ISOLDE Yield Database

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Motivation

- Accurate values of yields are essential for the preparation of the experimental proposals
- Data based in published yield values
- The yield database is based on ORACLE and has been developed by Manuela Turrion and Ursula Herman-Isycka

- Update of the yield database
  - Summer student project 2014 of Hayley Osman (Missouri State University)
  - Complemented with update of ionization and release parameters by Janka Stritsovska (Comenius University, Slovakia)

Beam developments in the past 5 years

X5 ^{30}Na Re ion source
X10 ^{20,21}Mg
sub-µm SiC

Molecular beams
^{17}C as CO+
Helicon Ion source

Molten salt target

$^{70+}$Ni beams

Purification of $^{80-82}$Zn,^{130}Cd with quartz (ΔHads)

^{9}Be(n,α)^{6}He

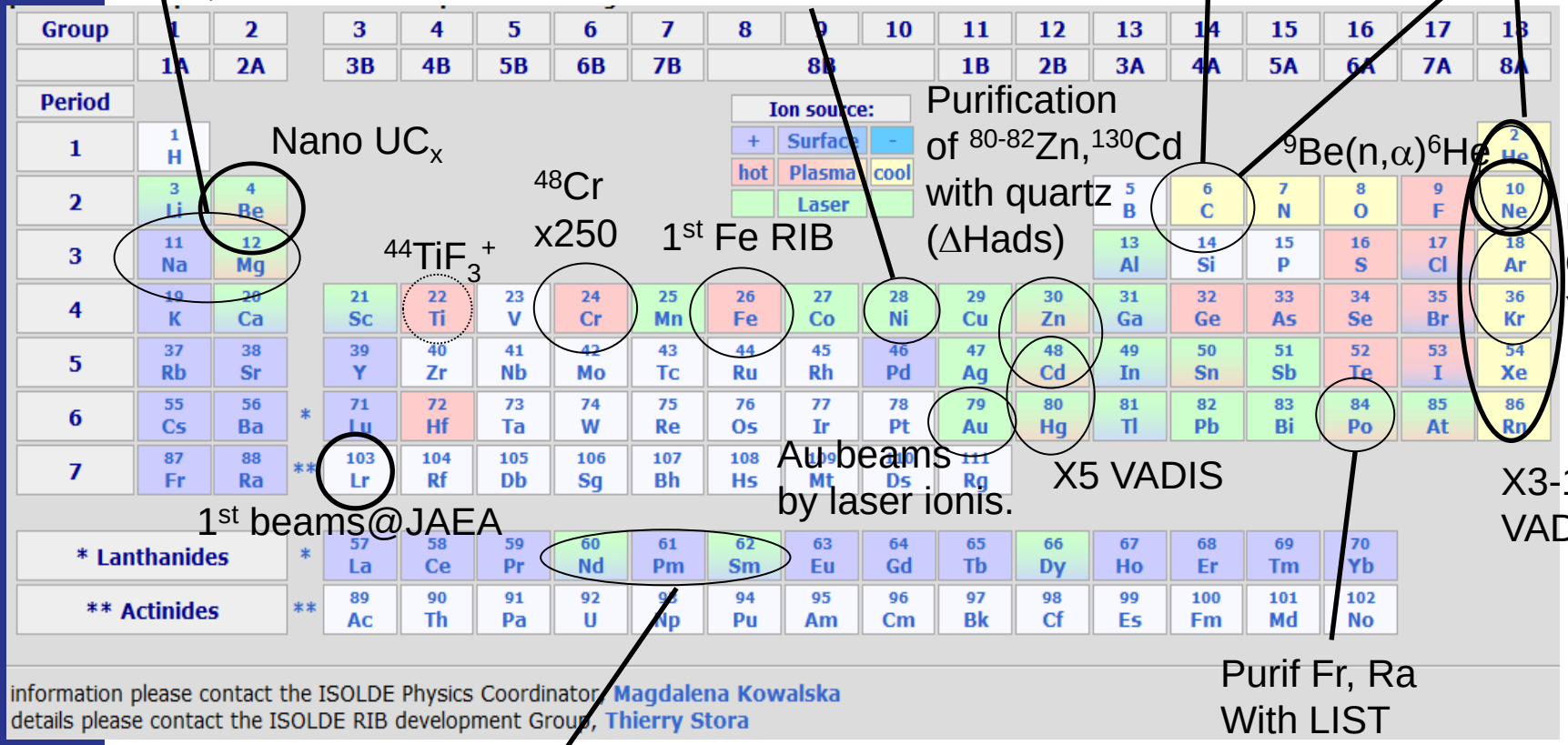
Nano UC$_x$

^{48}Cr x250

^{44}TiF$_3^+$

1st Fe RIB

Nano CaO Y_2O_3



Au beams by laser ionis.

X5 VADIS

X3-10 VADIS

1st beams@JAEA

Purif Fr, Ra With LIST

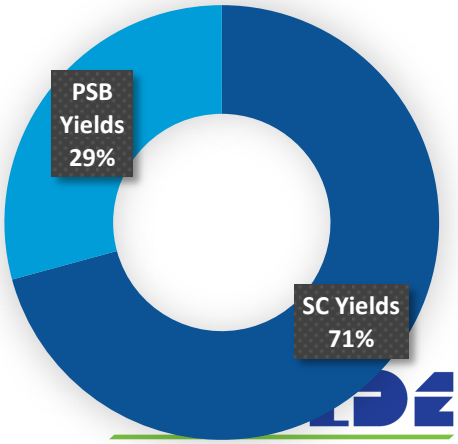
Purification of lanthanide beams ^{140}Nd, $^{140-142}$Sm:
GdB_6 ion source cavity + RILIS

Current Database Statistics

Total Yields Reported: 2330
Isotopes of 68 Elements

Group → / Period ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	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
