

# Coordinated Research Projects and Meetings of the A+M Data Unit

B. J. Braams and H.-K. Chung

Consultants' Meeting on Data Needs for Erosion and Tritium Retention in Beryllium Surfaces

IAEA, Vienna, 30-31 May 2011



**IAEA**

International Atomic Energy Agency

# A+M Data Unit Activities

“A+M Data”: really A+M/PMI: atomic, molecular and plasma-material interaction data

## Organizational

- Part of the Nuclear Data Section (12 P-staff)
- Division of Physical and Chemical Sciences
- Department of Nuclear Applications

## Activities of the Unit

- Maintain numerical and bibliographical databases and knowledge base (ALADDIN, AMBDAS and A+M/PMI Wiki pages)
- Organize coordinated research projects
- Organize technical and other meetings

# Coordinated Research Projects

<http://www-amdis.iaea.org/CRP/>

CRPs are the main mechanism by which the A+M Data Unit (and the Nuclear Data Section) encourages new research.

- Focussed objectives in data generation, compilation and evaluation for specific types of A+M or PMI processes relevant to fusion.
- CRP normally lasts 4-5 years; three research coordination meetings plus time for final report and data preparation.
- About 8-15 participants; most with research agreements, some research contracts.
- Outputs of a CRP include meeting reports, journal articles by participants, final report in APID series, data in ALADDIN database.
- Long lead time, not a very flexible mechanism.

# Past, Present and Planned CRPs of the A+M Data Unit

2002-2006: Tritium Inventory in Fusion Reactors

2004-2008: Atomic and Molecular Data for Plasma Modelling

2005-2009: Atomic Data for Heavy Element Impurities in Fusion Reactors

2007-2011: Data for Surface Composition Dynamics Relevant to Erosion Processes

2008-2012: Characterization of Size, Composition and Origins of Dust in Fusion Devices

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 State-Resolved Modelling of Molecules of H and He and their Isotopes in Fusion Plasma

2012-2016 (planned): Erosion and Tritium Retention for Plasma Interaction with Beryllium Surfaces

2013-2017 (tentative): Plasma Interaction with Irradiated Tungsten and Tungsten Alloys in Fusion Devices

# CRP on Data for Surface Composition Dynamics Relevant to Erosion Processes (2007-2011)

## *Participants*

**Karl Krieger**, MPI für Plasmaphysik, Garching, Germany

**Jungling Chen**, Chinese Academy of Sciences, Heiji, China

**Alain Allouche**, University of Provence, Marseille, France

**James Davies**, University of Toronto, Canada

**Yury Martynenko**, Kurchatov Institute, Moscow, Russia

**Daiji Kato**, National Institute for Fusion Science, Toki-City, Japan

**Predrag Krstic**, Oak Ridge National Laboratory, USA

**Kai Nordlund**, University of Helsinki, Finland

**Russel Doerner**, University of California at San Diego, USA

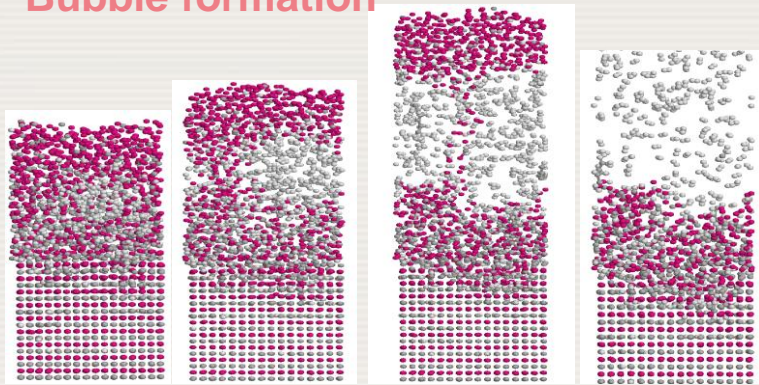
**Rinad Zalavutdinov**, Russian Academy of Science, Moscow, Russia

# CRP on Data for Surface Composition Dynamics Relevant to Erosion Processes (2007-2011)

## Overall objectives

- To better understand erosion processes and to find new methods to control erosion
- To collect and generate new data relevant to erosion dynamics in fusion reactors
- Investigated materials mainly the ones foreseen for ITER: C, W, Be

## Bubble formation



100 eV 90% D +10% W on  
W-terminated tungsten-carbide  
*Kai Nordlund, University of Helsinki*

## First outputs and outcomes

- Some new data included in ALADDIN
- New ALADDIN web interface for PSI

**First RCM**, 17-19 October 2007

**Second RCM**, 11-13 March 2009

**Final RCM**, 13-15 September 2010

# CRP on Size, Composition and Origin of Dust in Tokamaks (2008-2012)

## *Participants*

**Phil Sharpe**, Idaho National Laboratory, Idaho Falls, ID, USA

**Charles Skinner**, PPPL, Princeton, NJ, USA

**Christian Grisolia**, CEA, Cadarache, France

**Anna Widdowson**, UKAEA, Abingdon, UK

**Volker Rohde**, IPP Garching, Germany

**Jörg Winter**, Ruhr Universität, Bochum, Germany

**Carmine Castaldo**, ENEA, Roma, Italy

**Naoko Ashikawa**, NIFS, Toki-City, Japan

**Suk-Ho Hong**, NFRI, Korea

## *Observer*

**Sergio Ciattaglia**, ITER, Cadarache, France

# CRP on Size, Composition and Origin of Dust in Tokomaks (2008-2012)

## Objectives

- To determine the size, composition and origin of dust in tokamaks
- Understand dust transport
- Improve dust estimates
- Understand tritium retention in dust
- Investigate dust removal techniques
- Focus on dust from C, W and Be

