Feel free to use your laptop in my talk!

Databases for simulation of plasmas (elementary collisional data)

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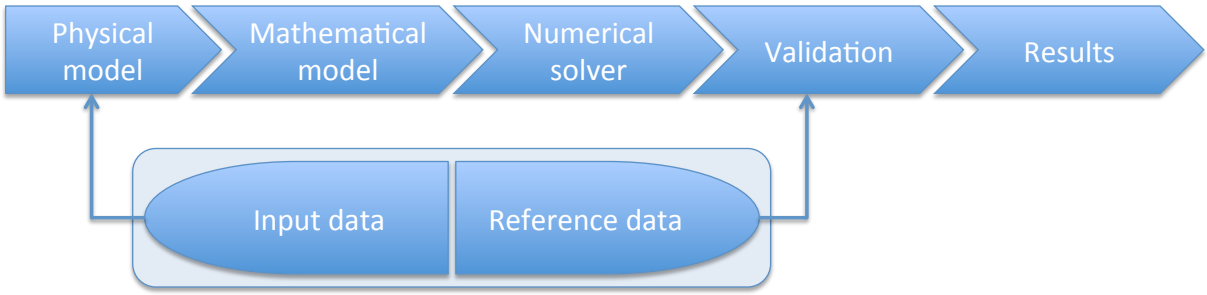
19th International Summer School on
"Low Temperature Plasma Physics: Basics and Applications"
Master Class "Plasma Kinetics"

Physikzentrum Bad Honnef (Germany), October 4-11 2014

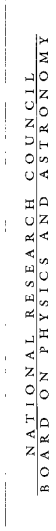
why we need data

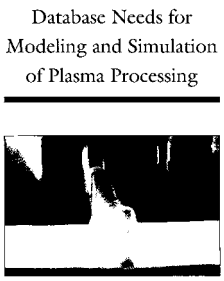


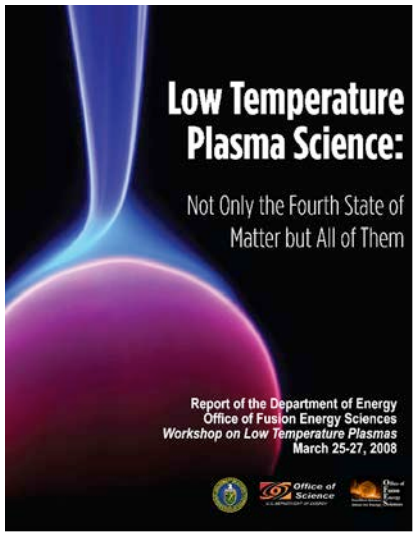
example

Required input data	Method	Reference data for validation
Scattering matrixes	Quantum calculations	Scattering cross sections
Scattering cross sections	Boltzmann solvers	Swarm/transport parameters
Swarm/transport parameters	CFD simulations	Power, densities, etc.

what data we need







- Database Needs for Modeling and Simulation of Plasma Processing, Panel on Database Needs in Plasma Processing, 1996. National Research Council, ed., Washington, D.C.: National Academy Press.
- Low Temperature Plasma Science, Report of the Department of Energy Office of Fusion Energy Sciences Workshop on Low Temperature Plasmas March 25-27, 2008.

priorities 2008

- Establish a clearinghouse for fundamental data for LTPS. A hierarchical evaluation, ranging from rough approximations to accurate and complete datasets, should be created. The data should be brought together, evaluated by experts, and made widely available by using up-to-date Web-based technologies.
- Create and support a standing body to identify needs, set priorities, and validate fundamental data in LTPS.
- Develop new approximate methods, scaling laws, and empirical formulas that can be used to quickly estimate unknown data.
- Via computation, provide fundamental data for large molecules, clusters, nanoparticles, and interactions with surfaces. This effort would link closely with developments in other fields, such as quantum chemistry, atomic, molecular, and optical physics, and surface physics, and utilize such powerful techniques as molecular dynamics simulation, quantum chemical codes, atomic structure techniques, and emerging high accuracy atomic and molecular scattering codes.
- A program of experimental measurements needs to be revitalized. New and existing laboratories and techniques should be used to measure key systems, providing key tests of theoretical and approximation method results, and to probe unique or complex situations not approachable with even the most powerful computational methods.

www.lxcat.net

LXCAT (PRONOUNCED "ELECSCAT")

Plasma Data Exchange Project

- The Plasma Data Exchange Project is a community-based project which was initiated as a result of a public discussion held at the 2010 Gaseous Electronics Conference (GEC), a leading international meeting for the Low-Temperature Plasma community.

- This project aims to address, at least in part, the well-recognized needs for the community to organize the means of collecting, evaluating and sharing data both for modeling and for interpretation of experiments.

LXCat project

- At the heart of the Plasma Data Exchange Project is LXcat (pronounced "elecscat"), an open-access website for collecting, displaying and downloading data required for modeling low temperature plasmas.

- This is a dynamic website, evolving as contributors add or upgrade data. Check back again frequently.

LXCAT: contributors (Sep. 2014)

- BSR (quantum-mechanical calculations by O Zatsarinny and K Bartschat)
- BIAGI (compilation of electron cross sections used by S F Biagi)
- BORDAGE (Compilation of electron cross sections used by M-C Bordage)
- BRAY
- DUTTON
- FLINDERS
- HAYASHI
- IST-LISBON
- ITIKAWA
- LAPLACE (Review of measurements after 1975)
- MORGAN (Kinema Research & Software)
- NGFSRDW
- PHELPS
- PUECH
- QUANTEMOL
- SIGLO
- TRINITI
- URQUIJO (compilation of De Urquijo)
- VIEHLAND
- UBC

New contributors are welcome!

LXCAT: electrons

Complete sets of cross sections for electron scattering from ground state neutral atoms and molecules.

The energy range of interest is from 0 to some 100's of eV and higher. A complete set of cross sections consists of elastic momentum transfer, and total cross sections for the processes of ionization, attachment and excitation. Complete sets of cross sections are needed as input to a Boltzmann equation solver to determine the electron or ion energy distribution function.

Partial sets of electron-neutral scattering cross sections.

Partial sets of electron neutral scattering cross sections are also included on this site. These include additional data concerning electron collisions with ground state molecules - such as total scattering, total elastic scattering - not used in the Boltzmann calculations. These also include cross sections for electron impact ionization of metastable or radicals, needed for the calculation of stepwise ionization, for example.

Differential scattering cross sections.

Measured electron swarm & transport data.

Swarm data consist of electron transport and rate coefficients as functions of reduced electric field strength, E/N, the ratio of the electric field to the neutral density. At present, we have excluded swarm data measured in the presence of magnetic fields, where a large body of data exist. This may be included in the future if users are interested.

LXCAT: ions

Ion-neutral interaction potentials.

Ion neutral interaction potentials can be used to calculate differential cross sections for ion-neutral scattering.

Ion-neutral scattering cross sections.

The limited ion-neutral cross section data available on this site were derived assuming that the differential scattering can be reasonably well approximated as the sum of an isotropic part and a backscatter part. These two components are provided as functions of the center or mass energy.

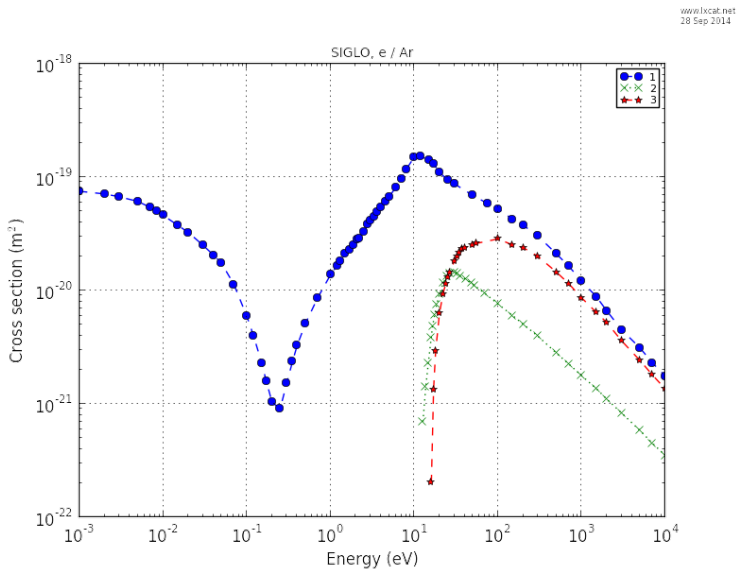
Measured ion swarm & transport data.

Swarm data consist of ion transport and rate coefficients as functions of reduced electric field strength, E/N, the ratio of the electric field to the neutral density. At present, we have excluded swarm data measured in the presence of magnetic fields, where a large body of data exist. This may be included in the future if users are interested.

LXCAT: photons

Databases containing oscillator strengths

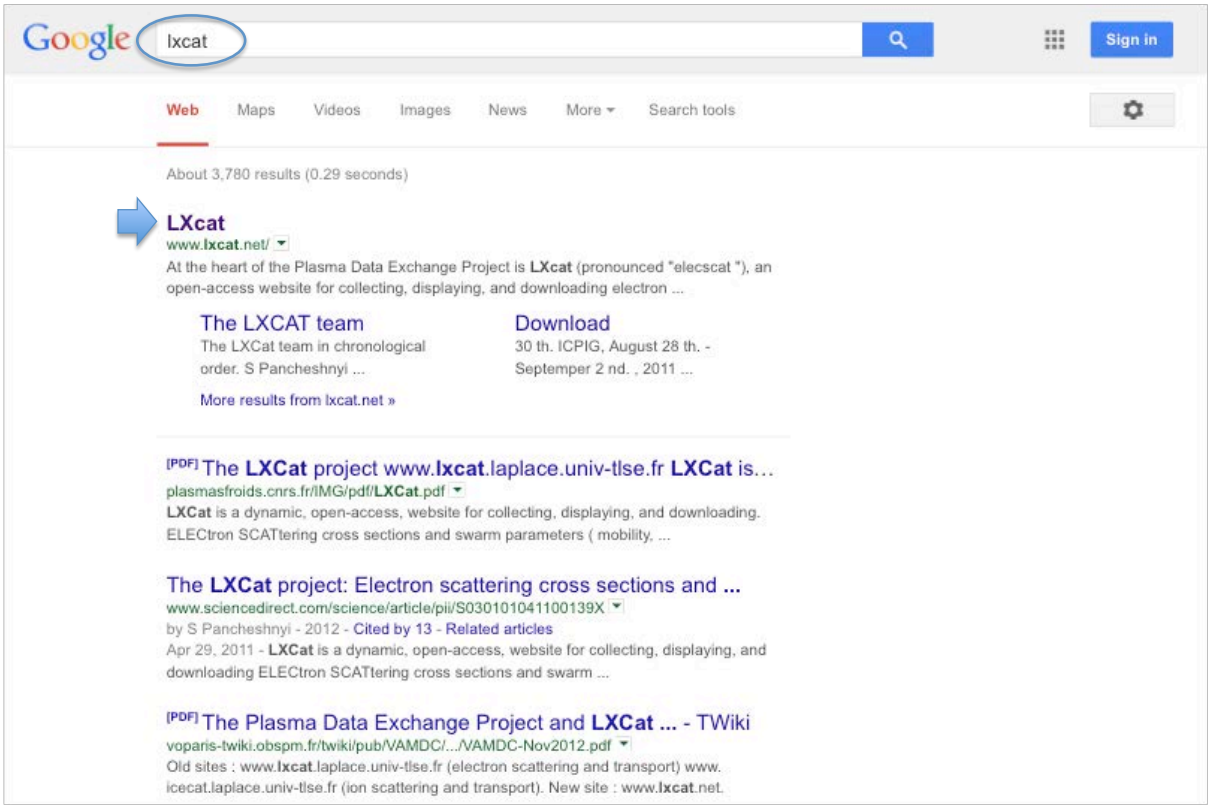
Oscillator strength is a quantity that expresses the probability of absorption or emission of electromagnetic radiation in transitions between energy levels of an atom or molecule. These data, combined with a suitable model such as BEF scaling (Y-K Kim, Phys Rev A, 2001), can be used to infer the energy dependence and magnitude of electron-neutral scattering cross sections for specific processes for energies greater than several times the threshold energy.



LXCAT step-by-step example

Retrieving scattering cross sections

See MC 01 Stephen Bruckman, Electron-scattering cross-sections: measurements & calculations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At the heart of the Plasma Data Exchange Project is LXcat (pronounced "elecscat "), an open-access website for collecting, displaying, and downloading electron ...
The LXCAT team
The LXCat team in chronological order. S Pancheshnyi ...
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The LXCat project: Electron scattering cross sections and ...
www.sciencedirect.com/science/article/pii/S030101041100139X
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[PDF] The Plasma Data Exchange Project and LXCat ... - TWiki
voparis-twiki.obspm.fr/twiki/pub/VAMDC/.../VAMDC-Nov2012.pdf
Old sites : www.lxcat.laplace.univ-tlse.fr (electron scattering and transport) www.icecat.laplace.univ-tlse.fr (ion scattering and transport). New site : www.lxcat.net.


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About the project
The Plasma Data Exchange Project is a community-based project which was initiated as a result of a public discussion held at the 2010 Gaseous Electronics Conference (GEC), a leading international meeting for the Low-Temperature Plasma community. This project aims to address, at least in part, the well-recognized needs for the community to organize the means of collecting, evaluating and sharing data both for modeling and for interpretation of experiments.
At the heart of the Plasma Data Exchange Project is LXcat (pronounced "elecscat"), an open-access website for collecting, displaying, and downloading electron and ion scattering cross sections, swarm parameters (mobility, diffusion coefficient, etc.), reaction rates, energy distribution functions, etc. and other data required for modeling low temperature plasmas. The available data bases have been contributed by members of the community and are indicated by the contributor's chosen title.
This is a dynamic website, evolving as contributors add or upgrade data. Check back again frequently.
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NEXT »
PROJECT STATISTICS
Scattering cross sections: 19 databases I 4 x 162 species I 3.2k records I updated: 25 August 2014
Differential scattering cross sections: 1 database I 1 species I 31 records I updated: 7 November 2013
Interaction potentials: 1 database I 56 x 8 species I 567 records I updated: 23 September 2014
Oscillator strengths: 1 database I 65 species I 150 records I updated: 25 November 2013
Swarm / transport data: 8 databases I 264 x 60 species I 129.8k records I updated: 23 September 2014
Publications, notes and reports: 3 databases I 23 records I updated: 25 August 2013
Supporting organizations
Laplace
cnrs
Plasmas Froids
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Curtin
University of Technology
CERN
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Drake
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Quantemol
Institute of Space and Astronautical Science
YORK
ABB
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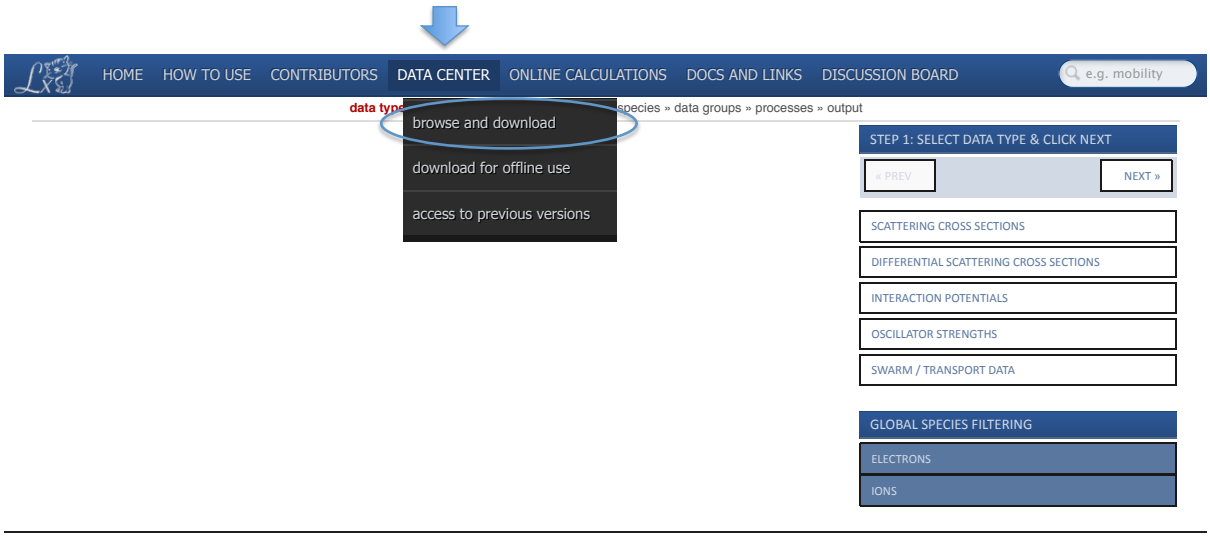
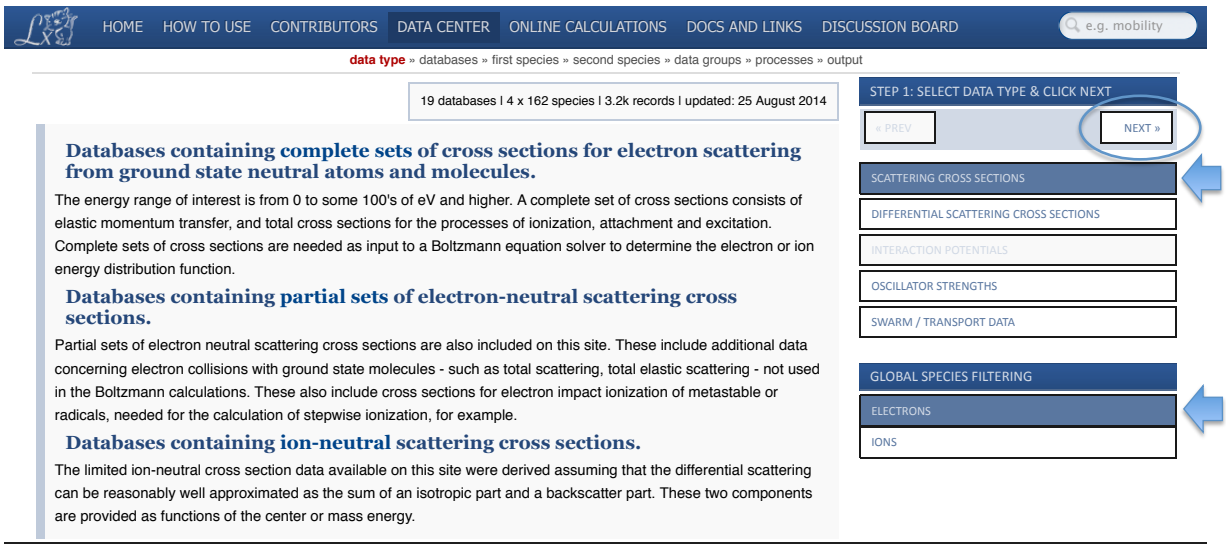
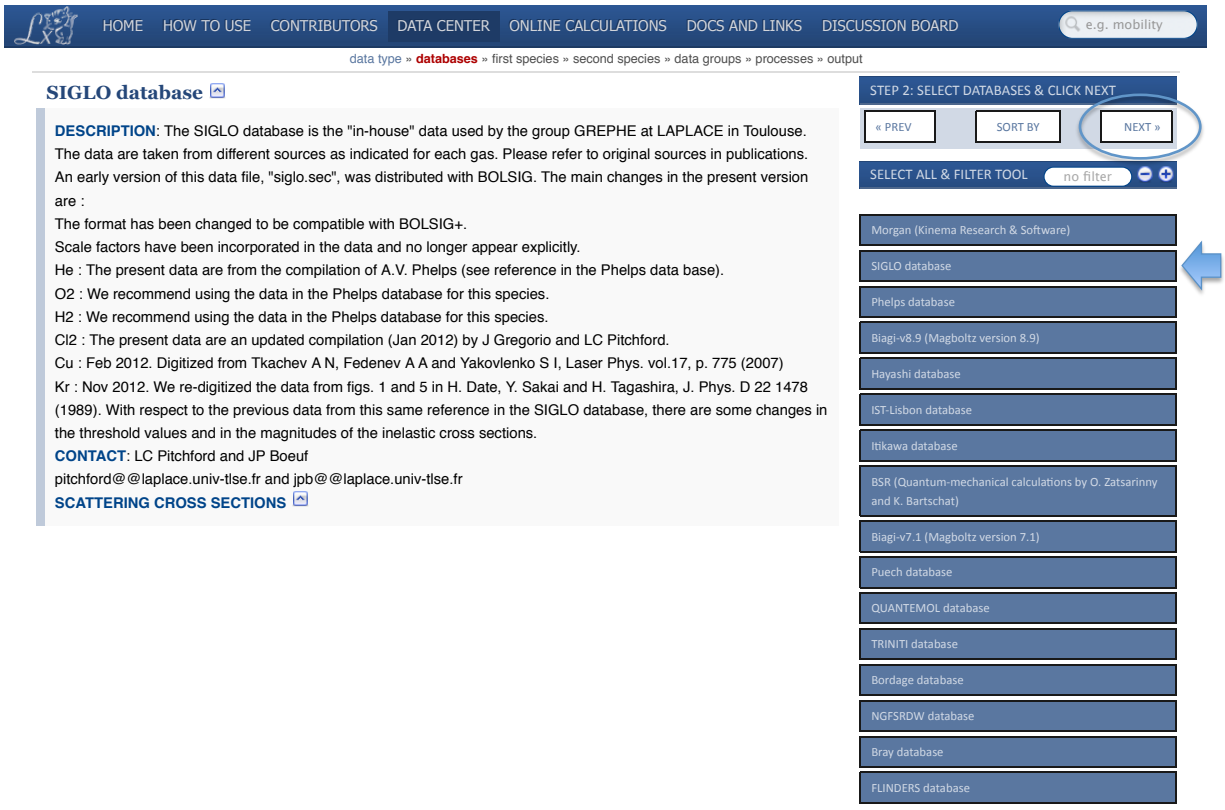
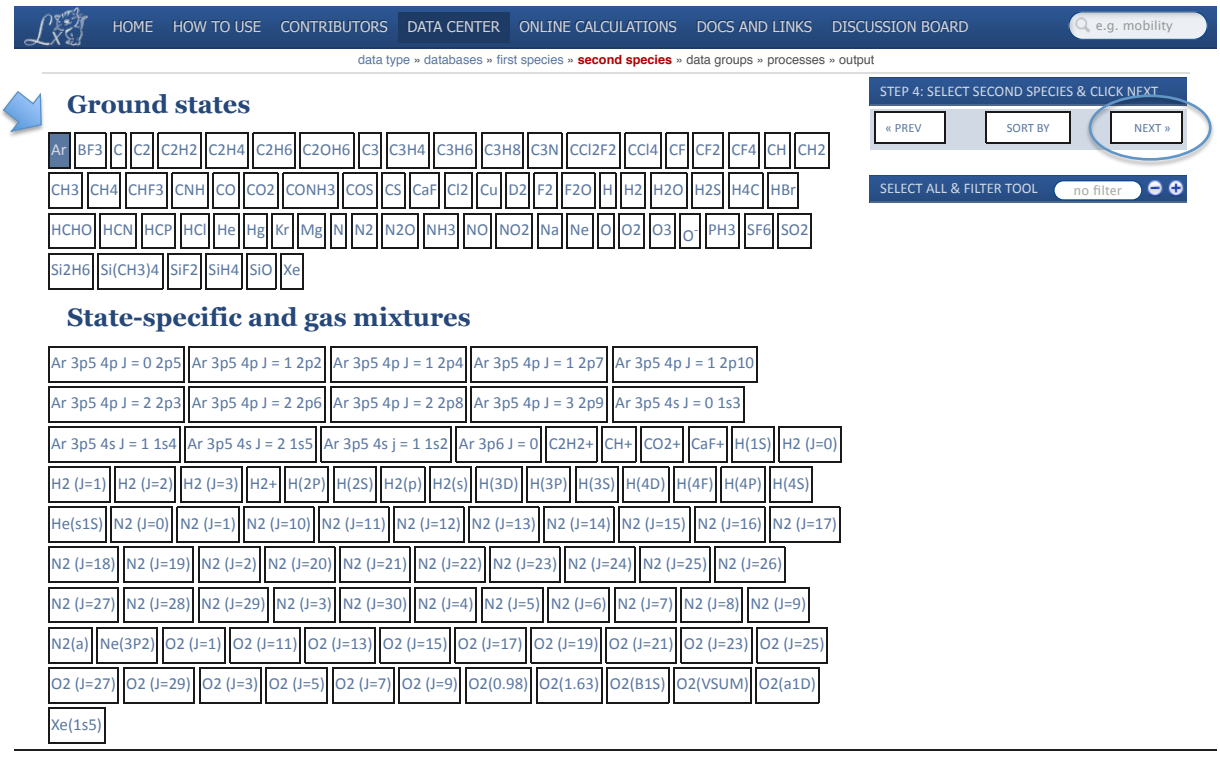
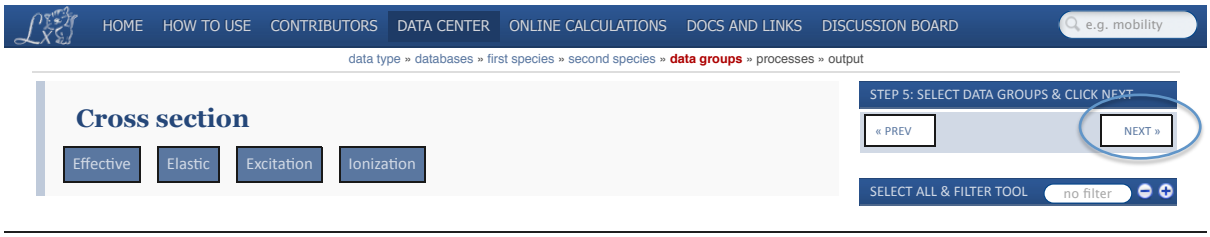
STAE
TOULOUSE

