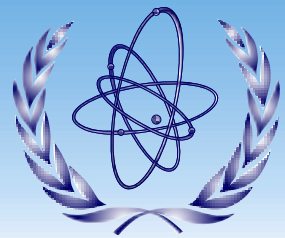


International Atomic Energy Agency

Contribution of Nuclear Data Section (NDS) and Nuclear Reaction Data Centres (NRDC)

IAEA Nuclear Data Section
Naohiko Otuka

Second Advanced Workshop on Model Codes for Spallation Reactions
Saclay, February 8-11, 2010

Contents

1. Improvement of EXFOR
   - Completeness
   - Accessibility

2. Possible Web Service (for future)
   - Code distribution
   - Upload/Analysis system

1. Improvement of EXFOR (Completeness, Accessibility)

Improvement of EXFOR (Completeness)

- **EXFOR: Experimental Database**
  (http://www-nds.iaea.org/exfor/ etc.)

- **Main scope of EXFOR:**
  Target $A \leq 12$, $E(/A?) \leq 1$ GeV
  (EXFOR is originally designed for low-energy neutron physics…)

- **No reason to miss useful data for our benchmark.**

→We are trying to fill gap for data used in our benchmark.

Progress in Compilation (Aug. 2009~)

Reaction	Quant.	Emin	Emax	Lab.	Author	Publication	EXFOR
Al,C,Cu,Pb(p,x+pi-, pi+)	DAE	7.30E+02	7.30E+02	1USABRK	D.R.F.Cochran+	J,PR/D,6,3085,1972	C1754 (NNDC)
Ni(p,x+p,d,t,h,a)	DAE	1.80E+02	1.80E+02	2GERJUL	A.Budzanowski+	J,PR/C,80,054604,2009	C1763 (NNDC)
Au(p,x+p,d,t,h,a,Li6,Li7)	DAE	2.50E+03	2.50E+03	2GERJUL	A.Letourneau+	J,NP/A,712,133,2002	D0579 (IAEA NDS)
Ta(p,x+p,d,t,h,a)	DAE	1.20E+03	1.20E+03	2GERGSI	C.-M.Herbach+	J,NP/A,765,426,2006	O1305 Digitized… (NEA DB)
Fe(p,x)nuclide	CS	1.70E+01	2.60E+03	2FR SAT+	R.Michel+	J,NSTS,2,242,2002	In compilation
Fe,Pb(p,x+n)	CSN	8.00E+02	1.60E+03	2FR SAT	S.Leray+	J,PR/C,65,44621,2002	In compilation
Pb(p,x+n)	MLT	1.20E+03	1.20E+03	2GERJUL?	A.Letourneau+	J,NIM/B,170,299,2000	???
Al,Fe,Zr,U(p,x+n)	MLT	1.20E+03	1.20E+03	2GERJUL?	C.-M.Herbach+	R,JUEL-SPEZ	???
Al(p,x+pi-)	DAE	2.20E+03	2.20E+03	2JPNKEK	H.En'yo+	J,PL/B,158,1,1985	Not original

We have many friendly experimentalists (Michel, Titarenko, Schmidt…)
But no response from some authors…

