A+M Data Center Activities in National Fusion Research Institute (2015~2017)

DCPP 플라즈마물성데이터센터

Mi-Young Song with PFTR team

Plasma Technology Research Center
National Fusion Research Institute

CONTENTS

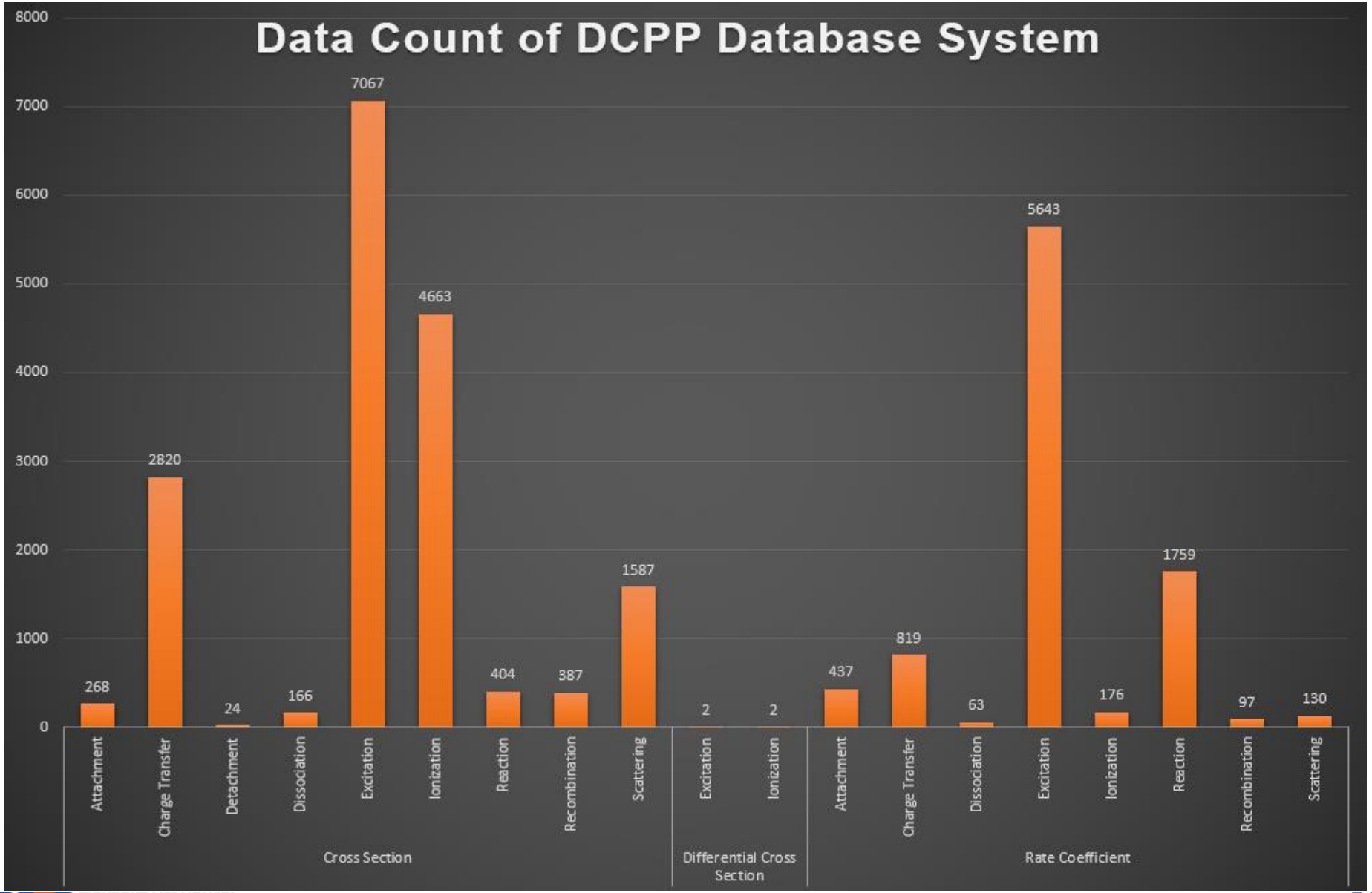
- A+M Database
- AMBDAS update.
- International Group Data Evaluation Activities
- Activities to Product of Fundamental Electron Scattering Data
- Summary and Future Plan

A+M Database

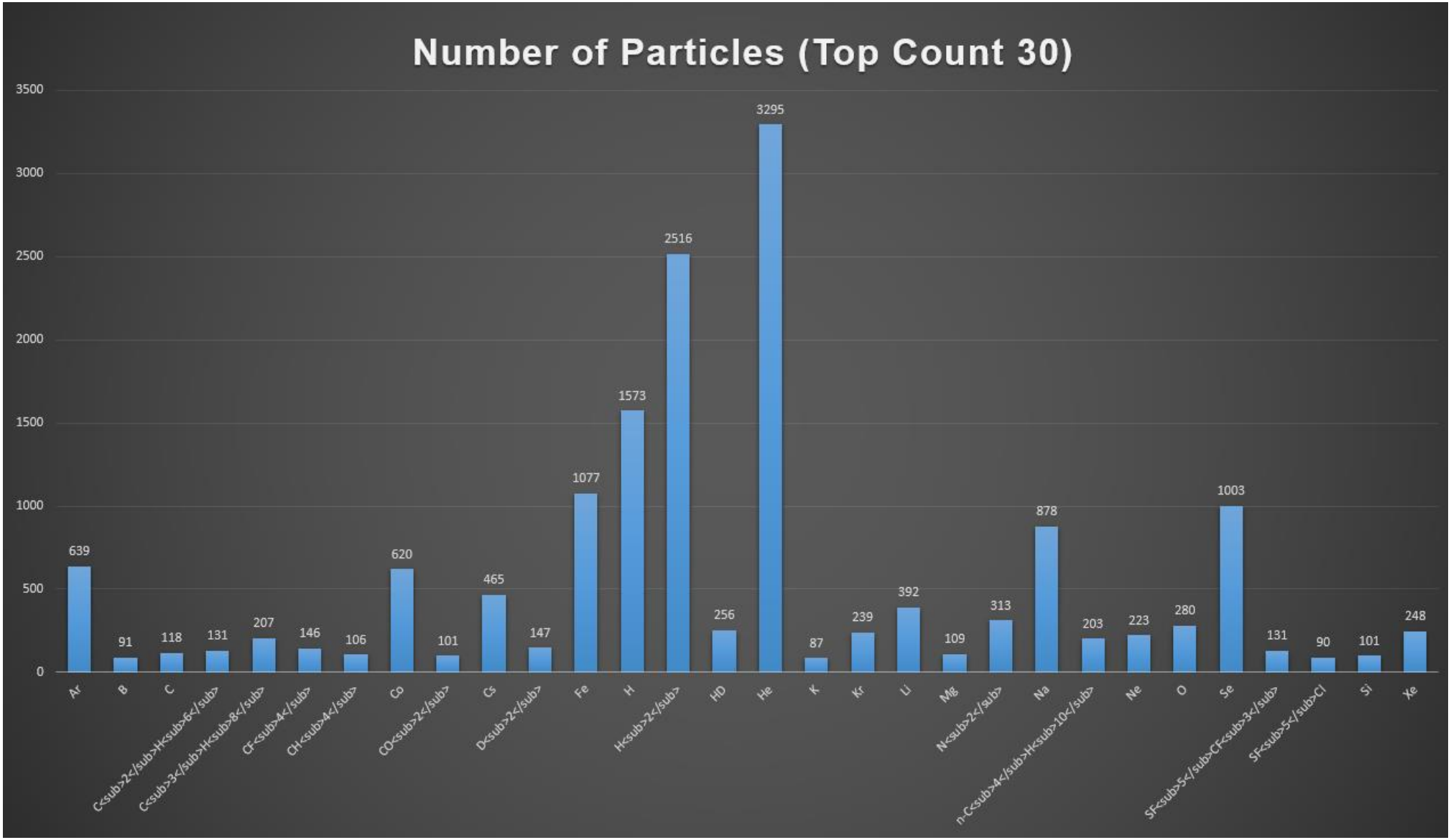
DCPP Web Database System

- http://dcpp.nfri.re.kr
- Web content
  - Collision cross sections
  - Rate coefficient
  - Electron collision
  - Heavy particle reactions
  - numerical and bibliographic data
  - Evaluation process
- Total amount of data : 26,518 recodes.
- DCPP web database system is improved by **a new system** that focuses on user convenience.
- We will plan to add plasma-surface reaction data end of this year.

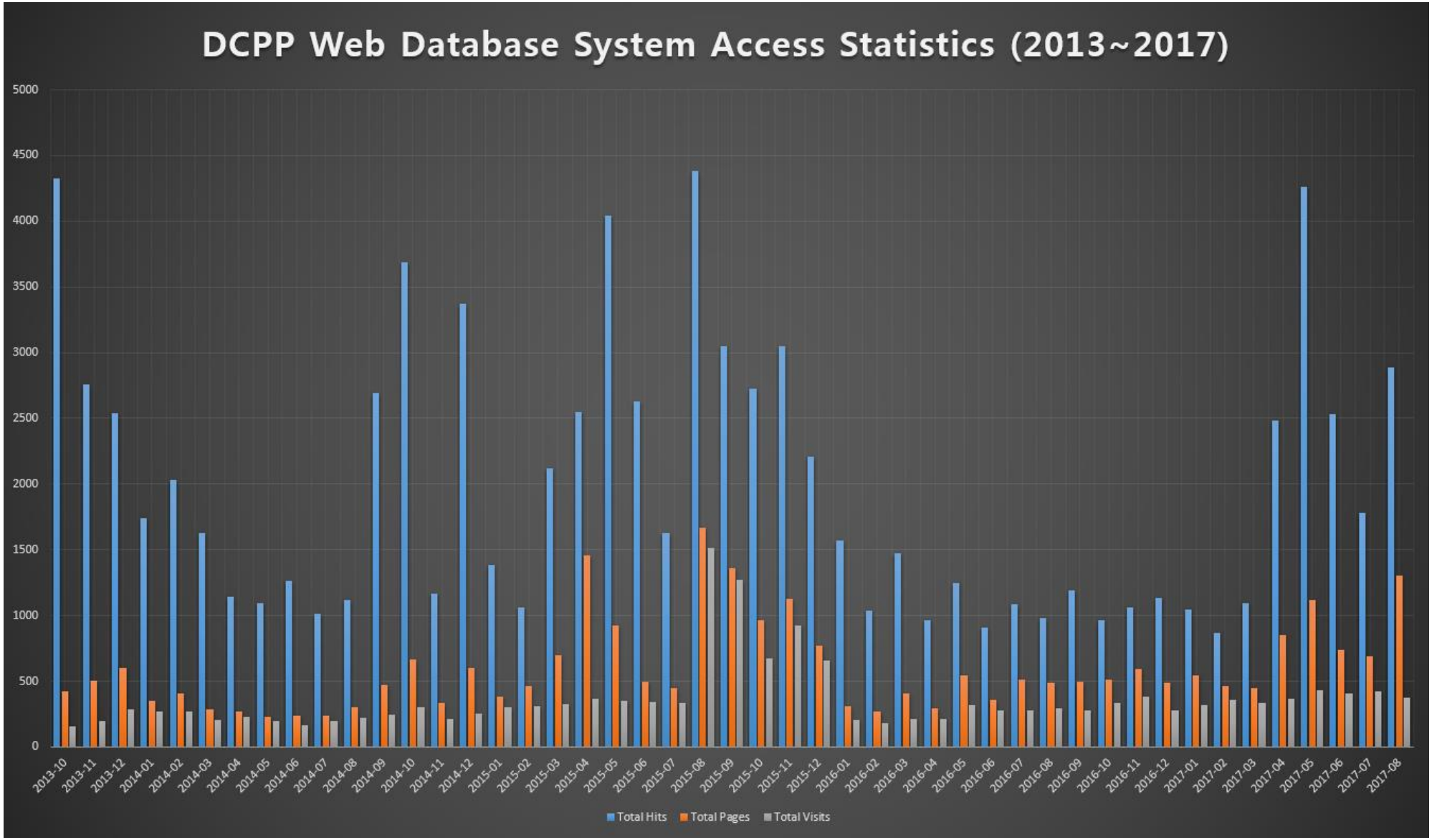
Data Statistics (1)



Data Statistics (2)



Access Statistics (Monthly)

