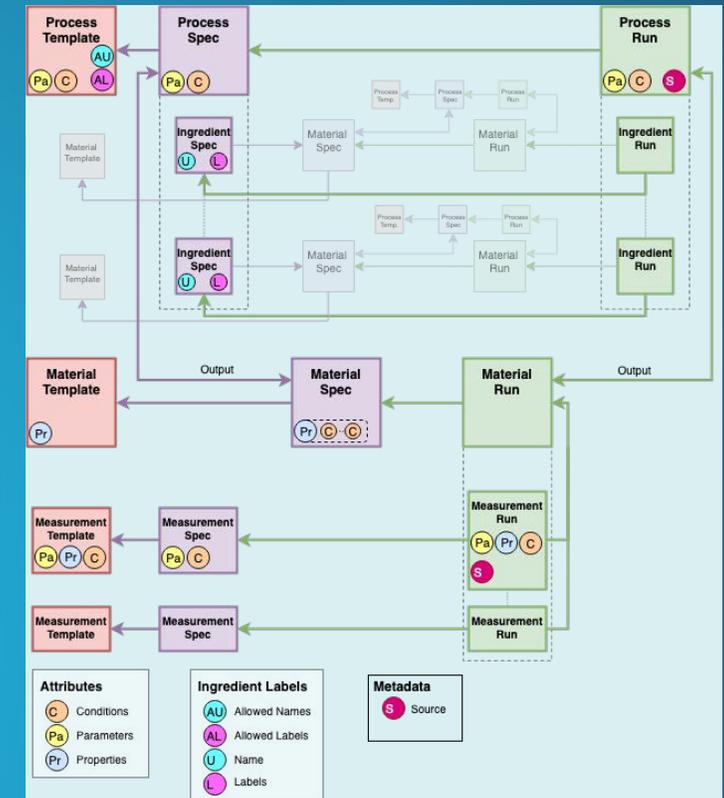
Environment customization

- Extend Jupyter Project's *repo2docker* framework
 - Simple approach
 - Specify environment using well-known files
 - Used to build container image



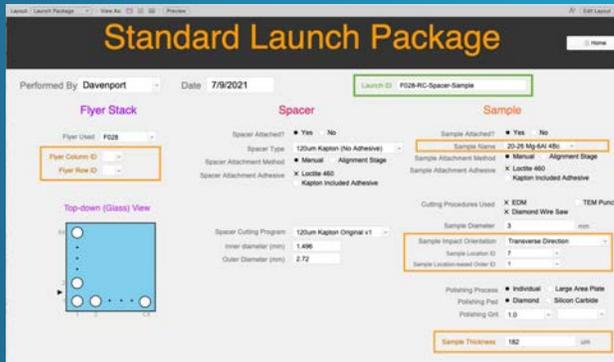
Semantics: Connecting Data – Connecting HTMDEC Community

- Formal Data – Metadata Relationships (People, Places, Things, Events)
- Single root of semantic lexicon describes “everything”
- Tracks provenance & metadata
- Links materials – processes – measurements
 - Full workflow – Intent and Outcome
 - Graph-based material history



