

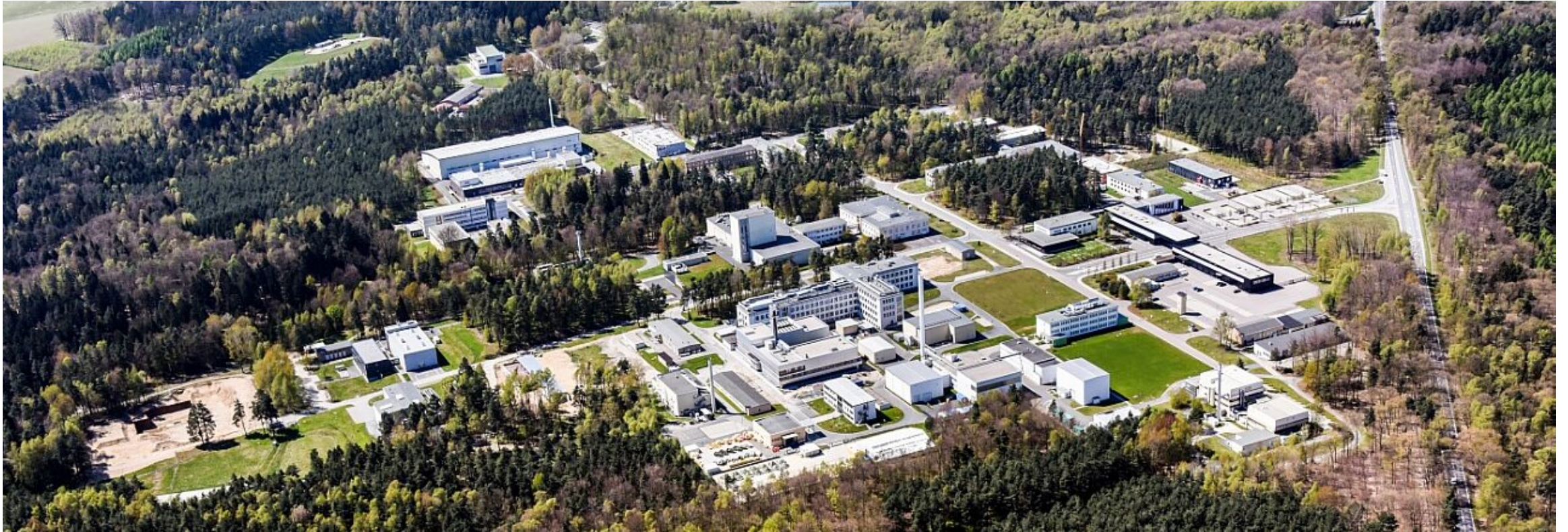
## DRACO-HELIPORT integration for metadata enhanced data-acquisition

Lokamani, T. Ghosh, S. Bock, H. Peter, D. Pape, J. Kelling, O. Knodel,  
U. Schramm and G. Juckeland

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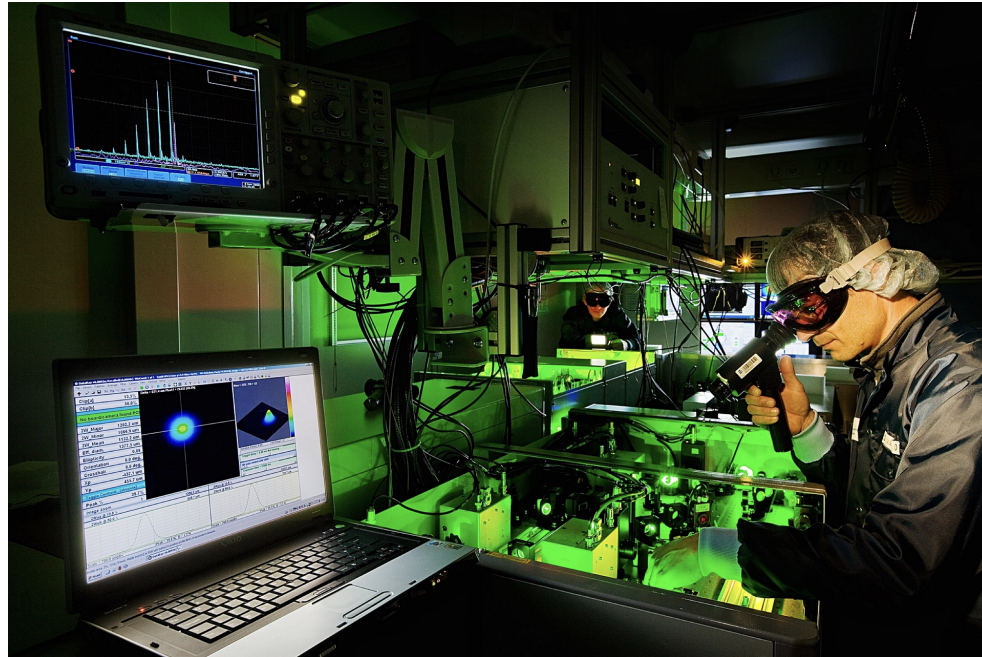