5	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
6	55 Cs	56 Ba		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
7	87 Fr	88 Ra		104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
Lanthanides				57 La	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				89 Ac	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

Missing ~6 years of yield data!



Update of the database

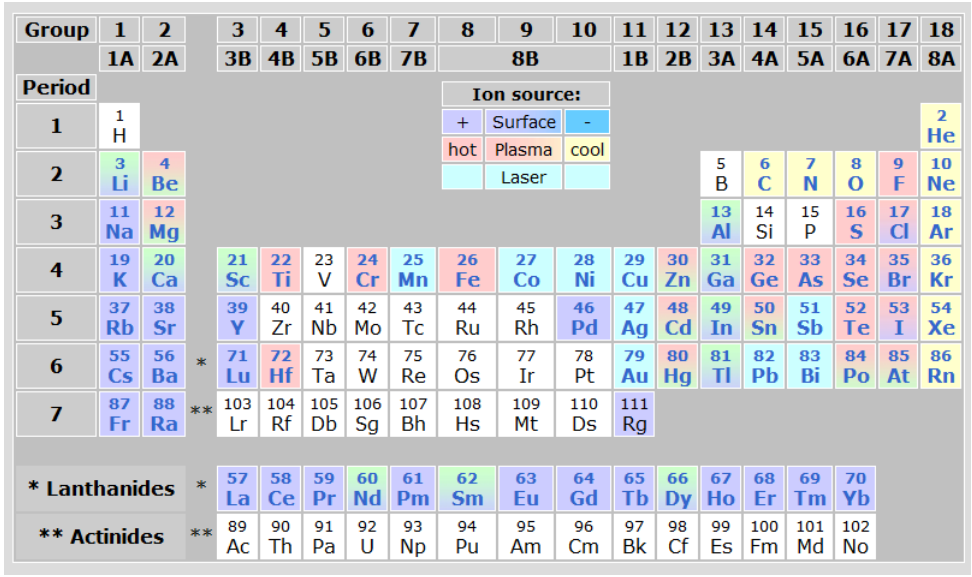
Update of yield data following recent developments and publications

Graphical restoration (lost with new ISOLDE website)

Cloned database for data update and analysis of the problems

Group	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1A	2A		3B	4B	5B	6B	7B		8B		1B	2B	3A	4A	5A	6A	7A	8A
Period									Ion source:										
1	1 H								+ Surface -										2 He
2	3 Li	4 Be							hot Plasma cool					5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg							Laser					13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	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
5	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
6	55 Cs	56 Ba	*	71 Lu	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
7	87 Fr	88 Ra	**	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg							

