Second ANDES annual metting

Detailed investigation of fission in reactions p+^{208}Pb at 500 MeV in inverse kinematics

José Benlliure

Universidad de Santiago de Compostela
Spain

Task 4.2

Objectives:

Accurate data on few selected high energy reactions for benchmarking model calculations:

- solve few inconsistencies identified in previous data (p+^{208}Pb @ 500 MeV)
- perform exclusive measurements: isotopic cross sections of fission fragments in coincidence with observables providing stringent constraints for model calculations such as the neutron and light-charged particles multiplicities.

Methodology:

New generation experiment in inverse kinematics were both fission fragments are (fully) indentified and measured in coincidence with neutrons and/or light-charged particles.

ANDES participants:

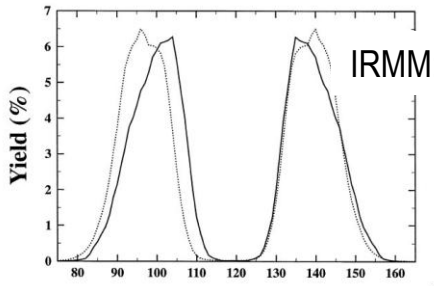
USC-Spain, CEA-France, GSI-Germany

Motivation

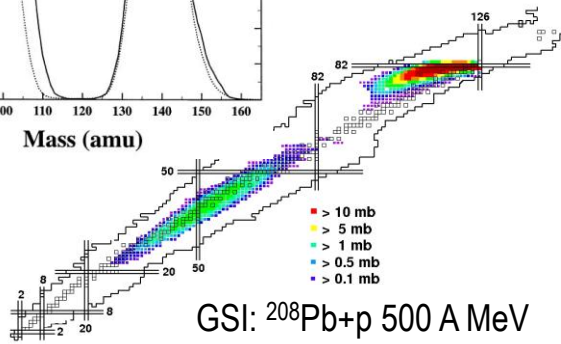
A complete identification of the two fragments produced in fission reactions has never been achieved.

- in **direct kinematics** only the masses of both fragments or the charge of the light one has been measured

- in **inverse kinematics** only one of the fragments has been fully identified or only the charge of both has been determined.



IRMM: ^{235}U, ^{238}U



GSI: ^{208}Pb+p 500 A MeV

Inverse kinematics measurements with advanced detection systems can give access to a complete characterization of the fission fragments.

Detection of neutrons and/or light charged particles in coincidence with fission fragments will help to constraint our present knowledge on spallation induced fission and solved some existing contradictory measurements of the reaction p+^{208}Pb at 500 MeV.

Proposed experiment

New generation fission experiment: Study On FIssion with Aladin SOFIA

Advanced detection set-up making possible full kinematic measurements

- full acceptance setup (both fragments detected)

- fission fragment identification in atomic number (Z), mass number (A) and TKE

- detection of neutrons and charged particles emitted in coincidence

Participants:

CEA-Bruyeres (France), U. Santiago (Spain),GSI (Germany), IPNO (France), CENBG-Bordeux (France), U. Vigo (Spain), CEA-Saclay (France), GANIL (France), U. Chalmers (Sweden), U. Leuven (Belgium), U. West Scotland (UK)