Semantics: Connecting Data – Connecting Community

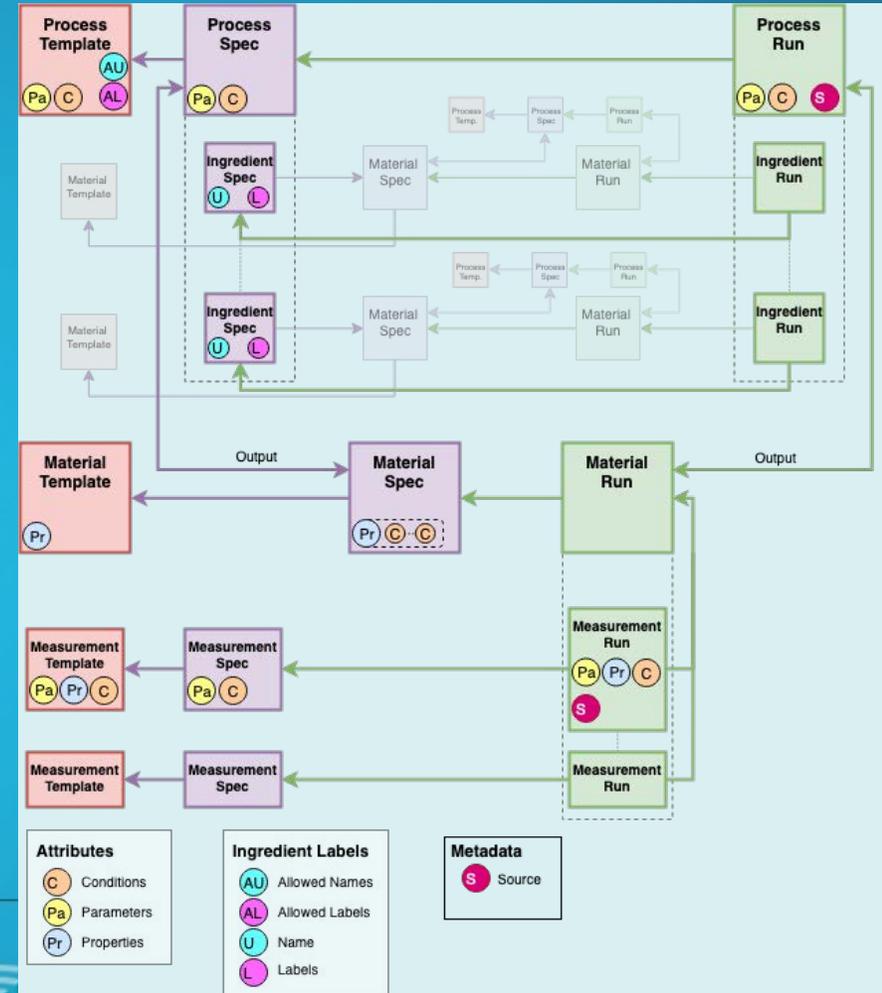
- Materials
 - physical or virtual materials
- Processes
 - Materials in, one material out
- Ingredients
- Measurements/Models



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  ]
}

```



What Can You Expect from Us?

- Two-way Communication
- Collaboration with Seedling Data Champions
- FAIR Data
 - Interoperability
 - DOI for Data References
- Workshops/Trainings
- Whiteboard Sessions
- New Ideas for Data-Forward Future Research



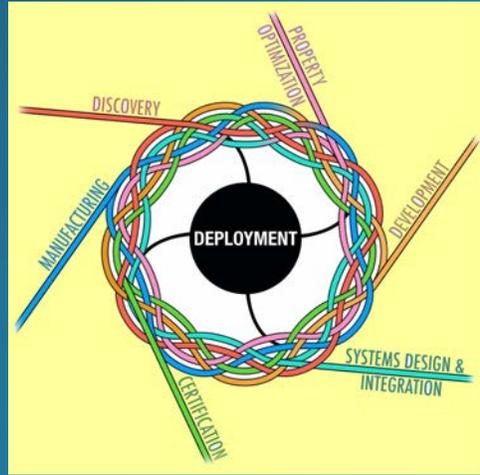
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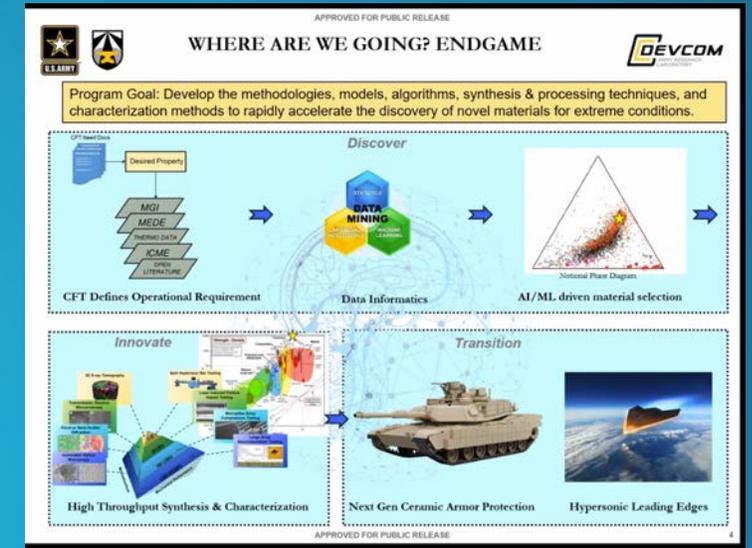
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MGI 2.0



Innovation and Translation
Across the Materials Domain

- Unify Materials Innovation Infrastructure
- Harness the Power of Materials Data
 - AI-Ready Data
 - FAIR
- Workforce



Endgame: *“How will the Army and researchers 10 or 20 years from now benefit from the data we are creating today”*

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