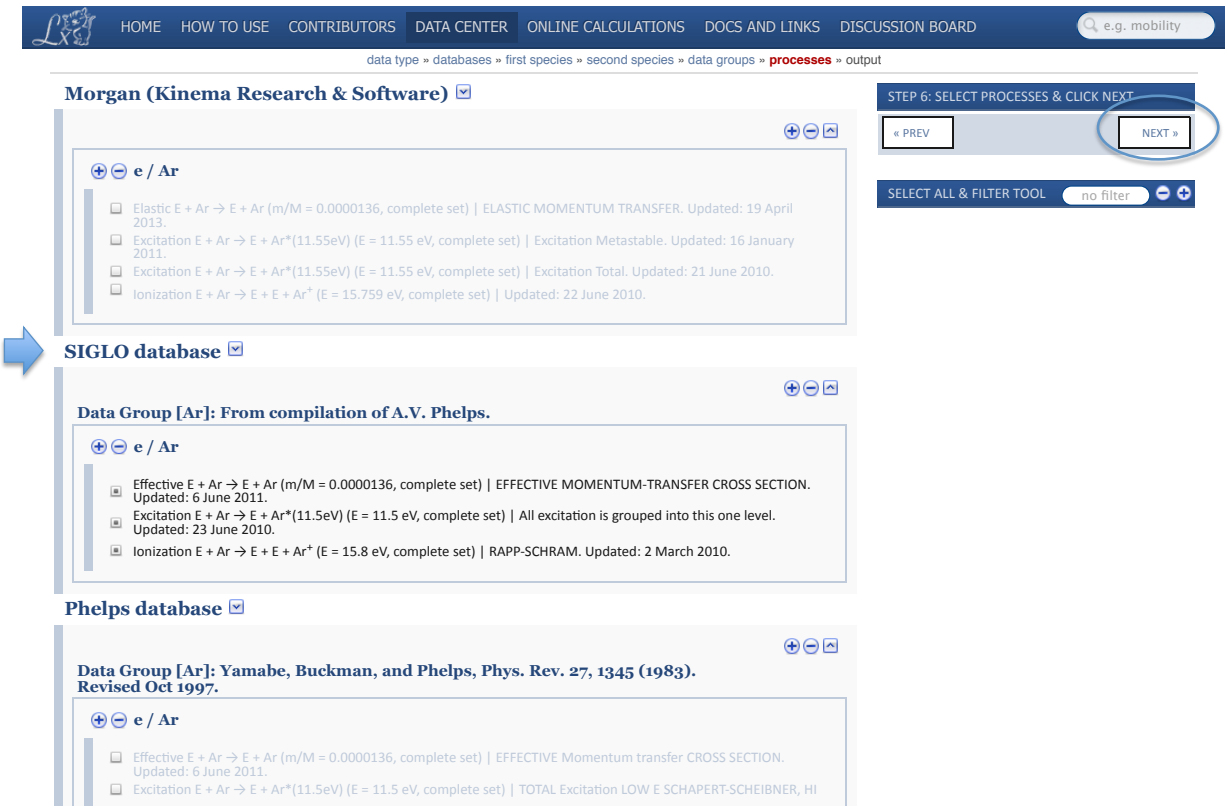












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USERS MUST AGREE TO THE TERMS OF USE TO ACCESS DATA (BROWSE AND DOWNLOAD)

YES, I have read and understood »

Terms of use

Users acknowledge understanding that LXCAT is a community-based project with open-access databases being freely provided by individual contributors.

Proper referencing of material retrieved from this site is essential for the survival of the project.

Users further accept that the databases on this site remain property of their respective contributors and are not to be distributed by third parties or used for commercial purposes. All questions regarding copyright should be addressed to the LXCAT team.

How to reference data

Use of the data from this site in publications should be accompanied by proper references. Original references should be used where possible and reference should be made to the specific database(s) from which data were retrieved, the LXCat site address, and the retrieved date. Example:

> **Biagi-v8.9** database, www.lxcat.net, retrieved on September 28, 2014.

How to reference on-line calculations

Swarm coefficient calculated on this site should make reference to both the cross section data in the above format and to BOLSIG+, the Boltzmann solver used in the calculations:

> **G.J.M. Hagelaar** and **L.C. Pitchford**, "Solving the Boltzmann equation to obtain electron transport coefficients and rate coefficients for fluid models", Plasma Sci Sources and Tech 14, 722 (2005).

How to reference text documents

Publications and conference proceedings should be referenced according to journal specifications. All unpublished material on this site should be referenced as **"private communication"** with the date given on the document, the author's name, date, and the retrieved date. Example:

> **Morgan** database, private communication, www.lxcat.net, retrieved on September 28, 2014.

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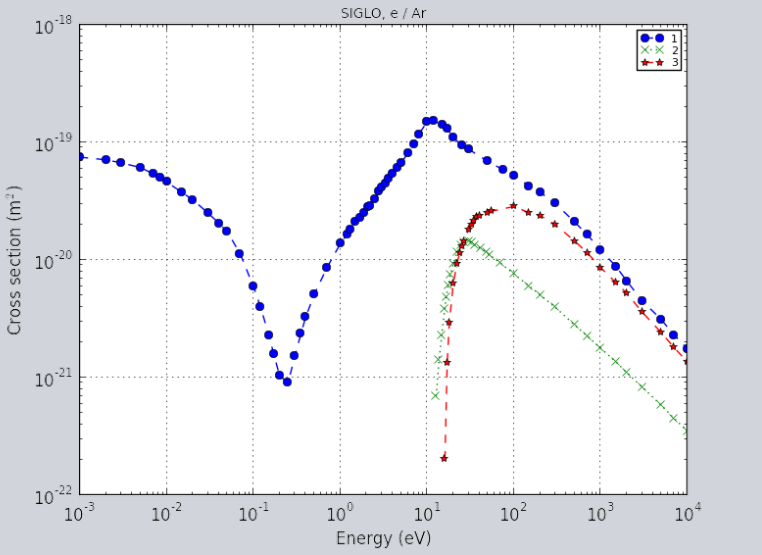
data type » databases » first species » second species » data groups » processes » **output**

Cross section

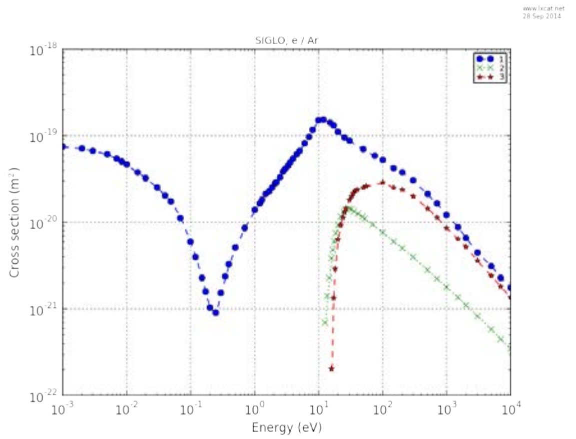
GO BACK | KEEP WINDOW AND GO BACK | RESCALE IN NEW WINDOW | DOWNLOAD IMAGE | DOWNLOAD DATA

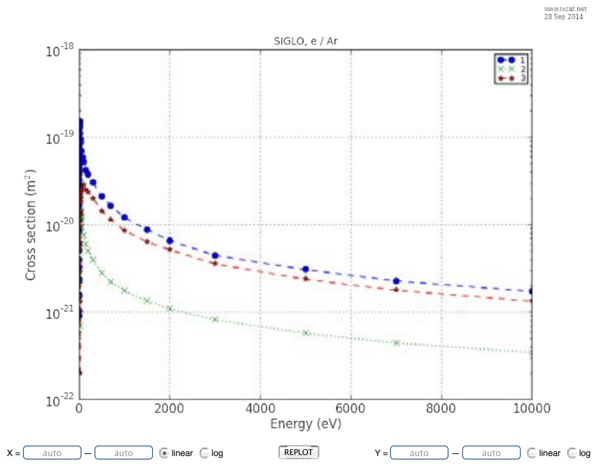


SIGLO database

Data Group [Ar]
e / Ar

1. Effective E + Ar → E + Ar (m/M = 0.0000136, complete set) | EFFECTIVE MOMENTUM-TRANSFER CROSS SECTION. Updated: 6 June 2011.
2. Excitation E + Ar → E + Ar*(11.5eV) (E = 11.5 eV, complete set) | All excitation is grouped into this one level. Updated: 23 June 2010.
3. Ionization E + Ar → E + E + Ar^+ (E = 15.8 eV, complete set) | RAPP-SCHRAM. Updated: 2 March 2010.



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LXCat, www.lxcat.net
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RECOMMENDED REFERENCE FORMAT
- SIGLO database, www.lxcat.net, retrieved on September 28, 2014.

CROSS SECTION DATA FORMAT
In downloaded files, each collision process is defined by a block consisting of
1st line
Keyword in capitals indicating the type of the collision. Possible collision types are elastic, effective, excitation,
ionization, or attachment (capital letters required, key words are case sensitive), where "elastic" is used to denote
the elastic momentum transfer cross section and where "effective" denotes the total momentum transfer cross section (sum
of elastic momentum transfer and total inelastic cross sections).  The latter is useful for solving the Boltzmann
equation in the 2-term approximation.
2nd line
Name of the target particle species. This name is a character string, freely chosen by the user, e.g. "Ar". Optionally
for excitation processes, the name of the corresponding excited state can be specified on the same line, separated from
the first name either by arrow "->" (dash + greater than) or by double-head arrow "<->" (less than + dash +
greater than), e.g. "Ar -> Ar*" and "Ar <-> Ar*", respectively. In the later case BOLSIG+ will automatically
define the inverse superelastic process, constructing the superelastic cross-section by detailed balancing, and
considering the indicated excited state as the target. In this case, the ratio of statistical weights must be input in
the 3rd line (see below).  Alternatively, superelastic collisions could be defined explicitly as excitation collisions
with a negative electron energy loss with user input cross sections and species name, "Ar*", for example.
3rd line
For elastic and effective collisions, the ratio of the electron mass to the target particle mass. For excitation or
ionization collisions, the electron energy loss (nominally the threshold energy) in eV. For attachment, the 3rd line is
missing. In case of an excitation process where an excited state has been indicated on the 2nd line using double-head
arrow "<->", the 3rd line must specify also ratio of the statistical weights of the final state to the initial state
as the second parameter in 3rd line this is needed by BOLSIG+ to calculate the de-excitation cross-section.
from 4th line (optionally)
User comments and reference information, maximum 100 lines. The only constraint on format is that these comment lines
must not start with a number.
Finally
Table of the cross section as a function of energy. The table starts and ends by a line of dashes "------" (at least 5),
and has otherwise two numbers per line: the energy in eV and the cross section in m2.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
DATABASE:         SIGLO database
DESCRIPTION:      The SIGLO database is the "in-house" data  used by the group GREPHE at LAPLACE in Toulouse. The data
                  are taken from different sources as indicated for each gas. Please refer to original sources in
                  publications.
                  An early version of this data file, "siglo.sec", was distributed with BOLSIG.  The main changes in the
                  present version are :
                  The format has been changed to be compatible with BOLSIG+.
                  Scale factors have been incorporated in the data and no longer appear explicitly.
                  He : The present data are from the compilation of A.V. Phelps (see reference in the Phelps data
                  base).
                  O2 : We recommend using the data in the Phelps database for this species.
                  H2 : We recommend using the data in the Phelps database for this species.
                  Cl2 : The present data are an updated compilation (Jan 2012) by J Gregorio and LC Pitchford.
                  Cu : Feb 2012. Digitized from Tkachev A N, Fedenev A A and Yakovlenko S I, Laser Phys. vol.17, p. 775
                  (2007)
                  Kr :  Nov 2012.  We re-digitized the data from figs. 1 and 5 in H. Date, Y. Sakai and H. Tagashira, J.
                  Phys. D 22 1478 (1989).  With respect to the previous data from this same reference in the SIGLO
                  database, there are some changes in the threshold values and in the magnitudes of the inelastic cross
                  sections.
CONTACT:          LC Pitchford and JP Boeuf
                  pitchford@@laplace.univ-tlse.fr and jpb@@laplace.univ-tlse.fr
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

****************************************************************************************************************

COMMENT: From compilation of A.V. Phelps.

EFFECTIVE
Ar
 1.360000e-5
SPECIES: e / Ar
PROCESS: E + Ar -> E + Ar, Effective
PARAM.:  m/M = 0.0000136, complete set
COMMENT: EFFECTIVE MOMENTUM-TRANSFER CROSS SECTION.
UPDATED: 2011-06-06 18:21:14
COLUMNS: Energy (eV) | Cross section (m2)
-----------------------------
 0.000000e+0    7.500000e-20
 1.000000e-3    7.500000e-20
 2.000000e-3    7.100000e-20
 3.000000e-3    6.700000e-20
 5.000000e-3    6.100000e-20
 7.000000e-3    5.400000e-20
 8.500000e-3    5.050000e-20
 1.000000e-2    4.600000e-20
 1.500000e-2    3.750000e-20
 2.000000e-2    3.250000e-20
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 4.000000e-2    2.050000e-20
 5.000000e-2    1.730000e-20
 7.000000e-2    1.130000e-20
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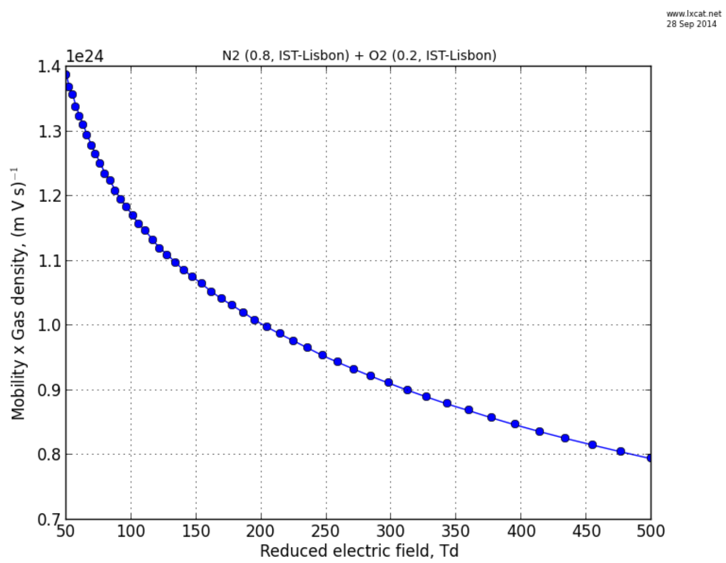
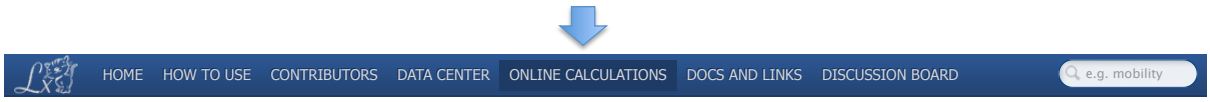


LXCAT step-by-step example

Online calculated electron swarm parameters



Online calculation of electron swarm parameters with BOLSIG+

Swarm parameters are calculated here using BOLSIG+ solver for the numerical solution of the Boltzmann equation for electrons in weakly ionized gases in uniform electric fields, conditions which typically appear in the bulk of collisional low-temperature plasmas. It has been developed by Gerjan Hagelaar (LAPLACE, France). Click to visit the homepage of BOLSIG+ or to start on-line calculations »

RESET | UPDATE LIST OF SPECIES

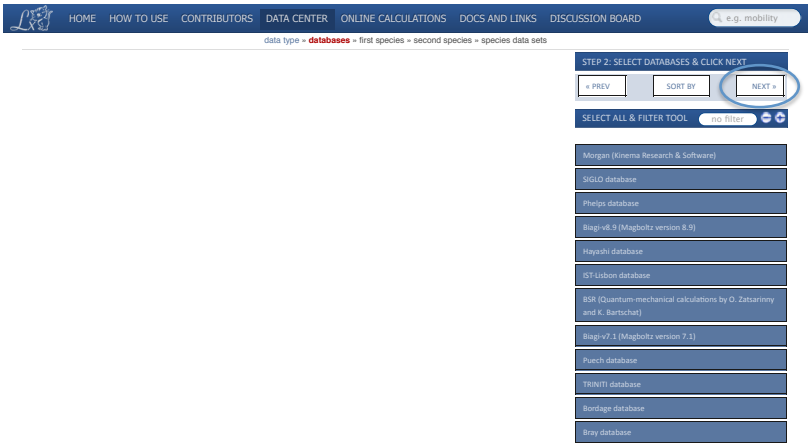
About the solver

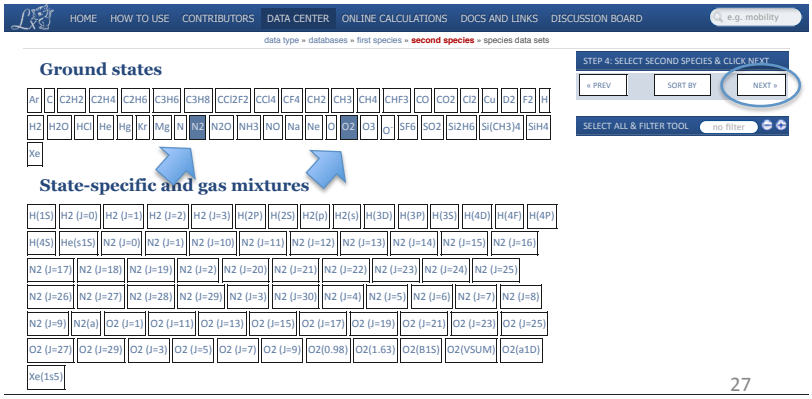
Swarm parameters are calculated here using BOLSIG+ (ver. 1.2) solver for the numerical solution of the Boltzmann equation for electrons in weakly ionized gases in uniform electric fields, conditions which typically appear in the bulk of collisional low-temperature plasmas. It has been developed by Gerjan Hagelaar (LAPLACE, France).
Note that BOLSIG+ makes use of the classical "2-term approximation". Some of the data sets on this site were developed for use with Monte Carlo or "multiterm" Boltzmann solvers and errors may be introduced by the 2-term approximation used in BOLSIG+. We have tried to indicate when this could be of concern. Please consult BOLSIG+ for the details and to download the complete freeware application for Windows.
Users of this site are kindly requested to reference to BOLSIG+ and the appropriate cross section databases in all publications making use of data from this site.

