

1st One-Day Workshop on New Aspects and Perspectives in Nuclear Physics

September 8, 2012 • Ioannina, Greece

Photo-album



University
of Ioannina



HELLENIC
INSTITUTE OF
NUCLEAR
PHYSICS



Physics Department
University of Ioannina

1ST ONE DAY WORKSHOP ON NEW ASPECTS AND PERSPECTIVES IN NUCLEAR PHYSICS

8th of September, 2012
Ioannina, Greece

Schedule:
Session I: Theory: Nuclear Structure and Nuclear Astrophysics
Session II: Experiments: Nuclear Reactions, Hadrons
Session III: Applications: Environment – Material Science – Medical – Dating
Session IV: Round Table Discussion: The Present and Future of Nuclear Physics in Greece

Organizing committee

A. Pakou
D. Bonatsos
G. Lalazissis
E. Stiliaris

Opening: A. Pakou



8th of September, 2012
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Session I: Theory: Nuclear Structure and Nuclear Astrophysics
Session II: Experimental: Nuclear Reactions, Hadrons
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in

Organizing

A. Pak
D. Bor
G. Lal
E. Stil

Opening: C. Baikoussis



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Session III: Applications: Environment – Material Science – Medical – Dating

Session IV: Round Table Discussion: The Present and Future of Nuclear Physics in Greece

Opening: T. Bakas





- Collaborators
- R. F. Casten (Yale)
 - K. Blaum, R.B. Cakirli (MPI Heidelberg)
 - C. Quesne (U. Libre Bruxelles)
 - N. Minkov (INRNE Sofia)

Session I: D. Bonatsos

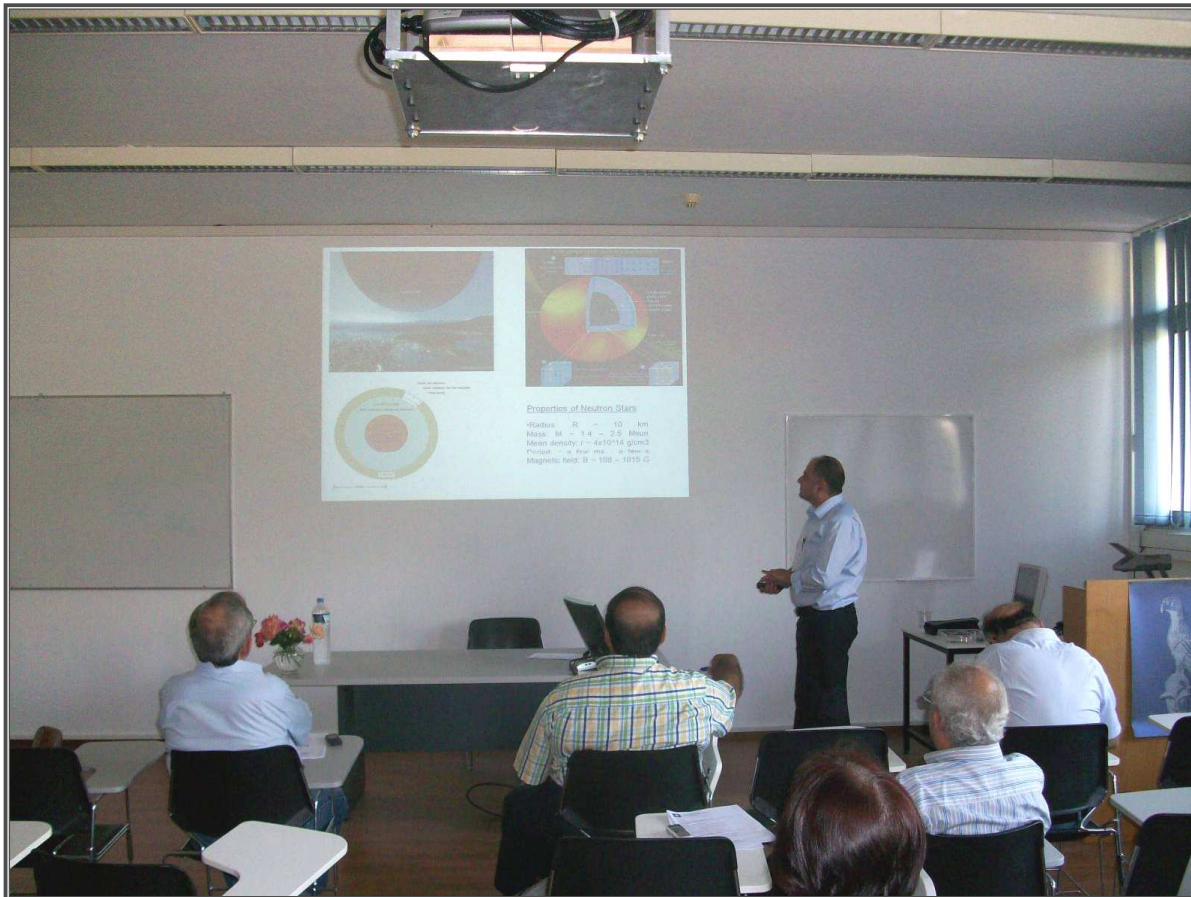


$0[110]$ pairs

- 168 Er: p $7/2$ [523]; n $7/2$ [633]
- 172 Yb: p $1/2$ [411]; n $1/2$ [521]
- 178 Hf: p $7/2$ [404]; n $7/2$ [514]
- 180 W: p $7/2$ [404]; n $7/2$ [514]

Session I: D. Bonatsos





Session I: Ch. Moustakidis



r-mode instability

- Neutron stars suffer a number of instabilities with a common feature: they can be directly associated with unstable modes of oscillation lead to the production of gravitational radiation
- The first prediction for the r-mode made by Chandrasekhar (1970), Friedeman and Schutz (1978) (CFS Instability)
- The r-modes are always retrograde in the rotating frame and prograde in the inertial frame (satisfy the CFS criterion at all rates of rotation ----> the r-modes are generically unstable in rotating perfect fluid (interior neutron stars))
- The CFS instability allows some oscillation modes of a fluid body to be driven rather than damped by radiation reaction (gravitational waves), essentially due to a disagreement between two frames of reference.
- The role of nuclear equation of state and density dependence of nuclear symmetry energy is very important.





