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Structuring and Visualizing Microgravity Material Science Data in a Topic Maps Ontology

Alois Grimbach [(1)] **Philipp Wever** [(1)] **Stephan Schneider** [(1)] **Rainer Willnecker** [(1)]

[(1)] **German Aerospace Center DLR, Cologne, Germany**

Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

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Roadmap

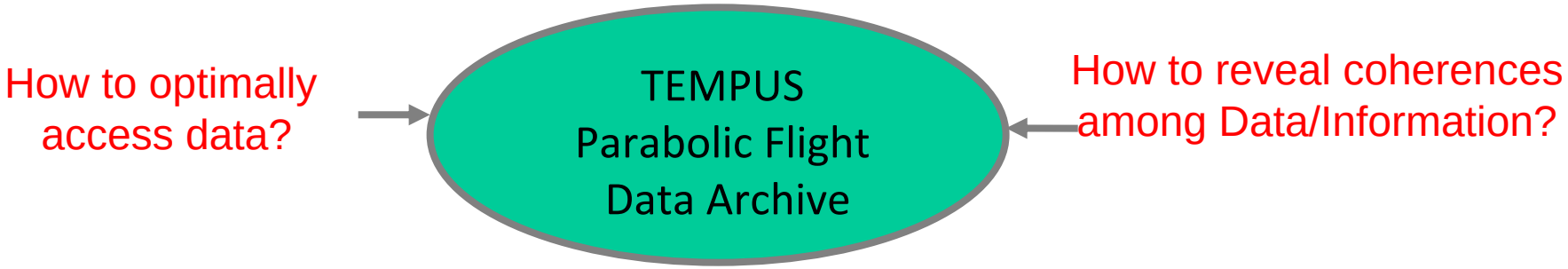
- Motivation
- The TEMPUS Hypertest Data Management System
- A Semantic Approach with Topic Maps
- The Hypergator Application
- Conclusion and Outlook

Motivation

- Increasing amount and versatility of data for various projects

  → Hypertest Data Archive (Werum/DLR since 2005)

Example:



- Enhance the data archive using semantic techniques (since 2008)
- Triggered by upcoming FP7 ULISSE Project (Launch 2009)

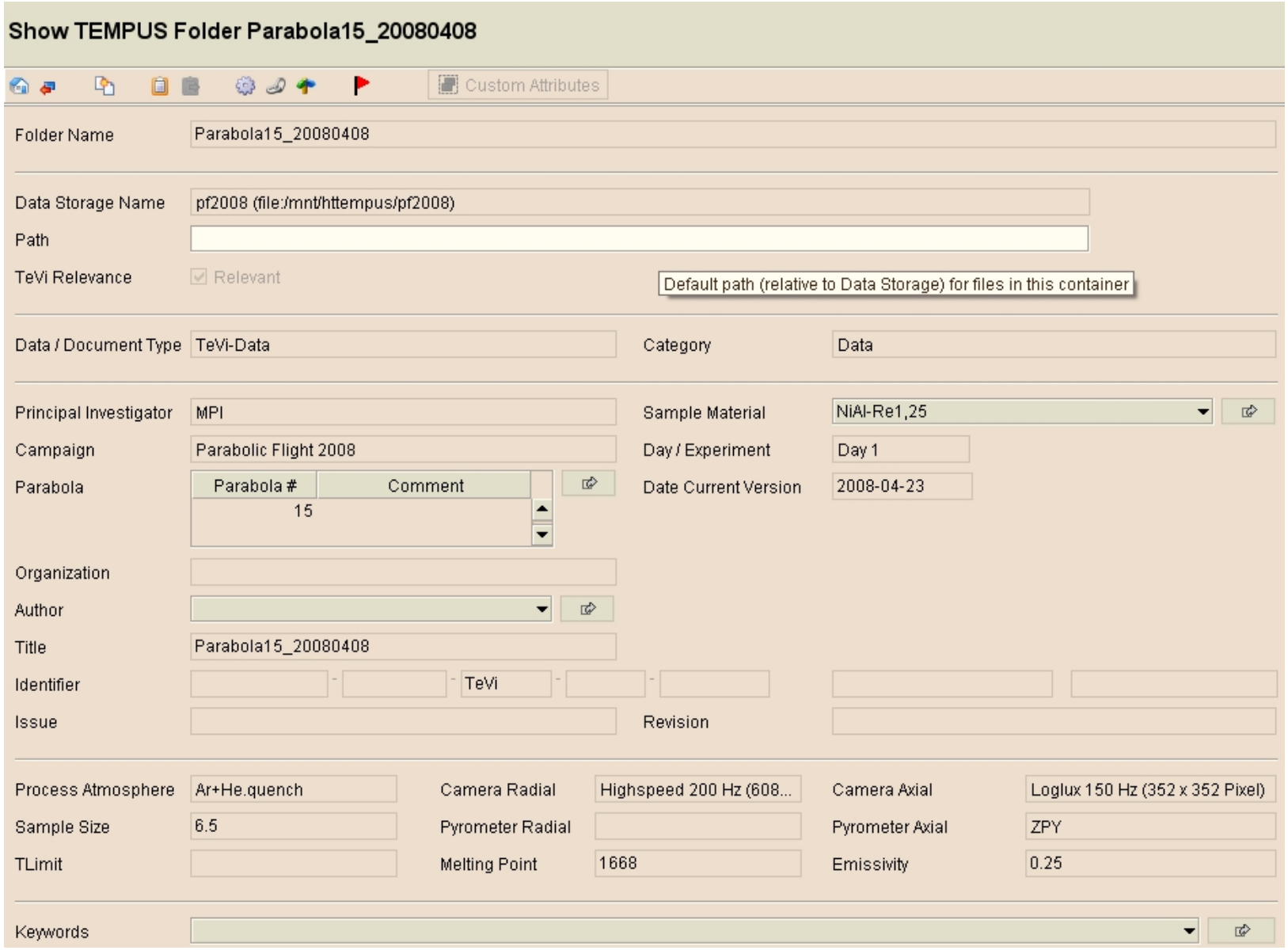
TEMPUS

(Containerless Electromagnetic Processing under Microgravity)

- Developed by DLR for Spacelab Experiments
- Parabolic Flights since 1988
- Since 2001 min. 1 Parabolic Flight per year with A300 Zero G

- Semi-automatic Data Ingestion into Hypertest Data Archive
- Manual Metadata Description

