

# Current Activities of IAEA A+M Unit

Kalle Heinola and Christian Hill

Atomic and Molecular Data Unit, Nuclear Data Section  
Division of Physical and Chemical Sciences

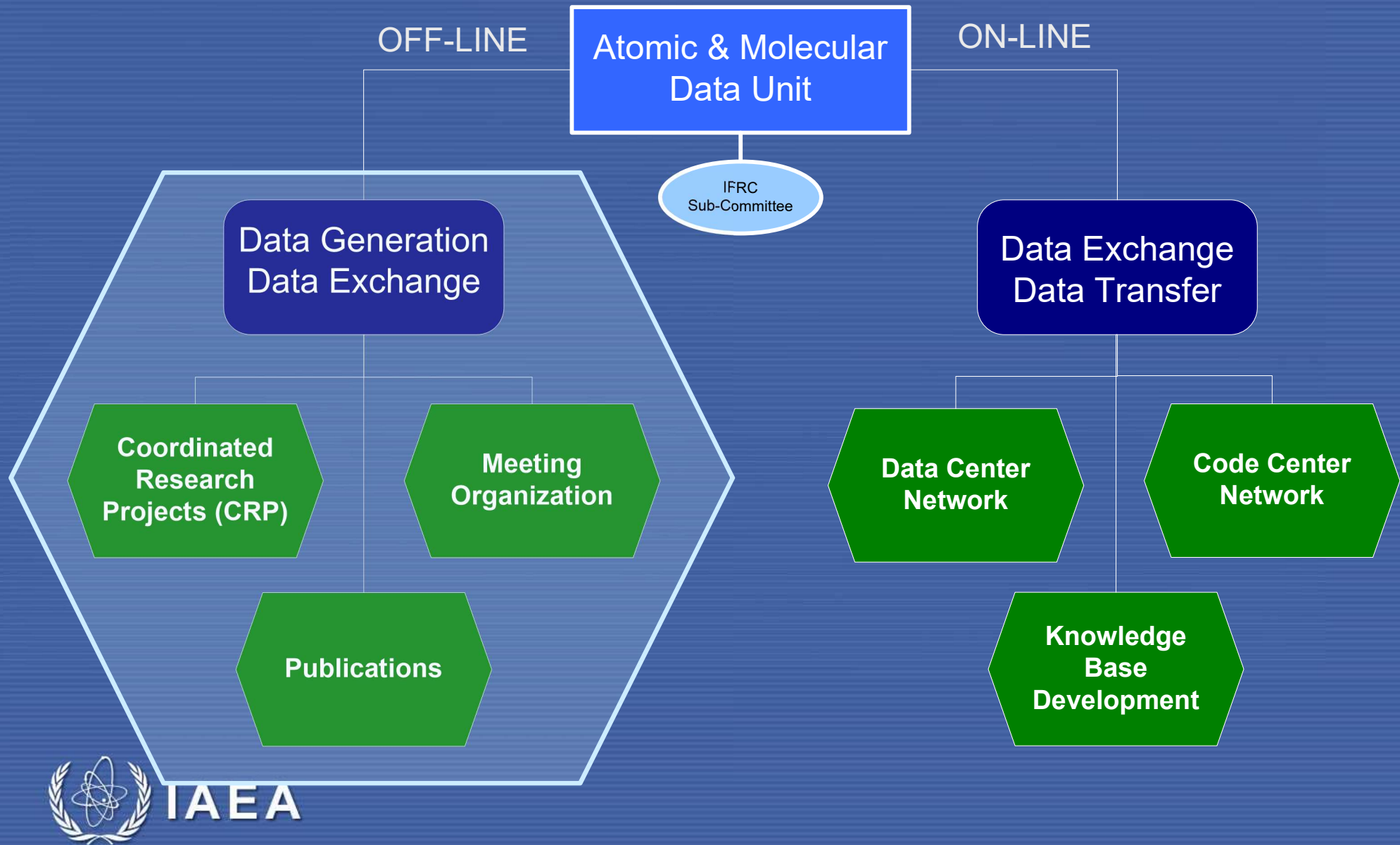
25th Data Centre Network (DCN) Meeting, 30/9-2/10, 2019



# Unit Staff

- Former Unit Head, Hyun Chung left the Agency 30 Sep 2017 due to rotation policy
- Christian Hill has been new Unit Head since 1<sup>st</sup> Oct 2017
- Kalle Heinola new Atomic Physicist since 1<sup>st</sup> May 2018
- Unit's Scientific Data Manager Andras Vasaros, retired in September 2018
- Recruitment of new SDM finished in spring 2019. Ludmila Marian started as a new SDM on 1<sup>st</sup> April 2019.

# Overview of A+M Data Unit Activities



# Coordinated Research Projects (CRP)

## Data Generation and Exchange

### CRP: Coordinated Research Project

- Main mechanism by which the AMD Unit encourages new research
- Unique opportunity for comprehensive and synergistic collaboration

### Joint research on A+M and PSI data for fusion

- Representatives from 10 to 15 institutes worldwide
- Duration 3 – 4 years; 3 Research Coordination Meetings (RCM)

### Objectives: to define and coordinate international research on

- Generation, compilation, and evaluation of data (A+M/PSI)
- Establishment of databases
- Development of new techniques

### Outputs:

- Publications, Meeting presentations and reports
- Final reports “Atomic and Plasma-material Interaction Data for Fusion (APID)”; more recently in journals (Nuclear Fusion, JPCS, Atoms)
- Data and results in ALADDIN numerical Database and Knowledge Base

# Coordinated Research Projects (CRP)

Data Generation and Exchange: past, present and future CRPs

Up-to-date list on interim url <https://www-amdis.org/CRP/>

2009-2013: Light Element Atom, Molecule and Radical Behaviour in the Divertor and Edge Plasma Regions.

2010-2014: Spectroscopic and Collisional Data for Tungsten from 1 eV to 20 keV.

2011-2015: Data for Hydrogen and Helium and Their Isotopes in Fusion Plasma.

2012-2016: Erosion and Tritium Retention in Beryllium Plasma-facing Materials.

2013-2017: Plasma-wall Interaction with Irradiated Tungsten and Tungsten Alloys.

2015-2019: Plasma-wall Interaction with Reduced-activation Steel Surfaces.

