The ADAS-EU and ADAS Projects

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ADAS workshop
3 Sep 2013
Bad Honnef

ADAS-EU

European Union Framework 7 Support Action for fusion in Europe; Jan 2009 - Dec 2012.

Univ. of Strathclyde research staff based full-time at fusion labs. in Europe - CCFE Culham/ JET Facility, IPP Garching, Fz-Juelich, CEA Cadarache/ITER.

Included eight sub-contracts for special studies.

Extension to Sep 2013 for further knowledge transfer - including ITER participating countries outside Europe.

The ADAS-EU team

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ADAS-EU: physics theme support time chart

Figure 1

ADAS-EU: Physics theme and sub-theme support time chart

Theme	Code	Actions	2009	2010	2011	2012
Heavy element [1] spectroscopy and models	T1	applic.		Superstages & emissivities		Global scaling
		fund.	Baseline & emissivities [2]	Ionisation level 1	DR/GBPP level 1	Neutrals, level 2
		exploit. [3]	Heavy species in ITER studies	Tungsten spectral emission (ASDEX-U, JET)	Atomic model support of ITM for ITER	
Charge exchange spectroscopy	T2	applic.	CXSFIT shared analysis Parametric CXS	NEW-CHEAP shared analysis	CXS/UTC/transport link	
		fund.	Bundle-n & l-mix models	CTMC (improved) /CCAO/CCMC	Bundle-nl models for partially stripped receivers	
		exploit	CXS line fittiing extended to argon	Multi-line CXS region observation	Cross-linked CXS & passive diagnostic	
Beam stopping beam emission spectroscopy	T3	applic.		Li/Na beam analysis and database		Beam emission/beam stopping consistency
		fund.	Li/Na beam database	Bundle-n & Stark GCR		
		exploit.		Li/Na beam edge parameter diagnosis	Beam emission exploitation for ITER	
Special features	T4	applic.				Integrated special feature fitting and display
		fund.		Zeeman, soft-X-ray, Balmer series special features		
		exploit.	Fitting with spectral primitives	He-like soft X-ray line analysis	Balmer series/limit observations	
Diatomic spectra and coll-rad models	T5	applic.			H_2 isotopomer spectral simul.	
		fund.	H_2/H electr. & ion database	H_2/H vibronic/GCR populations		
		exploit.		Composite continuum emission studies	Integrated edge modelling	

Notes: (1) Sets of 3 to 5 work packages make up the scientific support of each theme. Each work package is sub-divided into tasks.
(2) The completion of the sub-themes in the `applic.' and `fund.' categories mark science milestones. The sub-theme is an assembly of work package tasks.
(3) `exploit' indicates the expected use by fusion plasma modellers and spectral diagnosticians on-site at European fusion laboratories, with which ADAS-EU staff will assist.

ADAS-EU: physics theme support time chart

Figure 9a: Theme 6: Medium weight element Generalised-Collisional-Radiative modelling

Work package	No.	Task	Task no.
AS/DW baseline lift to levels 1 and 2	27.	AUTOSTRUCTURE / Distorted Wave implementation in ls and ic coupling for ADAS adf04 production.	27-1
		AUTOSTRUCTURE / Distorted Wave mass production for medium weight elements.	27-2
GCR ionisation and recombination	28.	GCR ionisation fractionisation for metastables for level 1 and level 2 modelling.	28-1
		GCR dielectronic recombination for level 1 and level2 modelling using BBGP/adf04 type 6 and hybrid/adf09	28-2

ADAS-EU: sub-contract special studies

1. Univ. Autonoma, Madrid – Clara Illescas

   Charge exchange and ion impact data for fusion plasma spectroscopy: State-selective charge transfer and excitation for low/medium charge projectiles and neutral hydrogen targets

2. Univ. Vilnius, Lithuania (x2) - Pavel Bogdanovich

   Atomic structure and electron data for heavy element ions (1) configuration interaction and relativisitic/quasi-relativistic structure. (2) auger/cascade, multiple ionisation and shake-off. (3) production of configuration interaction, quasi-relativistic atomic structure and cross-sections for the adas database. (4) atomic structure interchange.

3. Univ. Giessen, Germany – Alfred Mueller, Stefan Schippers

   Electron impact cross-section data for fusion applications: Ionisation and recombination of heavy element ions

4. Tech. Univ. Vienna – Katherina Igenbergs

   Atomic data and models for neutral beam diagnostics. (1) lithium and sodium beam models and data. (2) CCAO calculations for H (n=1,2) targets.

5. Queen's Univ. Belfast – Allan Hibbert, Kathy Ramsbottom

   Electron collision cross-sections for heavy element ions : Pilot r-matrix calculations for tungsten – W^{+44} .

6. Univ. Mons-Hainaut (x2) - Pascal Quinet, Patrick Palmeri

   Atomic structure and electron data for heavy element ions: (1) The tungsten ions W^{+0} to $W^{+4}$and adjacent element systems (2) The ions W^{+3} to W^{+5} and adjacent element neutral/near-neutral ions. Atomic structure mapping between codes

ADAS-EU: Modules

The ADAS-EU Euratom - Framework 7 Project of the European Community has sponsored six 3-day workshop/advanced training courses at fusion laboratories in Europe and in ITER participating countries outside Europe.

There are eight modules, each of duration 1.5 hours, comprising a lecture, demonstration and discussion.

1. Impurity atomic species in fusion plasma, their ionisation state and radiating characteristics - the ADAS approach.
2. Complex species in the core and edge of the fusion plasma. Describing and calculating their characteristics - the current state.
3. H_2 molecular emission and collisional-radiative modelling.
4. Modelling and analysing special spectral features. A unified approach.
5. Charge exchange and beam emission spectroscopy. Modelling emitter populations and analysing spectra.
6. Advanced charge exchange plasma receiver and beam donor modelling – the current state.
7. Calculating fundamental atomic structure and electron impact cross-section data – Autostructure and R-Matrix .
8. Spectral diagnostics for special environments – the interface between fusion and astrophysics.

The final summative meeting is at the JET Facility 30 Sep – 3 Oct.

ADAS in the long term

The ADAS time frame :

ITER start-up + 10 years
Many of us will be long retired

The University & ADAS:

Independence of specific national fusion laboratories
Able to teach and so bring on new PhD students
Ensure fundamental atomic physics development continues

The interested parties:

ITER
JET Facility and CCFE Culham Laboratory
The European Commission/EURATOM
International subscribers to ADAS

Commitments:

Admin. tasks for ADAS for the next two years.
Preparation of a plan for the attention & action of interested parties.

ADAS – immediate practical issues

The next ADAS Workshop :

Looking into possibility of holding it at a University in Poland.

Change the time to around the third week of October.

The problem of IDL :

The cost of IDL licences is proving a deterrent to use of ADAS.

Carry out a feasibility study for conversion to PYTHON.

If successful bring forward a conversion costing for consideration by ADAS members.