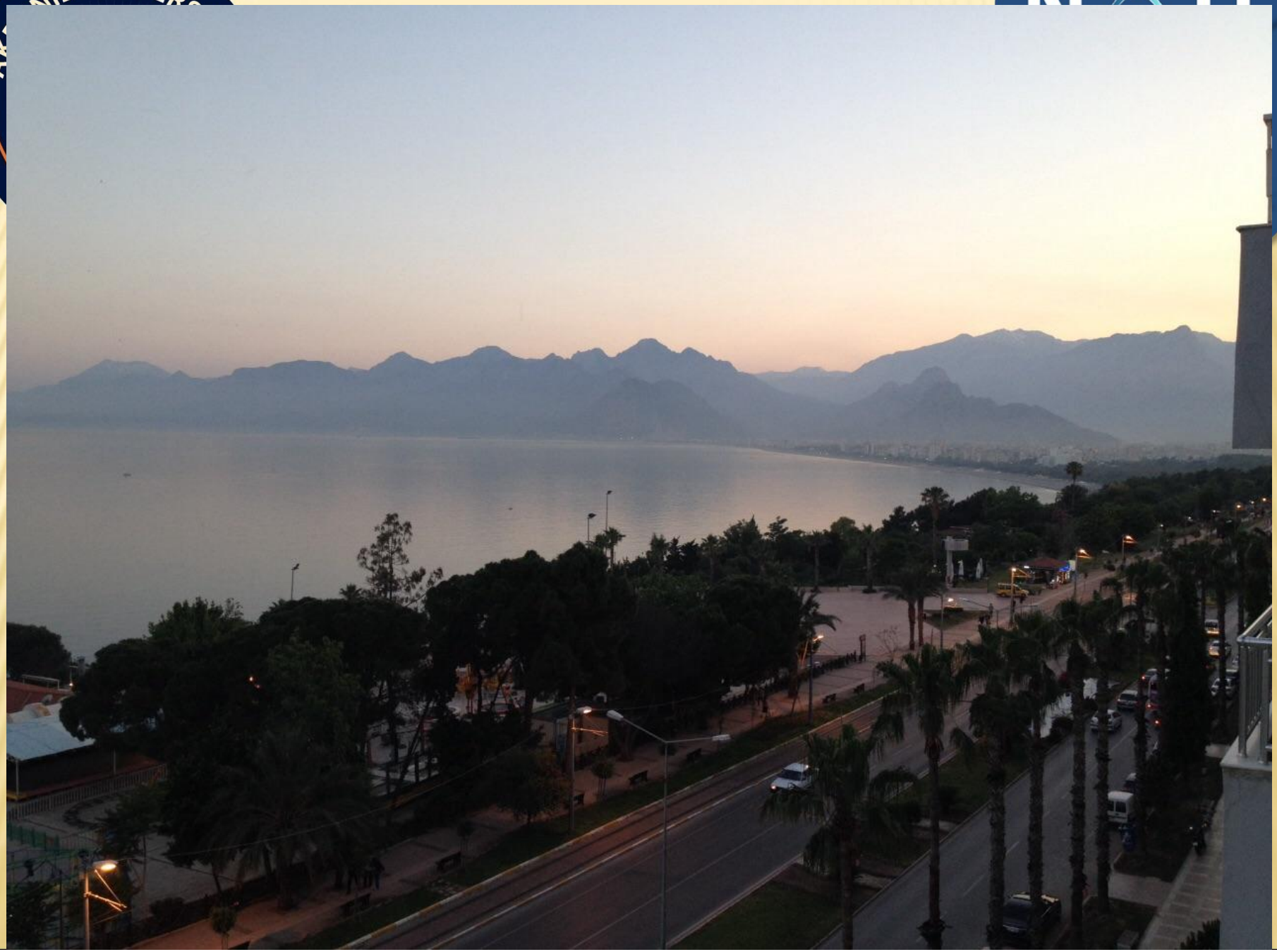
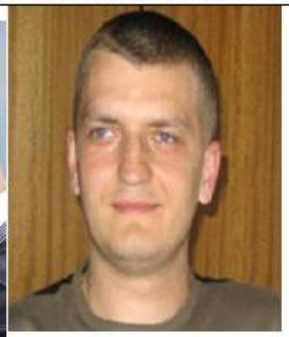


NUBA-founded in 31 Mayıs 2013

NUBA BOARD OF MANAGEMENT

PROJECT LEADERS

Photonuclear	Photoactivation	Material Science	Medical Physics	Space Science & Astrophysics	Radiactive Dating
Mesut Karakoç	Haris DJAPO	Yılmaz Aksu	Yiğit Çeçen	Timur Şahin	Edib Bayram
					