International Collaboration for EXFOR

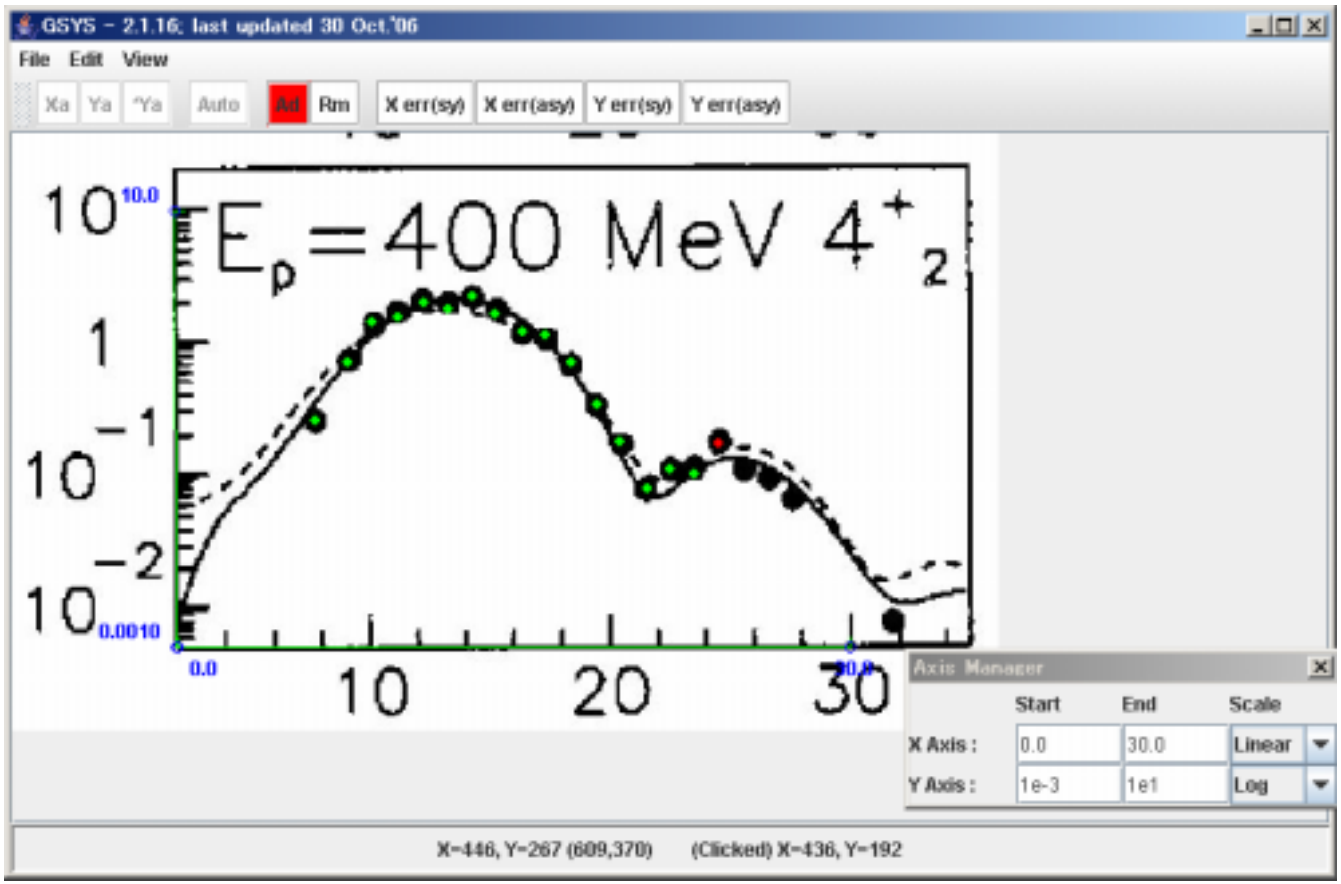
International Network of
Nuclear Reaction Data Centres
(*NRDC*)

Coordinated by IAEA-NDS

- **NNDC**
- **NEA-DB**
- **CJD, CAJaD, CDFE, CNPD**
- **ATOMKI**
- **UkrNDC**
- **KAERI-NDEL**
- **JCPRG**
- **CNDC**
- **BARC**

Do not digitize data from figure images! Ask us numerical data!

, but we also offer a good digitizer…



A java-based digitizer used by EXFOR compilers (GSYS).
Available at http://www.jcprg.org/gsys/ (free)

Database for Elemental Process in INC

Useful experimental data for inputs to INC

N-N reaction

$pp \rightarrow pn\pi^+$, $pp\pi^+\pi^-$, $pp\eta$, ...

N-π reaction

$\pi^-p \rightarrow \pi^0 n$, $\pi^+p \rightarrow n\pi^+\pi^+$, $\pi^+p \rightarrow p\pi^+\eta$,...

Not in the current EXFOR scope (boundary between nuclear and hadron physics…). But we may think about it (if it is necessary).

