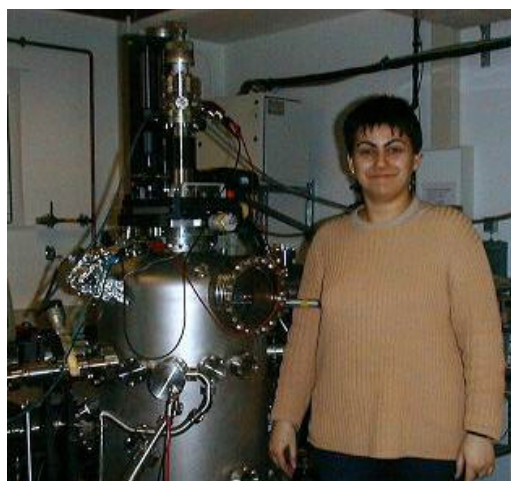


# Mihaela Gorgoi

Chemnitz University of Technology



Dublin

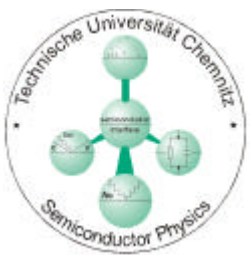
26.07.2002



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**TU Chemnitz**



# Background Experience

**1991 – 1995:** Theoretical High School, Zalău, Mathematics – Physics English Department;

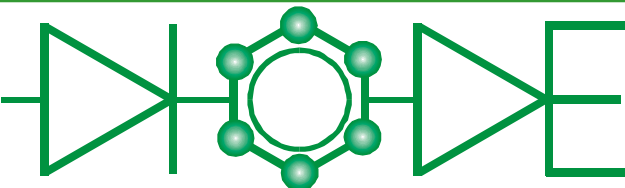
**1995 – 2000:** Faculty of Physics, „Babes-Bolyai“ University, Cluj-Napoca; Bachelor degree and diploma work in the field of: ***Local structure of La atoms in La-Al-B-O systems determined through EXAFS.***

**2000 – 2001:** Master of Science Studies at Faculty of Physics, „Babes-Bolyai“ University, in collaboration with Institute of Physics, University of Technology Chemnitz, Germany. Subject: ***Inverse Photoemission Spectroscopy.***

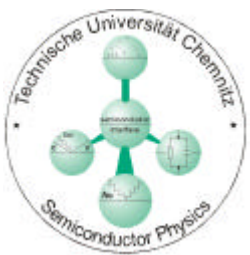
**October 2001:** start PhD studies at Dept. of Semiconductor Physics, Institute of Physics, University of Technology Chemnitz and joins the **DIODE** network.



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# Responsibilities in the Network

Research Title:

***Characterisation of **organic** thin films deposited on **GaAs** by means of **inverse photoemission spectroscopy** and **ultraviolet photoemission spectroscopy**.***

 *Building of the inverse photoemission system*

Vacuum parts:

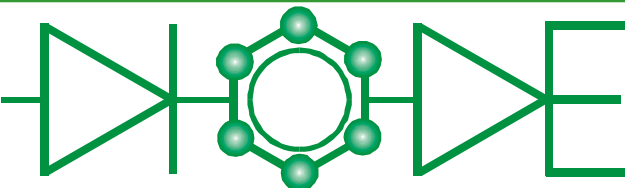
Electron gun  
Geiger-Müller detector

Data acquisition system:

Counter  
Power supplies



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# Motivation

S. Park et al., unpublished.  
 A. Rajagopal et al. JAP 83 (5) (1998) 2649.  
 Y. Hirose et al. PRB 54 (19) (1996) 13748.  
 R. Schlaf et al. JAP 86 (3) 1499.