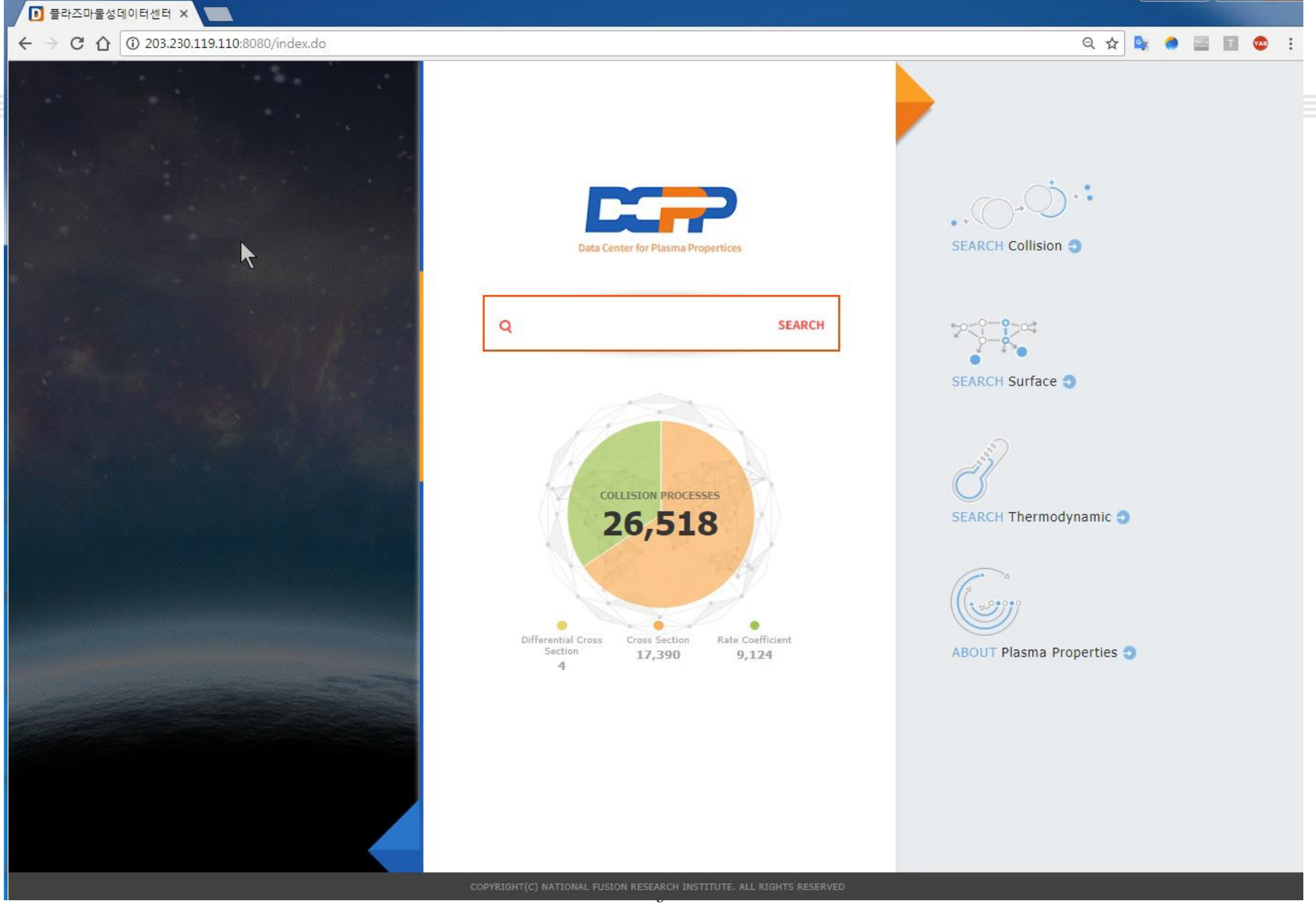


Evaluated Data (~2017)

Total species : 90

Very small amount data

	Species	TCS	ES	MT	DCS	TICS	PICS	TDCS	NDCS	TACS	DACS	VI	RO	EX
Atoms	9	2	2	2	2	9	21	0	0	0	0	0	0	0
2 Atoms	10	6	5	4	4	7	29	2	0	4	4	11	7	26
3 Atoms	7	4	4	3	3	7	35	1	0	2	9	3	0	2
4 Atoms	4	4	2	2	2	4	9	0	0	1	2	1	1	0
5 Atoms	7	7	1	1	2	4	18	0	0	0	0	0	0	0
CxFy (x=0~4, y=1~8)	28	5	6	5	103	8	45	4	1	4	1	1	0	0
CHxFy, CClxFy (x=1~3, y=1~3)	4	2	2	2	15	4	34	1	0	1	2	2	0	0
NFx, SFy (x=1~3, y=1~6)	7	3	2	2	2	3	20	0	0	0	3	0	0	0
SixYz (x=1~2, Y=Cl, F, H, D, z=1~6)	14	4	2	2	4	10	57	2	4	0	0	0	0	0
total	90	37	26	23	137	56	268	10	5	12	21	18	8	28


플라즈마물성데이터센터
203.230.119.110:8080/index.do
Data Center for Plasma Properties
SEARCH
COLLISION PROCESSES
26,518
Differential Cross Section
4
Cross Section
17,390
Rate Coefficient
9,124
SEARCH Collision
SEARCH Surface
SEARCH Thermodynamic
ABOUT Plasma Properties
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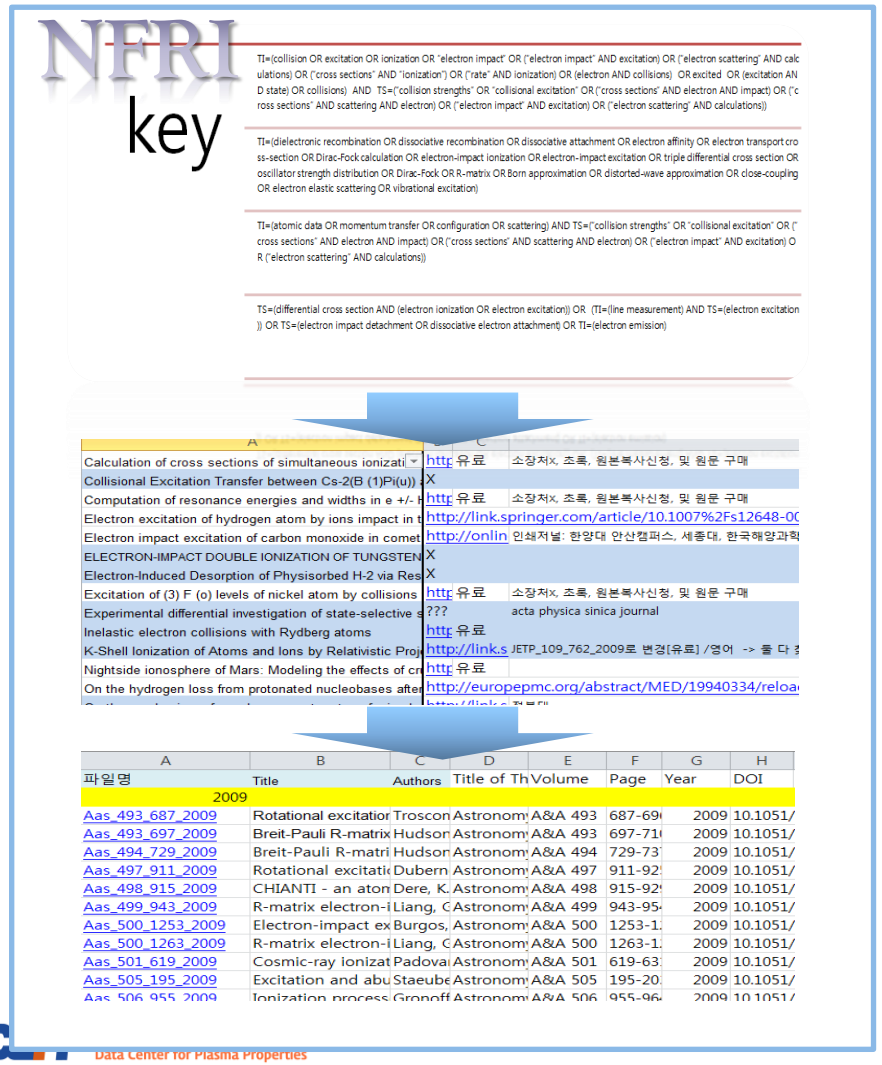
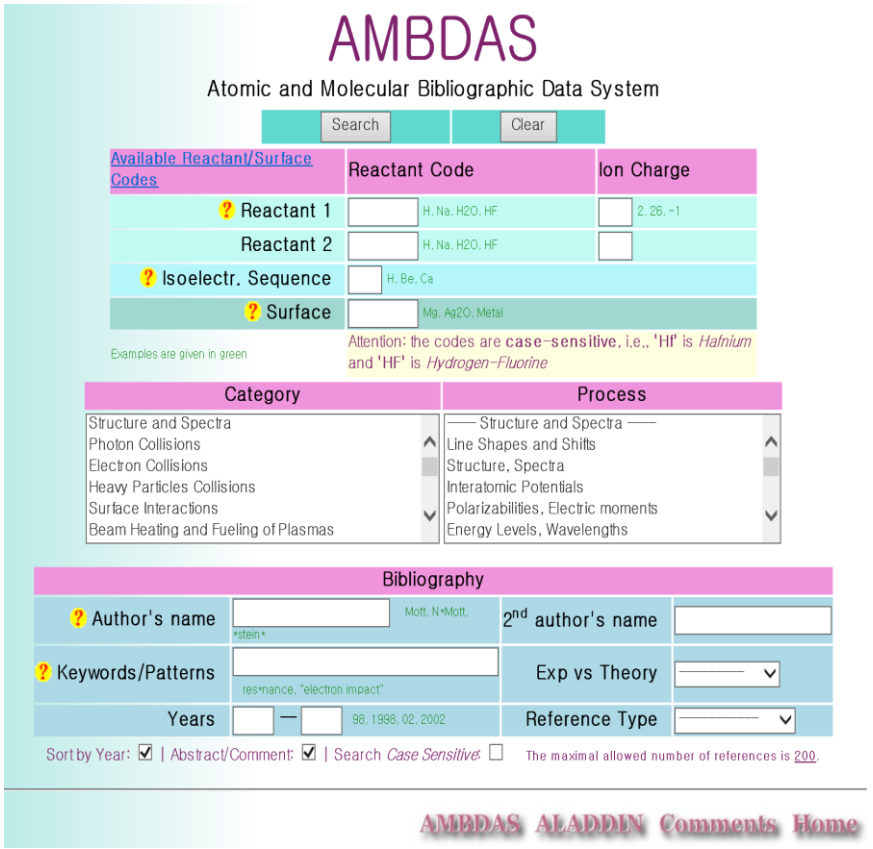
AMBDAS Update

AMBDAS – Journal Collection

- Maintenance of Bibliographical Data on Collisional Processes (AMBDAS).