Metadata in the TEMPUS Hypertest Instance

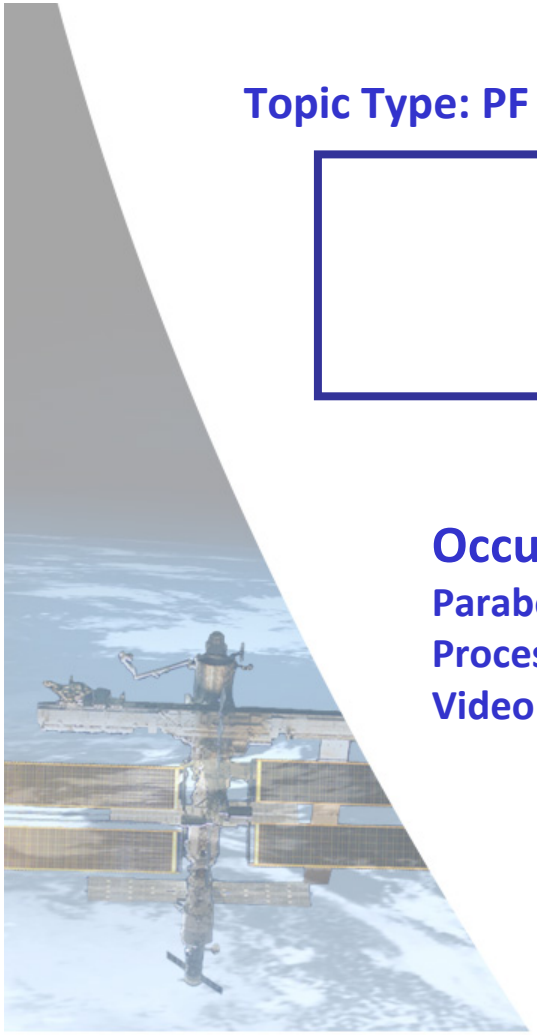


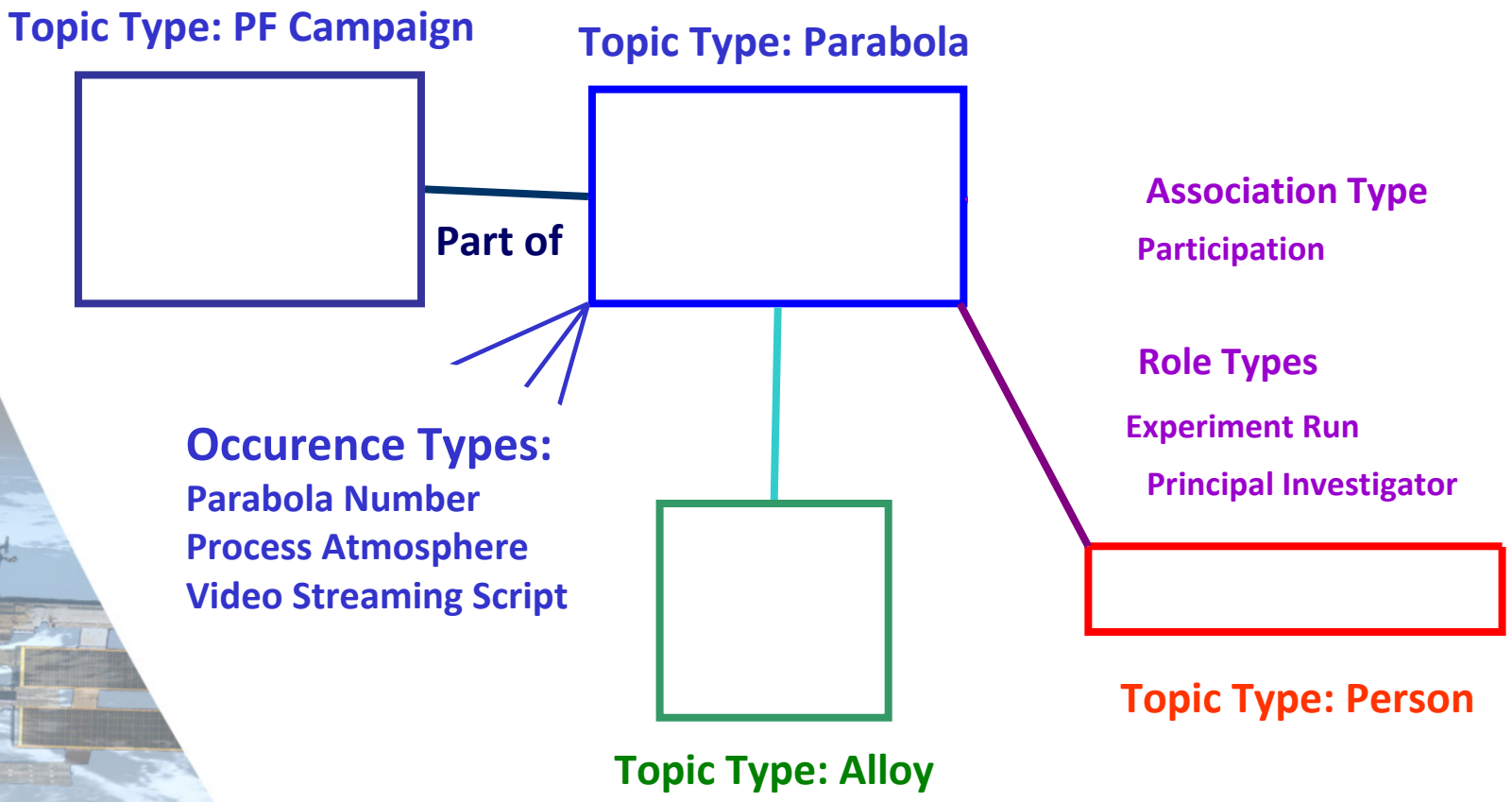
Questions

- What about Navigation ?
- What about Metadata Extension ?
- What about Including External Data / Information ?
- What about Information Interconnection?

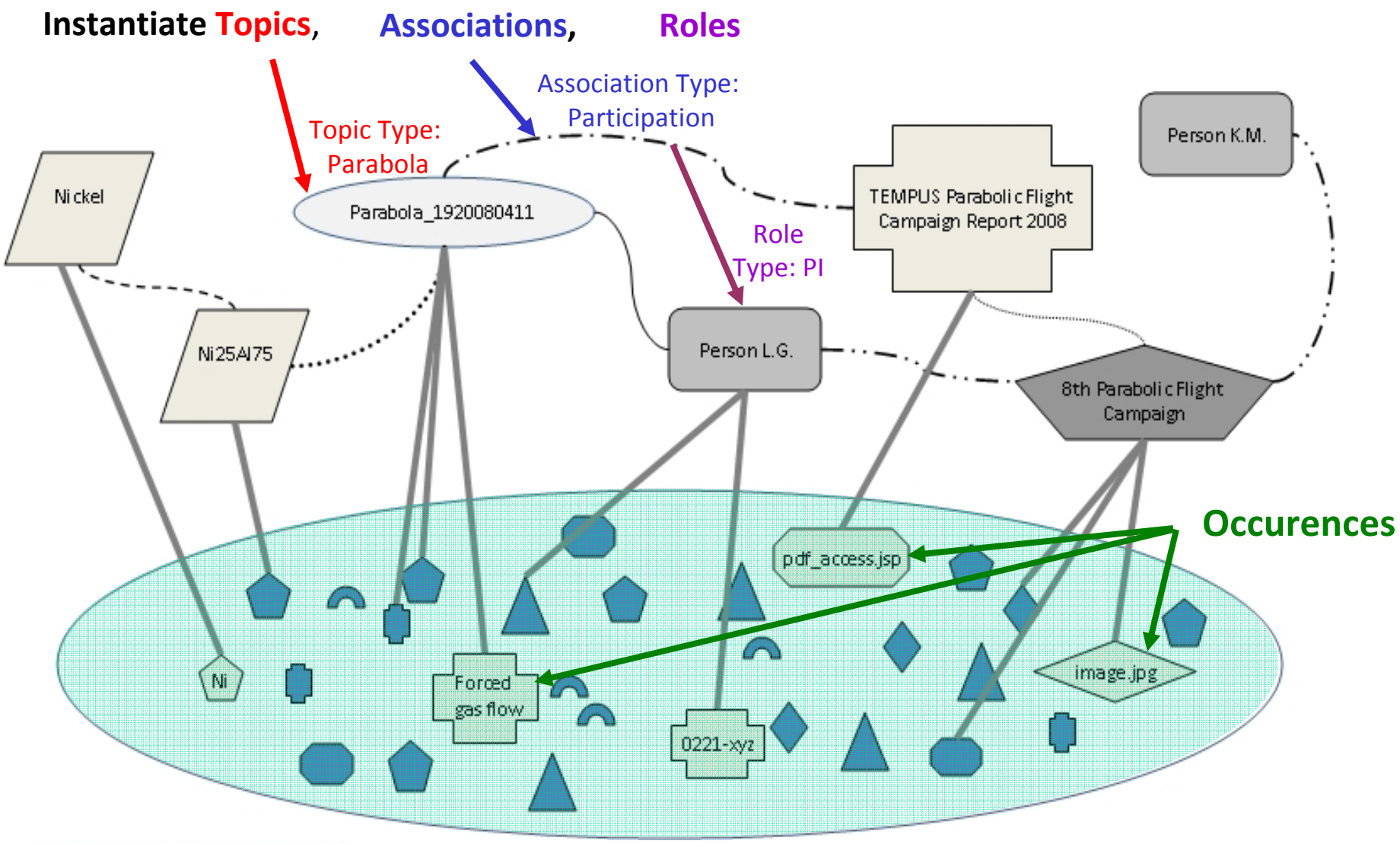
→ Organise Available Data in Topic Maps and Merge Additional Information