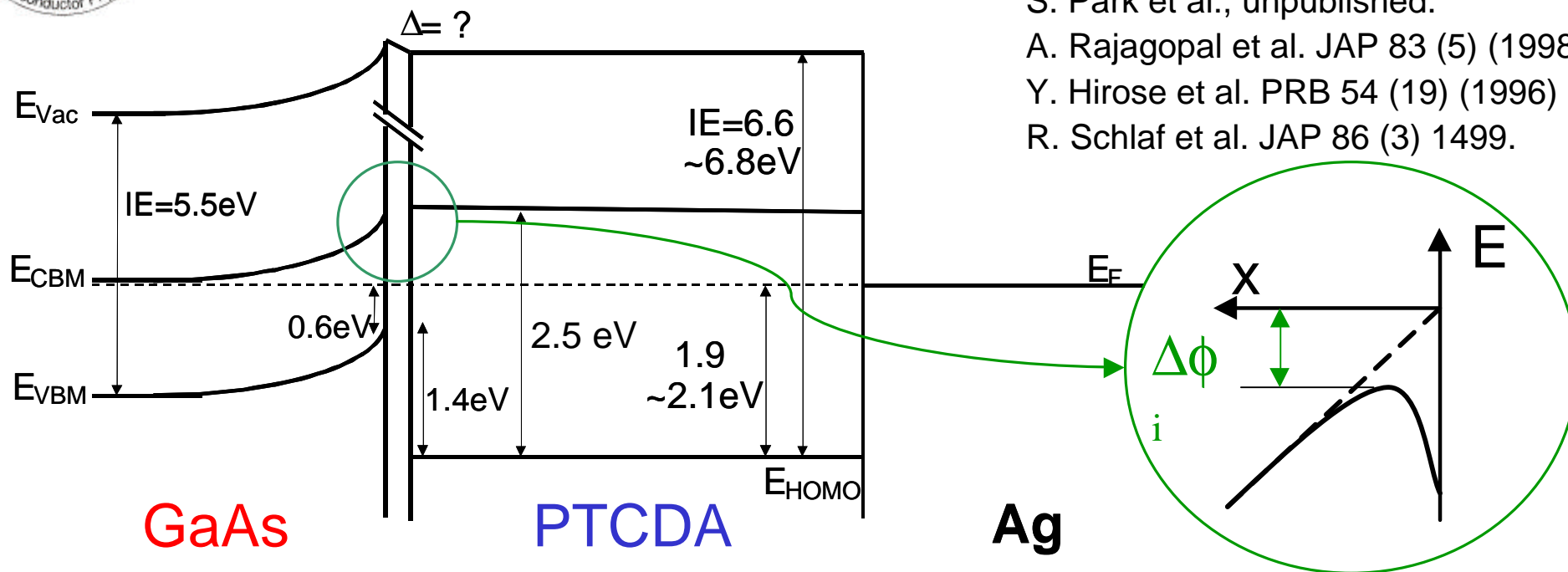
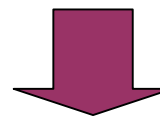


Image force lowering:

GaAs ( $\epsilon = 13.1$ ):  $\Delta f_i = 50 \text{ meV}$

PTCDA ( $\epsilon = 2$ ):  $\Delta f_i = 200 \text{ meV}$

LUMO position is not determined



Use of **IPES**



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# The Work - Inverse Photoemission Spectroscopy (**IPES**)

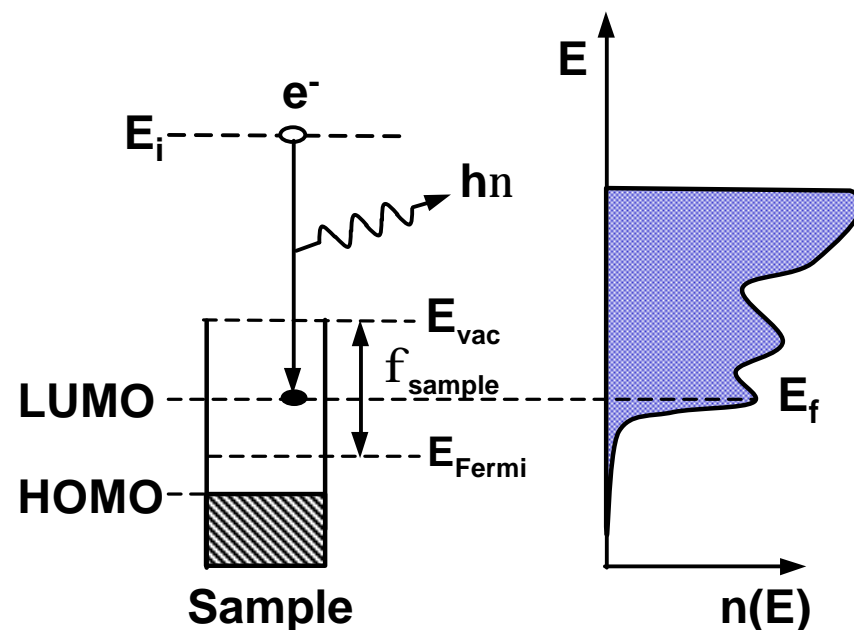
## Principle:

- a beam of electrons with a well defined energy impinges on the sample and light is emitted when electrons make direct / optical transitions into the unoccupied states.

