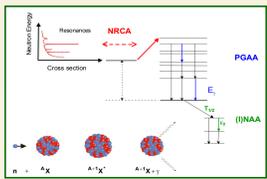


ANCIENT CHARM: a new project for neutron-based 3D imaging with applications to archaeological research

Zsolt Kasztovszky – Institute of Isotopes, Hungarian Academy of Sciences, Budapest and the Ancient Charm Collaboration*



ANCIENT CHARM:

Analysis by
Neutron resonant Capture Imaging and other Emerging Neutron Techniques: new
Cultural Heritage and Archaeological Research Methods

INTRODUCTION: AIM OF THE ANCIENT CHARM PROJECT

Neutrons can take part in various interactions with matter (capture- and scattering based ones), which are perfectly applicable for non-destructive testing of valuable Cultural Heritage objects. Most of the existing methods have already been applied in archaeometry research.

The EC has launched a 3-year long project to work out "a new, comprehensive neutron-based imaging approach, which will be applied for the 3D imaging of elemental and phase composition of objects selected as a result of a broad scope archaeological research."

Ten European Institutions are participated in the collaboration, involving Natural and Human Science experts.

THE ANCIENT CHARM COLLABORATION

Number	Organisation name	Lead Scientist(s)	Town	Country
1	Università degli Studi di Milano-Bicocca	G.Gorini	Milano	Italy
2	Università degli Studi di Roma Tor Vergata	C.Andreani	Roma	Italy
3	Hungarian National Museum	K.Biro	Budapest	Hungary
4	Institute of Isotopes - Chemical Research Center - Hungarian Academy of Sciences	T.Belgya	Budapest	Hungary
5	Rheinische Friedrich-Wilhelms Universität Bonn	A.Kirfel	Bonn	Germany
6	Universität zu Köln	J.Jolie	Koeln	Germany
7	European Commission – Joint Research Centre - Institute for Reference Materials and Measurements	P.Schillebeeckx	Geel	Belgium
8	Leiden University	H.Kamermans	Leiden	Netherlands
9	Technical University Delft	H.Postma C.van Eijk	Delft	Netherlands
10	Central Laboratory of the Research Councils	P.Radaelli	Didcot	United Kingdom

EXISTING NEUTRON BASED METHODS TO BE APPLIED

Prompt Gamma Activation Analysis (PGAA)

BNC - IKI Budapest, Kasztovszky et al.

IRRADIATION	DETECTION	SENSITIVITY	APPLICATIONS
Cold / th beam Bulk	Prompt- and delayed γ	Medium: Major, traces (H, B, Cl, Cd, Sm, Gd)	pottery, stones, metals, glass

Neutron Resonance Capture Analysis (NRCA)

IRMM – Geel, Postma et al.

IRRADIATION	DETECTION	SENSITIVITY	APPLICATIONS
Epithermal pulsed n beam Bulk	Energy of the resonance-captured neutrons	High for heavy elements (Cu, As, Zn, Ag, Sb, Sn)	Bronze, copper-alloys

Neutron Tomography (NT)

IRMM – Geel, Materna et al. ??

IRRADIATION	DETECTION	SENSITIVITY	APPLICATIONS
Cold / th beam Image 10 μ m resolution	Transmitted neutrons	High for light components (H, water, organic, air)	Contrast image with 10 μ m resolution bronze, wood sculpture

Neutron Diffraction (ND)

ROTAX ISIS – Didcot, Kockelmann et al.

IRRADIATION	DETECTION	SENSITIVITY	APPLICATIONS
Epithermal pulsed beam Bulk	Elastic scattered neutrons (ED / TOF)	Long / short range atomic order, phases	Alloys (bronze, Pb-Sn, Ag-Cu), marble, pottery

HOW TO SELECT THE OBJECTS?

