WP4: Relation with Industry

Report
Last AIDA annual meeting
CERN 9th-11th December 2014

AIDA is co-funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 262025

Agenda

WP4: Relation with industry

Work completed

- **D4.1: Overall Industry Report**
- D4.2: Follow-up structure for the project

D4.1 Report: Content

- Academia Industry Matching Events (AIME)
  - Concept
  - Statistics
  - National events
  - Analysis
- Collaboration Spotting
  - Concept and purpose
  - Technology patterns
  - Selecting attendance
  - Event impact and follow-up
- Conclusion and future plans

D4.1: AIME

- Strategy
  - Foster collaborations between Academia & Industry
- Methodology
  - AIME
    - Topical Events
    - Needs of communities (HEP and others)
    - Capability of Industry
    - Two half-day events with booths, posters, long coffee breaks
    - Networking dinner
- Statistics

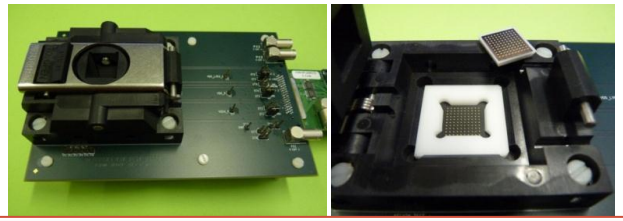
AIME's scope

- **Enhance industry involvement in R&D for curiosity driven research**
- Foster collaborations between academia and industry
- Promote the use of research results in other research disciplines and industrial applications

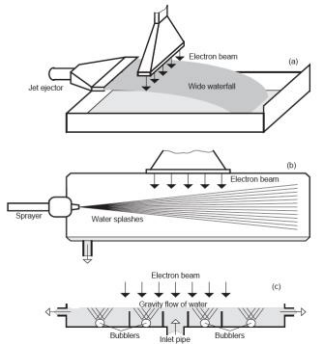
Pre-commercial procurement

Application oriented

3D-IC



3D Interconnection event (Frascati)



Industrial Applications Accelerators

Events for Industry Report

11 AIME events organised since 2011 (7 reported in D4.1)

- **Si-Photomultipliers** (CERN, Geneva, 2011) (AIDA kick-off, HEPTech)
- Vacuum & Cryogenics (GSI, Darmstadt, 2011) (Jointly organised with ASPERA)
- **Position Sensitive Solid State Detectors (DESY, Hamburg, 2012)**
- Beam monitoring (GSI, Darmstadt, 2012)
- **Micro Pattern Gaseous Detectors** (IN2P3/LAPP, Annecy, 2012)
- **3D-IC** (INFN, Frascati, 2013)
- Super conductivity (CIEMAT, Madrid, 2013) (HEPTech)
- Industrial applications of accelerators (STFC, Daresbury, 2013)
- **Neutron detection with MPGDs** (CERN, Geneva, 2013) (Jointly organised with RD-51)
- **Control Systems** (Demokritos, Athens, 2013)
- **RPC and TGC (Vienna, 2014)** (jointly organised with HEPTech)

AIME RPC-TGC Report

AIDA

Academia meets Industry:
Resistive-Plate Chambers and Thin-Gap Chambers
24-25 March 2014, Vienna University of Technology

ORGANIZING COMMITTEE:

Marcello Abbrescia
Giulio Aielli
Thomas Bergauer
Brigitte De Monte
Marko Dragicevic
Sotirios Fragkiskos
Manfred Krammer
Imad Laktineh
Jean-Marie Le Goff
Abdenour Lounis
George Mikenberg
Vladimir Peskov
Rinaldo Santonico

HEPHY Institute of High Energy Physics · ÖAW Austrian Academy of Sciences · AIDA · CERN · HEPTech Leading HEP technologies for industry · Technology Transfer opportunities · Seventh Framework Programme

- National Events
  - AIME-like event at Thessaloniki, 4-5/4/2011
    - Implementation of informatics to the HEP research
    - NTUA, NRSC “Demokritos”, SEPVE
  - AIME-like event at Alexandroupolis, 26-27/11/2011
    - Implementation of Advanced Electronics and Precise Mechanical Components to the HEP research
    - NTUA, NRSC “Demokritos”
  - Event organized by Ivan Vila in Seville, 24-25/6/2013
    - CPAN Workshop on technology transfer at CNA

AIME: Statistics

EVENT	# of registrants	# of companies	# of registrants Companies	# of Inst.	# of registrants Inst.	Date of Event	% EU Industry
AIME on Si-PM at CERN	134	23	34	40	102	2011/02/16-17	91
AIME on PSSSD at DESY	86	15	18	25	68	2012/03/26-27	100
AIME on MPGD at LAPP	70	11	13	19	57	2012/04/26-27	100
AIME on 3-D interconnection at LNF	91	14	15	27	77	2013/04/08-09	71
AIME on MPGD (neutron) at CERN	91	9	10	31	81	2013/04/14-15	90
AIME on Controls at Demokritos	93	21	21	24	72	2013/12/03-04	100
AIME on RPC & TGC at TU Vienna	46	8	10	12	34	2014/04/24-25	92

Table 1: Academia-industry matching events on Detector R&D organised during 2011-2014; Si-PM: Silicon Photomultipliers; PSSSD: Position Sensitive Solid State Detectors; MPGD: Micro Pattern Gaseous Detectors; RPC: Resistive Plate Chambers, TGC: Thin Gap Chambers.

- **611** people attended these events with an average of **87** participants per event
- **101** Companies attended the seven events for an average of **14** companies per event
  - MPGD, RPC → Small industrial community supporting the activity
  - Technologies where Europe could meet the needs of academia →EU industry is about **90% or above**.
  - Percentage goes **down to 70%** when the leading industry for a technology topic is in the US and/or Asia.
    - 3-D interconnections

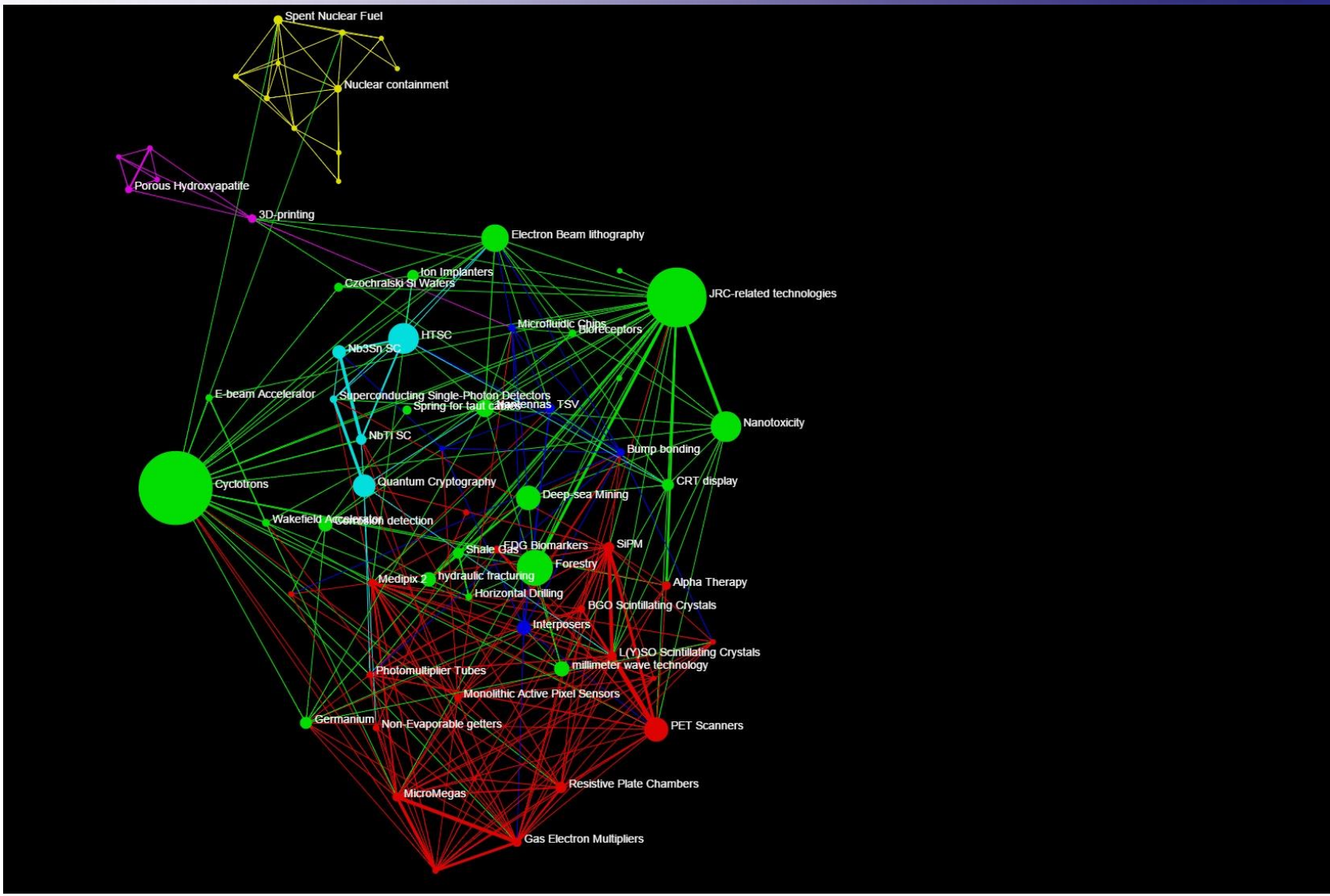
D4.1 Report: AIME

- Analysis
  - Interactions between academia and industry strongly depend on the type and readiness level of the technology and its use in detectors.
  - Early collaborations with industry are essential. But academic needs depend on the detector technology:
    - Industry alone can manufacture critical components
      - 3D-interconnections, Position Sensitive Solid State Detectors
      - →Development of an industrial process to meet physics requirements
        - » Prototypes, characterisation, academic feedback to industry
    - Industry has developed technologies for commercial applications that can be used for detectors with some optimizations.
      - RPC, TGC
      - Ex: PCB, coolant in gas mixtures
      - →Improvement of existing materials to meet physics requirements
        - » Specific production in limited quantities → Risk of cost increase

D4.1 Report: AIME

- Analysis (continued)
  - Early collaborations with industry are essential. But purpose depends on the detector technology:
    - Industry alone can manufacture critical components
      - 3D-interconnections, Position Sensitive Solid State Detectors
      - Aim at including our needs into processes that can address a larger market
    - Manufacturing of very large detectors no longer possible without the involvement of industry
      - RPC, TGC
      - No market outside PP
      - Applications outside PP are important to convince industry to invest in equipment (ex: Ore mining with TGC-based detectors)
      - Interesting market for education

Collaboration Spotting



Visualisation of large data sets as interactive graphs derived from metadata information

Data Set
Files containing structured data, documents, database tables, web pages

Metadata set
instances of metadata of various types pointing to data

e.g. Publication metadata = (title, abstract, authors/org, subject categories, citations, DOI, etc.)