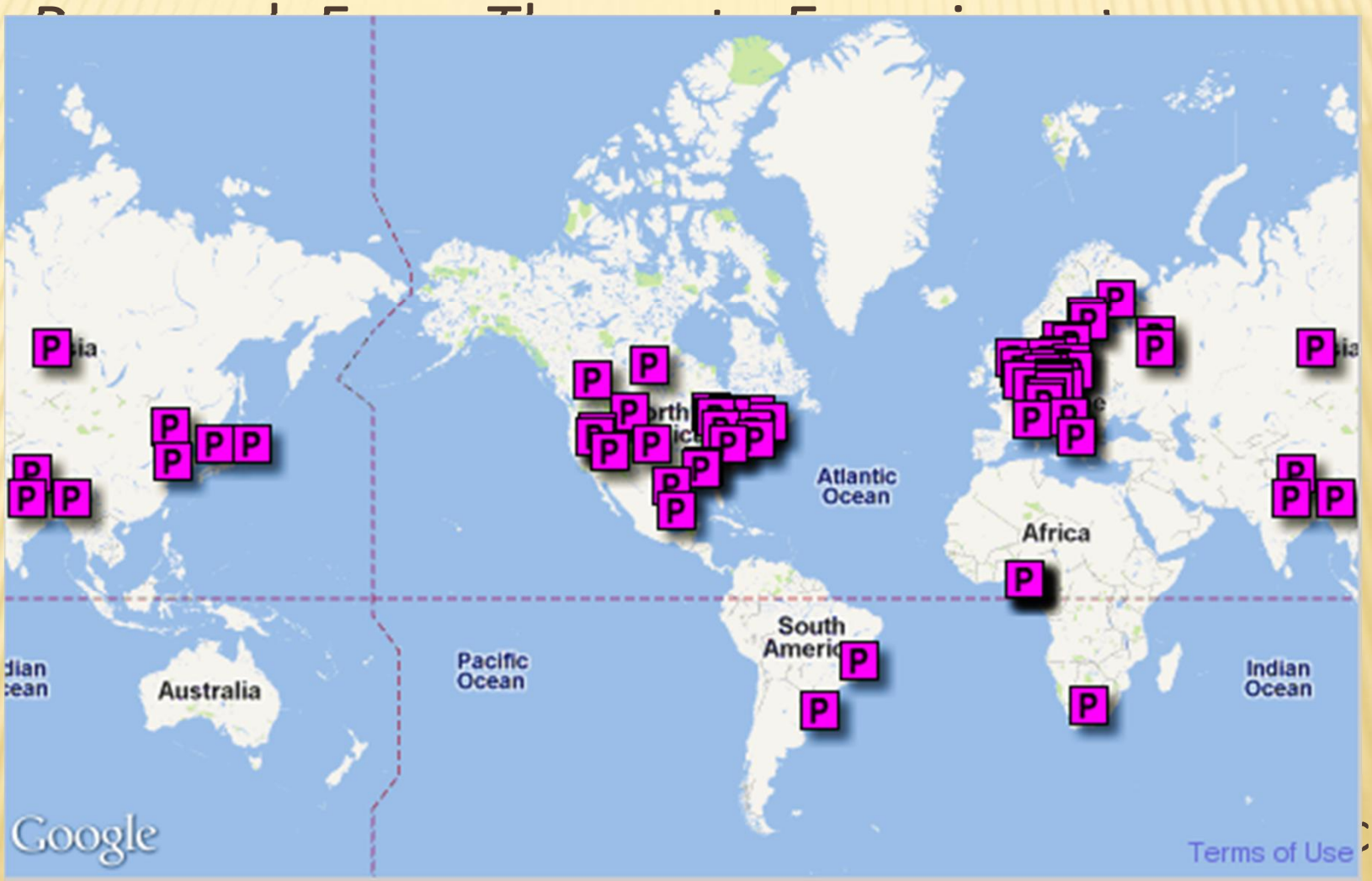
Accelerator & Detector	Environmental Science	Agriculture-Breeding	High Energy Physics	Irradiation Services	Technical Standards
Şerafettin Yaltkaya	Tserenpil Shukruu	Fatih Özmen	İbrahim Albayrak	Deniz Kaya	Christian Segebade
					

NUBA: http://nukleer.akdeniz.edu.tr

NUBA: Motivations

i.

ii.