- **Helmholtz Zentrum Dresden Rossendorf**
- **Outskirts of Dresden**

# DRACO Introduction



# DRACO Introduction



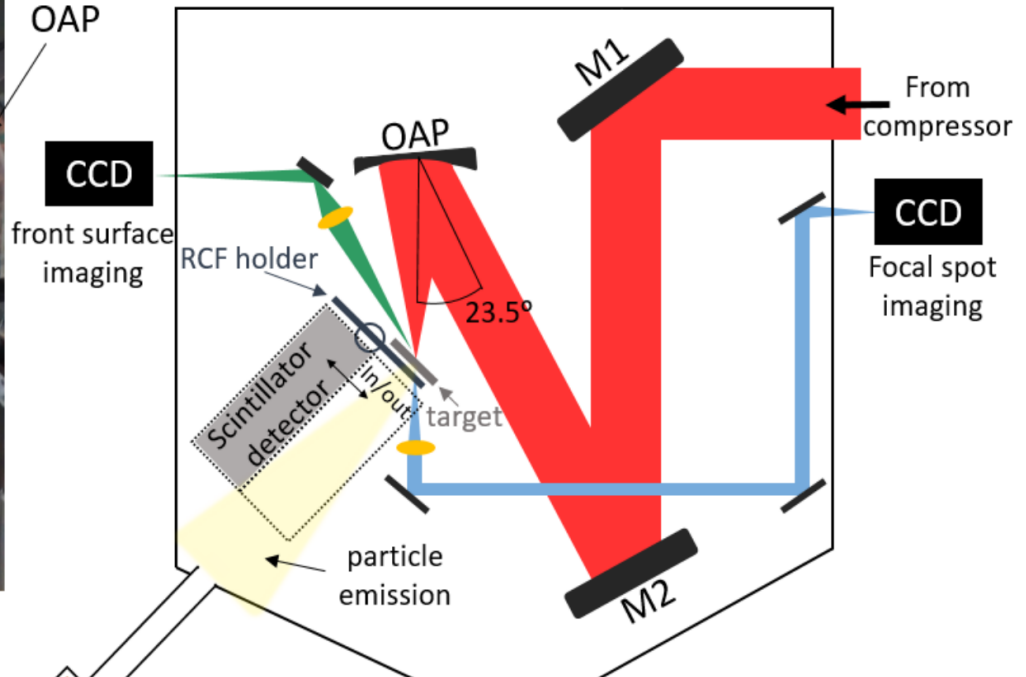
- Dresden laser **acceleration source**
- State-of-the-art high-power ultra-short pulse laser system<sup>[1,2]</sup>
- Amplitude Technologies Pulsar architecture to form main and diagnostics beams
- 6J to 45J pulse energy, typical pulse duration 30fs and a typical frequency 1Hz
- Beam characteristics are recorded in the form of images and several instrument parameters

<sup>[1]</sup> First results with the novel Petawatt laser acceleration facility in Dresden, U. Schramm et al, J. Phys. Conf. Ser. 874 012028 (2017)

<sup>[2]</sup> High dynamic, high resolution and wide range single shot temporal pulse contrast measurement, T. Oksenhendler et. al., Opt. Express 25, 12588-12600 (2017)