Topic Maps Ontology

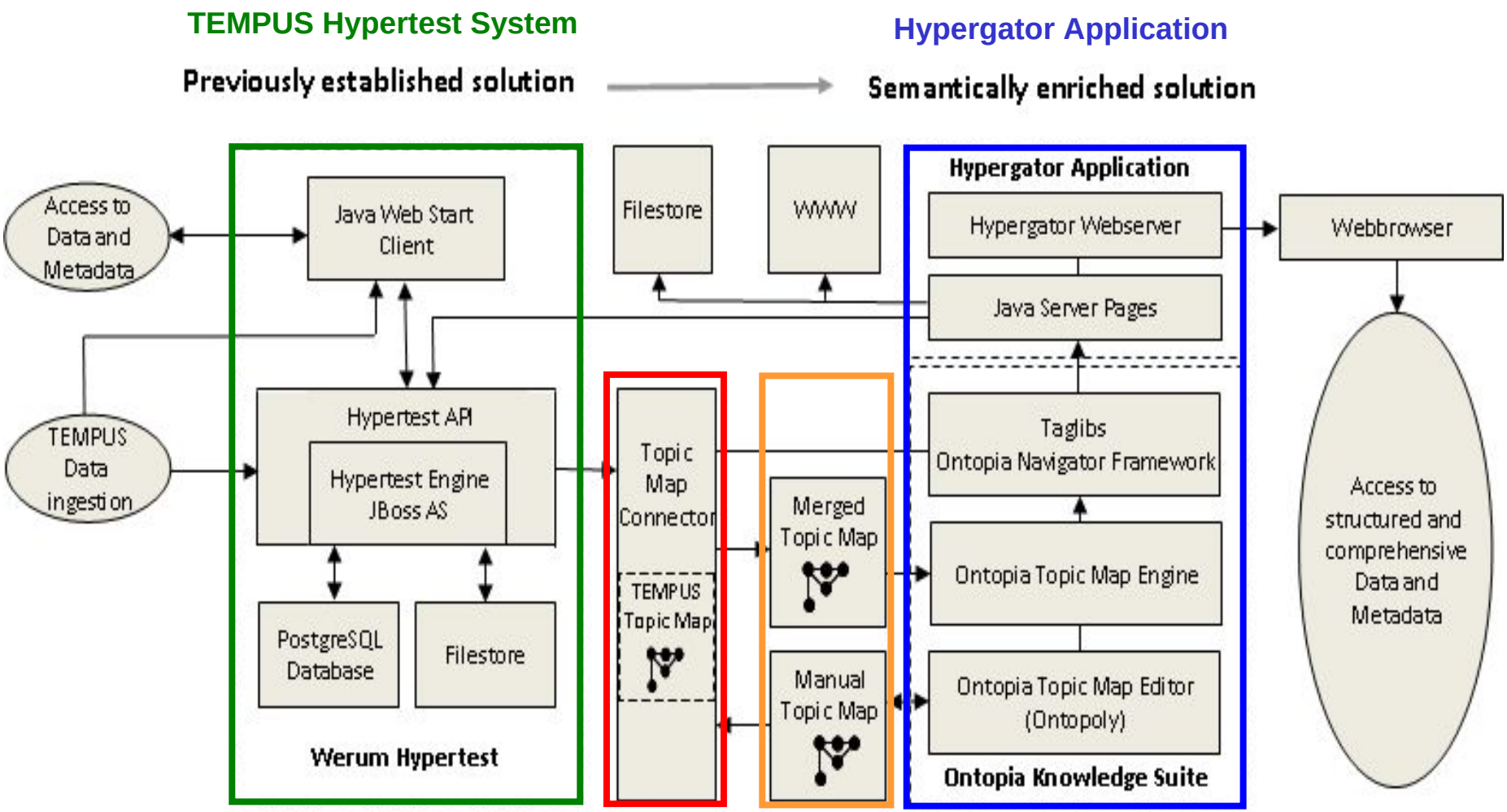




Populating the TEMPUS Topic Map



The Hypergator System Architecture



Populate Topic Map
and Merge Information

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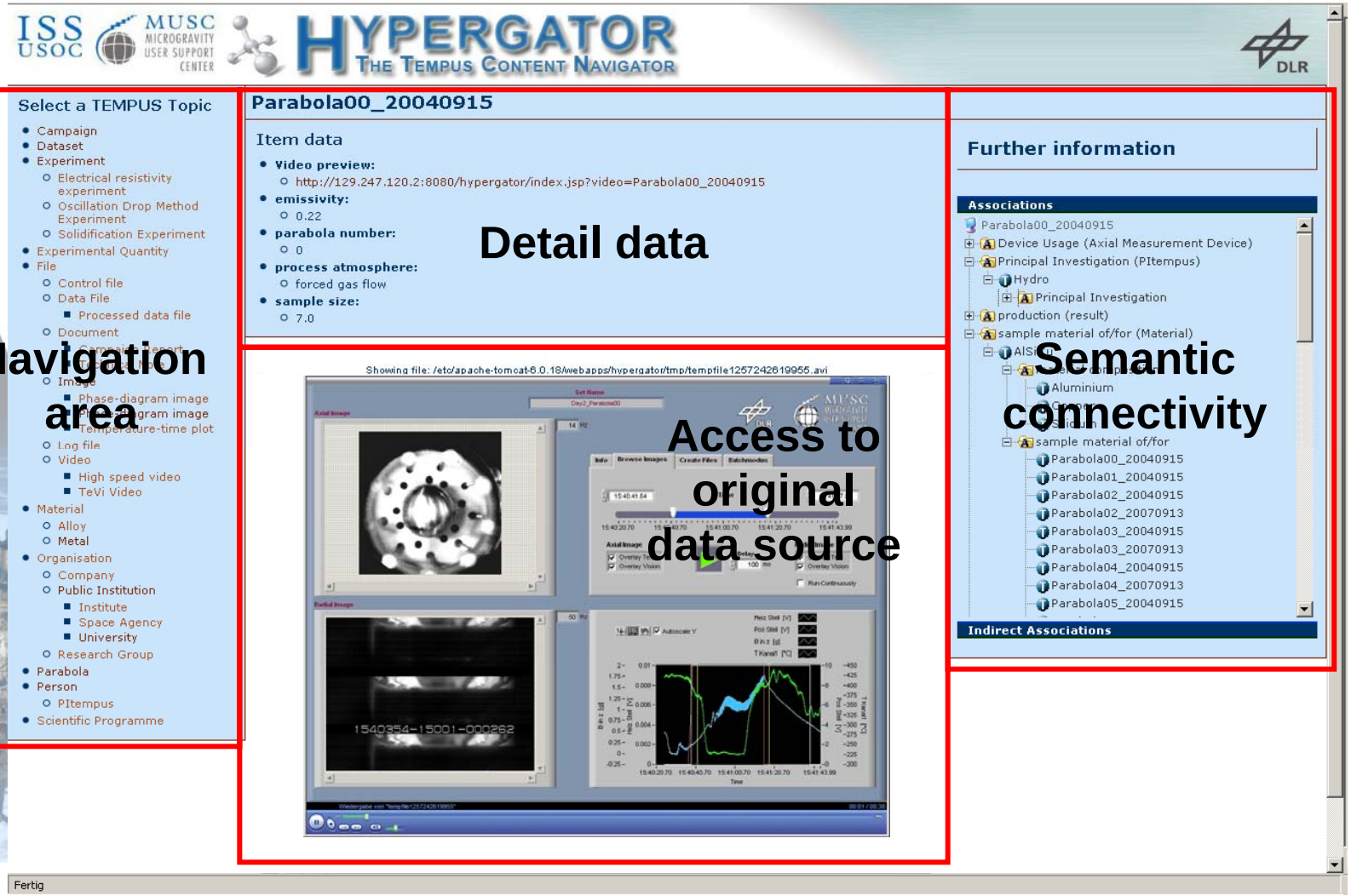
The Hypergator Application

- Browsing the scientific content via an intuitively usable Web-Frontend
- Accessing and Describing “tacit knowledge” by browsing associations