Improvement of EXFOR (Accessibility)

"Traditional" EXFOR compilation for GSI experiments

```
SUBENT        O1302002   20060526
BIB                  3         11
REACTION   (1-H-1(92-U-238,X)ELEM/MASS,,SIG)
…
ENDBIB              11
NOCOMMON
EN
GEV
       238.
ENDCOMMON            3

DATA                 5        254
ELEMENT    MASS       DATA       DATA-ERR1  DATA-ERR2
NO-DIM     NO-DIM     MB         PER-CENT   PER-CENT
         7.        15.        1.8        23.        22.
         7.        16.       0.44        22.        21.
```

Users cannot search this data set as p (1 GeV) + ^{238}U reaction.
(J.-C. David, WPEC SG30 meeting, NEA/NSC/DOC(2007)25)

New Coding for Inverse Kinematics

```
SUBENT        O1302002   20060526
BIB                  3         11
REACTION   ((1-H-1(92-U-238,X)ELEM/MASS,,SIG)=
           (92-U-238(P,X)ELEM/MASS,,SIG))
…
ENDBIB              11
NOCOMMON
EN
GEV/A
      1.
ENDCOMMON            3

DATA                 5        254
ELEMENT    MASS       DATA       DATA-ERR1  DATA-ERR2
NO-DIM     NO-DIM     MB         PER-CENT   PER-CENT
         7.        15.        1.8        23.        22.
         7.        16.       0.44        22.        21.
```

Can be searched as proton-induced reaction data

Incident energy expression invariant under target ⇔ projectile

To be proposed in next NRDC meeting (Apr., 2010)