# DRACO Team



## Technical support



S. Bock



Dr. H. Peter

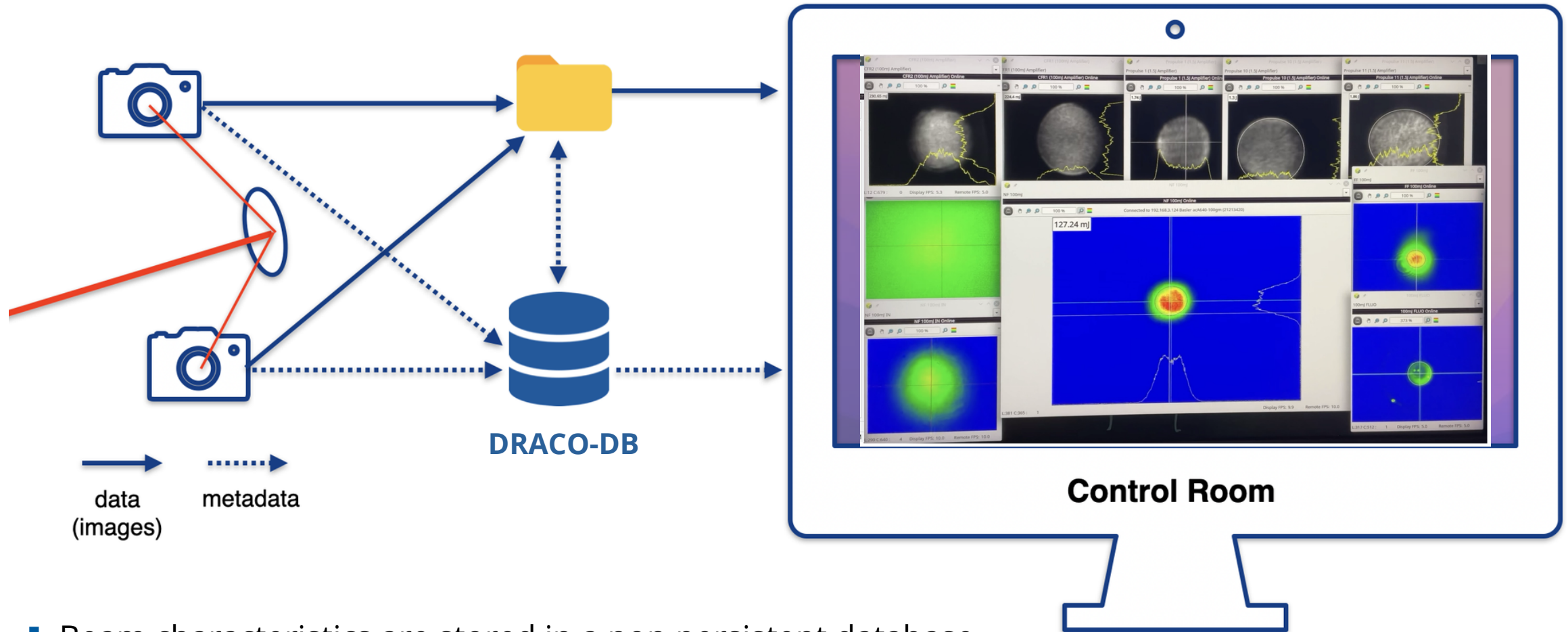


## Scientific analysis

# DRACO Data acquisition

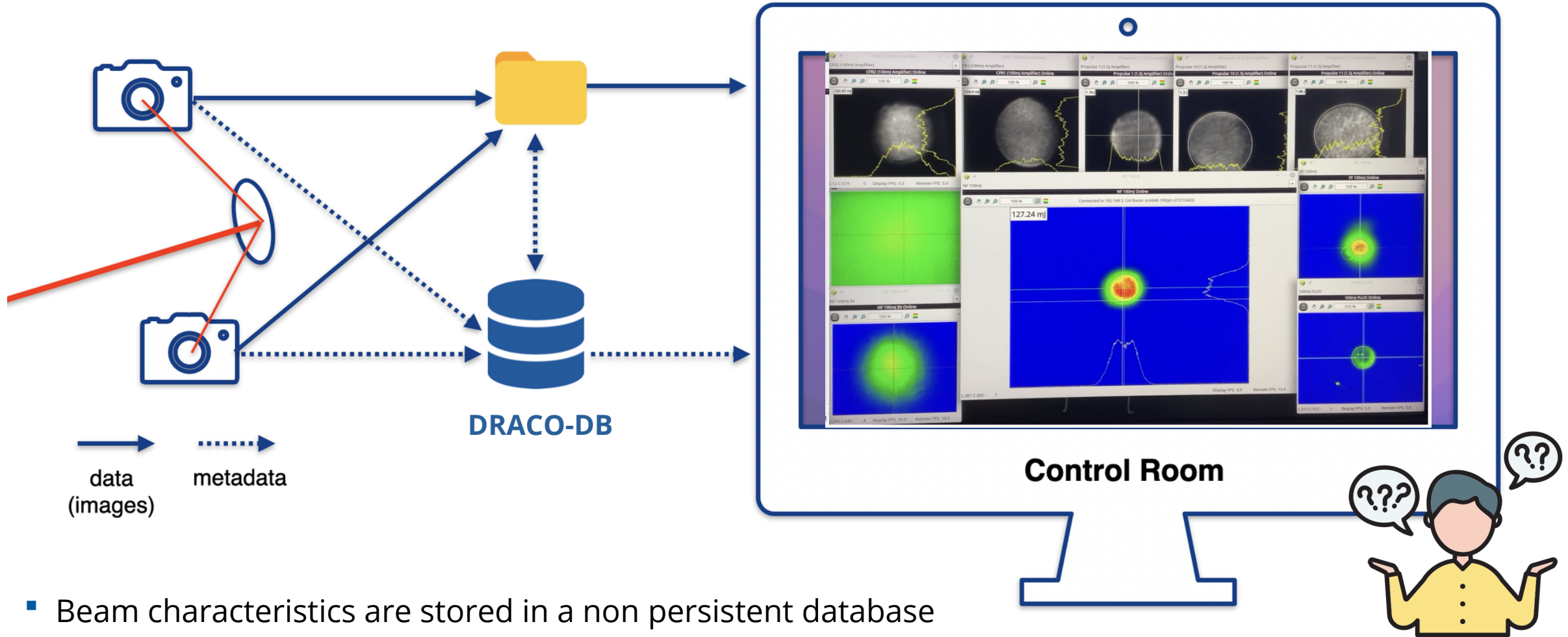


# DRACO Real-time Data-Acquisition



- Beam characteristics are stored in a non persistent database
- Images in raw format

# DRACO Real-time Data-Acquisition



- Beam characteristics are stored in a non persistent database
- Images in raw format



# Draco Datastructure in SQL-DB

run_id	origin_id	datatype	top_origin_id ▲ 1	history_len	name	path
1	0000-00000065-00000000-000000040000002100000014	101	0000-00000065-00000000-000000040000002100000014	2	Propulse 1 (1.5J Amplifier)_Datas_Image	UNRESOLVED (33/Datas/Image)
1	0000-00000032-00000000-000000040000002100000015	50	0000-00000065-00000000-000000040000002100000014	NULL	Image.Is Object Visible	NULL
1	0000-0000003c-00000000-000000040000002100000016	60	0000-00000065-00000000-000000040000002100000014	NULL	Image.EnergyCentroid	NULL
1	0000-0000003c-00000000-000000040000002100000018	60	0000-00000065-00000000-000000040000002100000014	NULL	Image.HProfileLine.X	NULL
1	0000-00000034-00000000-000000040000002100000019	52	0000-00000065-00000000-000000040000002100000014	NULL	Image.HProfileLine.Y	NULL
1	0000-00000066-00000000-000000040000002100000017	102	0000-00000065-00000000-000000040000002100000014	NULL	Image.HProfileLine	NULL

run_id	tstamp	shot_counter_id	origin_id ▲ 1	history_index	data
1	2023-11-27 17:07:39.378476	36494	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.378465	36504	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.178437	36492	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.478485	36505	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.778506	36498	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.878526	36499	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.278534	36503	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.678483	36497	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.178451	36502	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.578476	36496	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.078508	36501	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.978453	36500	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.478471	36495	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.278446	36493	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.478471	36495	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.678483	36497	0000-00000032-00000000-000000040000002100000015	0	1