students

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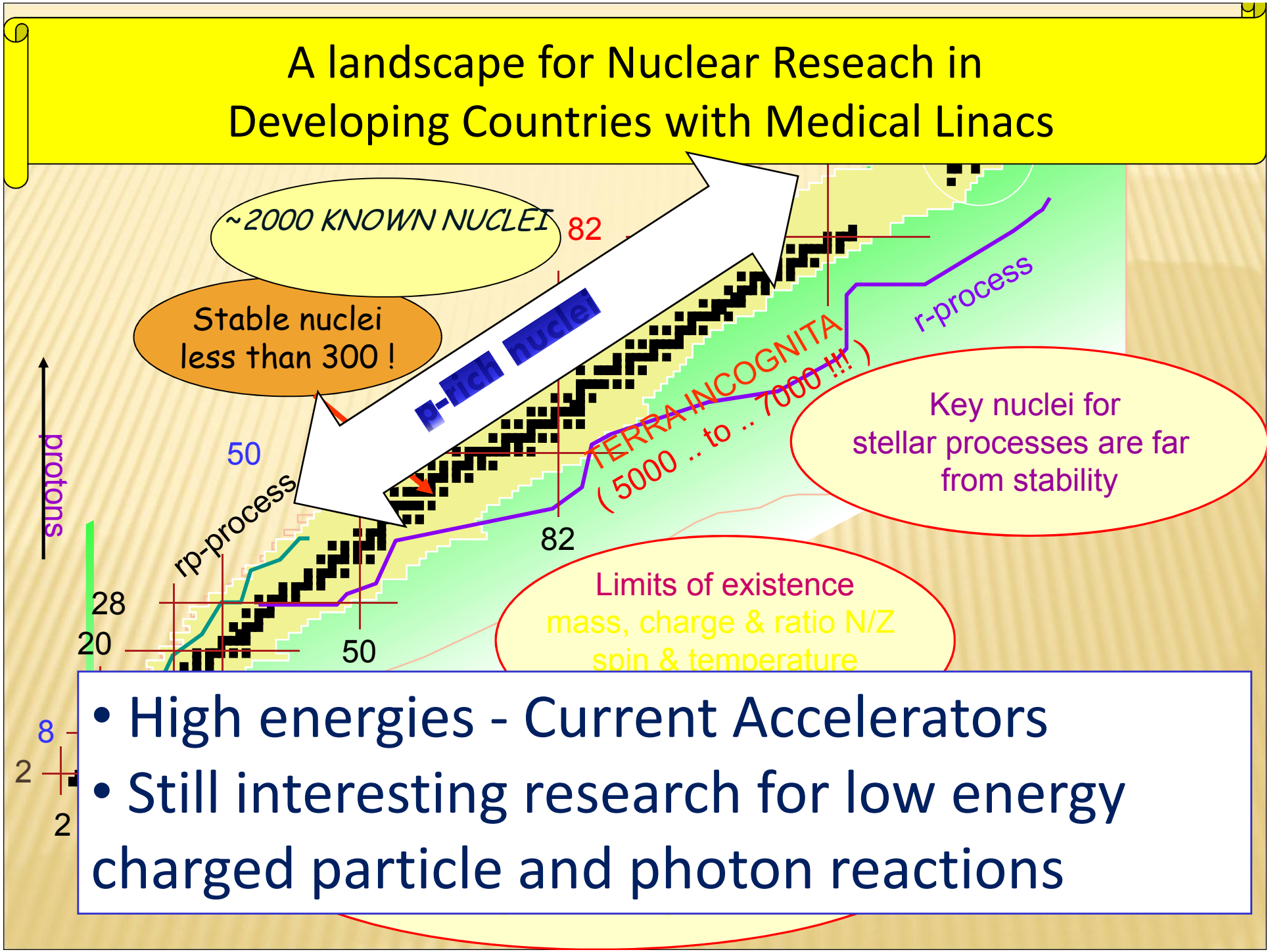
A landscape for Nuclear Reseach in Developing Countries with Medical Linacs



- High energies - Current Accelerators
- Still interesting research for low energy charged particle and photon reactions

NUBA: Coincise & well-focused Research Program

- A New Oppurtunity for developing countries,
  - Nuclear Reactions
    - A Re-measurement of Phonuclear Cross-section,
    - (γ,n) (γ,p) (γ, γ) and (γ, γ')
  - Nuclear Structure
    - Energy Level & Half Life of Proton Rich Nuclei
    - Pgyme&Giant Dipole Resonance measurements
- Photonuclear and Photoactivation,
- Experimental setup
  - Industrial Electron Linac: Hard/Software
  - Detector Devolopments