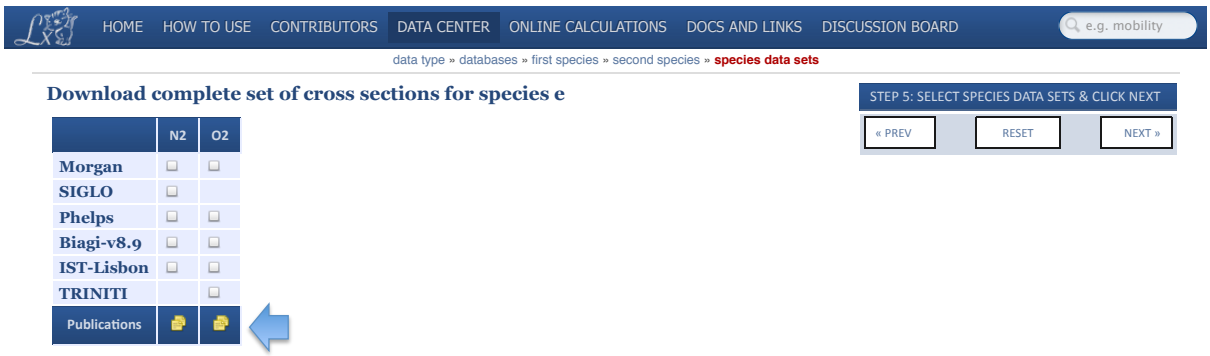
CONFIG

This menu will be activated after you update the list of species. Click to continue »

The online version of BOLSIG+ has limited functionality. Use the full version (www.bolsig.laplace.univ-tlse.fr) for more complex cases.

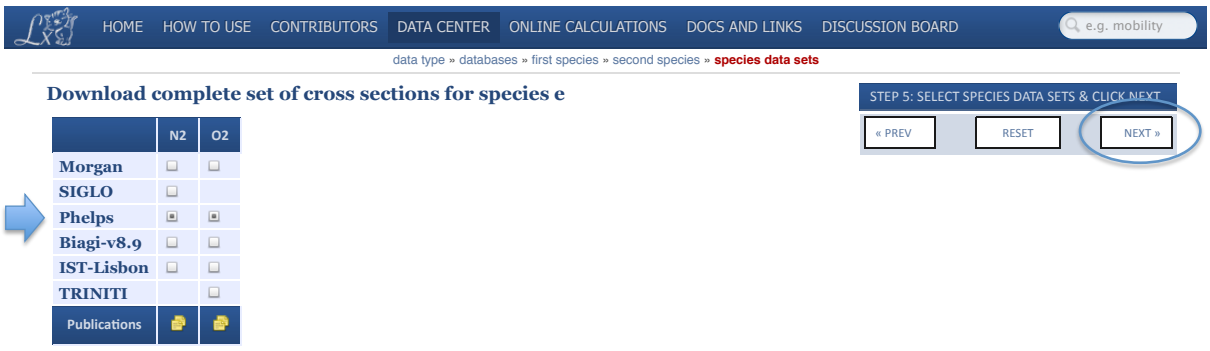


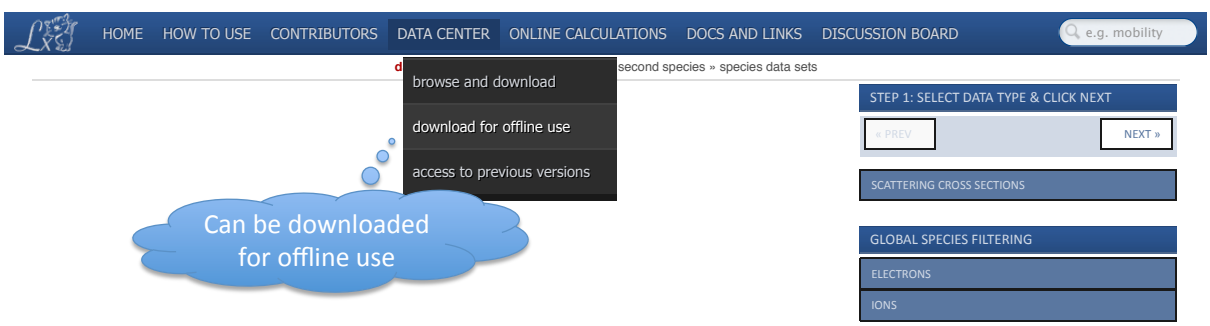




A complete set of cross sections consists of elastic momentum transfer, and total cross sections for the processes of ionization, attachment and excitation.

Complete sets of cross sections are needed as input to a Boltzmann equation solver to determine the electron or ion energy distribution function.





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RESET UPDATE LIST OF SPECIES RUN CALCULATIONS »

About the solver

Swarm parameters are calculated here using BOLSIG+ (ver. 1.2) solver for the numerical solution of the Boltzmann equation for electrons in weakly ionized gases in uniform electric fields, conditions which typically appear in the bulk of collisional low-temperature plasmas. It has been developed by Gerjan Hagelaar (LAPLACE, France).
Note that BOLSIG+ makes use of the classical "2-term approximation". Some of the data sets on this site were developed for use with Monte Carlo or "multiterm" Boltzmann solvers and errors may be introduced by the 2-term approximation used in BOLSIG+. We have tried to indicate when this could be of concern. Please consult BOLSIG+ for the details and to download the complete freeware application for Windows.
Users of this site are kindly requested to reference to BOLSIG+ and the appropriate cross section databases in all publications making use of data from this site.

CONFIG
non-Maxwellian EEDF | Maxwellian EEDF
E/N = 0.1 - 1000 Td
Te = 0.03 - 10 eV
T_{gas} = 300 K # points = 25

SPECIES MOLE FRACTIONS
N2 = 0.80
O2 = 0.20

BROWSE
Electron cross sections (new window)

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Cross section input file

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About the solver

Swarm parameters are calculated here using BOLSIG+ (ver. 1.2) solver for the numerical solution of the Boltzmann equation for electrons in weakly ionized gases in uniform electric fields, conditions which typically appear in the bulk of collisional low-temperature plasmas. It has been developed by Gerjan Hagelaar (LAPLACE, France).
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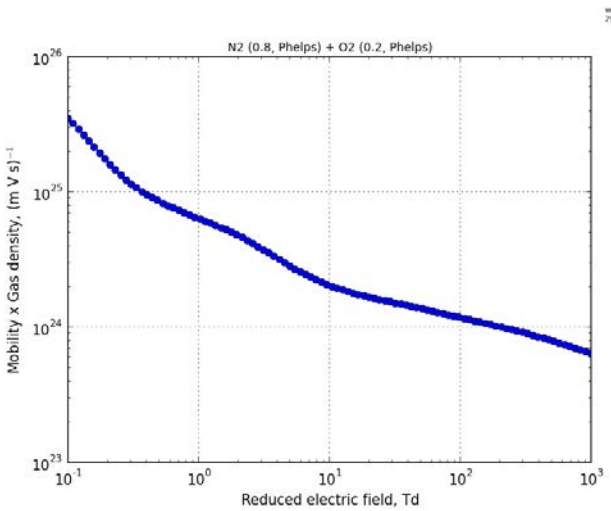
Users of this site are kindly requested to reference to BOLSIG+ and the appropriate cross section databases in all publications making use of data from this site.



CONFIG
non-Maxwellian EEDF | Maxwellian EEDF
E/N = 0.1 - 1000 Td
Te = 0.03 - 10 eV
T_{gas} = 300 K # points = 100

SPECIES MOLE FRACTIONS
N2 = 0.8
O2 = 0.2

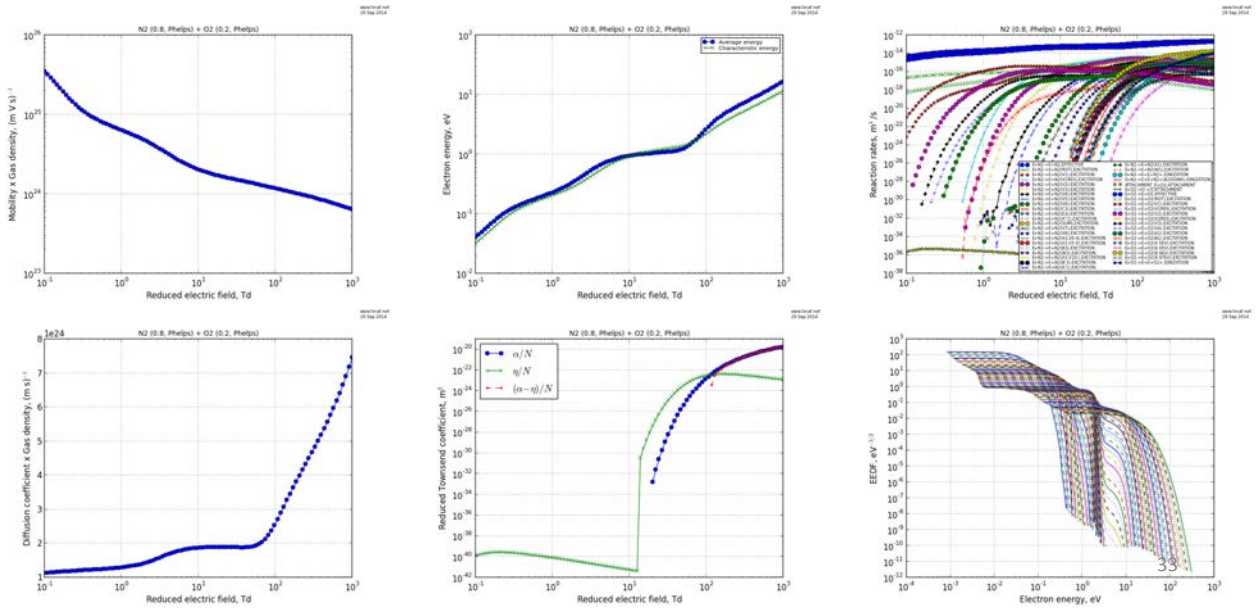
BROWSE
Mobility x Gas density
Diffusion coefficient x Gas density
Reduced Townsend coefficient
Electron energy
Reaction rates
Electron energy distribution functions
Electron cross sections (new window)

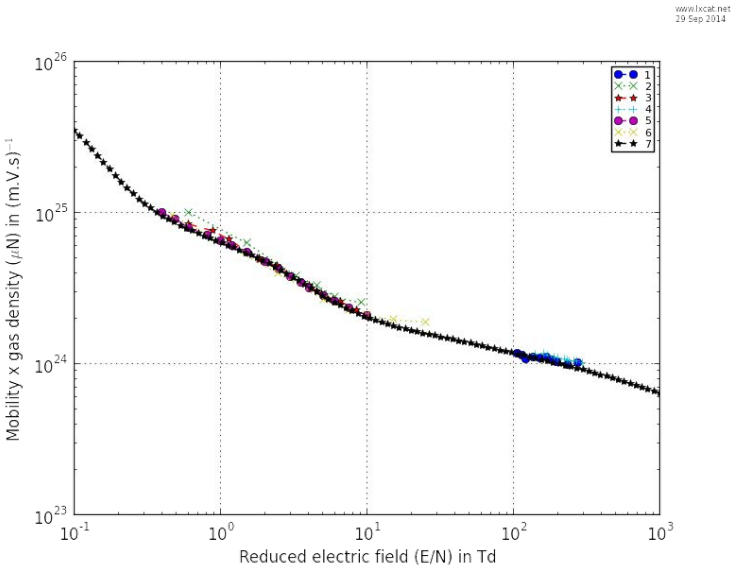
DOWNLOAD
Swarm parameters in text file
All figures in zip archive
Cross section input file

SAVE DATA FOR FURTHER BROWSING

browse & download

- Mobility x Gas density
- Diffusion coefficient x Gas density
- Reduced Townsend coefficient
- Electron energy
- Reaction rates
- Electron energy distribution functions
- Electron cross sections (new window)





LXCAT step-by-step example

Comparison of measured and calculated swarm parameters

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About the solver

Swarm parameters are calculated here using BOLSIG+ (ver. 1.2) solver for the numerical solution of the Boltzmann equation for electrons in weakly ionized gases in uniform electric fields, conditions which typically appear in the bulk of collisional low-temperature plasmas. It has been developed by Gerjan Hagelaar (LAPLACE, France).
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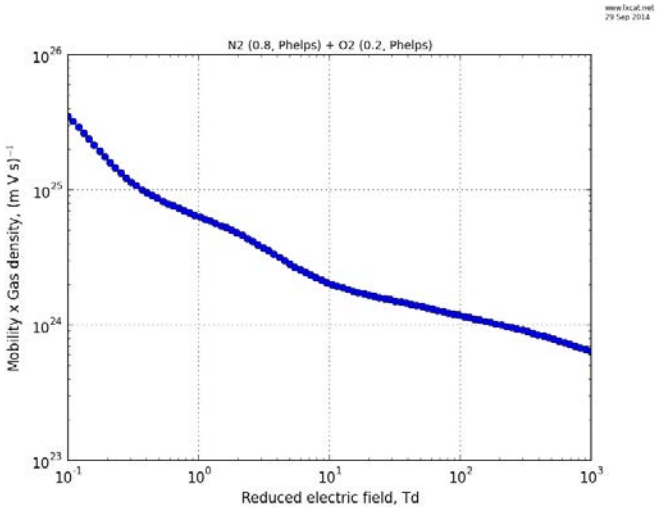
Users of this site are kindly requested to reference to BOLSIG+ and the appropriate cross section databases in all publications making use of data from this site.



CONFIG
non-Maxwellian EEDF | Maxwellian EEDF
E/N = 0.1 - 1000 Td
Te = 0.03 - 10 eV
T_{gas} = 300 K # points = 100

SPECIES MOLE FRACTIONS
N2 = 0.8
O2 = 0.2

BROWSE
Mobility x Gas density
Diffusion coefficient x Gas density
Reduced Townsend coefficient
Electron energy
Reaction rates
Electron energy distribution functions
Electron cross sections (new window)

DOWNLOAD
Swarm parameters in text file
All figures in zip archive
Cross section input file

SAVE DATA FOR FURTHER BROWSING
Assign label Calculated and Submit

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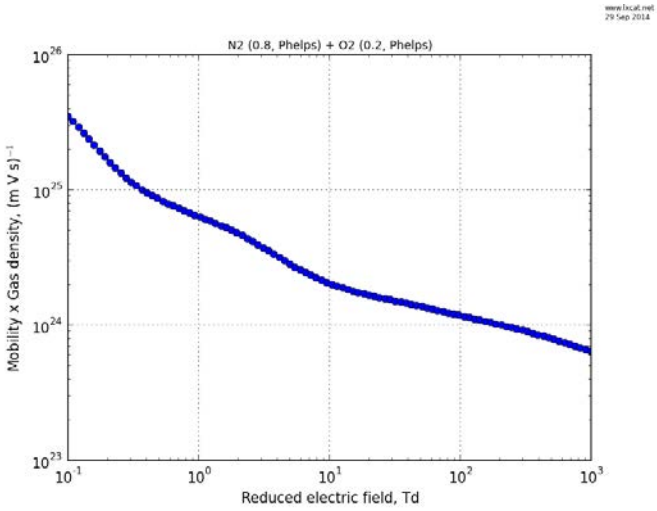
About the solver

Swarm parameters are calculated here using BOLSIG+ solution of the Boltzmann equation for electrons in weakly ionized gases in uniform electric fiel ear in the bulk of collisional low-temperature plasmas. It has been developed by Gerjan Hagelaar (LAPLACE, France).
Note that BOLSIG+ makes use of the classical "2-term approximation". Some of the data sets on this site were developed for use with Monte Carlo or "multiterm" Boltzmann solvers and errors may be introduced by the 2-term approximation used in BOLSIG+. We have tried to indicate when this could be of concern. Please consult BOLSIG+ for the details and to download the complete freeware application for Windows.
Users of this site are kindly requested to reference to BOLSIG+ and the appropriate cross section databases in all publications making use of data from this site.



CONFIG
non-Maxwellian EEDF | Maxwellian EEDF
E/N = 0.1 - 1000 Td
Te = 0.03 - 10 eV
T_{gas} = 300 K # points = 100

SPECIES MOLE FRACTIONS
N2 = 0.8
O2 = 0.2

BROWSE
Mobility x Gas density
Diffusion coefficient x Gas density
Reduced Townsend coefficient
Electron energy
Reaction rates
Electron energy distribution functions
Electron cross sections (new window)

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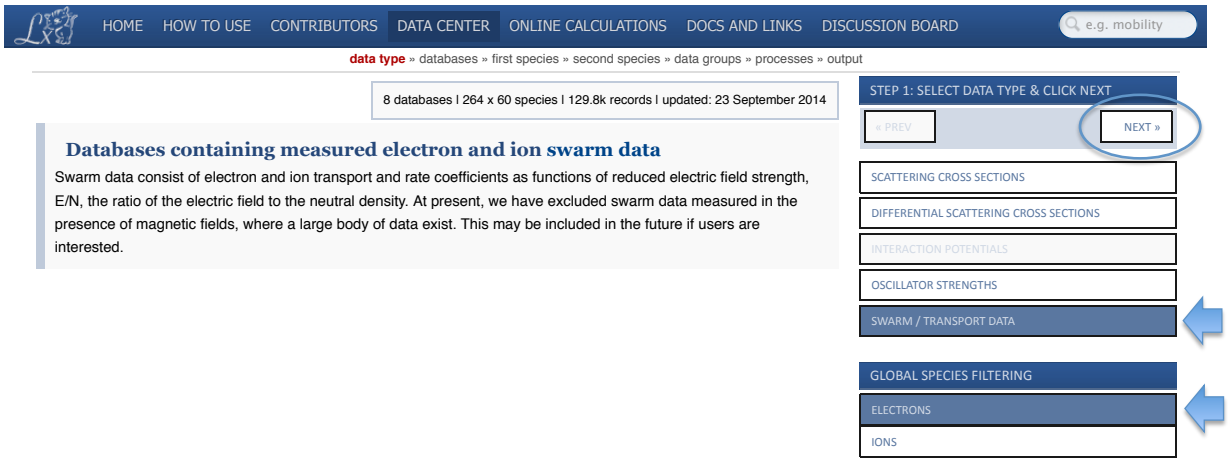