Definitions

Graph = nodes and edges showing features of metadata instances

Node = an instance of metadata subtype or type

Edge = metadata instances common to two nodes

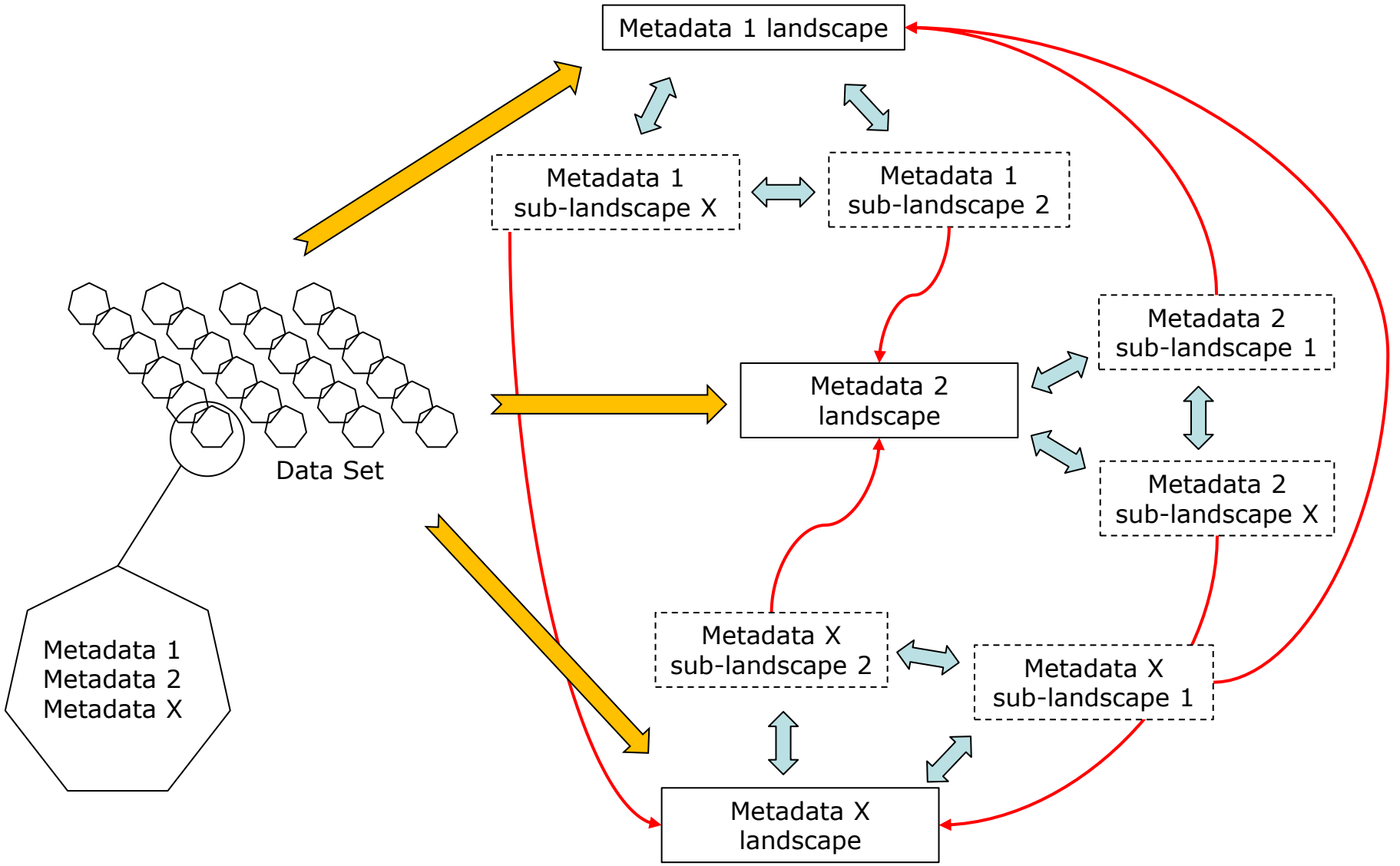
Graph navigation

Within same data set, across a same landscape using different instances of metadata sub-types as nodes in graph
e.g. Graph of subject categories ←→ Graph of organisations

Across data sets with different metadata type using nodes graph to access another graph
e.g. technology Node in the Technogram ←→ Graph of organisations

Underlying mathematical formalism to be published soon.

Data set navigation



Monitoring of innovation and technological development

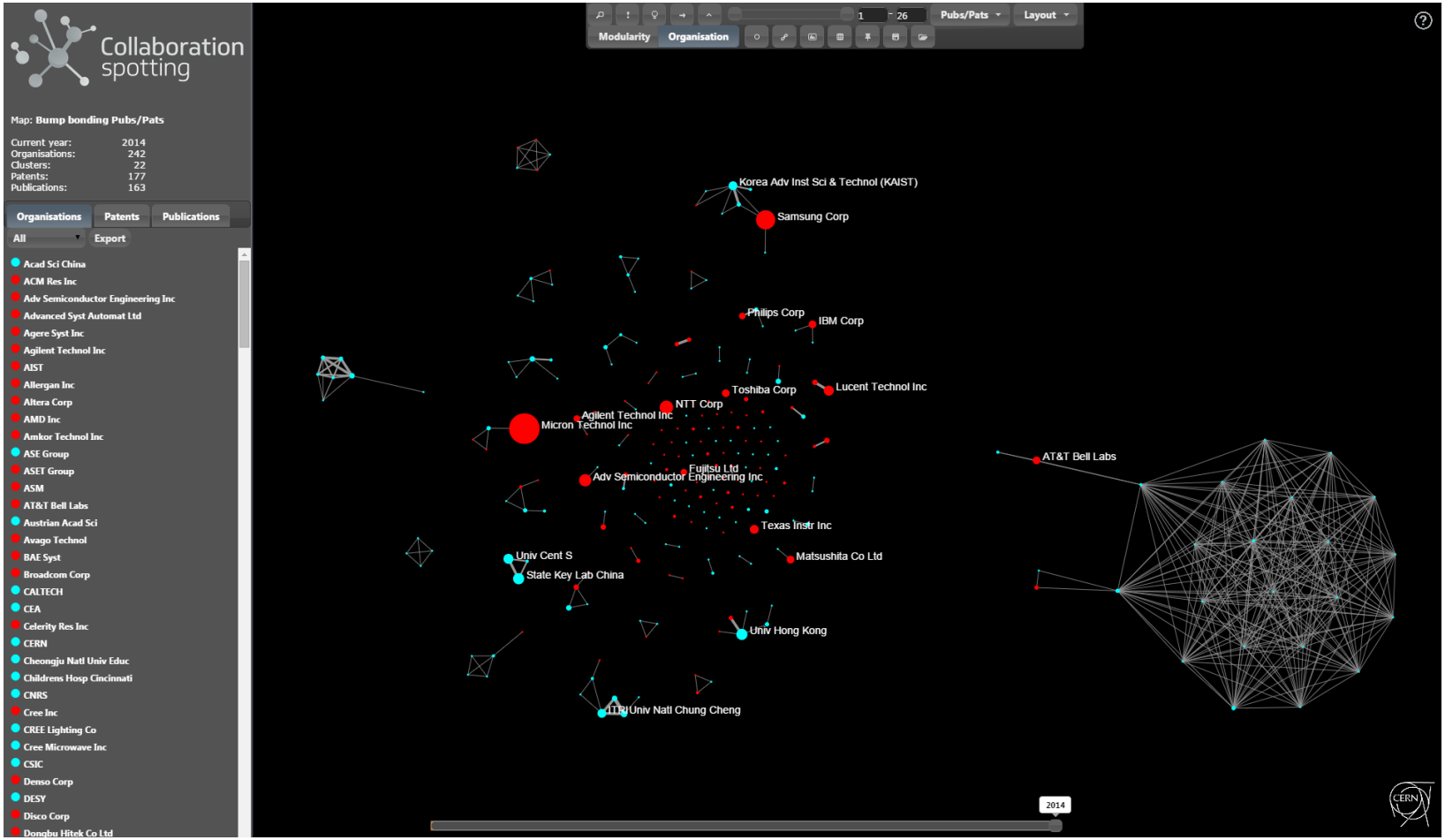
Data sets: patents databases, scientific publication databases

