A Diamond Active Target for the PADME experiment

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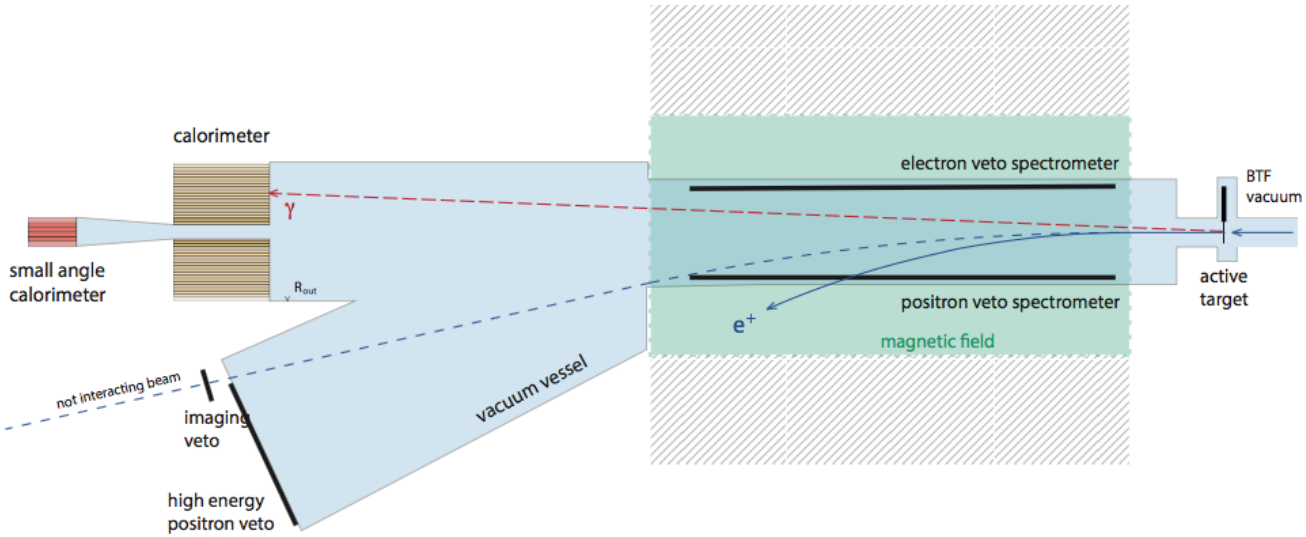
PADME detectors layout

Searching for the dark photon A'

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



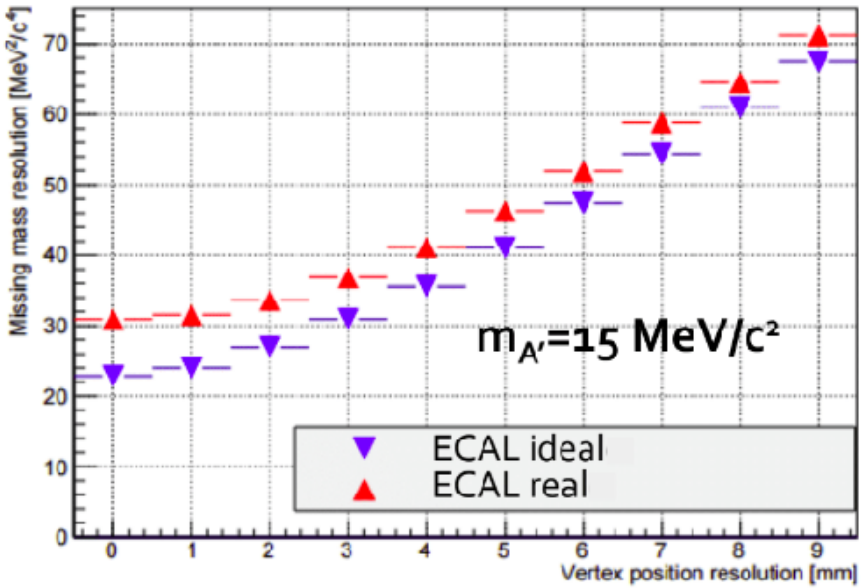
SIGNAL: $e^+e^- \to \gamma A'$

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

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**

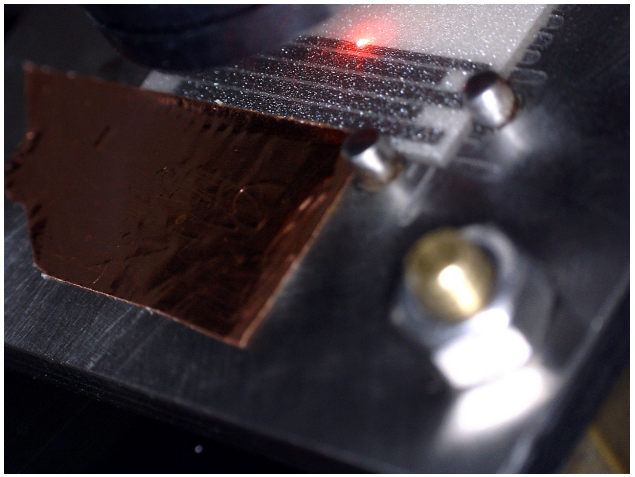
$$N_{brem} \propto Z^2 \qquad N_{\gamma\gamma} \propto Z$$

