Task 11: Calculations of Beam Intensities

- progress report -

CERN

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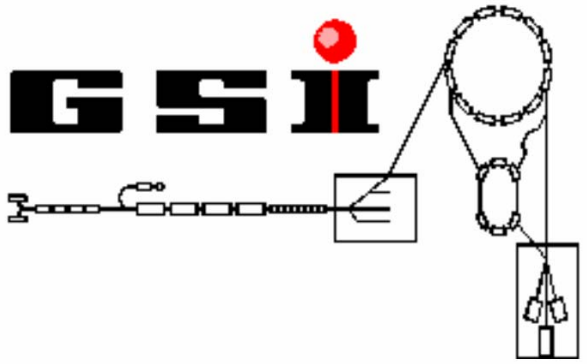

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Task description

- **Objectives**: Estimation of the available secondary-beam intensities, limitations in *N*-to-*Z* ratio, choice of the best adapted technical solutions.
- **7 participants**: ISOLDE-CERN (P4), CEA/Saclay (P6), University of Jyväskylä (P8), University of Warsaw (P12), IoP Bratislava (P13), GSI (P15), University Santiago de Compostella (P16)
- **2 contributors**: Khlopin Radium Institute (C4), VINČA-INS Belgrade (C16)

Milestones previewed for the period 01/02/06 – 31/10/06

No.	Milestones	Months due	Status
M1	**Heavy-ion requirement for driver accelerator**		
M1.1	Preliminary investigation	12	achieved
M1.2	Heavy-ion yields studies	22	achieved
M2	**Fragmentation of post accelerated ISOL beams**		
M2.1	Preparation experiment	12	achieved
M3	**Fission models** – *no milestone previewed*		
M4	**Spallation and fragmentation reactions**		
M4.1	Data and benchmarking of model for ^{238}U	12	achieved
M4.2	Data and benchmarking of model for ^{136}Xe	17	achieved
M5	**Neutron and proton induced reactions up to Fermi energy**		
M5.1	Experiment results	18	achieved
M6	**Aspects of secondary reactions** – *no milestone previewed*		
M7	**Predictions of secondary beam intensities**		
M7.1	Completion of the ISOLDE yield data base	12	achieved
M7.2	Extrapolation of measured called release-efficiency data	17	postponed

Actual expenditure for the period 1/2/2006 - 31/10/2006

PERSONNEL		CERN	CEA	JYV	UW	SAS	GSI	USD C	TOTAL
Personnel (k€)	Req. Contr.	22.25	0	20.82	4	0	40.5	17.2	104.77
FTE (person*month)	Req. Contr.	3	0	5	6	0	9	7.5	30.5
FTE (person*month)	Total	3	11.7	8	6	13.5	25.5	24	91.7

TRAVEL/CONSUMABLE		CERN	CEA	JYV	UW	SAS	GSI	USDC	TOTAL
Consumable (k€)	Req. Contr.	0	0	0	0	0.2	0	0	0.2
Travel and subsistence (k€)	Req. Contr.	0	1.750	2.37	1.7	0.5	12.14	0.8	19.26

TOTAL		CERN	CEA	JYV	UW	SAS	GSI	USD C	TOTAL
Cost Request (k€)	Total	22.25	1.750	23.19	5.7	0.7	52.64	18	124.23

Progress achieved in the period 1/2/2006 - 31/10/2006

ST1 Benefit of heavy-ion capabilities of the driver accelerator:

- D1- Heavy-ion capabilities of driver accelerator, "Report on heavy-ion yields" submitted; available at http://www.gsi.de/charms/sck06.htm

ST2 Fragmentation of post-accelerated ISOL beams:

- Experiment on two-step reaction scheme is being performed

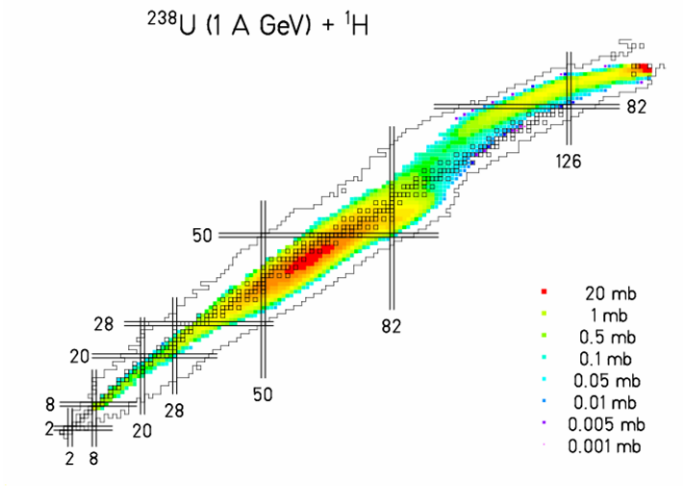
ST3 Fission models

- The independent yields of the nuclides with Z=26-65 in the reactions ^{238}U(p, f) and ^{238}U(n, f) at Ep = 10-100 MeV have been calculated using the **FIPRODY** code.

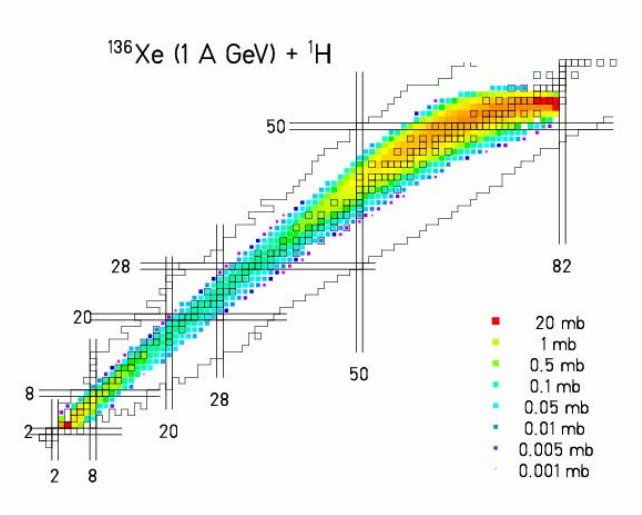
- The GSI code ABLA has been improved by including the influence of initial conditions on time-dependent fission width, double-humped structure in fission barriers and influence of symmetry classes in low-energy fission, and change of the angular momentum due to particle emission.

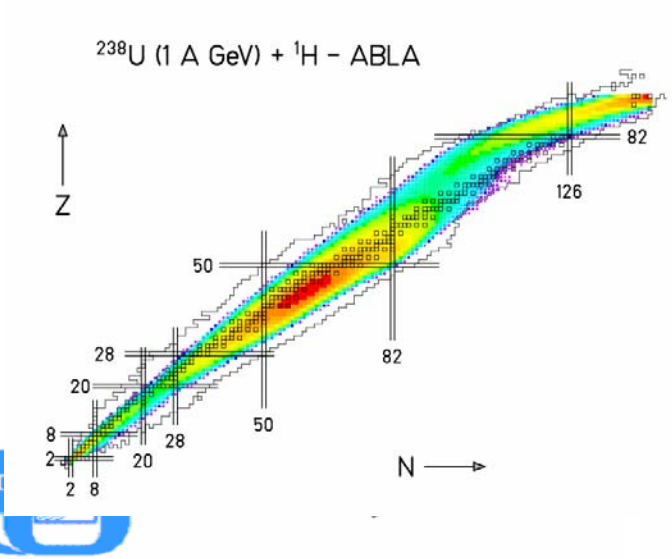
ST4 Spallation and fragmentation reactions:

➢ Data on ^{238}U(1 *A* GeV)+^{1}H,^{2}H,Pb and on ^{136}Xe(1 *A* GeV)+^{1}H,Be,Pb analysed and benchmarked to model calculations