run_id	tstamp	shot_counter_id	origin_id ▼ 1	history_index	data
1	2023-11-27 17:07:40.078402	36501	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:40.178430	36502	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.778484	36498	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.678409	36497	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.478397	36495	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.878473	36499	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.878526	36499	0000-0000003c-00000000-00000004000000210000002a	0	10.009099181073704
1	2023-11-27 17:07:39.478471	36495	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:40.478485	36505	0000-0000003c-00000000-00000004000000210000002a	0	10.009099181073704
1	2023-11-27 17:07:39.578476	36496	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:40.278534	36503	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:40.378465	36504	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:39.678483	36497	0000-0000003c-00000000-00000004000000210000002a	0	10

run_id	tstamp	shot_counter_id	origin_id	history_index	data
1	2024-09-02 15:28:11.915125	40559880	0000-00000032-00000000-000000010000000500000028	2	[BLOB - 3 B]
1	2024-09-02 15:28:11.915125	40559880	0000-0000003c-00000000-0000000100000005000000b2	2	[BLOB - 16 B]
1	2024-09-02 15:28:11.915125	40559881	0000-0000003c-00000000-000000010000000100000098	0	[BLOB - 16.0 KiB]
1	2024-09-02 15:28:11.915125	40559881	0000-0000003c-00000000-000000010000000100000099	0	[BLOB - 16.0 KiB]
1	2024-09-02 15:28:11.915125	40559881	0000-00000032-00000000-00000001000000010000009b	0	[BLOB - 3 B]
1	2024-09-02 15:28:11.915125	40559881	0000-00000032-00000000-00000001000000010000009c	0	[BLOB - 3 B]
1	2024-09-02 15:28:11.915125	40559881	0000-00000065-00000000-000000010000000500000014	1	[BLOB - 316.5 KiB]

# Draco Datastructure in SQL-DB

Instruments and measurement types as *top\_origin\_id* and *origin\_id*

run_id	origin_id	datatype	top_origin_id ▲ 1	history_len	name	path
1	0000-00000065-00000000-000000040000002100000014	101	0000-00000065-00000000-000000040000002100000014	2	Propulse 1 (1.5J Amplifier)_Datas_Image	UNRESOLVED (33/Datas/Image)
1	0000-00000032-00000000-000000040000002100000015	50	0000-00000065-00000000-000000040000002100000014	NULL	Image.Is Object Visible	NULL
1	0000-0000003c-00000000-000000040000002100000016	60	0000-00000065-00000000-000000040000002100000014	NULL	Image.EnergyCentroid	NULL
1	0000-0000003c-00000000-000000040000002100000018	60	0000-00000065-00000000-000000040000002100000014	NULL	Image.HProfileLine.X	NULL
1	0000-00000034-00000000-000000040000002100000019	52	0000-00000065-00000000-000000040000002100000014	NULL	Image.HProfileLine.Y	NULL
1	0000-00000066-00000000-000000040000002100000017	102	0000-00000065-00000000-000000040000002100000014	NULL	Image.HProfileLine	NULL



Connection btw. the tables using *shot\_counter\_id* and *origin\_id*

run_id	tstamp	shot_counter_id	origin_id ▲ 1	history_index	data
1	2023-11-27 17:07:39.378476	36494	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.378465	36504	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.178437	36492	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.478485	36505	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.778506	36498	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.878526	36499	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.278534	36503	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.678483	36497	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.178451	36502	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.578476	36496	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:40.078508	36501	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.978453	36500	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.478471	36495	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.278446	36493	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.478471	36495	0000-00000032-00000000-000000040000002100000015	0	1
1	2023-11-27 17:07:39.678483	36497	0000-00000032-00000000-000000040000002100000015	0	1

Instrument parameters segmented into integer and double tables

run_id	tstamp	shot_counter_id	origin_id ▼ 1	history_index	data
1	2023-11-27 17:07:40.078402	36501	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:40.178430	36502	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.778484	36498	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.678409	36497	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.478397	36495	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.878473	36499	0000-0000003c-00000000-000000040000002200000020	0	0
1	2023-11-27 17:07:39.878526	36499	0000-0000003c-00000000-00000004000000210000002a	0	10.009099181073704
1	2023-11-27 17:07:39.478471	36495	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:40.478485	36505	0000-0000003c-00000000-00000004000000210000002a	0	10.009099181073704
1	2023-11-27 17:07:39.578476	36496	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:40.278534	36503	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:40.378465	36504	0000-0000003c-00000000-00000004000000210000002a	0	10
1	2023-11-27 17:07:39.678483	36497	0000-0000003c-00000000-00000004000000210000002a	0	10