Outlook

- Core is intermediate energy γ -rayless cross sections calculations are required to:
 - 1) be accurate on radiological experiments (CUORE, MOON, COMAR)
 - 2) for a realistic GRSZ, β -decay dating in neutrino ν -cross sections
 - 3) astrophysical processes (stellar nucleosynthesis, etc.)
- The μ -neutrinos (e.g. mu2 ν) oscillator is a powerful probe for studying:
 - CP-violations and getting nuclear constraints in ν - ν parameters of non-standard theories.
- Nuclear physics aspects and neutrino transition MB calculations (with COMAR) (as complement) such experiments

Session I: T. Kosmas



Semi-leptonic weak interaction

- > Help us to deepen our knowledge on:
the fundamental electro-weak interactions and nuclear structure
- > Inspire probes within and beyond the SM searching:
 - (i) ν -detection, lepton-capture, beta-decay modes, etc.
 - (ii) $0\nu\beta\beta$ -decay, exotic ν -processes, nuclear μ -e conversion, etc
- > Play important role in astrophysics:
nucleo-synthesis, core collapse SN (e-capture), etc.

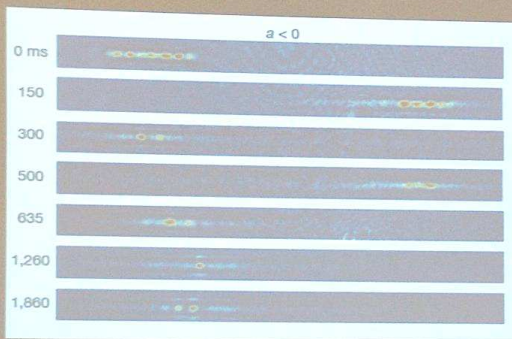
Numerous questions are still unanswered and reactions cross sections for such processes are required to understand many of them

This motivates theoretical studies (reactions cross sections) on prominent nuclei to be used as targets in the relevant experiments

Session I: T. Kosmas



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Session I: M.A. Martinou

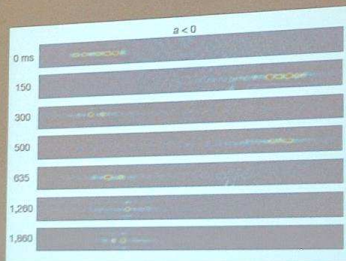
1st One-Day Workshop on New Aspects and Perspectives in Nuclear

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The experiment in Rice University

Four BECs were created. Each of them consisted of 5000 Lithium atoms that were tuned to **attract** each other. The specific atoms are considered to be bosons. But a gap between the BECs indicates a fermionic behavior of them.