- **isochromat mode**
- **constant initial state mode**

➡ unoccupied density of states are determined

➡ PES / **IPES** combination leads to the determination of the *band gap*



$$E_i = E_f + hn$$

$E_i$  – the initial state of the electron

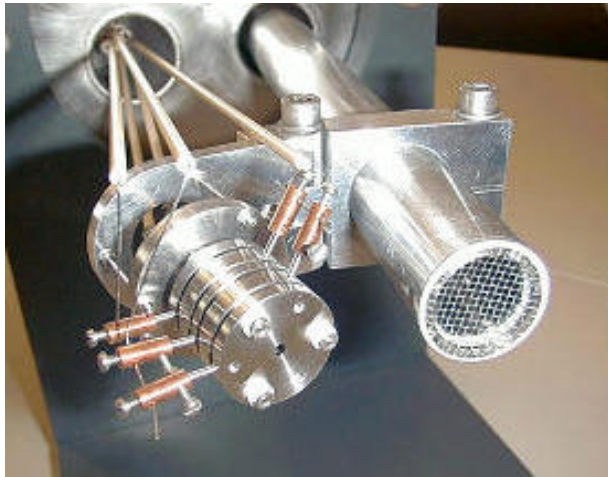
$E_f$  – the final state of the electron

$hn$  – energy of emitted photon

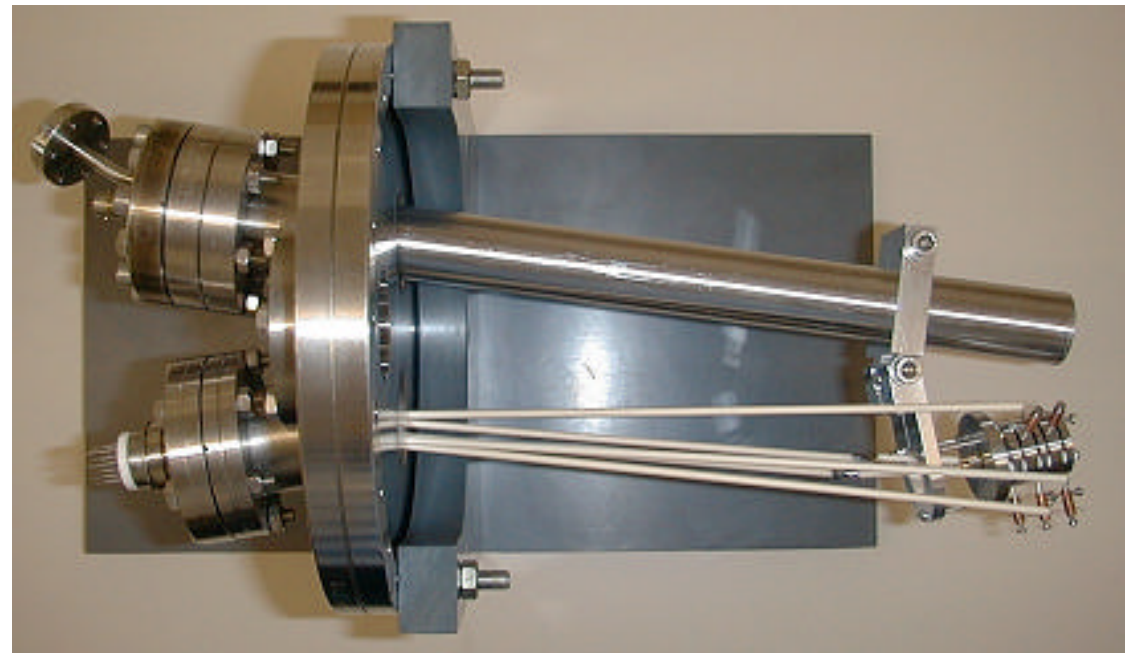
# Inverse Photoemission System

Characteristics of the **IPES** set-up:

- Home built system : vacuum parts and data acquisition system;
- Built after *Ian Hill* PhD thesis<sup>\*</sup>.