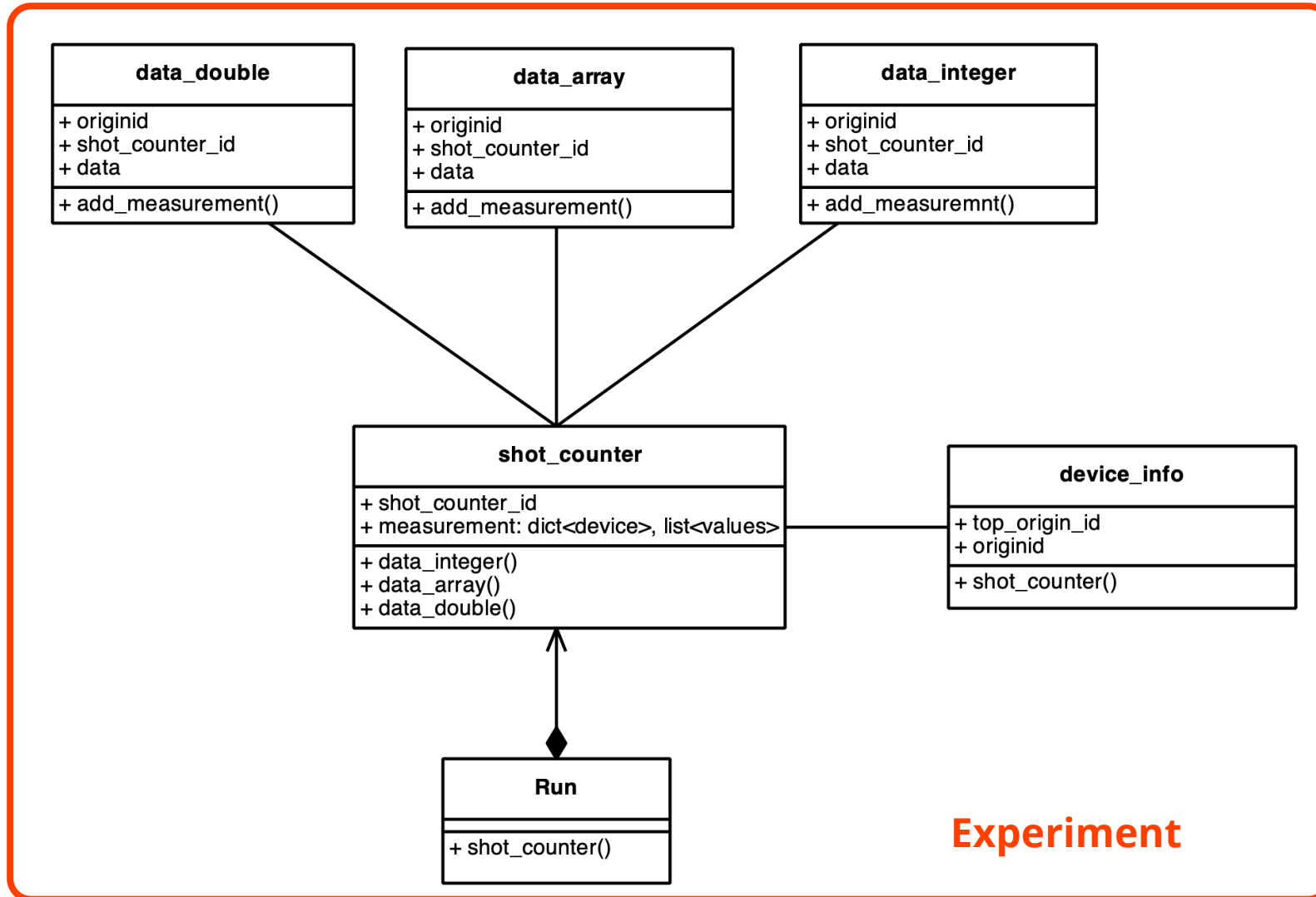
Images and spectra saved as array

run_id	tstamp	shot_counter_id	origin_id	history_index	data
1	2024-09-02 15:28:11.915125	40559880	0000-00000032-00000000-000000010000000500000028	2	[BLOB - 3 B]
1	2024-09-02 15:28:11.915125	40559880	0000-0000003c-00000000-0000000100000005000000b2	2	[BLOB - 16 B]
1	2024-09-02 15:28:11.915125	40559881	0000-0000003c-00000000-000000010000000100000098	0	[BLOB - 16.0 KiB]
1	2024-09-02 15:28:11.915125	40559881	0000-0000003c-00000000-000000010000000100000099	0	[BLOB - 16.0 KiB]
1	2024-09-02 15:28:11.915125	40559881	0000-00000032-00000000-00000001000000010000009b	0	[BLOB - 3 B]
1	2024-09-02 15:28:11.915125	40559881	0000-00000032-00000000-00000001000000010000009c	0	[BLOB - 3 B]
1	2024-09-02 15:28:11.915125	40559881	0000-00000065-00000000-000000010000000500000014	1	[BLOB - 316.5 KiB]