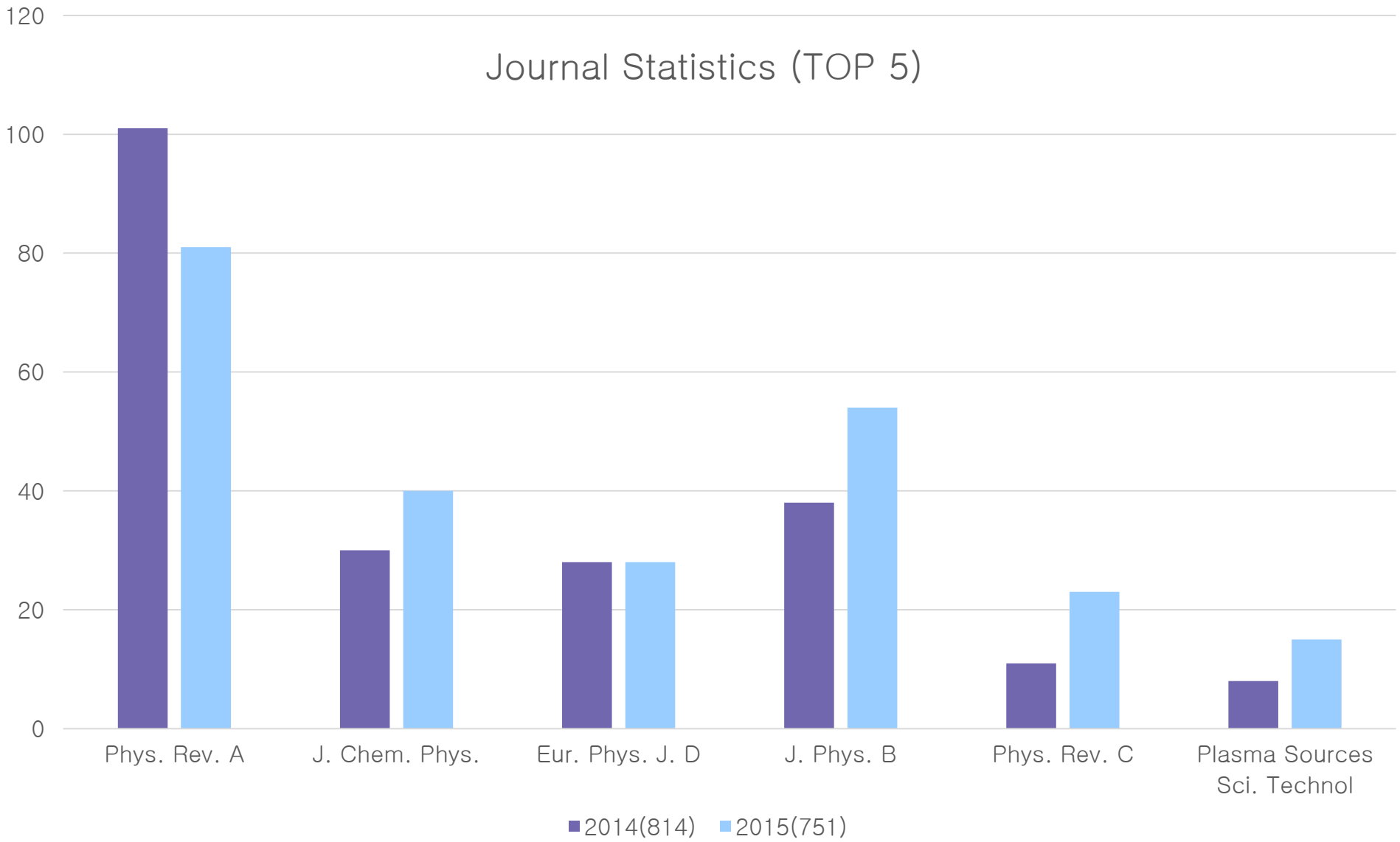




	Job Time	2014	2015		2016	2017
Search period		2009 ~2012	2013	2014	2015	2016
Number of searches	2 weeks	3631	1138	1181	1150	1054
Filtering (1st)	2 weeks	2993	739	814	751	844
Original paper collections	2~3 months	2863	527	627	549	600
Expert Reviews & update	1 months		433	407	248	

- Key word searching
- Additional filtering (only figure or table)
- Number of journals retrieved : 170 ~ 150
- Too many papers collected before experts see data

→ There is a need to change the filtering method or collection method.


Journal Statistics (TOP 5)
120
100
80
60
40
20
0
Phys. Rev. A
J. Chem. Phys.
Eur. Phys. J. D
J. Phys. B
Phys. Rev. C
Plasma Sources Sci. Technol
2014(814)
2015(751)

International Group Data Evaluation Activities

Activities of Data Evaluation

- Group Data Evaluation project (since 2013)
- Our purpose
  - To establish and to generate the internationally agree standard reference data library for AM/PMI data
- Group Members:
  - Grzegorz P. Karwasz (Nicolaus Copernicus University)
  - J. Tennyson (University College London)
  - Viatcheslav kokoouline (University of Central Florida)
  - H. Cho (Chung-Nam National University)
  - Y. Nakamura (Tokyo Denki University)
  - J.-S. Yoon, M.-Y. Song (National Fusion Research Institute)

2014

- 8-9 January 2014, Seoul, South Korea
- 4 -5 July 2014, Cumberland Lodge, UK
- 14 December 2014, Deajeon, South Korea

2015

- 14-15 May 2015, University College London, UK
- 17-19 November 2015, Seoul, Korea

2016

- 13-16 May 2016, University College London, UK
- 27 September 2016, NFRI, South Korea

2017

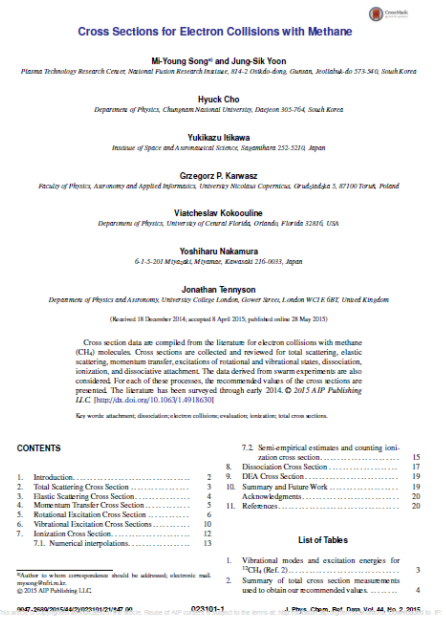
- 16~17 May 2017, Seoul, South Korea
- 13 ~ 14 September, Jeju, South Korea.

Cross section for electron collisions with Methane

2013 ~ 2014 : review and assessment

2014.12 : submitted article. (**J. Phys. Chem. Ref. Data, 44 ,023101, 2015)**

- Presentation : 9th International Conference on Atomic and Molecular Data and Their Applications, 21 ~ 25 September 2014, Jena, Germany



Cross Sections for Electron Collisions with Methane

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(Received 18 December 2014; accepted 8 April 2015; published online 28 May 2015)

Cross section data are compiled from the literature for electron collisions with methane (CH_4) molecules. Cross sections are collected and reviewed for total scattering, elastic scattering, momentum transfer, excitations of rotational and vibrational states, dissociation, ionization, and dissociative attachment. The data derived from swarm experiments are also considered. For each of these processes, the recommended values of the cross sections are presented. The literature has been surveyed through early 2014. © 2015 AIP Publishing LLC. [http://dx.doi.org/10.1063/1.4918630]

Key words: attachment; dissociation; electron collisions; evaluation; ionization; total cross sections.

CONTENTS

List of Tables

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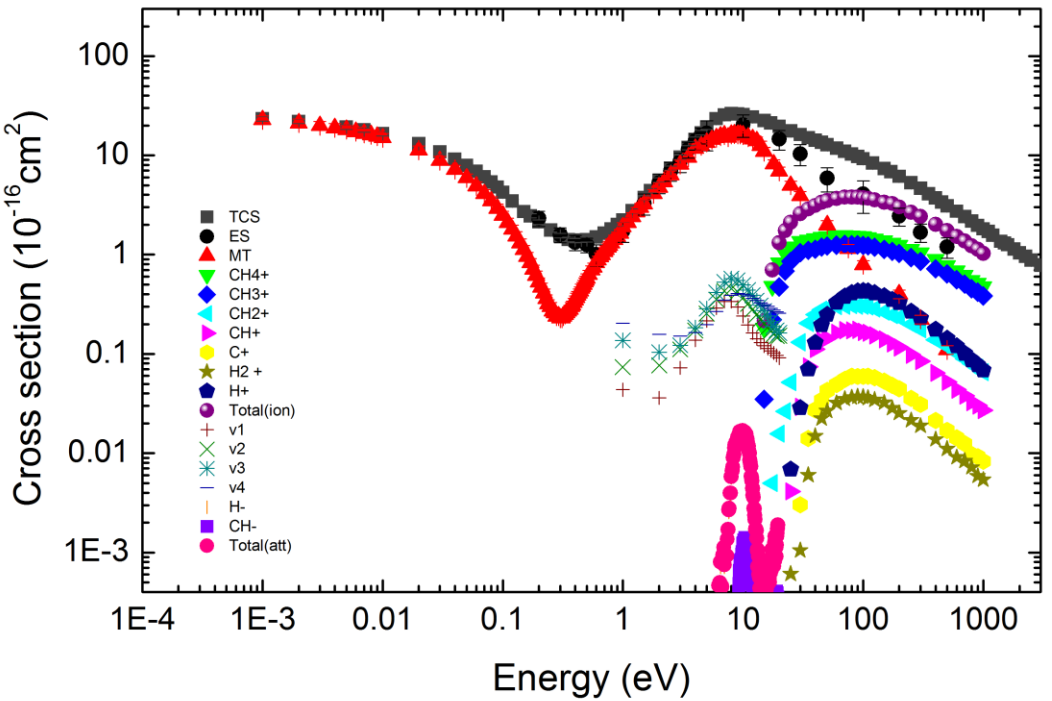
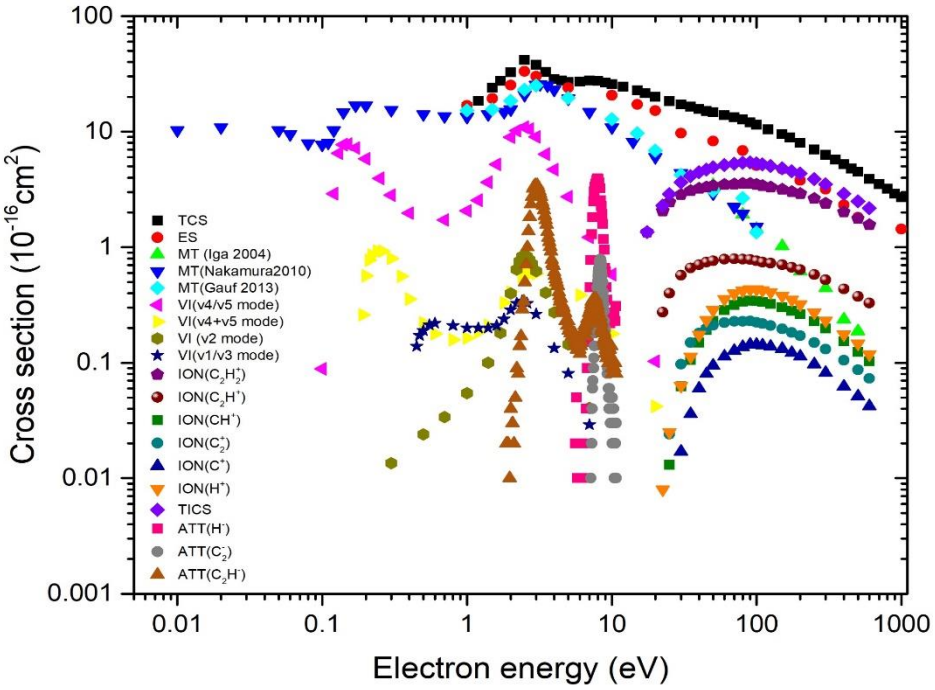


Cross section for electron collisions with Acetylene

2014 ~2016 : review and assessment

2016.11 : submitted article (**J. Phys. Chem. Ref. Data, 47 ,013106, 2017**)

- Key evaluation procedures
  - ✓ Swarm method (MTCS, VICS)
- Presentation :
  - ✓ XVIII International Workshop on Low-Energy Positron and Positronium Physics & the XIX International Symposium on Electron-Molecule Collisions and Swarms, 17 - 20 July 2015, Lisboa, Portugal
- Results derived from this project :
  - ✓ **Kamil Fedusa** and Grzegorz P. Karwasz, "Electron scattering on molecules: search for semi-empirical Indications" Eur. Phys. J. D (2017) 71: 138

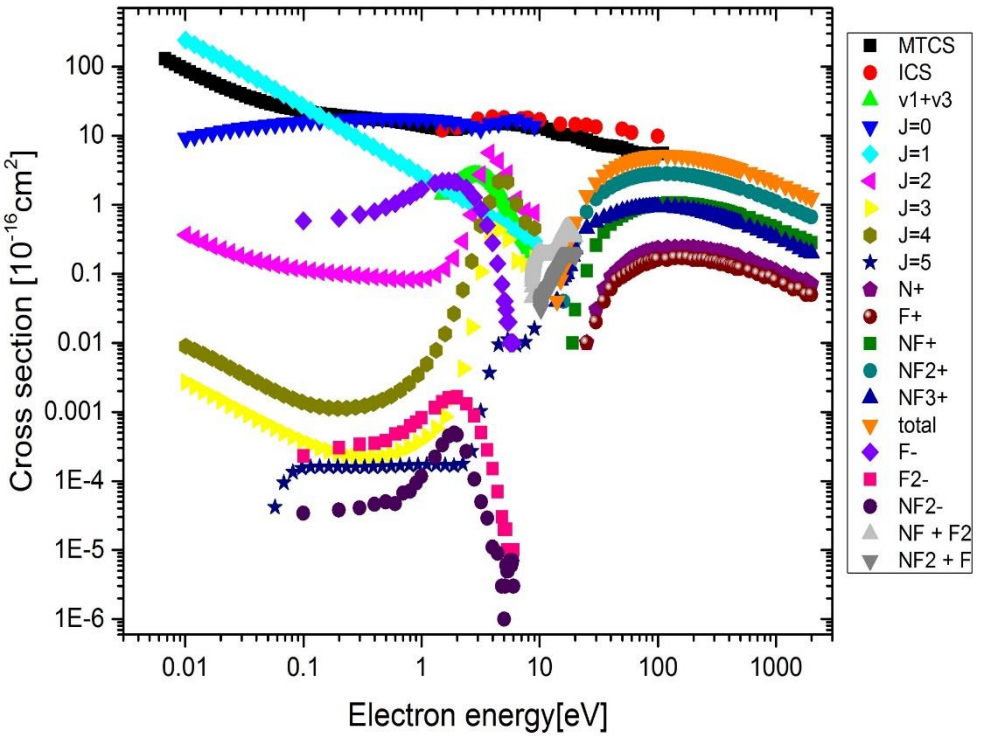


Cross section for electron collisions with NF3

2015 ~2016 : review and assessment

2017.07 : submitted article (**J. Phys. Chem. Ref. Data)**

- Key evaluation procedures
  - ✓ Swarm method (MTCS, VICS)
  - ✓ New study (rotational excitation, electronic excitation)
- Results derived from this project :
  - ✓ **James R Hamilton**, Jonathan Tennyson, Shuo Huang and Mark J Kushner, “Calculated cross sections for electron collisions with NF3, NF2 and NF with applications to remote plasma sources” Plasma Sources Sci. Technol. 26 (2017) 065010.