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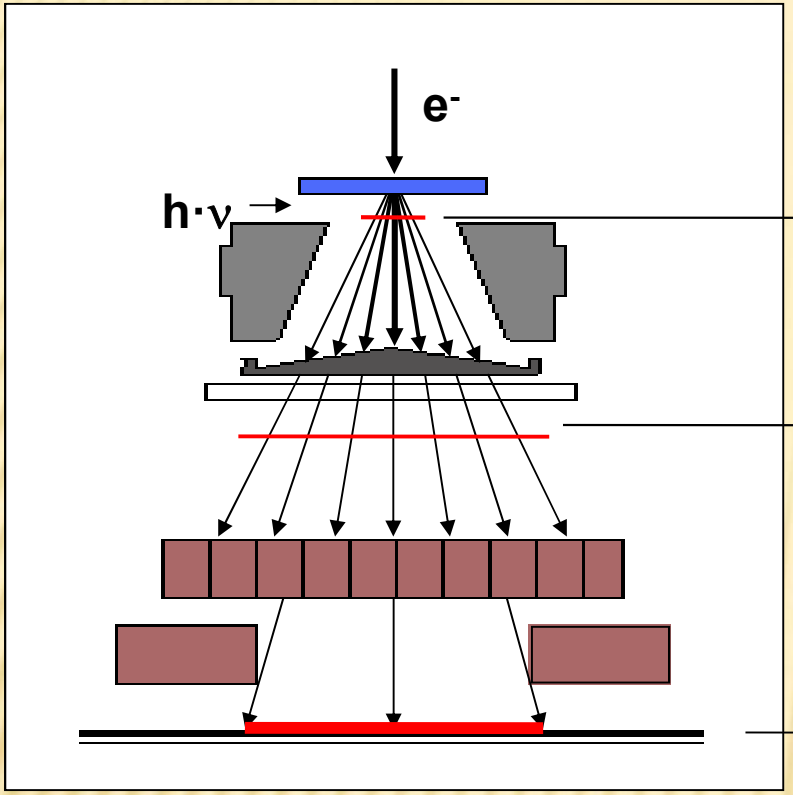
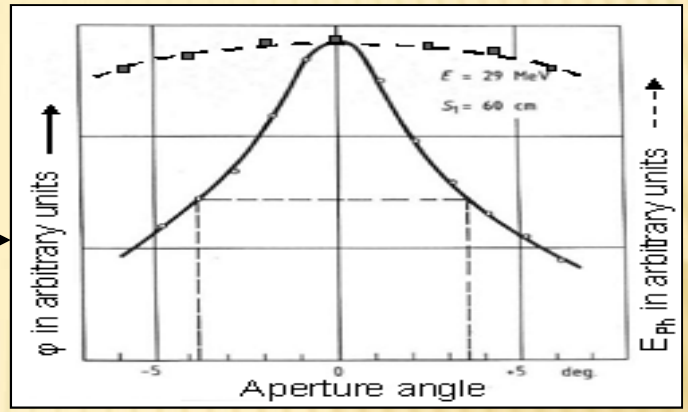
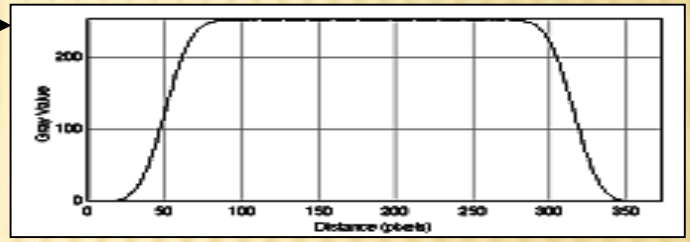
Me  or

Bremsstrahlung spectrum at sample position

The bremsstrahlung field; lateral homogeneity



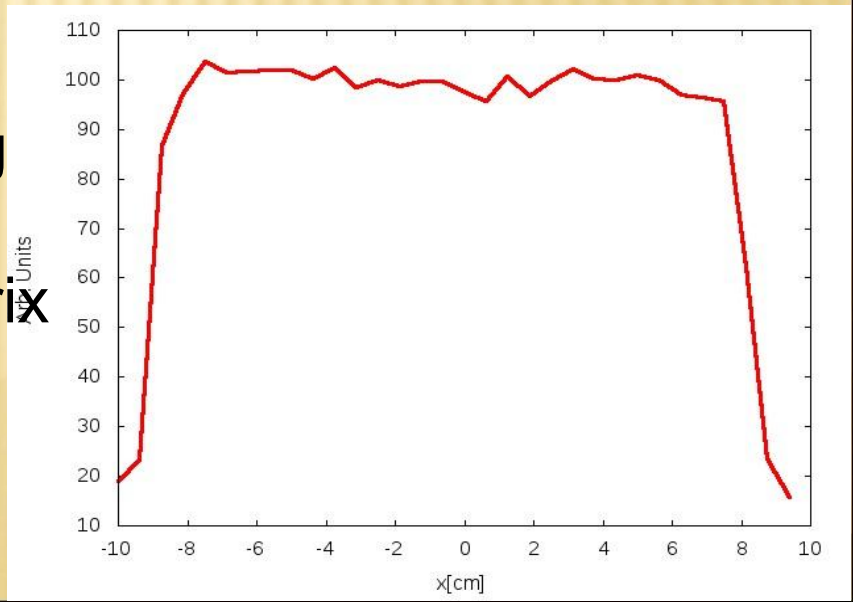




Spatial beam uniformity at y=0 along the x-axis

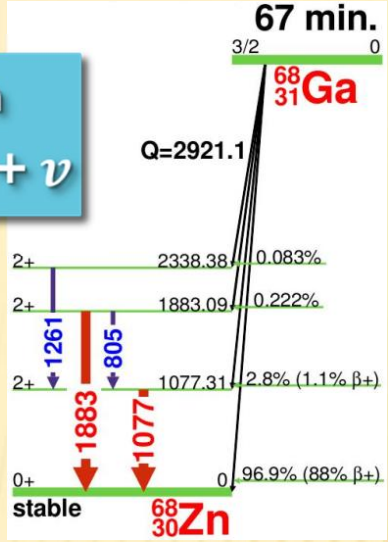
Measurement performed with a matrix of 32x32 ion chambers for 2 s.