EPO, Thomson Innovation

Scopus, WoS, ArXiv

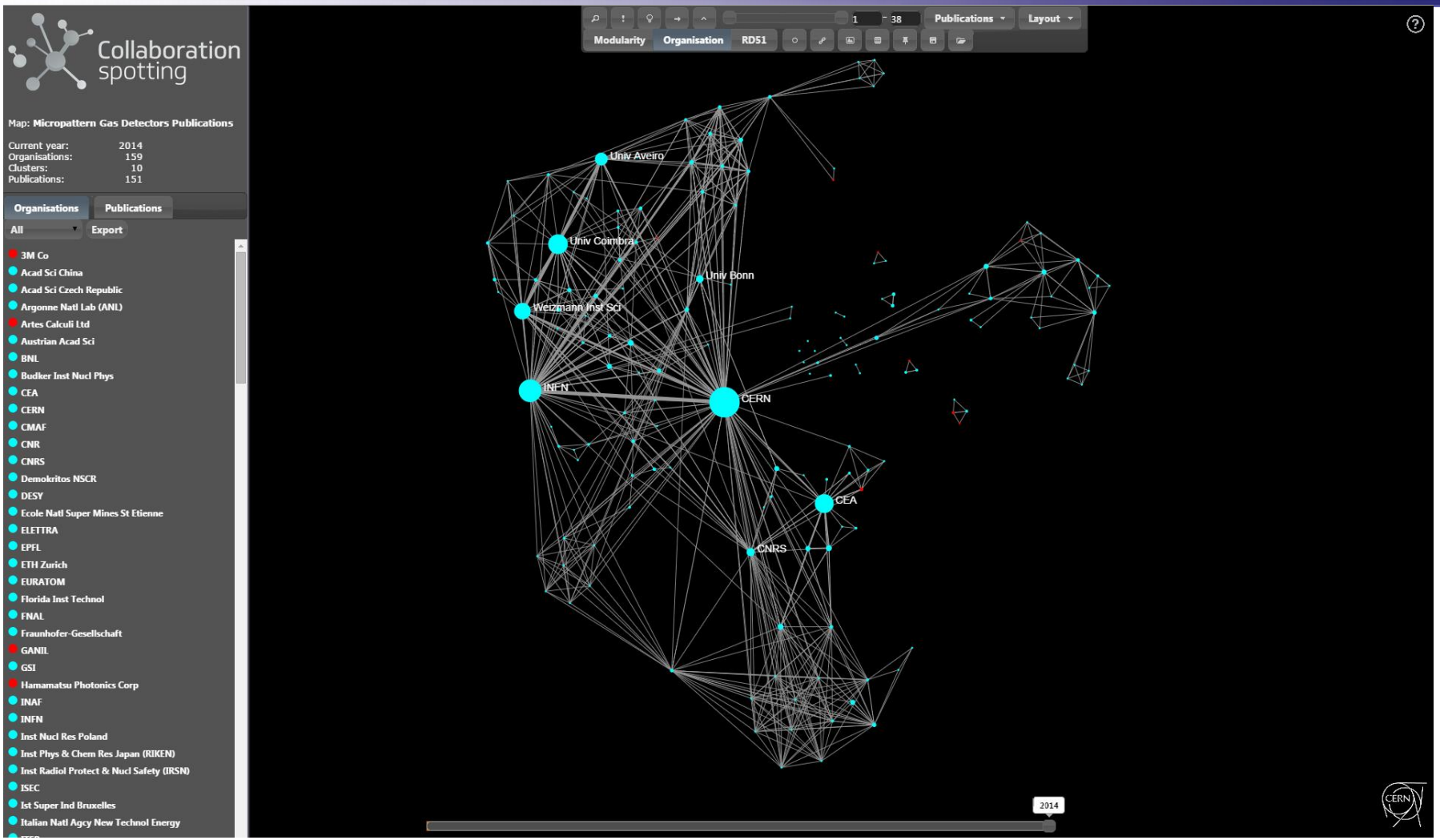
Under development: input from experts and future users is key

Technology patterns



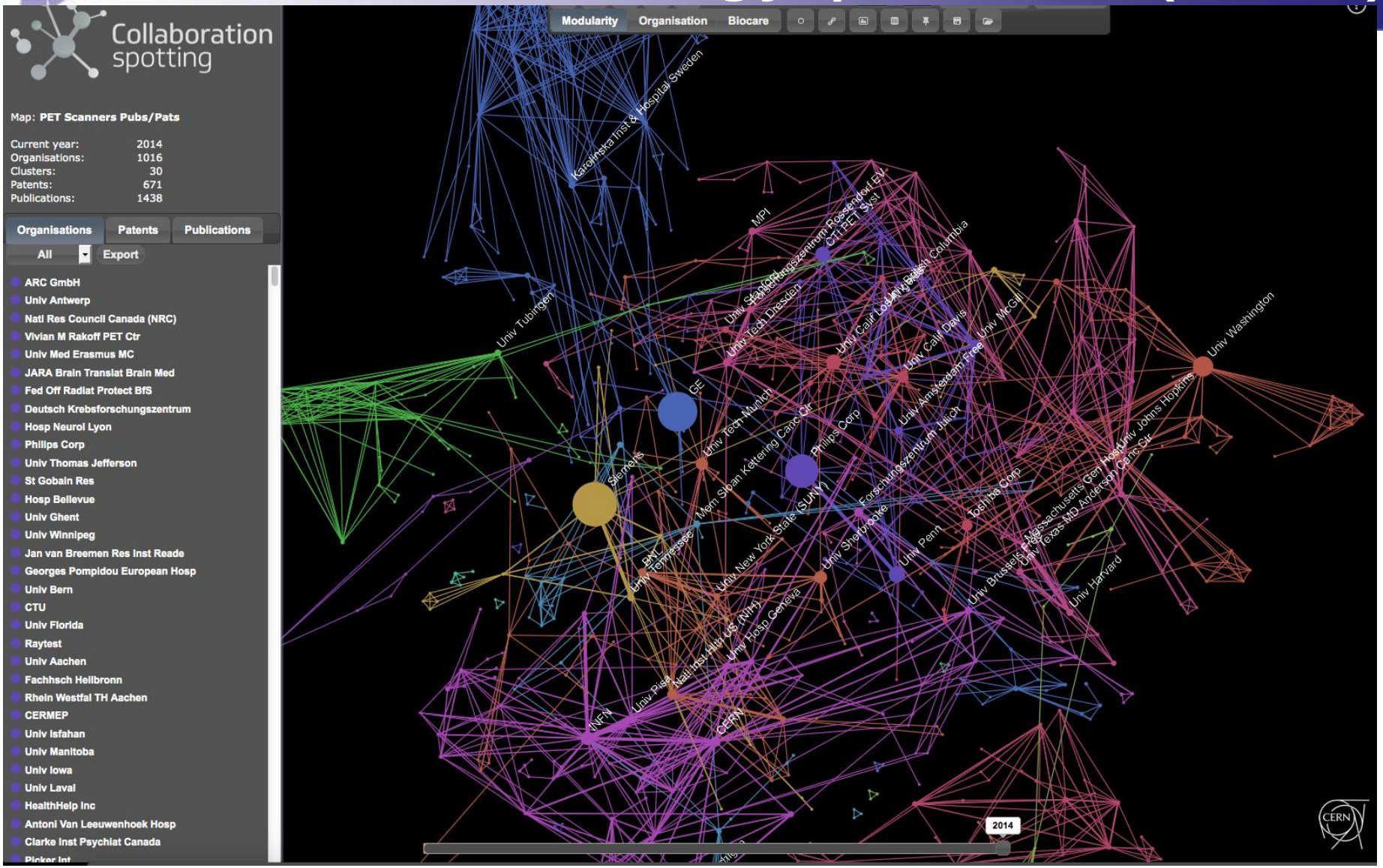
Organisation landscape of the Bump Bonding technology. – Red: Companies, Blue: Institutions

AIDA Technology patterns(cont.)



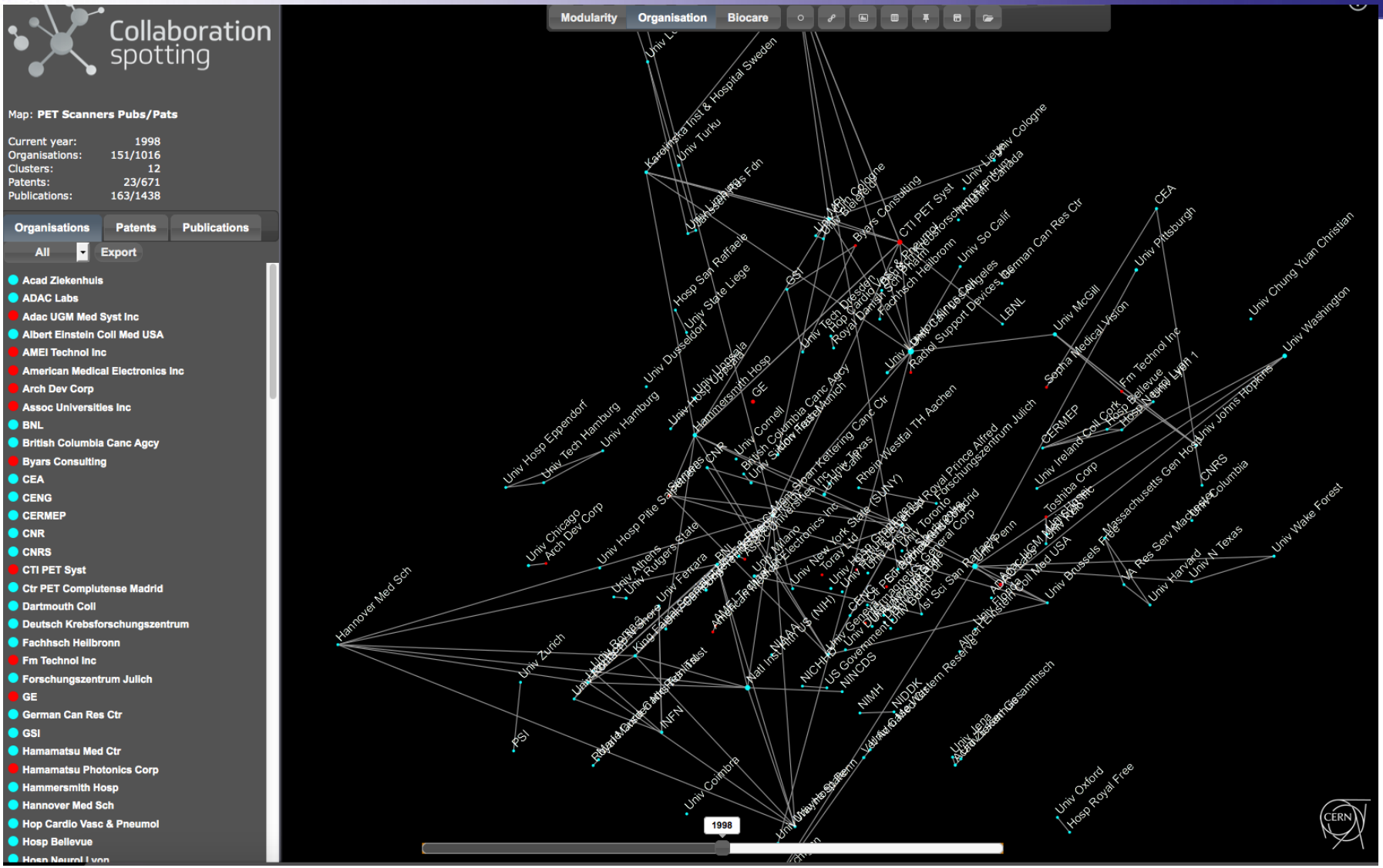
Organisation landscape of the MPGD technology

AIDA Technology patterns(cont.)