- Five years of team composition, 3 evaluation papers published
- The evaluation group tried to **provide the data set as complete as possible.**
- We **are suggesting other researchers to study it** , if we don't find any data
- The important data for evaluation is **the total scattering cross-section, and swarm data** is required to verify the dataset
- We plan to make the Group data evaluation project for continuous activity.
- Using know-how, it is possible to evaluate molecular data related to the fusion research.

Activities to create Fundamental electron, ion, neutral species Scattering Datasets

	A&M	Year	total scattering	elastic scattering	momentum transfer	DCS	total ionization	partial ionization	TDCS	Neutral dissociation	Total attachment	Dissociative attachment	vibrational excitation	rotational excitation	electronical excitation
			TCS	ES	MT	DCS	TICS	PICS	TDCS	NDCS	TACS	DACS	VI	RO	EX
1	H2	2007, 2008	C	V	V	D	Q	Q			Q		V	Q	Q
2	O2	2008	Q	Q	Q	D	Q	V	Q			V	Q		V
3	N2	2008	Q	Q	V	D	Q	V	Q				Q	Q	Q
5	Xe	2008	V	Q	Q	D	V	V							
6	CF4	2009, 2014	V	V	V	V	V	Q	Q	Q	Q				
7	C2F6	2009, 2015	V	Q	Q	V	V	V	Q		Q				
8	C3F8-2013	2009, 2013, 2015	V	Q	Q	V	V	Q	Q		Q				
9	C4F8-2013	2009, 2013, 2015	V	V	V	V	Q	Q	Q		Q				
10	CF3I-2013	2009, 2013	V			D	Q	Q							
11	CHF3	2009, 2013		V	V	D	V	Q	Q						
12	CCl2F2	2009	Q	Q		D	V	Q							
13	SF6	2009	V	Q	Q	D	Q	Q							
14	CCl4	2010	V			D	V	V							
15	SiF4	2010	V			D	Q	Q		Q					
16	SiF3	2010					Q	Q							
17	SiF2	2010					Q	Q							
18	SiF	2010					Q	Q							
19	Si	2010					Q	Q							
20	SiH4	2010	V	Q	Q	D	V	V	Q						
21	Si2H6	2010	Q	Q	Q	D			Q						
23	NH3	2010	V	Q	Q	D	Q	Q							
27	C	2011					Q	Q							
28	O	2011					Q	Q							
29	N	2011					Q	Q							
30	F	2011					Q	Q							
31	Cl	2011					Q	Q							
32	Br	2011					Q	Q							
33	I	2011					Q	Q							
34	CFx	2011, 2014				Q		Q							
35	NFx	2011						Q							
36	SFx	2011					Q	Q							
37	C2F4	2011, 2015	Q	Q	Q	V	Q						Q		
38	F2	2011					Q	Q				Q			
39	Cl2	2011	V				V	Q							
40	BCl3	2011	Q				Q	Q							

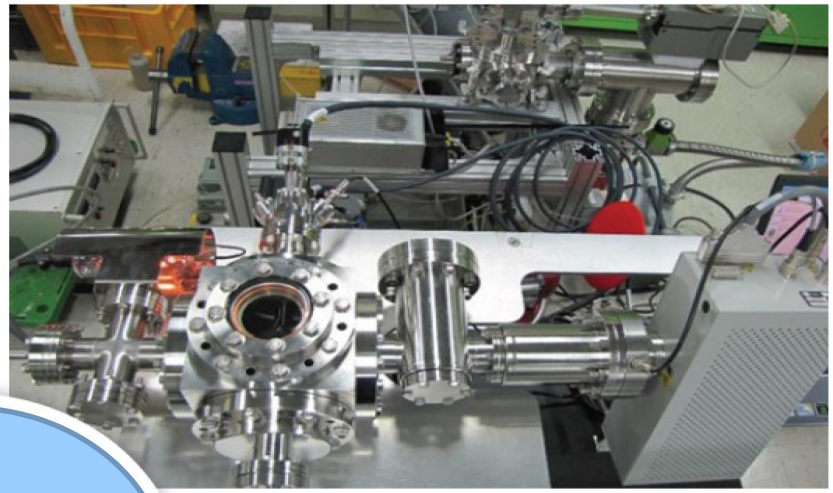
- **Insufficient data set (excitation, dissociation, …)**

Experimental measurement

Total Cross Section

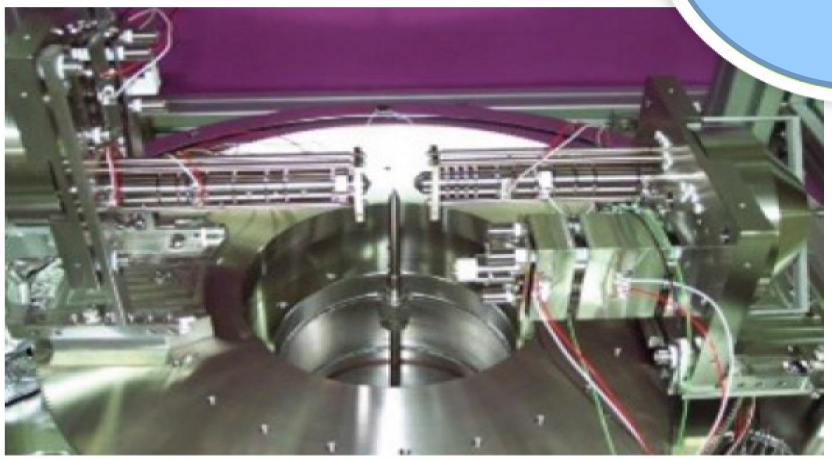
Measurement of total cross sections for electron scattering on atomic and molecules using magnetized electron beam

Experimental apparatus

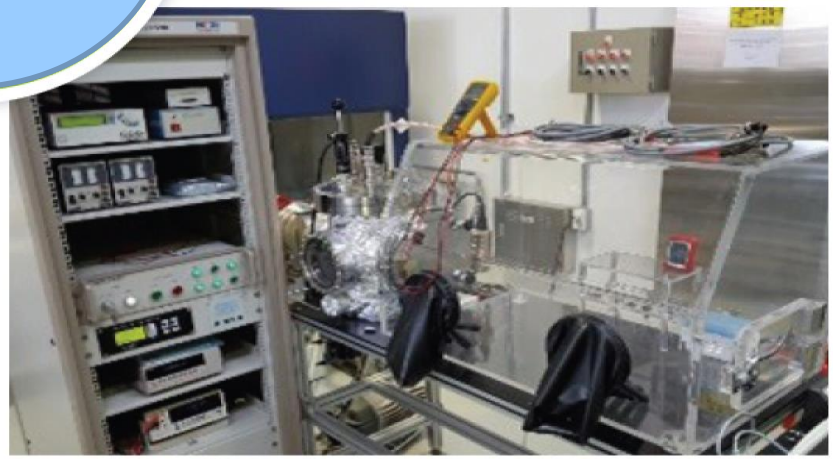


Dissociation Cross Section

Ionization threshold spectroscopy method



Elastic Differential Scattering Cross Section

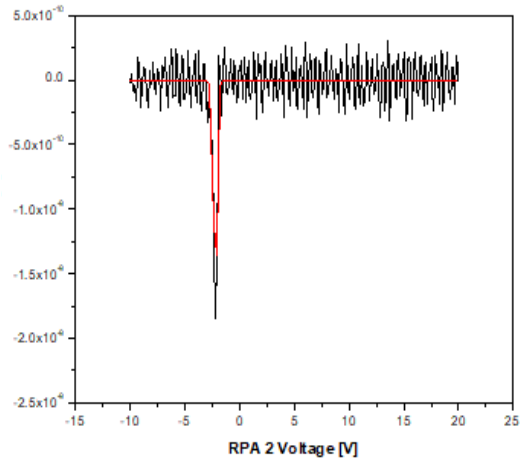


Biomolecule-Electron Collision Data

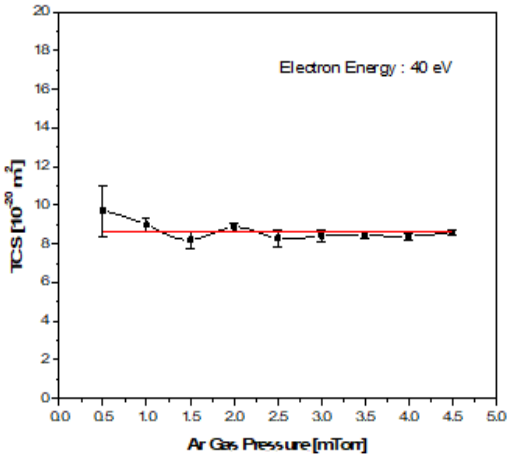
at electron energy 1 eV

DC mode, 500 Gauss

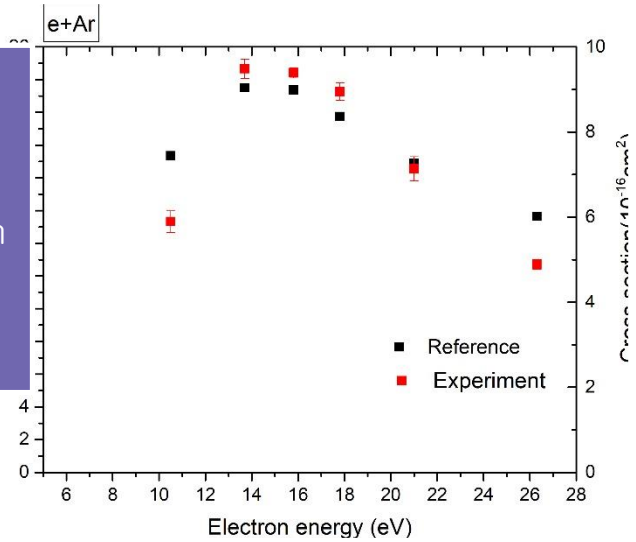
FWHM : 0.38 eV



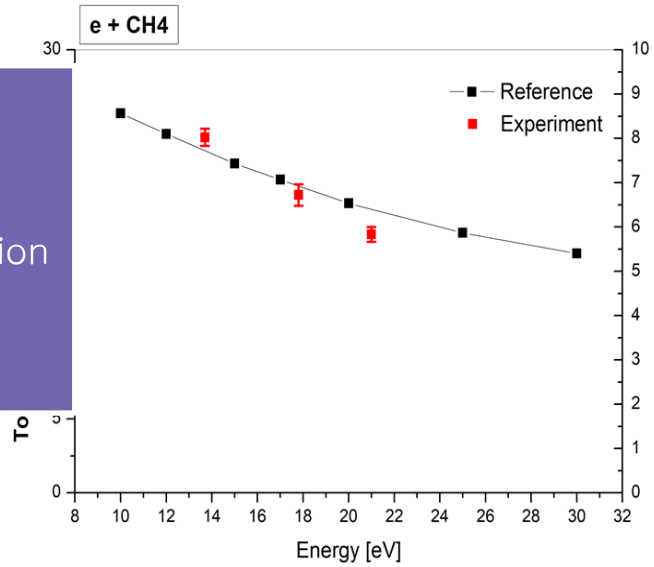
Electron TCS for Argon plotted against gas pressure



Total Cross Section by electron collision (Ar)



Total Cross Section by electron collision (CH_4)



Theoretical Calculations

- Total ionization cross section (BEB Model)

C_2F_x (x=1~6), C_3F_x (x=1~8), C_4F_x (x=1~8)