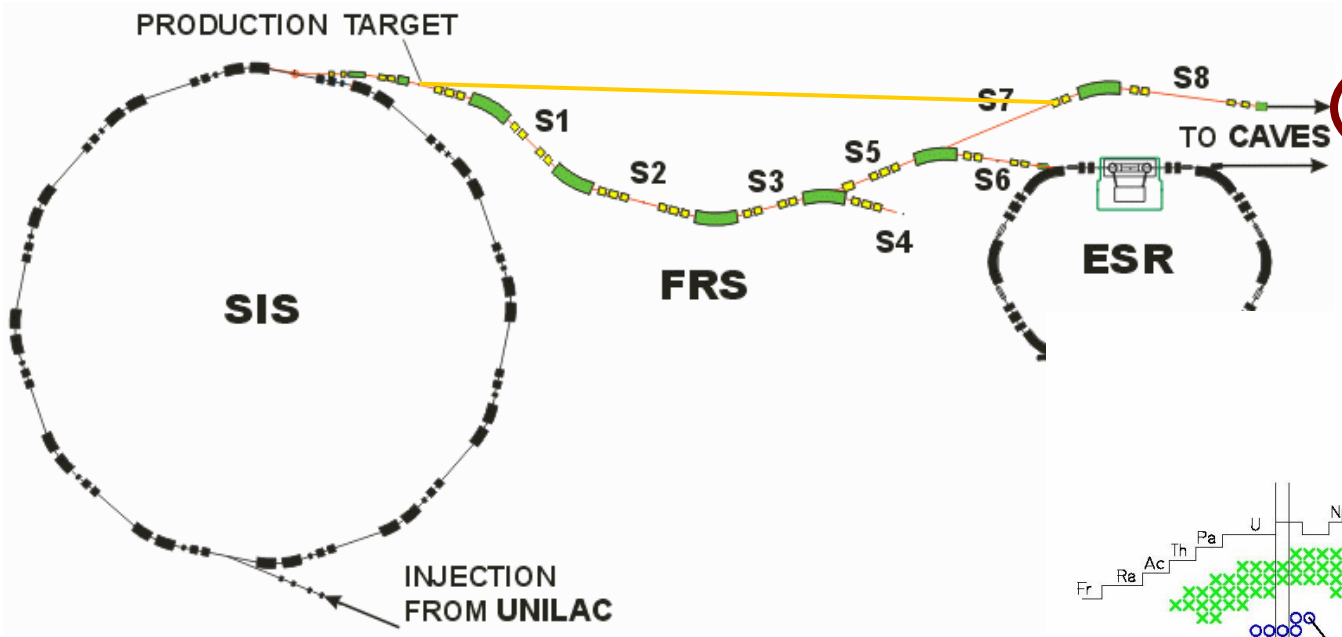
Additional possibilities:

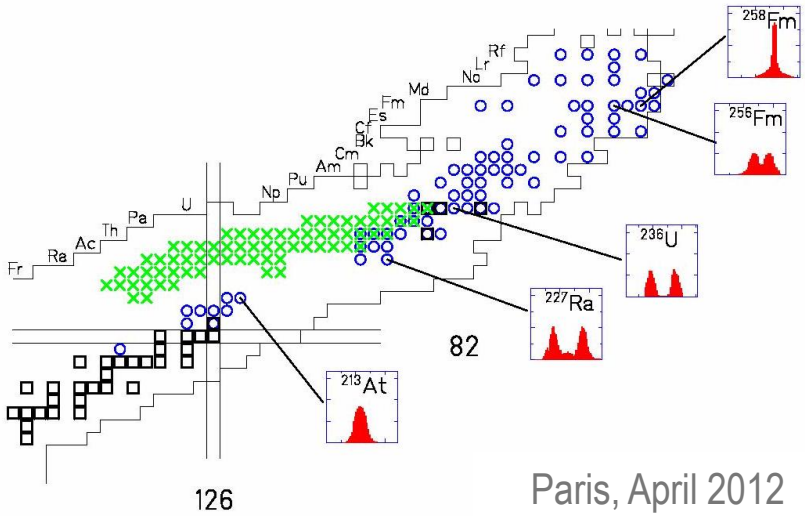
SOFIA will offer the possibility to investigate Coulomb induced fission of actinides

Proposed experiment

New generation fission experiment: Studies On FIssion with Aladin SOFIA

GSI is the only facility worldwide where stable beams of ^{208}Pb or ^{238}U can be accelerated at relativistic energies for fission investigations in inverse kinematics or ^{238}U projectiles can be fragmented to produce and investigate Coulomb induced fission of non stable actinides and pre-actinides