September 5, 2012

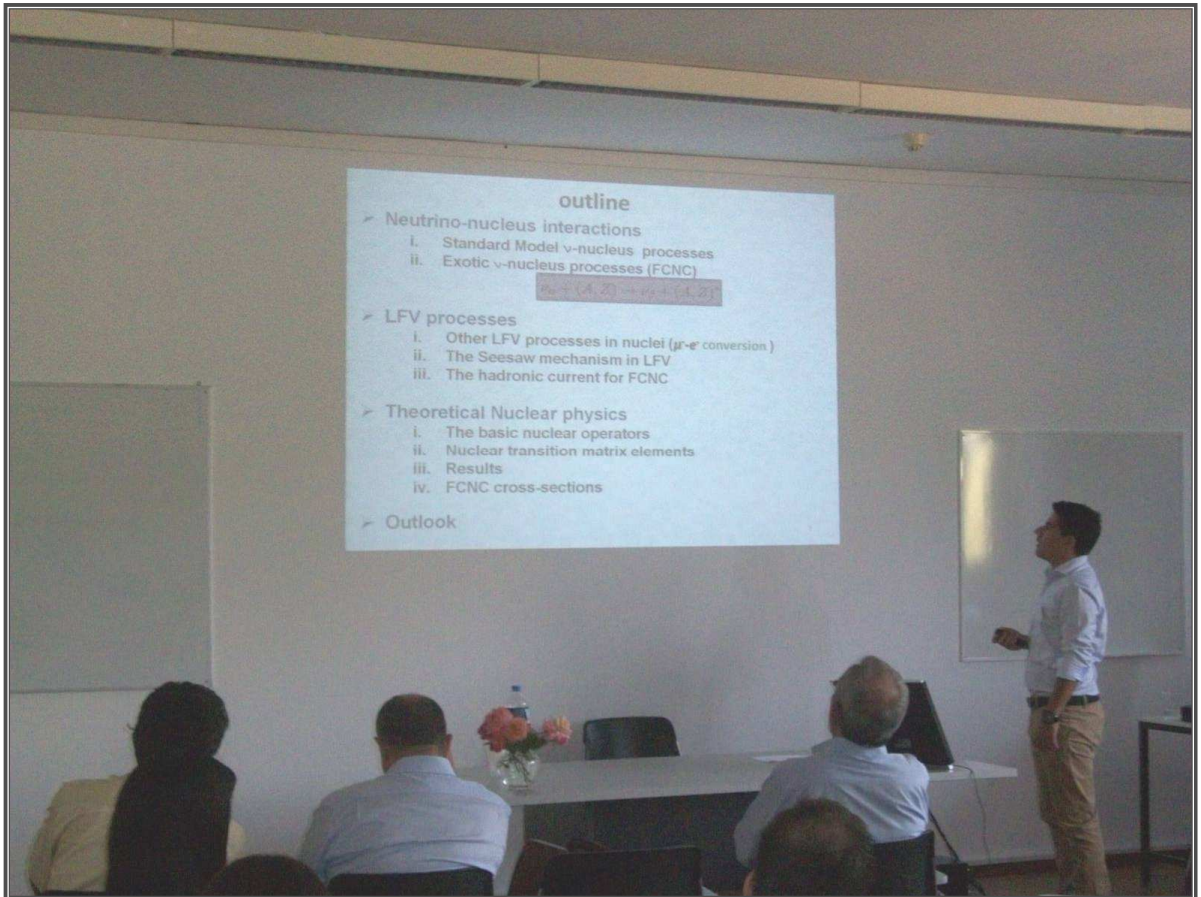
Session I: M.A. Martinou





Session I: D. Papoulias





- outline
- Neutrino-nucleus interactions
 - i. Standard Model ν -nucleus processes
 - ii. Exotic ν -nucleus processes (FCNC)
 - LFV processes
 - i. Other LFV processes in nuclei (μ - e conversion)
 - ii. The Seesaw mechanism in LFV
 - iii. The hadronic current for FCNC
 - Theoretical Nuclear physics
 - i. The basic nuclear operators
 - ii. Nuclear transition matrix elements
 - iii. Results
 - iv. FCNC cross-sections
 - Outlook

$$\nu_{\mu} + (A, Z) \rightarrow \nu_{\tau} + (A, Z)$$





Session I: P. Giannaka

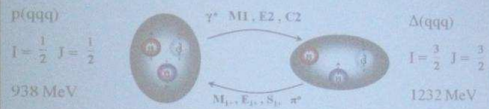


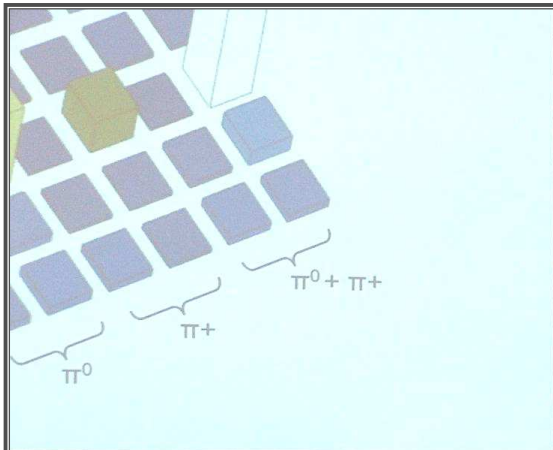


Session I: P. Giannaka



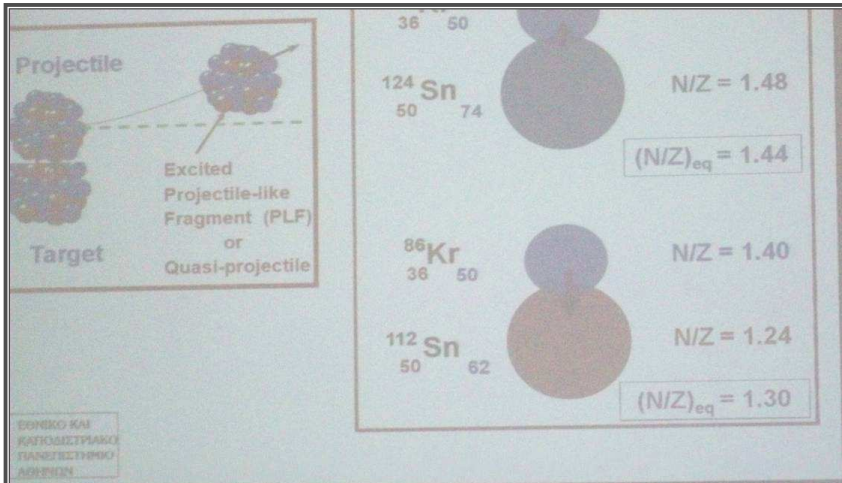
The signal for deformation in the $\gamma^* N \rightarrow \Delta$ transition





Session II: E. Stiliaris





Session II: G. Souliotis



Overview of recent activities:

Recent work:

- deep inelastic collisions below the Fermi energy:
- $^{86}\text{Kr}(25\text{MeV/nucleon}) + ^{64}\text{Ni}, ^{124}\text{Sn}$ PRL 91, 022701 (2003)
- $^{86}\text{Kr}(15\text{MeV/nucleon}) + ^{64}\text{Ni}, ^{124}\text{Sn}$ PRC 84, 064607 (2011)

Findings:

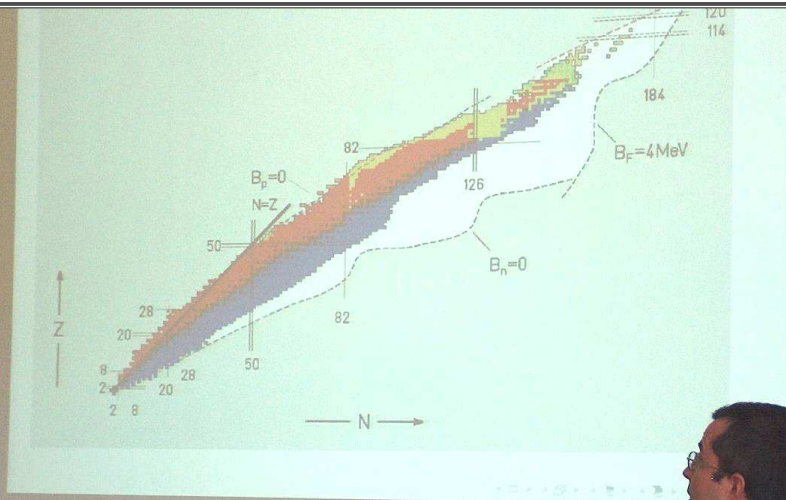
- Peripheral collisions: enhanced production of neutron-rich nuclei
- Heavy Residues as equation-of-state (EOS) probes:
 - Heavy-residue isoscaling PRC 73, 024606 (2006)
 - N/Z equilibration PLB 588, 35 (2004)

Present efforts: production of n-rich nuclei in 15 MeV/nucleon reactions

N/Z transport w.r.t. to TKEL (\sim degree of dissipation)
Comparisons with DIT, CoMD models.

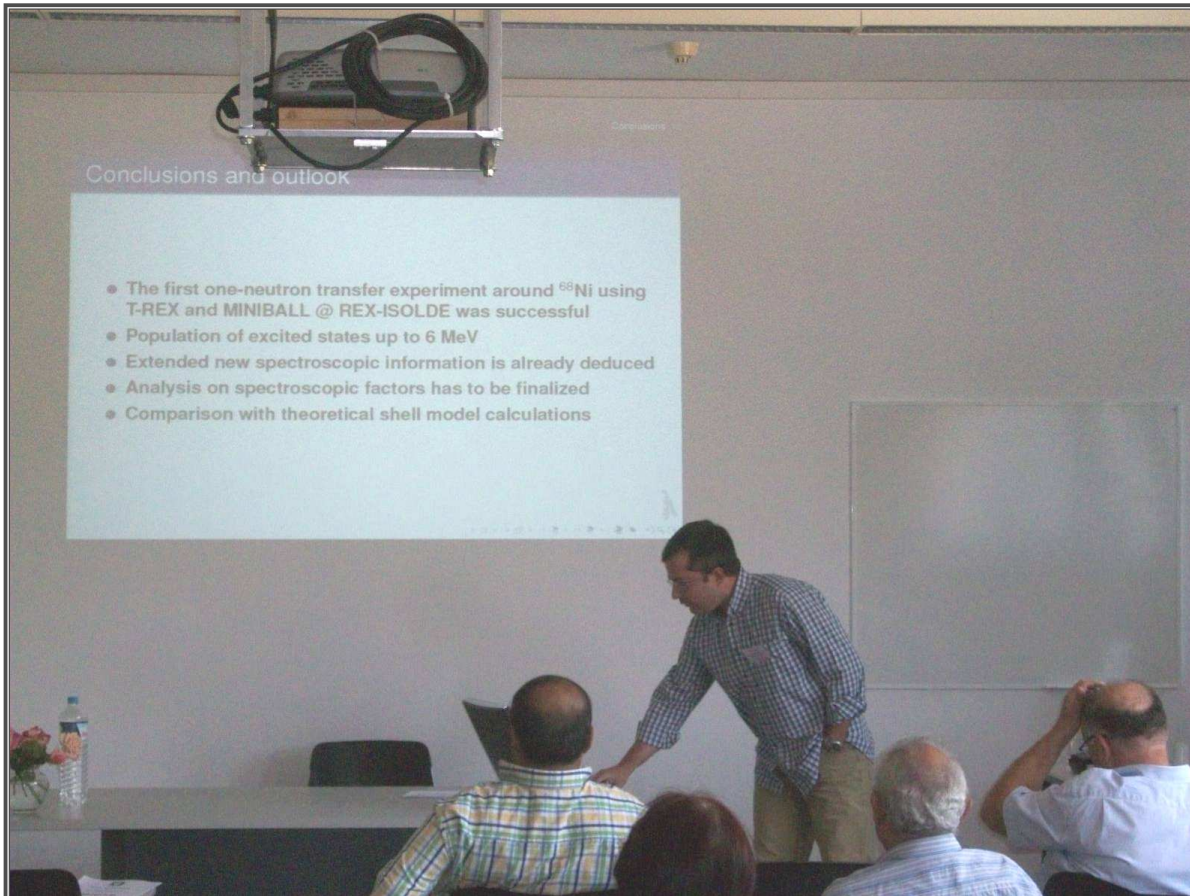


Session II: G. Souliotis



Session II: N. Patronis





Conclusions and outlook

- The first one-neutron transfer experiment around ^{68}Ni using T-REX and MINIBALL @ REX-ISOLDE was successful
- Population of excited states up to 6 MeV
- Extended new spectroscopic information is already deduced
- Analysis on spectroscopic factors has to be finalized
- Comparison with theoretical shell model calculations