2016-2020: Data for Atomic Processes of Neutral Beams in Fusion Plasma.

2019-2023: Atomic Data for Vapour Shielding in Fusion Devices

2020-2024: (in preparation) Hydrogen Permeation in Fusion Materials

# CRP on Plasma-Wall Interaction with Reduced-activation Steel Surfaces in Fusion Devices (2015-2019)

<https://www-amdis.org/CRP/steel-surfaces>

## Background

- Main wall in DEMO and in future fusion power plants (FPPs) cannot be of low-Z materials (high erosion). Various kinds of Reduced-activation steels (RAFM) are being considered as an alternative material for certain plasma-facing components (PFCs).
- In ITER, the “Test Blanket Modules” (TBMs) used for Tritium breeding comprise of RAFM components facing the plasma

## CRP Topics and Objectives

- Develop data for tritium in irradiated steel and support assessment of the role of steel as PFC material in DEMO or FPP.
- Develop information about the relation between steel microstructure after irradiation and properties for erosion, tritium migration and ways to extract trapped tritium.
- To synthesize new information and provide best expert estimates and uncertainties for PMI properties for steel surfaces in a fusion reactor environment.

## Participants

Anna Golubeva, Kurchatov Inst. (Russia)  
Naoko Ashikawa, NIFS (Japan)  
Daisuke Nishijima, Russell Doerner, UCSD (USA)  
Dmitry Terentyev, SCKCEN (Belgium)  
Haishan Zhou, Peng Wang, ASIPP (China)  
Yoshihiko Hirooka, Chubu Univ. (Japan)  
Vadym Makhilai, Kharko Inst. (Ukraine)  
Wolfgang Jacob, IPP Garching (Germany)

## Meetings and other actions

- **1<sup>st</sup> RCM:** Dec 2015. **2<sup>nd</sup> RCM:** Oct 2017. **3<sup>rd</sup> RCM:** March 2019
- **Round-robin study** launched for 2019 – 2020: comparison of sputter yields of identical RAFM samples exposed to D plasmas/ions





# CRP on Data for Atomic Processes of Neutral Beams in Fusion Plasmas (2016-2020)

<https://www-amdis.org/CRP/neutral-beams>

## Objectives

Provide evaluated and recommended data for the principal atomic processes of heating and diagnostic neutral beams in fusion plasma.

## Data needs

- Data for beam penetration, BES, MSE and CXRS/CHERS spectroscopy.
- Excitation and ionization in collisions between electrons and H/D/T neutrals.
- Excitation, ionization and charge transfer in collisions between hydrogen neutrals and fuel and selected impurity ions.
- (Lower priority:) collision processes in the hydrogen beam neutralizer; atomic processes of neutral beams of helium and lithium in fusion plasma.

Electron energy from 100 eV to 100 keV, neutral energy from 1 keV to 1 MeV.

## Participants

Alan Dubois, LCPMR (France)  
Alisher Kadyrov, Curtin Univ. (Australia)  
Brian Grierson, Daren Stotler, PPPL (USA)  
Clara Illescas, UAM (Spain)  
Gergő Pokol, BME (Hungary)  
Károly Tőkési, ATOMKI (Hungary)  
Jinsek Ko, NFRI (Korea)  
Martin O'Mullane, Univ. Strathclyde (UK)  
Oleksandr Marchuk, FZJ (Germany)  
Tom Kirchner, York Univ. (UK)  
Yong Wu, IAPCM (China)

## Meetings and other actions

- **1<sup>st</sup> RCM:** June 2017. **2<sup>nd</sup> RCM:** Feb 2019. **3<sup>rd</sup> RCM:** planned for Dec 2020
- **Two code comparison workshops (CCW) in conjunction with the CRP:**  
Atomic Collisions CCW & Neutral Beam Penetration and Photoemission CCW



# CRP on Atomic Data for Vapour Shielding in Fusion Devices (2019-2023)

<https://www-amdis.org/CRP/vapour-shielding>

## Background

- Plasma transient events and disruptions may induce rapid evaporation or ablation of the surface layers of the plasma-facing components (PFCs). This may result in a dense expanding plasma cloud in front of the PFC surface.
- In the formed plasma cloud, or vapour, the incoming energy from the hydrogen plasma can be converted into radiation, thereby shielding the PFC surface from further PWIs.

## Objectives

Provide an authoritative and evaluated set of data relevant to vapour shielding with particular emphasis on *liquid metals*.

## Data needs

- Data relevant to liquid metals including Li, Sn, LiSn mixtures etc.
- Collisional and radiative properties of relevant atoms, ions and molecules (A+M)
- Impact of impurities, such as O, N, and C
- Effect of surface chemistry. Especially: effect of H/D/T co-deposition on sputtering and evaporation of plasma-facing wall materials

## Participants

Francisco Tabarés, CIEMAT (Spain)

Igor Bray, Curtin Univ. (Australia)

Ling Liu, IAPCM (China)

Mohamad Akeel, AECS (Syria)

Narendra Singh, Univ. Delhi (India)

Predrad Krstić, PPPL (USA)

Ratko Janev, MASA (Macedonia)

Roberto Celiberto, Univ. Bari (Italy)

Ronnie Hoekstra, Univ. Groningen (Netherlands)

## Meetings

- **1<sup>st</sup> RCM:** March 2019. **2<sup>nd</sup> RCM:** planned for Autumn 2020.<sup>8</sup>