**First RCM:** 10-12 December 2008

**Second RCM:** 21-23 June 2010

**Third RCM:** 30 Nov – 02 Dec 2011

**Planning a real dust database!** Effort centred at IPP Garching; based on analysis of 10s of thousands of individual dust images



Flaking of co-deposited layer on lower part of limiter, TFTR, Nov 1998



# Three other ongoing CRPs (not PMI)

## CRP on Light Element Atom, Molecule and Radical Behaviour in the Divertor and Edge Plasma Regions (2009-2013)

**Objective:** To generate new data for radiative and collisional processes in ions of atoms and molecules of hydrogen, helium, lithium, beryllium, boron, carbon, nitrogen and oxygen at temperatures and densities typical of the edge and divertor region of fusion reactors.

## CRP on Spectroscopic and Collisional Properties of Tungsten from 1 eV to 20 keV (2010-2014)

**Objective:** To produce validated database of cross-sections and spectroscopic properties for tungsten in plasma, including electron-impact, radiative, photon-induced and heavy particle collision processes.

## CRP on Atomic and Molecular Data for State-Resolved Modelling of Hydrogen and Helium and their Isotopes in Fusion Plasma (2011-2015)

**Objective:** To extend the database of cross-sections for processes of molecules and molecular ions of H and He resolved with respect to excited states of the molecules.

# Meetings of the A+M Data Unit

- CM on XML Schema for Atomic and Molecular Data (24-26 Mar 2010, NIFS)
- TM of IFRC Sub-committee on A+M Data for Fusion Research (27-28 Apr 2010)
- 2nd RCM of CRP on Dust in Fusion Devices (21-23 Jun 2010)
- 3rd RCM of CRP on Surface Composition Dynamics (13-15 Sep 2010)
- TM of the International Code Centres Network (27-28 Sep 2010)
- CM/TM on XML Schema for Atomic and Molecular Data (17-19 Nov 2010)
- Contribution to ITER-IAEA TM on ITER Technology and Materials (23-25 Nov 2010, Monaco)
- 1st RCM of CRP on Tungsten from 1 eV to 20 keV (13-15 Dec 2010)
- 2nd RCM of CRP on Light Elements in Edge and Divertor (23-25 May 2011)
- CM on Erosion and Tritium Retention in Beryllium PMI (30-31 May 2011)
- 1st RCM of CRP on State-Resolved Data for H and He (10-12 Aug 2011)
- TM of A+M/PMI Data Centres Network (7-9 Sep 2011)
- CM on XML Schema for Atomic and Molecular Data (3-5 Oct 2011, NIST)
- 3rd RCM of CRP on Dust in Fusion Devices (30 Nov – 02 Dec 2011)
- Cooperate in 7th Code Comparison Workshop on NLTE Kinetics (5-9 Dec 2011)
- (Tentative) TM on Codes and Data for PMI (Q4 2011)
- (Tentative) CM on Updating the Sputtering Database (Q4 2011)

# Proposed CRP on Beryllium PMI

## Erosion and tritium retention in beryllium plasma-facing materials

- Recommended to us by IFRC in April 2010 (together with a CRP on PMI with irradiated tungsten and tungsten alloys)
- Approved by Committee on Coordinated Research Activities (CCRA) in Aug 2010 as new CRPs in the 2012-2013 Programme and Budget

## Tentative schedule

- Jun-Jul 2011: Discussions with potential participants
- 15 Aug: Detailed proposal (without final list of participants) is submitted to CCRA for their meeting on 31 Aug; assume that they approve it...
- 10 Oct: Most proposals for participation have been received for review by CCRA at their meeting on 27 Oct; assume they approve...
- (Late proposals to be received by 18 Nov for CCRA review 07 Dec)
- Research agreements and research contracts are sent to the participating institutes; get signatures
- Feb 2012: First research coordination meeting

# Questions for this Consultants' Meeting

We trust that you endorse the idea of CRP on PMI with beryllium

Current state of knowledge on PMI with beryllium surfaces

- Sputtering, erosion, redeposition
- Hydrogen retention, transport of H in beryllium
- Ways to remove trapped tritium
- Melting and ablation under high heat loads

Desired focus for the CRP

- Erosion and tritium retention are probably central topics; how much emphasis on melting and ablation?
- Balance between experiment and modelling

Suggestions for participating institutes

- Not a definitive list
- Indication of capabilities and programmes

# Questions for this CM, Continued

## Some other issues for which we value your thoughts and advice

- Are there areas in PMI where we may contribute by organizing a smaller single meeting, rather than the heavy CRP mechanism? For example, evaluation of existing data for some class of processes.
- We have in mind to organize a “code comparison workshop” for plasma-material interaction. Code authors would come together for 5 days to review and compare their calculations on some precisely specified problems. What do you think of this?
- In the past our Section and Unit have not often organized large meetings. However, the A+M Unit has organized about every 10 years a bigger meeting on the status of A+M/PMI data for fusion, last in Jülich in 2002. Should we do more of this?

**Thank you for being here!**

