



UNIVERSITÀ
DEL SALENTO



A Diamond Active Target for the PADME experiment



Federica Oliva

PhD Student

University of Salento
INFN LECCE



XIX FRASCATI SPRING SCHOOL Bruno Touschek

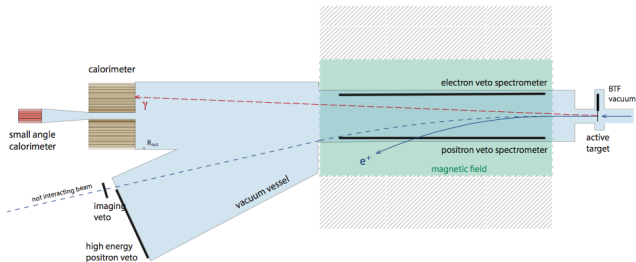
Frascati, 7th May 2018

- 1 The PADME experiment
 - PADME detectors layout
 - Diamond active target
- 2 Diamond hardware in Lecce
 - Diamond detectors realised
 - Interconnection with the PCB
 - The first prototype tested in 2015
 - DCS and DAQ setup
- 3 Diamond software in Lecce
- 4 Conclusions

PADME detectors layout

Searching for the dark photon A'

$$m_{A'}^2 = (P_{beam} + P_{e^-} - P_{\gamma})^2$$



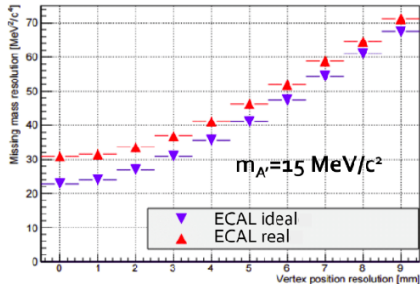
SIGNAL: $e^+e^- \rightarrow \gamma A'$

BACKGROUND: $e^+N \rightarrow e^+\gamma N, e^+e^- \rightarrow \gamma\gamma$

Diamond active target

Why is important to have an active target?

The missing mass resolution is related to the resolution of the production point of the dark photon



Why is a diamond detector a good candidate for the PADME active target?

- **Low Z improves Signal/Background**

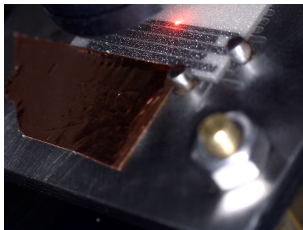
$$N_{brem} \propto Z^2 \quad N_{\gamma\gamma} \propto Z$$

The **Padme LECCE group** works on the development of the diamond active target.

Diamond detectors realised

Starting from a CVD polycrystalline diamond film $2 \times 2 \text{ cm}^2$ area and $100\mu\text{m}$ thickness, **2 types** of detectors are assembled, which differ by the nature of their electrodes:

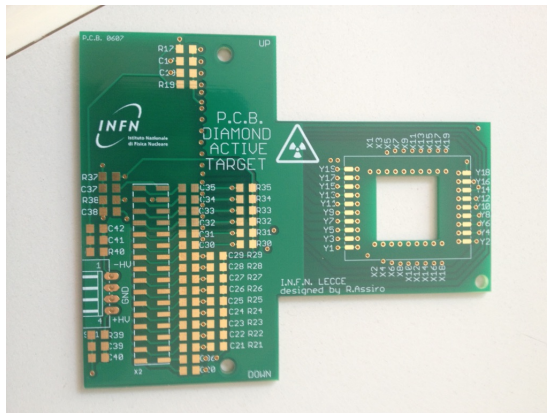
- graphitic strips useful as ohmic electrodes produced in the **L3** Laser Laboratory in Lecce using an excimer laser ArF ($\lambda=193 \text{ nm}$);



- Cr-Au contacts provided directly from Applied Diamond.