* Lanthanides	*	57 La	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				
** Actinides	**	89 Ac	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				



Yield data update

- ✓ 200+ Publications reviewed
- ✓ 205 Yield entries

Nitrogen	N									
A Number	Half life	Energy (GeV)	Yield at ISOLDE (ions/μC)	Database Yield (Old)	Target Material	Target Details	Target thickness (g/cm^2)	Target temperature	Ion source	Publication Source
16N+14N		1.4	6.00E+03		NaF:LiF	478	24.51	725 C	VD7	GPS E log 12/6/12
17N+14N		1.4	5.00E+03		NaF:LiF	478	24.51	725 C	VD7	GPS E log 12/6/12
17N+14N		1.4	1.40E+04		NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
Oxygen	**O**									
Fluorine	**F**									
A Number	Half life	Energy (GeV)	Yield at ISOLDE (ions/μC)	Database Yield (Old)	Target Material	Target Details	Target thickness (g/cm^2)	Target temperature	Ion source	Source
17	64.49 s	1.4	1.27E+03	None	NaF:LiF	478	24.51	725 C	VD7	GPS E log 12/6/12
Neon	**Ne**									
A Number	Half life	Energy (GeV)	Yield at ISOLDE (ions/μC)	Database Yield (Old)	Target Material	Target Details	Target thickness (g/cm^2)	Target temperature	Ion source	Source
18	1672 ms	1.4	2.00E+04	None for target	NaF:LiF	478	24.51	725 C	VD7	GPS E log 12/6/12
18	1672 ms	1.4	9.10E+03	None for target	NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
18	1672 ms	1.4	2.50E+04	None for target	NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
18	1672 ms	1.4	3.00E+04	None for target	NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
19	17.22 s	1.4	7.00E+06	None for target	NaF:LiF	478	24.51	725 C	VD7	GPS E log 12/6/12
19	17.22s	1.4	7.00E+06	None for target	NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
19	17.22s	1.4	6.00E+06	None for target	NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
19	17.22 s	1.4	9.00E+05	None for target	NaF:LiF	478	24.51	at 283 A	VD7	GPS E log 13/6/12
Sodium	**Na**									
A Number	Half life	Energy (GeV)	Yield at ISOLDE (ions/μC)	Database Yield (Old)	Target Material	Target Details	Target thickness (g/cm^2)	Target temperature	Ion source	Source
20	447.9 ms	1.4	1.20E+05	SC ONLY	SiC	483	14.13	1640 C (at 490 A)		HRS E log 1/8/12
20	447.9 ms	1.4	3.00E+06	SC ONLY	SiC	483	14.13			HRS E log 8/8/12
21	22.49 s	1.4	1.30E+07	SC ONLY	SiC	483	14.13	1640 C (at 490 A)		HRS E log 1/8/12
21	22.49 s	1.4	3.35E+02	SC ONLY	NaF:LiF	478	24.51	725 C	VD7	GPS E log 12/6/12
21	22.49 s	1.4	9.00E+07	SC ONLY	SiC	483	14.13			HRS E log 8/8/12
27	301 ms	1.4	2.20E+03	None for target	SiC	483	14.13	1640 C (at 490 A)		HRS E log 1/8/12
27	301 ms	1.4	4.00E+06	8.50E+06	Ucx	484	31.35	2050 C (at 690 A)	W	GPS E log 10/8/12
27	301 ms	1.4	5.50E+04	None for target	SiC	483	14.13			HRS E log 8/8/12
27	301 ms	1.4	3.30E+06	8.50E+06	Ucx	487	33.65	at 600 A		HRS E log 4/9/12
30	48 ms	1.4	2.17E+03	5.10E+04	Ucx	487	33.65	at 600 A		HRS E log 4/9/12
Magnesium	**Mg**									
A Number	Half life	Energy (GeV)	Yield at ISOLDE (ions/μC)	Database Yield (Old)	Target Material	Target Details	Target thickness (g/cm^2)	Target temperature	Ion source	Source
27	9.46 m	1.4	4.20E+08	1.50E+07	Ucx	487	33.65	at 600 A		HRS E log 4/9/12
30	335 ms	1.4	7.50E+05	6.00E+05	Ucx	477	30.84	2000 C	W	HRS E log 14/8/12
30	335 ms	1.4	1.20E+06	6.00E+05	Ucx	487	33.65	at 600 A		HRS E log 4/9/12