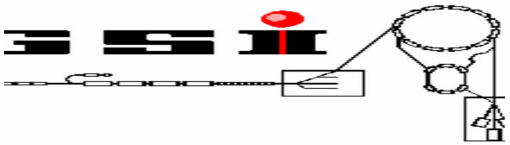


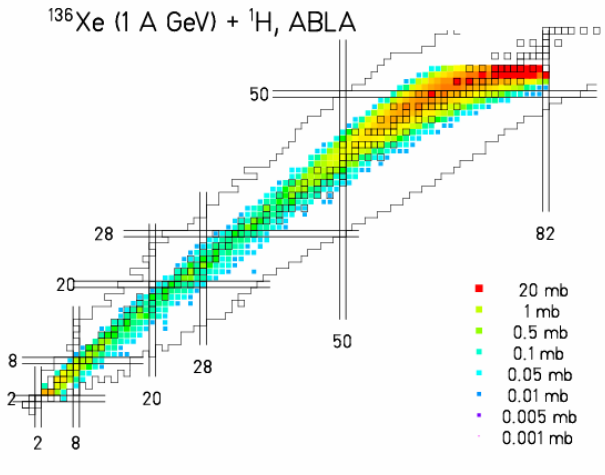
← Experiment →





← ABRABLA →

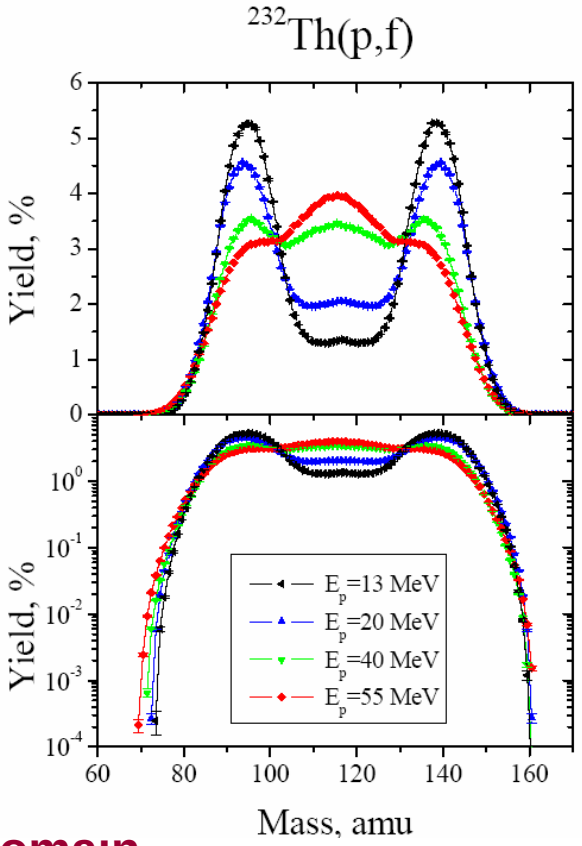




ST5 Neutron- and proton-induced reactions up to Fermi energy:

- Mass-TKE distributions on ^{232}Th(p, f) at E_p = 13, 20, 40, and 55 MeV analysed ⇒

- Analysis of data in ^{238}U(p, f) utilising a Penning trap to determine isotopic yields is in the progress.