2. Possible Web Services
(Code Distribution, Web-based Analyzing Tool)

An Example of Code Distribution

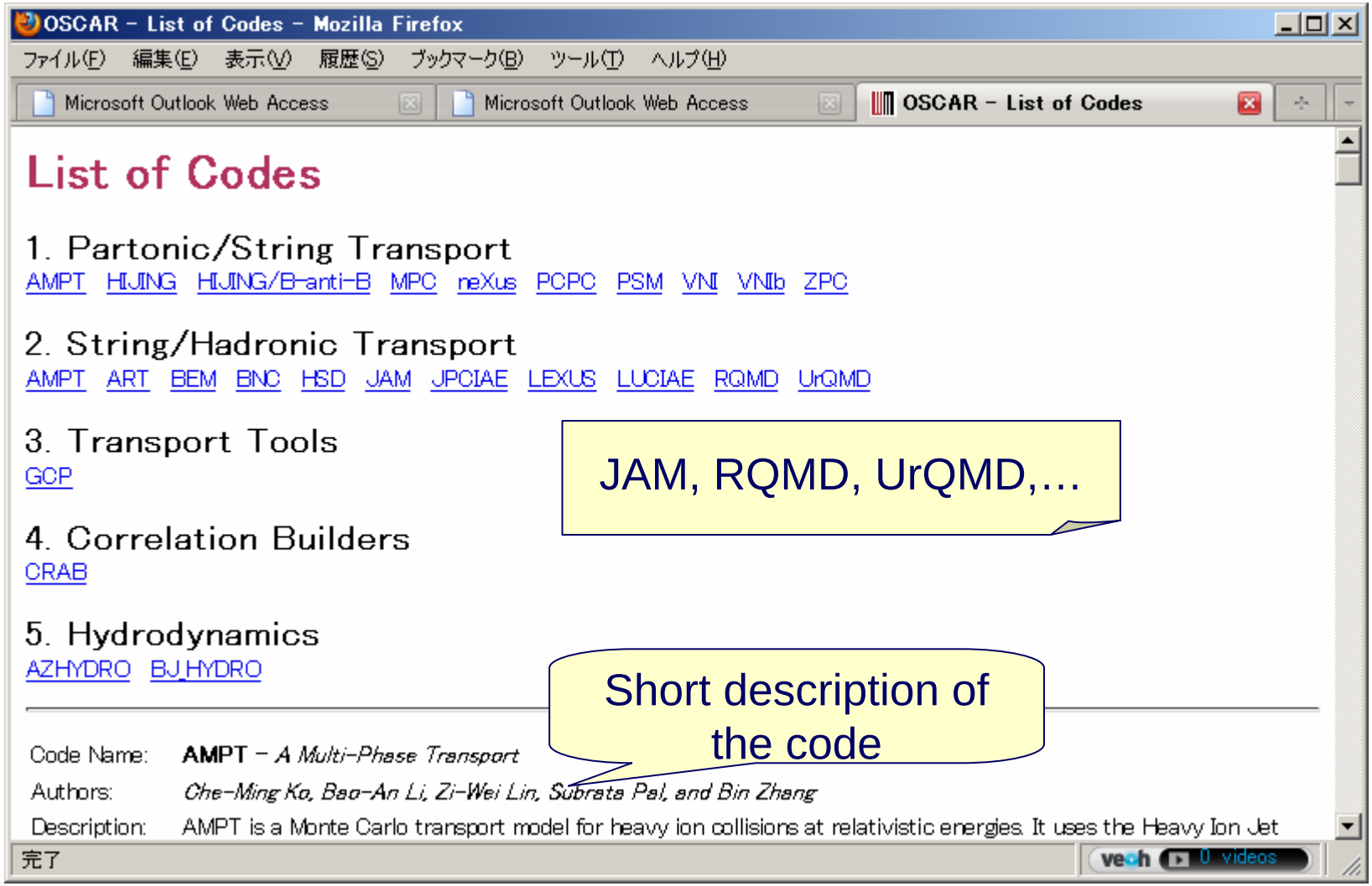
OSCAR: Open Standard Codes and Routines

A code distribution website for transport models for relativistic heavy-ion collision research (1997~2008)

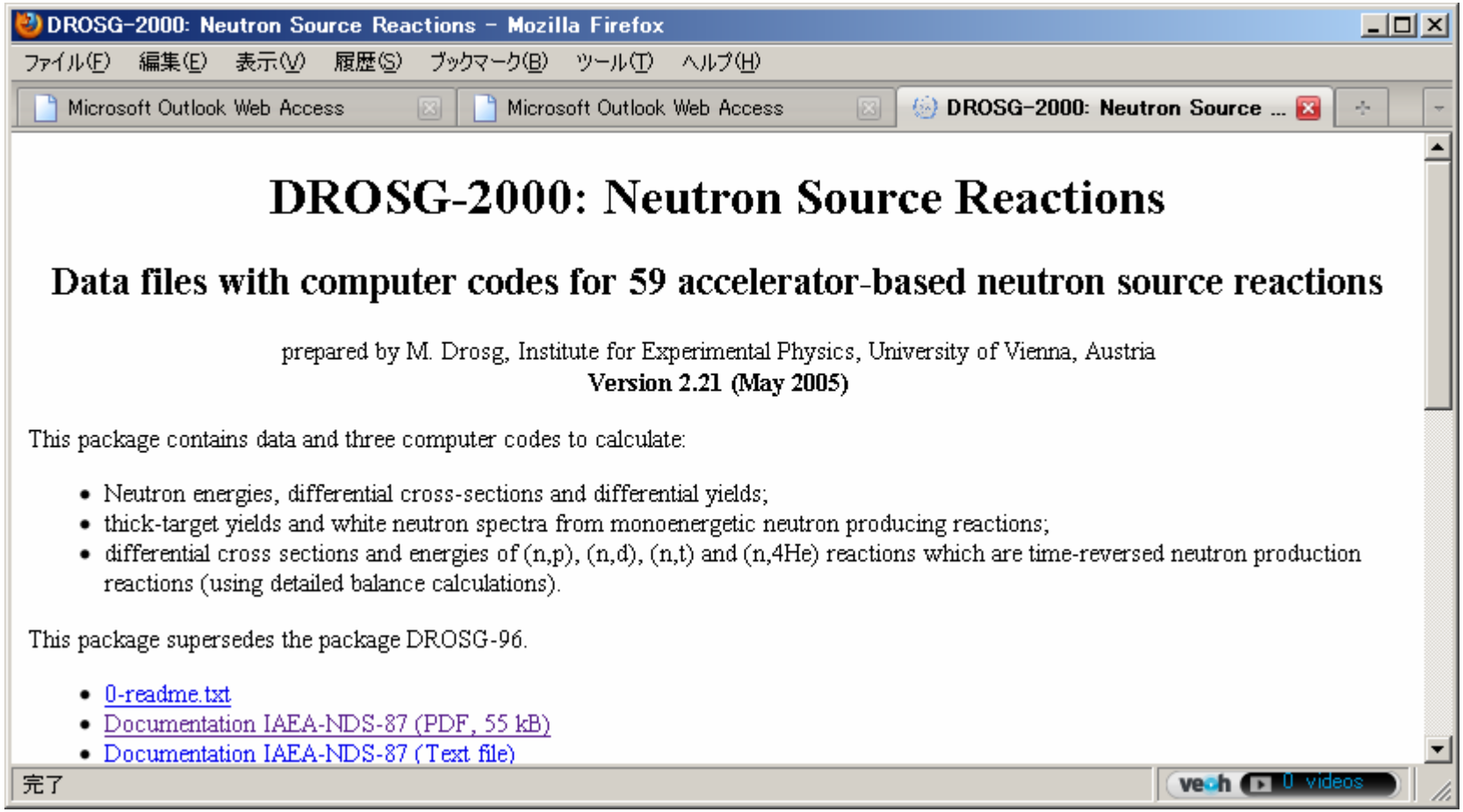
"It was established in June of 1997 *to address the problem concerning the lack of common standards, documentation, version control, and accessibility* in many transport codes at that time. "