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

Diamond detectors realised

Starting from a CVD polycrystalline diamond film 2×2 **cm^2 area** and 100μ**m thickness**, **2 types** of detectors are assembled, which differ by the nature of their electrodes:

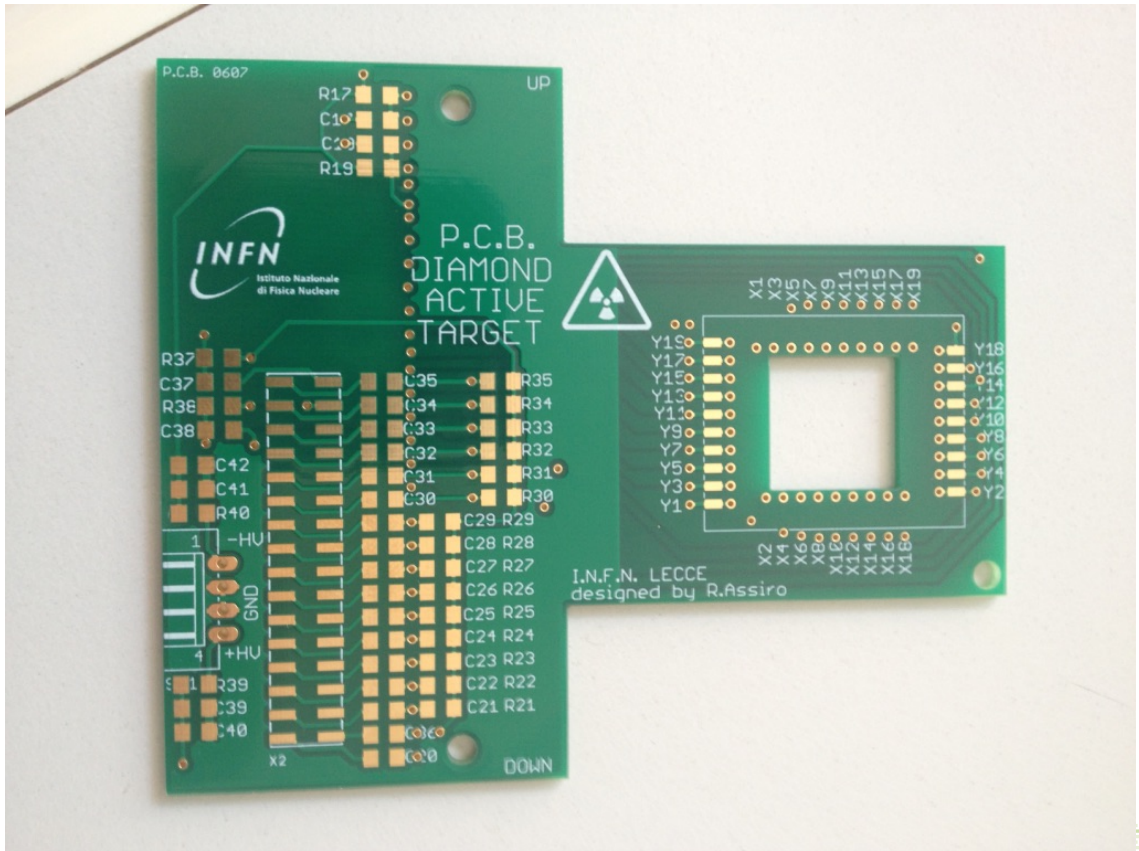
- graphitic strips useful as ohmic electrodes produced in the **L3** Laser Laboratory in Lecce using an excimer laser ArF (λ=193 nm);



- Cr-Au contacts provided directly from Applied Diamond.