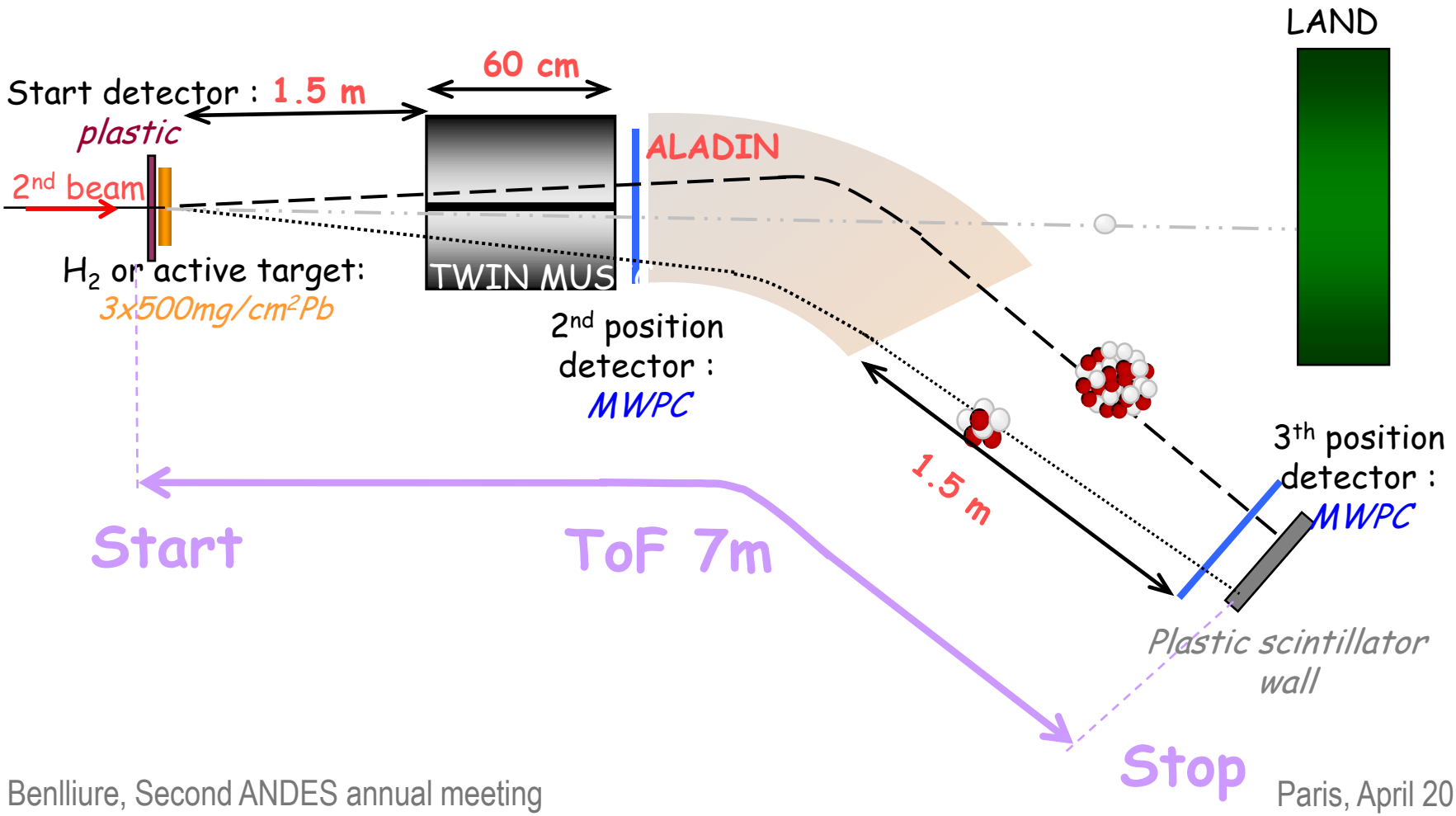




Proposed experiment

Experimental setup

Full identification in A, Z of both fission fragments together with TKE and neutrons