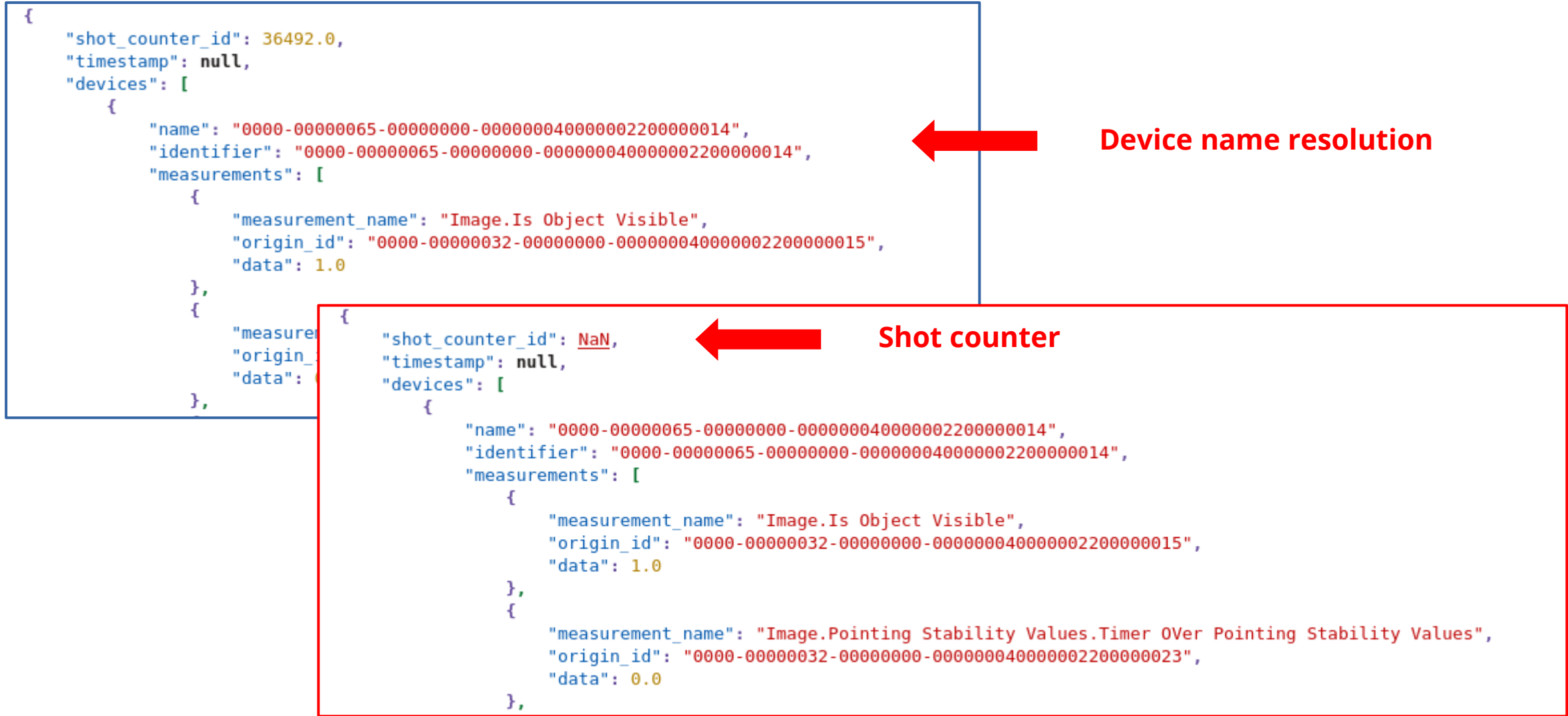


# Draco Data Acquisition

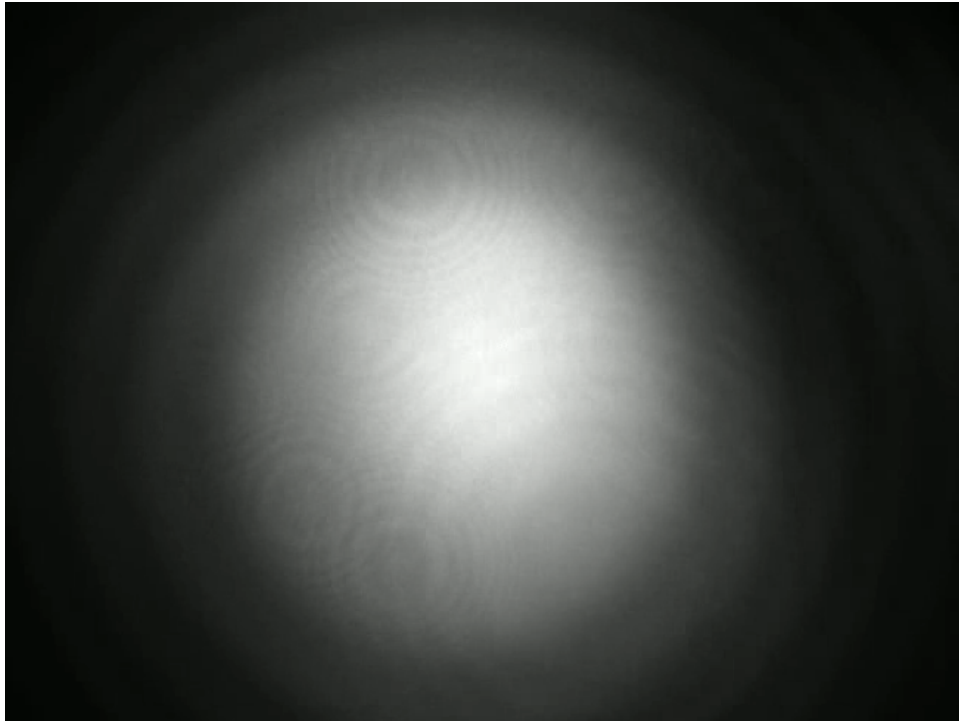
(Entity-Relationship diagram)