- Knowledge domain contained in XTM Topic Map
- Topic Map Occurrences represent resources on external data sources

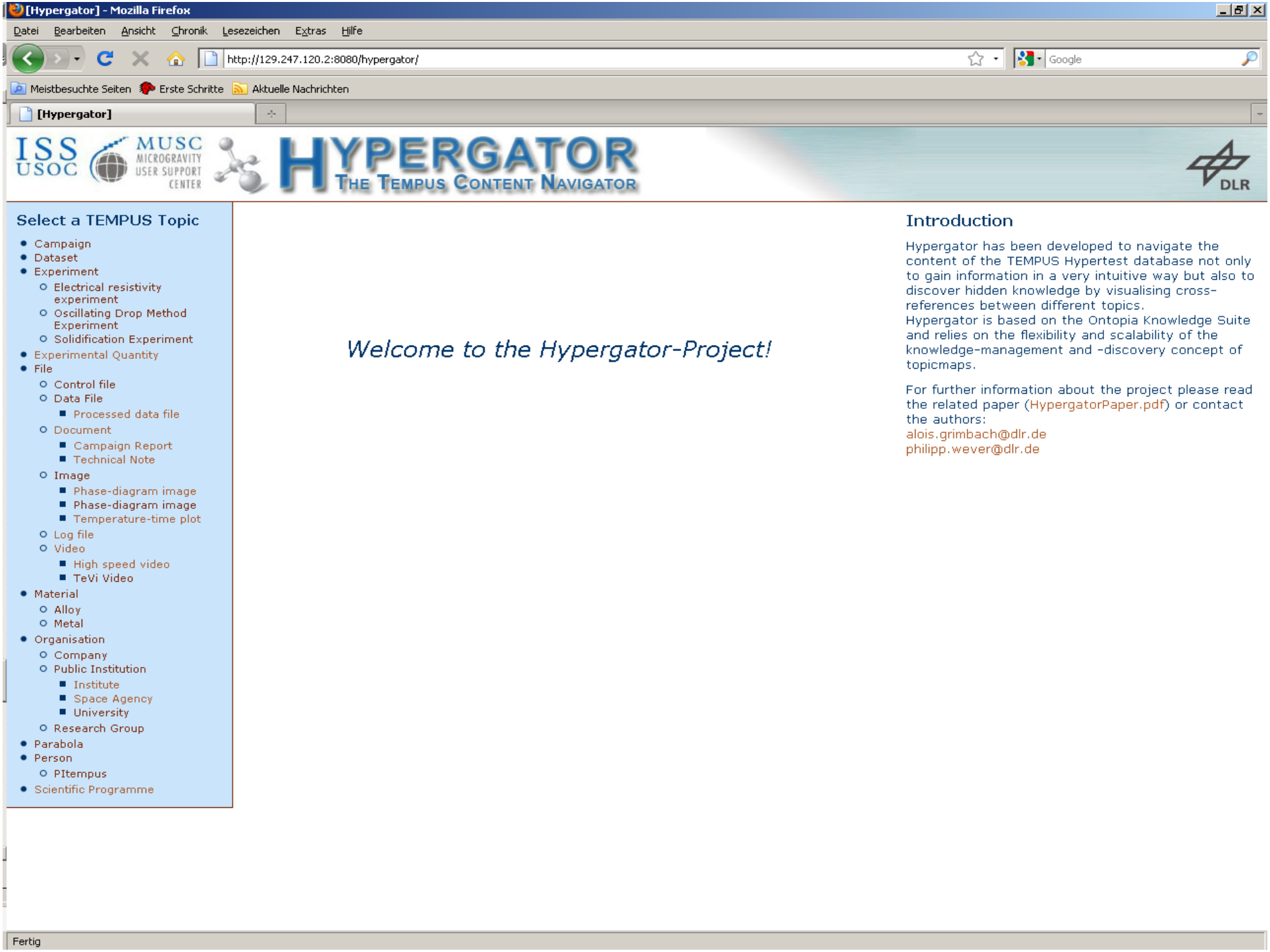
- Access to original data sources via JSP Servlets
- Access to the Topic Map via the Ontopia Knowledge Framework
- Querying the knowledge domain with the “tolog” query language

The Hypergator User Frontend



Looking at a use case

Which Copper based materials have been used so far in DLR Parabolic Flight Campaigns?


[Hypergator] - Mozilla Firefox
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http://129.247.120.2:8080/hypergator/
Google
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[Hypergator]
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HYPERGATOR
THE TEMPUS CONTENT NAVIGATOR
DLR
Select a TEMPUS Topic
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Solidification Experiment
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Phase-diagram image
Temperature-time plot
Log file
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TeVi Video
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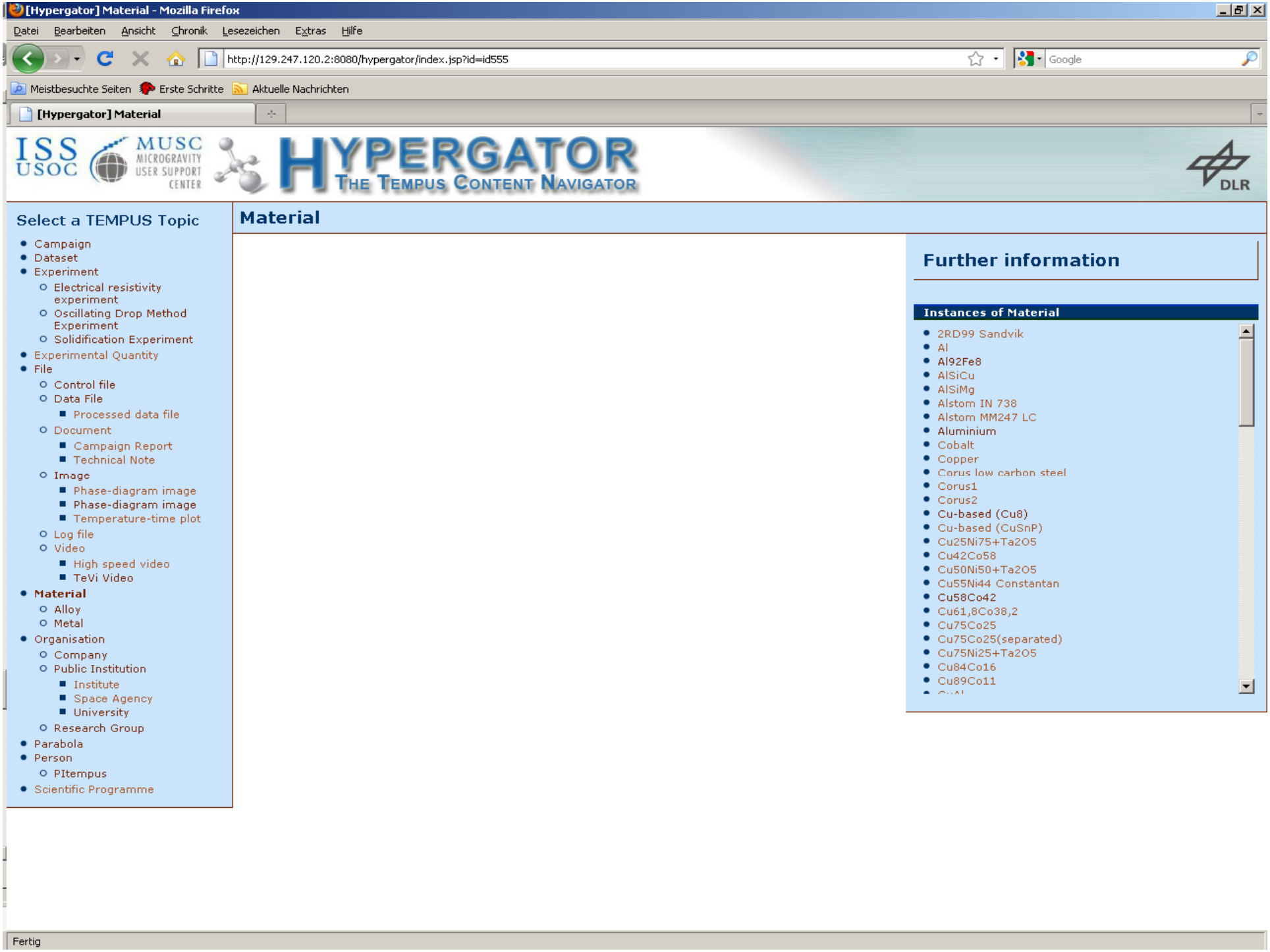
Public Institution
Institute
Space Agency
University
Research Group
Parabola
Person
PItempus
Scientific Programme
Welcome to the Hypergator-Project!
Introduction
Hypergator has been developed to navigate the content of the TEMPUS Hypertest database not only to gain information in a very intuitive way but also to discover hidden knowledge by visualising cross-references between different topics.
Hypergator is based on the Ontopia Knowledge Suite and relies on the flexibility and scalability of the knowledge-management and -discovery concept of topicmaps.
For further information about the project please read the related paper (HypergatorPaper.pdf) or contact the authors:
alois.grimbach@dlr.de
philipp.wever@dlr.de
Fertig


