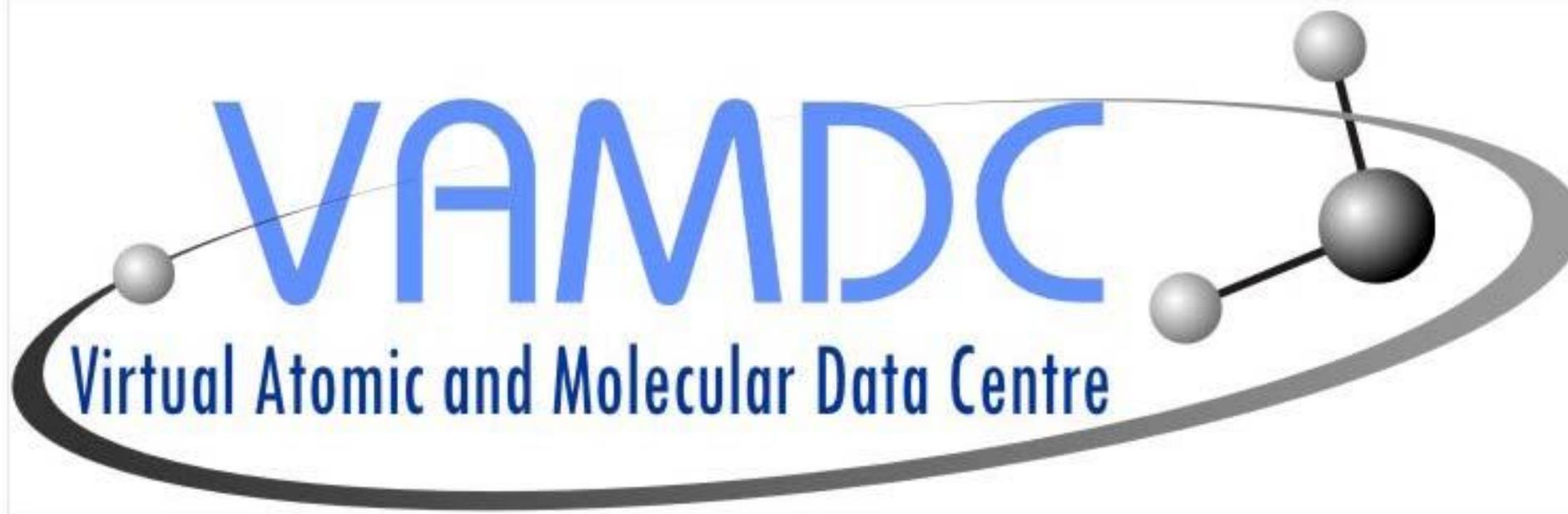# EUROPEAN VIRTUAL ATOMIC AND MOLECULAR DATA CENTER (VAMDC) AND STARK-B DATABASE

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VAMDC

Virtual Atomic and Molecular Data Centre

Virtual Atomic and Molecular Data Center

Virtual Atomic and Molecular Data Center (VAMDC) is an European FP7 project with aims to build a flexible and interoperable e-science environment based interface to the existing Atomic and Molecular data. It is a complex project including 15 institutions with 24 scientific groups France, Serbia, Russia, England, Austria, Italia, Germany, Sweden and Venezuela.

VAMDC

Collaboration between groups involved in the generation, evaluation, and use of atomic and molecular data. VAMDC aims to build a secure, documented, flexible and interoperable e-science environment-based interface to existing atomic and molecular databases. It will also provide a forum for training potential users .

1. Vienna Atomic Line Database (VALD)

The VALD database of atomic data for analysis of radiation from astrophysical objects. Created in 1995 in Vienna. The nodes are in Vienna, Uppsala and Moscow. VALD provides an e-mail and web-based user interface to a vast collection of spectral line parameters (central wavelengths, energy levels, statistical weights, transition probabilities, line broadening parameters) for all chemical elements of astronomical importance

2. CHIANTI

CHIANTI is an atomic database for spectroscopic diagnostics of astrophysical plasmas. Created in 1997, it is a database for ions of astrophysical importance. It is used in the analysis of optically thin collisionally ionised plasmas and is the preferred reference database in solar physics. The CHIANTI data and programs are distributed via SolarSoft (sohowww.nascom.nasa.gov/solarsoft) to the solar community, but are also available on the web (www.damtp.cam.ac.uk/user/astro/chianti/) as a large number of ASCII files.