front view

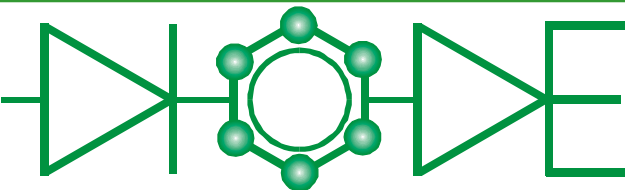


top view

\* nanoPhysics – <http://zoot.phy.queensu.ca/index.html>



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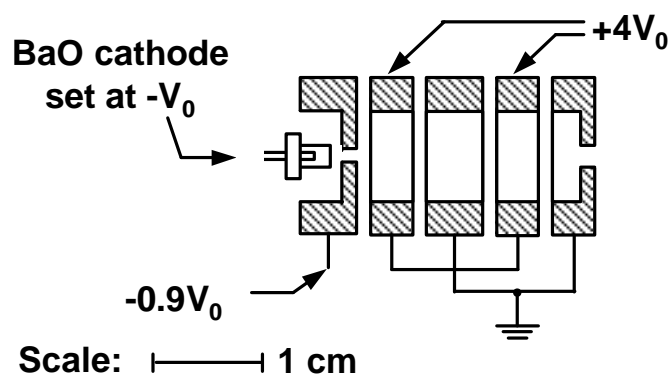
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# The Two Components of IPES

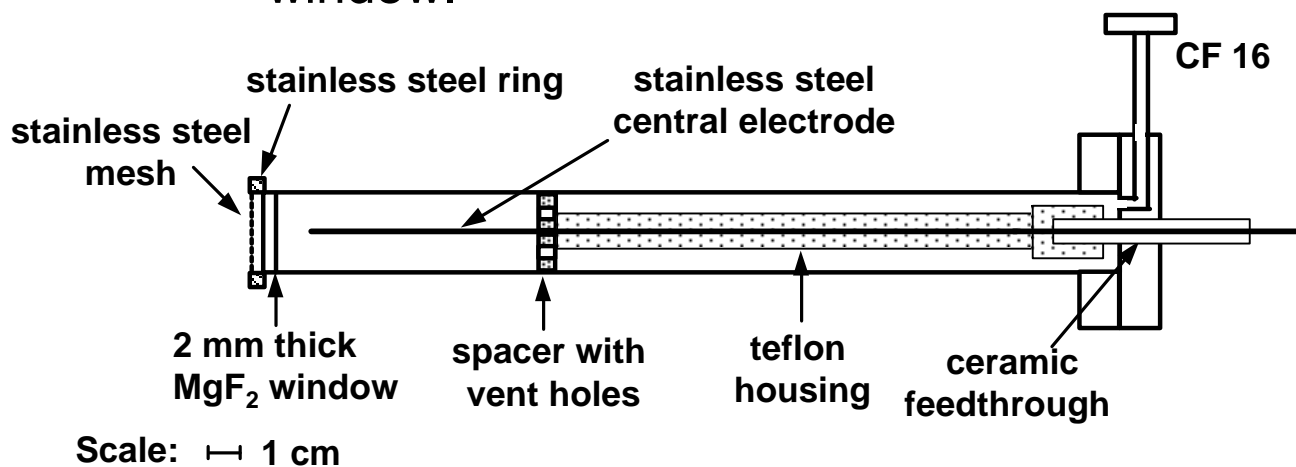
## Electron Gun

- Built after Erdman-Zipf\* design parameters;
- $V_0$  is the nominal electron kinetic energy;
- Operating range: 0 – 20 eV.