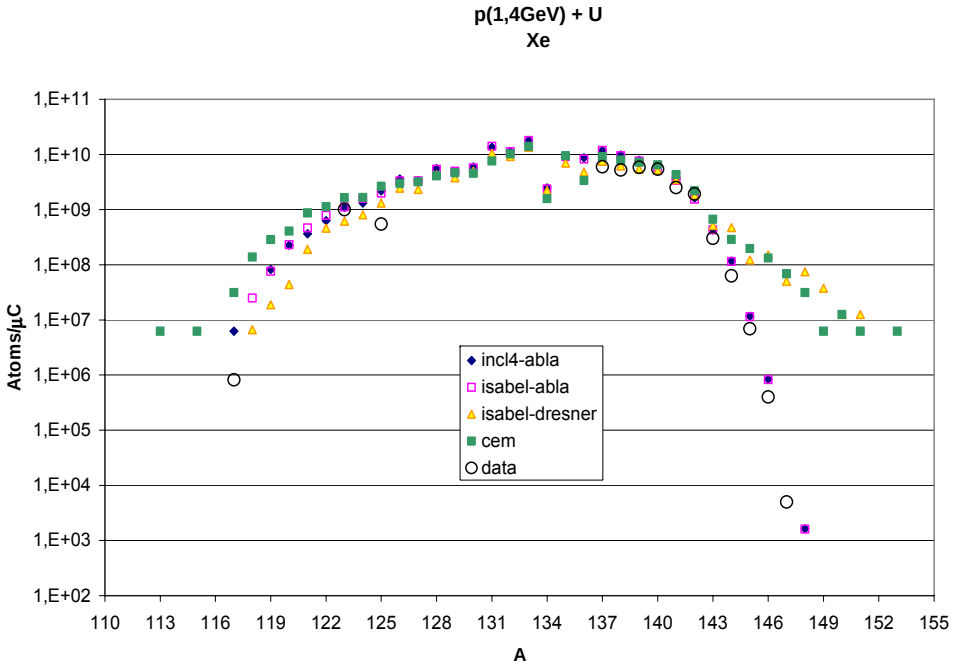


ST6 Heavy-ion reactions in the Fermi-energy domain

- Improvements in the description of production mechanisms of neutron-rich nuclei in nucleus-nucleus collisions around 28 *A*MeV

ST7 Secondary reactions in single- and double-stage targets

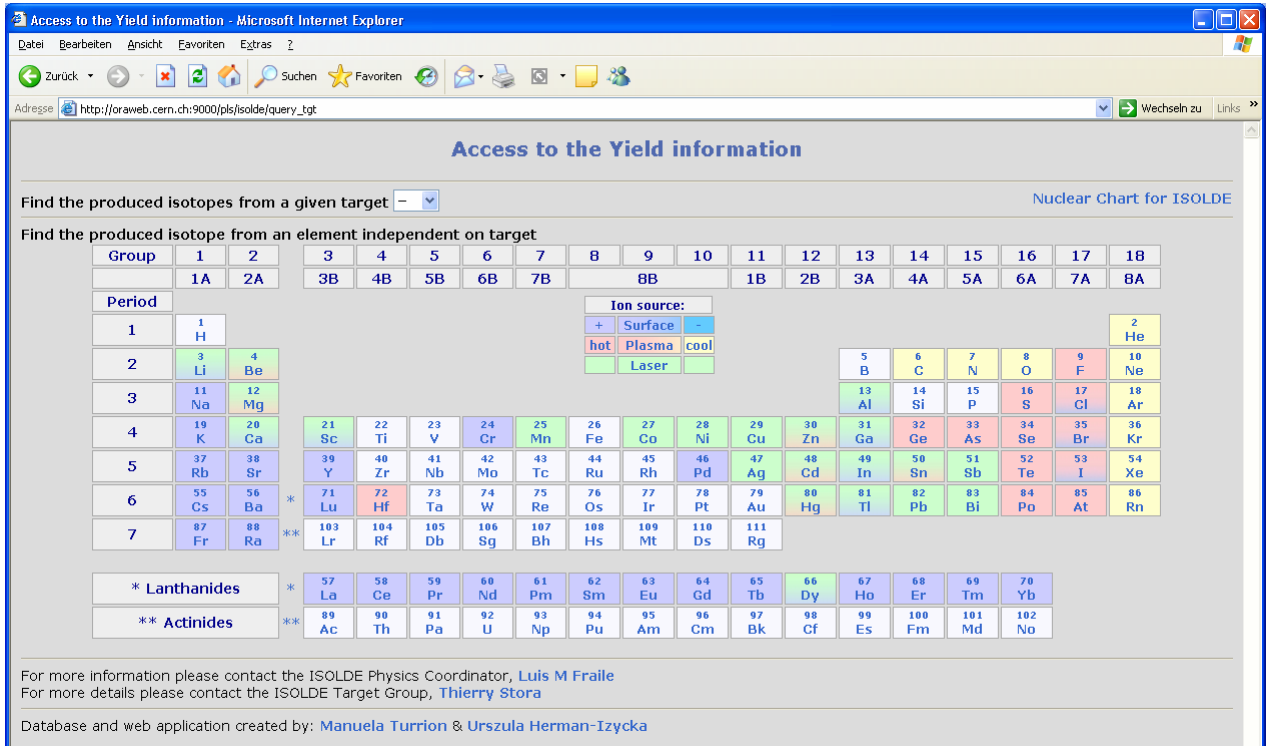
- Secondary reaction effects in thick targets with UC*x* and ThC*x* targets have been studied:



- Experiment on thick target data (30cm thick Pb target irradiated by a 660 MeV proton beam) has been performed. Data have been analysed; benchmarks on these data are in progress.
- Using the *baseline parameters* provided by CERN for realistic single stage targets, in target yield calculations have been started.

ST8 Predictions of secondary-beam intensities:

- The new ISOLDE database has been released and is now available at the following address: http://oraweb.cern.ch:9000/pls/isolde/query_tgt.



- The milestone M7.2, “Extrapolation of measured release-efficiency data”, has been postponed to a later stage (month 33), see Interim Report.

Planned milestones for the third period 1/2/2007 - 31/01/2008

No.	Milestones	Months due	Months expected
M1	**Heavy-ion requirement for driver accelerator - *finalised***		
M2	**Fragmentation of post accelerated ISOL beams**		
M2.2	Data analysis of the experiment	28	33
M2.3	Optimal post-acceleration energy estimation	33	33
M3	**Fission models**		
M3.3	Validation and improvement of codes	29	29
M4	**Spallation and fragmentation reactions**		
M4.3	Cross section estimations	33	33
M5	**Neutron and proton induced reactions up to Fermi energy**		
M5.2	Cross section studies	33	33
M6	**Aspects of secondary reactions**		
M6.2	Yields for single stage targets	24	24
M6.3	Yields for double stage targets	33	33
M7	**Predictions of secondary beam intensities**		
M7.2	Extrapolation of measured called release-efficiency data	17	33

Estimated expenditure for the third period 1/2/2007 - 31/01/2008

COSTS		CERN	CEA	JYV	UW	SAS	GSI	USDC	TOTAL
Personnel (k€)	Req. Contr.	29.67	45.0	1.4	8.5	0	54	25	163.57
Consumable (k€)	Req. Contr.	0	0	0	0	5	0	0	5
Travel and subsistence (k€)	Req. Contr.	0	3.0	3.8	6	4	10	10	36.8
Cost Request (k€)	Total	**29.67**	**48.0**	**5.2**	**14.5**	**9**	**64**	**35**	205.37

PERSONNEL		CERN	CEA	JYV	UW	SAS	GSI	USDC	TOTAL
FTE (person*month)	Req. Contr.	4	12.0	0.2	12	0	12	14	54.2
FTE (person*month)	Total	4	19.2	18	12	13.5	30	25	121.7

Open questions and needs

Plan:

• Data bank for estimations of beam intensities. ⇒ The most adapted way to make the result of the work in task 11 available to the community.

Open questions:

• Lack of money for Jyväskylä ⇒ Isotopic fission cross sections with high-resolution mass spectrometry. Any possibility?

• Support for experiments on reactions at Fermi energies in Lanchau and/or Texas A&M ⇒ Optimum energy for 2-step reactions (fragmentation of n-rich secondary beams). Is there a possibility to finance travels to experiments outside EU?

•Transfer of Warsaw activities from task 5 to task 11 ⇒ Help in setting up the data bank?

• Benchmark of FLUKA in EURISOL Task 11? Marta Felcini (CERN)