[Hypergator] Material - Mozilla Firefox
Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe
http://129.247.120.2:8080/hypergator/index.jsp?id=id555
Google
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[Hypergator] Material
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Scientific Programme
Material
Further information
Instances of Material
2RD99 Sandvik
Al
Al92Fe8
AlSiCu
AlSiMg
Alstom IN 738
Alstom MM247 LC
Aluminium
Cobalt
Copper
Corus low carbon steel
Corus1
Corus2
Cu-based (Cu8)
Cu-based (CuSnP)
Cu25Ni75+Ta2O5
Cu42Co58
Cu50Ni50+Ta2O5
Cu55Ni44 Constantan
Cu58Co42
Cu61,8Co38,2
Cu75Co25
Cu75Co25(separated)
Cu75Ni25+Ta2O5
Cu84Co16
Cu89Co11
Fertig

[Hypergator] Copper - Mozilla Firefox

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http://129.247.120.2:8080/hypergator/index.jsp?id=id725

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[Hypergator] Copper

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DLR

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- Person
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- Scientific Programme

Copper

Item data

- **chemical sign:**
  - Cu

All these Copper based materials have been used so far !

Further information

Associations

- Copper
- material composition (Alloy)
  - AlSiCu
  - Cu-based (Cu8)
  - Cu-based (CuSnP)
  - Cu25Ni75+Ta2O5
  - Cu42Co58
  - Cu50Ni50+Ta2O5
  - Cu55Ni44 Constantan
  - Cu58Co42
  - Cu61,8Co38,2
  - Cu75Co25
  - Cu75Co25(separated)
  - Cu75Ni25+Ta2O5
  - Cu84Co16
  - Cu89Co11
  - CuAl
  - CuCo
  - CuNb
  - CuSnP Wieland
  - CuSnTi Wieland
  - Ni10Ag50Cu40

Indirect Associations

javascript: d.o(1);

[Hypergator] Cu25Ni75+Ta2O5 - Mozilla Firefox

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http://129.247.120.2:8080/hypergator/index.jsp?id=id21606

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  - PItempus
- Scientific Programme

Cu25Ni75+Ta2O5

All these Tantalium based Materials have been used so far !

Further information

Associations

- Cu25Ni75+Ta2O5
- material composition (Metal)
  - Copper
  - Nickel
  - Tantalium
    - material composition
      - Cu25Ni75+Ta2O5
      - Cu50Ni50+Ta2O5
      - Cu75Ni25+Ta2O5
      - NiTa
      - NiTa+Ta2O3
      - NiTa+Ta2O5
      - TiAl-Ta
- sample material of/for (Experiment)

Indirect Associations

Fertig

[Hypergator] Cu25Ni75+Ta2O5 - Mozilla Firefox

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Cu25Ni75+Ta2O5

In which parabola(s) has Cu25Ni75+Ta2O5 been used?

Further information

Associations

- Cu25Ni75+Ta2O5
- material composition (Metal)
  - Copper
  - Nickel
  - Tantalium
    - material composition
      - Cu25Ni75+Ta2O5
      - Cu50Ni50+Ta2O5
      - Cu75Ni25+Ta2O5
      - NiTa
      - NiTa+Ta2O3
      - NiTa+Ta2O5
      - TiAl-Ta
- sample material of/for (Experiment)

Indirect Associations

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Cu25Ni75+Ta2O5

In which parabola(s) has Cu25Ni75+Ta2O5 been used?

Further information

Associations

- Cu25Ni75+Ta2O5
- material composition (Metal)
  - Copper
  - Nickel
  - Tantalium
    - material composition
      - Cu25Ni75+Ta2O5
      - Cu50Ni50+Ta2O5
      - Cu75Ni25+Ta2O5
      - NiTa
      - NiTa+Ta2O3
      - NiTa+Ta2O5
      - TiAl-Ta
- sample material of/for (Experiment)
  - Parabola16_20080411

Indirect Associations

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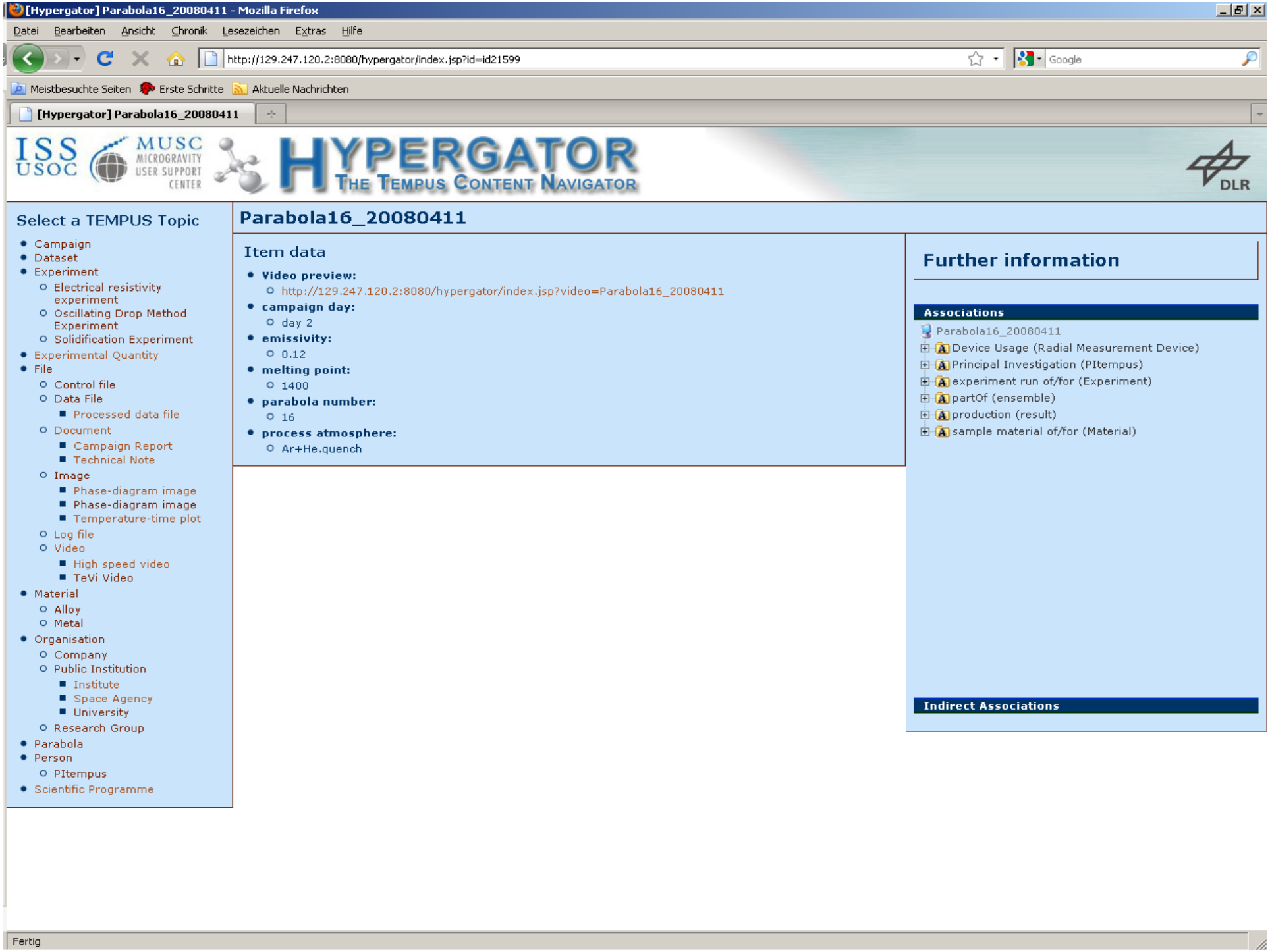
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PItempus
Scientific Programme
Parabola16_20080411
Item data
Video preview:
http://129.247.120.2:8080/hypergator/index.jsp?video=Parabola16_20080411
campaign day:
day 2
emissivity:
0.12
melting point:
1400
parabola number:
16
process atmosphere:
Ar+He.quench
Further information
Associations
Parabola16_20080411
Device Usage (Radial Measurement Device)
Principal Investigation (PItempus)
experiment run of/for (Experiment)
partOf (ensemble)
production (result)
sample material of/for (Material)
Indirect Associations
Fertig