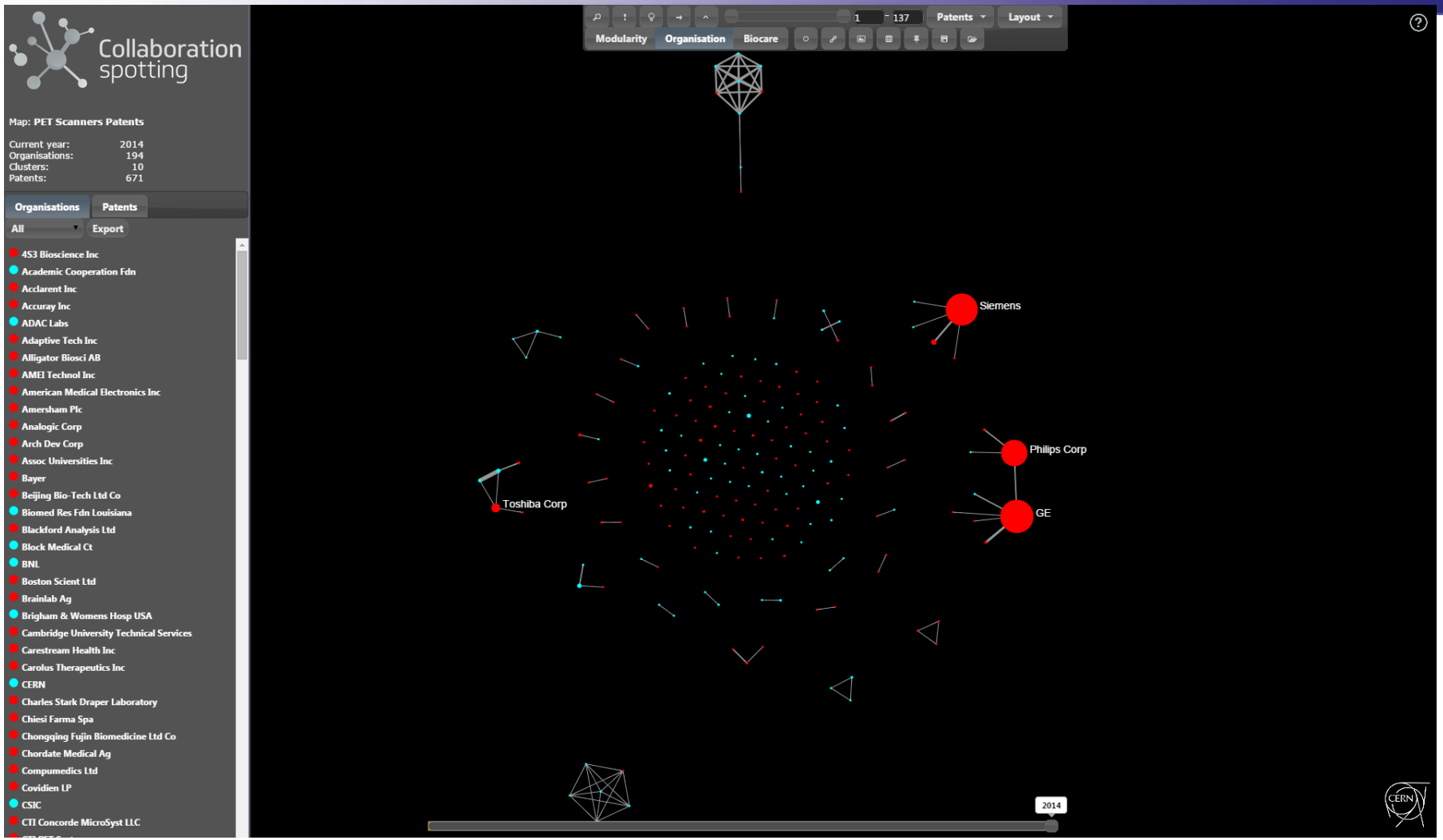
Organisation landscape of the Positron Emission Tomography (PET) technology

AIDA Technology patterns(cont.)



Subset of the PET scanner organisation landscape in 1998

AIDA Technology patterns(cont.)

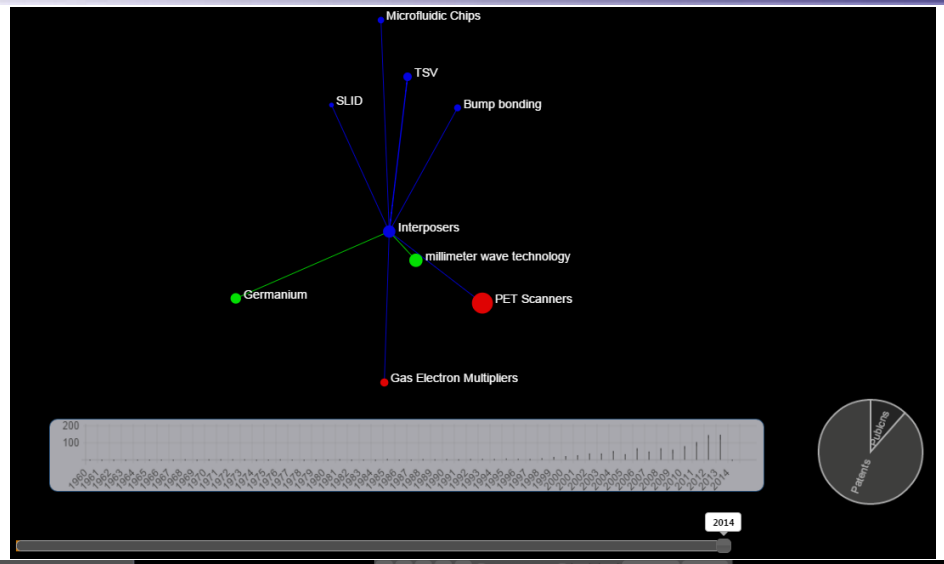


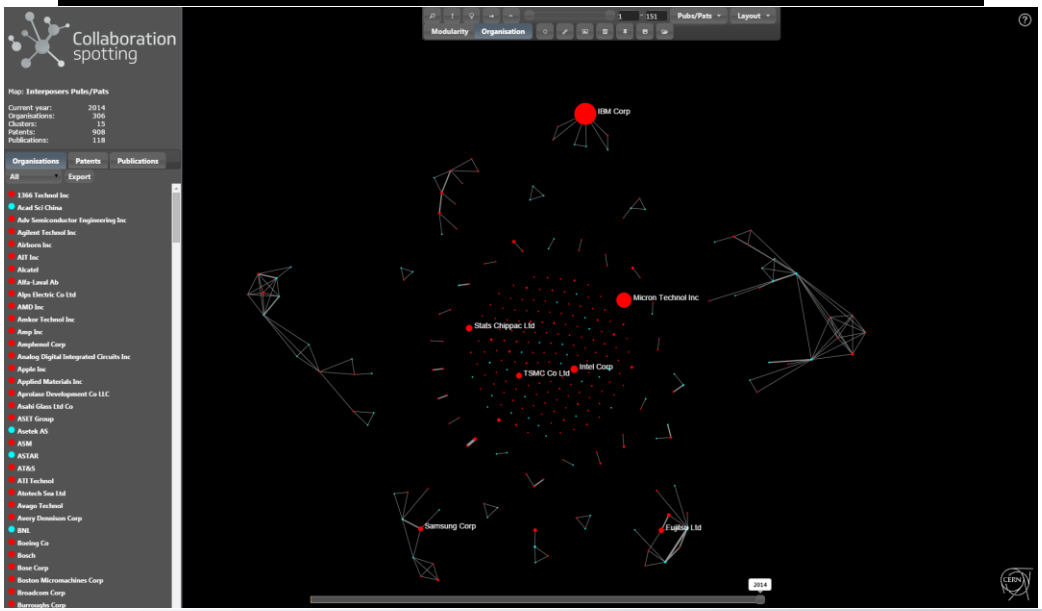
PET scanners organisation landscape with patents only

Selecting Attendance

- We can use Collaboration Spotting to invite experts to attend AIME events
- Example: 3-D interconnections
  - Three main technologies identified by AIDA experts:
    - Interposers
    - Through Silicon Vias (TSV)
    - Solid Liquid Inter-Diffusion (SLID)