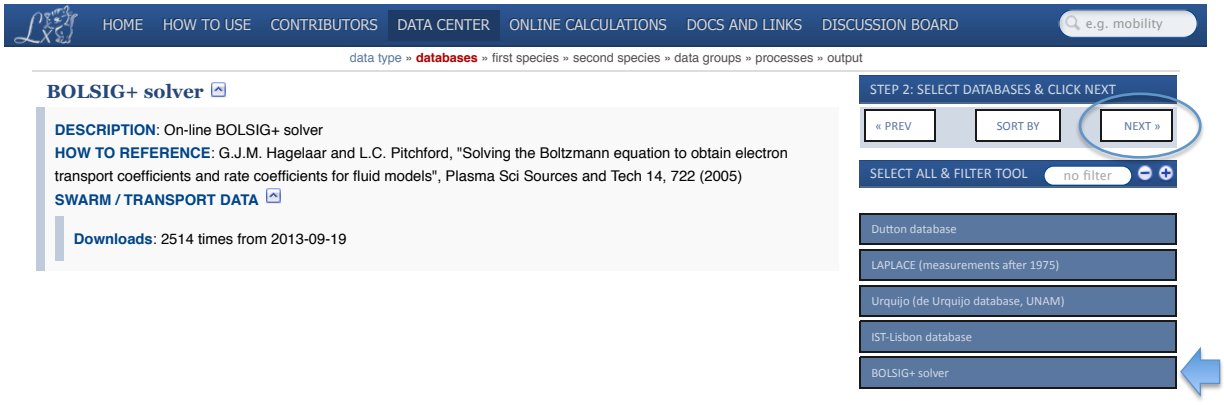

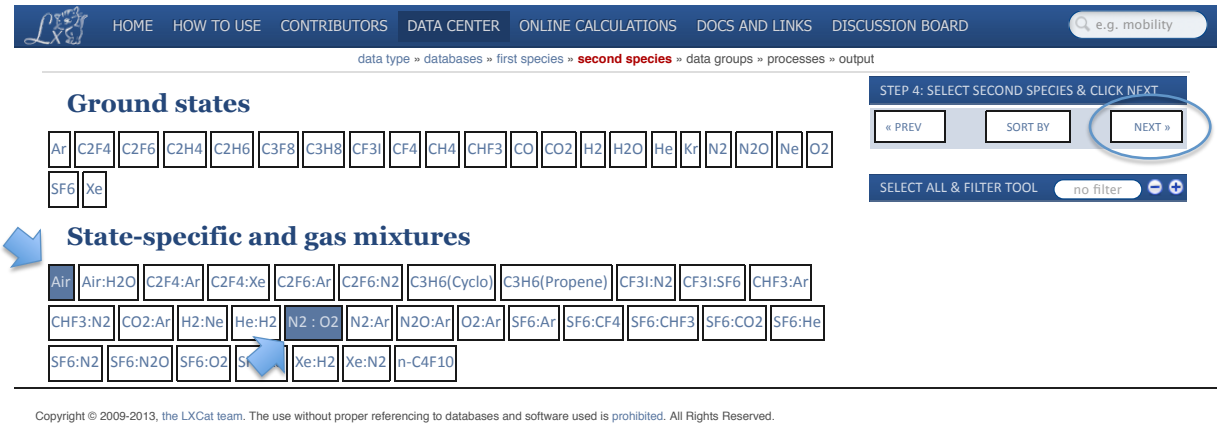

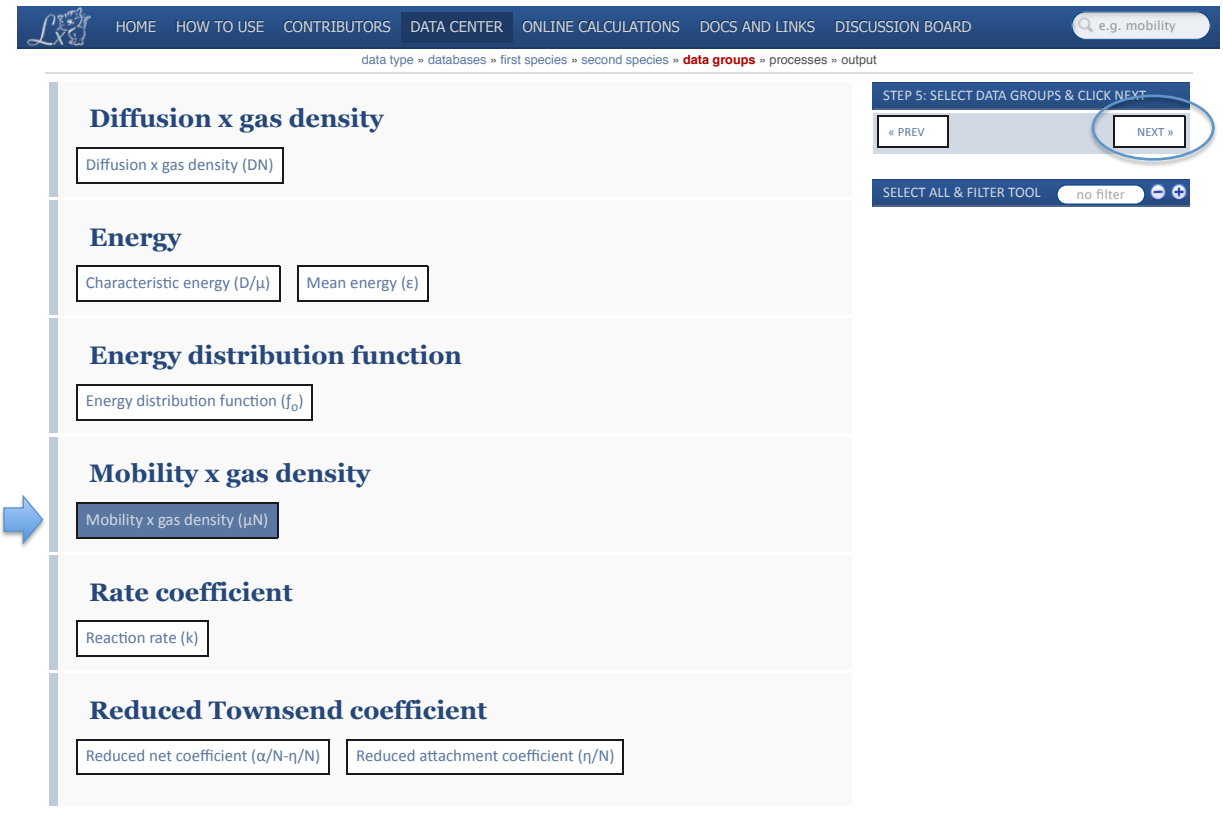


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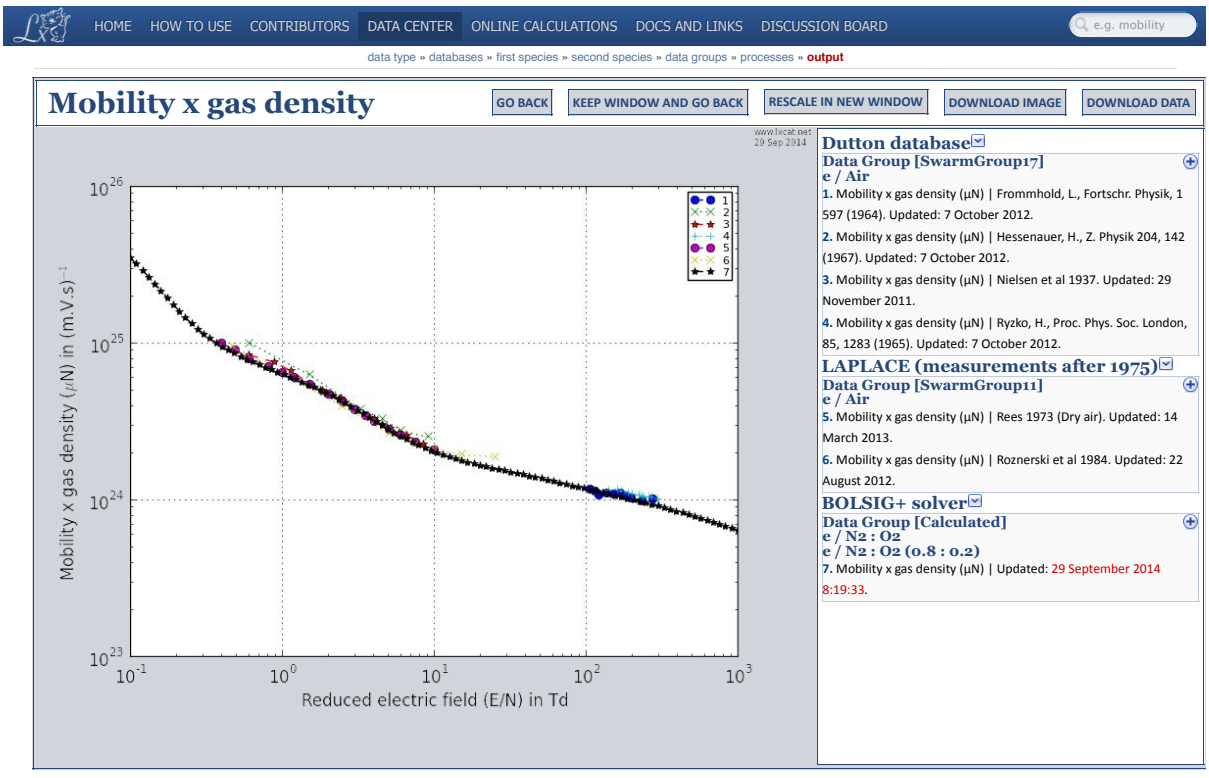
data type » databases » first species » second species » data groups » processes » output
Dutton database
Data Group [SwarmGroup17]: Crompton, R. W., Huxley, L. G. H., Sutton, D. J., Proc. Roy. Soc. London Ser A, 218, 507 (1953);
Frommhold, L., Fortschr. Physik, 1 597 (1964);
Hessenauer, H., Z. Physik 204, 142 (1967);
Nielsen, R. A., Bradbury, N. E., Phys. Rev. 51, 69 (1937);
Rees, J. A., Jory, R. L., Austr. J. Phys. 17, 307 (1964);
Ryzko, H., Proc. Phys. Soc. London, 85, 1283 (1965);.
e / Air
Mobility x gas density (μN) | Frommhold, L., Fortschr. Physik, 1 597 (1964). Updated: 7 October 2012.
Mobility x gas density (μN) | Hessenauer, H., Z. Physik 204, 142 (1967). Updated: 7 October 2012.
Mobility x gas density (μN) | Nielsen et al 1937. Updated: 29 November 2011.
Mobility x gas density (μN) | Ryzko, H., Proc. Phys. Soc. London, 85, 1283 (1965). Updated: 7 October 2012.
LAPLACE (measurements after 1975)
Data Group [SwarmGroup11]: Milloy, H. B., Reid, I. D., Crompton, R. W., Aust. J. Phys. 28, 231 (1975);
Rees, J. A., Aust. J. Phys. 26, 427 (1973);
Roznerski, W., Leja, K., J. Phys. D: Appl. Phys. 17, 279 (1984);
Ruiz-Vargas, G., Urquijo, 29th ICPIG, 12-17 July (2009);.
BOLSIG+ solver
Data Group [Calculated]: Tgas 300 K
EEDF 1 (type of EEDF : 1 = non-Maxwellian)
ENmin 0.1 Td
ENmax 1000 Td
points 100
N2 0.8 Phelps database
O2 0.2 Phelps database.
e / N2 : O2
e / N2 : O2 (0.8 : 0.2)
Mobility x gas density (μN) | Updated: 29 September 2014 8:19:33.
STEP 6: SELECT PROCESSES & CLICK NEXT
« PREV
NEXT »
SELECT ALL & FILTER TOOL
no filter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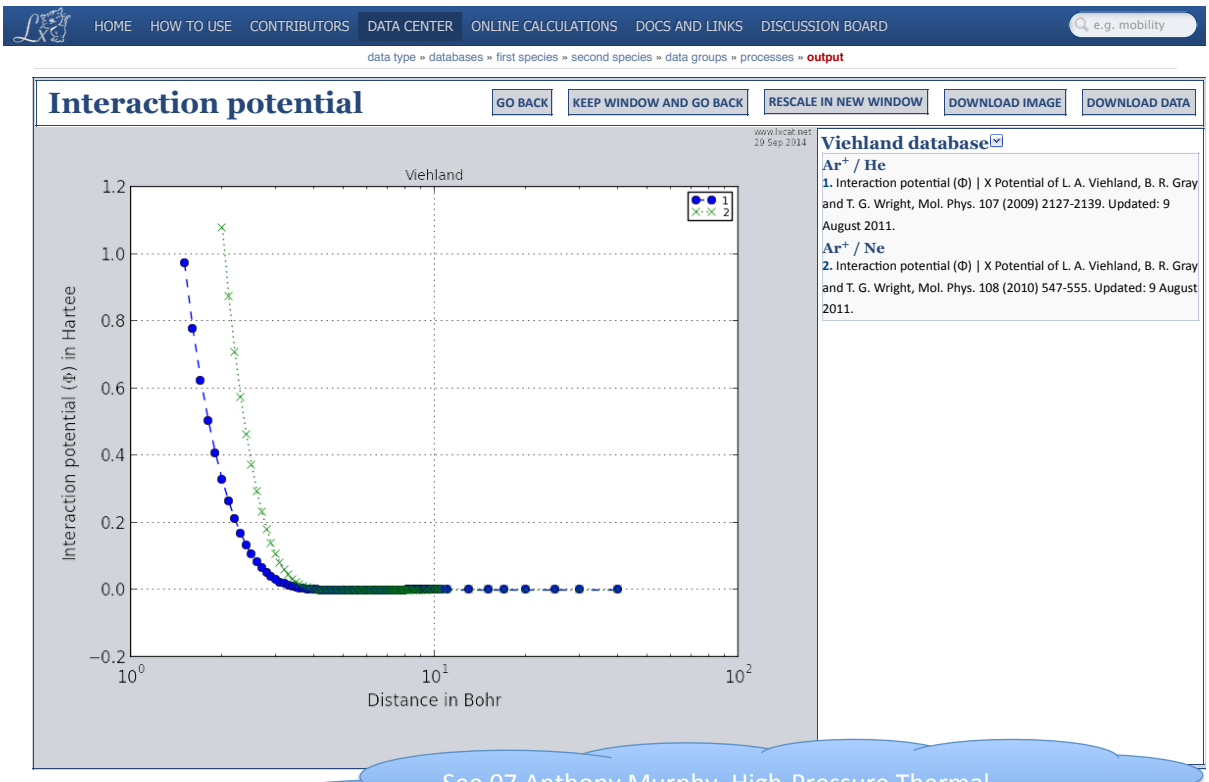
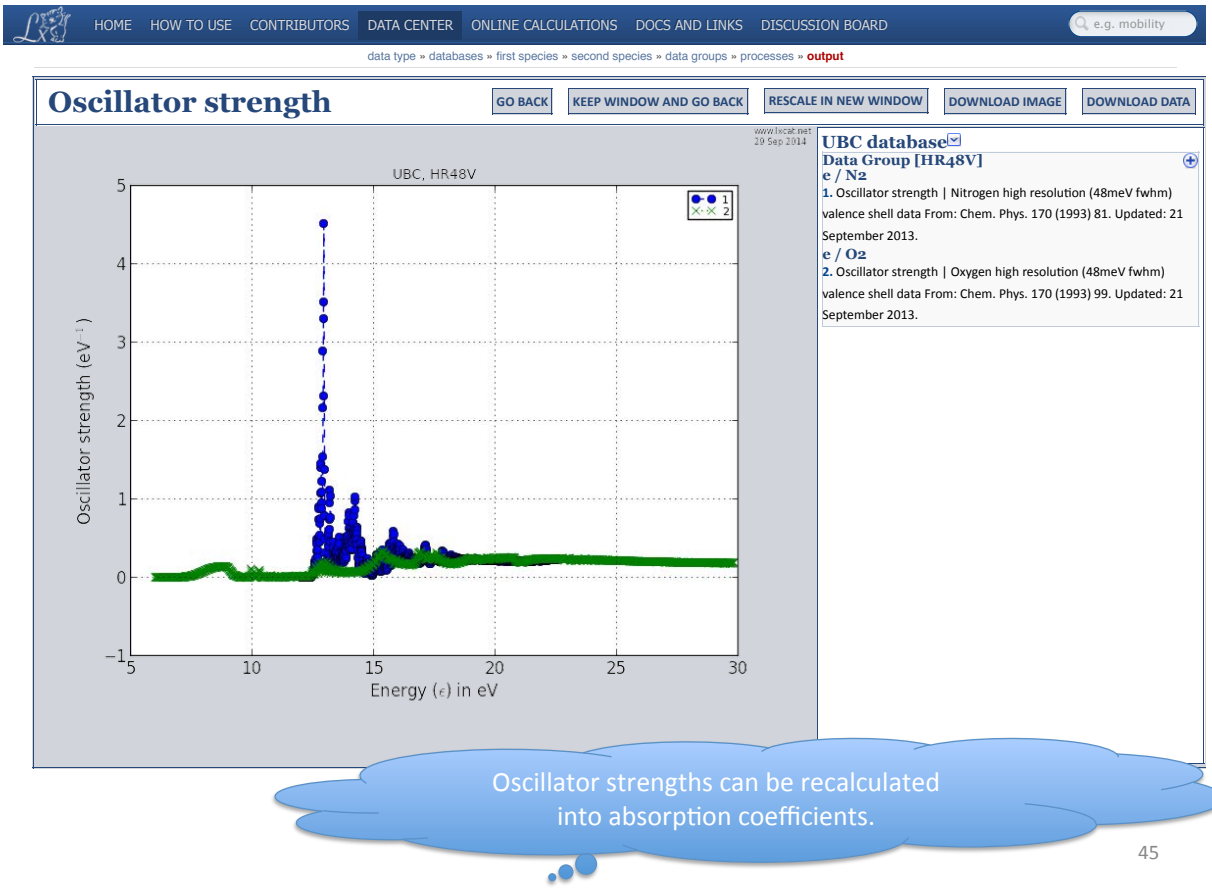
29 Sep 2014
Mobility x gas density (μN) in (m.V.s)-1
Reduced electric field (E/N) in Td
Dutton database
Data Group [SwarmGroup17]
e / Air
1. Mobility x gas density (μN) | Frommhold, L., Fortschr. Physik, 1 597 (1964). Updated: 7 October 2012.
2. Mobility x gas density (μN) | Hessenauer, H., Z. Physik 204, 142 (1967). Updated: 7 October 2012.
3. Mobility x gas density (μN) | Nielsen et al 1937. Updated: 29 November 2011.
4. Mobility x gas density (μN) | Ryzko, H., Proc. Phys. Soc. London, 85, 1283 (1965). Updated: 7 October 2012.
LAPLACE (measurements after 1975)
Data Group [SwarmGroup11]
e / Air
5. Mobility x gas density (μN) | Rees 1973 (Dry air). Updated: 14 March 2013.
6. Mobility x gas density (μN) | Roznerski et al 1984. Updated: 22 August 2012.
BOLSIG+ solver
Data Group [Calculated]
e / N2 : O2
e / N2 : O2 (0.8 : 0.2)
7. Mobility x gas density (μN) | Updated: 29 September 2014 8:19:33.

inter-comparison

- Measurements from different databases
- Calculations using different sets of input data
- Any combinations of thereof

