Tecniche laser per contattazione diamante e chip di lettura

M. Martino – Responsabile WP4 DIAPIX

INFN Leccce and Università del Salento

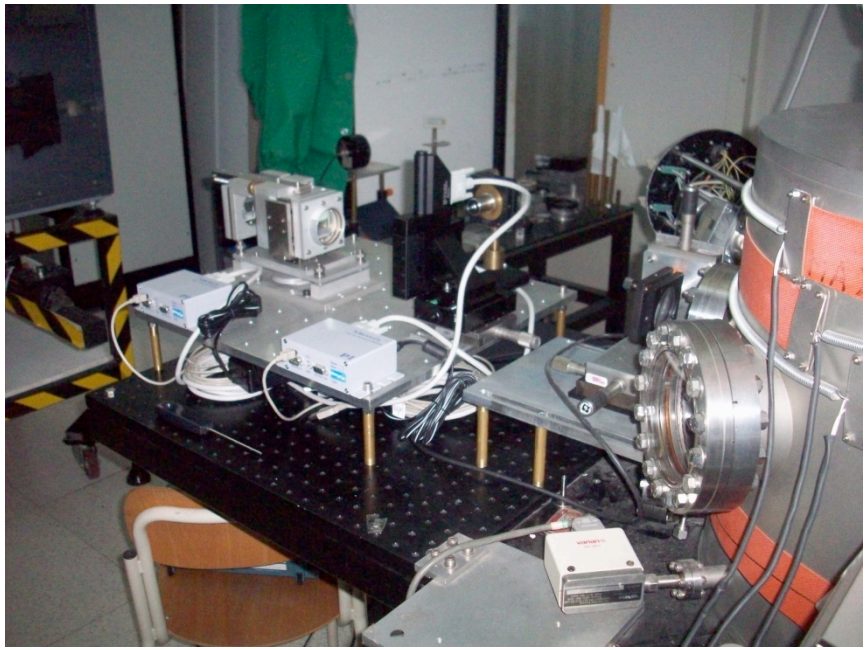
6 Dic 2012

G. Chiodini, P. Fiore, R. Perrino
INFN Lecce
E. Alemanno, A.P. Caricato, M. Corrado, M. Martino, C. Pinto, S. Spagnolo
INFN Lecce and Universita' del Salento

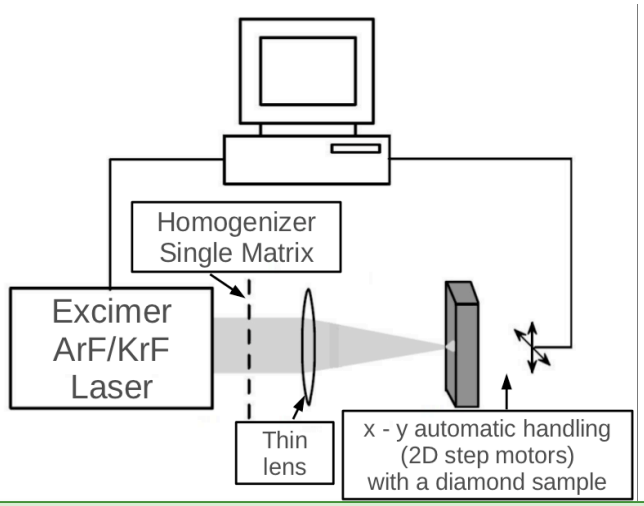
Setup for diamond graphitization

Il gruppo di Lecce (INFN+Universita') comincia a lavorare sul diamante nel 2011 con G5

- KrF mixture: 248 nm transparent to detector grade absorbed by thermal grade diamond
- ArF mixture: 193 nm absorbed by detector grade diamond Eg 5.5 eV



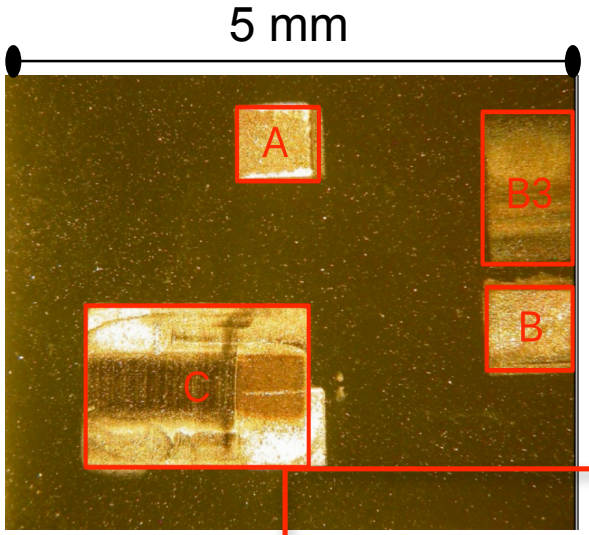
LAB L^3 Università del Salento.