http://www-cunuke.phys.columbia.edu/OSCAR/
(Colombia Univ. etc.)

OSCAR – List of Codes

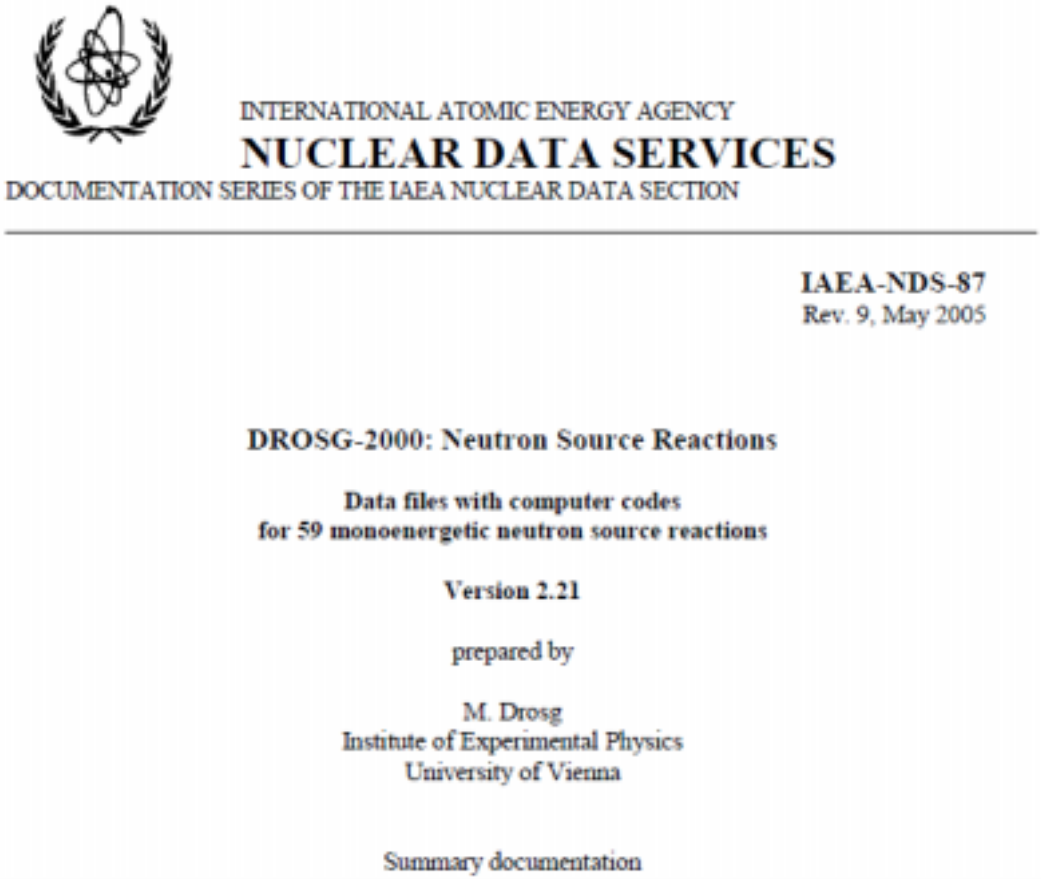


Example of Distribution from NDS



Purpose of the code, Links to package and manual,
How to run (short manual).