3. EMol

The EMol Database (Open University), provides a comprehensive listing of measured and calculated cross sections for electron interactions with molecular systems.   Access is also provided to a suite of semi-empirical theoretical methods so that cross sections may be evaluated for targets for which there are currently no experimental data.

4. CDMS

Cologne Database for Molecular Spectroscopy (CDMS) (http://www.ph1.uni-koeln.de/vorhersagen/) provides recommended values of spectroscopic transition frequencies and intensities (including error estimates) for atoms and molecules of interest to the astronomical community and for studying the terrestrial atmosphere.

5. BASECOL

The BASECOL database (http://basecol.obspm.fr) provides excitation rate coefficients for ro-vibrational excitation of molecules by electrons, He and H2 including error estimates.   BASECOL is mainly used for the study of interstellar, circumstellar and cometary atmospheres.

6 GhoSST

The GhoSST (Grenoble astrophysics and planetology Solid Spectroscopy and Thermodynamics, http://ghosst.obs.ujf-grenoble.fr) database service, provides spectroscopic laboratory data on molecular and atomic solids and liquids from the near UV to the far-infrared.

7.UMIST database for astrochemistry

University of Manchester Institute of Science and Technology (UMIST) Database for astrochemistry (http://www.udfa.net/), created in 1991, provides a fundamental set of reaction rate data and related software for use in chemical kinetic modelling of astronomical regions.

8. KIDA

KInetic Database for Astrochemistry (KIDA)
is a database that contains chemical reactions used in the modelling of the chemistry in the interstellar medium and in planetary atmospheres. A preliminary version was released in June 2009 (http://kida.obs.u-bordeaux1.fr)

9 Polycyclic Aromatic Hydrocarbon spectral database

The CESR (Centre d'Etude Spatiale des Rayonnements/CNRS)-Cagliari spectral database of PAHs (polycyclic aromatic hydrocarbons) and carbon clusters (http://astrochemisty.ca.astro.it/database/) makes available a number of properties for a sample of presently about 60 species.

10 LASP Database

- The LASP (Laboratorio di Astrofisica Sperimentale) Database (http://web.ct.astro.it/weblab/dbindex.html#dbindex) at the Catania Astrophysical Observatory. It provides infrared (IR) spectra and constants of molecules in the solid phase, band strengths of the most relevant IR absorption bands and other relevant quantities.

- This database is particularly useful for detailed studies of the profile of absorption bands of solid phase molecules observed in astronomical spectra recorded in the direction of interstellar molecular clouds.

11 Spectr-W3

The Spectr-W3   atomic database (Russia) includes experimental, calculated, and compiled data on ionization potentials, energy levels, wavelengths, radiation transition probabilities and oscillator strengths, and also parameters for analytic approximations for electron-collision cross-sections and rates for atoms and ions. The Spectr-W3 site (http://spectr-w3.snz.ru) has been operating on the web since 2002.

12. CDSD

- The Institute of Atmospheric Optics (IAO) in Tomsk (http://www.iao.ru/) hosts

- The Carbon Dioxide Spectroscopic Databank (CDSD) (http://cdsd.iao.ru and ftp://ftp.iao.ru/pub/CDSD-2008)

13. S&MPO

The S&MPO (Spectroscopy & Molecular Properties of Ozone) relational database (http://ozone.iao.ru http://ozone.univ-reims.fr/ Tomsk-Reims)

14 "Spectroscopy of Atmospheric Gases"

"Spectroscopy of Atmospheric Gases" (http://spectra.iao.ru Tomsk): is a compilation that contains databases HITRAN, GEISA and HITEMP. Both "Spectroscopy of Atmospheric Gases" and S&MPO have the programs for simulation of synthetic spectra from microwave to visible wavelengths.