Session II: N. Patronis

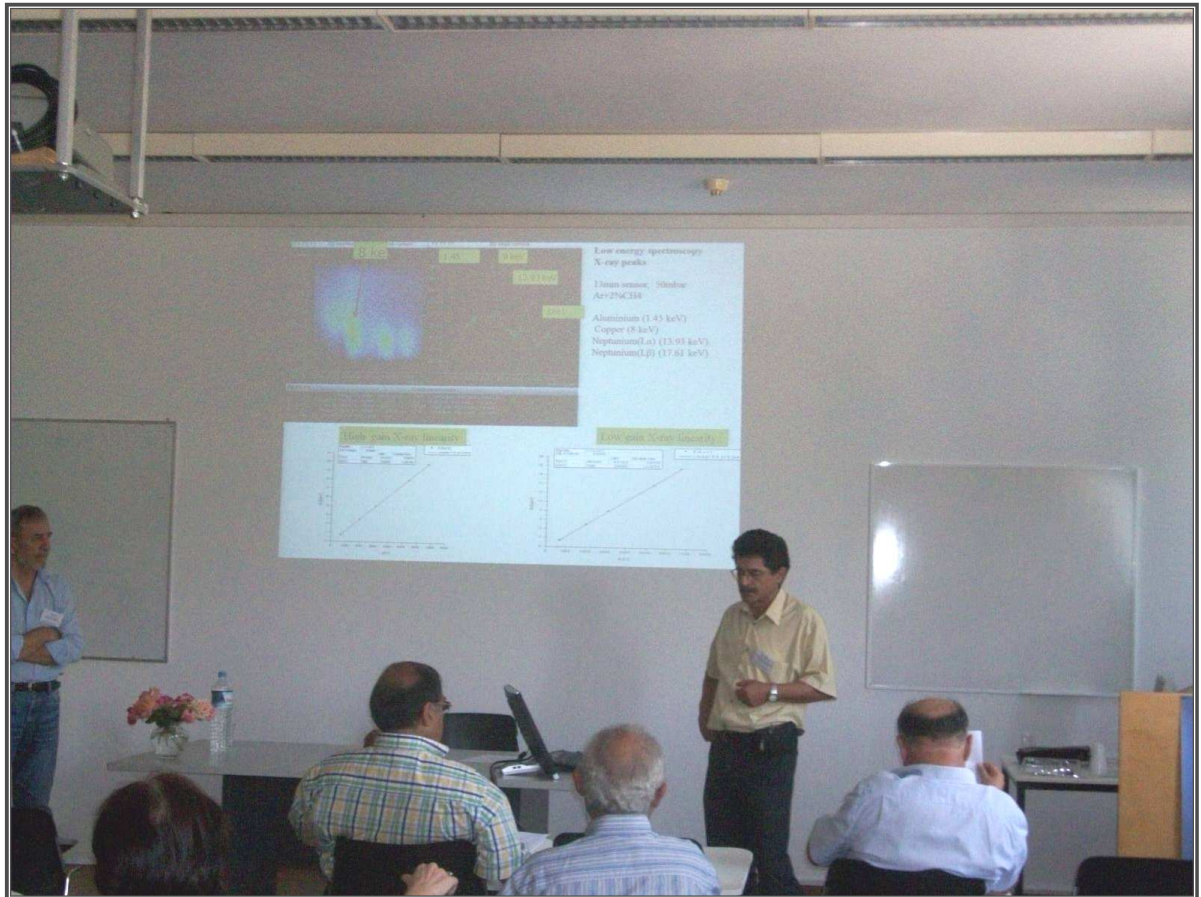


Neutron emission from uranium and plutonium isotopes

Nuclide	Half-life	Spontaneous Fission prob. (%) per decay	Neutrons per fission	Neutrons per (g.s)
^{238}U	7.04×10^8 years	7.0×10^{-9} %	1.86	1.0×10^{-5}
^{235}U	4.47×10^9 years	5.4×10^{-5} %	2.07	0.0136
^{239}Pu	2.41×10^4 years	4.4×10^{-10} %	2.16	2.2×10^{-2}
^{240}Pu	6569 years	5.0×10^{-6} %	2.21	920
^{242}Cf	2.638 years	3.09 %	3.73	2.3×10^{12}

Session II: I. Savvidis





Session II: I. Savvidis



CASTOR: Centauro And Strange Object Research

- CASTOR is an EM/H calorimeter system, conceived and proposed for the H. I. Physics Program at the LHC.
- It is designed for potential discovery of “New Physics” such as “Centauro” and “Strangelets”, in addition to “mainstream” Physics.
- It has been adopted for very forward pp Physics studies.