Manual as an IAEA-NDS report



INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

IAEA-NDS-87
Rev. 9, May 2005

DROSG-2000: Neutron Source Reactions

Data files with computer codes
for 59 monoenergetic neutron source reactions

Version 2.21

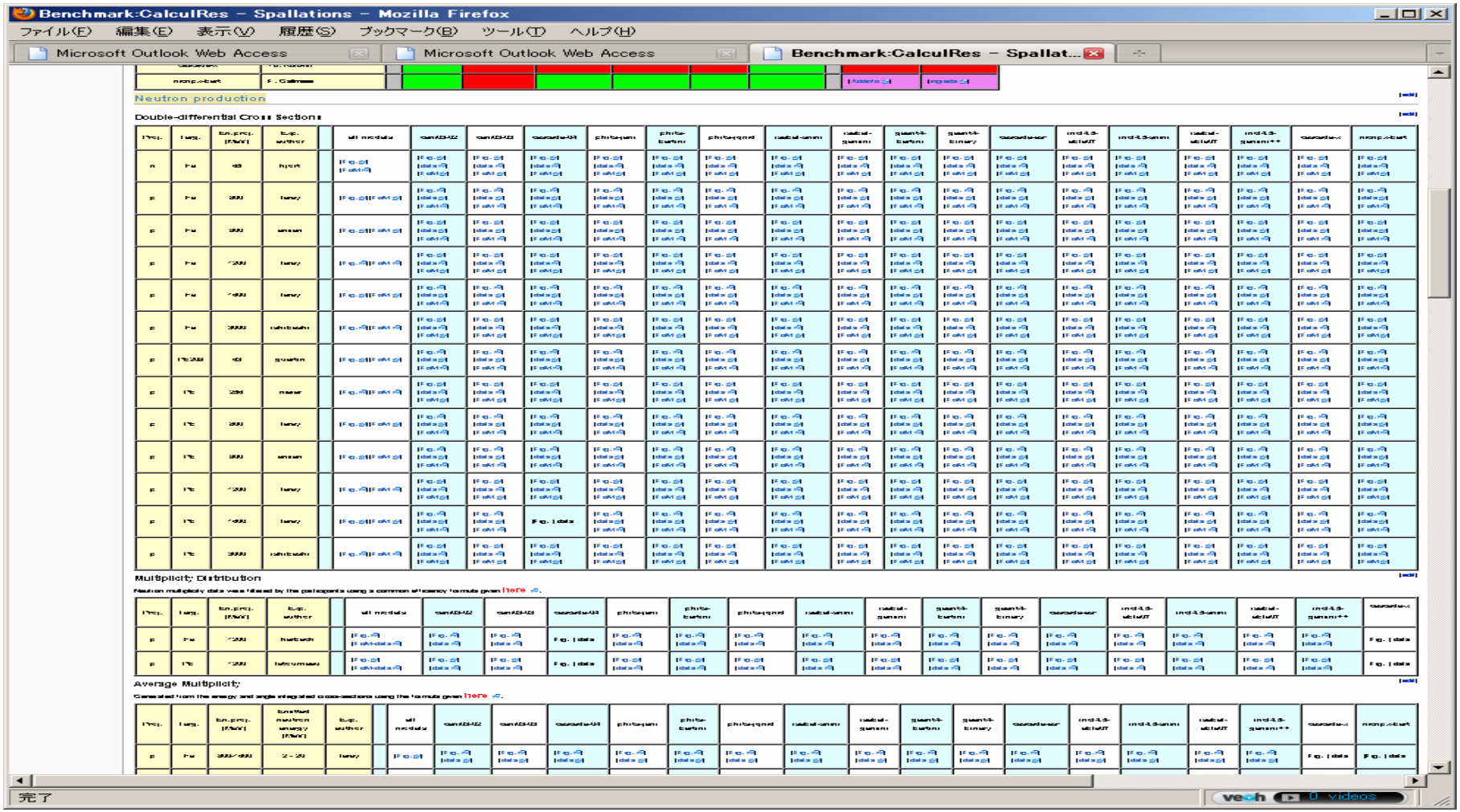
prepared by

M. Drosg
Institute of Experimental Physics
University of Vienna

Summary documentation

Note: Code distribution is not the main task of NDS. If you need additional services (e.g. validiation), codes should go to NEA.