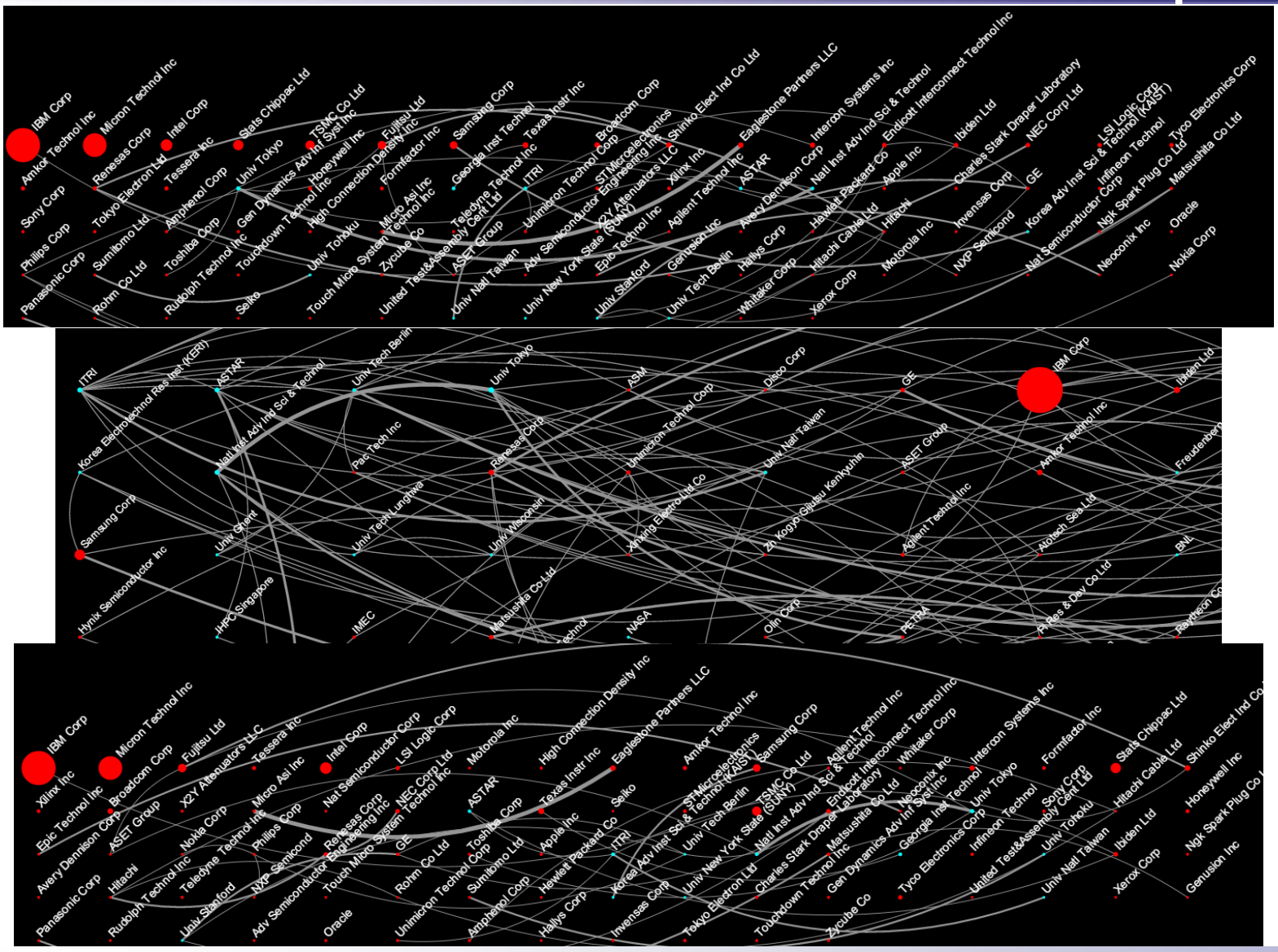
Selecting Attendance: Interposers





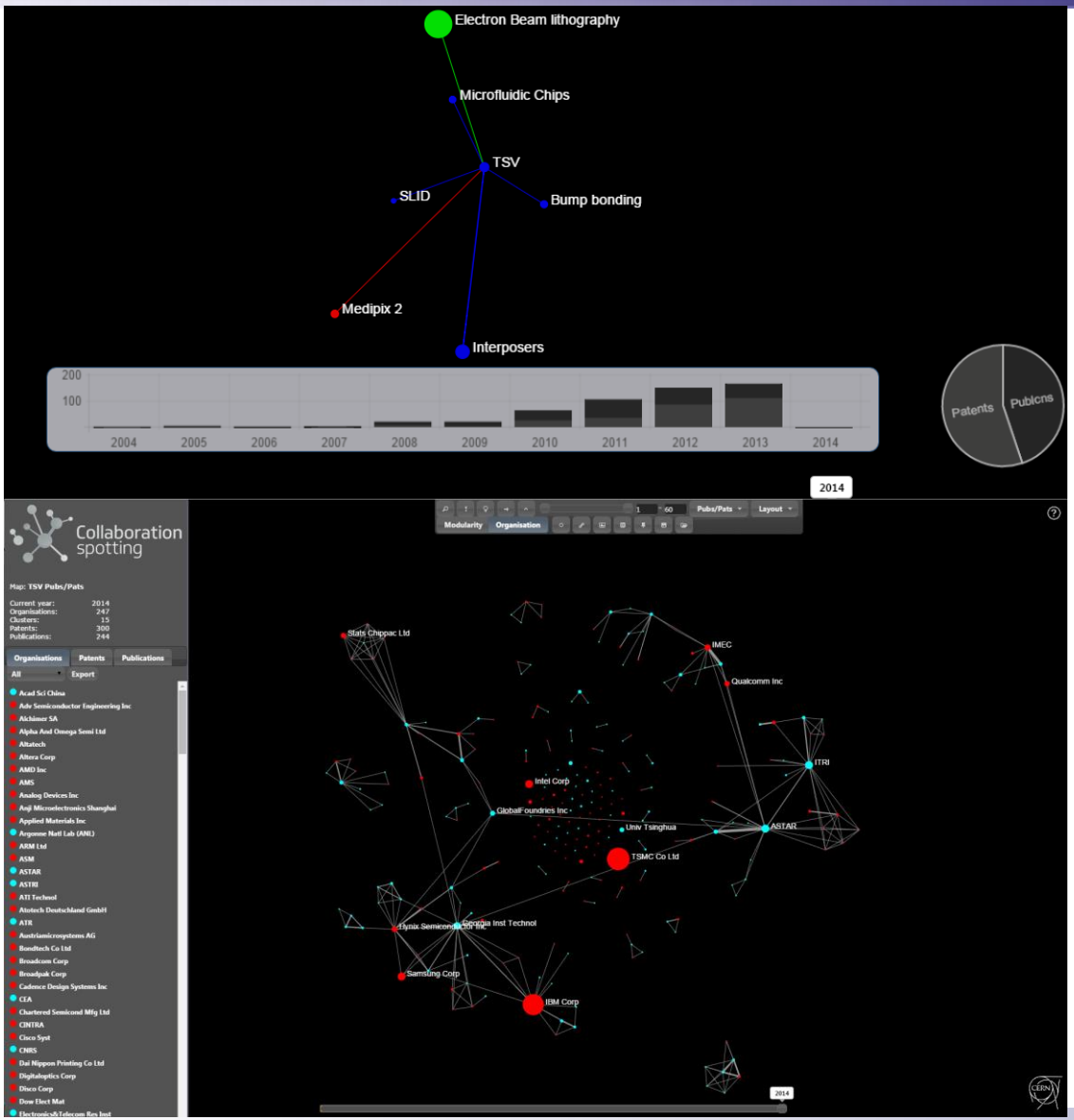
Patents and publications related to interposers /Organisation landscape