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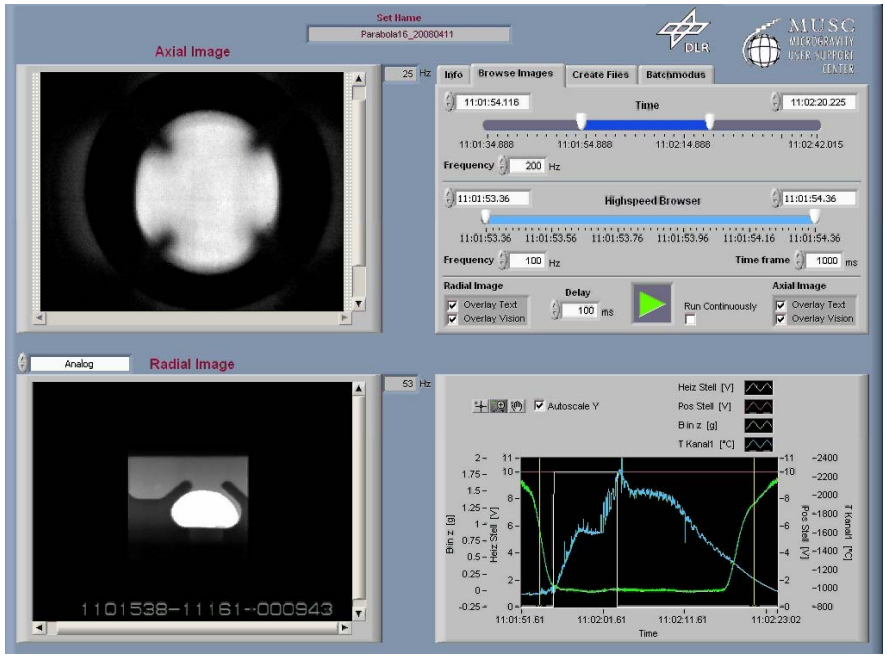
Parabola16_20080411

Item data

- **Video preview:**
  - http://129.247.120.2:8080/hypergator/index.jsp?video=Parabola16_20080411
- **campaign day:**
  - day 2
- **emissivity:**
  - 0.12
- **melting point:**
  - 1400
- **parabola number:**
  - 16
- **process atmosphere:**
  - Ar+He.quench



Further information

Associations

- Parabola16_20080411
- Device Usage (Radial Measurement Device)
- Principal Investigation (PItempus)
- experiment run of/for (Experiment)
- partOf (ensemble)
- production (result)
- sample material of/for (Material)

Indirect Associations

Fertig

[Hypergator] Parabola16_20080411 - Mozilla Firefox

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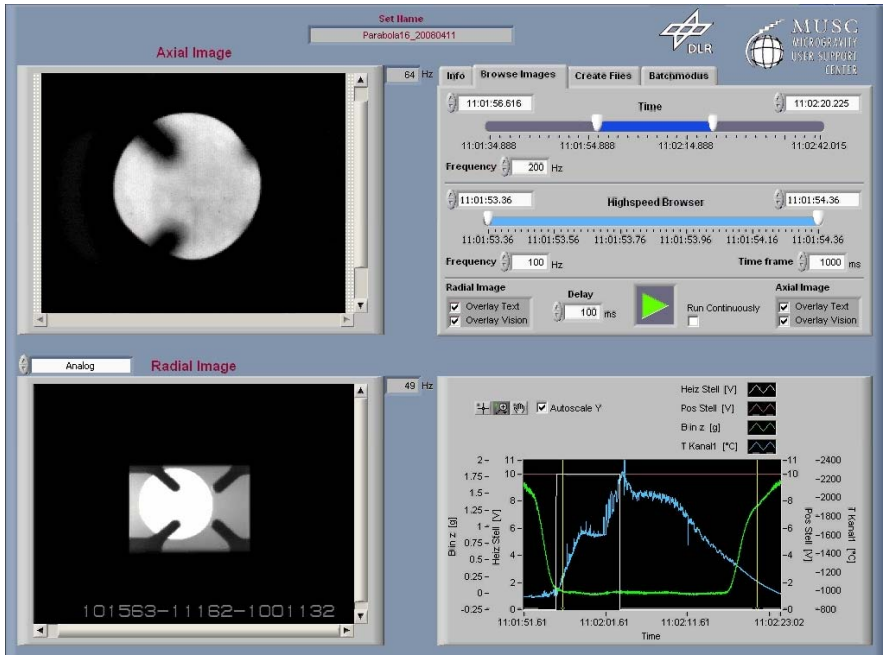
Parabola16_20080411

Item data

- **Video preview:**
  - http://129.247.120.2:8080/hypergator/index.jsp?video=Parabola16_20080411
- **campaign day:**
  - day 2
- **emissivity:**
  - 0.12
- **melting point:**
  - 1400
- **parabola number:**
  - 16
- **process atmosphere:**
  - Ar+He.quench

To which experiment does the parabola belong to?



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Associations

- Parabola16_20080411
- Device Usage (Radial Measurement Device)
- Principal Investigation (PItempus)
- experiment run of/for (Experiment)
- partOf (ensemble)
- production (result)
- sample material of/for (Material)

Indirect Associations

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Parabola16_20080411

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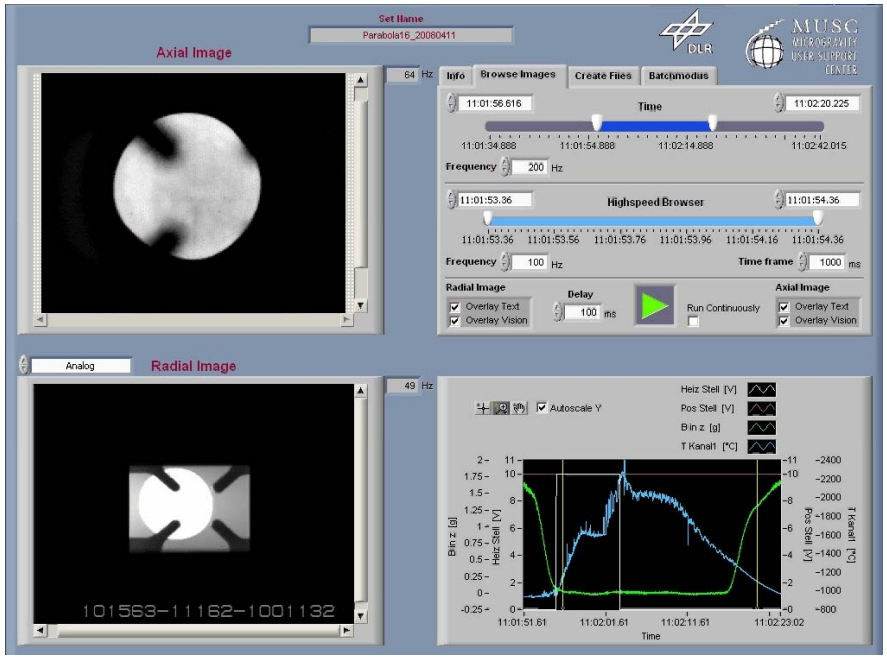