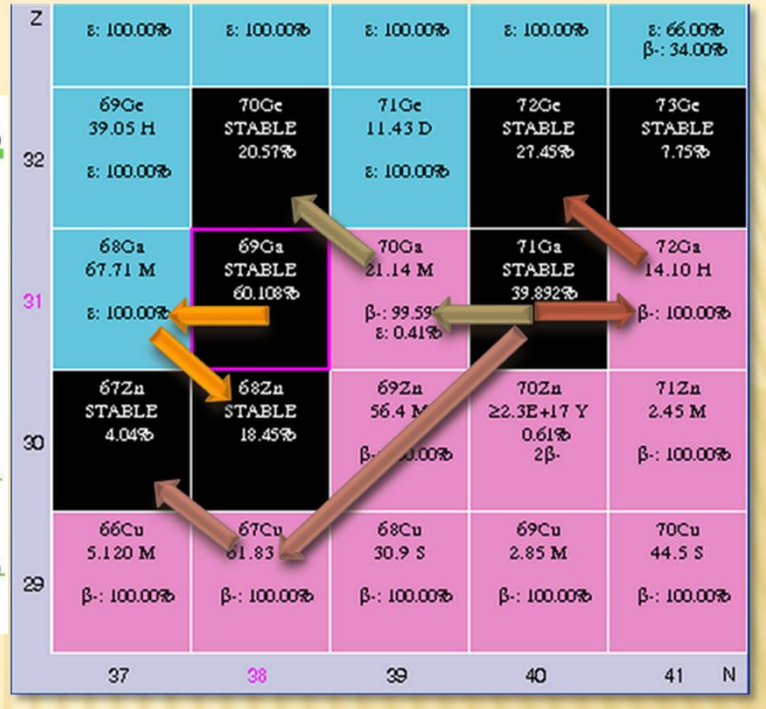
Longer measurement times reduce the variations.



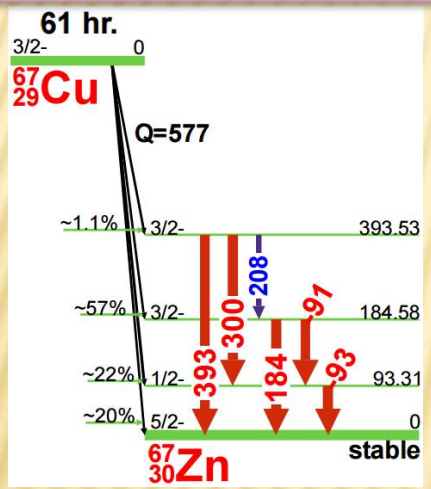
PHOTONUCLEAR REACTIONS

$$\gamma + {}^{69}Ga \rightarrow {}^{68}Ga + n$$
$$^{68}Ga \rightarrow {}^{68}Zn^{*} + \beta^{+} + \nu$$

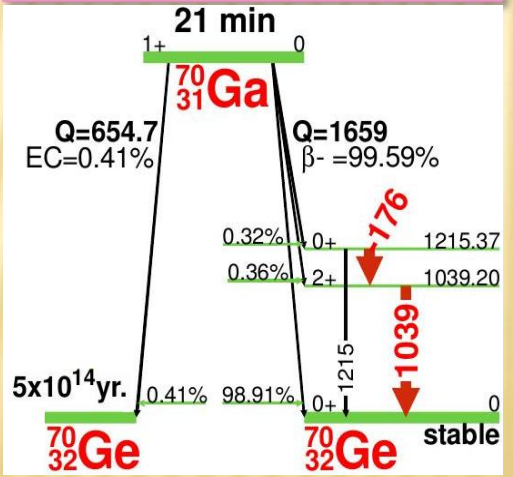




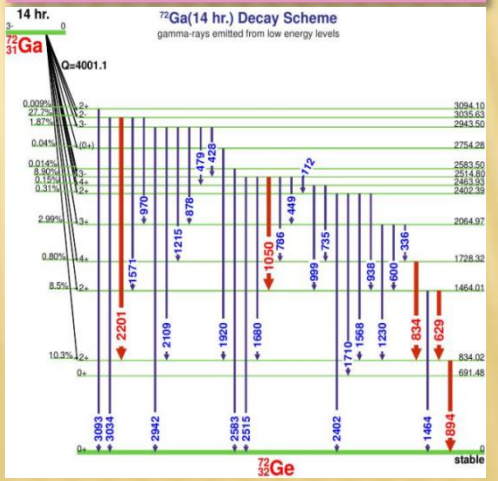
$$\gamma + {}^{71}Ga \rightarrow {}^{67}Cu + \alpha$$
$$^{67}Cu \rightarrow {}^{67}Zn^{*} + \beta^{-} + \bar{\nu}$$



$$\gamma + {}^{71}Ga \rightarrow {}^{70}Ga + n$$
$$^{70}Ga \rightarrow {}^{70}Ge^{*} + \beta^{-} + \bar{\nu}$$