# Planned CRP on Hydrogen Permeation in Nuclear Fusion Materials (2020-2024)

<https://www-amdis.org/CRP/hydrogen-permeation>

## Background

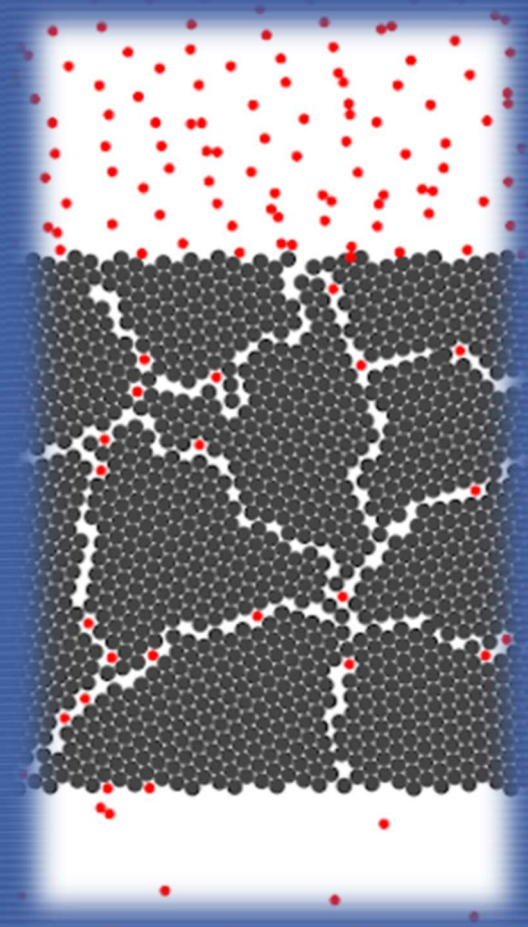
- Hydrogen permeation in fusion reactor materials plays a crucial role since the radioactive Tritium behaviour in materials determines the in-vessel source term, and the ex-vessel release term in the reactor safety assessments for licensing future fusion facilities.

## Objectives

To enhance the knowledge base and reduce uncertainties in data concerning the migration of hydrogen in materials of relevance to ITER, DEMO and FPPs

## Data needs

- Evaluated permeation data relevant for divertor and first wall materials such as W and various RAFM steels. Also data requirement for joining materials, such Cu and its alloys (CuCr1Zr0.1).
- Parameters affecting hydrogen permeation, trapping, retention, release, scrutinized both experimentally and computationally (*ab initio*, multi-scale simulations).
- Effect of the neutron-induced damage in the material and the materials microstructural temperature evolution
- Effect of surface chemistry, surface evolution through plasma-surface interactions



## Meetings

- Preparatory Consultancy Meeting:**  
26 – 27 Sep 2019
- 1<sup>st</sup> RCM:** planned for Spring 2020.

# Meetings, Workshops

## Data Generation and Exchange

<https://www-amdis.org/workshops/>

## Annual Joint IAEA-ICTP Workshops

AMD Unit

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Other Workshops

### ICTP Workshops

The IAEA organizes several Workshops in conjunction with the [Abdus Salam International Centre for Theoretical Physics \(ICTP\)](#) in Trieste; in recent years the AMD Unit has participated in this by running an annual event to provide training and information exchange for computational scientists working on models and data for atomic, molecular and materials processes relevant to fusion energy research.

The workshops are aimed at advanced PhD students and other early-stage career researchers, particularly those from developing countries.

ICTP Workshop 2020: Radiation Damage in Nuclear Systems: from Bohr to Young

This proposed Workshop will assist Ph.D. students and early-career researchers develop a quantitative of the impact of radiation damage on materials, both for existing fission and proposed fusion reactors. The emphasis on the conceptual progression of theoretical and experimental techniques across spatial scale from atomistic descriptions to the macroscopic behaviour of bulk material.

Full details

<https://www-amdis.org/meetings/>

## Technical Meetings and Consultancies

AMD Unit

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Code Centres Network

GNAMPP

Meetings

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### Meetings

The IAEA AMD Unit organizes several types of experts' meetings:


- *Technical Meetings (TMs)* of experts with a broad spectrum of expertise to provide advice regarding either general policy and programme orientation questions, or on specific technical issues concerning Unit's activity;
- *Consultants' Meetings (CMs)* of experts to obtain advice or perform a specific task related to a particular database or activity;
- *Research Coordination Meetings (RCMs)* are meetings of the Principal Scientific Investigators representing research groups participating in a [Coordinated Research Projects](#) (see CRPs).

These meetings differ in the allowed number of participants and the level of Agency support for participation in them. The IAEA AMD Unit organizes, on average, 4 – 6 experts' meetings each year. The proceedings and the results of each meeting is described in a Summary Report issued shortly after the meeting.



# Meetings, Workshops 2018

## Data Generation and Exchange

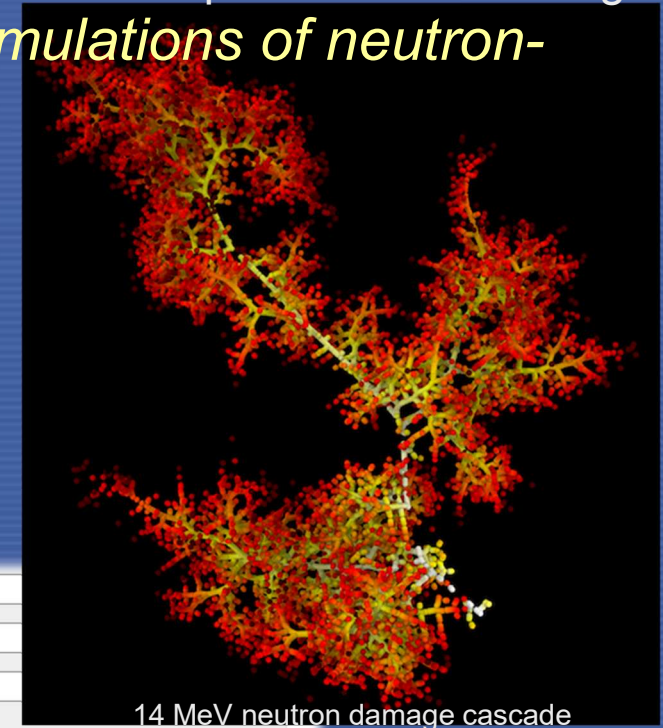
- 2<sup>nd</sup> Research Coordination Meeting of the Steel Surfaces CRP
  - 16 – 18 Oct 2017, IAEA
- 5<sup>th</sup> Meeting Code Centre Network (CCN): “TM on Molecular Dynamics Data of Collisional Cascades after Irradiation” → Cascades Database
  - 19 – 21 Nov 2017, IAEA
- Preparatory Consultancy Meeting of the Vapour Shielding CRP
  - 19 – 20 March 2018, IAEA
- ICTP-IAEA Workshop 2018: Fundamental Methods for A+M and Materials Properties in Plasma Environments
  - 16 – 20 April 2018, Abdus Salaam International Centre for Theoretical Physics (ICTP), Italy
- 21<sup>st</sup> Meeting of the IFRC Subcommittee on A+M Data for Fusion
  - 3 – 4 May 2018, IAEA
- IAEA Crowdsourcing Challenge on Materials for Fusion
  - 26 April – 14 July 2018, IAEA
-  1<sup>st</sup> Meeting of the Global Network for the A+M Physics of Plasmas (GNAMPP)
  - 19 – 21 Nov 2018, IAEA