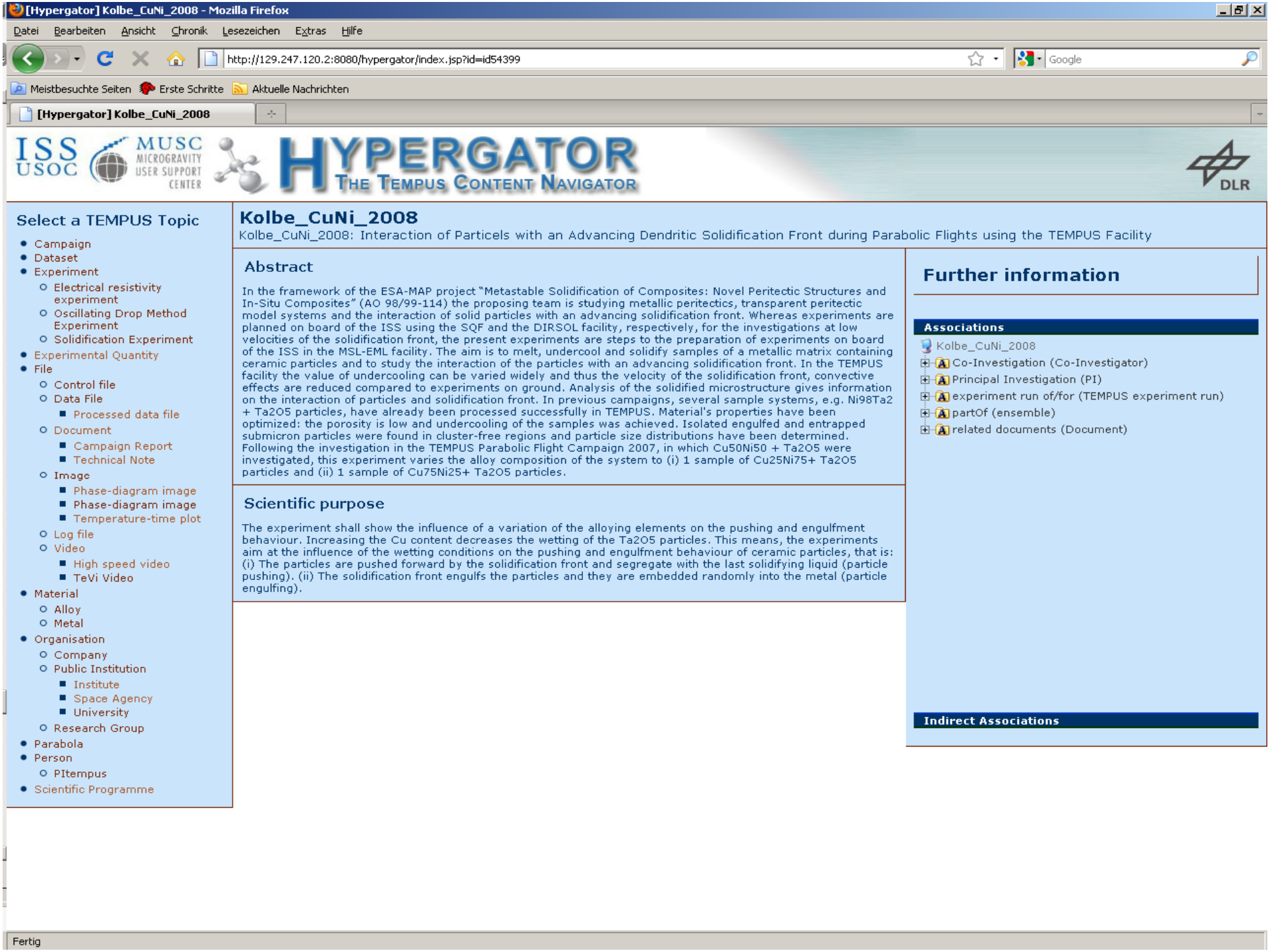
Further information

Associations

- Parabola16_20080411
- Device Usage (Radial Measurement Device)
- Principal Investigation (PItempus)
- experiment run of/for (Experiment)
  - Kolbe_CuNi_2008
- partOf (ensemble)
- production (result)
- sample material of/for (Material)

Indirect Associations

Fertig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Google
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Alloy
Metal
Organisation
Company
Public Institution
Institute
Space Agency
University
Research Group
Parabola
Person
PItempus
Scientific Programme
Kolbe_CuNi_2008
Kolbe_CuNi_2008: Interaction of Particels with an Advancing Dendritic Solidification Front during Parabolic Flights using the TEMPUS Facility
Abstract
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The experiment shall show the influence of a variation of the alloying elements on the pushing and engulfment behaviour. Increasing the Cu content decreases the wetting of the Ta2O5 particles. This means, the experiments aim at the influence of the wetting conditions on the pushing and engulfment behaviour of ceramic particles, that is: (i) The particles are pushed forward by the solidification front and segregate with the last solidifying liquid (particle pushing). (ii) The solidification front engulfs the particles and they are embedded randomly into the metal (particle engulfing).
Further information
Associations
Kolbe_CuNi_2008
Co-Investigation (Co-Investigator)
Principal Investigation (PI)
experiment run of/for (TEMPUS experiment run)
partOf (ensemble)
related documents (Document)
Indirect Associations
Fertig

[Hypergator] Kolbe_CuNi_2008 - Mozilla Firefox

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  - Oscillating Drop Method Experiment
  - Solidification Experiment
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  - Data File
    - Processed data file
  - Document
    - Campaign Report
    - Technical Note
  - Image
    - Phase-diagram image
    - Phase-diagram image
    - Temperature-time plot
  - Log file
  - Video
    - High speed video
    - TeVi Video
- Material
  - Alloy
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Which organizations have participated in that experiment?

Further information

Associations

- Kolbe_CuNi_2008
- Co-Investigation (Co-Investigator)
- Principal Investigation (PI)
- experiment run of/for (TEMPUS experiment run)
- partOf (ensemble)
- related documents (Document)