$t = T / B$, $u = U / B$, $S = 4 \pi a_0^2 N (R / B)^2$

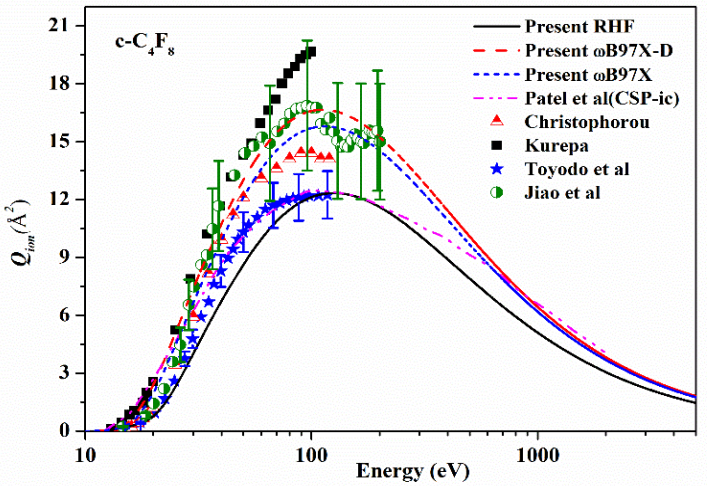
$a_0 = 0.5292$ Å, $R = 13.60$ eV

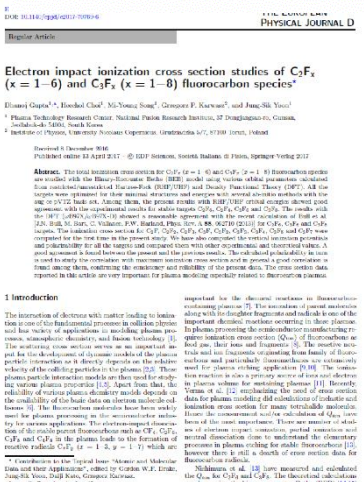
at the HF//ωB97X-D/avtz level

$$\sigma_{BEB} = \frac{S}{t+u+1}\left[\frac{\ln t}{2}\left(1-\frac{1}{t^2}\right)+1-\frac{1}{t}-\frac{\ln t}{t+1}\right]$$

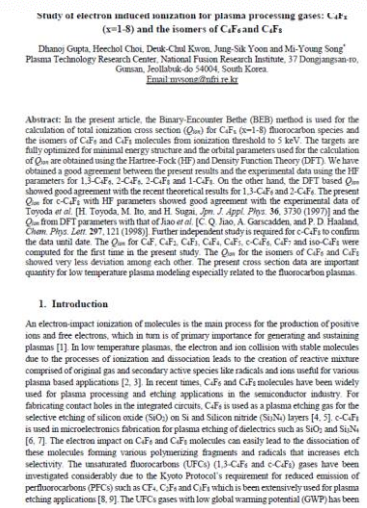
by using the BEB model

B = electron binding energy, eV
U = average kinetic energy, eV
N = electron occupation number




PHYSICAL JOURNAL D

Electron impact ionization cross section studies of C_2F_x (x = 1–6) and C_3F_x (x = 1–8) fluorocarbon species


Study of electron induced ionization for plasma processing gases: C_4F_x (x=1-8) and the isomers of C_4F_8 and C_5F_8

Dhanoj Gupta, Heechol Choi, Deuk-Chul Kwon, Jung-Sik Yoon and Mi-Young Song

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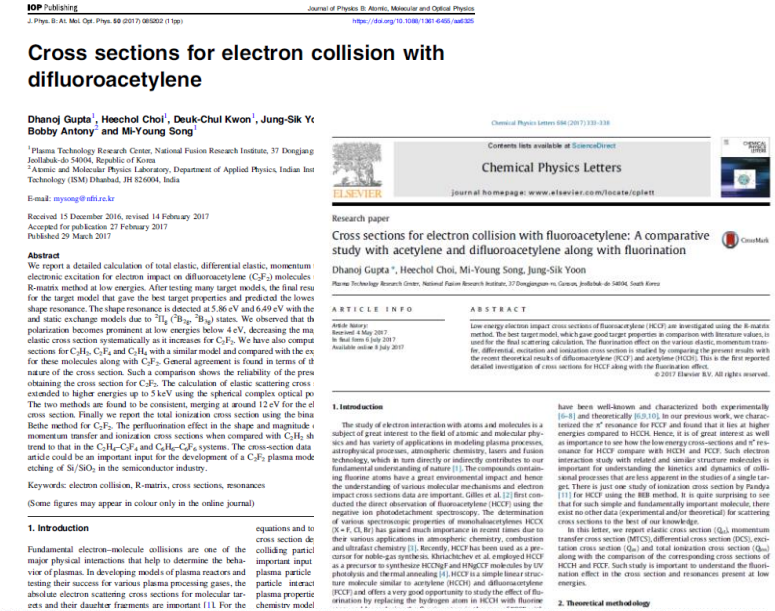
Email:mysong@nfri.re.kr

Abstract: In the present article, the Binary-Encounter Bethe (BEB) method is used for the calculation of total ionization cross section (Q_{ion}) for C_4F_x (x=1-8) fluorocarbon species and the isomers of C_4F_8 and C_5F_8 molecules from ionization threshold to 5 keV. The targets are fully optimized for minimal energy structure and the orbital parameters used for the calculation of Q_{ion} are obtained using the Hartree-Fock (HF) and Density Function Theory (DFT). We have obtained a good agreement between the present results and the experimental data using the HF parameters for 1,3-C_4F_6, 2-C_4F_6 and 1-C_4F_7. On the other hand, the DFT based Q_{ion} showed good agreement with the recent theoretical results for 1,3-C_4F_6 and 2-C_4F_6. The present Q_{ion} for c-C_4F_8 with HF parameters showed good agreement with the experimental data of Toyoda *et al.* [H. Toyoda, M. Ito, and H. Sugai, *Jpn. J. Appl. Phys.* 36, 3730 (1997)] and the Q_{ion} from DFT parameters with that of Jiao *et al.* [C. Q. Jiao, A. Garscadden, and P. D. Haaland, *Chem. Phys. Lett* 297, 121 (1998)]. Further independent study is required for c-C_4F_8 to confirm the data until date. The Q_{ion} for C_4F, C_4F_2, C_4F_3, C_4F_4, C_4F_5, c-C_4F_6, C_4F_7 and iso-C_4F_8 were computed for the first time in the present study. The Q_{ion} for the isomers of C_4F_8 and C_5F_8 showed very less deviations among each other. The present cross section data are important quantity for low temperature plasma modeling especially related to the fluorocarbon plasmas.

1. Introduction

An electron-impact ionization of molecules is the main process for the production of positive ions and free electrons, which in turn is of primary importance for generating and sustaining plasmas [1]. In low temperature plasmas, the electron and ion collision with stable molecules due to the processes of ionization and dissociation leads to the creation of reactive mixture comprised of original gas and secondary active species like radicals and ions useful for various plasma based applications [2, 3]. In recent times, C_4F_8 and C_5F_8 molecules have been widely used for plasma processing and etching applications in the semiconductor industry. For fabricating contact holes in the integrated circuits, C_4F_8 is used as a plasma etching gas for the selective etching of silicon oxide (SiO_2) on Si and Silicon nitride (Si_3N_4) layers [4, 5]. c-C_4F_8 is used in microelectronics fabrication for plasma etching of dielectrics such as SiO_2 and Si_3N_4 [6, 7]. The electron impact on C_4F_8 and C_5F_8 molecules can easily lead to the dissociation of these molecules forming various polymerizing fragments and radicals that increases etch selectivity. The unsaturated fluorocarbons (UFCs) (1,3-C_4F_6 and c-C_4F_6) gases have been investigated considerably due to the Kyoto Protocol's requirement for reduced emission of perfluorocarbons (PFCs) such as CF_4, C_2F_6 and C_3F_8 which is been extensively used for plasma etching applications [8, 9]. The UFCs gases with low global warming potential (GWP) has been

- **Theoretical Methodology**
  - ✓ The well-known *ab initio* R-matrix method through Quantemol-N
- **Target models**
  - ✓ The have optimized the structure of C_xF_y using the Density Functional Theory DFT (wB97X-D/aug-cc-pVTZ) using the Gaussian 09



IOP Publishing — Journal of Physics B: Atomic, Molecular and Optical Physics

J. Phys. B: At. Mol. Opt. Phys. 50 (2017) 085202 (11pp) — https://doi.org/10.1088/1361-6455/aa6325

Cross sections for electron collision with difluoroacetylene

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Accepted for publication 27 February 2017
Published 29 March 2017

Abstract

We report a detailed calculation of total elastic, differential elastic, momentum
electronic excitation for electron impact on difluoroacetylene (C_2F_2) molecules
R-matrix method at low energies. After testing many target models, the final resu
for the target model that gave the best target properties and predicted the lowes
shape resonance. The shape resonance is detected at 5.86 eV and 6.49 eV with the
and static exchange models due to $^2\Pi_g$ ($^2B_{3g}$, $^2B_{1g}$) states. We observed that th
polarization becomes prominent at low energies below 4 eV, decreasing the ma
elastic cross section systematically as it increases for C_2F_2. We have also compu
sections for C_2H_2, C_2F_4 and C_2H_4 with a similar model and compared with the ex
for these molecules along with C_2F_2. General agreement is found in terms of th
nature of the cross section. Such a comparison shows the reliability of the pres
obtaining the cross section for C_2F_2. The calculation of elastic scattering cross
extended to higher energies up to 5 keV using the spherical complex optical po
The two methods are found to be consistent, merging at around 12 eV for the el
cross section. Finally we report the total ionization cross section using the bina
Bethe method for C_2F_2. The perfluorination effect in the shape and magnitude
momentum transfer and ionization cross sections when compared with C_2H_2 sh
trend to that in the C_2H_4–C_2F_4 and C_4H_6–C_4F_6 systems. The cross-section data
article could be an important input for the development of a C_2F_2 plasma mode
etching of Si/SiO_2 in the semiconductor industry.

Keywords: electron collision, R-matrix, cross sections, resonances

(Some figures may appear in colour only in the online journal)

1. Introduction

Fundamental electron–molecule collisions are one of the major physical interactions that help to determine the behavior of plasmas. In developing models of plasma reactors and testing their success for various plasma processing gases, the absolute electron scattering cross sections for molecular targets and their daughter fragments are important [1]. For the

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Research paper

Cross sections for electron collision with fluoroacetylene: A comparative study with acetylene and difluoroacetylene along with fluorination

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ABSTRACT

Low energy electron impact cross sections of fluoroacetylene (HCCF) are investigated using the R-matrix method. The best target model, which gave good target properties in comparison with literature values, is used for the final scattering calculation. The fluorination effect on the various elastic, momentum transfer, differential, excitation and ionization cross section is studied by comparing the present results with the recent theoretical results of difluoroacetylene (FCCF) and acetylene (HCCH). This is the first reported detailed investigation of cross sections for HCCF along with the fluorination effect.

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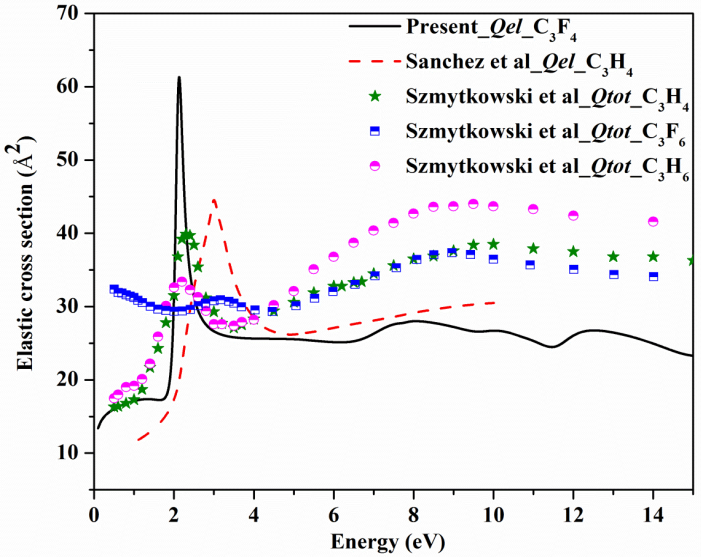
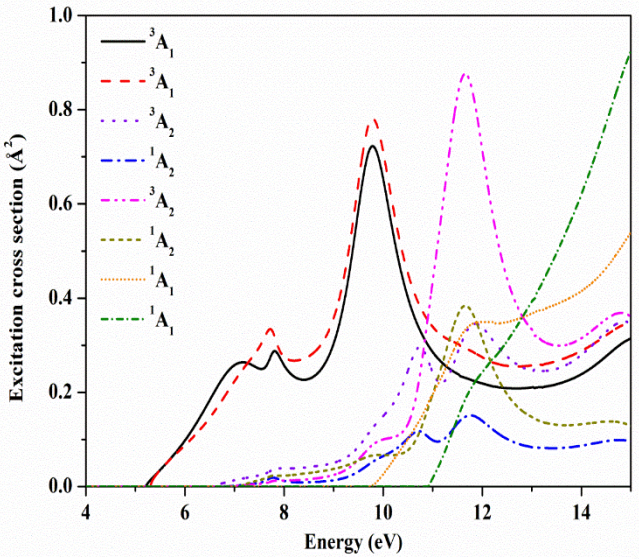
1. Introduction