Selecting Attendance: Interposers

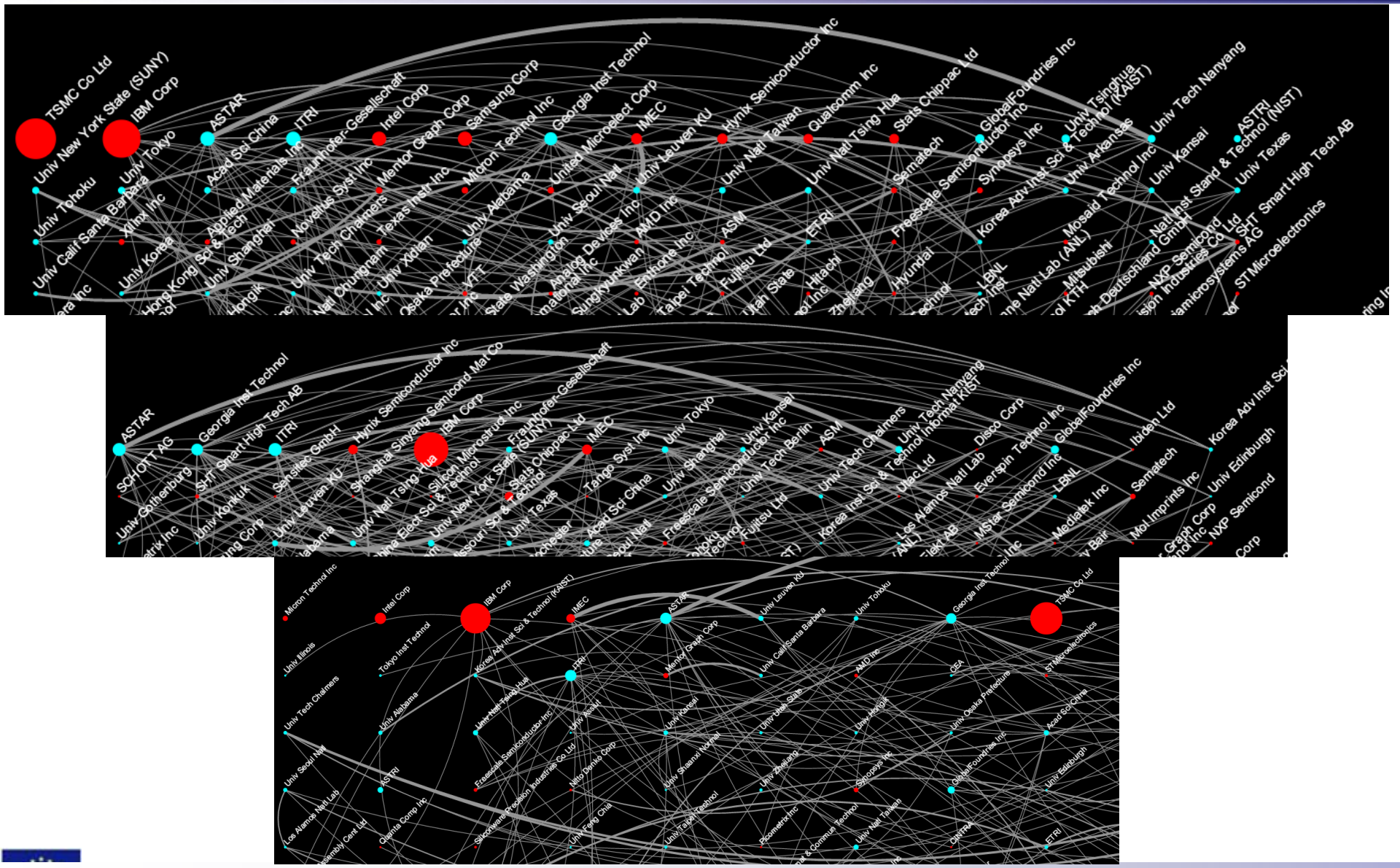


Organisation landscape sorted by size, connectivity and impact

Selecting Attendance: TSV

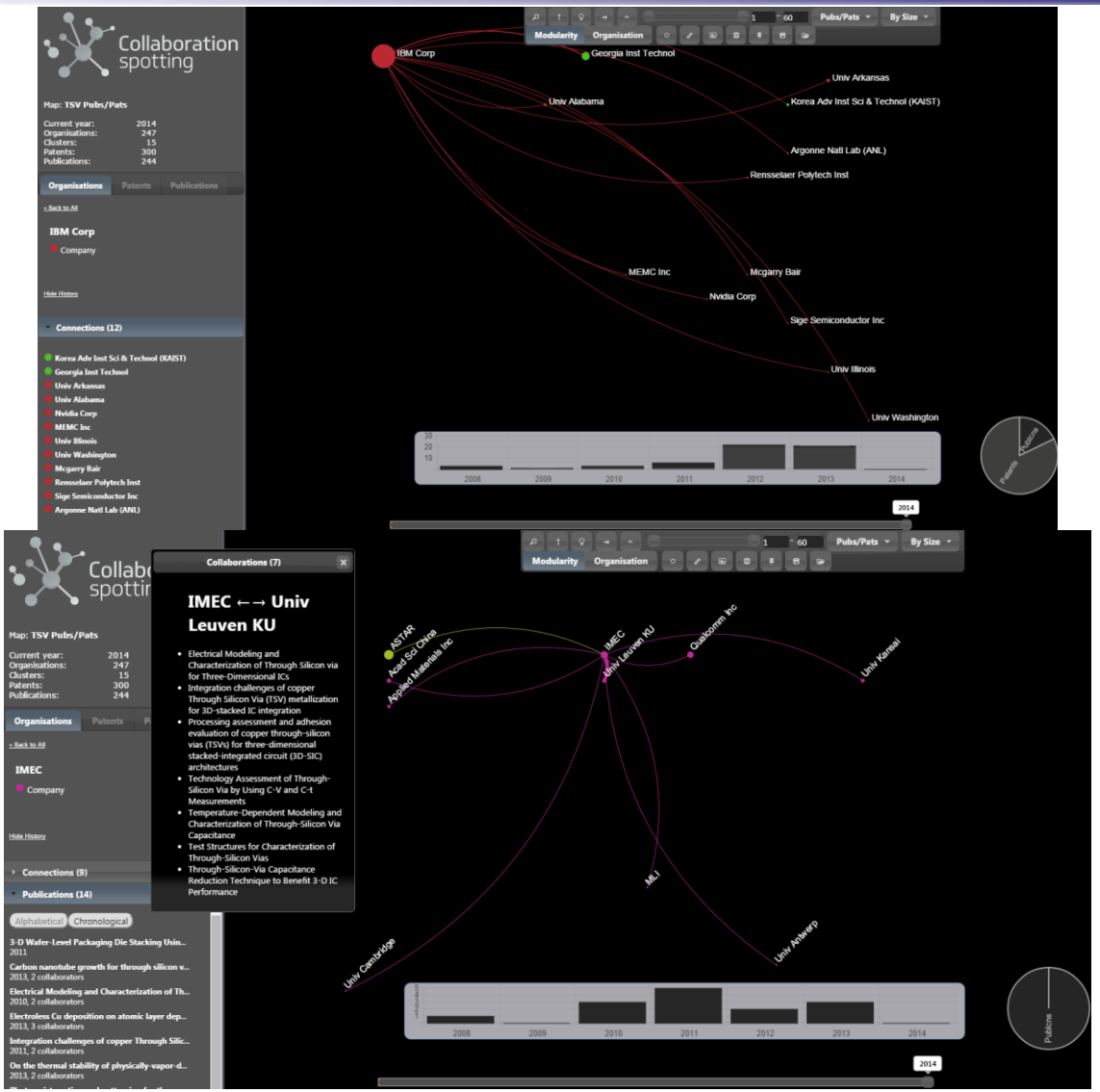


Patents and publications related to TSV/Organisation landscape



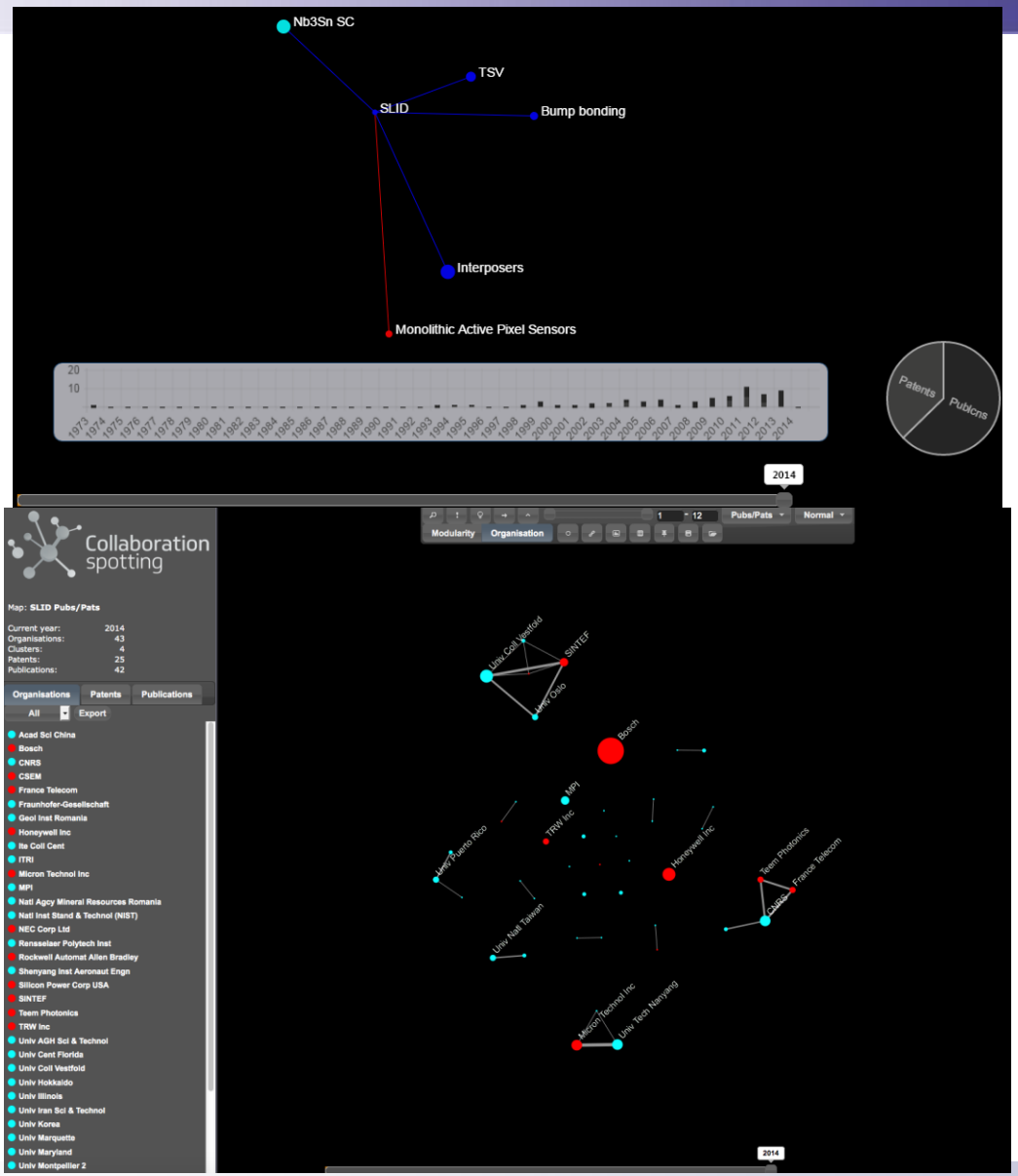
Organisation landscape for TSV sorted by size, connectivity and impact

Selecting Attendance: TSV



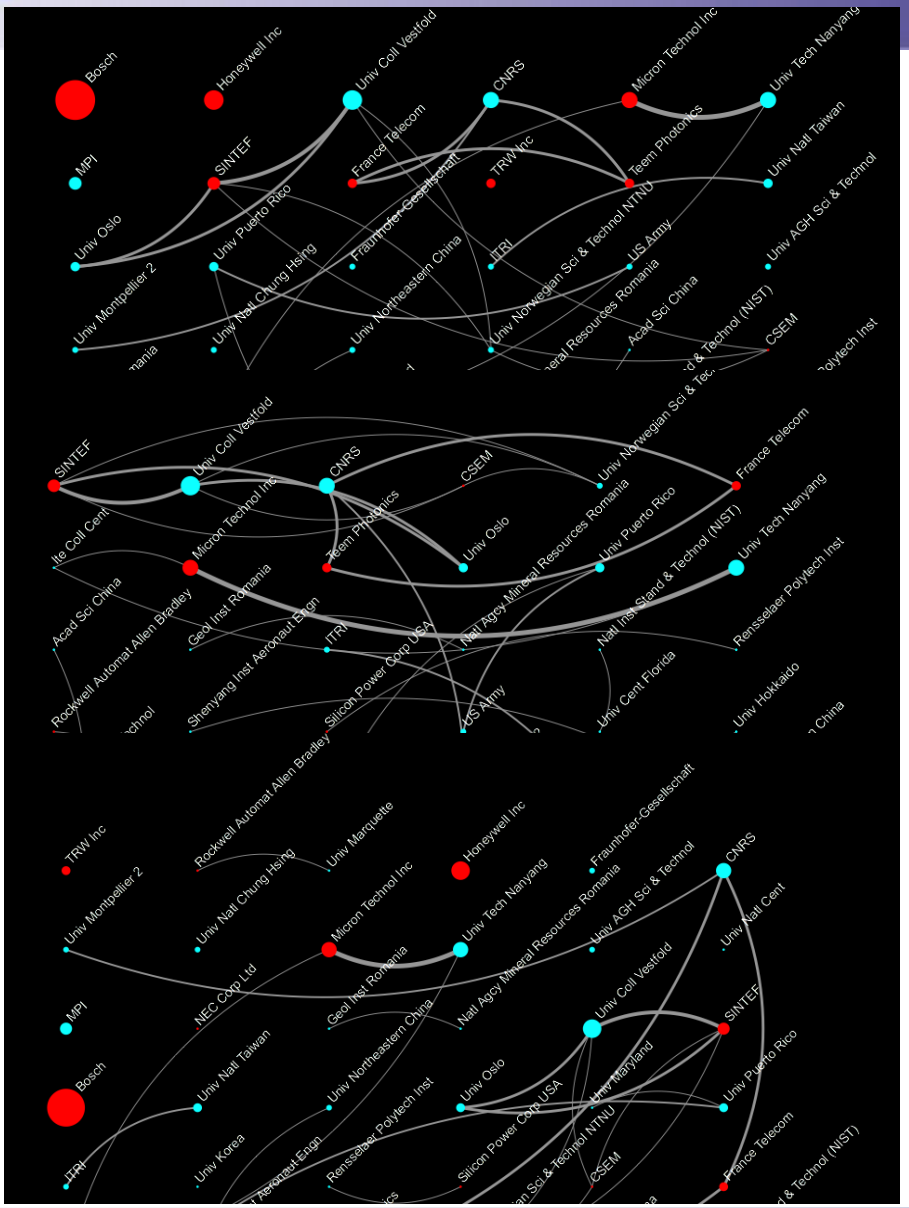
Patents and publications: IBM & IMEC connectivity diagrams

Selecting Attendance: SLID



Patents and publications related to SLID/Tech context & Organisation landscape

Selecting Attendance: (SLID) cont.