14a HITRAN

HITRAN (HIgh-resolution TRANsmission molecular absorption database)   lists individual line parameters for molecules in the gas phase from the microwave through to the UV spectral region as well as photoabsorption cross-sections for many molecules. It is widely used by planetology community.

14b HITEMP

- HITEMP, is a high temperature extension to HITRAN. So far HITEMP only contains data for five species (water, CO_2, CO, NO and OH), but the extension to elevated temperatures leads to a vast increase in the number of spectral lines in the database.

- GEISA An archive for Earth and planetary atmospheric studies

15 W@DIS

W@DIS (Water Internet @ccessible Distributed Information System) (http://wadis.saga.iao.ru Tomsk) contains experimental water-vapour spectroscopy data from the literature and calculated line lists. W@DIS contains energy levels, transition positions and line intensities, and line profile characteristics.

16.TIPTOP

TIPTOPbase located at the Centre de Données astronomiques de Strasbourg, France (http://cdsweb.u-strasbg.fr/topbase/home.html), contains the atomic data computed in the Opacity Project and Iron Project, namely energy levels, gf-values, A-values, photoionization cross sections and electron impact cross sections and rates for light chemical elements with atomic number, Z = 1 - 28.

17 OPserver

OPserver, located at the Ohio Supercomputer Center, USA, (http://opacities.osc.edu/), is a remote, interactive server for the computation of mean opacities for stellar modelling using the monochromatic opacities computed by the Opacity Project. It can be accessed through a web portal or from a stellar modelling code.

The NIST (National Institute of Standards and Technology) Atomic Database

- Atomic Spectra Database contains evaluated data on about 77,000 energy levels and 144,000 spectral lines from atoms and ions of 99 elements.

- Handbook of Atomic Spectroscopic Data contains energy levels and prominent spectral lines for neutral and singly ionised atoms.

- The Spectral Data for the Chandra X-Ray Observatory database presents critically compiled wavelengths (20 Å to 170 Å), energy levels, line classifications, and transition probabilities

- Three bibliographic databases contain references on atomic energy levels and spectral lines, transition probabilities and spectral line shapes and line broadening
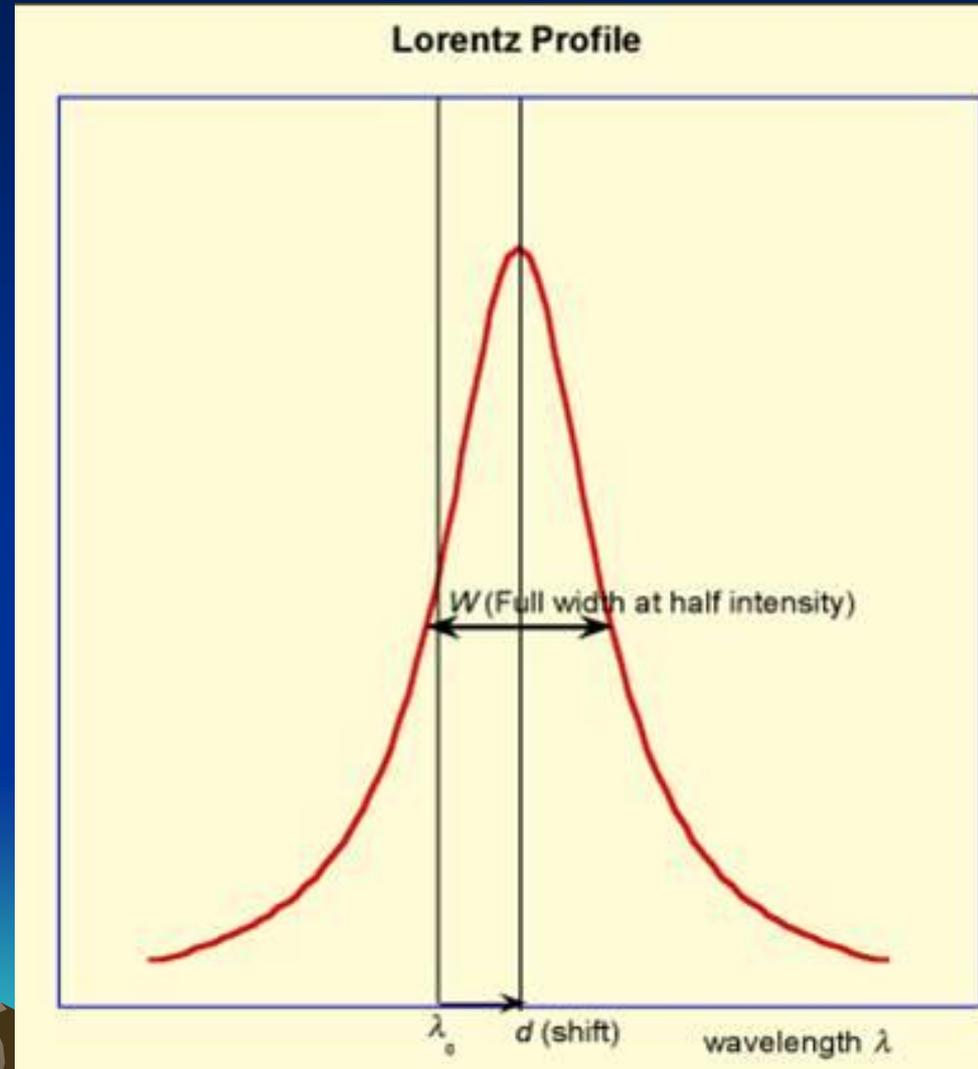
STARK-B