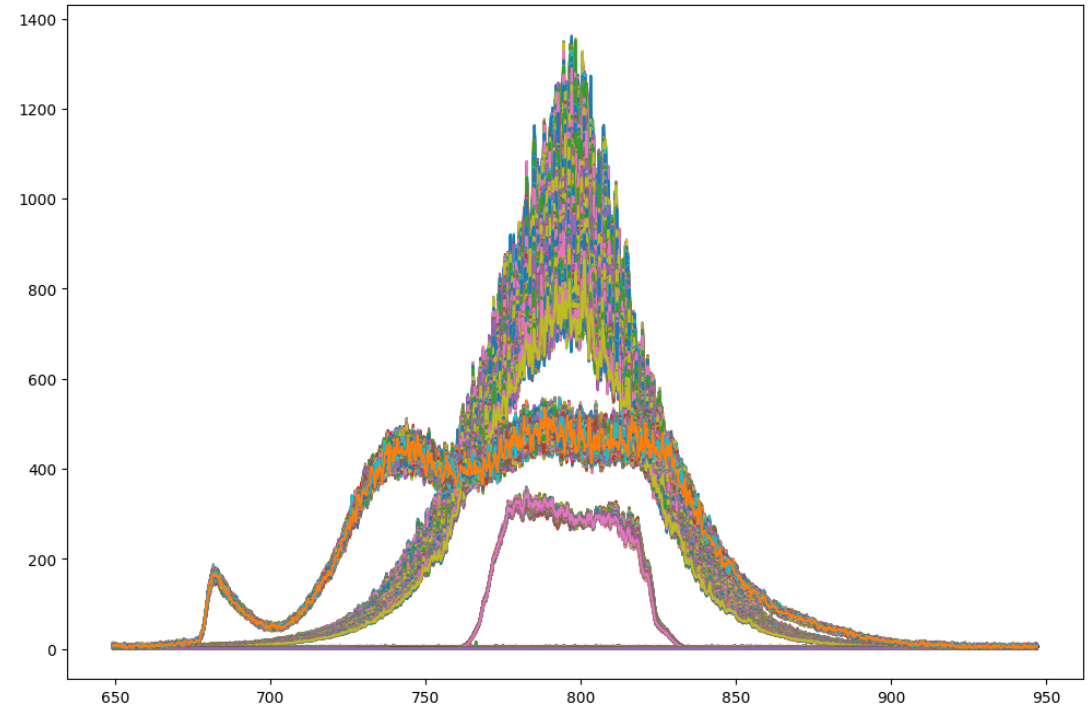
# Draco Data Acquisition



# Draco Data Acquisition



Laser Beam



Energy profile

**F**indable **A**ccessible **I**nteroperable **R**eusable

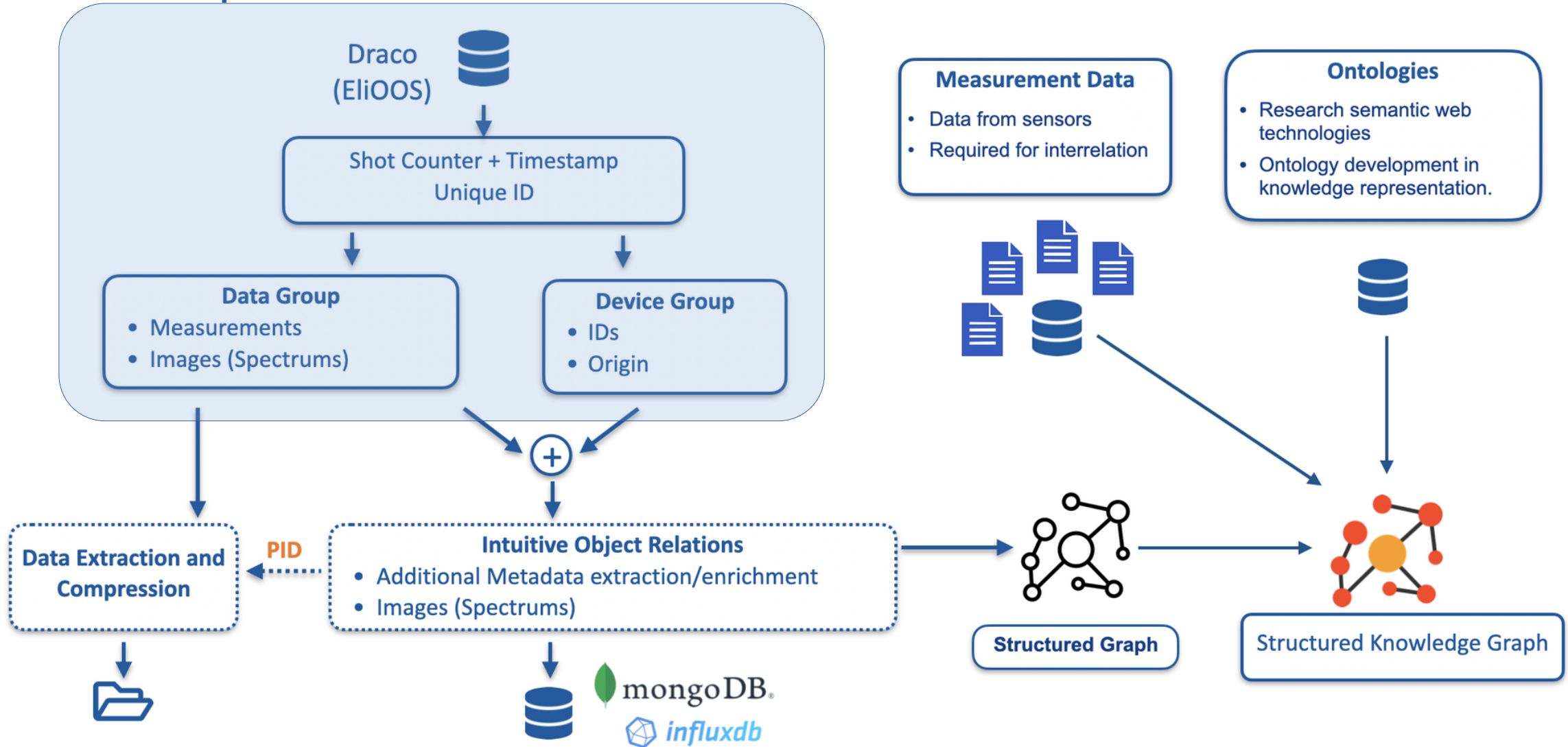


# DRACO Data pipeline

# Extending Draco Data Pipeline

(taking full advantage of HZDR infrastructure)