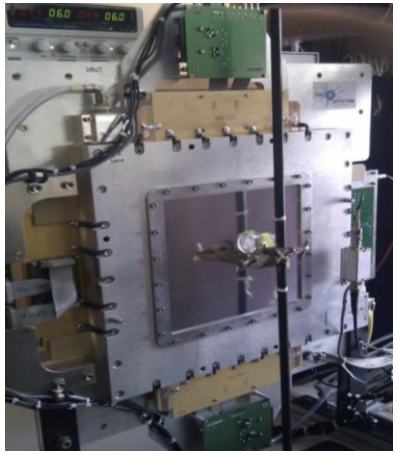


Proposed experiment

Experimental challenges

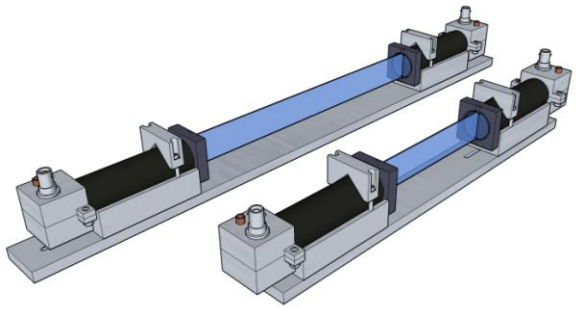
The A and Z identification up to 150 with the ALADIN bending requires:

- 200 μm resolution in position → ALICE type MWPC (IPN-Orsay)
- 40 ps (FWHM) time resolution over 7 m flight path → scintillator ToF-wall (Bruyeres)
- minium angular straggling → gasseous detectors (TWIN-MUSIC) and helium pipes



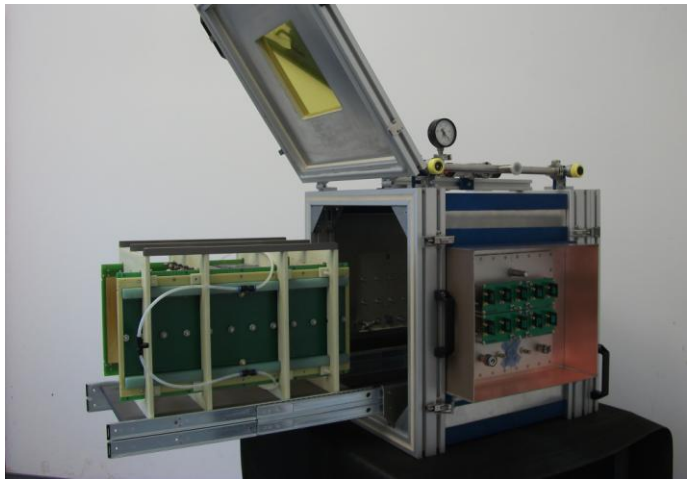
MWPC1 operational with 150 μm resolution