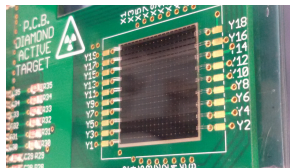
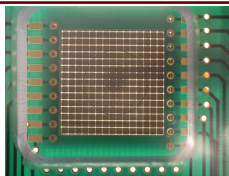
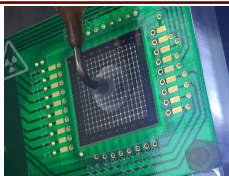
Interconnection with the PCB

The diamond detectors are made up of **19×19 strips**, orthogonally oriented in the two views, with a pitch of 1 mm.



Different steps needed to interconnect the detector to the board:

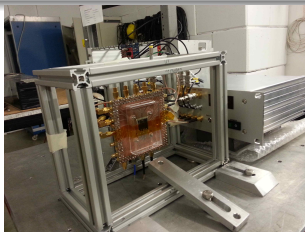
- mechanic connection PCB-diamond using Araldite;
- back side electric connection with conductive glue E-Solder;
- front side electric connection via wire bonding (thanks to INFN Perugia).



The first prototype tested in 2015

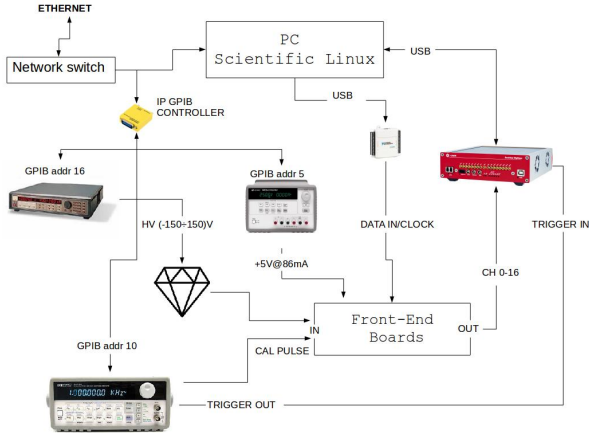
CVD polycrystalline diamond film, $2 \times 2 \text{ cm}^2$ area and $50 \mu\text{m}$ thickness provided by Applied Diamond

18 \times 18 graphitic strips orthogonally oriented, pitch of 1 mm and an inter-strip dead gap of $150 \mu\text{m}$ produced in the L3 Laboratory of Lecce



In November 2015 the prototype was tested during the beam test at the Beam Test Facility (BTF) at the LNF, giving a good spatial resolution (0.3 mm).

DCS and DAQ setup of the FE calibration



DCS GUI and Data Acquisition

DIAMOND TARGET GUI SOFTWARE
Version 11 - 6th February 2018
Author: Federica Oliva

LOW VOLTAGE p6V
LV value(V) LV I (mA)(A)
Set LV 5 0.2
Read back V LV Read back I LV
0 0

PULSER
Choose a waveform
SET WPP (V) SET RATE (kHz)
Read back WPP 0

HIGH VOLTAGE
HV value HV step HV delay(sec)
Set HV 0 1 3
Read back HV HV V read back Unleakage current (A)
0 0

Initialize
Reacquisition
The acquisition can be done through 2 type of LOOP
V(V) W(V) N step DELAY(s)
Loop on HV 0 10 10 10
Loop on Pulser 0,05 0,05 2 5
Leave a loop comment here channel: - attenuator:
Loop on pulser(all Ds) Loop on HV (all Ds)
The data will be saved in PADME DB!

Help Exit

Please push the Help button to know how the GUI works!

PADME

- Acquisition through PADME DAQ software
- FE Calibration looping on Pulser and HV
- Run information stored in PADME MySQL DB LECCE

Conclusions



Waiting for PADME data taking..

- Two detectors are ready to be tested, both with metallic and graphitic strips;
- the PADME active target will be one of the first diamond detectors with graphitic strips ever used in High Energy Physics experiments.

**The search is yet to begin.
TURN THE DARK ON!**