# 5th Meeting Code Centre Network: MD Cascades Database

<https://cascadesdb.org/>  
*CASCADESDB: database of Molecular Dynamics simulations of neutron-induced collision cascades in PFMs*

- Data source
  - Open to research groups performing MD simulations on irradiations
  - Validated data and relevant for fusion
  - Currently data from Finland (Helsinki), and US. More on its way...
- Data search
  - Reactants, energy and temperature ranges, publication DOI, authors
  - Results with authors, reference, data set (material, lattice, energy, temperature, time,...)



Author name:

Publication DOI:

Material chemical formula:  e.g. W, Fe

Tmin K  ≤ Initial temperature /K ≤ Tmax K

Emin keV  ≤ Projectile / PKA energy /keV ≤ Emax keV

Archive name:

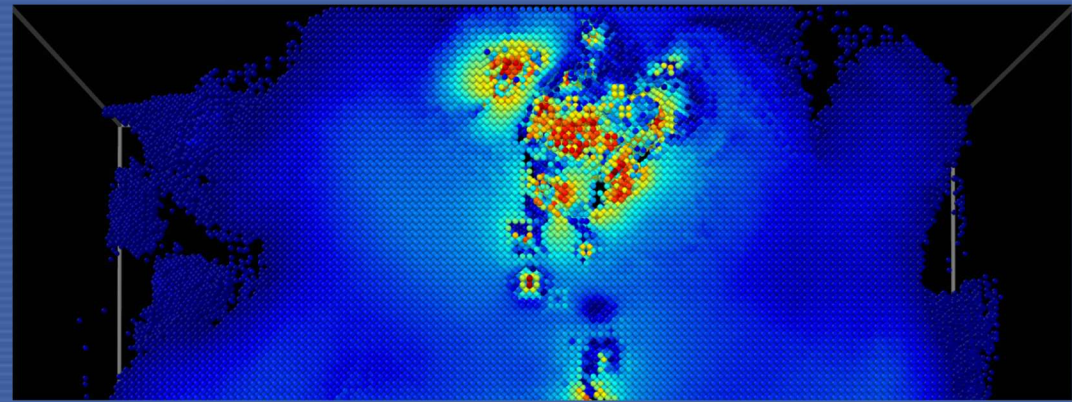
## Results

Attribution	Material	PKA energy /keV	Initial T /K	Simulation time /ps	Metadata	Data	Source
Andrea SAND	W (bcc)	50.0	0.0	40.0	<a href="#">html   xml   txt</a>	R001 (146.1 MB)	<a href="#">link   bibtex</a>

# IAEA Crowdsourcing Challenge on Materials for Fusion

Crowdsourcing challenge for visualising, analysing and exploring neutron-induced collisional cascades simulated with Molecular Dynamics

- Participants requested
  - Novel software for visualizing material damage
  - new software tools for rapid and reliable identification, classification and quantification of damage patterns and structures
- Unit received innovative submissions from 14 groups representing 10 MS
- Winner announced Sep 2018
  - Udo von Toussaint, IPP (Germany)



# Meetings, Workshops 2019

## Data Generation and Exchange

- 2<sup>nd</sup> Research Coordination Meeting of the Neutral Beams CRP
  - 18 – 20 Feb 2019, IAEA
- 1<sup>st</sup> Research Coordination Meeting of the Vapour Shielding CRP
  - 13 – 15 March 2019, IAEA
- 3<sup>rd</sup> Research Coordination Meeting of the Steel Surfaces CRP
  - 25 – 27 March 2019, IAEA
- ICTP Workshop 2019: A+M Spectroscopy in Plasmas
  - 6 – 10 May 2019, Abdus Salaam International Centre for Theoretical Physics (ICTP), Italy
- 5<sup>th</sup> Spectral Lineshapes in Plasmas (SLSP) Workshop
  - 27– 31 May 2019, Vrdnik, Serbia
- Consultancy Meeting on Evaluation of Fundamental Data Be-containing Species for Edge Plasma Modelling
  - 6 – 7 June 2019, IAEA