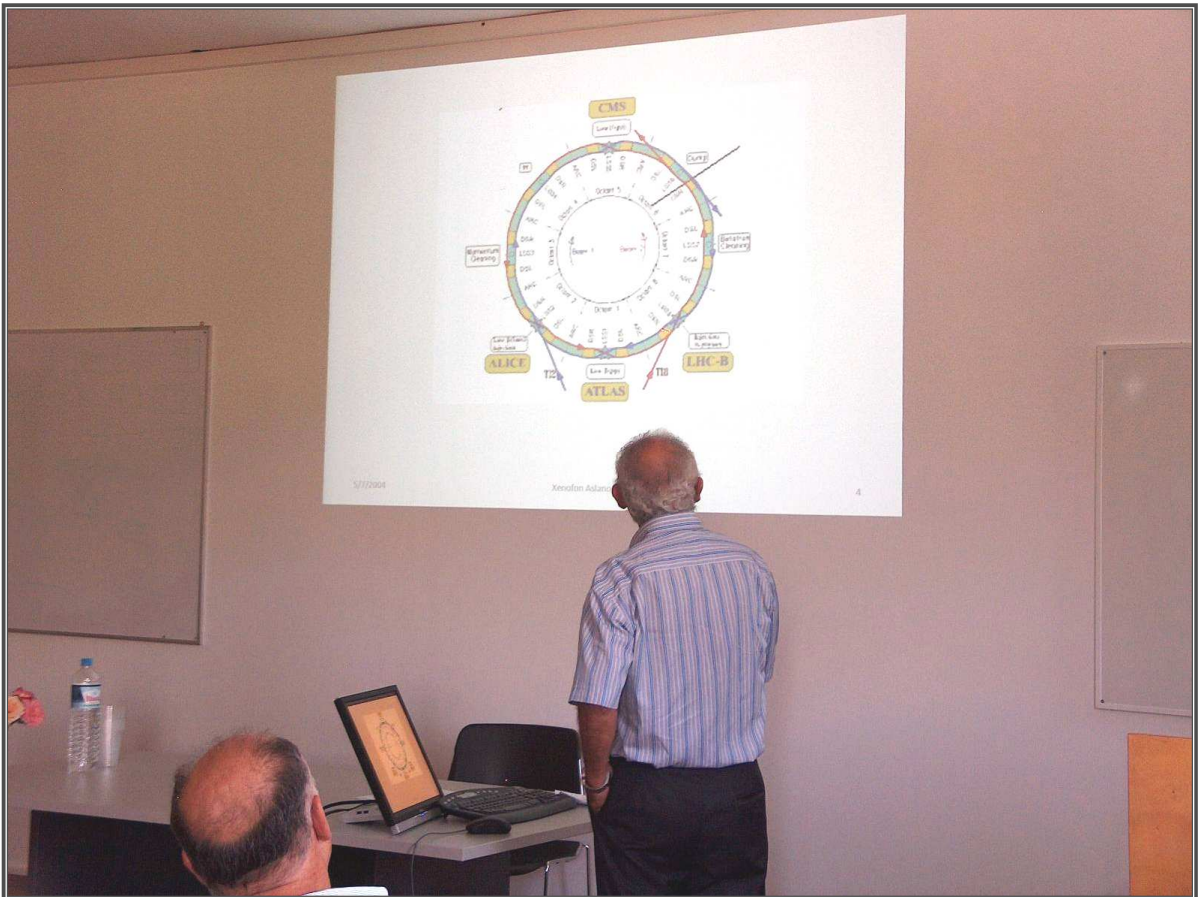
5/7/2004

Xenofon Aslanoglou

2

Session II: X. Aslanoglou





Session II: X. Aslanoglou



Future perspectives and the life tree

Nucleus-Nucleus optical potential, and relevant reaction mechanisms

$6,7\text{Li}+^{28}\text{Si}$

$^8\text{B}, ^7\text{Be}, ^6\text{He} + ^{28}\text{Si}$

$^{20}\text{Ne}+^{28}\text{Si}$

inverse kinematics probing clustering effects Vassilis



Proton-Nucleus optical potential

$17\text{F}+p$ off resonances

$6\text{Li}+p$ inclusion of compound couplings

$18\text{Ne}+p$ inclusion of clustering effects

Session II: A. Pakou



The optical potential

A successful method to describe the nucleus-nucleus interaction is the optical potential method either in a macroscopic or a microscopic approach

$$U(r, E) = V(r, E) + iW(r, E)$$

Macroscopic approach- e.g. use a Woods-Saxon potential

$$V(r, E) = \frac{V_0}{1 + \exp\left(\frac{r - R}{\alpha}\right)}$$

depth (pointing to V_0)
radius (pointing to R)
diffusivity (pointing to α)

Adjustable parameters V_0 , R , α
Igo ambiguities etc

Session II: A. Pakou



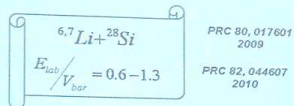


Session II: K. Zerva



vation

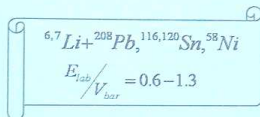
experiment \Rightarrow



sion:

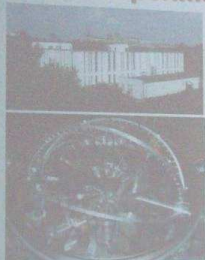
tering technique is a more accurate technique to probe the
tential than the conventional angular distribution

t work \Rightarrow





Experimental setup



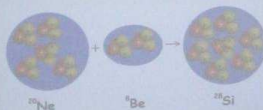
- ❖ The experimental setup was visualized in ICARE facility of the H.I.L. (Warsaw).
- ❖ ICARE consists of a big chamber with various facilities for setting up numerous detectors. In this respect, the chamber includes two platforms (A,B) and several rings that allow us to place many detectors.

Session II: V. Soukeras

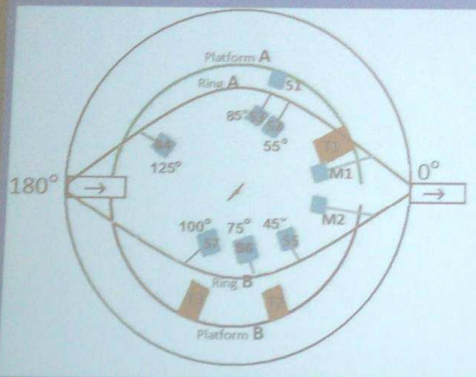


Explanation of the oscillations through coupling mechanisms

- Assuming that 2 sequential alphas are transferred from the target to projectile, the results were not satisfactory.
- On the other hand, a whole ^8Be transfer between ^{20}Ne and ^{28}Si can explain such a behavior.