- ✓ 2 Years of E-logs (~1,500 entries)
- ✓ 184 Unpublished yield entries

Z	A	Yield	SC or PSB	Ion Source	Target material
6	9	3.2E+00	SC	MK6	CaO
6	9	4.0E+02	PSB	MK7	CaO
6	9	1.0E+03	PSB	MK7	TiO_2
6	9	2.0E+03	PSB	MK7	CaO
6	9	4.0E+03	SC	MK6	MgO
6	10	2.4E+02	PSB	Helicon	HfO
6	10	9.7E+03	PSB	MK7	MgO
6	10	1.8E+04	SC	MK6	MgO
6	10	2.0E+04	SC	MK6	CaO
6	10	1.2E+05	PSB	MK7	CeO_x
6	10	2.0E+05	PSB	MK7	TiO_2
6	10	3.0E+05	PSB	VD7	NaF
6	10	5.3E+05	PSB	MK7	CaO
6	10	7.0E+05	PSB	VD7	CaO
6	11	1.2E+04	PSB	VD7	NaF
6	11	4.4E+04	PSB	Helicon	HfO
6	11	2.1E+05	PSB	MK7	MgO
6	11	4.8E+05	SC	MK6	CaO
6	11	6.8E+05	SC	MK6	MgO
6	11	2.7E+06	PSB	Helicon	CaO
6	11	4.8E+06	PSB	MK7	CeO_x
6	11	6.2E+06	PSB	MK7	TiO_2
6	11	7.7E+08	PSB	VD7	NaF
6	15	2.9E+02	PSB	Helicon	HfO
6	15	6.5E+02	PSB	Helicon	CaO
6	15	7.7E+02	SC	MK6	MgO
6	15	6.2E+03	SC	MK6	CaO
6	15	9.2E+03	PSB	MK7	TiO_2
6	15	1.1E+04	PSB	MK7	CeO_x
6	15	7.9E+05	PSB	VD7	CaO
6	16	5.9E+01	PSB	Helicon	HfO
6	16	6.9E+02	PSB	MK7	TiO_2
6	16	2.1E+03	PSB	MK7	CeO_x
6	16	2.5E+03	PSB	MK7	CaO
6	16	4.0E+03	SC	MK6	CaO
6	17	8.0E+00	PSB	Helicon	HfO

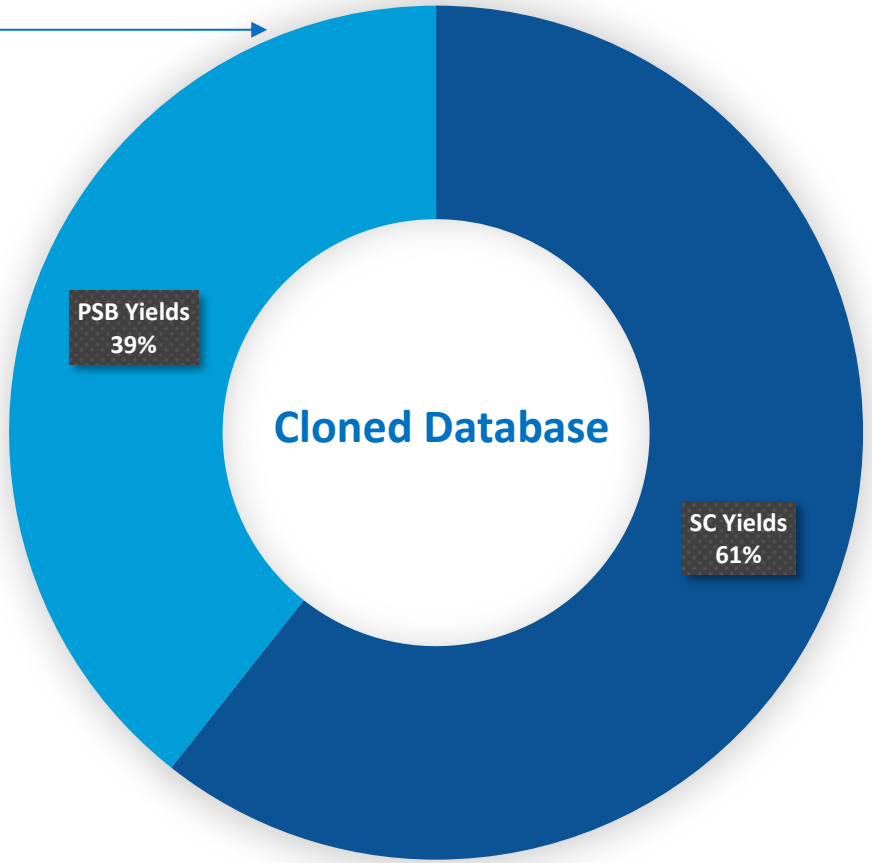
Hayley Osman – Summer Student Project 2014