- http://stark-b.obspm.fr/
- This is a database of calculated widths and shifts of isolated lines of atoms and ions due to electron and ion collisions.

  This database is devoted to modellisation and spectroscopic diagnostics of stellar atmospheres and envelopes. In addition, it is also devoted to laboratory plasmas, laser equipments and technological plasmas.

Broadening by interaction with charged particles =

STARK BROADENING

Lorentz Profile

W (Full width at half intensity)

λ_0 d (shift)   wavelength λ

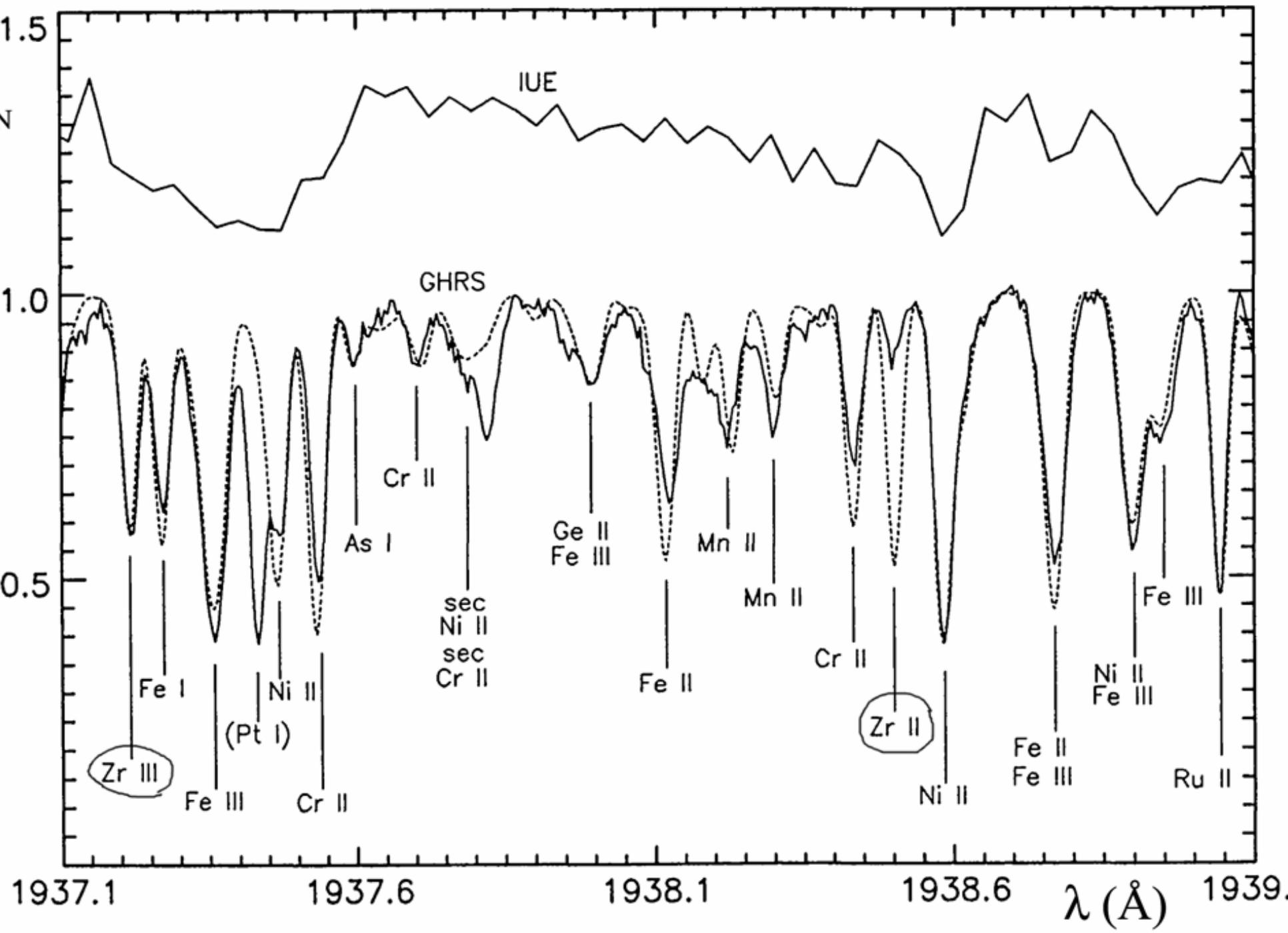# STARK-B

Scientific objectives:
 Spectroscopic diagnostics,
 Modelisation
 Synthetic spectra

Addresses
 Astrophysics
 Virtual Observatories
 Laboratory and technological plasmas

NEEDS FOR LARGE STARK BROADENING DATA SET

- DEVELOPMENT OF COMPUTERS FOR EXAMPLE: PHOENIX CODE FOR MODELLING OF STELLAR ATMOSPHERES INCLUDES A PERMANENTLY GROWING DATABASE WITH ATOMIC DATA FOR MORE THAN 500 MILLIONS TRANSITIONS