Indirect Associations

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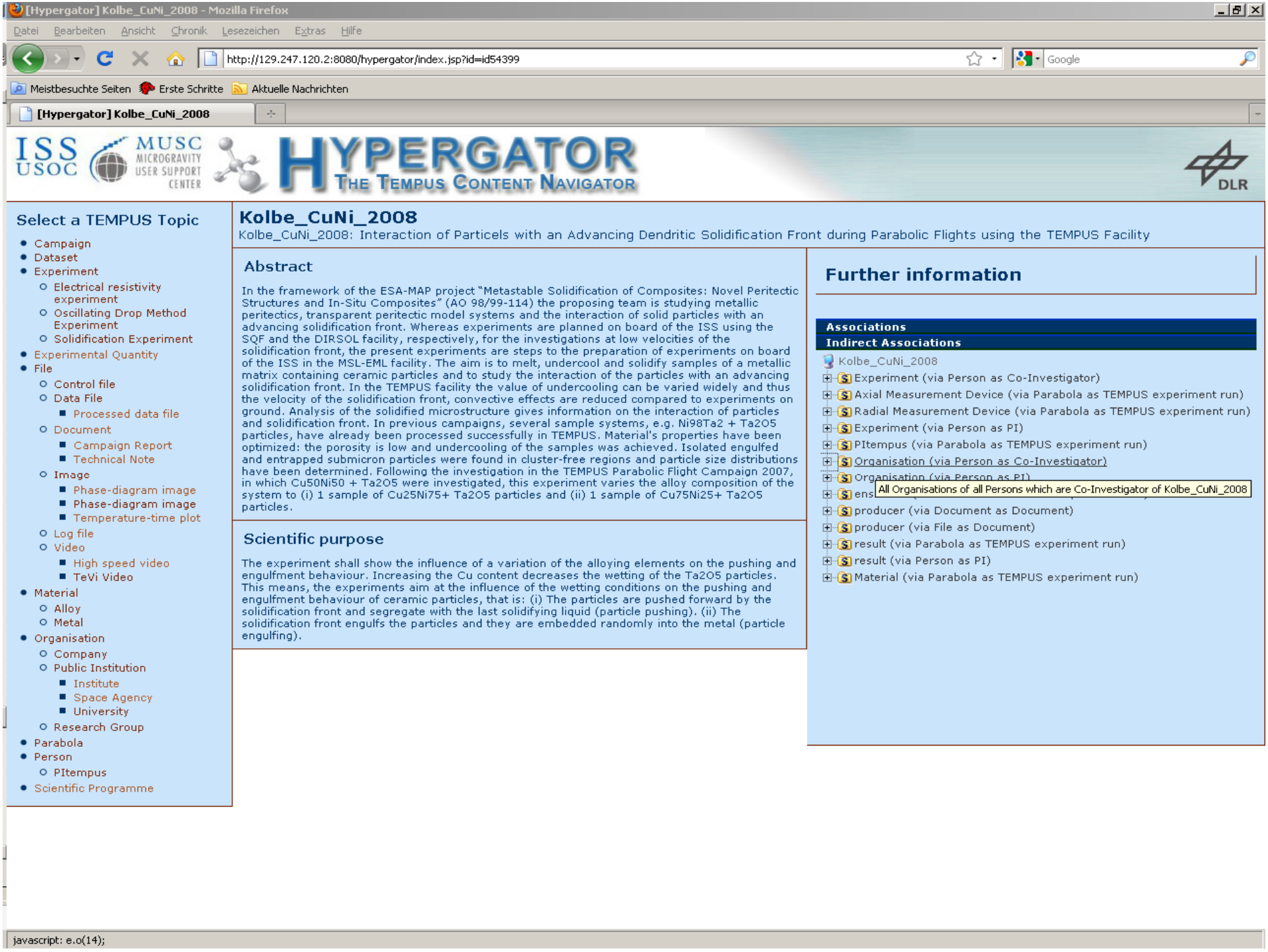
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Further information
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Indirect Associations
Kolbe_CuNi_2008
Experiment (via Person as Co-Investigator)
Axial Measurement Device (via Parabola as TEMPUS experiment run)
Radial Measurement Device (via Parabola as TEMPUS experiment run)
Experiment (via Person as PI)
PItempus (via Parabola as TEMPUS experiment run)
Organisation (via Person as Co-Investigator)
Organisation (via Person as PI)
All Organisations of all Persons which are Co-Investigator of Kolbe_CuNi_2008
producer (via Document as Document)
producer (via File as Document)
result (via Parabola as TEMPUS experiment run)
result (via Person as PI)
Material (via Parabola as TEMPUS experiment run)
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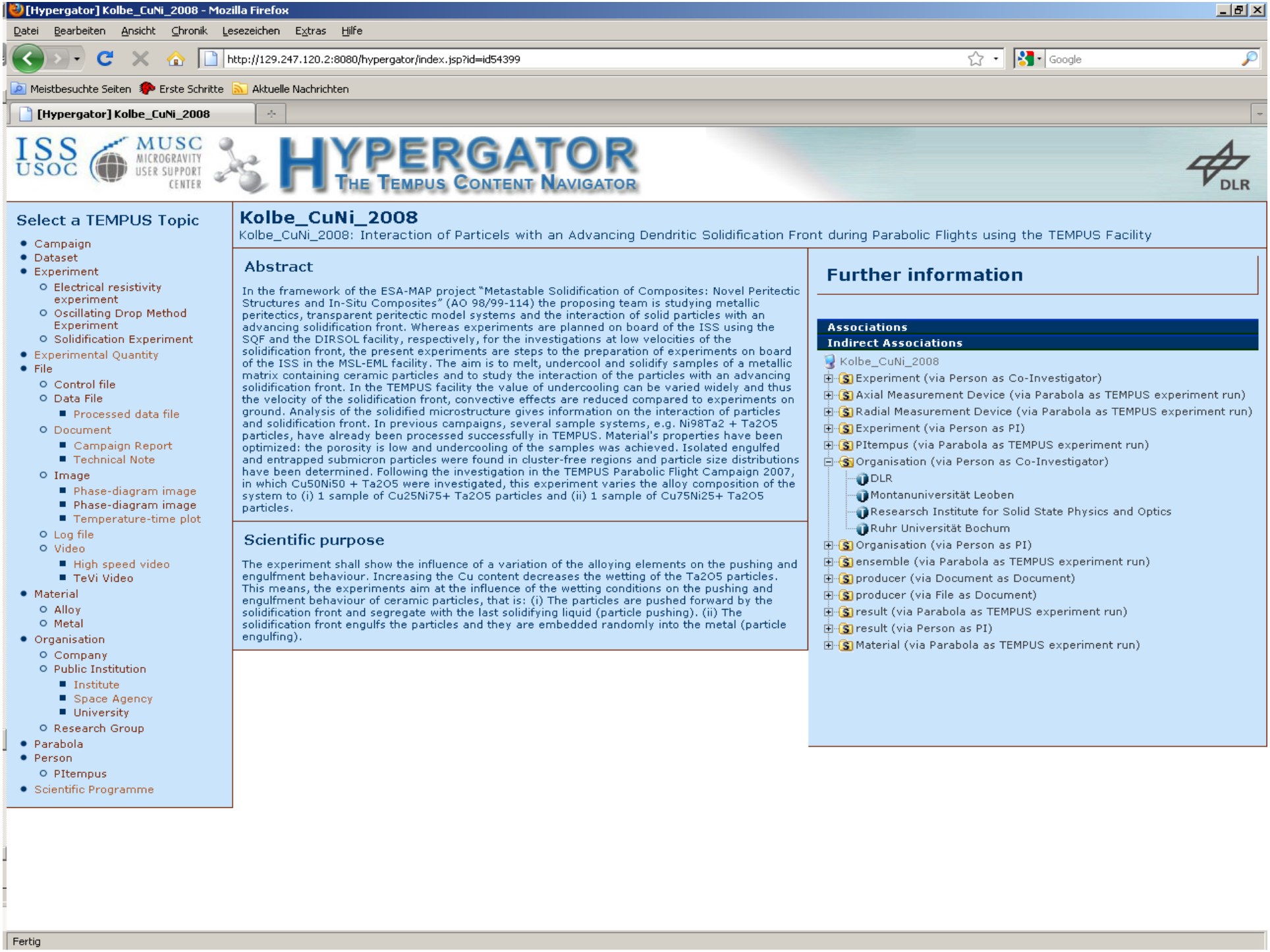
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Organisation (via Person as Co-Investigator)
DLR
Montanuniversität Leoben
Researsch Institute for Solid State Physics and Optics
Ruhr Universität Bochum
Organisation (via Person as PI)
ensemble (via Parabola as TEMPUS experiment run)
producer (via Document as Document)
producer (via File as Document)
result (via Parabola as TEMPUS experiment run)
result (via Person as PI)
Material (via Parabola as TEMPUS experiment run)
Fertig

Conclusion and Outlook

- ***Goal:***

  Applying semantic techologies to a productive data archive
  and assess its benefit

  - ✓ Hypergator Web Application Developed
  - ✓ Populated Topic Map with 700 Parabolas and Existing Metadata
  - ✓ Domain expert performing a cognitive walkthrough to accomplish a predefined task using the Hypergator Web Application

- ***Future prospect:***

  - ➢ Enrichment of the application with supplemental information
  - ➢ Questionning is being investigated by FP7 Programme ULISSE in the larger context of space experimentation pursuing
    Valorisation, Dissemination and Exploitation of µg Scientific Data

MUSC Point of Contacts

- Project Members:
  - Alois.Grimbach@dlr.de
  - Philipp.Wever@dlr.de
  - Stephan.Schneider@dlr.de
- Head of Microgravity User Support Center (MUSC):
  - Rainer.Willnecker@dlr.de