

From Particle Detection to Medical Applications

Ziad Abou-Haidar¹, Alessio Bocci¹

1. Centro Nacional de Aceleradores - CNA, 41092 Seville - Spain.



The Detectors



Double Sided Silicon Strip Detector

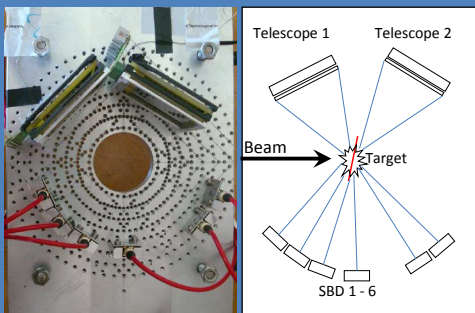
- Commercial silicon detectors (W1 type from Micron Semiconductor Ltd)
- Low cost
- Dedicated commercial electronics
- Active area 50 x 50 mm² & thickness between 40 and 1500 μm
- Single sided 16 strips or double sided 16 x 16 (3.1 mm pitch)
- DSSSD: pixel measurement capability
- Good radiation hardness
- Good energy ($\approx 1\%$) and angular resolution



Single Sided Silicon Strip Detector

Nuclear Reaction Measurements

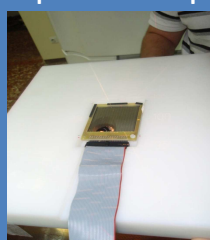
- Fragment Detection
- Two experiments were performed :
 - Oct 2009 Technological and Nuclear Institute – ITN Lisbon
 - July 2010 National Accelerator Center – CNA Seville
- Experimental Setup :
 - A thin DSSSD mounted in a “telescope” structure with a thick non segmented silicon detector
 - Several “telescopes” mounted around the target
 - Several Silicon Surface Barrier Detectors – SBD with a 3 mm collimator mounted around the target to cross check the results: small active area, very precise angle
 - Cover a maximum angular range



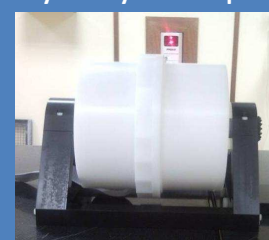
Experimental Setup

Dosimetric Measurements

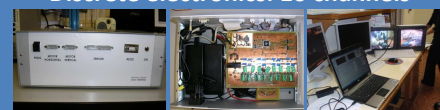
- Two phantoms prototypes have been designed :
1. A water-equivalent slab phantom – detector characterization
 2. A quasi anthropomorphic cylindrical phantom – for 2D treatment plans verification dedicated to Intensity Modulated Radiation Therapy (IMRT)
- Water-equivalent slab phantom Polyethylene cylindrical phantom



Clinical Linac accelerator 6MV photon beams

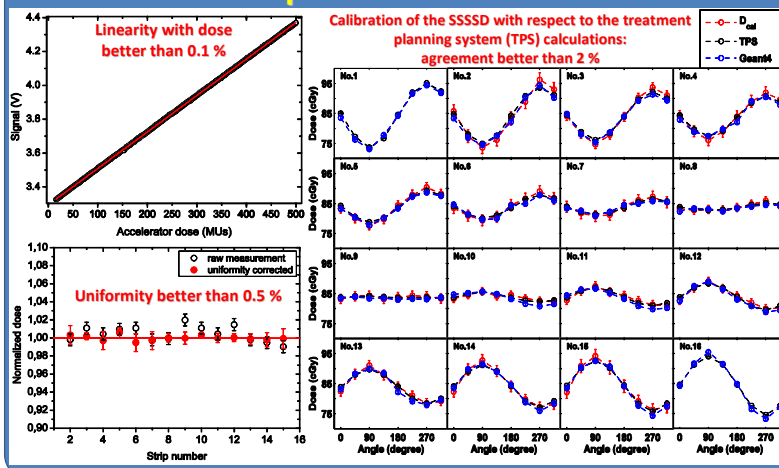


Discrete electronics: 16 channels



The charge is digitized and analyzed using a digital signal processor (DSP). Signals are transferred to a PC that permits to control and to retrieve data via an RS-232 serial bus (LabVIEW platform)

Experimental results



Conclusions

- Knowledge obtained from nuclear reaction instrumentation at CNA has been transferred to IMRT applications
- A prototype used to benchmark a novel method dedicated to IMRT pre-treatment dose verification has been designed, built and tested
- The characterization of the SSSSD showed that the system has good characteristics to adopt it in a quality assurance (QA) IMRT verification plan
- The system is ready for a dedicated plan verification
- Future improvements will be possible using a 2D silicon detector

The “Dosimetric Measurements” project (Patent Pending) is in collaboration with:

M.A.G. Alvarez², M. I. Gallardo², J. M. Espino², M. A. Cortes Giraldo², J. M. Quesada², R. Arrans³, A. Perez Vega-Leal⁴, F. J. Perez Nieto⁵

2. Department of Atomic, Molecular and Nuclear Physics (FAMN), University of Seville, 41080 Seville - Spain; 3. Hospital Universitario Virgen Macarena, 41007 Seville - Spain; 4. Escuela Superior de Ingenieros, 41092 Seville - Spain; 5. Instalaciones Inabensa S.A., 41014 Seville - Spain

The “Nuclear Reaction Measurement” project is in collaboration with:

B. Fernández¹, M.A.G. Alvarez², J.P. Fernández-García^{1,2}, L.C. Chamon⁶, D. Pereira⁶, L.R. Gasques⁶

1. Centro Nacional de Aceleradores - CNA, 41092 Seville - Spain; 2. Department of Atomic, Molecular and Nuclear Physics (FAMN), University of Seville, 41080 Seville - Spain; 6. Departamento de Física Nuclear, Instituto de Física da Universidade de, São Paulo, Caixa Postal 66318, 05315-970 São Paulo, SP - Brazil