## Geiger-Müller tube

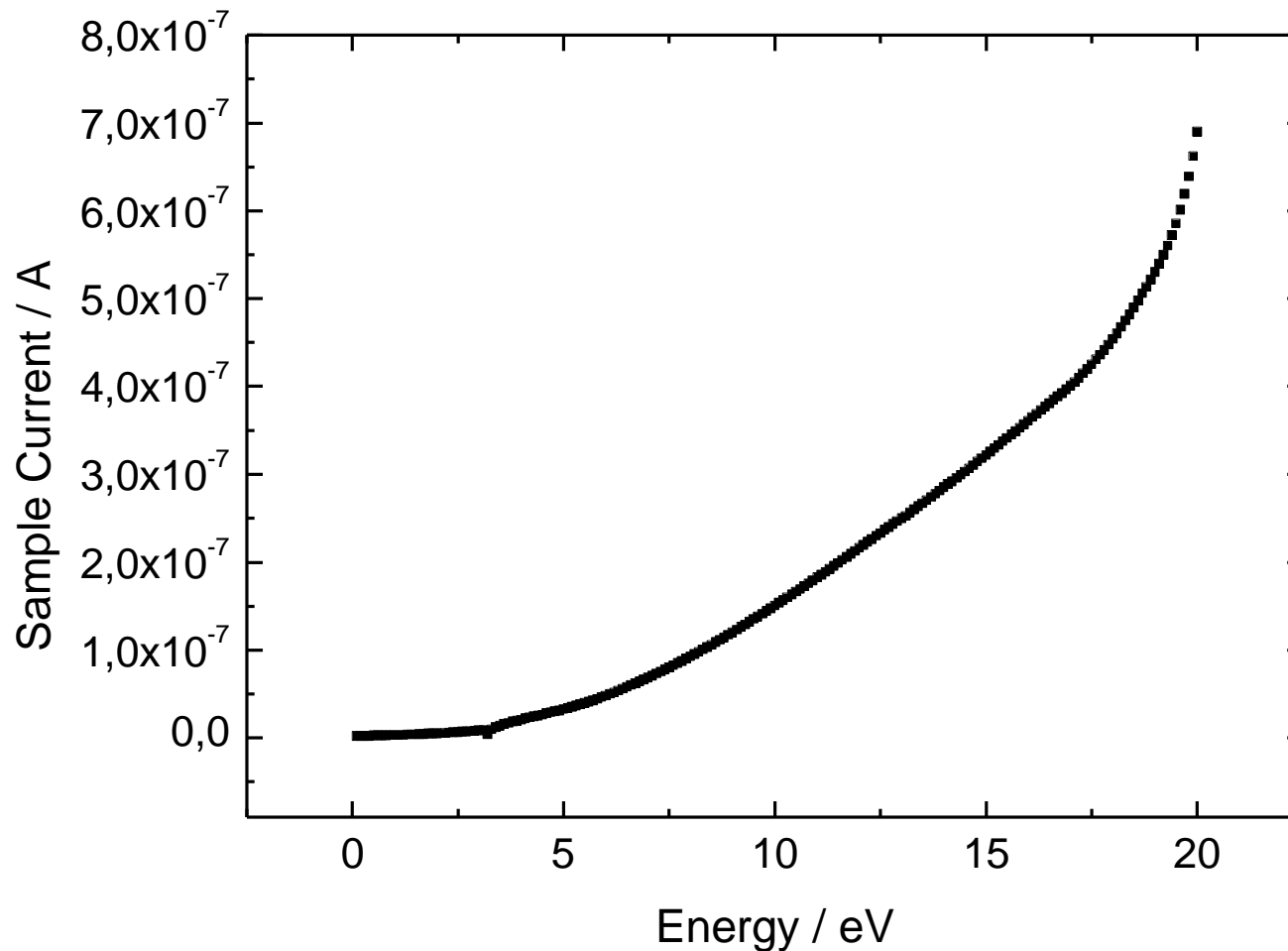
- Built after the original description of K. C. Prince\*\*;
- Nominal photon detection energy of 10.6 eV given by dimethyl ether ionisation potential and the transmission range of the  $\text{MgF}_2$  window.



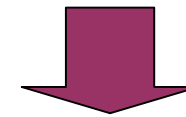
\* P. W. Erdman, E.C. Zipf, *Rev. Sci. Instrum.*, Vol. 53, 225, 1982

\*\* K. C. Prince, *Rev. Sci. Instrum.*, Vol. 59, 741, 1988

# Testing the Electron Gun

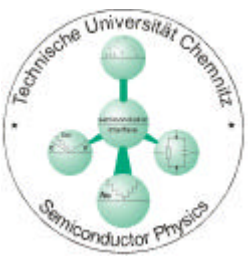


Range of the sample current:  $\mu\text{A}$



The current density is comparable to other citations in the literature ( $10^{-7} - 10^{-4} \text{ A/cm}^2$ ).



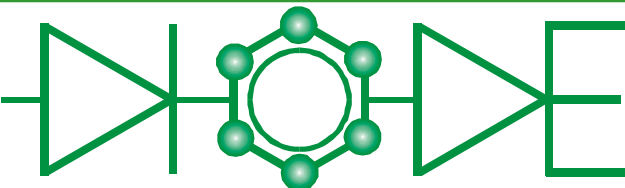


# Outlook

- ➡ Find the functioning parameters for the Geiger-Müller tube and for the whole **IPES** system.
- ➡ Improve the overall resolution of the system and perform the measurements in order to achieve the aims.
- ➡ Increase the exchange of information with the other young researchers.



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