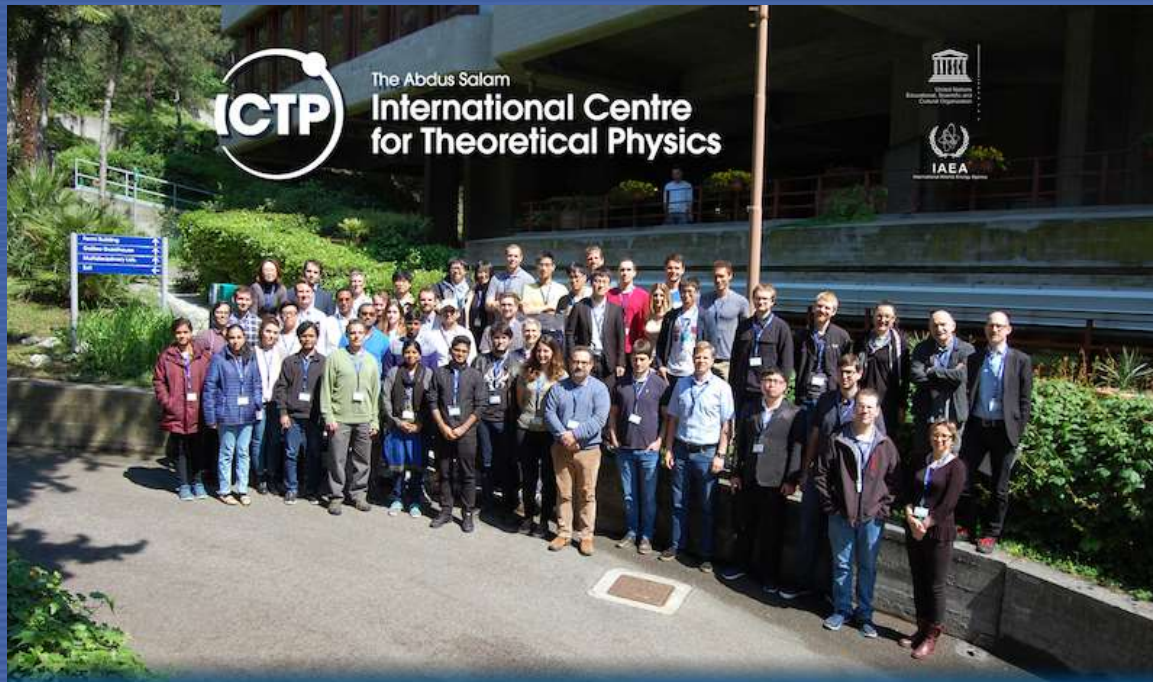


# Joint ICTP-IAEA Workshop on Atomic and Molecular Spectroscopy in Plasmas

6 – 10 May 2019, Trieste, Italy

44 participants from 20 countries. 9 lecturers.

**Objectives:** provide lectures, hands-on computing and knowledge transfer for early-career plasma physicists, plasma spectroscopists and astrophysicists. Focus was on plasmas relevant to nuclear fusion, astrophysics and other high-energy environments.



Joint ICTP-IAEA School on Atomic and Molecular Spectroscopy in Plasmas

6 - 10 May 2019, Miramare - Trieste, Italy

## Lecture topics:

atomic structure and radiation, molecular spectroscopy, collisions in plasmas, line broadening, collisional-radiative processes, opacity and radiative transfer in plasmas, astrophysical spectroscopy, magnetic confinement spectroscopy, spectroscopic applications for PSI studies, fusion plasma diagnostics, experimental spectroscopy.

# Meetings, Workshops 2019

## Data Generation and Exchange

- International Workshop on Models and Data for Plasma-Material Interactions in Fusion Devices (MoD-PMI 2019)
  - 18– 20 June 2019, Toki, Japan
- Code Comparison Workshop on Neutral Beam Penetration and Photoemission
  - 26 – 28 August 2019, Hungarian Academy of Sciences (ATOMKI)
- Neutral Beams CRP: Electron Dynamics for Atomic Collisions Code Comparison Workshop
  - calculations done during 2<sup>nd</sup> half of 2019 for comparison in 2020, IAEA
- Preparatory Consultancy Meeting of the Hydrogen Permeation CRP
  - 26 – 27 Sep 2019, IAEA
- 25<sup>th</sup> Meeting of the Data Centre Network
  - 30 Sep – 2 Oct 2019, IAEA
- 6<sup>th</sup> Meeting of the Code Centre Network: “*development of CascadesDB*”
  - 16 – 18 Oct 2019, IAEA

## Global Network for the Atomic and Molecular Physics of Plasmas GNAMPP

1<sup>st</sup> meeting 19 – 21 Nov 2018

<https://www-amdis.org/GNAMPP>

### Purpose

- Consortium of research groups working in the area of *fundamental A+M* physics relevant to plasma processes
- Focus on promoting *collaboration and communication* between experimentalists and theorists to improve the quality and completeness of data used in modelling and interpreting fusion plasmas

## Global Network for the Atomic and Molecular Physics of Plasmas GNAMPP

<https://www-amdis.org/GNAMPP>

### Functions

- Data evaluation
- Data dissemination
- Benchmarking calculations against experiments
- Find collaborators
- Setting priorities for data needs in nuclear fusion research
- Mailing list for communicating events, funding, and job opportunities, new data
- Description of research interests with recent publications