Organisation landscape for SLIDsorted by size, connectivity and impact

AIME: Attendance

Focus on Interposers and TSV. SLID not mature enough

Advacam	CMP	Dectris	IBM	IMEC
IPDiA	KETEC GmbH	Micron Semiconductor Ltd	Philips	Printech Circuit Laboratories Ltd
Tezzaron Semiconductor	Tohoku-MicroTec Co., Ltd	TTA Techtra	BELLELLE	

Table 3a: Companies and not-for-profit organisations attending the event on 3-D interconnections.

Academy of Sciences Czech Republic	CEA	CERN	CNRS	DESY	Fermilab
Fraunhofer EMFT	Fraunhofer ENAS	GSI	STFC	CSIC	IFJ PAN
Fraunhofer IZM Berlin	INFN	Institute for Microelectronics	Institute of Physics, Prague	KTH	MPI
NTUA	TU Vienna	Uni Geneva	Uni Bergamo	Uni Bergen	Uni Liverpool
Uni Heildelberg	Uni Manchester	Uni Bonn	Polytechnico Milano		

Table 3b: Institutions attending the event on 3-D interconnections.

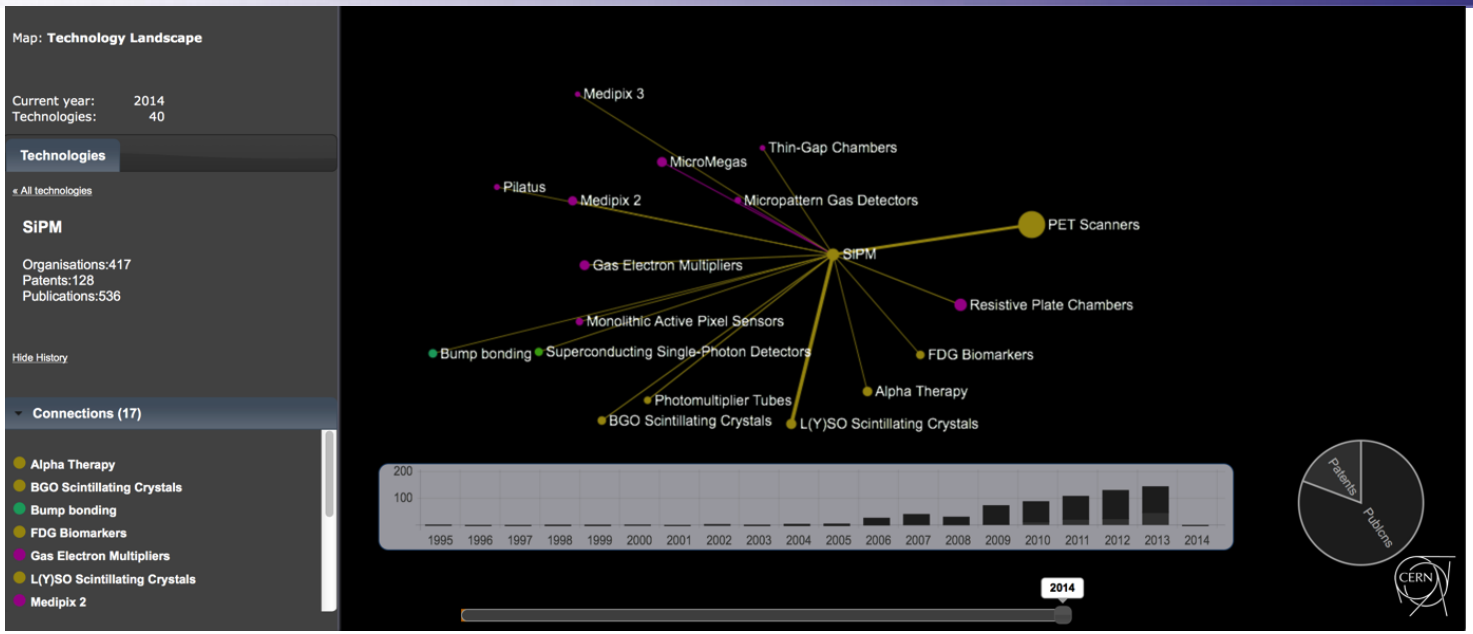
The case of Tezzaron Semicond.

- Tezzaron Semiconductor, one of the prominent industrial players in 3-D packaging does not appear in TSV, nor Interposers. When searching for this company specifically we found two publications and five patents related to 3-D packaging:
- Publications:
  - A novel chip-to-wafer (C2W) three-dimensional (3D) integration approach using a template for precise alignment
  - Three-dimensional integrated circuits and the future of system-on-chip designs
- Patents:
  - Method for bonding wafers to produce stacked integrated circuits
  - Fiducial scheme adapted for stacked integrated circuits
  - NETWORK WITH PROGRAMMABLE INTERCONNECT NODES ADAPTED TO LARGE INTEGRATED CIRCUITS
  - Method for bonding wafers to produce stacked integrated circuits
  - 3D INTEGRATED CIRCUIT PACKAGE AND METHOD OF FABRICATION THEREOF
- None of these publications or patents can be found by looking for TSV or interposers. Indeed when looking into Tezzaron website one finds the following quotation: "*These incredibly fine vertical connections are applied by the hundreds of thousands, allowing a single circuit to be spread vertically across multiple dies. They are so small we don't even call them TSVs. They are* ***SuperContacts***™*!*" confirming the pertinence of this company in the TSV technology and indicating that there are other technologies close to TSV that should be included in the searches in relation with 3-D packaging.

Event impact & follow-up

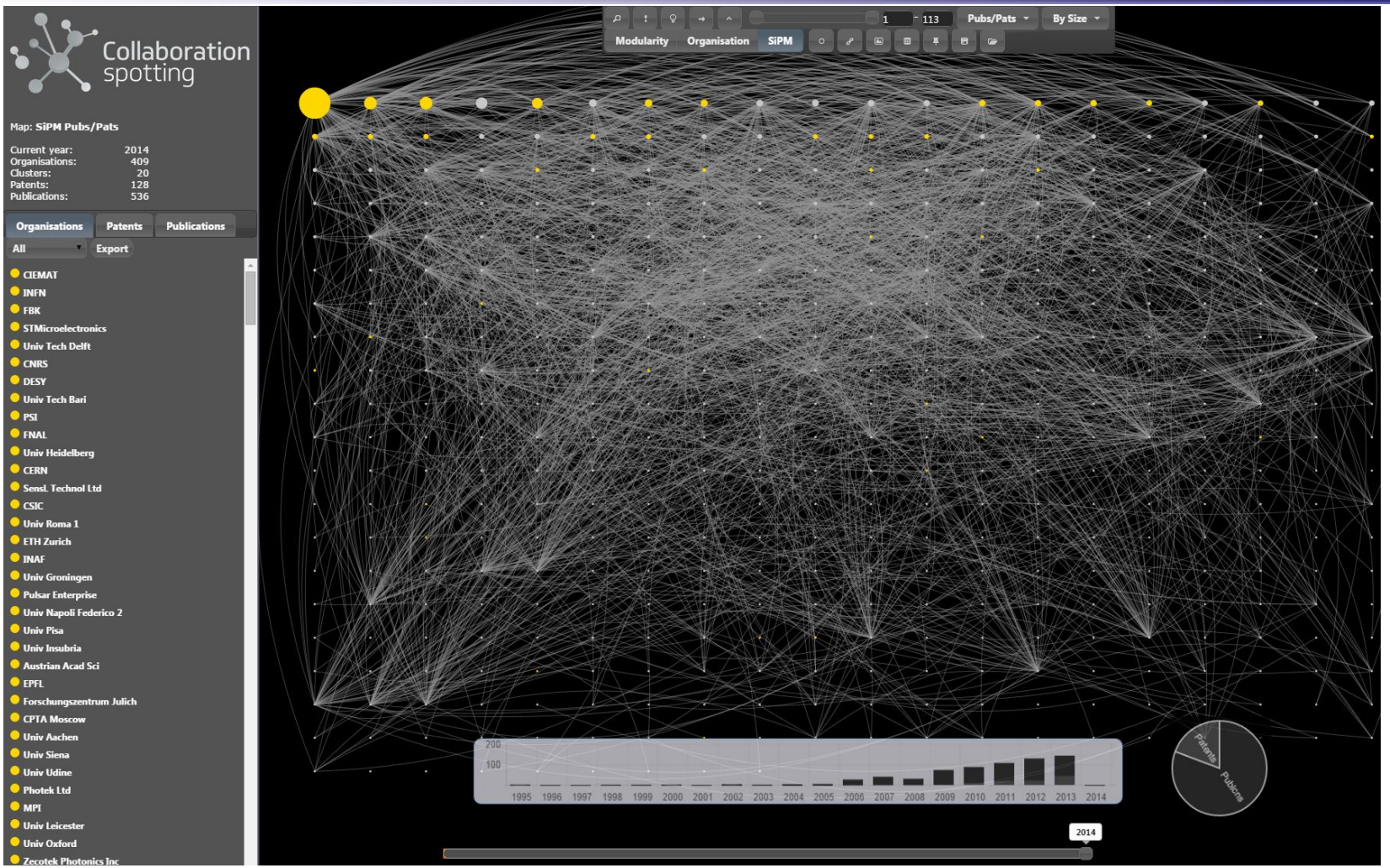
- Increasing attractiveness for attending industry
- Representativeness of the attendance
- Fostering collaborations