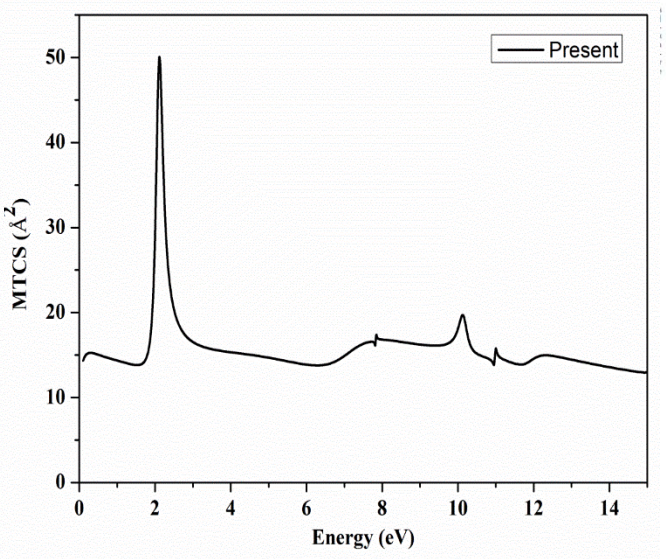
The study of electron interaction with atoms and molecules is a subject of great interest to the field of atomic and molecular physics and has variety of applications in modeling plasma processes, astrophysical processes, atmospheric chemistry, lasers and fusion technology, which in turn directly or indirectly contributes to our fundamental understanding of nature [1]. The compounds containing fluorine atoms have a great environmental impact and hence the understanding of various molecular mechanisms and electron impact cross sections data are important. Gilles et al. [2] first conducted the direct observation of fluoroacetylene (HCCF) using the negative ion photodetachment spectroscopy. The determination of various spectroscopic properties of monohaloacetylenes HCCX (X = F, Cl, Br) has gained much importance in recent times due to their various applications in atmospheric chemistry, combustion and ultrafast chemistry [1]. Recently, HCCF has been used as a precursor for noble-gas synthesis. Khriachtchev et al. employed HCCF as a precursor to synthesize HCCNgF and HNgCCF molecules by UV photolysis and thermal annealing [4]. HCCF is a simple linear structure molecule similar to acetylene (HCCH) and difluoroacetylene (FCCF) and offers a very good opportunity to study the effect of fluorination by replacing the hydrogen atom in HCCH with fluorine have been well-known and characterized both experimentally [6–8] and theoretically [8,9,10]. In our previous work, we characterized the π^* resonance for FCCF and found that it lies at higher energies compared to HCCH. Hence, it is of great interest as well as importance to see how the low energy cross-sections and π^* resonance for HCCF compare with HCCH and FCCF. Such electron interaction study with related and similar structure molecules is important for understanding the kinetics and dynamics of collisional processes that are less apparent in the studies of a single target. There is just one study of ionization cross section by Pandya [11] for HCCF using the BEB method. It is quite surprising to see that for such simple and fundamentally important molecule, there exist no other data (experimental and/or theoretical) for scattering cross sections to the best of our knowledge.

In this letter, we report elastic cross section (Q_{el}), momentum transfer cross section (MTCS), differential cross section (DCS), excitation cross section (Q_{ex}) and total ionization cross section (Q_{ion}) along with the comparison of the corresponding cross sections of HCCH and FCCF. Such study is important to understand the fluorination effect in the cross section and resonances present at low energies.

2. Theoretical methodology

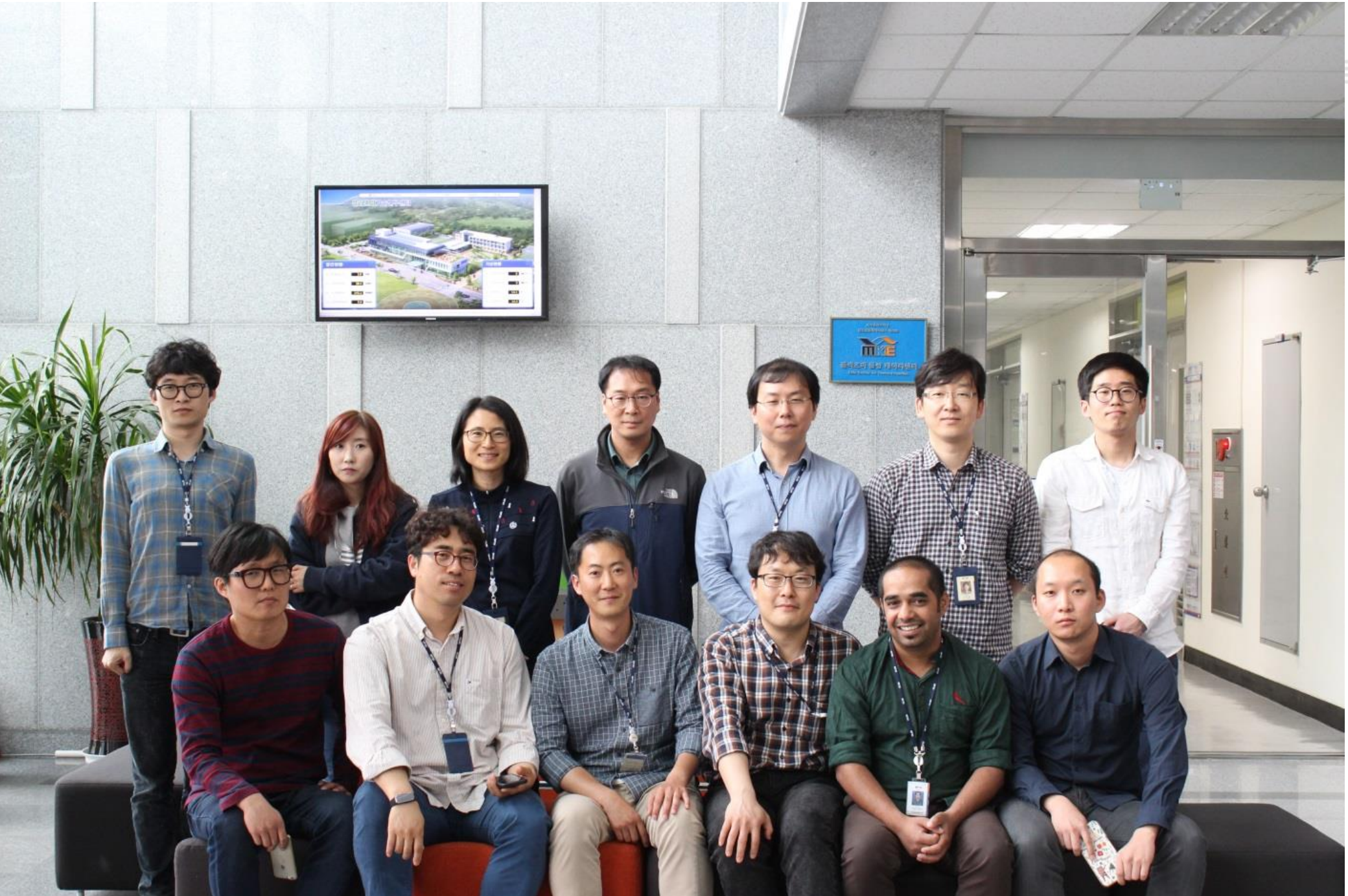






Summary and Future Plan

- **Our DCPP web database system reorganization**
  - ✓ Electron collision data : ~26,000 recodes
  - ✓ Change to user friendly system
  - ✓ Evaluated data: ~700 recodes
- **AMBDAS update. (supporting IAEA)**
  - ✓ AMBDAS Updated from 2009 to 2016.
  - ✓ Need to change the data searching method to shorten the time required.
- **Group Data Evaluation Project**
  - ✓ Completed evaluation of CH_4 and C_2H_2 molecules by operating an evaluation group
  - ✓ Find next evaluation data
    - Possible to evaluate fusion data and related molecular data
- **Data product**
  - ✓ Measurement of total scattering cross section for e – Ar, CH_4 collisions at low electron energies.
  - ✓ Calculation of total ionization cross section for e - C_xF_y collisions



Thank you very much for your attention!

DCPP 플라즈마물성데이터센터

Demonstrate of DCPP WEB

2003. **01. Plasma Properties Information System**

- with KISTI (Korea Institute of Science, Technology and Information)
- A+M DB for Industrial Plasma Applications

2006. **12. Launch of DCPP Project**

- Supported by Ministry of Knowledge Economy
- making Standard Reference Data for Low Temperature Plasmas
- making USER Network
- ISO 9001:2000 / KSA 9001:2001 (Quality Management System)

2008. **09. Construction of APAN Network**

- APAN : Asia-Pacific Atomic data Network
- Korea, Japan, Australia, India, China

2010. **05. ADAS Project Steering Committee**

- IDL – ADAS Program install & committee activity

2010. **06. Construction of Data User Network**

- 3 major Company join DUN, 30 small and medium company
- University-Industry-Institute value chain for Data Business
- 2 Technology Transfer

2011. **05. IAEA- Co-ordinated Research Project**

- Evaluation of Cross Section for Electron Impact with Hydrogen and Helium and Their Combination Molecules in Fusion Plasma

2012. **09. NFRI-IAEA-Technical Meeting**

- The Joint IAEA-NFRI Technical Meeting (TM) on Data Evaluation for Atomic, Molecular and Plasma Material Interaction Processes in Fusion

2013. **01. Organization of Evaluator group**

- Group Meeting on Procedures for Evaluation of CH4 Collision Processes

2014. **12. NFRI-IAEA-Technical Meeting**

- Decennial IAEA Technical Meeting on Atomic, Molecular and Plasma-Material Interaction Data for Fusion Science and Technology

2015. **11. IAEA Data Center Network**

- The Joint IAE Data Center Network Meeting in the world

2016. **09. ICAMDATA , ADAS WORKSHOP**

- International Conference for atomic and molecular data

Missions

1. Research of plasma Fundamental data

- Molecular structure, Physical and Chemical parameters
- Electron collision processes with Molecules
- Plasma characteristics diagnostic studies
- Surface reactions related data necessary to study the plasma process analysis
- Data evaluation

2. Development of plasma modeling and simulator

- Developing a multi-dimensional simulator for low-temperature plasma analysis
- Development of plasma fluid model based on multi-dimensional simulator for analysis equ ipment
- Development S / W for the data optimization.

3. Activities for the dissemination of data

- Date collection and dissemination
- International collaboration for data evaluation and production
- Developing user-friendly web system

Chemical properties

2012 ~2017 , 73 species

Group	Molecules	ion	EA	IP	α	L-J (σ, ε/k_B)	Thermodynamics
Noble gas	1	(2)	1	1	1	1	2
	Ex) Ar	neutral		15.76 eV	1.64 Å^3	4.66 Å, 134 K	
CxFy	52	(86)	43	52	76	13	28
(x=0~4, y=1~8)	Ex) c-C_4F_8	neutral	0.60 eV	11.79 eV	7.80 Å^3		
CxHyFz	9	(15)	9	9	14	7	15
(x=0~1, y=1~2, z=1~2)	Ex) CH_2F_2	neutral	-0.56 eV	13.04 eV	2.63 Å^3	3.70 Å, 730 K	
CxOyFz	8	(10)	3	3	3	4	10
(x=0~1, y=1~3, z=0~2)	Ex) CO_2	neutral			2.91 Å^3	3.94 Å, 195 K	
NFx	3	(3)	2	3	3	0	0
(x=0~3)	Ex) NF_3	neutral	1.39 eV	13.14 eV	2.74 Å^3	4.08 Å, 277 K	
Recodes	73	(116)	59	68	97	25	55

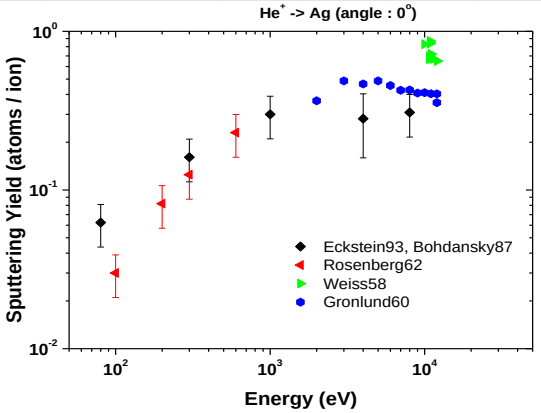
Evaluated Sputtering Yield data

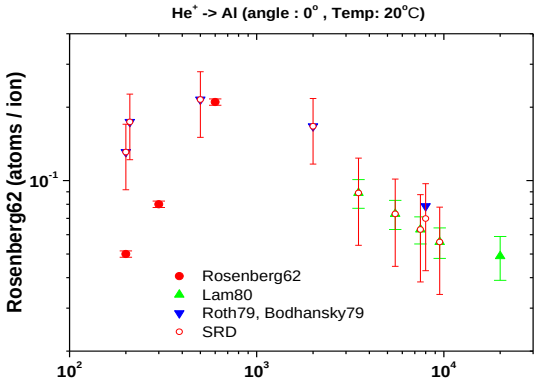
2007 ~2017 , 70species

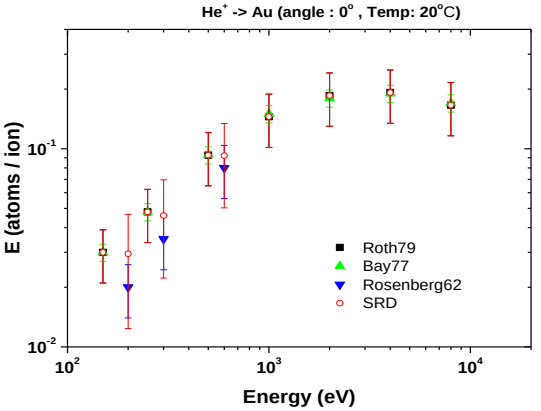
- Starting : 2016
- Sputtering yield (angle, energy)
- Projectile ion