# GNAMPP

Researcher network

## Global Network for the Atomic and Molecular Physics of Plasmas GNAMPP

<https://www-amdis.org/GNAMPP>

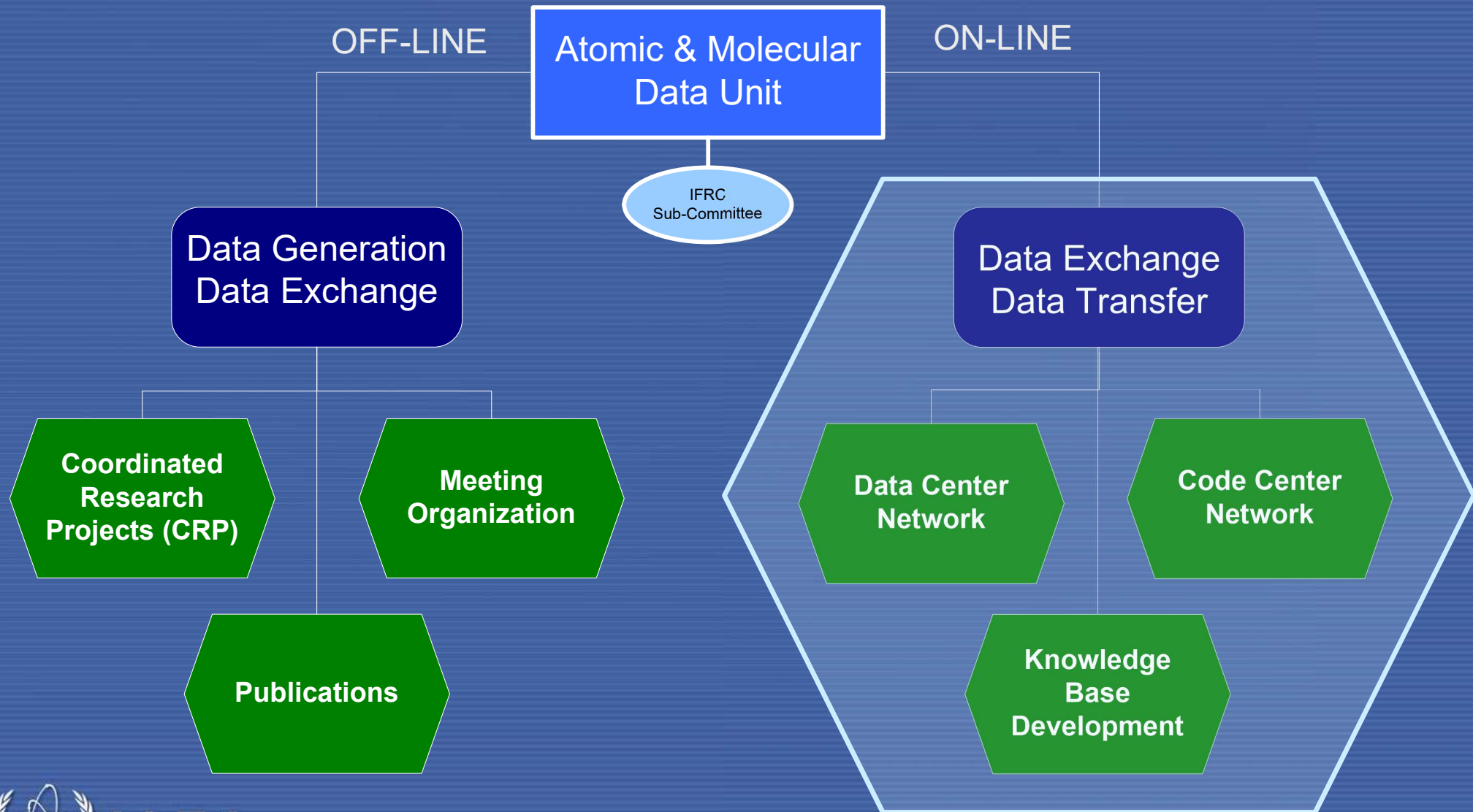


# Publications

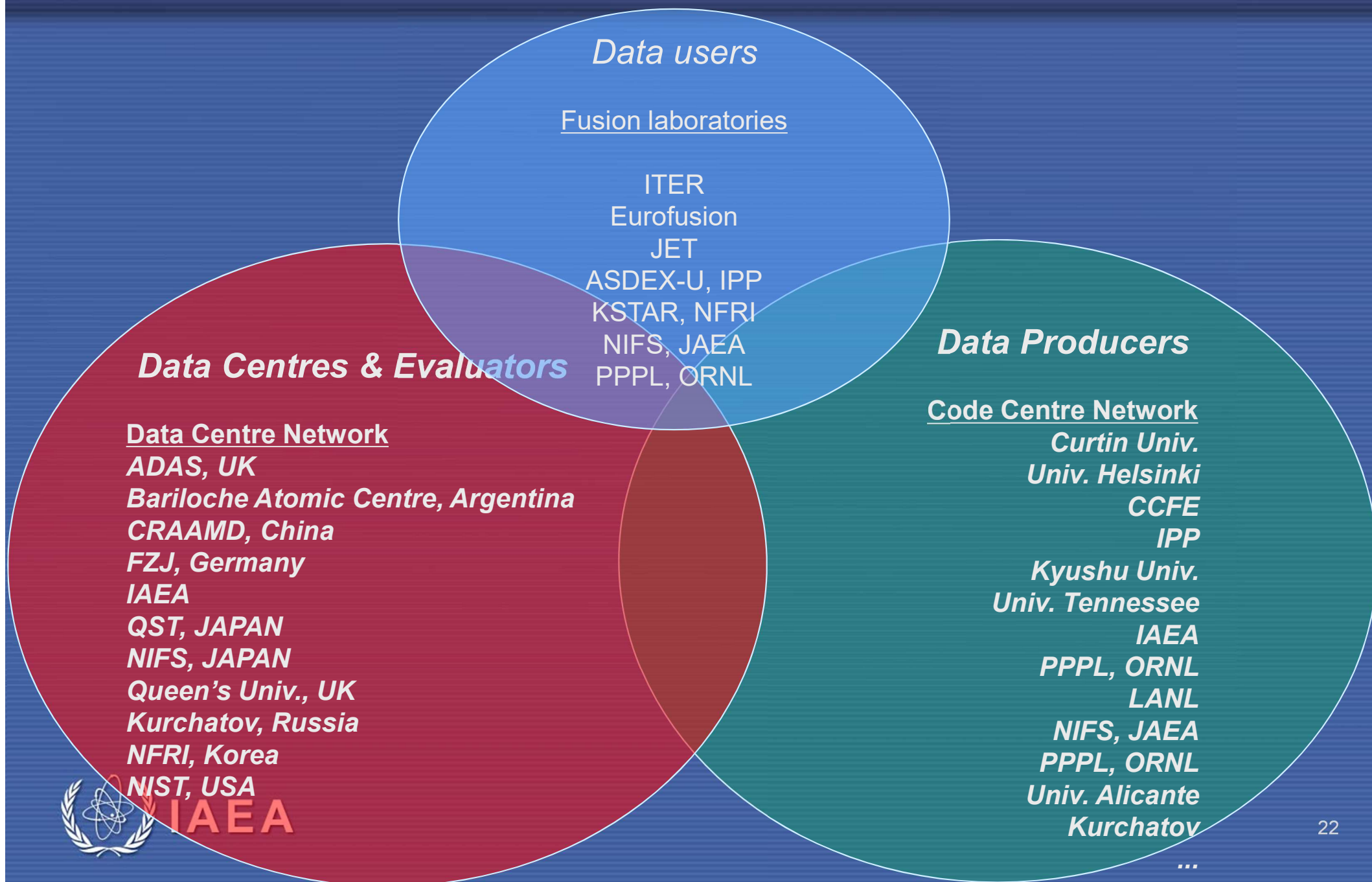
- IAEA-INDS(NDS) reports <https://www-amdis.org/publications/reports>
  - Reports published after every meeting
- International Bulletin on Atomic and Molecular Data for Fusion <https://www-amdis.org/publications/bulletin>
  - Bibliographic information on A+M/PSI data
  - Volume 70 Nov 2016
- Atomic and Plasma-Material Interaction Data for Fusion (APID series; “Green book”)
  - Data and papers related to results produced by CRPs and Consultants groups
  - All volumes available online <https://www-amdis.org/publications/apid>  
Volume 18: CRP on “Plasma-Wall Interaction with Irradiated Tungsten and Tungsten Alloys in Fusion Devices”
- External publications <https://www-amdis.org/publications/external-publications>
  - CRP on “Data for Erosion and Tritium Retention in Beryllium Plasma-Facing Materials”, *Nuclear Fusion* Special Issue (in preparation)
  - Spectral Line Shapes in Plasmas II, *Atoms* 7 (2019)
  - Review of the 9<sup>th</sup> NLTE code comparison workshop, *High Energy Density Physics* 23