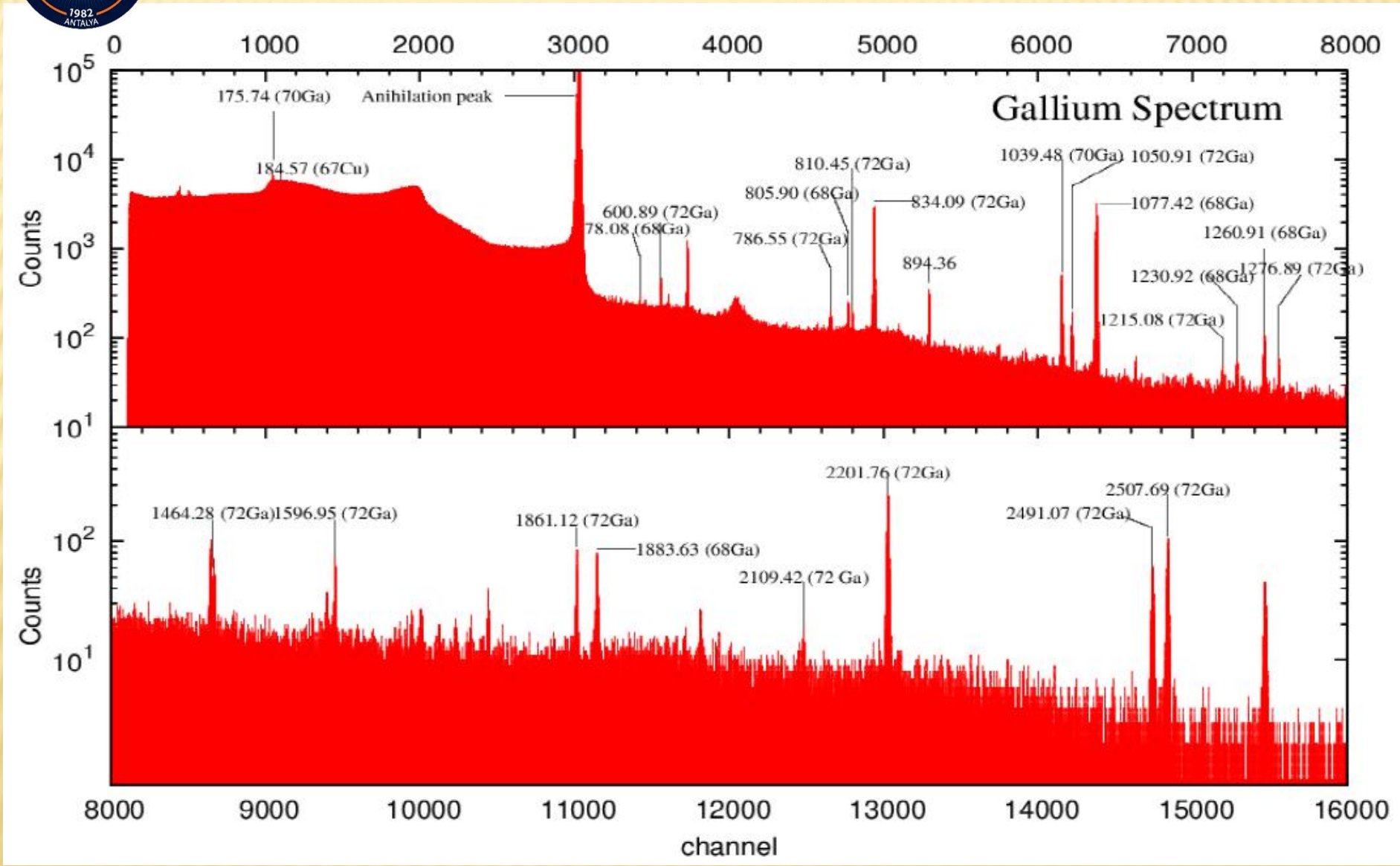
$$n + {}^{71}Ga \rightarrow {}^{72}Ga$$
$$^{72}Ga \rightarrow {}^{72}Ge^{*} + \beta^{-} + \bar{\nu}$$