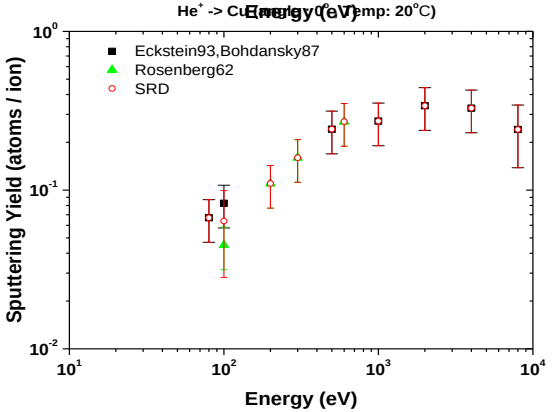
  H, He, D
- Target

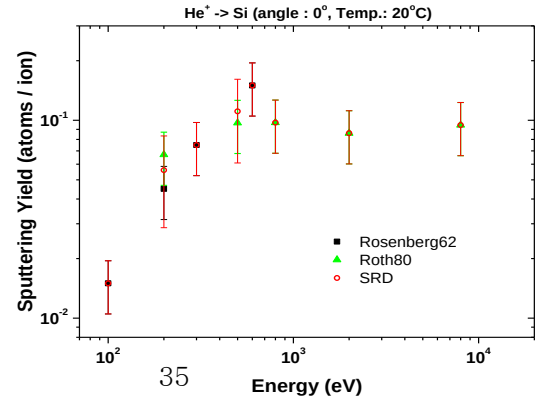
  Ag (4), Al (3), Au (6), Cu (9), Fe(5), Si(5)

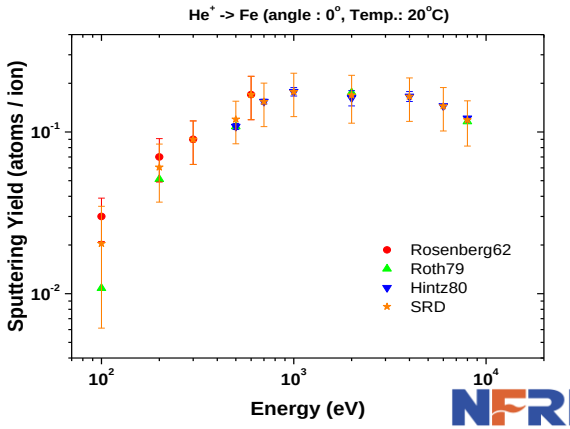






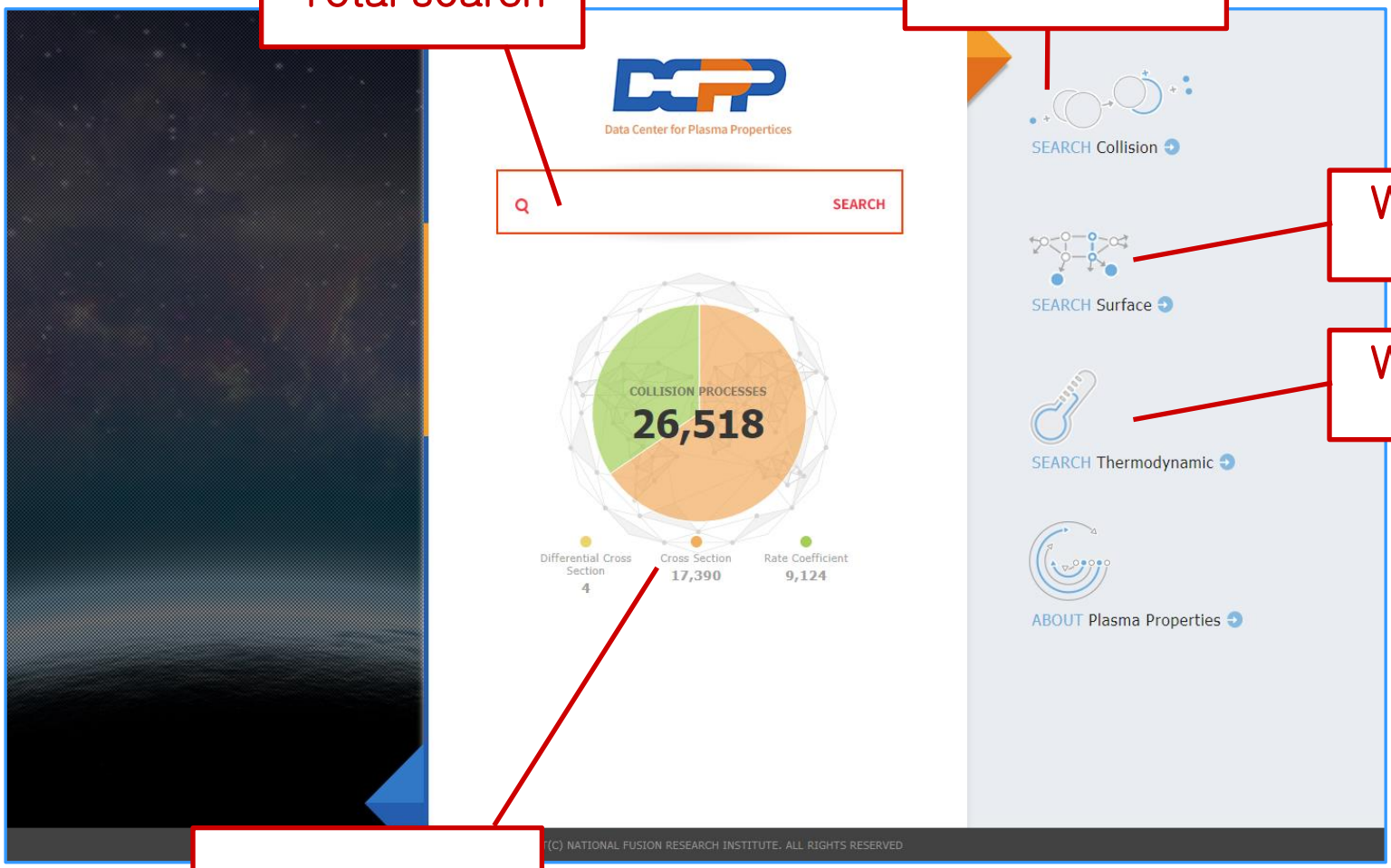




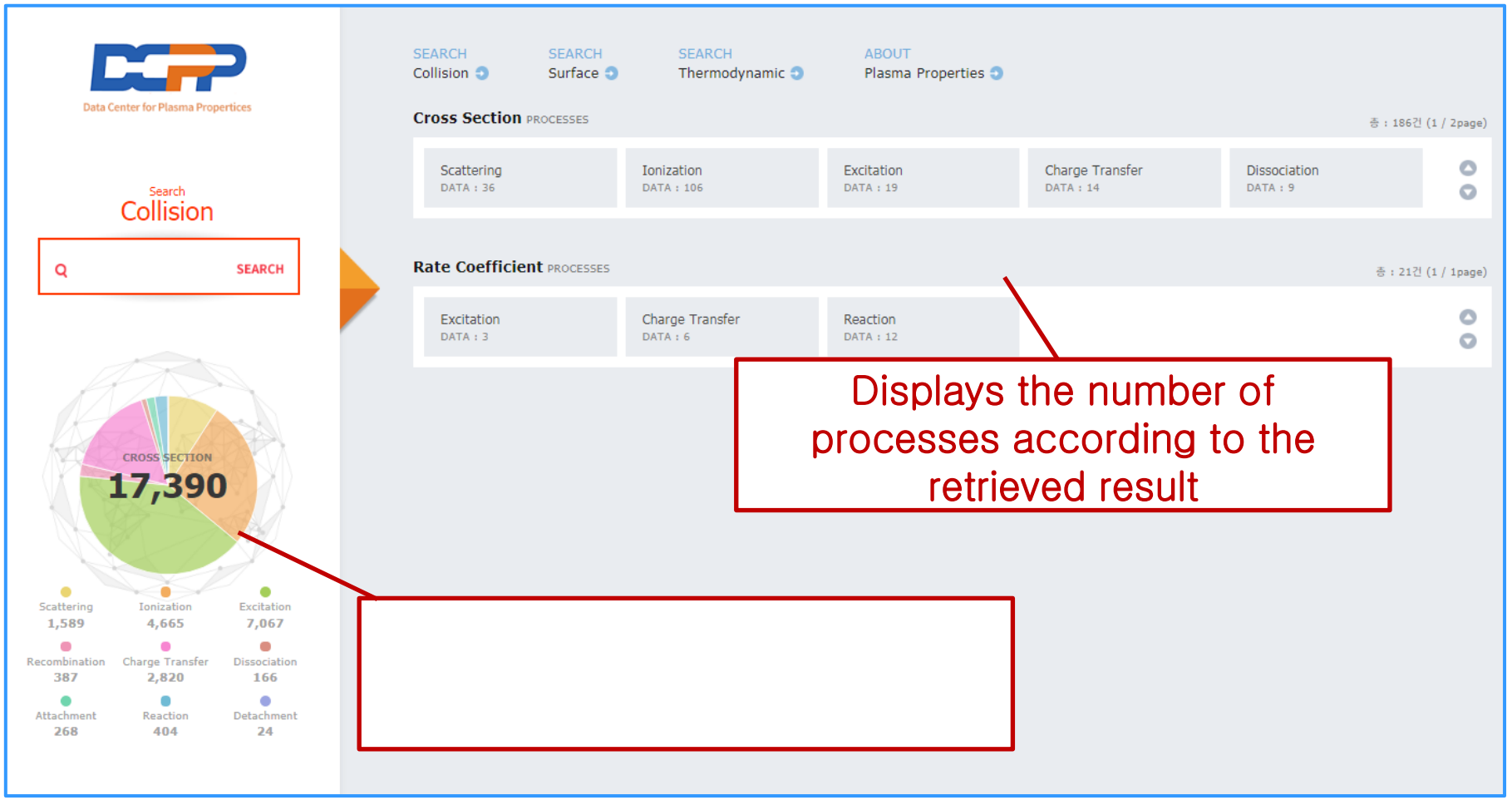


Demonstrate of DCPP WEB

New DCPP Web Database System (1)



New DCPP Web Database System (2)



New DCPP Web Database System (3)