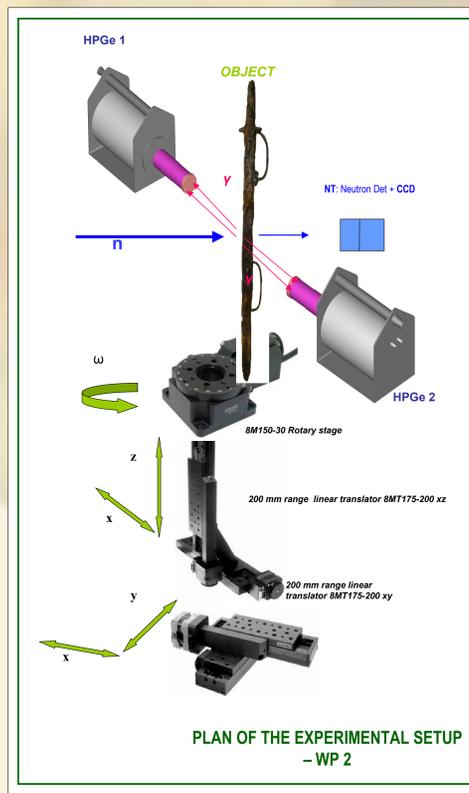
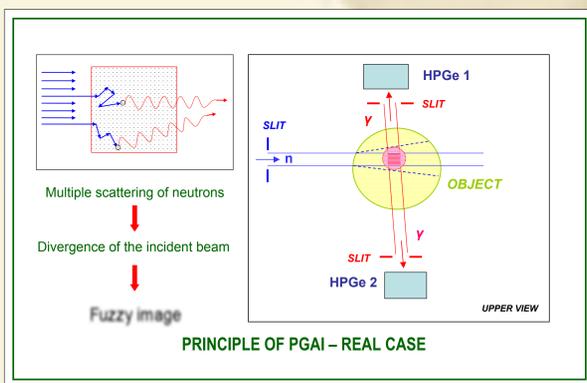
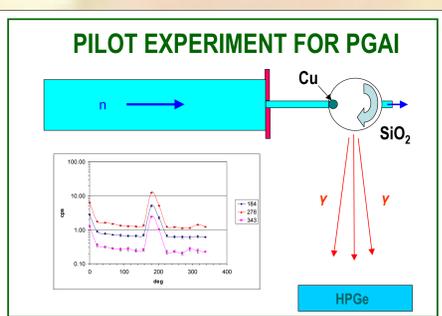
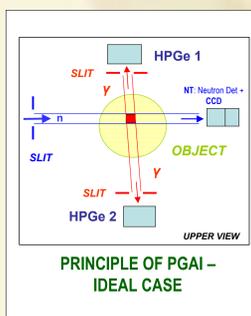
WP 1

- Current archaeological research problems should drive the selection of objects
- They will, in turn, set the measurement requirements
- The objects should be representative of different classes:
 - objects with voids; composite, multi-layered materials; jewellery with inlays
- Other selection criteria:
 - geographical provenance (throughout Europe)
 - archaeological / historical periods (e.g. Neolithic, Roman, ...)
- The information output from neutron based methods should be unique

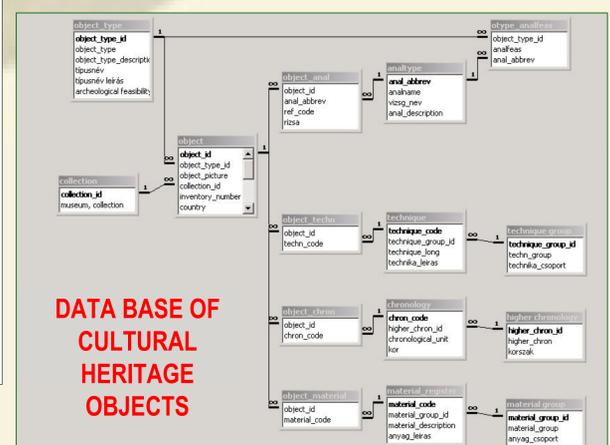
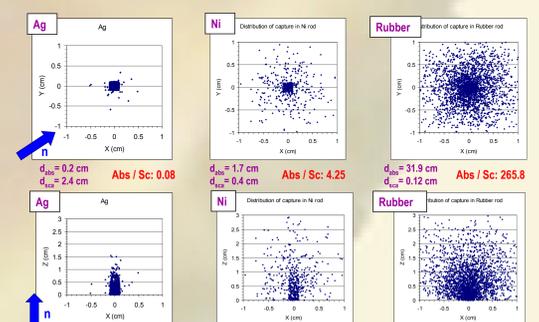
POSSIBLE ART OBJECTS TO ANALYSE



ANCIENT CHARM - STATE OF ART



MONTE CARLO SIMULATION OF NEUTRON INTERACTIONS



*Published by G. Gorini ... (2006)

ACKNOWLEDGEMENT ??