

# BEAST: Expanding Sustainable Data Infrastructure for High-Enthalpy Facilities

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## Abstract

Reproducible, data-driven thermal protection system (TPS) research requires that experimental records from high-enthalpy testing be consistently structured, traceable, and accessible across campaigns and institutions. In practice, however, arcjet and plasma facilities data remain largely fragmented: raw diagnostics are stored in ad hoc formats, material sample histories are disconnected from test conditions, and metadata standards are absent, precluding systematic cross-campaign analysis and long-term reuse. *BEAST* (Backend for Experiment Analysis, Storage, and Traceability) is an open-source, web-based platform that addresses these limitations by providing a unified, queryable infrastructure for high-enthalpy ground-test data [1]. First presented at the 15th Ablation Workshop [2], *BEAST* has since undergone significant development. The platform ingests and structures multi-channel time-series diagnostics, facility configurations, and material property records within a common provenance model, ensuring end-to-end traceability from raw sensor acquisition to reduced experimental quantities. A versioned material library links specimen identity and processing history to the specific runs in which each sample was tested. An integrated modeling workbench enables training and evaluation of regression models directly on archived experimental data, supporting condition interpolation and the construction of empirical material response databases. Beyond its original deployment at NASA Ames Research Center, *BEAST* has been designed to be facility-agnostic, with ongoing efforts to extend its adoption to other facilities. Its modular architecture accommodates heterogeneous diagnostic setups and facility types, and its future open-source distribution allows institutions to build on a common data standard rather than maintaining isolated, bespoke solutions. *BEAST* is further integrated within a broader ecosystem of companion tools: *arcjetCV* [3] extracts recession rates and shock standoff distances from high-speed video using computer vision, and *miniSTARscan* [4] provides sub-minute, portable photogrammetric surface reconstruction of test articles before and after exposure. All tools share a common data schema, enabling seamless ingestion of surface geometry, imagery, and time-series data into a single, coherent experimental record.

**Keywords:** High-enthalpy testing, data management, thermal protection systems, ablation, material traceability, experimental database

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## References

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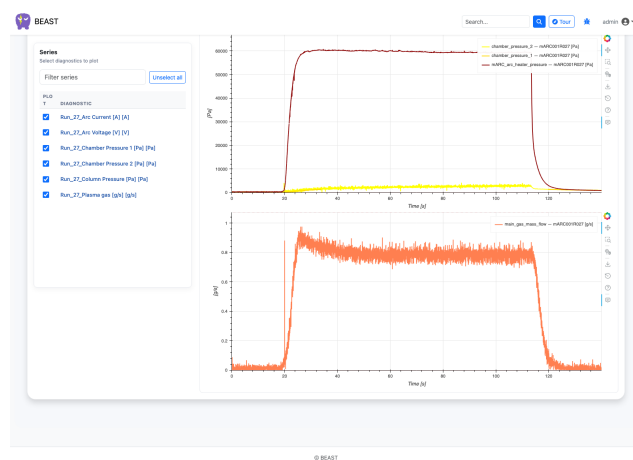
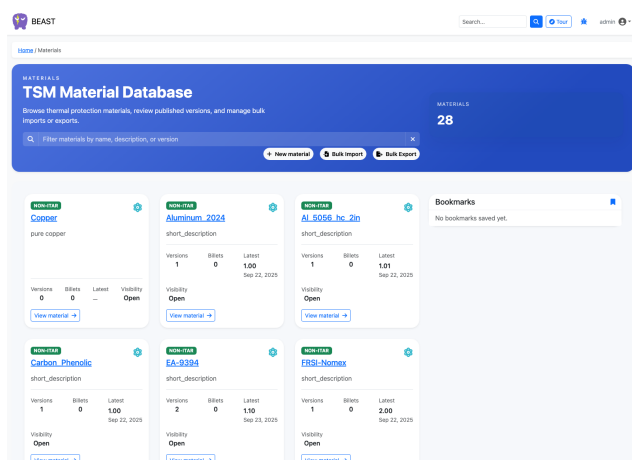
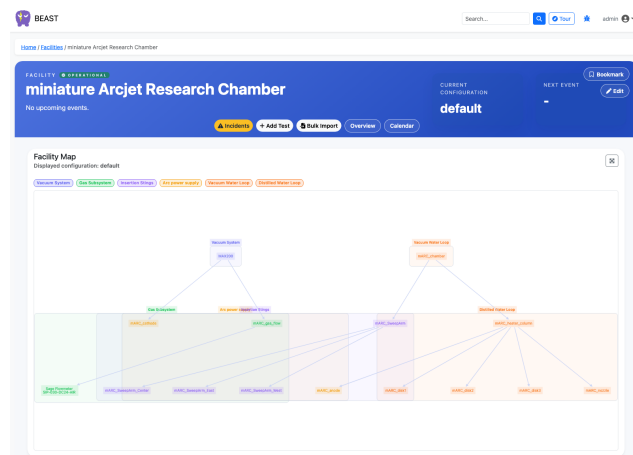
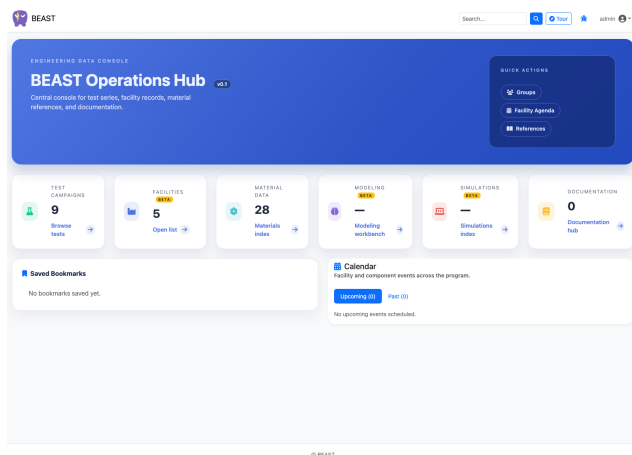


Figure 1: Overview of the BEAST web interface.