MWPC2 to be tested in May



Scintillator ToF operational with 30 ps (FWHM) resolution

TDC cards to be delivered



TWIN MUSIC operational

Some noise problems solved and to be tested in May

Proposed experiment

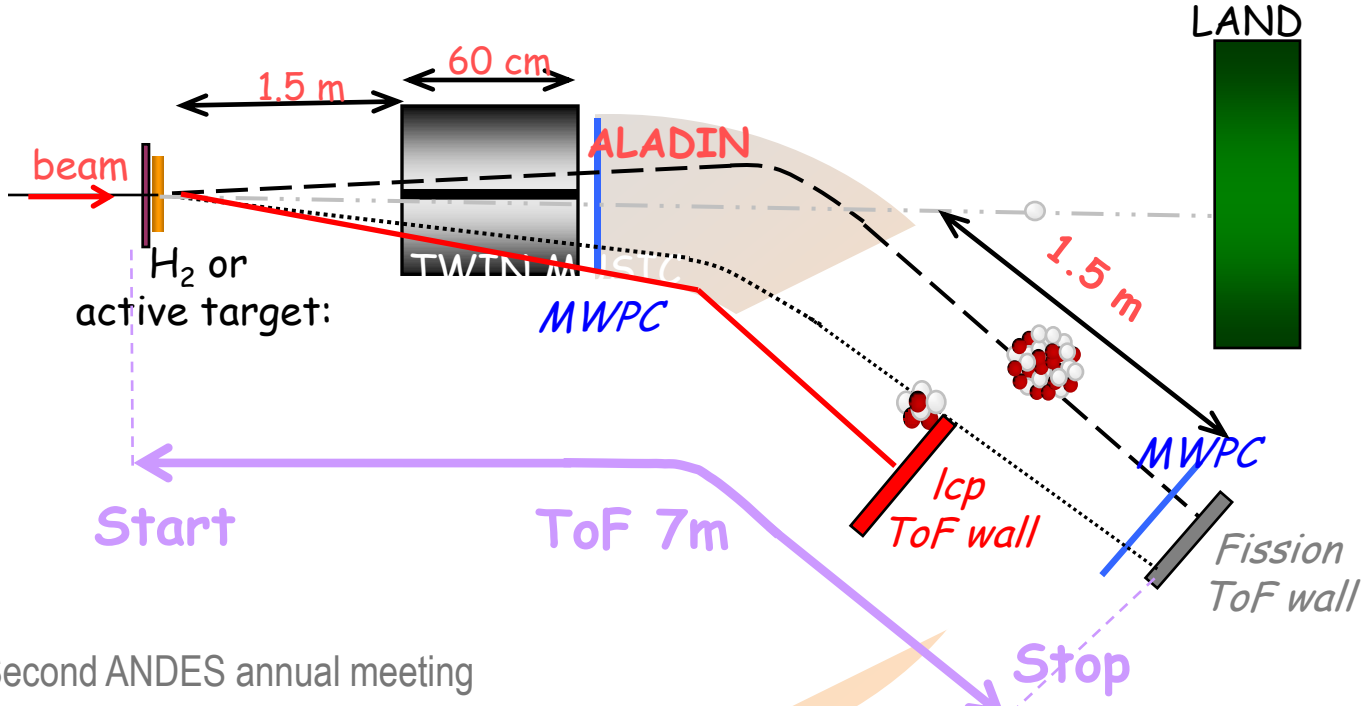
Experimental challenges

Detection of neutrons and light charged particles:

- The distance from the target to the dipole required for the identification of both fission fragments, limits the transmission of protons through the dipole

- Protons could be identified using a ToF-wall with a hole in front of the dipole. Heavier particles should be identified with another ToF-wall behind the dipole

- Most of the neutrons will reach LAND (80%) but with large multiplicities



Task 4.2: working plan

2010:
- conceptual design of the experiment (CEA,USC)
- detector design: MUSIC (GSI), ToF-Wall (CEA), MWPC (IPNO)

2011:
- simulation of the detection setup
- detector construction
- detector beam test in june and september 2011
- data acquisition setup

2012:
- detector beam test in May 2012
- mass reconstruction algorithms
- experiment commisioning in July 2012
- experiment run August/September 2012

2013:
- data shorting

Milestone 4.3:

Because of large preassure for getting beam time at GSI, the experiment run was delayed until summer 2012

Conclusions

- The SOFIA setup for the full identification in A and Z of both fission fragments using the inverse kinematic technique is almost ready

- This new capability offers very interesting possibilities for a full characterization of fission fragments (A,Z,TKE, ν) not initially foreseen for ANDES

- The possible detection of light-charged particles is under study

- Beam time schedule issues at GSI have delayed the experiment running until summer 2012 (Milestone 4.3 delayed by 3 months)