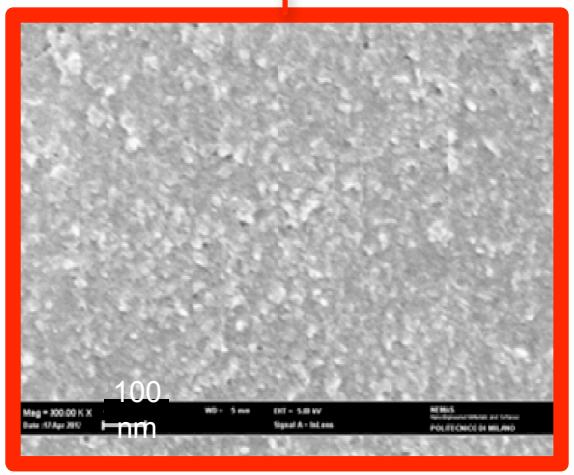


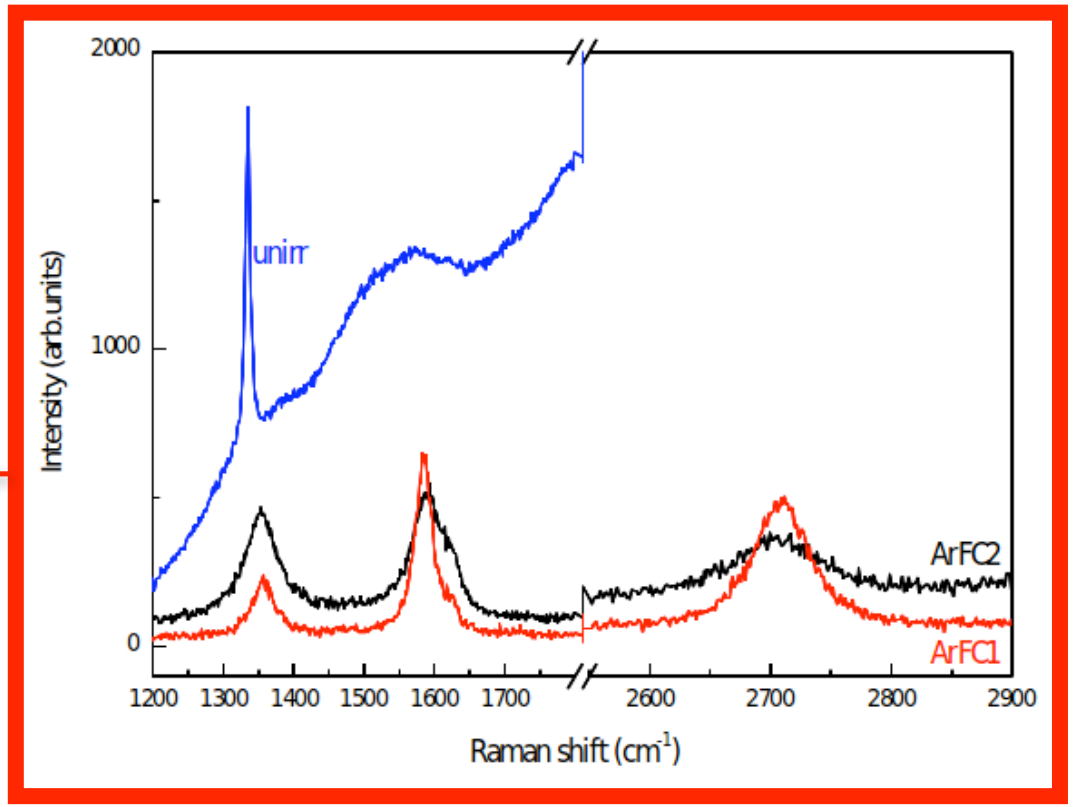
Laser parameters

Spot surface: 3 mm^2.
Fluence: 5 J/cm^2.
Repetition rate: 10 Hz.
Holding samples velocity: 0.3 mm/s.

Graphitization thermal grade polycrystal CVD diamond







ArFC1:

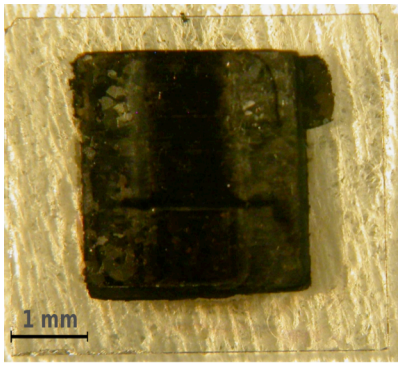
1350 cm^{-1} (D band), 1590 cm^{-1} (G band), 2720 cm^{-1} (G' band, FWHM: **70** cm^{-1}).

ArFC2 :

1350 cm^{-1} (D band), 1590 cm^{-1} (G band), 2720 cm^{-1} (G' band, FWHM: **110** cm^{-1}).