Yield data update

3 New Elements

Ti Fe Au

33 New Isotopes



Graphical Restoration

Graphical layout lost with change of the ISOLDE website
Update of database code needed to restore graphics

https://oraweb.cern.ch/pls/isolde/query_tgt - Original Source

File Edit Format

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd"><HTML>
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<LINK REL="stylesheet" HREF="http://isolde.web.cern.ch/isolde/yields/css/isolde_yield_db.css" TITLE="text/css">
<script src="http://isolde.web.cern.ch/isolde/yields/js/isolde_yield_db.js" type="text/javascript"></script>
</HEAD>
<BODY onload="">
<H1 ALIGN="CENTER">Access to the Yield information</H1>
<HR>
<div id="nt_link"><div id="target_link"><FORM ACTION="q_tgt_isotope" METHOD="POST">
<B>Find the produced isotopes from a given target  </B>
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<OPTION>--
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<OPTION value="C ">C
<OPTION value="Ca">Ca
<OPTION value="Ce">Ce
<OPTION value="Gd">Gd
<OPTION value="Ge">Ge
<OPTION value="Ir">Ir
<OPTION value="La">La
<OPTION value="Mg">Mg
<OPTION value="Nb">Nb
<OPTION value="Pb">Pb
<OPTION value="Pt">Pt
<OPTION value="Sc">Sc
<OPTION value="Si">Si
<OPTION value="Sn">Sn
<OPTION value="Sr">Sr
<OPTION value="Ta">Ta
<OPTION value="Te">Te
<OPTION value="Th">Th
<OPTION value="Ti">Ti
<OPTION value="U ">U
<OPTION value="V ">V
<OPTION value="Zr">Zr
</SELECT>
<noscript><INPUT TYPE="submit" VALUE="Submit">
</noscript></FORM>
</div><div id="nucl_link"><A HREF="nucl_chart.nuclear_chart?scale=1">Nuclear Chart for ISOLDE</A>
</div></div><HR>
<B>Find the produced isotope from an element independent on target</B>
<P>
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<th class="i_bigSize">Group</th>
<th class="i_normalSize">1</th>
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<th class="i_smallSize"></th><th class="i_normalSize">3</th>
<th class="i_normalSize">4</th>
<th class="i_normalSize">5</th>
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<th class="i_normalSize">7</th>
<th class="i_normalSize">8</th>
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<th class="i_normalSize">10</th>
<th class="i_normalSize">11</th>
<th class="i_normalSize">12</th>
<th class="i_normalSize">13</th>
<th class="i_normalSize">14</th>
```