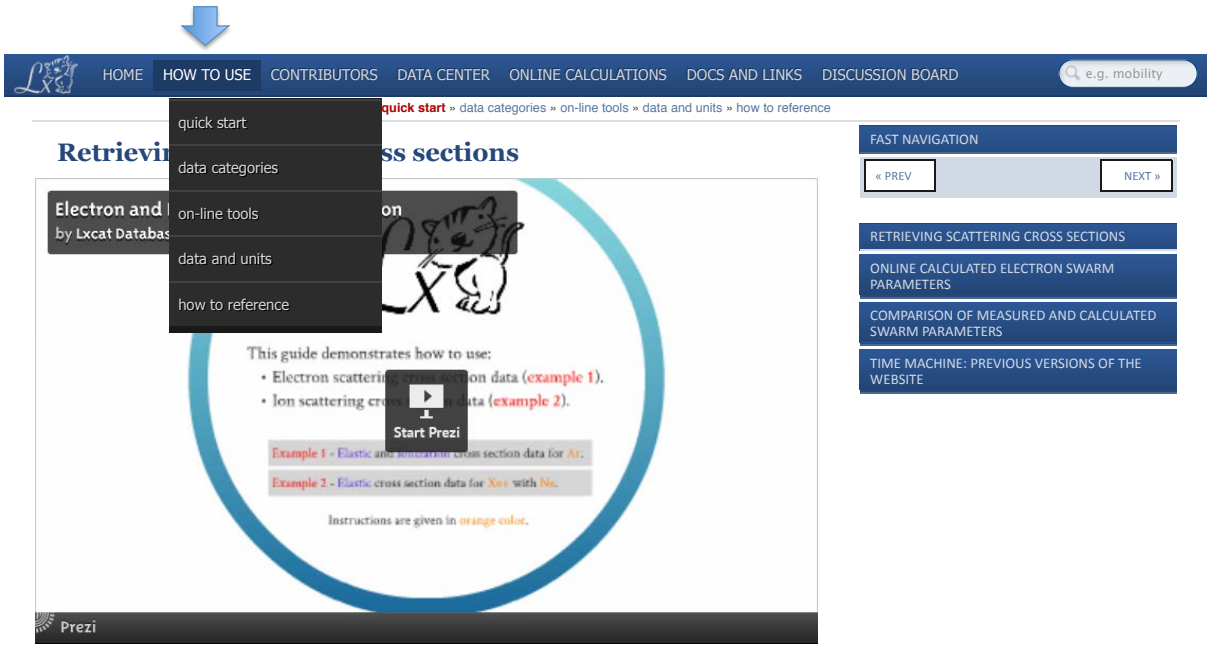


See 07 Anthony Murphy, High-Pressure Thermal Plasmas and Sources

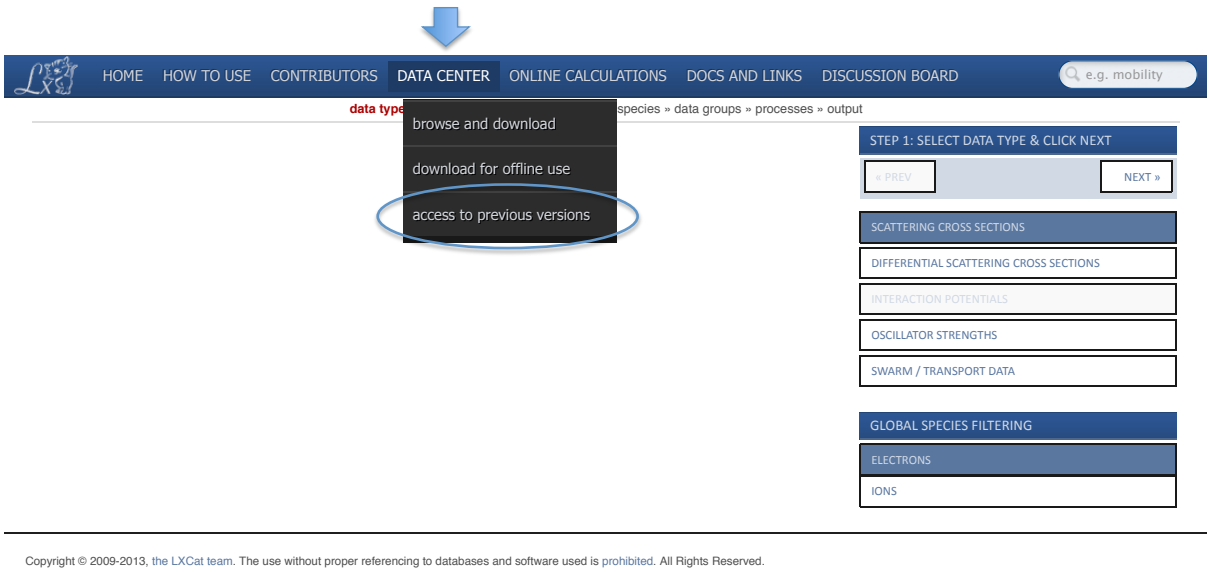


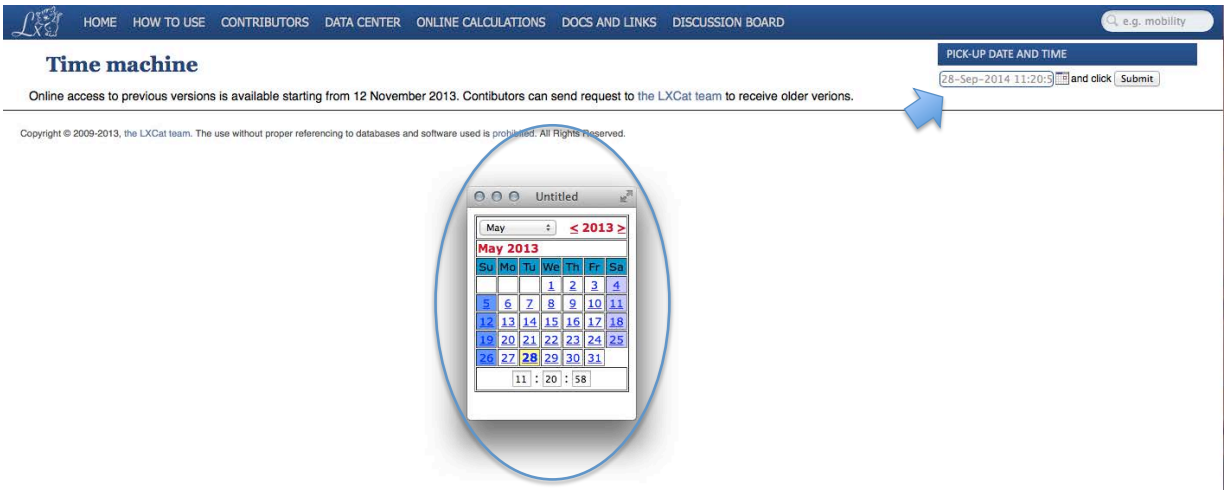
Oscillator strengths can be recalculated into absorption coefficients.

LXCAT next steps



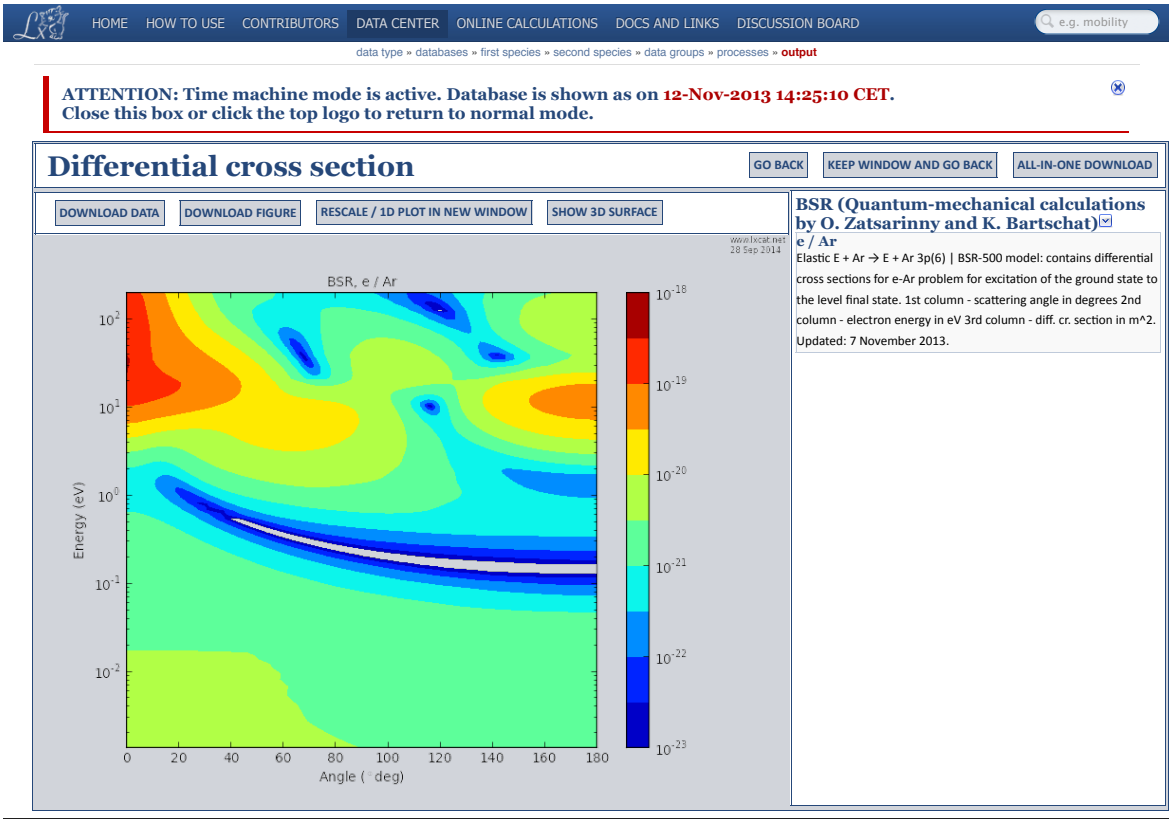
Online calculated electron swarm parameters

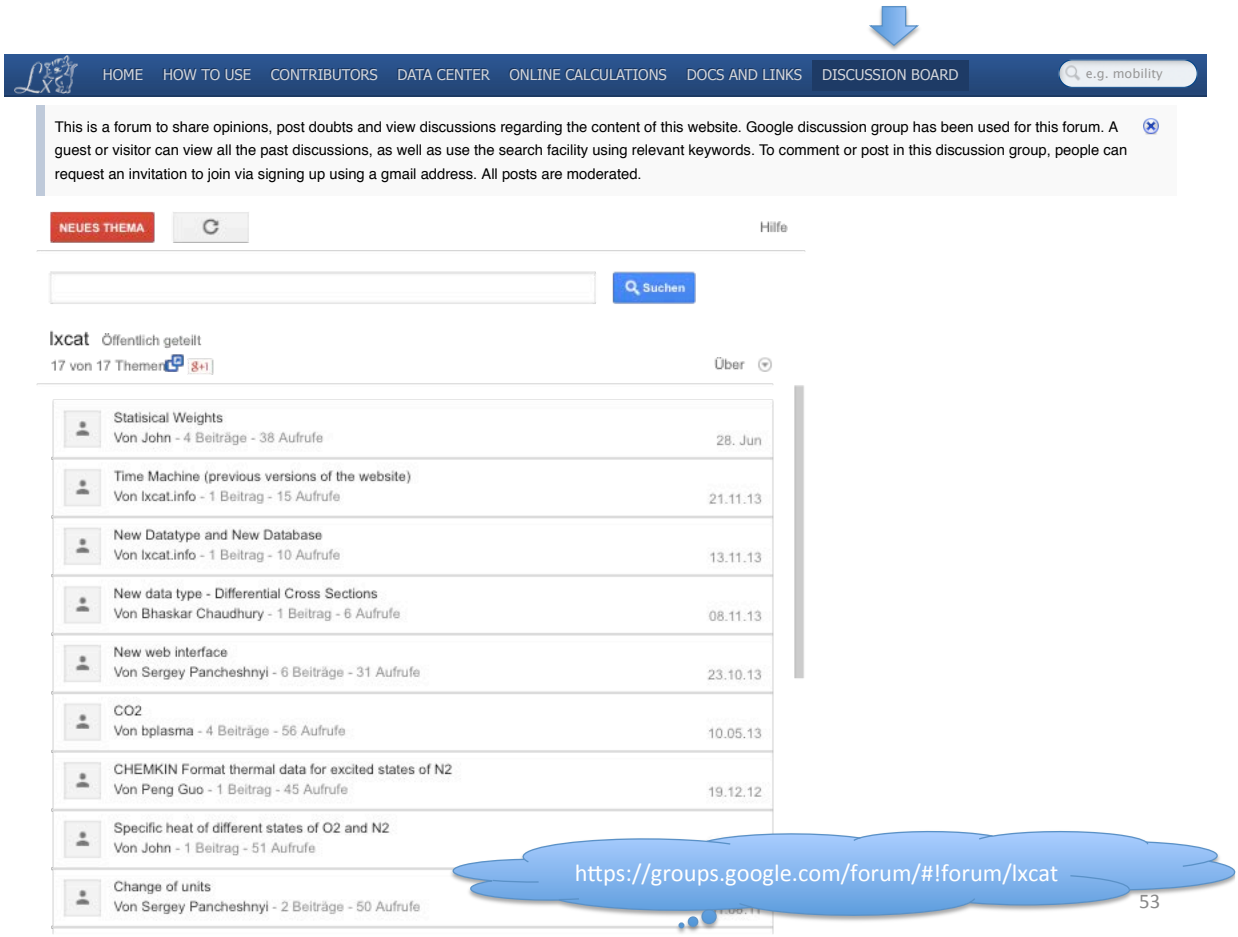




Time machine mode is active. You can use top menu to continue browsing data as it was on 12-Nov-2013 14:25:10 CET. Click the top logo to return to normal mode.

	Data type	Previous update	Next update
	scattering cross sections	first filling	14-Nov-2013 15:00:00
	differential scattering cross sections	first filling	up to date
	interaction potentials	first filling	15-Dec-2013 04:15:00
	swarm / transport data	first filling	15-Nov-2013 11:30:00
Database	**Data type**	**Previous update**	**Next update**
BSR		first filling	up to date
	scattering cross sections	first filling	up to date
	differential scattering cross sections	first filling	up to date
Biagi-v7.1	scattering cross sections	first filling	up to date
Biagi-v8.9	scattering cross sections	first filling	up to date
Bordage	scattering cross sections	first filling	up to date
Bray	scattering cross sections	first filling	up to date
Dutton	swarm / transport data	first filling	up to date
Hayashi	scattering cross sections	first filling	15-Feb-2014 15:30:00
IST-Lisbon		first filling	up to date
	scattering cross sections	first filling	up to date
	swarm / transport data	first filling	up to date
Itikawa	scattering cross sections	first filling	up to date
LAPLACE	swarm / transport data	first filling	15-May-2014 12:30:00
Morgan	scattering cross sections	first filling	up to date
NGFSRDW	scattering cross sections	first filling	up to date
Phelps		first filling	14-Nov-2013 15:00:00
	scattering cross sections	first filling	14-Nov-2013 15:00:00
	swarm / transport data	first filling	up to date
Puech	scattering cross sections	first filling	up to date

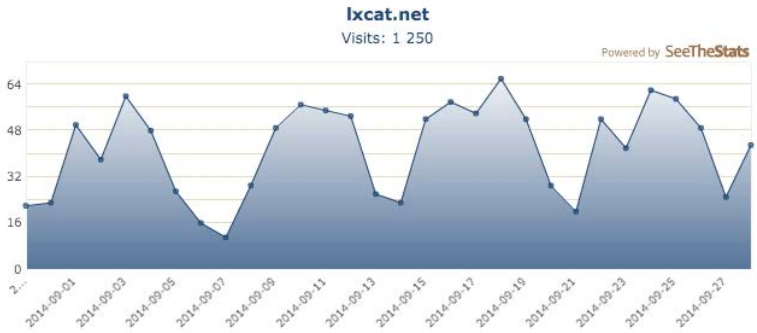




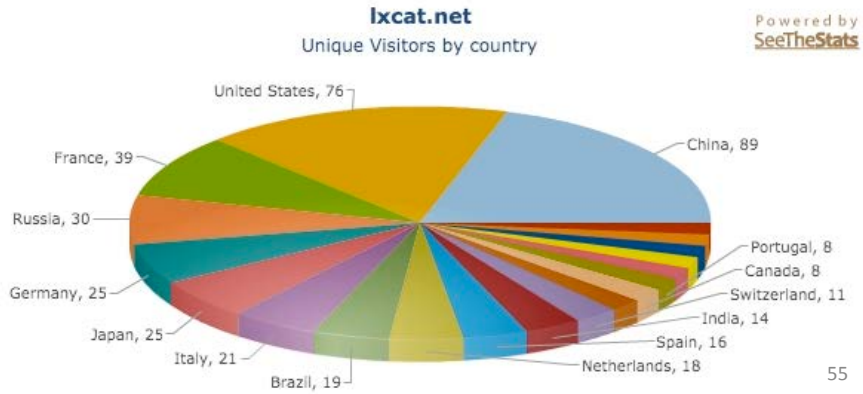
LXCAT: some statistics

- **Scattering cross sections:**
  19 databases | 4 x 162 species | 3.2k records | updated: 25 August 2014
- **Differential scattering cross sections:**
  1 database | 1 species | 31 records | updated: 7 November 2013
- **Interaction potentials:**
  1 database | 56 x 8 species | 567 records | updated: 23 September 2014
- **Oscillator strengths:**
  1 database | 65 species | 150 records | updated: 25 November 2013
- **Swarm / transport data:**
  8 databases | 264 x 60 species | 130k records | updated: 23 September 2014
- **Publications, notes and reports:**
  3 databases | 23 records | updated: 25 August 2013

LXCAT: some statistics



About 40 visitors per day

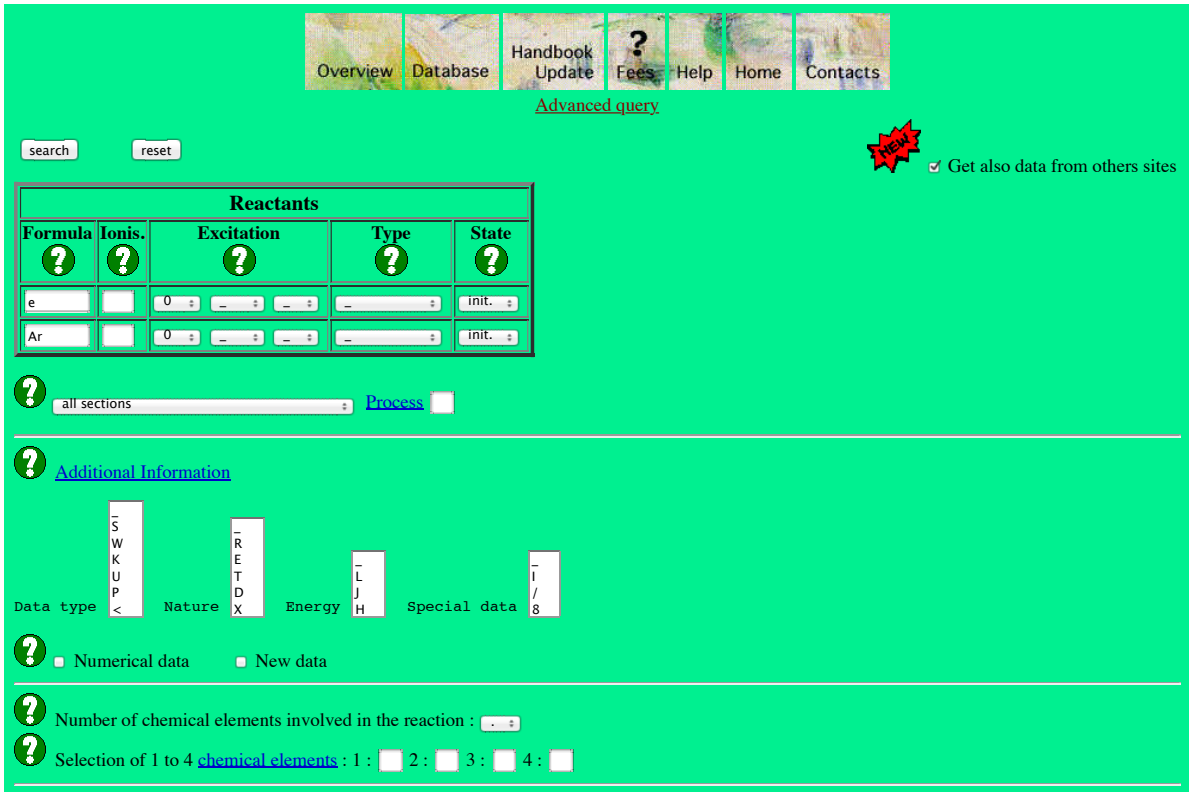


http://gaphyor.lpgp.u-psud.fr/gaphyor/

GAPHYOR (GAZ-PHYSICS-ORSAY)

GAPHYOR

- Five domains of physics, chemical physics and plasma physics are
  - Properties of isolated atoms and molecules.
  - Collisions with photons.
  - Collisions with electrons.
  - Collisions and reactions between atoms and molecules.
  - Macroscopic properties of gases
- Based on a large coverage of the specialized literature in the fields of atomic and molecular physics, chemical physics and plasma physics. After a detailed analysis of papers by a team of scientific experts the information is coded and indexed in a concise and structured way.
- Data include bibliographical, factual and numerical information.
- No longer updated since 2005.



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Steward Jr M D (US WI MA), Chilton J E , Boffard J B , Lin C C
Phys. Rev. A, US vol.65 p.32704 (2002)

Ar, e --> Ar *, e
Excitation (Electronic collisions)

Total cross sections (absolute values)
Medium energies (10 eV < E < 10 keV CM system)
Experimental data
energies: 20 - 200 eV
notes: 2s2, 2s4, 3d5 levels

Haynes M A (AU QU NA), Lohmann B
Phys. Rev. A, US vol.64 p.44701 (2001)

Ar, e --> Ar +, e, e
Ionization (Electronic collisions)

Differential cross sections (absolute values)
Medium energies (10 eV < E < 10 keV CM system)
Experimental data
energies: 113.5 eV
notes: triply differential cross section

Amusia M Y (IL YE YU), Chernysheva L V, Felfli Z , Msezane A Z
Phys. Rev. A, US vol.64 p.32711 (2001)

http://consult.cern.ch/writeup/magboltz/

MAGBOLTZ - TRANSPORT OF ELECTRONS IN GAS MIXTURES

Magboltz - transport of electrons in gas mixtures

Responsible at CERN: Rob Veenhof
Manual Type: Source files, cross sections
Version: 10.0.4, 2.4
Author: Stephen Biagi
Reference: none

Created: 20 May 1995
Last Update: 22 Apr 2014
Verified: 17 Jun 2014
Valid until: further notice
Support Level: Normal

Magboltz

Magboltz solves the Boltzmann transport equations for electrons in gas mixtures under the influence of electric and magnetic fields.