## Data acquisition



# DRACO Metadata



# Draco Metadata for HELIPOINT



The screenshot shows the HELIPOINT web application interface. At the top, there is a search bar and navigation links for 'About', 'Docs', and a user profile 'knodel39'. Below this is a 'Project List' table with columns for 'Project Name', 'Last Modified', and 'Owner'. Each row includes an 'Open' button. The projects listed include 'Semantic x-Lab', 'gELBE Projects' (with sub-entries for beamtime 21102205-ST and 21202619-ST), 'Example parent project', 'ML Ops Project', 'SOTA on Uncertainties', 'Phase-resolved Higgs response in superconducting cuprates', 'Digital Twin Showcase', 'Beamtime Dashboard Test', and 'Rodare Data Publication Project'. A 'Create Project' button is at the bottom left, and a pagination control is at the bottom right.

```
{
  "shot_counter_id": 36492.0,
  "timestamp": null,
  "devices": [
    {
      "name": "0000-00000065-00000000-000000040000002200000014",
      "identifier": "0000-00000065-00000000-000000040000002200000014",
      "measurements": [
        {
          "measurement_name": "Image.Is Object Visible",
          "origin_id": "0000-00000032-00000000-000000040000002200000015",
          "data": 1.0
        }
      ]
    }
  ],
}
```

- Structured experimental data
- Metadata for Heliport
  - Proposal metadata
  - Beamline information
  - Sample, technique, documentation
  - Data location
- Metadata for HelmholtzAI
  - Images, beam characteristics
  - Curated data
  - **Control beam characteristics in real time using machine learning**

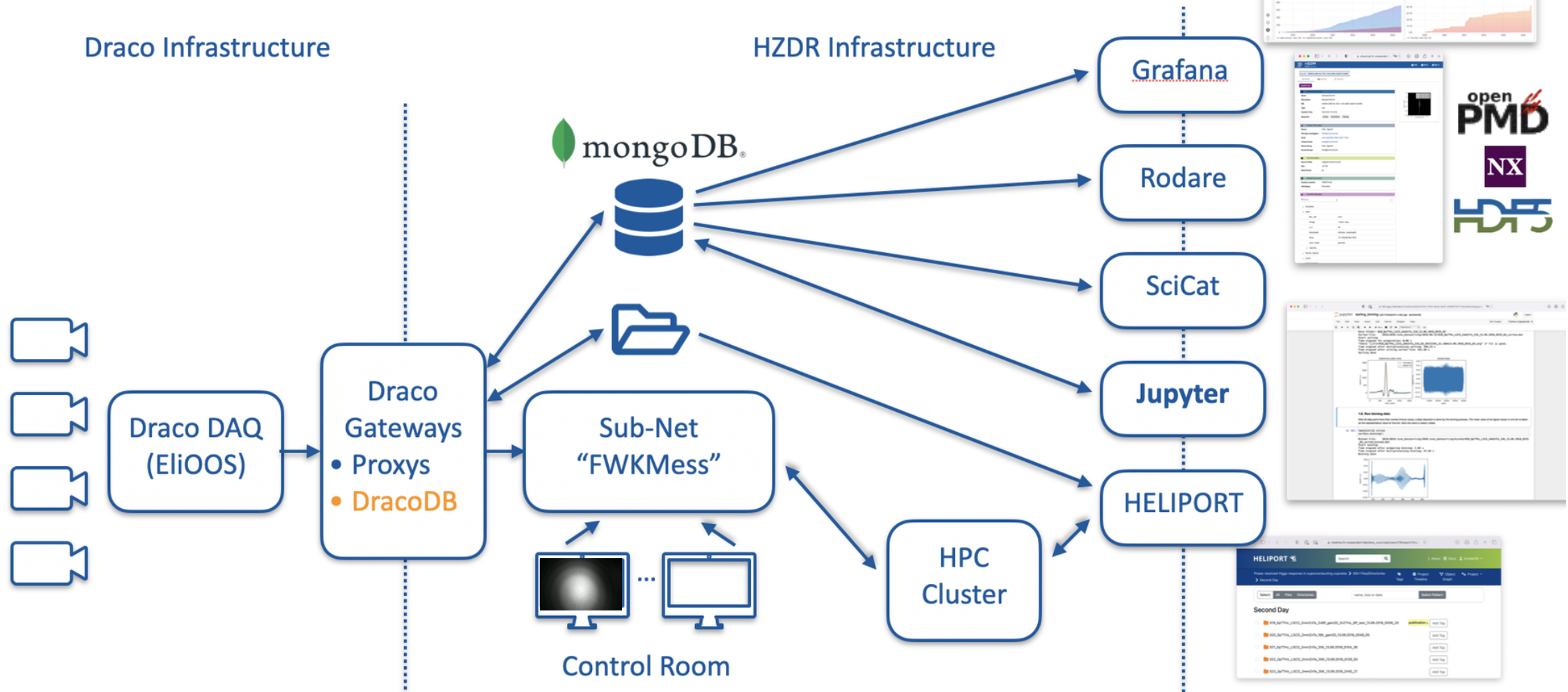
**F**indable **A**ccessible **I**nteroperable **R**eusable

# DRACO Dataflow

## Advanced Data Management



# Draco Data Flow for Advanced Data Management



**F**indable **A**ccessible **I**nteroperable **R**eusable

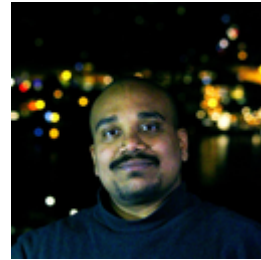


# Acknowledgments

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HelmholtzAI  
J. Kelling



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