Experimental Setup



Schematic details of the setup

Detector	Distance from the target (cm)
M1	31.5
M2	31.5
T1	11.5
T2	11.5
T3	11.4
S1	11.1
S2	11.5
S3	11.5
S4	11.5
S5	11.6
S6	13.5
S7	11.6

Detectors' distances from the target

Session II: O. Sgouros





Conclusions

- Angular distribution measurements of one-alpha and two-alpha transfer reactions for the system $^{20}\text{Ne}+^{28}\text{Si}$ were performed at near barrier energies.
- One and two alpha transfer reaction products were observed.
- The data were analyzed in a DWBA framework. The agreement with the data is good for both energies, indicating the validity of the proposed potential.
- Future activity:** Study $^{20}\text{Ne}+^{28}\text{Si}$ transfer reactions using a mass spectrometer.

Session II: O. Sgouros



Beam Analysis techniques to the study of near-surface layers of

Interactions of radionuclides and natural and synthetic sorbents - Chemistry (ca.30%).

*Chemistry & Natural radioactivity
Alpha- and gamma-spectroscopy*



Session III: P. Misaelides



*Thank you very much
for your attention!*



Session III: P. Misaelides






Arctic Research Centre of the FMI at Sodankylä
Location: 67°37' N, 26°55' E, 180 m asl
Offers unique possibilities for carrying out
research on atmospheric radioactivity in the
northernmost continental Europe.

anho@fmi.fi or ioannidou@earth.gm

Ioannina, 8 Sep. 2012

Session III: A. Ioannidou



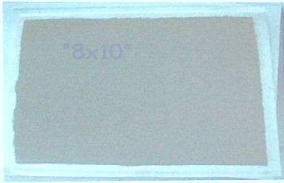


HV air Sampler (Staplex TFIA-2)
Flow rate: 1.6-1.7 m³/min (60cfm)
Sampling duration: 23 h
Total Volume: 2400-2700 m³
Air Volume Uncertainty (2σ): 30-50 m³

11/09/2010

ss Fiber Filters TFAGF810

Very high retention of fine particles. 99.98% retention efficiency of 0.3 micron particles.



Ioannina, 8 Sep, 2012



Ion-Beam Analysis (IBA) techniques

Our aim:

the characterization of near surface layers of biomaterials in order to investigate their corrosion resistance and biocompatibility

the characterization and the investigation of the oxidation and corrosion resistance of materials used for industrial applications

The materials

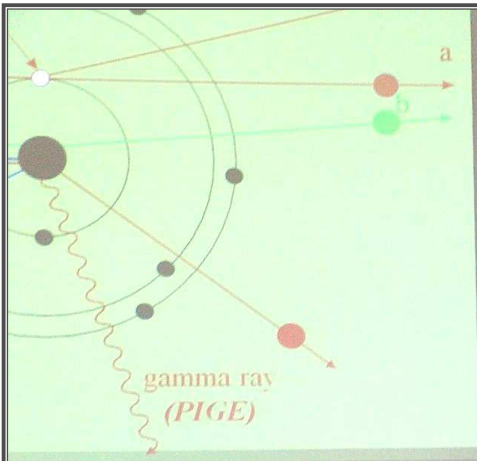
Ti-alloys (e.g. Ti-6Al-4V) and Co-based alloys (CoCrMo) used as orthopaedic, dental and cardiac implants

stainless steels implanted with Al, Zr, Mg, Y for industrial applications

Cu-alloys in environment and in cultural heritage

Session III: F. Noli





Session III: F. Noli





AN INTRODUCTION TO SELECTED APPLIED NUCLEAR PHYSICS ACTIVITIES AT IOANNINA

K. G. Ioannides¹, C. Papachristodoulou² and K. Stamoulis³

- ¹Nuclear Physics Laboratory, The University of Ioannina
- ²NSRF and INF units, Horizontal Labs Network of The University of Ioannina
- ³The Accelerator Centre Horizontal Labs Network of The University of Ioannina

<http://omega.physics.uoi.gr>

Session III: K. Ioannides

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Applied Nuclear Physics at
and right after the Chernobyl
6 in the field of Environmental
measurements.

was broadened by the
research in countermeasures
nuclear accident and the
radionuclides transfer to
components and Man.



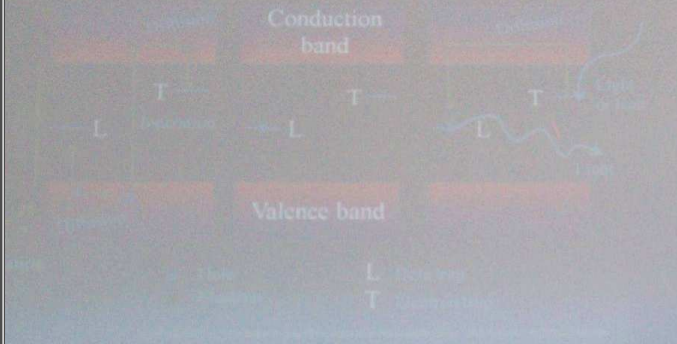
Session III: K. Ioannides



Principles of TL/OSL dating

Irradiation, storage, eviction

Luminescence in a mineral crystal lattice (i.e. quartz)



Session III: K. Stamoulis



pottery, soils,
techniques

various kinds of
(of air, water)

elements (waterlands,
series)

September 2012, Ioannina



Session III: K. Stamoulis



The performance of a Compton Camera is studied through GEANT4/GATE simulations for various geometrical characteristics.