Further information:

- LXCAT cross section compilation;
- The cross sections used by Magboltz 7.1, interfaced with Garfield 9 (current default)
- How to use Magboltz

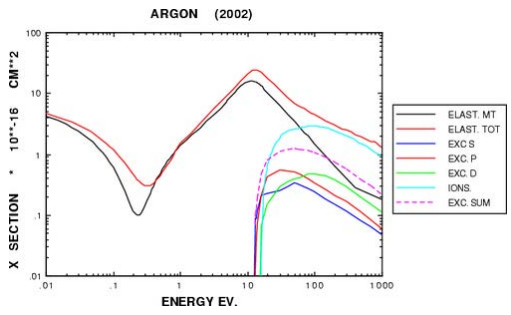
Magboltz source files:

- Source file for version 7.1 (default since 13/4/2005);
- Source file for version 8.9.1 (edition of 27 Sep 2010, reinstoring GeH_4 and SiH_4 and improving $C_2H_2F_4$);
- Source file for version 8.9.2 (edition of 14 Nov 2010, hydrogen update);
- Source file for version 8.9.3 (edition of 24 Feb 2011, xenon ionisation cross section corrected);
- Source file for version 8.9.4 (edition of 25 May 2011, xenon ionisation cross section changed at threshold);
- Source file for version 8.9.5 (edition of 12 Jun 2011, TMA);
- Source file for version 8.9.6 (edition of 27 Aug 2011, update of low energy argon excitation cross sections);
- Source file for version 8.9.7 (edition of 25 Sep 2011, krypton update);
- The source file for version 9.0.1 (edition of 12 May 2012) was corrected with version 9.0.3;
- Source file for version 9.0.3 (edition of 28 Aug 2013);

Cross sections used by Magboltz 7.1

argon

Cross sections



Further information

Cross section graph in PostScript format.

Background information from Britannica

Information on the element from WebElements periodic table

Select your gases

Update | Reset selection

- hydrogen
- deuterium
- helium
- nitrogen
- oxygen
- ozone
- fluorine
- neon
- argon
- krypton
- xenon
- cæsium
- mercury
- methane
- deuterated methane
- methanol
- ethane
- ethanol
- ethylene
- acetylene
- propane
- 2-propanol

- cyclo propane
- propylene
- isobutane
- n-butane
- neopentane
- n-pentane
- silane

http://jilawww.colorado.edu/~avp/

A COMPILATION OF ATOMIC AND MOLECULAR DATA, ASSEMBLED AND EVALUATED BY PHELPS AND COLLABORATORS

Arthur V. Phelps
Fellow Adjoint of JILA

Current Research Interests:

- Atomic and molecular collision data for modeling electrical discharges in rare gases, air, and so on

  A compilation of atomic and molecular data, assembled and evaluated by Phelps and collaborators, is available.


Return to JILA Home Page

Index of /~avp/collision_data

	Name	Last modified	Size	Description
	Parent Directory		-	
	ararnotes/	20-May-2005 14:24	-	
	attachment-detachment/	20-May-2005 14:24	-	
	cathodefalldata/	20-May-2005 14:24	-	
	electronneutral/	21-May-2005 16:52	-	
	hehenotes/	20-May-2005 14:25	-	
	ionneutral/	26-Aug-2005 10:40	-	
	methanenotebooks/	20-May-2005 14:25	-	
	millsnotes/	20-May-2005 14:23	-	
	ndvcr/	20-May-2005 14:25	-	
	neutralneutral/	20-May-2005 14:26	-	
	nitrogen/	20-May-2005 14:26	-	
	readme.txt	20-May-2005 14:23	7.8K	
	temporary/	20-May-2005 14:26	-	

Apache/2.2.15 (Red Hat) Server at jilawww.colorado.edu Port 80

COMPILATION OF ELECTRON CROSS SECTIONS USED BY A. V. PHELPS

Please refer to these data using the sources cited for each gas. Please do not refer to any of them as "JILA cross sections", because a) the data shown here for a given gas may come from several sources that should be referred to by the respective authors names; b) in most cases no one else at JILA or NIST has approved the data or even looked at it. Reference to this data as "JILA data" could be interpreted incorrectly as indicating NIST approval and could jepordize my Web site usage.

GASES COMPILED: O2, N2, CO, CO2, H2, H2O, NO, SF6, He, Ne, Ar, Xe, Na, and Mg

Comments are made on cross sections from other sources for some of these and other gases.

WE MAKE NO CLAIMS FOR THESE CROSS SECTIONS BEYOND THOSE STATED IN THE PAPERS WHERE THEY ARE PUBLISHED OR CITED. IN MOST CASES THESE CROSS SECTIONS WERE ASSEMBLED IN THE 1970'S AND 1980'S. IN ONLY A FEW CASES HAVE THEY BEEN MODIFIED OR TESTED SINCE THAT TIME. I DO NOT PLAN ANY UPDATES. ADDITIONS HAVE BEEN MADE WHEN CROSS SECTIONS HAVE BEEN ASSEMBLED FOR OTHER PURPOSES. SINCE THE JILA INFORMATION CENTER WAS CLOSED BY NIST, THERE IS NO ONE THERE TO HELP YOU. OPINIONS EXPRESSED ARE THOSE OF A. V. PHELPS AND DO NOT IMPLY JILA, CU, OR NIST APPROVAL.

The cross sections are in 1E-16 cm2. The two-term Boltzmann code, BACKPRO, used in deriving our cross sections employs linear interpolation between points in the cross section tables. Therefore linear interpolation should be applied when using them. Except as noted below for N2, the cross sections listed in JILA Information Center Reports 26, 27, and 28 for N2, H2, and O2 should be the same as those listed here. (This aspect has not been checked in detail, so please inform me of discrepancies.)

It should be kept in mind that the momentum transfer cross sections tabulated are effective values that include the effects of inelastic collisions as is appropriate for use in the two-tern spherical harmonic expansion. See, for example, Baraff and Buchsbaum, Phys. Rev. 130, 1007 (1963) and Sec. IIB of Pitchford and Phelps, Phys. Rev. A 25, 540 (1982). Where data is available, the effective Qm is set equal to the sum of the inelastic cross sections plus the elastic momentum transfer cross section. This is an approximate relation.

Some of the terms used in the tables and the BACKPRO code are:

O2 MOMENTUM-TRANSFER CROSS SECTION

	ENERGY	Effective Qm - Defined in introduction
1	0.0000	0.3500
2	0.0010	0.3500
3	0.0020	0.3600
4	0.0030	0.4000
5	0.0050	0.5000
6	0.0070	0.5800
7	0.0085	0.6400
8	0.0100	0.7000
9	0.0150	0.8700
10	0.0200	0.9900
11	0.0300	1.2400
12	0.0400	1.4400
13	0.0500	1.6000
14	0.0700	2.1000
15	0.1000	2.5000
16	0.1200	2.8000
17	0.1500	3.1000
18	0.1700	3.3000
19	0.2000	3.6000
20	0.2500	4.1000
21	0.3000	4.5000
22	0.3500	4.7000
23	0.4000	5.2000
24	0.5000	5.7000
25	0.7000	6.1000
26	1.0000	7.2000
27	1.2000	7.9000
28	1.3000	7.9000
29	1.5000	7.6000
30	1.7000	7.3000
31	1.9000	6.9000
32	2.1000	6.6000
33	2.2000	6.5000
34	2.5000	6.1000
35	2.8000	5.8000
36	3.0000	5.7000
37	3.3000	5.5000
38	3.6000	5.4500
39	4.0000	5.5000
40	4.5000	5.5500
41	5.0000	5.6000
42	6.0000	6.0000
43	7.0000	6.6000

Gaseous Electronics Laboratory Data Centre, University of Belgrade
http://mail.ipb.ac.rs/~cep/ipb-cnp/ionsweb/

A DATABASE ON THE TRANSPORT PROPERTIES OF ELECTRONS, POSITRONS AND IONS

GELDC database

The GELDC database maintains transport and collision data for the following charged particle species: electrons, positrons, positive and negative ions.

Centre for Non-Equilibrium Processes

A Database on the Transport Properties of Electrons, Positrons and Ions

[home | overview | data | help | contact | links]

Chose one of the sections and click on one of the gas below to get a plot of the transport and collision data. The coresponding numerical data are available by request. Send an email to Zoran Lj. Petrovic stating the transport property and/or the cross sections you want. Transport parameters of the charged particles include the mean energy, drift velocity and diffusion tensor components and rate coefficients, presented as a function of E/N and/or B/N.

Electron Transport and Collision Data

BF_3	CF_4	HBr	N_2O

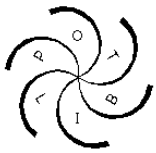
Positron Transport and Collision Data

Ar	H_2	N_2

Positive Ions Transport and Collision Data

Negative Ions Transport and Collision Data

He	Ar	Ne	Kr	Xe



http://comp.chem.umn.edu/potlib/

POTLIB - LIBRARY OF POTENTIAL ENERGY SURFACES

POTLIB Library

- Global and semiglobal potential energy surface subprograms for calculating Born-Oppenheimer energies as a function of nuclear geometry.
- The library currently features nearly 300 potential energy routines for a wide range of chemical systems.
- Our goal is to facilitate chemical dynamics research by collecting and disseminating a comprehensive collection of state-of-the-art potential energy routines (developed by a wide, international group of researchers) with systematic and well-defined interfaces for use with chemical dynamics programs.

Potential energy surface ch4T8

Potential energy surface information	
System	CH4
ID	ch4T8
Number of bodies	5
Common name	Schwenke-Partridge T8
Functional form	
Interface	Section-2
Number of electronic surfaces	1
Number of derivatives	0
References	D. W. Schwenke and H. Partridge, Spectrochim. Acta A 57, (2001) 887
Notes	The data file (ch4T8datafile.tar) contains two files: ch4pes is a data file read once by the PES routine getpot_ch4t8.f90 is a calling routine that accepts cartesian coordinates, converts them to Radau coordinates (the required input for the T8 PES), calls the surface, zeroes it so that the ZOE is at the global minimum, and returns the energy. There are no derivatives. One should use nuclear rather than atomic masses for the C and H atoms.

Click here to download ch4T8

http://www.nist.gov/pml/data/

THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST, US)

NIST physical reference data

Atomic Spectroscopy Data

Contains databases for energy levels, wavelengths, and transition probabilities for atoms and ions and related bibliographic databases.

Molecular Spectroscopic Data

Includes databases containing spectroscopic data for small molecules, hydrocarbons, and interstellar molecules. In addition, there are two publications containing equations and the underpinning theory for molecular spectroscopy.

Atomic and Molecular Data

Contains databases on thermophysical properties of gases, electron-impact cross sections (of atoms & molecules), potential energy surfaces of group II dimers, and atomic weights and isotopic compositions.

X-Ray and Gamma-Ray Data

Contains databases on the interaction of x-rays and gamma-rays with elements and compounds.

Radiation Dosimetry Data

This database calculates stopping-power and range tables for electrons, protons, or helium ions.

Nuclear Physics Data

Contains a table of the half lives of 65 radionuclides and a database of the isotopic compositions, atomic weights and relative atomic masses of the elements.

Condensed Matter Physics Data

This database consists of evaluated data for use in total-energy calculations of electronic structure by density-functional theory. It contains total energies and orbital energy eigenvalues for all atoms from hydrogen to uranium.

Atomic and Molecular Data

- Thermophysical Properties of Gases Used in the Semiconductor Industry
- Electron-Impact Cross Sections for Ionization and Excitation
- Potential Energy Surface Database of Group II Dimer Molecules
- Atomic Weights and Isotopic Compositions

Thermophysical Properties of Gases Used in the Semiconductor Industry

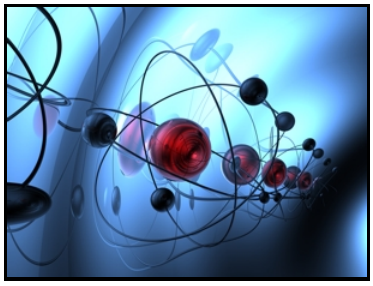
J. Hurly and K. Gillis

NIST is measuring the thermophysical properties of the process gases, the "surrogate" gases, and binary mixtures of process and carrier gases. The process gases are used in chemical vapor deposition (CVD) and the surrogate gases are used to calibrate mass flow controllers (MFCs). The results will be disseminated in this data base providing the heat capacity, thermal conductivity, viscosity, and the virial coefficients for the virial equation of state providing the pressure-density-temperature relation for the process gases.

Electron-Impact Cross Sections for Ionization and Excitation

Y.-K. Kim, K.K. Irikura, M.E. Rudd, M.A. Ali, and P.M. Stone

This is a database primarily of total ionization cross section of molecules by electron impact. The database also includes cross section for a small number of atoms and energy distributions of ejected electrons for H, He, and H_2. The cross sections were calculated using the Binary-Encounter-Bethe (BEB) model, which combines the Mott cross section with the high-incident energy behavior of the Bethe cross section. Selected experimental data



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General Information:
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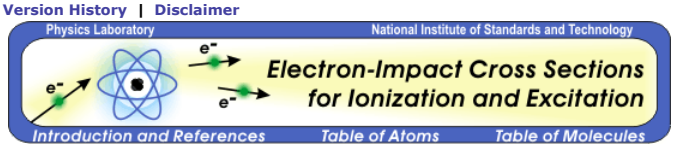
301-975-3038 Facsimile

100 Bureau Drive, M/S 8400
Gaithersburg, MD 20899-8400

Version History | **Disclaimer**



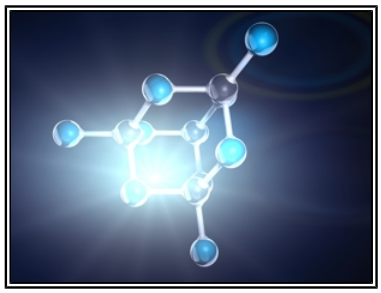
Y.-K. Kim,[1] K.K. Irikura,[2] M.E. Rudd,[3] M.A. Ali,[4] and P.M. Stone[1]
J. Chang,[1] J.S. Coursey,[1] R.A. Dragoset,[1] A.R. Kishore,[1] K.J. Olsen,[1] A.M. Sansonetti,[1]
G.G. Wiersma,[1] D.S. Zucker,[1] and M.A. Zucker,[1]

[1]NIST, Physical Measurement Laboratory
[2]NIST, Material Measurement Laboratory
[3]University of Nebraska-Lincoln, Department of Physics and Astronomy, Lincoln, NE 68588-0111
[4]Howard University, Department of Chemistry, Washington, DC 20059

This is a database primarily of total ionization cross sections of molecules by electron impact. The database also includes cross sections for some atoms and energy distributions of ejected electrons for H, He, and H_2. The cross sections were calculated using the Binary-Encounter-Bethe (BEB) model, which combines the Mott cross section with the high-incident energy behavior of the Bethe cross section. Selected experimental data are included. Electron-impact excitation cross sections are also included for some selected atoms.

Introduction and **References**

Contributions of the following colleagues are gratefully acknowledged:



Access the Database:

Atoms | Molecules

NIST Standard Reference Database 107
Rate our products and services.
Online: August 1997 - **Last update:** August 2005

Physical Measurement Laboratory — National Institute of Standards and Technology

Electron-Impact Cross Sections for Ionization and Excitation

Introduction and References | Table of Atoms | Table of Molecules

Select an element of interest to view its data

Order by Element Name:

Hydrogen, H
Indium, In
Lithium, Li
Nitrogen, N
Oxygen, O

Submit

1a	2a	3b		4b	5b	6b	7b	VIII		1b	2b	3a	4a	5a	6a	7a	0
^{1}H																	^{2}He
^{3}Li	^{4}Be											^{5}B	^{6}C	^{7}N	^{8}O	^{9}F	^{10}Ne
^{11}Na	^{12}Mg											^{13}Al	^{14}Si	^{15}P	^{16}S	^{17}Cl	^{18}Ar
^{19}K	^{20}Ca	^{21}Sc		^{22}Ti	^{23}V	^{24}Cr	^{25}Mn	^{26}Fe	^{27}Co	^{28}Ni	^{29}Cu	^{30}Zn	^{31}Ga	^{32}Ge	^{33}As	^{34}Se	^{35}Br	^{36}Kr
^{37}Rb	^{38}Sr	^{39}Y		^{40}Zr	^{41}Nb	^{42}Mo	^{43}Tc	^{44}Ru	^{45}Rh	^{46}Pd	^{47}Ag	^{48}Cd	^{49}In	^{50}Sn	^{51}Sb	^{52}Te	^{53}I	^{54}Xe
^{55}Cs	^{56}Ba	^{57}La	*	^{72}Hf	^{73}Ta	^{74}W	^{75}Re	^{76}Os	^{77}Ir	^{78}Pt	^{79}Au	^{80}Hg	^{81}Tl	^{82}Pb	^{83}Bi	^{84}Po	^{85}At	^{86}Rn
^{87}Fr	^{88}Ra	^{89}Ac	+	^{104}Rf	^{105}Db	^{106}Sg	^{107}Bh	^{108}Hs	^{109}Mt	^{110}Uun	^{111}Uuu	^{112}Uub		^{114}Uuq				
* Lanthanides				^{58}Ce	^{59}Pr	^{60}Nd	^{61}Pm	^{62}Sm	^{63}Eu	^{64}Gd	^{65}Tb	^{66}Dy	^{67}Ho	^{68}Er	^{69}Tm	^{70}Yb	^{71}Lu	
+ Actinides				^{90}Th	^{91}Pa	^{92}U	^{93}Np	^{94}Pu	^{95}Am	^{96}Cm	^{97}Bk	^{98}Cf	^{99}Es	^{100}Fm	^{101}Md	^{102}No	^{103}Lr	

BEB/BE-scaled References for Atoms*

Number	Symbol	Ionization	Ionization Data: Reference	Ionization Data: Comparison to Experiment	Excitation Data: Reference	Excitation Data: Comparison to Experiment
1	H	I	[1]	Yes	[21]	3 Yes, 6 No
2	He	I	[1]	Yes	[21]	3 Yes, 6 No
3	Li	I			[21]	1 Yes, 8 No
5	B	I	[18]	No		
6	C	I	[20]	Yes		
7	N	I	[20]	Yes		
8	O	I	[20]	Yes		
13	Al	I	[18]	Yes		
31	Ga	I	[18]	Yes		
49	In	I	[18]	Yes		

*References to other calculations and experimental measurements for each atom are shown beside the graph for that atom.

Physical Measurement Laboratory — National Institute of Standards and Technology

Electron-Impact Cross Sections for Ionization and Excitation

Introduction and References | Table of Atoms | Table of Molecules

Select a molecule of interest to view its data.

BEB References*

Small molecules	Atmospheric molecules	Oxygenates
H_2 H_2^+ HO_2 H_2O H_3O^+	H_2S N_2O NO_2	CHO
N_2 N_2^+ NH_3 NO O_2	O_3 CS COS	CH_2O
CO CO^+ CO_2	S_2 SO_2 CS_2	C_2H_3O

Hydrocarbons				
CH	C_2H_2	C_3H_3	C_4H_2	C_6H_2
CH^+	$C_2H_2^+$	C_3H_4 (allene)	C_4H_4	C_6H_6 (benzene)
CH_2	C_2H_3	C_3H_4 (propyne)	C_4H_6	C_6H_6 (fulvene)
CH_2^+	C_2H_4	C_3H_5	C_4H_8 (1-butene)	
CH_3	$C_2H_4^+$	C_3H_6	C_4H_8 (trans-2-butene)	
CH_3^+	C_2H_6	C_3H_8	C_4H_8 (isobutene)	
CH_4	$C_2H_6^+$			
CH_4^+				

Silicon and Germanium Hydrides			SiF_x	SF_x	
SiH SiH_2 SiH_3	GeH GeH_2 GeH_3		SiF SiF_2	SF SF_2 SF_3	
SiH_4 Si_2H_6 $Si(CH_3)_4$	GeH_4 Ge_2H_6		SiF_3 SiF_4	SF_4 SF_5 SF_6	

Fluorocarbons	Boron Compounds	Freons
CF CF_2 CF_3	BCl BCl_2 BCl_3	$CClF_3$ CCl_2F_2 CCl_3F
CF_4 C_2F_6 C_3F_8	BF BF_2 BF_3	$CHClF_2$ $CHCl_2F$ CH_2ClF

Select molecule by formula:

BCl – Boron monochloride
BCl2 – Boron dichloride
BCl3 – Boron trichloride
BF – Boron fluoride
BF2 – Boron difluoride
BF3 – Boron trifluoride
CClF3 – Freon 13
CCl2F2 – Freon 12
CCl3F – Freon 11
CF – Fluoromethylidyne

Submit

- OR -

Select molecule by name:

Acetylene – C2H2
Acetylene ion – C2H2+
Allene – C3H4
Allyl – C3H5
Ammonia – NH3
Benzene – C6H6
Boron dichloride – BCl2
Boron difluoride – BF2
Boron fluoride – BF
Boron monochloride – BCl

Submit

Version History & Citation Information | Disclaimer

NIST Atomic Spectra Database

Version 5

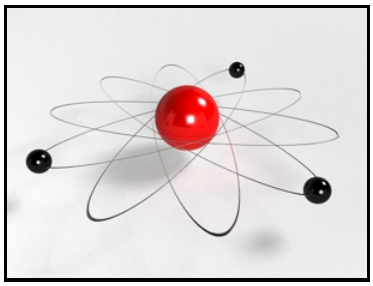
Welcome to the NIST Atomic Spectra Database, NIST Standard Reference Database #78. The spectroscopic data may be selected and displayed according to wavelengths or energy levels by choosing one of the following options:

Lines — Spectral lines and associated energy levels displayed in wavelength order with all selected spectra intermixed or in multiplet order. Transition probabilities for the lines are also displayed where available.