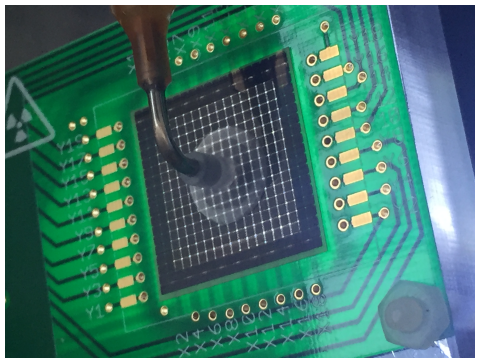
Interconnection with the PCB

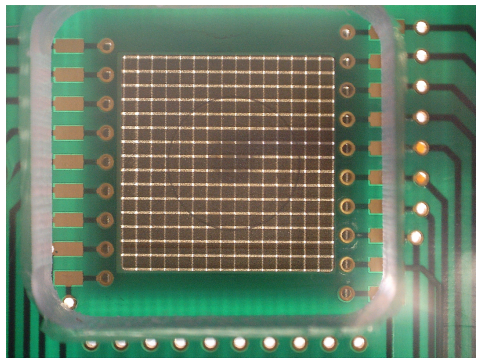
The diamond detectors are made up of **19×19 strips**, orthogonally oriented in the two views, with a pitch of 1 mm.

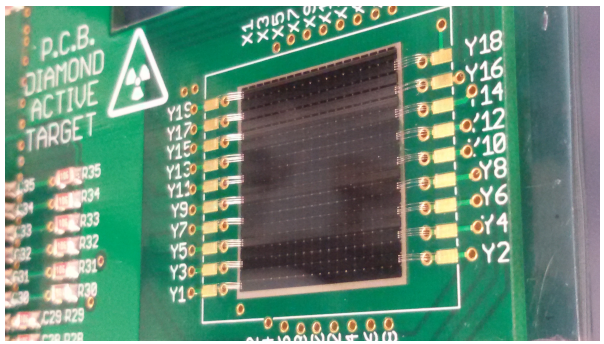


Different steps needed to interconnect the detector to the board:

- 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).

