



**16<sup>th</sup> International Conference  
on  
Particle Induced X-ray Emission**

*Unravelling secrets from atoms to planets*

**PIXE2019 - Programme and Abstracts**



24-29 March 2019 - Cultural and Congress Centre of Caldas da Rainha – Portugal

## PIXE2019 - Oral Presentations

Tuesday, March 26, 2019		
<b>Session - Detectors, Software and Experimental Systems 2</b>		
Chair: M. Kavčič		
9:20-10:00	A. Mantero PIXE Simulation in Geant4, an Update	L3
10:00-10:20	V. Bilyk PIXE depth profiling of components in heavy-ion irradiated Zr alloys	O.11
10:20-10:40	E. Obiajunwa Ion beam analysis facility at the centre for energy research & development at Ile-Ife Nigeria and its application in research	O.12
10:40-11:00	K. Phelan CryoGenX - A High-resolution Spectrometer for Advanced Nuclide Analysis	O.13
<b>Coffee/Tea break</b>		
<b>Session - Simulation and Techniques Combination 1</b>		
Chair: T. Calligaro		
11:20-11:40	M. Bailey Ion Beam Analysis for the 2020's : An Integration of Elemental Mapping and Omics	O.14
11:40-12:00	D. Strivay Analysis of archeological artefacts from Ostia and Arena Roman sites by PIXE-PIGE and Proton Activation Analysis	O.15
12:00-12:20	V. Corregidor PIXE and RBS on CIGS solar cells to study the elemental distribution	O.16
12:20-14:00	<b>Lunch</b>	
<b>Session - Simulation and Techniques Combination 2</b>		
Chair: J. F. Dias		
14:00-14:40	C. Ryan PIXE and synchrotron XRF imaging: Comparisons using the Maia detector array	L2
14:40-15:00	J. Cruz $\mu$ -PIXE/ $\mu$ -EBS and SEM analysis of surface spots in gold coins/discs from the Portuguese Mint House	O.17
15:00-15:20	Z. Kertész What killed the apothecarius of Vác in 1763? Micro-PIXE study of mummified bones	O.18
<b>Coffee/Tea break</b>		
<b>Session - Cultural Heritage &amp; Geological Applications 1</b>		
Chair: Ž. Šmit		
15:40-16:00	Z. Szőkefalvi-Nagy Ancient glass analysis by milli-PIXE and PGAA - the case of late Roman and Byzantine glasses	O.19
16:00-16:20	F. Munnick Characterization of Goethe's prisms by external ion beam	O.20
16:20-16:40	H. Hofsäss PIXE analysis of antique pottery from the Mediterranean sea area	O.21
16:40-17:40	Round Table on Detectors & Software C. Jeynes	
17:40-19:00	<b>Poster Session 2</b>	
19:00-20:00	IAC - IHC Meeting	
Wednesday, March 27, 2019		
9:00-10:00	Buses to ESTM	
<b>Open Session</b>		
Chair: M. A. Reis		
10:00-11:00	J. L. Campbell Alpha particle PIXE on Earth and Mars	L5
11:00-19:00	Conference outing	



## PIXE and RBS on CIGS solar cells to study the elemental distribution

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O.16

### Abstract

Among thin film solar cells materials CIGS materials ( $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$ ) are the most used, jointly with CdTe, having the advantages of their application in flexible substrates, long term stability, high electrical performance and production versatility. Although they are available in the photovoltaic market, at the same time a lot of research is on-going in order to increase the cell photo conversion efficiency (about 23 % at the moment) not only in lab conditions, but also under real conditions. Active optoelectronic defects, as composition inhomogeneities, created during the manufacturing process, are the main responsible for efficiency limitations. For instance, even small changes in the In-Ga depth distribution inside the CIGS layer will influence the bandgap and thus, the light to power conversion efficiency of the solar cell. RBS and PIXE techniques coupled to a nuclear microprobe can reliably accomplish both the determination of the elemental surface distribution and their depth distribution even in the final electronic device. Three different solar cell devices (two of them belonging to the same substrate) were irradiated with 900 keV proton beam and the NDF software code was used to perform the Total-IBA approach through the simultaneous and self-consistent analysis of the data collected from PIXE and RBS spectra. Results will be presented and discussed.