Levels — Energy levels of a particular atom or ion displayed in order of energy above the ground state.

Ground States & Ionization Energies — Ground states and ionization energies of atoms and atomic ions.

Additional information about the database may be obtained through the following links:



NIST ASD Team

Principal Developers (Currently Active):
Alexander Kramida, Yuri Ralchenko, and Joseph Reader

Data Compilers (Currently Active):
Alexander Kramida, Edward B. Saloman, Jean E. Sansonetti, Jeffrey R. Fuhr, Larissa I. Podobedova, and Wolfgang L. Wiese

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Physical Measurement Laboratory

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Molecular Spectroscopic Data

- Microwave Spectral Data:
  - Diatomics
  - Triatomics
  - Hydrocarbons
- Wavenumber Tables for Calibration of Infrared Spectrometers
- Frequencies for Interstellar Molecular Microwave Transitions
- Photoionization of CO_2 (ARPES)
- Equations & Underpinning Theory:
  - Diatomic Rotational Calculations
  - Methane Symmetry Operations

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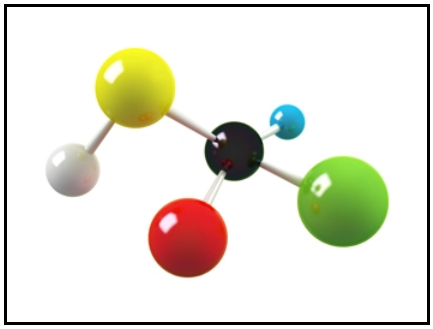

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Microwave Spectral Data: Diatomics, Triatomics, and Hydrocarbons

F.J. Lovas, E. Tiemann, and R.D. Suenram

These three databases of diatomic, triatomic, and hydrocarbon molecules were originally published as spectral tables in the Journal of Physical and Chemical Reference Data. Each of the databases covers primarily the microwave region with some data available for the radio frequency region.

Physical Reference Data

Contact

General Information:
301-975-4200 Telephone
301-975-3038 Facsimile

100 Bureau Drive, M/S 8400

http://dbshino.nifs.ac.jp/

ATOMIC AND MOLECULAR DATA RESEARCH CENTER, NATIONAL INSTITUTE FOR FUSION SCIENCE (NIFS, JAPAN)

Information on the NIFS Bibliographic and Atomic and Molecular Numerical Database

We have Atomic and Molecular (A & M) numerical databases and bibliographic databases on plasma physics and atomic physics:

Bibliographic Database

ORNL bibliographic information for atomic collisions compiled by Oak Ridge National Laboratory, USA since 1959.

A & M numerical Database

AMDIS	Ionization, excitation, and dissociation cross sections by electron impact and recombination cross sections and rate coefficients by electron impact Examples from AMDIS
CHART	Charge transfer cross sections of ions with atoms and molecular hydrogen Examples from CHART
SPUTY	Sputtering yields for monatomic solids
BACKS	Backscattering coefficients of light ions from solid
AMOL	Cross sections and rate coefficients for electron - molecule collision processes Examples from AMOL
CMOL	Cross sections and rate coefficients for heavy particle - molecule collision processes Examples from CMOL

These databases are available for research purposes.
You can use them now without registration.

Please note these databases are copyrighted:
ORNL by ORNL
AMDIS, CHART, SPUTY and BACKS by NIFS.

When you use numerical data extracted from our database in your publication, we request you to refer to our database.

[Help]

OutPut Data in AMDIS IONIZATION

#1 [Ar ($3p^6$) + e --> Ar^+ + 2e]

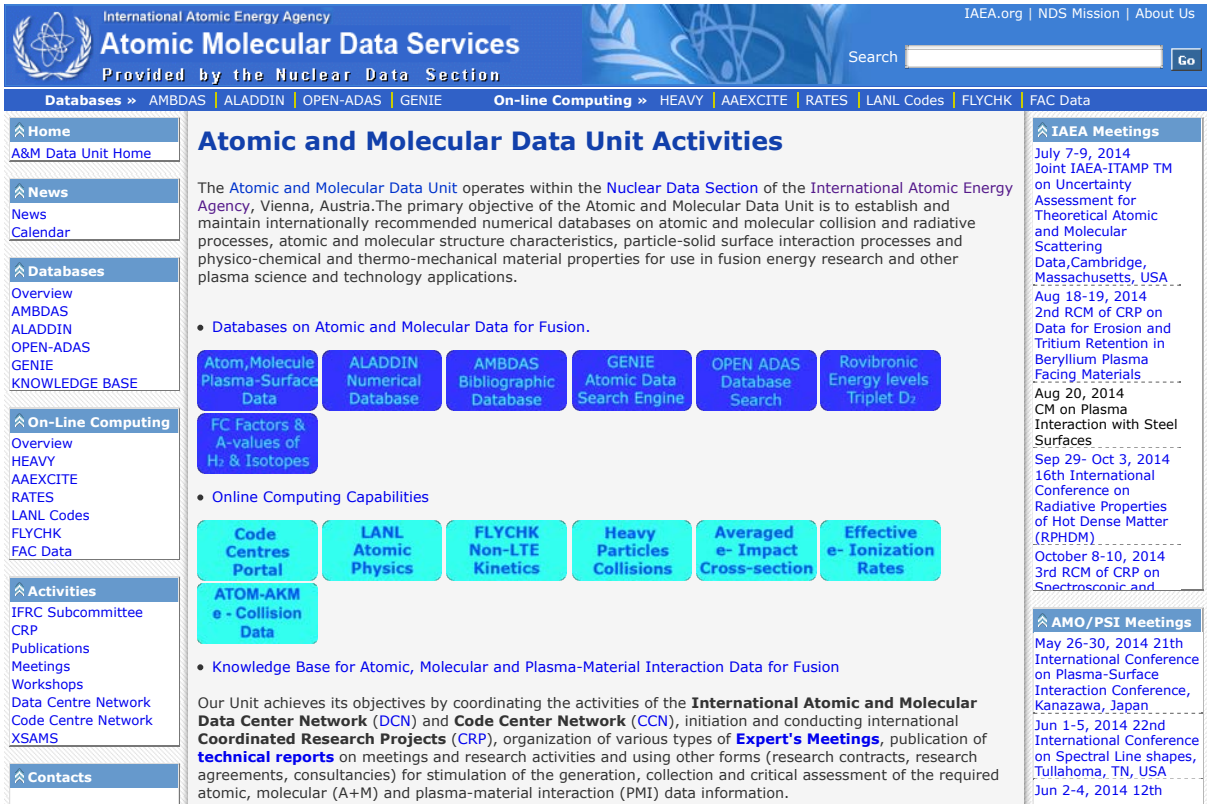
Record Number = 020701
Process = ION
Theory or Experment = T
Method = Coulomb-Born approximation with exchange
Atomic Number = 18
Element = Ar
Ionic State = 0
#Of Electrons = 18
Initial State = Ar +0
Initial State Ion Conf = 3p^6`
Final State = Ar +1
Final State Ion Conf =
Data Producer =
# of Data Points = 17
Author(s) = Povyshev, V.M.$Sadovoy, A.A.$Shevelko, V.P.$Shirkov, G.D.$Vasina, E.G.$Vatulin, V.V.
Title = ELECTRON-IMPACT IONIZATION CROSS SECTIONS OF H,He,N,O,Ar,Xe,Au,Pb ATOMS AND THEIR IONS IN THE ELECTRON ENERGY RANGE FROM THE THRESHOLD UP TO 200 keV
Journal Name = Commun. Joint Inst. Nucl. Res. Dubna
Volume and Issue No =
Page of Publication =
Date of Publication = 2001
Comment = Table5.1. Atom code
Sub Comment =
AM Record No. =
ORNL Record No. =

#2 [Ar ($3s^23p^6$) + e --> Ar^+ ($3s3p^6$) + 2e]

International Atomic Energy Agency
Atomic Molecular Data Services
Provided by the Nuclear Data Section

https://www-amdis.iaea.org/

ATOMIC AND MOLECULAR DATA UNIT, INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)



ALADDIN

Numerical database maintained by the IAEA Nuclear Data Section A+M Data Unit

Atomic and Molecular Data

Electron Collisions
Photon Collisions
Heavy Particle Collisions

Particle-Surface Interactions

Erosion, Sputtering, Sublimation
Reflection
Trapping, Penetration

Note

Data presented here are IAEA recommended at their time of compilation. Data are mostly compiled from the IAEA APID series, published results of Co-ordinated research projects (CRP) and from consultancies inside the IAEA Atomic and Molecular Data Unit.

The Author's Units for heavy particle collision cross-sections from 3 publications (NUC-FUS-SUPP/87 (1987), ORNL-6090 (1987), ORNL-6086 (1990)) were given incorrectly in ALADDIN as eV. The correct Author's Units are eV/amu. This was fixed on 2010-Feb-10.

Dictionary Glossary Comments AMBDAS A+M Data Unit IAEA

Go to data selection | Filter from selection | Reset request

Category	Process Category
Heavy particle collisions Electron collisions Photon collisions	Charge Exchange Detachment Dissociation Elastic Scattering

Reactant 1	Product
hv e H D	hv e 2e 3e

Data Quantity	Data Type	Accuracy
Differential Cross Sections Rate Coefficients Cross Sections	Derived Experimental Theoretical	3% or better 3% to 10% 3% to 25% 3% to 50%

Author	Publication	Date
J. Abdallah Jr. V.V. Afrosimov F. Aumayr C.F. Barnett	ADNDT, 33 (1985) ADNDT, 42 (1989) CLM-R294 (1989) H-HE-PLASMA (1987)	1980 1985 1987 1988

Go to data selection | Filter from selection | Reset request

Dictionary Glossary Comments Home

Electron collisions / N
Cross Sections

Reset page | Complete restart

Cross sections
select all data

Go to numerical data
Reset form

Units in: eV | Energy origin: Projectile
Apply unit conversion

1	2	3	4	Reactants	Products	7	Comment	Authors	Year	Publication	Validity Limits in eV	
☑	ION	A	DER	e, N [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	1.45000e+01	----- (E_P)
☑	ION	A	DER	e, N^+ [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	2.96000e+01	----- (E_P)
☑	ION	A	DER	e, N^{2+} [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	4.75000e+01	----- (E_P)
☑	ION	A	DER	e, N^{3+} [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	7.75000e+01	----- (E_P)
☑	ION	A	DER	e, N^{3+} [*]		BELI	comment	M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	6.91000e+01	----- (E_P)
☑	ION	A	DER	e, N^{4+} [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	9.79000e+01	----- (E_P)
☑	ION	B	DER	e, N^{5+} [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	5.52100e+02	----- (E_P)
☑	ION	A	DER	e, N^{6+} [G]		BELI		M.A. Lennon et al.	1988	JPCRD, 17/3 (1988)	6.67000e+02	----- (E_P)

Fitting Function Sources | BELI |

Output options				
Boundaries			Plot options:	Fitting coefficients
minimal X	maximal X	Number of points	PNG and PDF file: yes ☑ X log: ☑ Y log: ☑	show table ☐
1.45000e+01	2.e+4	50		

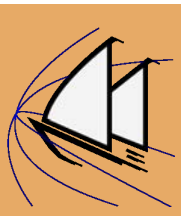
Go to numerical data
Reset page | Complete restart

http://esther.ist.utl.pt/

EUROPEAN SHOCK-TUBE FOR HIGH-ENTHALPY RESEARCH, INSTITUTE FOR PLASMAS AN NUCLEAR FUSION

ESTHER team

- ESTHER is part of the Gaseous Electronics Group of the Institute for Plasmas an Nuclear Fusion, an Associated Laboratory of Instituto Superior Técnico.
- The team hosts the European Shock-Tube for High Enthalpy Research, where experimental research on plasma radiation of high-speed (>10km/s) shocked flows is carried out.
- The team also carries theoretical and numerical research on non-equilibrium kinetics and radiation in hypersonic shocked flows.



GAS AND PLASMA RADIATION DATABASE

ESTHER Home **Home** Database Links Contact us

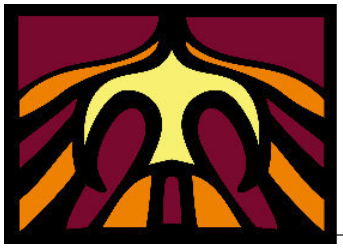
Gas and Plasma Radiation Database

Overview

The Gas and Plasma Radiation Database (GPRD) is a database containing all the relevant data defining the spectroscopic and radiative data for the overall atomic and diatomic species of atmospheric interest. Compilations of numerical data published by different authors is available in downloadable forms. The database is freely provided as is to the scientific community, without any warranty of any kind. Access to the database only requires the users to fill a **request form** and send it to the database manager (**mlinodasilva@mail.ist.utl.pt**) in order to be provided with the password to the datafiles.

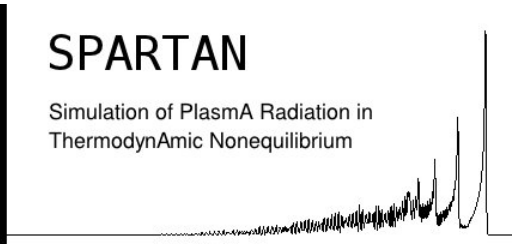
Scope

The database development team works in the field of high-temperature plasma radiation modelling (atmospheric entry and high temperature plasma sources). This database therefore mainly provides spectroscopic data for H, C, N, and O containing diatomic molecules. Most of the radiative transitions included in the database are rovibronic transitions, but ground-state transitions (rovibrational transitions) are also provided. In the near-future, it is expected to widen the initial scope of this database to nearby research fields (such as astrophysics or the study of atmospheric opacities). Future updates expected to occur include widening the GPRD molecular dataset to include minor isotopic species, and eventually to include more diatomic molecular species.
The database encompasses in it's present version over 300 different datasets and is ever growing. Users of the databse are strongly encouraged to **share** available data with the database managers in order to improve the



SPARTAN

Simulation of PlasmA Radiation in ThermodynAmic Nonequilibrium



home description database RKR_SCH Ray-Tracing license manual examples

The line-by-line radiative code SPARTAN

The numerical code SPARTAN is a Line-by-Line code for the simulation of high-temperature, low-pressure plasma radiation, with an emphasis on radiation from entry plasmas, plasma sources, and Hall effect thrusters.

The code has been developped in MATLAB and FORTRAN languages, and is freely distributed for academic and research purposes.

The spectral database of the code encompasses over 60 bound, bound-free, and free radiative transitions. This allows simulating high temperature gases and plasmas radiation for Earth (Air) and Martian-type (CO_2-N_2) mixtures, with typically 10,000 to 1,000,000 lines and the superposition of several continua. Other gas mixtures are partially implemented, enabling a variety of other simulations in general plasma science.

The current version of the code is **SPARTAN v2.5**, dated **July 2013**.

Dor any questions please contact the developper of the code:

Dr. Mário LINO DA SILVA
mlinodasilva@ist.utl.pt

Detailed description of the code

The code numerical routines are capable of simulating bound-bound atomic and molecular radiation with fine-structure effects (singlet, doublet and triplet transitions, with Lambda-doubling effects). Bound-free radiation

STELLAR Database

The STELLAR Database

The STELLAR database compiles a complete multiquantum dataset of vibrationally-specific rates for the simulation of the ground molecular states of Air (N_2, O_2, and NO).

The database encompasses over 34,000 rates for V-T, V-D, recombination, and Zeldovich rates.

for any questions please contact the maintainer of the database:

Dr. Mário LINO DA SILVA
mlinodasilva@ist.utl.pt

Database files (in MATLAB format)

3D Matrix, with (AB(vi),AB(vf),T)

The last vi, vf level corresponds to dissociated A+B (for a matrix with V-T, V-D and D-V processes). The Temperature interval is T=[100:100:100000]. The rate units are in log10(cm^3/particle)

STELLAR has been presented at the 5th ESA Radiation of High Temperature Gases in Atmospheric Entry in Barcelona, 16-19 Oct. 2012.

Software packages with databases

EMISSION/ABSORPTION SPECTRAL SIMULATIONS

specair

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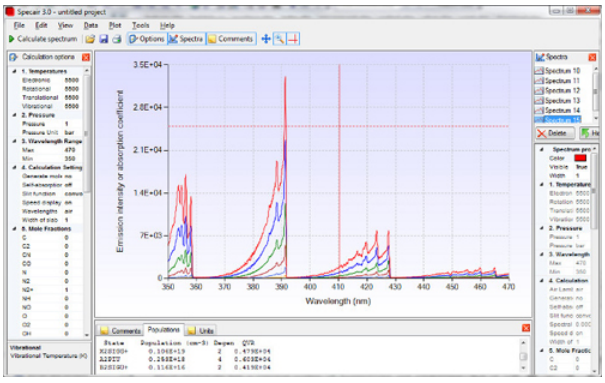
specair: spectral fitting made easy



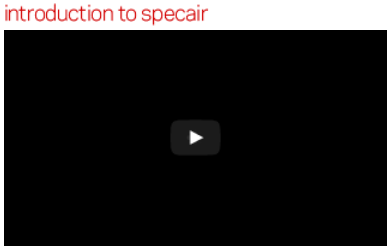
specair is the leading software for calculating and fitting plasma spectra

A demo version of Specair is available here:

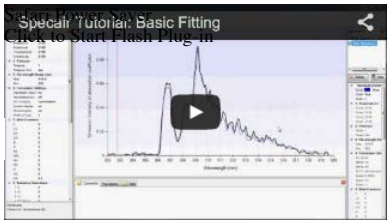
download specair

video tutorials

introduction to specair



basic fitting



global fitting

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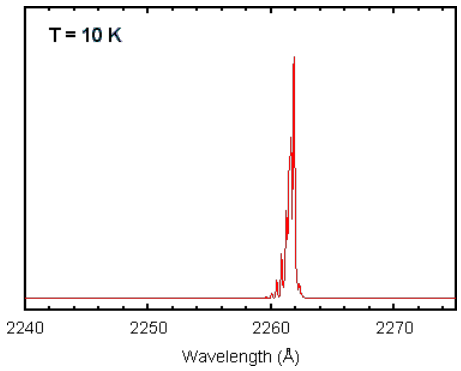
Products + Solutions

LIFBASE Spectroscopy Tool

LIFBASE is a free software program to chart the spectroscopy of diatomic molecules that is available as freeware from SRI. The software is compatible with all 32-bit Windows versions. No support is available.