Increasing attractiveness



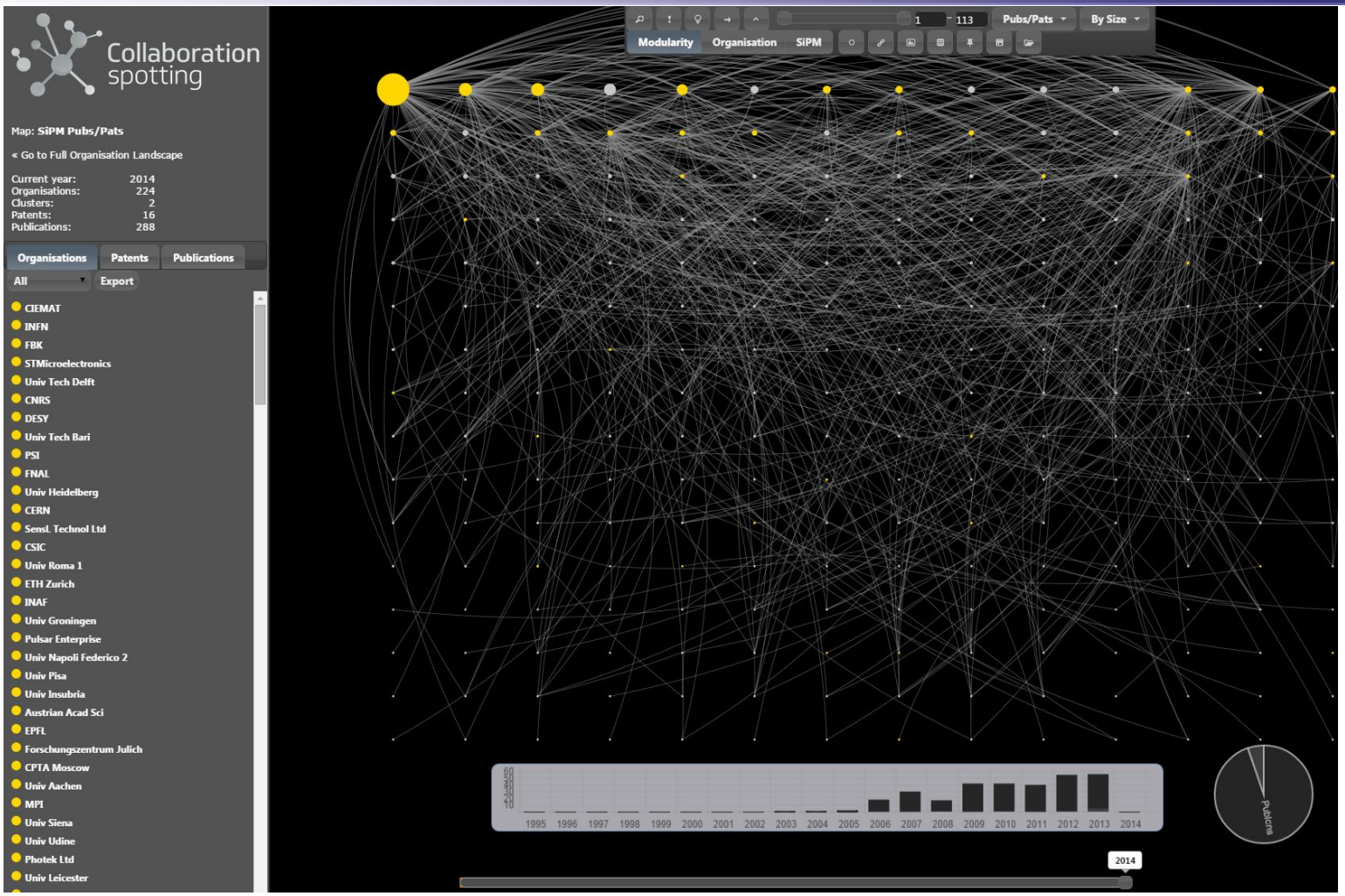
- PET industry is considering the use of SiPM in conjunction with L(Y)SO scintillating crystals in the next generation of scanners. This combination of technology allows the use of PET scanners in strong magnetic fields such as those of Magnetic Resonance Imaging. The technology landscape for SiPM clearly indicates the links with PET scanners and L(Y)SO crystals. Contributions from the medical imaging community at the AIME event on SiPM can strengthen the interests of the manufacturers in developing the SiPM technology.

Representativeness of attendance



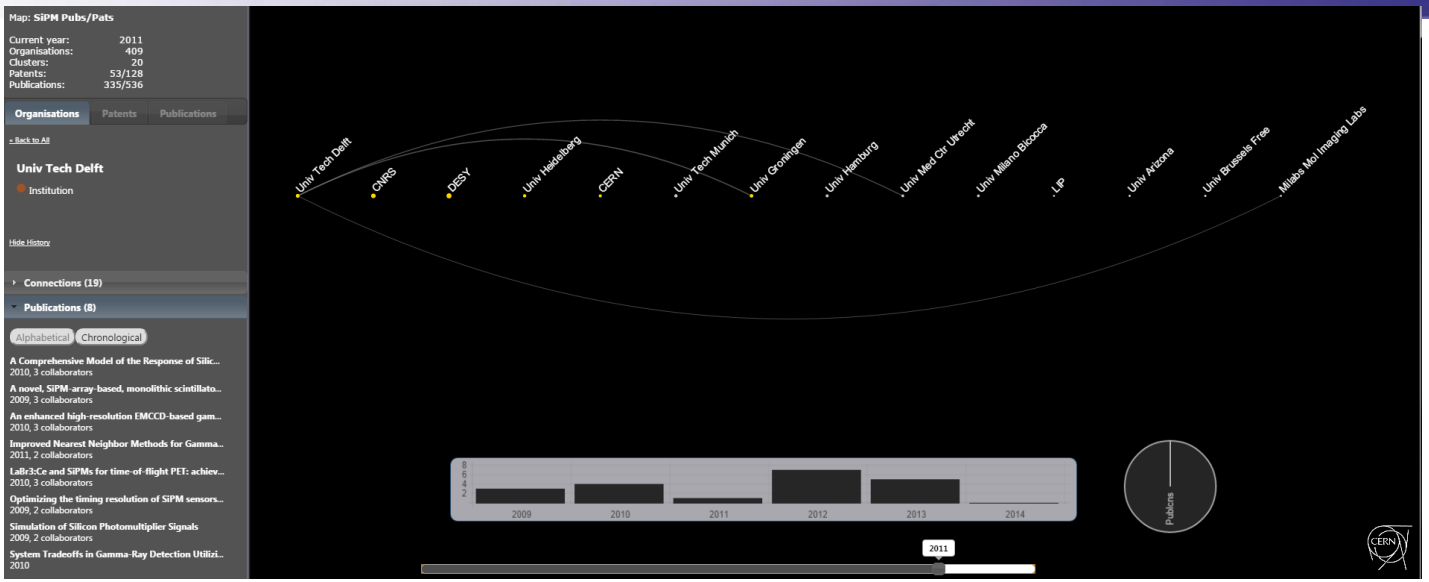
Organisation landscape of SiPM where organisations are ranked by size. Organisations that attended the AIME event are coloured in gold.

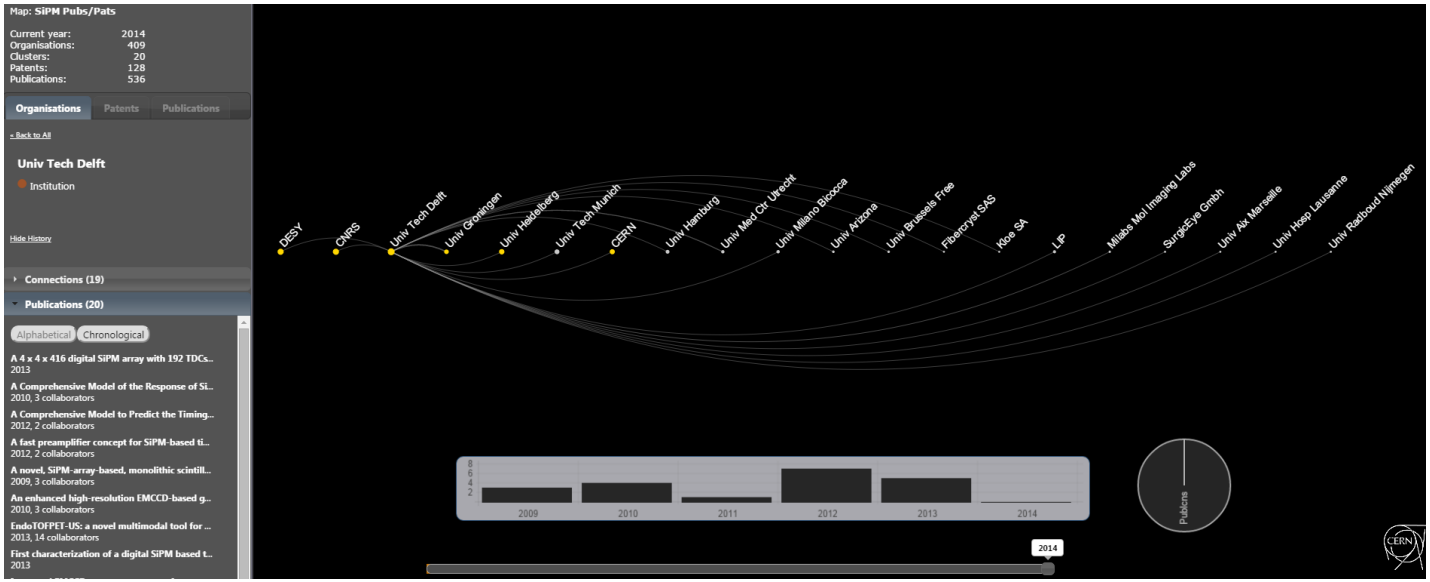
AIDA Representativeness of attendance(2)



Subset of the above representing the publications and patents of the attendees and their collaborators

Fostering collaborations





Evolution of the number Publications of the Technical University of Delft between 2011 and 2014

Conclusions & future plans

- AIME
  - Efficient tool to bring industry closer to academia
    - Ex: SI-PM: “Thanks to this event a company decited to enter the Si-PM business”
  - Address all detector technologies
    - Follow-ups
    - Calorimetry (not specifically address in AIDA WP4)

Conclusions & future plans

- Collaboration Spotting
  - Valuable tool to understand the organisation landscape of individual technologies
  - CERN-JRC collaboration for the development of a Technology Innovation Monitor
    - Fields of activity of an organisation
    - Evaluation of organisation's excellence in a field
    - Analysis of collaborations
    - Monitoring technology lifecycle & detection of emerging technologies
    - Assistance to decision makers
    - Understanding the dynamic of innovation
  - Extend the approach to other metadata
    - Ex: projects

Agenda

- AIME RPC-TGC Report
- D4.1: Overall Industry Report
- **D4.2: Follow-up structure for the project**

D4.2: Follow-up structure for the project

- Moving from R&D to pre-construction
  - Include the Detector dimension
- Distinguish between
  - HEP-driven developments (Ex: Gaseous detectors)
  - Industry-driven developments (Ex: Silicon detectors)
- Continue with AIME (Review format)
  - Technology follow-up
    - HEP community to propose topics requiring further AIMEs
    - Suggest continuing AIMEs in collaboration with RD-51, HEPTech, etc. to reach the HEP community beyond AIDA
    - For HEP-driven developments, include success stories to widen the market prospects for industry
  - Technologies related to detector integration
    - Adjust topics according to detector development needs
  - Search for partners and Impact-assessment: Collaboration Spotting

Thank you for your attention