- SATELLITE BORNE SPECTROSCOPY

STARK BROADENING IS IMPORTANT FOR:

- **PLASMAS IN ASTRONOMY**
- **LABORATORY PLASMAS**
- **PLASMA TECHNOLOGIES**

STARK BROADENING DATA ARE NEEDED IN ASTRONOMY FOR EXAMPLE FOR:

- **STELLAR PLASMA DIAGNOSTIC**
- **ABUNDANCE DETERMINATIONS**
- **STELLAR SPECTRA MODELLING, ANALYSIS AND SYNTHESIS**
- **CHEMICAL STRATIFICATION**
- **SPECTRAL CLASSIFICATION**
- **NUCLEAR PROCESSES IN STELLAR INTERIORS**
- **RADIATIVE TRANSFER**
- **STELLAR OPACITIES**

LABORATORY PLASMAS

- **PLASMA DIAGNOSTIC**
- **PLASMA MODELLING**
- **LASER PRODUCED PLASMA**
- **FUSION PLASMA**

PLASMAS IN TECHNOLOGY

- ## LASERS

- ## LIGHT SOURCES

VAMDC

- Astronomical and plasma science
- Atmospheric Science
- Technological plasma
- Fusion community
- Radiation science
- Lightning industry

ACKNOWLEDGEMENT