# Overview of A+M Data Unit Activities



# Network collaboration for A+M/PSI data for fusion



# Data Centre Network (DCN) activities

## Data Exchange and Transfer

<https://www-amdis.org/databases/>

AMD Unit

About Activities **Databases** Online Computing

## Databases

The Atomic and Molecular Data Unit manages several numerical and bibliographic databases for fusion and other plasma science research:



**AMBDAS: Atomic and Molecular Bibliographic Data System**



**ALADDIN: Numerical database of collisional cross sections and plasma-material interaction data**



**CascadesDB: Database of Molecular Dynamics simulations of collision cascades in materials of relevant to fusion research**



**Clerval: Database of institutions, people and events related to atomic and molecular data**

## Further resources

### ORNL "Red Book" Series: Atomic Data for Fusion

The Controlled Fusion Atomic Data Center (CFADC) at Oak Ridge National Laboratory (ORNL) produced a series of printed compilations of atomic data for fusion applications known as the "Red Books". Since its closure, scanned versions of some of these reports have been difficult to find – they are provided for download below as a convenience to the fusion data community.

- **Volume 1: "Collisions of H, H<sub>2</sub>, He and Li Atoms and Ions with Atoms and Molecules"** (pdf: 10.8 MB), C. F. Barnett (Ed.), ORNL-6086 (1990)
- **Volume 2: "Collisions of Electrons with Atoms and Molecules"**, J. W. Gallagher (Ed.), ORNL-6087, 2nd ed., (1994)



# Data Centre Network (DCN) activities

## Data Exchange and Transfer

**Domain :** A+M and PSI data as well as bulk material properties (plasma-material interaction - PMI) data for fusion and other applications.

(A+M/PSI/PMI)

**Established Program:** Collection, Dissemination, Critical assessment (evaluation) and generation of A+M, PSI, and PMI data

- ALADDIN: Numerical Database (A+M/PSI)
- AMBDAS: Bibliographic Database
- CASCADESDB: Irradiations damage Database (PMI)

*Other:*

- CLERVAL: Events and Institutes Database
- OPEN-ADAS: Numerical Database
- GENIE: Search Engine on Numerical Databases



**IAEA**

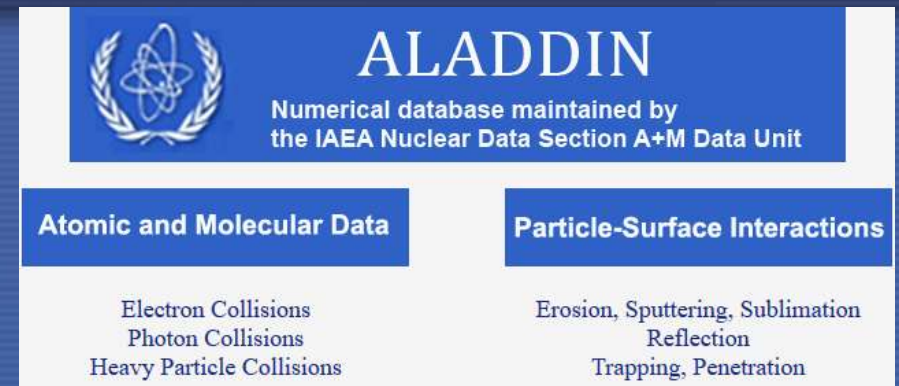
- The ORNL "Red Books" available (Vols 1, 3, 4, 5 and 6-2)

# Data Centre Network (DCN) activities

## Data Exchange and Transfer

<https://www-amdis.org/databases/>

### ALADDIN: Numerical database



- Atomic and Molecular collisional database
  - Heavy particle collisions / electron collisions / photon collisions
  - search by reactants, products, process, data types, author, publication
- Plasma-surface interaction database
  - Reflection / sputtering / radiation enhanced sublimation / penetration
  - Search by projectile, surface, chemical component, data type, author, publication
- Data developed through CRPs, and meetings recommended by IFRC



# Data Centre Network (DCN) activities

## Data Exchange and Transfer

<https://www-amdis.org/databases/>

### AMBDAS: *Bibliographical database*

- Data source
  - A+M/PSI Data entries relevant for fusion
  - Spectroscopic data from NIST
  - Collisional data from ORNL
  - Consultancies for plasma-material interaction data
- Data in the “International Bulletin on A+M Data for Fusion” available through AMBDAS
- Data search
  - Reactants, processes, authors, keywords, year
  - Results with authors, title, reference and DOI (Digital Object Identifier)



# Code Centre Network (CCN) activities

## Data Exchange and Transfer

### CCN: Joint effort to gather and provide access to any information relevant for modellers in fusion plasma science

- Online computing
  - Downloadable codes
  - Direct contacts with the CCN for any expertise
- 
- Online codes for **Heavy Particle Collisions** – *interaction processes for bare nucleus on hydrogenic target*
  - Online codes for **Average Approximation** – *e<sup>-</sup> impact excitation cross-sections for any ion*
  - Online codes for **Rate Coefficients** – *level population distributions and radiative power rates*
  - Online package **FAC** – *various atomic radiative and collisional processes*
  - Results and link to **FLYCHK** code (NIST)
  - Link to **Convergent Close Coupling database** (Curtin Univ.)
  - Link to **HYDKIN** reaction kinetics code (FZJ)
  - Link to **DEGAS 2** MC code for neutral transport (PPL)
  - Link to **Plasma Formulary** web application for plasma spectroscopic properties
  - (Weizmann Institute)

# Code Centre Network (CCN) activities

## Data Exchange and Transfer

<https://www-amdis.org/online-computing/>

AMD Unit | [About](#) [Activities](#) [Databases](#) [Online Computing](#)

## Online Computing

Below are some links to online computing resources for calculating plasma properties.

[HEAVY](#): Cross sections for excitation and charge transfer for collisions between hydrogenic targets and bare ions.

[AAEXCITE](#): An interface to average approximation cross sections for calculating electron impact cross sections for atomic ions.

[RATES](#): Results from collisional radiative calculations of plasmas carried out with the Los Alamos modeling codes are available. Interpolations allow the user to obtain total radiated power, average ion charge, and relative ionization populations in a steady state plasma.