Ga-69: 60.1%

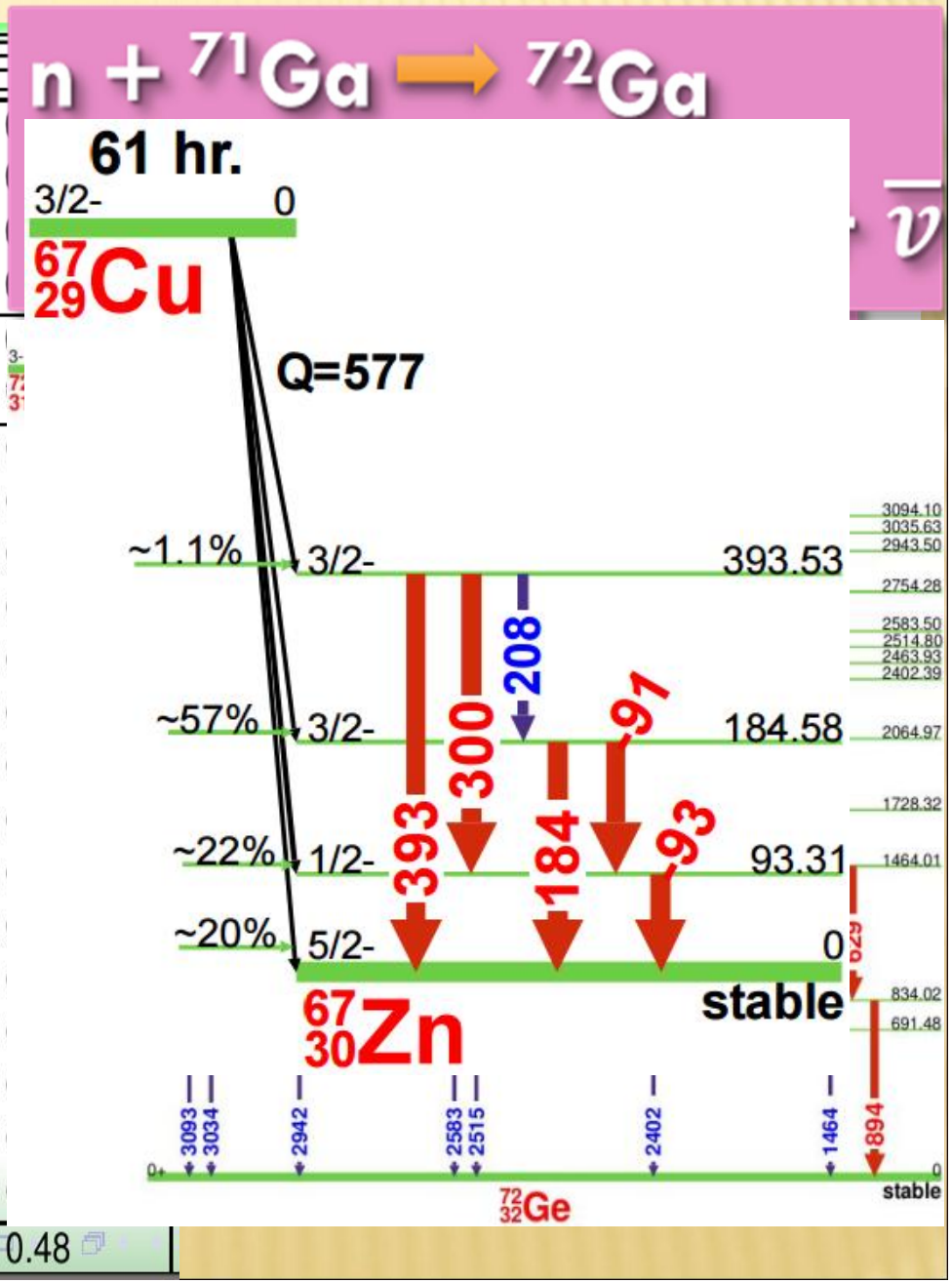
Ga-71: 39.9%

THE GALLIUM EXPERIMENT: GAMMA SPECTRUM



THE GALLIUM EXPERIMENT: ENERGY LEVELS

Ele.	E_{NUDAT}(keV)	σ_{NUDAT}	E(keV)	σ_E	$\Delta=\lvert E$
^{68}Ga	805.83	0.08	805.91	0.07	
^{68}Ga	1077.34	0.05	1077.28	0.02	
^{68}Ga	1261.08	0.09	1260.8	0.1	
^{68}Ga	1883.2	0.2	1883.39	0.09	
^{70}Ga	176.17	0.02	176.1	0.1	
^{70}Ga	1039.2	0.08	1039.28	0.04	
^{72}Ga	600.91	0.02	600.91	0.05	
^{72}Ga	629.97	0.02	629.86	0.02	
^{72}Ga	786.53	0.01	786.43	0.09	
^{72}Ga	834.13	0.04	833.97	0.02	
^{72}Ga	894.33	0.02	894.09	0.04	
^{72}Ga	999.99	0.02	1000.6	0.1	
^{72}Ga	1215.14	0.01	1215.15	0.08	
^{72}Ga	1230.93	0.01	1230.9	0.2	
^{72}Ga	1260.12	0.01	1260.8	0.1	
^{72}Ga	1464.05	0.01	1464.13	0.09	
^{72}Ga	1596.73	0.01	1596.87	0.09	
^{72}Ga	2109.36	0.02	2109.8	0.2	
^{72}Ga	2201.59	0.02	2202.01	0.04	
^{72}Ga	2491.03	0.02	2490.72	0.08	
^{72}Ga	2507.71	0.02	2507.27	0.06	
^{67}Cu	184.58	0.01	184.1	0.7	0.48



SUMMARY & OUTLOOK

- A unique research center having an accelerator that is capable of performing spectroscopy and instrumentation
  - Important to promote Nuclear Science at devoloping countries
  - Tranining and education facility for the PhD and MSc students: *i.e.* For the case of Turkey, CERN membership, Nuclear & HEP studies
  - Material hardening, space radiation and detector studies: compton background test for AGATA and ELI-NP
- Nuclear Reactions: (γ,n) (γ,p) (γ, γ) and (γ, γ') for PR and GDR
- Energy Levels and Half-life measurements for proton rich nuclei: Better results
  - Nuclear structure: level densities and transitions
  - Nuclear structure: Shape-Phase transitions
  - Nuclear Astrophysics: Nucleosynthesis for early universe
- Applications of Nuclear Techniques from Archeology, Engineering to Agriculture for devoloping countries