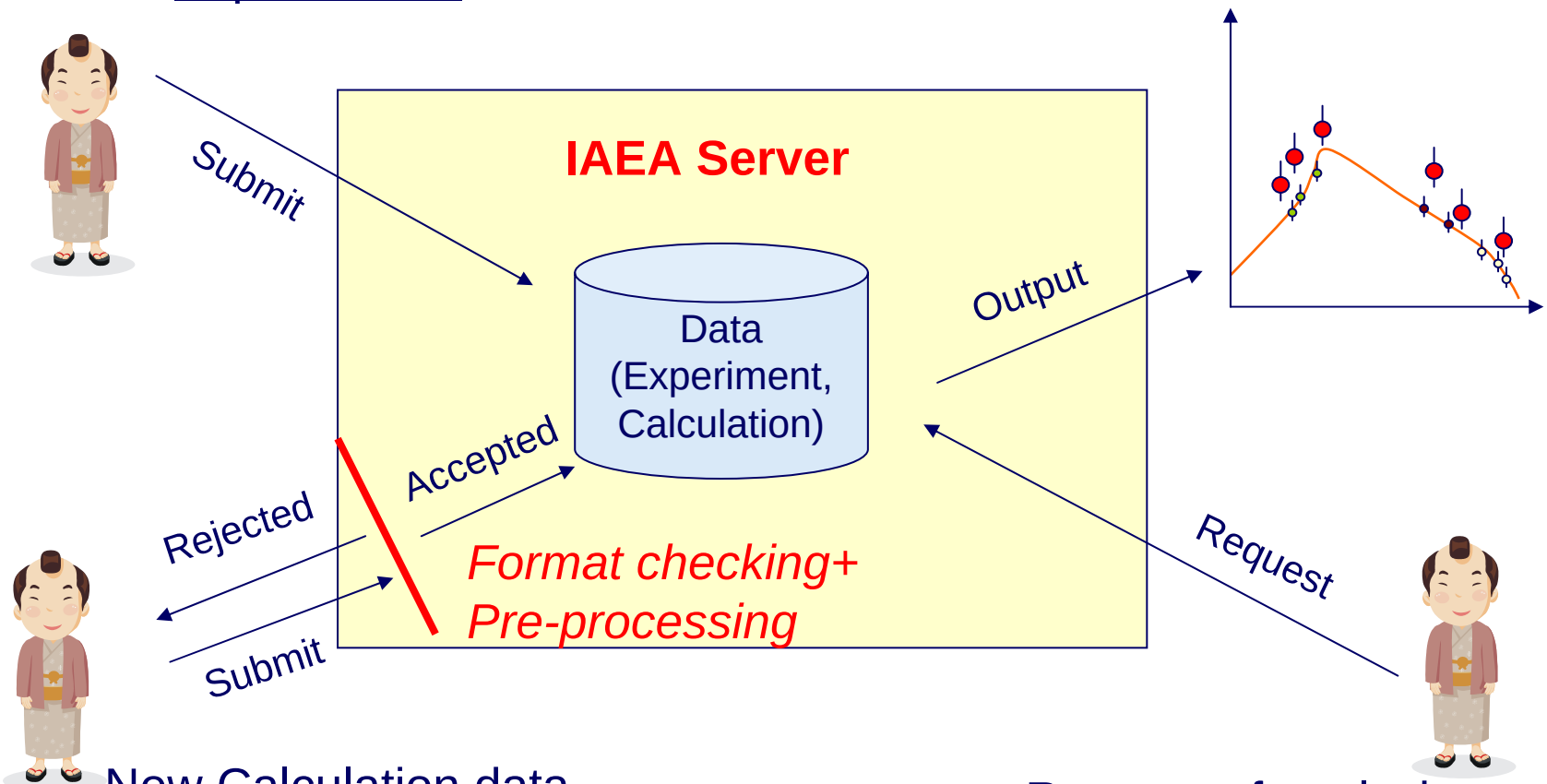
Future update of calc./exp. data



A lot of manual work by M. U. Khandaker (+J.-C.David and NO)

Upload / Analysis System (~1 year?)

New Experimental data



New Calculation data
(password protection?)

Request of analysis
(reaction, quantity etc.)

Summary

1. Improvement of EXFOR

Completeness – Effort by NRDC data centres

Accessibility – New coding for inverse kinematics

2. Web Services (if necessary)

- Code distribution

- Upload / Analysis system (short-term plan)

- Web calculation? (No enough CPU in NDS)

Best regards from Alberto in Japan !

Alberto's last working day at IAEA-NDS (2009-06-30)