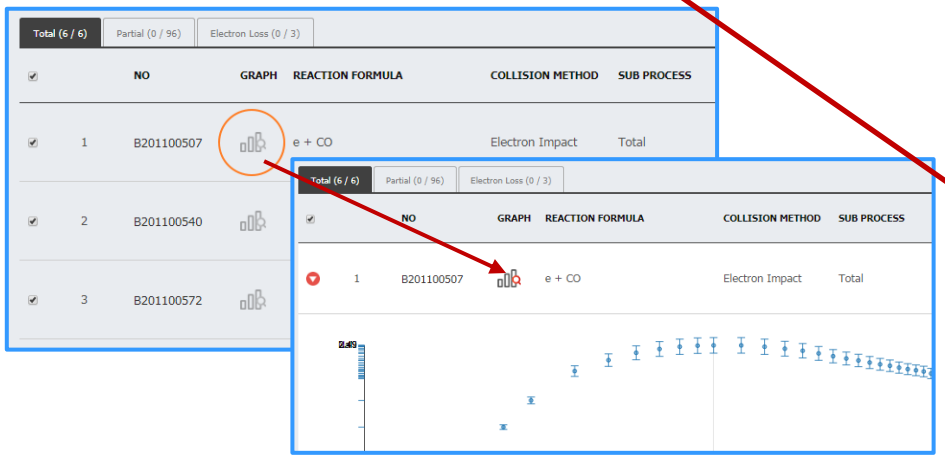
Graph showing search results

Data can be removed from selection list with just one click

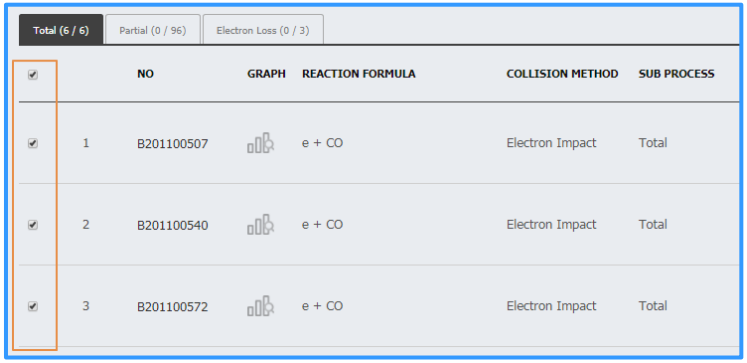
Tab-delimited list of search results

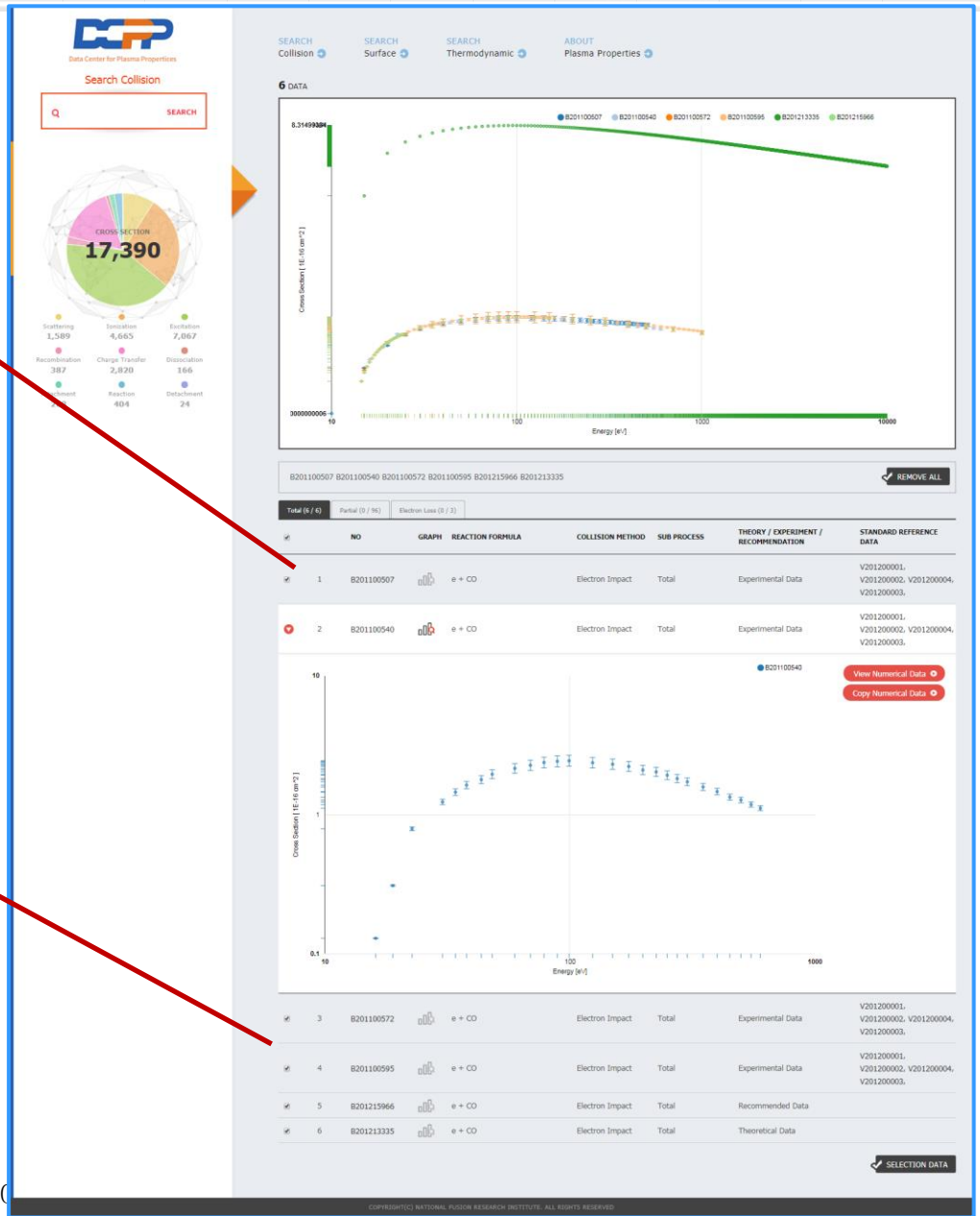
New DCPP Web Database System (4)

subgraph using wrapping method



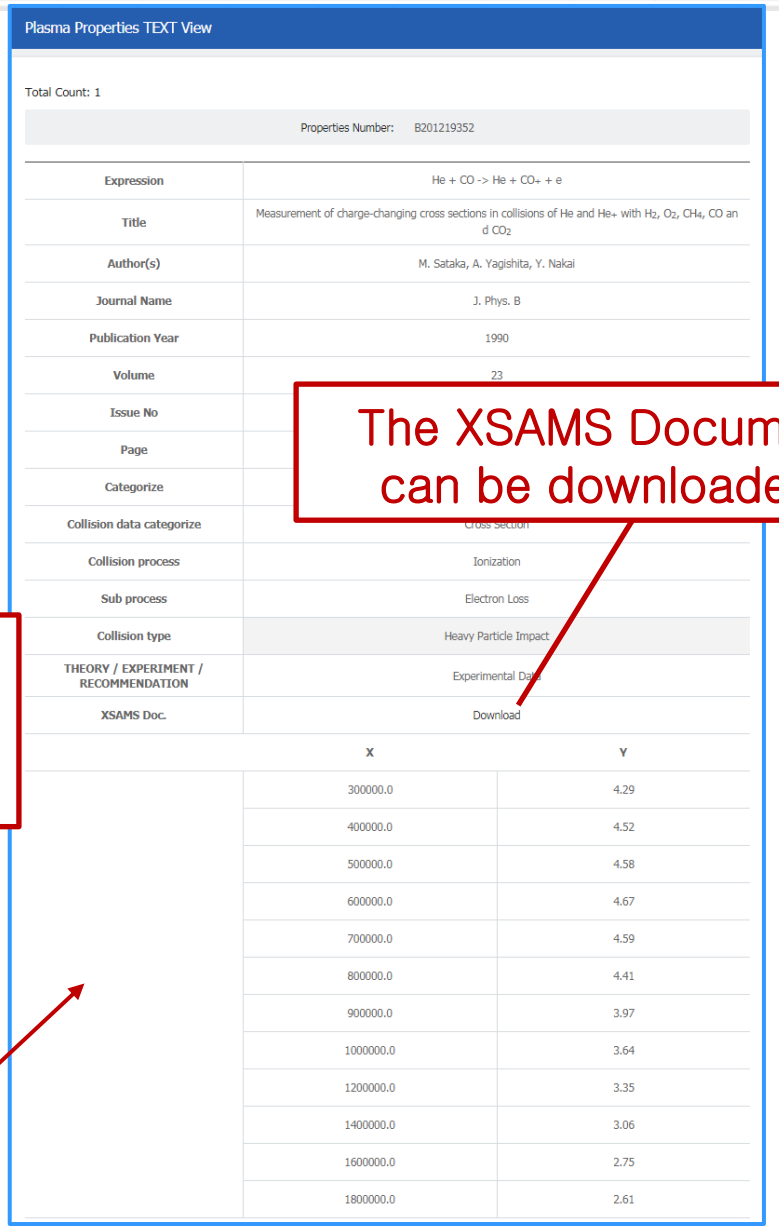
You can select all of the data and select individual data for viewing the graph.





New DCPP Web Database System (4)

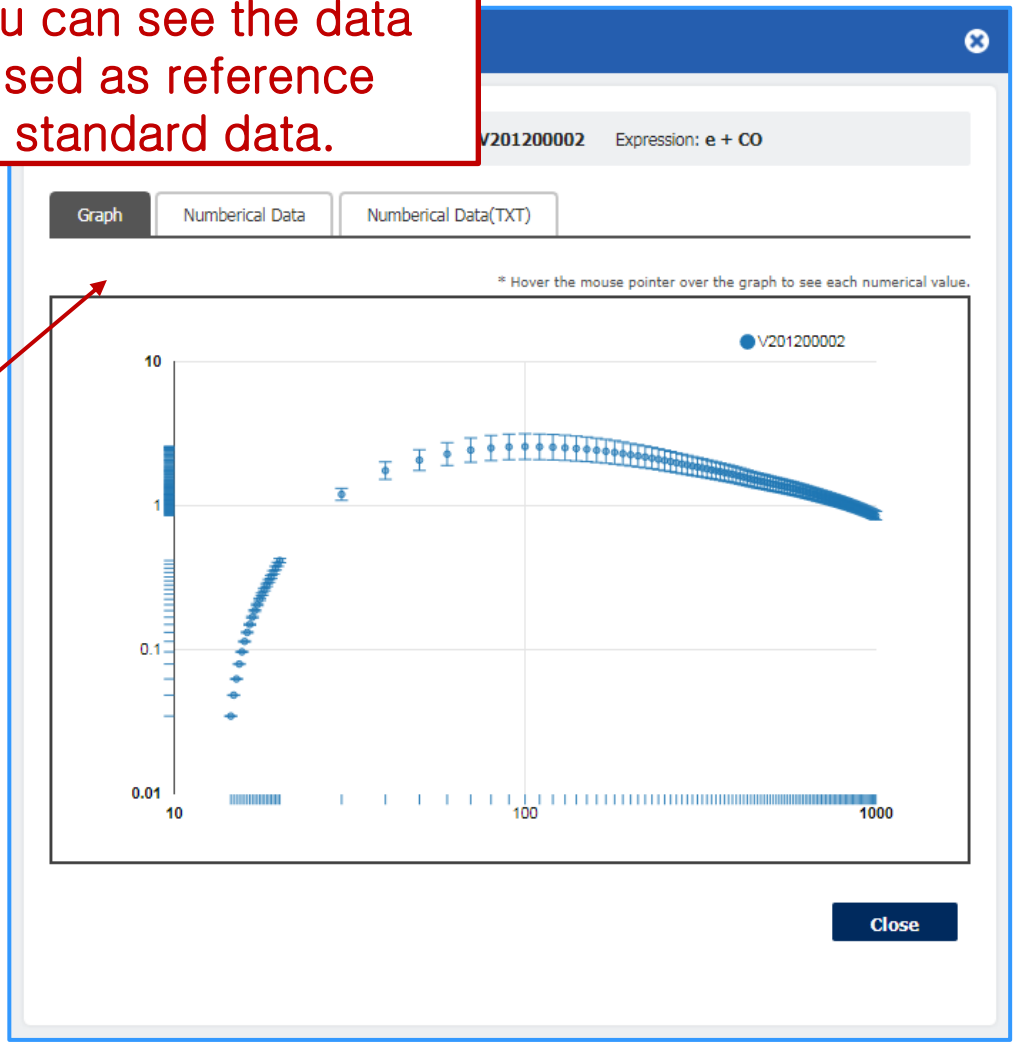
The selected data can be viewed in text form including detailed items.



The XSAMS Document can be downloaded.

New DCPP Web Database System (4)

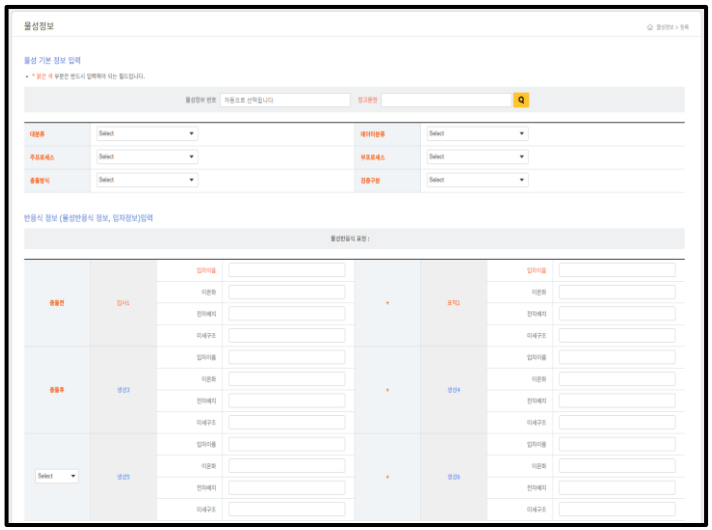
You can see the data used as reference standard data.



New DCPP Web Database System (5)

Other functions (Support for plasma properties experts)

- **Data Insert**



- **Data Evaluation**

- **Report (PDF)**