Download Software



Features include:

Comprehensive Database Capabilities

- Absolute rovibrational emission and absorption coefficients
- Variation of transition probabilities taking into account rovibrational wavefunctions and electronic transition moments
- Rotational radiative lifetimes and tabulated predissociation rates
- Frequencies for all rovibrational transitions

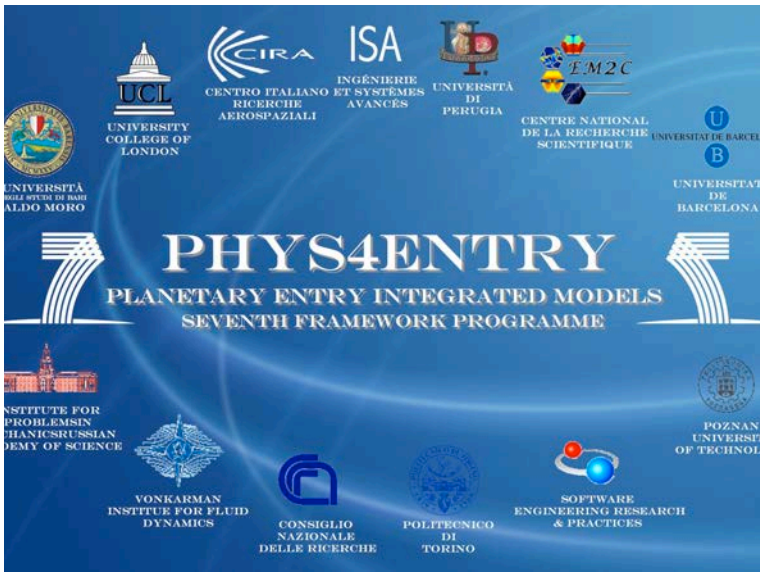
Spectral Simulation

- Optical emission, absorption, excitation laser-induced fluorescence
- Thermal and non-thermal population distributions

PLASMA CHEMICAL KINETICS

bad news

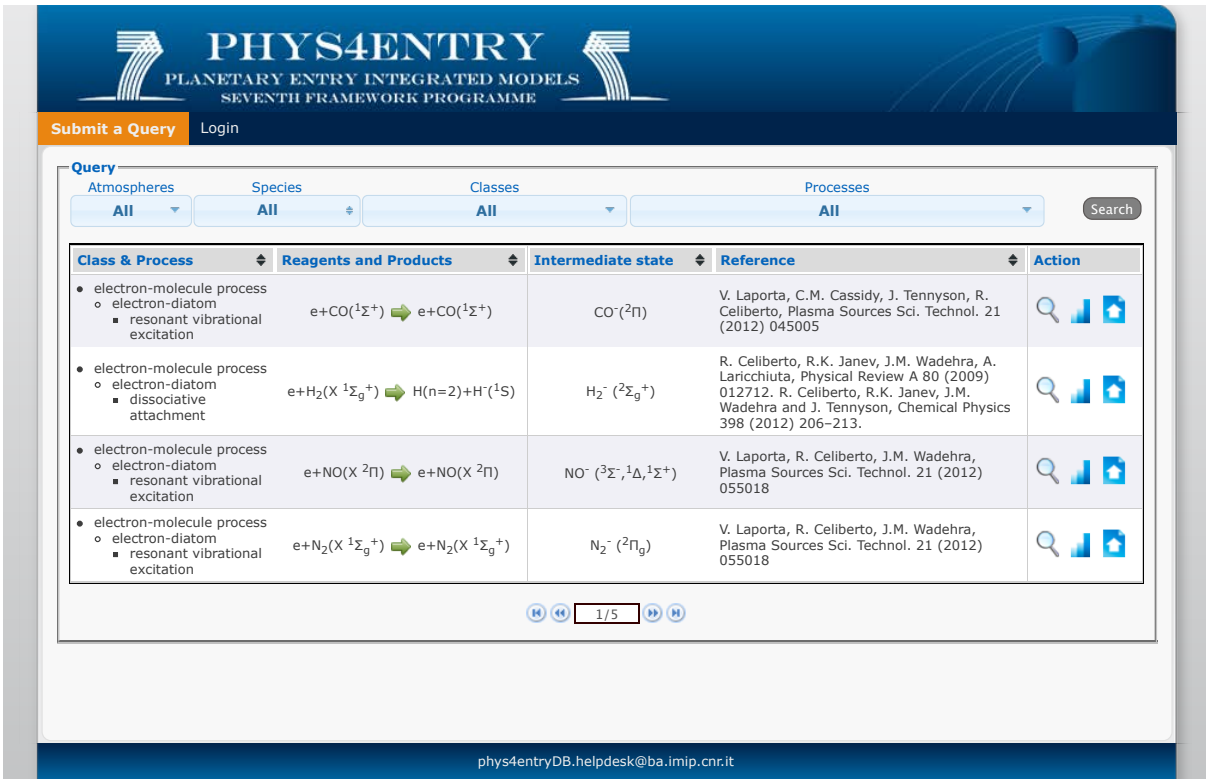
- In the majority of cases, plasma kinetic models are not freely available. Some of them are (partly) published, e.g.
  - 02: Annemie Bogaerts, Modeling of plasmas
  - MC 05: Daniil Marinov, New perspectives on surface-kinetics
  - MC 06: Vasco Guerra, Kinetic modeling of air plasmas: self-consistency, bottlenecks, successes



Planetary Entry Integrated Models

http://users.ba.cnr.it/imip/cscpal38/phys4entry/

see MC03: Annarita Laricchiuta, The state-of-the-art description of vibrational-electronic excitations



STELLAR Database

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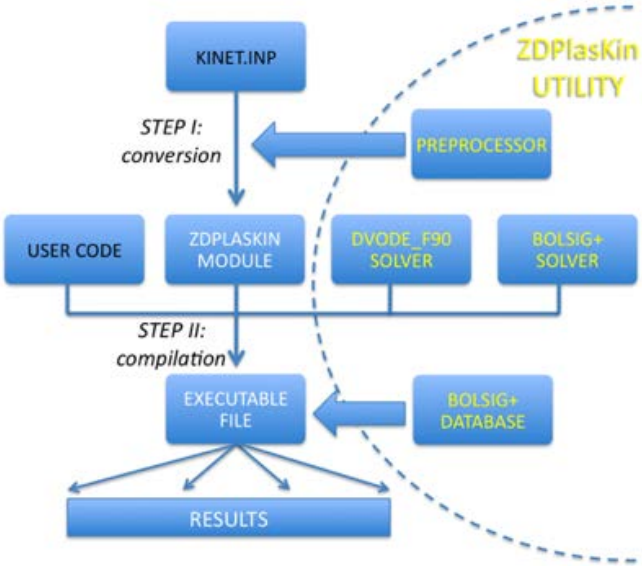

ZDPLASKIN: ZERO-DIMENSIONAL PLASMA KINETICS

http://www.zdplaskin.laplace.univ-tlse.fr/

ZDPLASKIN: ZERO-DIMENSIONAL PLASMA KINETICS

last update 16-feb-2014
google group

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N_2-O_2 MIXTURES

A ready-to-use complete list of plasmachemical processes in nitrogen-oxygen mixtures taken mainly from the book M. Capitelli, C.M. Ferreira, B.F. Gordiets and A.I. Osipov "Plasma Kinetics in Atmospheric Gases" (2000) Springer is available.

version 1.02

This is the version 1.02 and we encourage you to test it for your cases and send us your suggestions and contributions in order to improve this data.

This state-specific model of N_2-O_2 mixture includes a set of about 430 chemical reactions with the participation of 44 states, namely, molecules $N_2(X^1, v = 0 - 8)$, $N_2(A^3, B^3, a'^1, C^3)$, $O_2(X^3, v = 0 - 4)$, $O_2(a^1, b^1, 4.5eV)$, O_3, NO, atoms $N(^4S, ^2D, ^2P)$, $O(^3P, ^1D, ^1S)$, positive ions N^+, N_2^+, N_3^+, N_4^+, O^+, O_2^+, O_4^+, NO^+, $O_2^+N_2$, negative ions O^-, O_2^-, O_3^-, O_4^-, NO^- and electrons E.

The model also accounts the excitation of other electronic states of nitrogen and oxygen, but assumes instantaneous relaxation $N_2(W^3,B'^3) \Rightarrow N_2(B^3)$, $N_2(a^1,w^1) \Rightarrow N_2(a'^1)$ and $N_2(E^3,a''^1) \Rightarrow N_2(C^3)$. The generalized level $O_2(4.5eV)$ corresponds to $O_2(A^3, C^3)$ and $O_2(c^1)$ states.

Transport parameters and constant rates for electron-neutral interactions are calculated using build-in into the package BOLSIG+ solver. The density of 20 species, namely $N_2(X^1, v = 0 - 8)$, $O_2(X^3, v = 0 - 4)$, $N_2(A^3)$, $O_2(a^1)$, N, O, NO, O_3 and 78 collisional processes including super-elastic collisions with above-mentioned states are used solving the Boltzmann equation for electron energy distribution function.

Requred cross sections for electron processes with species indicated in section **BOLSIG** have to be stored in *bolsigdb.dat* data file. In the present example, these electron cross sections were retrieved from ELECTRON SCATTERING DATABASE, **SIGLO**(N_2,O_2) and **Phelps**(NO) databases. This cross-section database has to be completed with the cross sections for N, O atoms and N_2(A3), O_2(a1), O_3 species available at Kinema Research & Software, Humid air chemistry database, http://www.kinema.com/download.htm.

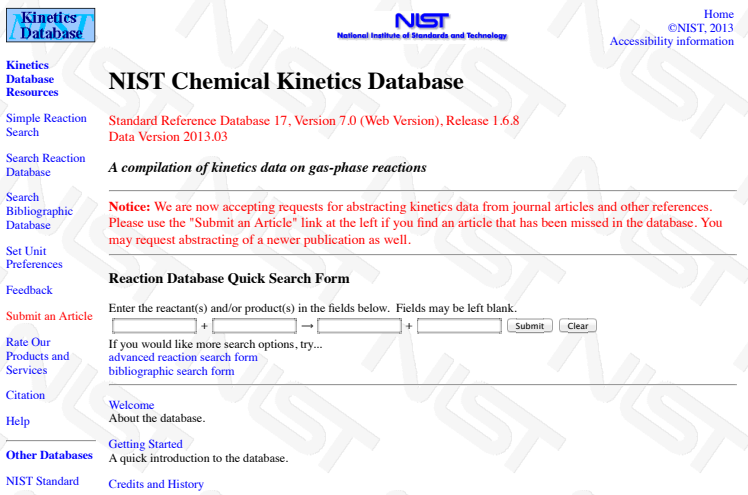
The constant rates of VT relaxation were applied for all vibrational levels using the harmonic oscillator model. A set of reverse processes was built with constant rates obtained using the principle of detailed balance.

version 1.03

A work-in-progress version 1.03 is also available for downloading. The following NxOy species with corresponding reactions are added: N_2O, NO_2, NO_3, N_2O_5, N_2O^+, NO_2^+, N_2O^- NO_2^- NO_3^-.

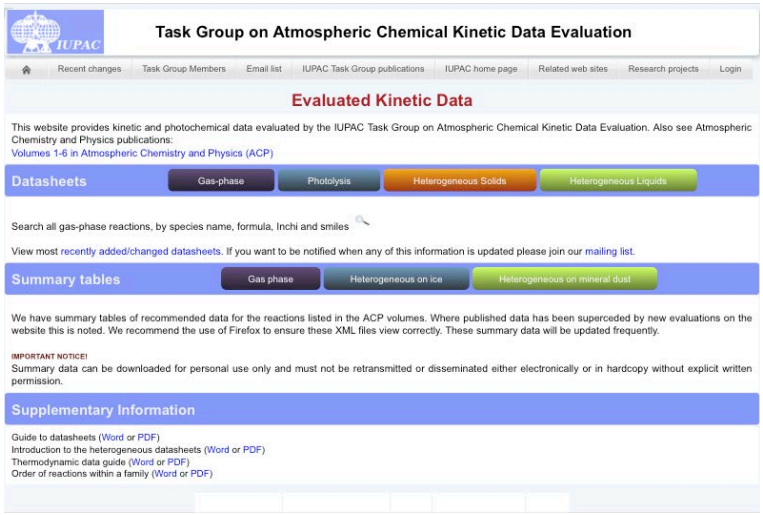
You can download all these files in a zip archive.

CHEMICAL KINETICS



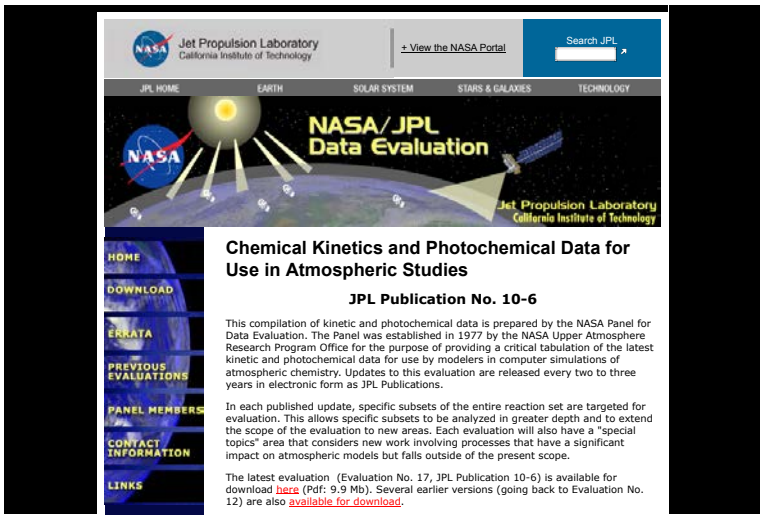
NIST Chemical Kinetics Database - Gas-Phase

http://kinetics.nist.gov/kinetics/



Task Group on Atmospheric Chemical Kinetic Data Evaluation, IUPAC (International Union of Pure and Applied Chemistry)

http://iupac.pole-ether.fr/



NASA Chemical Kinetics and Photochemical Data for Use in Atmospheric Studies

http://jpldataeval.jpl.nasa.gov/

PROJECT OVERVIEW

Introduction
What is GRI-Mech?
How to use GRI-Mech
Please tell us what you learn, and about your problems
Some cautionary notes

INTRODUCTION

The results reported on these Web pages are products of computational and experimental research sponsored by the Gas Research Institute. It has been carried out at The University of California at Berkeley, Stanford University, The University of Texas at Austin, and SRI International.

GRI-Mech is an optimized detailed chemical reaction mechanism capable of the best representation of natural gas flames and ignition that we are able to provide at this time. Our ongoing program comprises development of extensions to include more chemistry, more robust parameterizations, and additional tools and documentation to make working with GRI-Mech more effective for everybody.

In order to use the input files directly you need the Sandia National Laboratory Chemkin-II programs. Ignition profiles calculated with the GRI-Mech reaction mechanism and thermochemical data should be independent of the program used to compute them; noticeable small differences in flame profiles should be expected, however, if you are using a flame code other than Chemkin, because the transport calculation, the numerical method of solving the differential equations, and so on, differ from one flame modeling program to another.

More details are available on the optimization process.

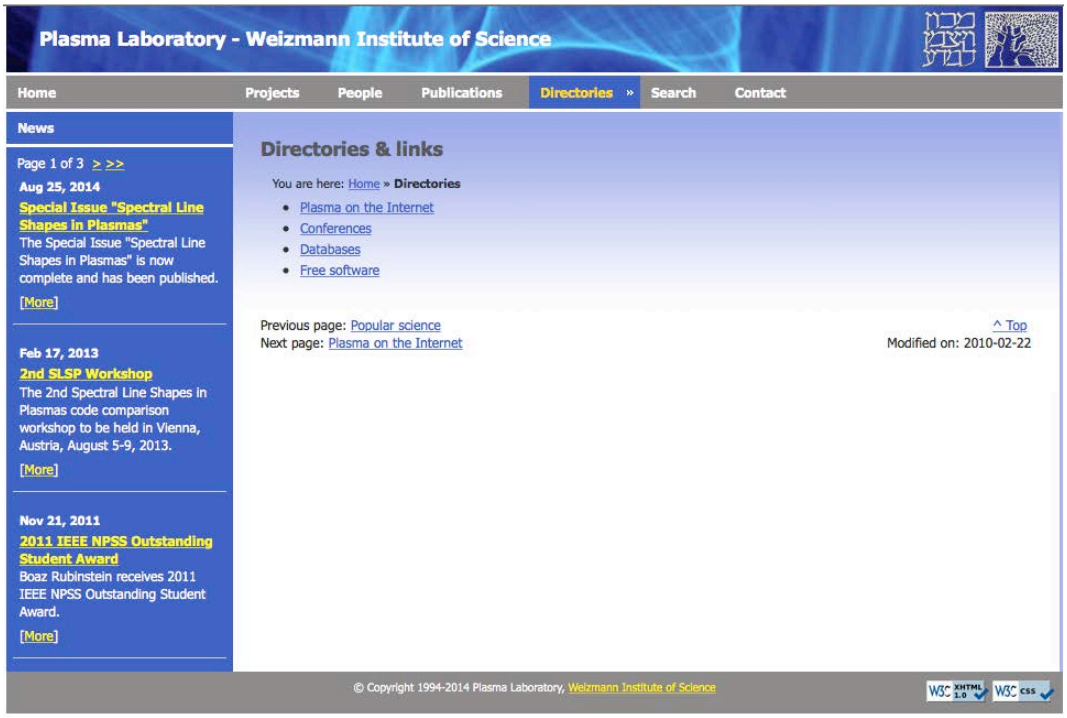
Before telling you more we are obliged to say:

GRI-Mech is an optimized detailed chemical reaction mechanism capable of the best representation of natural gas flames and ignition.

http://combustion.berkeley.edu/Combustion_Laboratory/gri-mech/

OTHER SOURCES

http://plasma-gate.weizmann.ac.il/directories/



http://plasma-gate.weizmann.ac.il/directories/

Atomic databases

- Opacity Project Database, Strasbourg, France:
  - TOPbase
  - telnet to TOPbase (password **Seaton+**) and USA Web interface
  - TOPbase user manual
  - ftp to TOPbase
  - Data for OP Opacities
- NIFS Database, Nagoya, Japan:
  - **registered** users only
  - free access
- AMDIS, IAEA, Vienna, Austria
  - AMBDAS Bibliographic Database
  - WWW ALADDIN Database
  - GENIE - General Internet Search Engine for Atomic Data
- GAPHYOR Data Center, Orsay, France
  - GENIE Mirror
- NIST PRD Databases, Gaithersburg, MD
  - Atomic Spectral Line Broadening Bibliographic Database
  - NIST Atomic Spectra Database
  - FLYCHK: Collisional-Radiative Code
  - SAHA Plasma Population Kinetics Database
  - Bibliographic Database on Atomic Transition Probabilities
  - Electron-Impact Ionization Cross Section Database
  - Spectrum of Platinum Lamp for Ultraviolet Spectrograph Calibration
  - Spectral Data for the Chandra X-Ray Observatory
  - Handbook of Basic Atomic Spectroscopic Data
  - Fundamental Physical Constants
  - Searchable Bibliography on Fundamental Constants
- Harvard-Smithsonian Center for Astrophysics Databases, MA
  - R.L.Kurucz site
  - Search R.L.Kurucz atomic linelist (CD-ROM 18 and CD-ROM 23)
    - European mirror of CD-ROM 23 database
  - Search R.L.Kelly atomic and ionic linelist
  - Chandra X-Ray Center: Atomic Database ATOMDB
  - Energy Levels of Hydrogen and Deuterium
- Uppsala University, Sweden
  - COREX Database
  - Electron binding energies
  - Henke scattering factors
  - X-Ray emission lines
- ORNL Controlled Fusion Atomic Data Center, Oak Ridge, TN
  - CFADC Bibliographic Database
  - Electron-Impact Excitation of Multicharged Ions at ORNL
  - Electron-Impact Ionization of Multicharged Ions at ORNL
- University of Kentucky, KY
  - Atomic Data for Astrophysics
    - Photoionization
    - Recombination
    - Collisional Ionization and Autoionization
    - Charge Transfer
    - Auger Processes
    - Energy Levels, Wavelengths, Transition Probabilities
    - Collision Strengths, Excitation Rates
    - Stark Broadening
    - Opacities
  - The Atomic Line List
- Observatory of Paris-Meudon, France
  - Bibliography Database on Atomic Line Shapes and Shifts
  - STARK-B: Database for Stark broadening of isolated lines of atoms and ions in the impact approximation
  - Stark Broadening Parameters for Neutral and Singly Charged Ions
- VALD: Vienna Atomic Line DataBase, Vienna, Austria
- MCHF/MCDHF Collection
- CHIANTI: A Database for Astrophysical Emission Line Spectroscopy
- CDS Catalogues, Strasbourg, France
- Atomic Data for Resonance Absorption Lines, Herzberg Institute of Astrophysics, Canada
- BIBL: spectral bibliography database, Institute of Spectroscopy, Russia (ftp version)
- Public domain archives of programs and data for physics, Masaryk University, Czech Republic
- RTAM Database, University of Helsinki, Finland
- Interactive Elastic Photon-Atom Scattering Database, Lawrence Livermore National Laboratory, CA
- Los Alamos National Laboratory, NM
  - Opacities of Mixtures Database
  - Atomic Structure and Cross Sections
- DABAX: DAtaBAse for X-rays, European Synchrotron Radiation Facility, France
- CCC Database, Curtin Universityi of Technology, Perth, Australia
- AMODS, Taejon, Korea
- Energy levels and transition probabilities (orthogonal operator technique), Amsterdam, Th Netherlands
- JEAMDL -- Japanese Evaluated Atomic and Molecular Data Library, JAERI, Japan
- DREAM -- Database on Rare Earths At Mons University, University of Mons-Hainaut, Belgium
- SPECTR-W^3 -- Database on Spectral Properties of Atoms and Ions, Snezhinsk, Russia
- CAMDB, Beijing, China
- Energy levels and atomic spectra of actinides, Paris, France
- Time-Dependent Ionization in Radiative Cooling Gas, TAU, Israel
- LAPLACE, CNRS and University of Toulouse, France
  - LXcat - electron scattering database
  - ICEcat - ion scattering database

Plasma Databases

- NASA/Goddard:
  - Goddard SFC Databases
  - Heliospheric Field and Plasma Data
  - OMNIWeb
  - COHOWeb
- Magnetic Fusion Energy Database, University of Texas at Austin
- ITER Databases and Modeling Activities

VAMDC consortium: www.vamdc.eu (development phase)

software packages with databases

- Boltzmann solvers:
  - BOLSIG (predecessor of BOLSIG+ and SIGLO)
  - MAGBOLTZ (http://consult.cern.ch/writeup/magboltz/)
  - ELENDIF (Kinema Research, USA)
  - EEDF code (http://www.lxcat.net/download/EEDF/)
- Emission/absorption spectra:
  - SPECAIR (http://www.specair-radiation.net/)
  - LIFBASE (http://www.sri.com/engage/products-solutions/lifbase)
- Gas/liquid/solid thermodynamics (LTE composition):
  - CANTERA & NASA database (code.google.com/p/cantera/)

don’t forget “old-fashion” regular publications, reports & private communications

AIP | Journal of Physical and Chemical Reference Data

ISSN: 0047-2689
E-ISSN: 1529-7845

Journal of Physical and Chemical Reference Data is the authoritative resource for critically evaluated reference data for physical science and engineering disciplines. Th journal publishes papers which report the best available measurements for the relevar properties.

CONCLUSIONS

Where do I get data, finally?

- Step 1: check specific plasma databases
  - LXCAT, GAPHYOR, MAGBOLTZ, ESTHER, GELDC, etc.
- Step 2: check general-purposes databases
  - NIST, NIFS, IAEA, IUPAC, NASA, etc.
- Step 3: search in the Internet and publications
  - Libraries, Google Scholar, Research Gate, etc.
- Step 4: ask colleagues
  - e.g. LXCAT discussion board
- Step 5: be critical