Outcomes: First photonuclear paper with local resources

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DOI 10.1140/epjp/i2015-15185-2

THE EUROPEAN PHYSICAL JOURNAL PLUS

Regular Article

Photonuclear reactions with zinc: A case for clinical linacs

I. Boztosun[1,2], H. Đapo[1,2,a], M. Karakoç[1,2], S.F. Özmen[1,2], Y. Çeçen[2,3], A. Çoban[1,2], T. Caner[1,2], E. Bayram[4], T.R. Saito[5,6,7], T. Akdoğan[8], V. Bozkurt[9], Y. Kuçuk[1,2], D. Kaya[1,2], and M.N. Harakeh[10]

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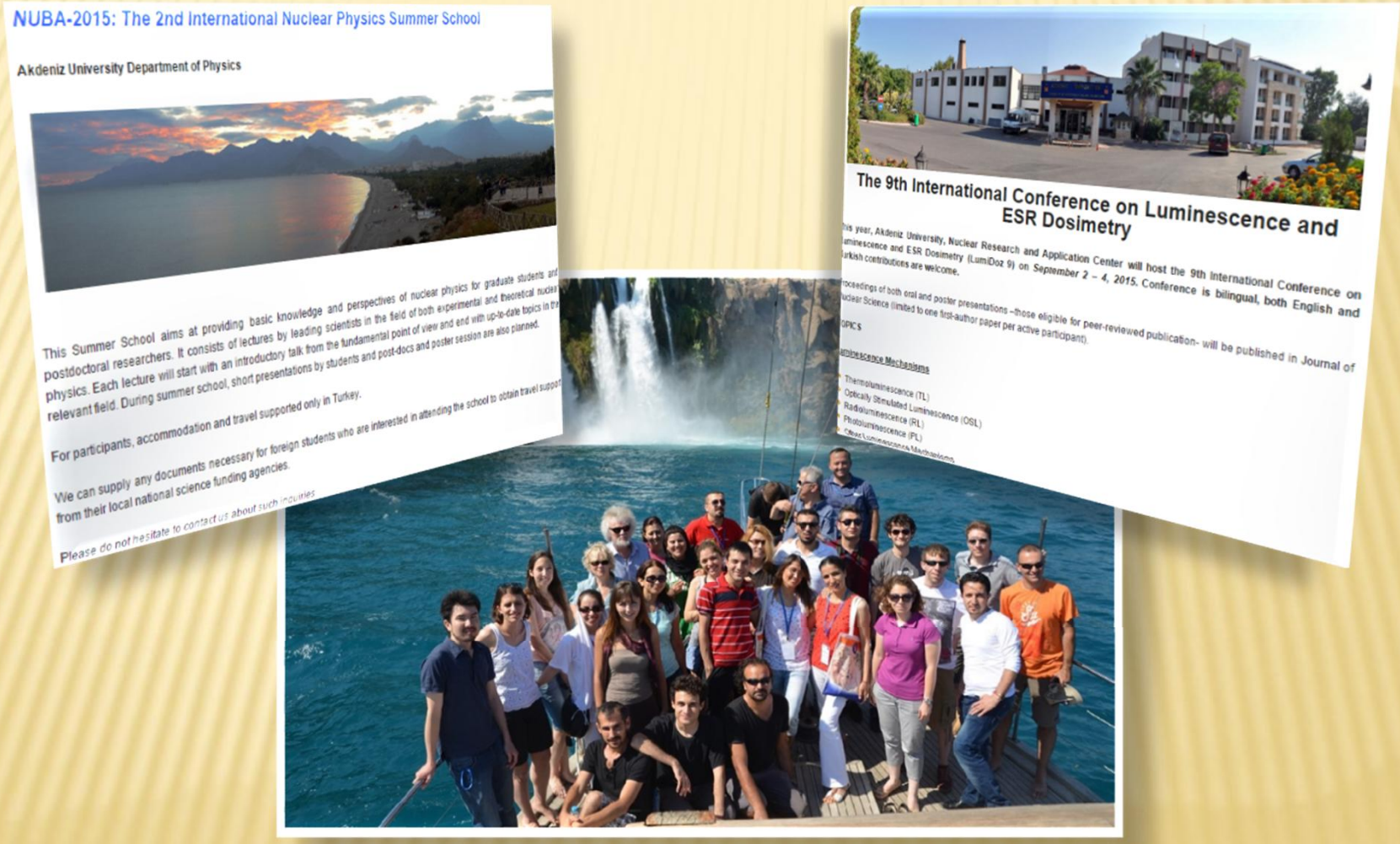
http://nukleer.akdeniz.edu.tr/lumidoz9



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