$N_{emitted}$: Number of source emitted photons
 $N_{reached}$: Number of photons reached scatterer
 $N_{interacted}$: Photons interacted with scatterer
 $N_{coincided}$: Number of detected coincidences

Session III: M. Mikeli



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System
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shows:

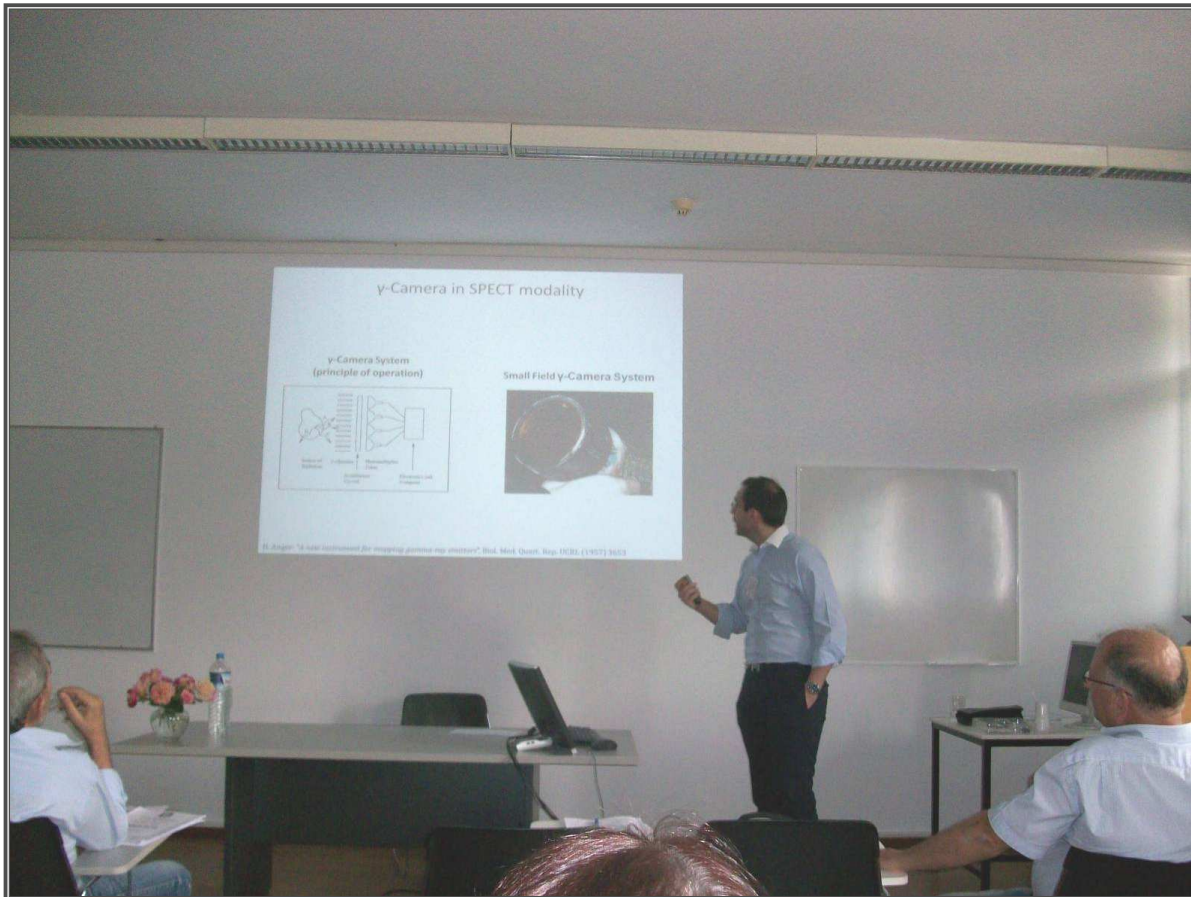
dose
y

Collimator

The diagram shows a schematic of a gamma camera system. It includes a 'Source of Radiation' on the left, a 'Collimator' in the center, a 'Scintillation Crystal' below the collimator, 'Photomultiplier Tubes' to the right of the crystal, and 'Electronics and Computer' at the far right. Arrows indicate the flow of radiation from the source through the collimator and crystal to the photomultiplier tubes, which then send signals to the electronics and computer. Below the diagram is a square image showing a grid of circular patterns, representing the output of a collimator.

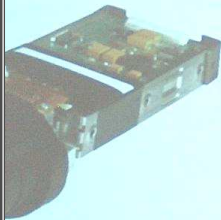
Session III: M. Mikeli





Session III: A.N. Rapsomanikis





Model Thermovision[®] 550
(AGEMA Infrared Systems)
with a built-in 200 lens in
the form of high resolution
color images (250x188
pixels).

used to detect the thermal
of objects.



Session III: A.N. Rapsomanikis



Small Field 3" γ -Camera

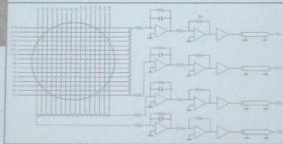
3. The Position Sensitive Photomultiplier Tube (PSPMT)



HAMAMATSU
Model R2486
3" Diameter
Circular Envelope PSPMT

16 X-wires & 16 Y-wires
Resistive Chain Technique

Only 4 Signals: (X_0, X_p, Y_0, Y_p)



Factor of a standard commercial γ -Camera :

be placed close to the organ of interest,
background activity from other neighbor

only certain planar projections to be imaged.

factors imply that the general purpose γ -Cameras
optimal spatial resolution and poor image
regarding the small organ imaging

ion → A dedicated, small field, high resolution
portable γ -Camera for clinical use

Session III: M. Zioga



The Present and Future of Nuclear Physics in Greece

Athena Pakou, University of Ioannina



Session IV: Round-table





Coffee Break





Workshop Photo