(This resource is currently unavailable.)

LANL: An interface is available to run several Los Alamos atomic physics codes for calculation of atomic structure, electron impact excitation, as well as ionization processes. Since 2010, atomic data sets of argon, chlorine and silicon produced by a group at LANL can be downloaded for all ionization stages.

[FLYCHK](#): An interface to the FLYCHK code available at NIST, which generates atomic level populations and charge state distributions for low-Z to mid-Z elements under NLTE(Non-Local Thermodynamic Equilibrium) conditions.

[FAC \(Flexible Atomic Code\)](#): A complete set of collisional and radiative data of atoms from Z=2 (Helium) to Z=14(Silicon).



# Code Centre Network (CCN) meetings

## Data Exchange and Transfer

- 5<sup>th</sup> CCN meeting in Nov 2017
  - Database on Molecular Dynamics Simulations on neutron-induced collisional cascades
- 6<sup>th</sup> CCN meeting in Oct 2019
  - Collision cascades data on nuclear materials: fusion with an inclusion of fission materials; development of CascadesDB; inclusion of experimental measurements; results from ab initio DFT calculations on properties of defect cascades
- Code Comparison Workshops
  - ICTP Workshop 2019: A+M Spectroscopy in Plasmas
  - 5th Spectral Lineshapes in Plasmas (SLSP) Workshop
  - Int'l Workshop on Models and Data for Plasma-Material Interactions in Fusion Devices (MoD-PMI 2019)
  - CCW on Neutral Beam Penetration and Photoemission
  - Neutral Beams CRP: Electron Dynamics for Atomic Collisions CCW

# Knowledge Base and Clerval


## Knowledge Base organization (<https://www-amdis.iaea.org/w>)

- Use of Wiki pages – AMD Unit in a coordinator role
- Community ownership: voluntary content contribution & peer review
- Central location – direct data storage or link to data storage
- Provide information on data and their applications in a context
- Closer community network → Foster collaboration on a focused topic
- Researcher information partially covered by GNAMPP network



# Knowledge Base and Clerval

Knowledge Base organization (<https://www-amdis.iaea.org/w>)



knowledge base

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- Data Sources
- Data Exchange
- Special Topics
- Fusion Research

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## Main Page

Knowledge Base for Atomic, Molecular and Plasma-Material Interaction Data For Fusion

### Introduction

Atomic, molecular and plasma-material interaction processes play an important role in the energy balance, confinement and stability of a thermonuclear plasma. The primary goal of this Knowledge base is to identify the needs in the atomic, molecular and plasma-surface interaction data sets for fusion research, both [magnetic confinement fusion](#) and [inertial confinement fusion studies](#), to provide a direct link to the relevant data sources and present more information on the available data sets.

### Data Needs

#### Magnetic Confinement Fusion

- Introduction
- Spectroscopic Data
- Collisional Data for Edge Studies
- Collisional Data for Neutral-Beam Heating
- Radiative Plasma Cooling
- Plasma-Wall Interaction
- Material Properties

#### Atomic Data

- Atom-Electron Collisions
- Atom-Heavy-particle Collisions
- Atomic Radiative Properties

#### Molecular Data

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- 4.1 Data Exchange Forum

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- 5.2 IAEA Workshops
- 5.3 NITE Kinetics Code Comparison Workshops
- 5.4 Meetings on A+M+PM/PSI Processes and Data
- 5.5 ITPA (International Tokamak Physics Activity)
- 5.6 European Fusion Development Agreement (EFDA)

6 Fusion Research

- 6.1 Magnetic Confinement Fusion Research
- 6.2 Inertial Confinement Fusion Research

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# Knowledge Base and Clerval

## Knowledge Base organization (<https://www-amdis.iaea.org/w>)

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## Clerval (<https://www-amdis.org/clerval/>)

- Database of
  - events
  - institutes

which have relevance to the use, calculation and measurement of A+M/PSI/PMI data in nuclear fusion research



# Knowledge Base and Clerval

[Clerval](https://www-amdis.org/clerval/) (<https://www-amdis.org/clerval/>)

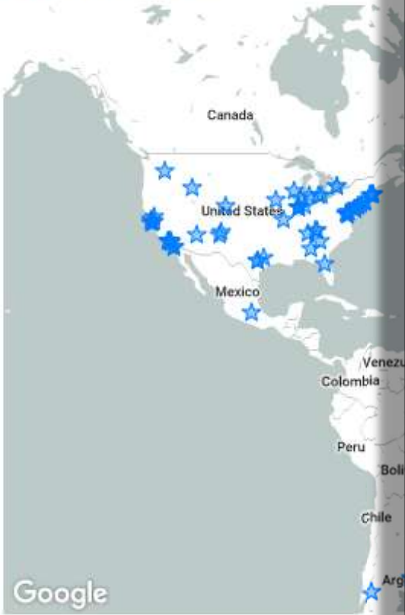
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Events

2019

October 2019

Date	Event
21 – 25 Oct	<b>61st APS Division of Plasma Physics Annual Meeting (APS-DPP 2019)</b> , Fort Lauderdale, Florida, USA <div><div>Biomedical Plasmas</div><div>Collisions in Plasmas</div><div>Industrial Plasmas</div><div>Low Temperature Plasmas</div><div>Plasma Diagnostics</div><div>Plasma Impurities</div><div>Plasma–Material Interaction</div></div>
27 Oct – 1 Nov	<b>19th International Conference on Fusion Reactor Materials (ICFRM 2019)</b> , La Jolla, CA, USA <div><div>Erosion</div><div>Fusion</div><div>Hydrogen Retention</div><div>Hydrogen Transport</div><div>Liquid Metal Walls</div><div>Material Science</div><div>Multiscale Modelling</div><div>Plasma–Material Interaction</div><div>Radiation Damage</div><div>Steel</div></div>

# Technical Discussions

- Funding for A+M/PSI data relevant to Fusion application
- Data evaluation activities
  - Technical Meetings?
- Priority list of A+M/PSI data for Fusion
- Database development
- Outreach to A+M/PSI/PMI scientists outside our community
- Outreach to plasma scientists for A+M/PSI/PMI data awareness