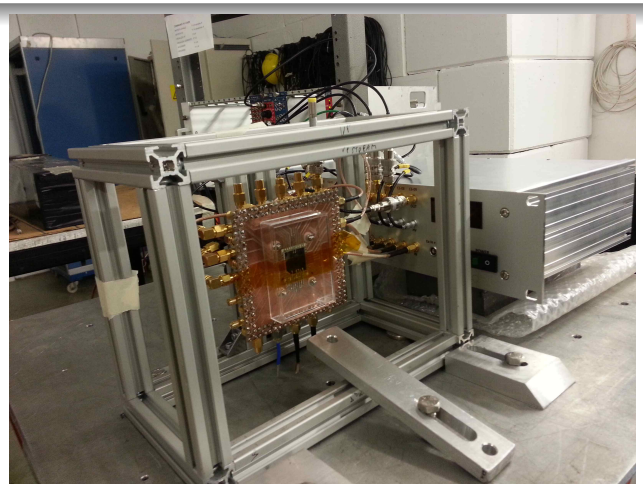






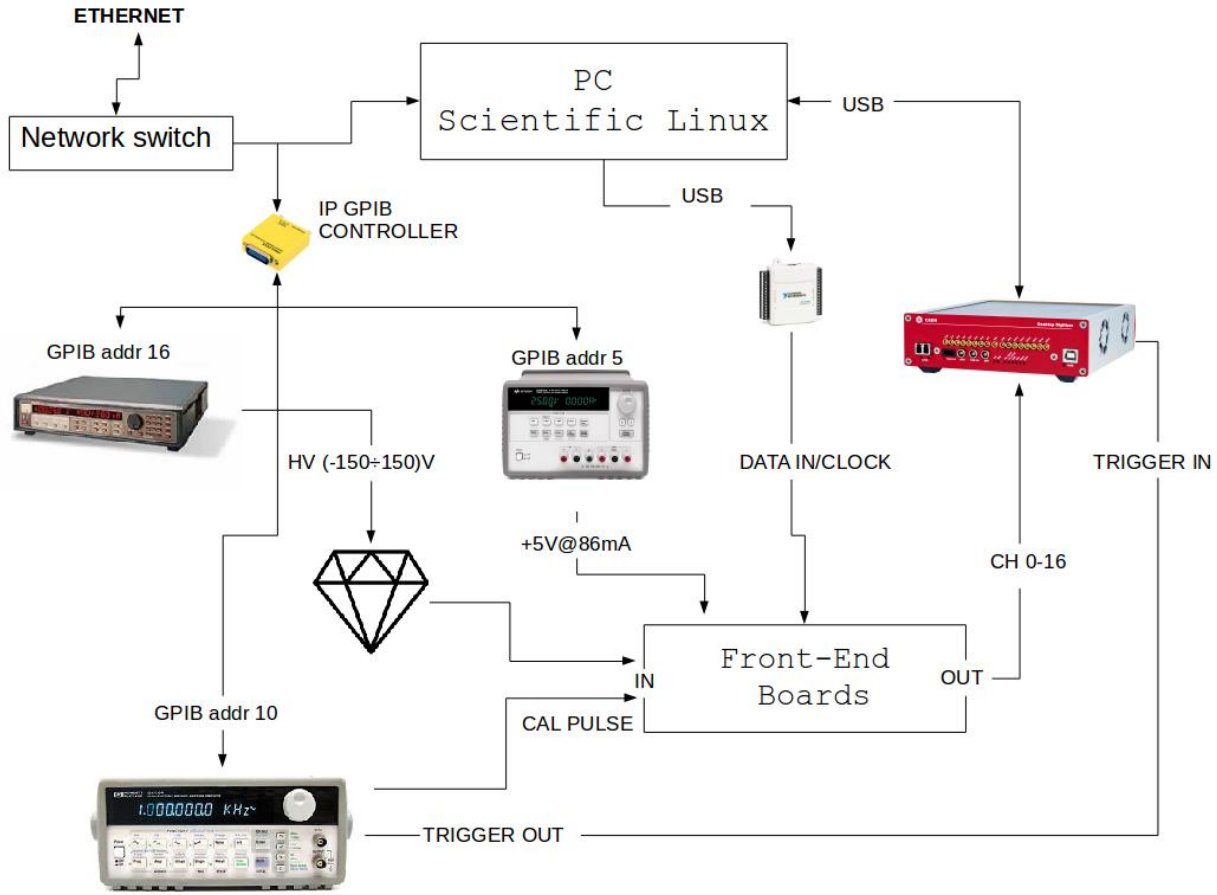
The first prototype tested in 2015

CVD polycrystalline diamond film, 2×2 cm^2 area and 50μm thickness provided by Applied Diamond
18×18 graphitic strips orthogonally oriented, pitch of 1 mm and an inter-strip dead gap of 150 μm produced in the L3 Laboratory of Lecce

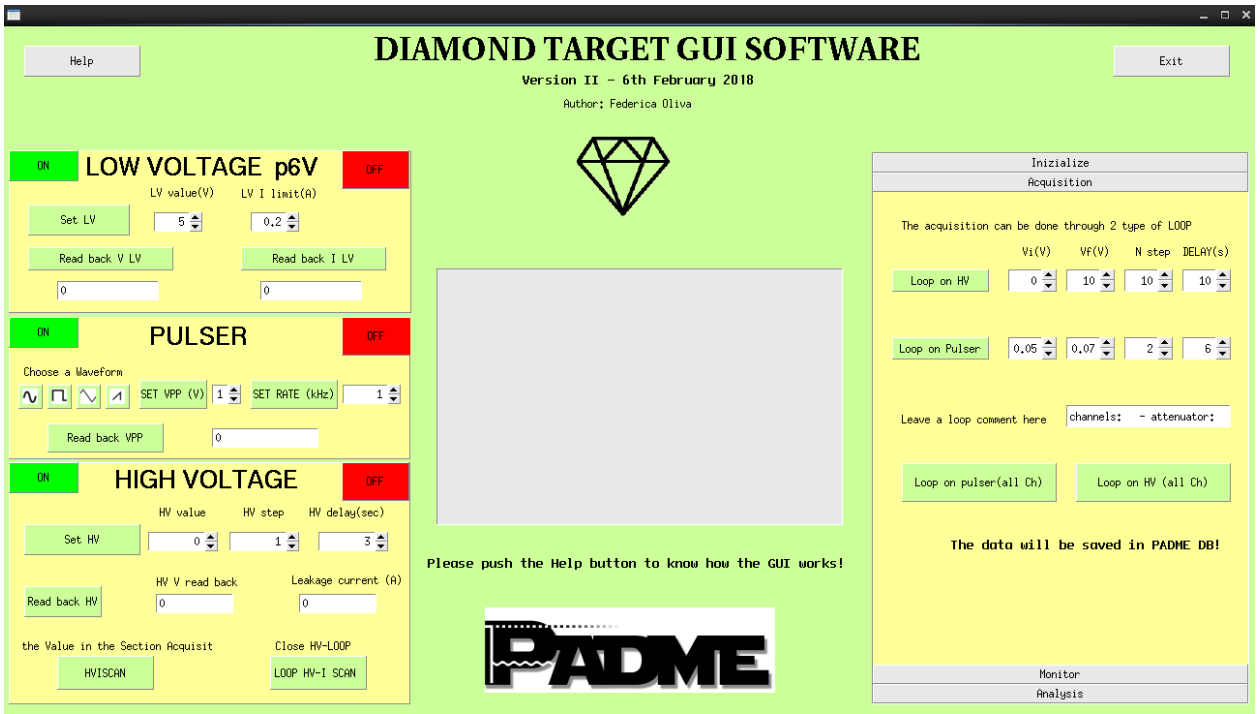


In November 2015 the prototype was tested during the beam test at the Beam Test Facility(BTF) at the LNF, giving a good spatial resolution(0.3mm).

DCS and DAQ setup of the FE calibration



DCS GUI and Data Acquisition



- 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!