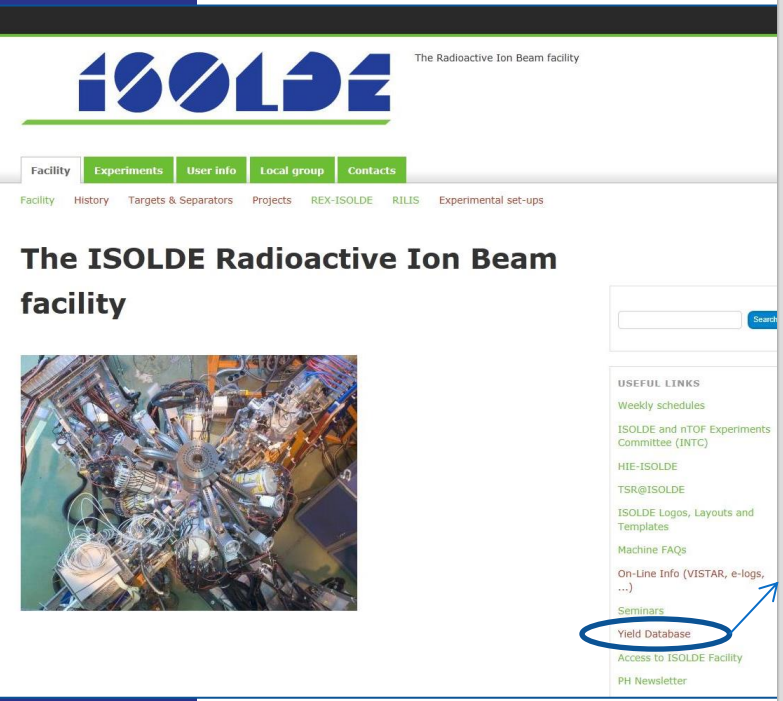
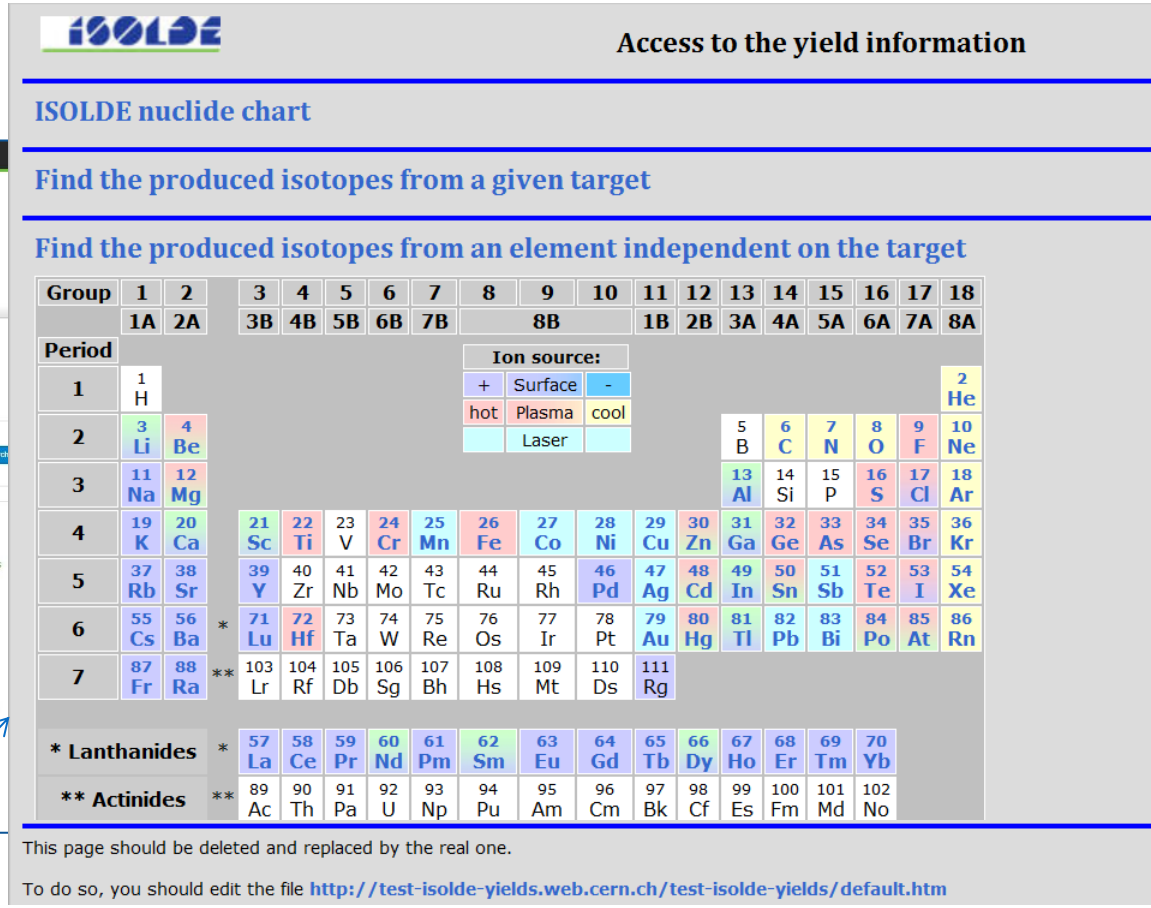

Graphical restoration - proposal

Creation of website with target information

Link to database

Graphical restoration process ongoing





Summary

Yield data update:

- 33 new isotopes included
- 205 new yield entries

Graphical restoration

- Proposal of creating website hosting target information and link to database
- Transparency to future Isolde website changes

Diffusion and effusion information to be included

Thank you for the attention!

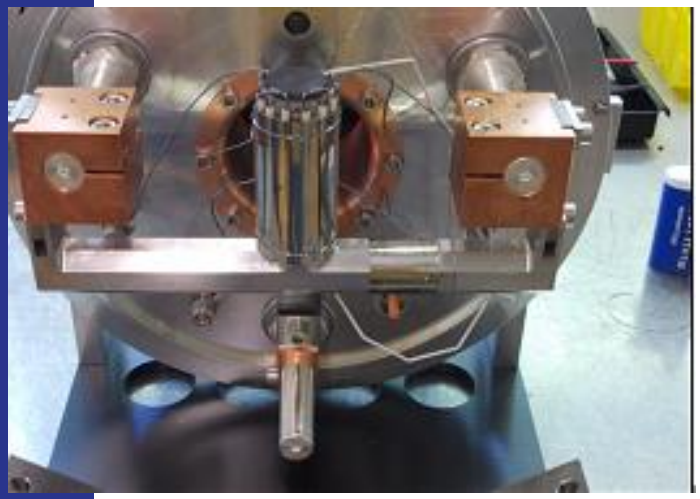
Molten NaF:LiF salt target
2014 experimental campaign

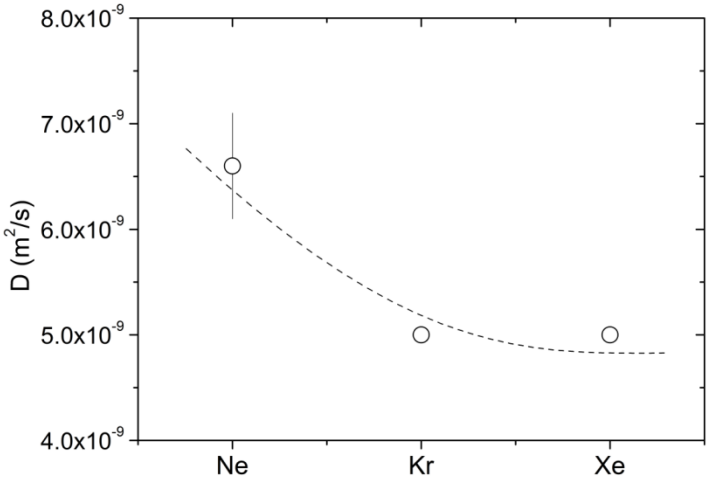
Online run from the 29th October to 1st November

Despite several problems at the start of the run (no thermocouples, HV trippings…) we could successfully validate the results obtained in 2012.

Preliminary results show yields for ^{19}Ne of 1e7/ uC and ^{11}CO of 6.7e8/uC.

Systematic measurement of data for the Ne diffusion coefficient in fluoride salts. Data analysis just started…





D(Ne) in NaF:LiF is 8 orders of magnitude higher than oxide targets (Data from 2012 run) (CaO, Al_2O_3 with D~10^{-17} m^2/s)