Graphitization detector grade polycrystal CVD diamond

I anno DIAPIX-WP4 (2011)



$\rho = (8 \times 10^{-6} \div 15 \times 10^{-6})\ \Omega$ cm

$$R_S = \frac{\rho}{t}$$

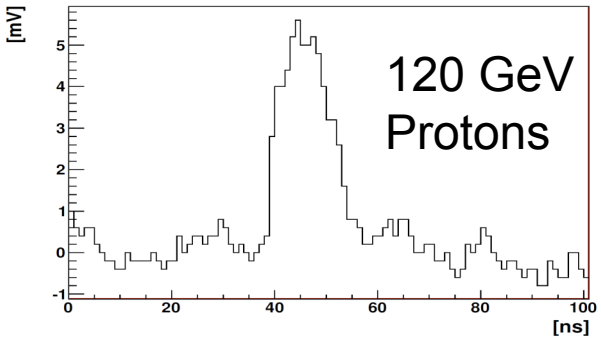
t = 44÷83 nm

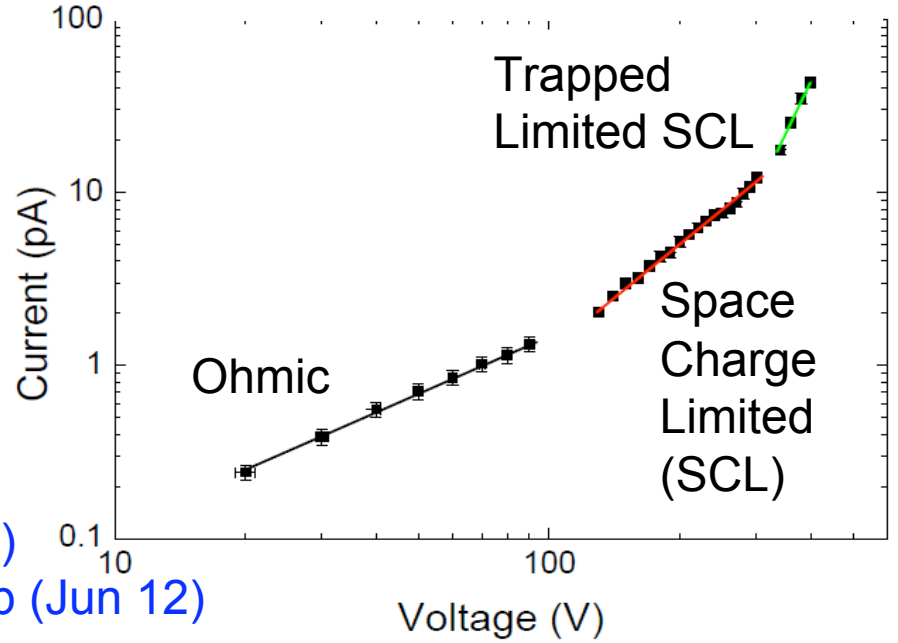
$$I \propto V^n$$

Region I: $n = 1 \rightarrow \rho_d \propto 10^{14}\ \Omega \cdot cm$

Region II: $n = 2$

Region III: $n = 5.6$

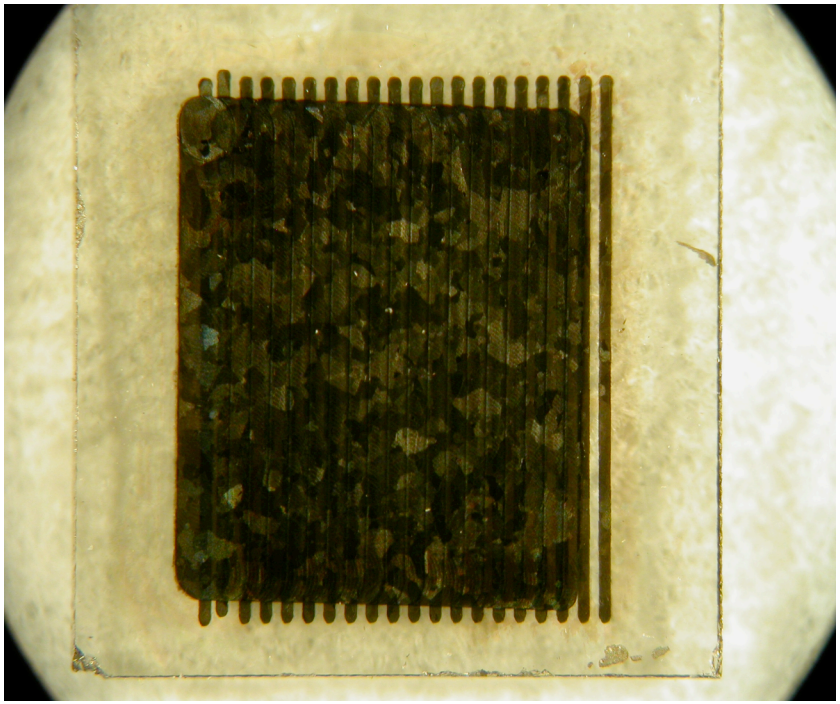


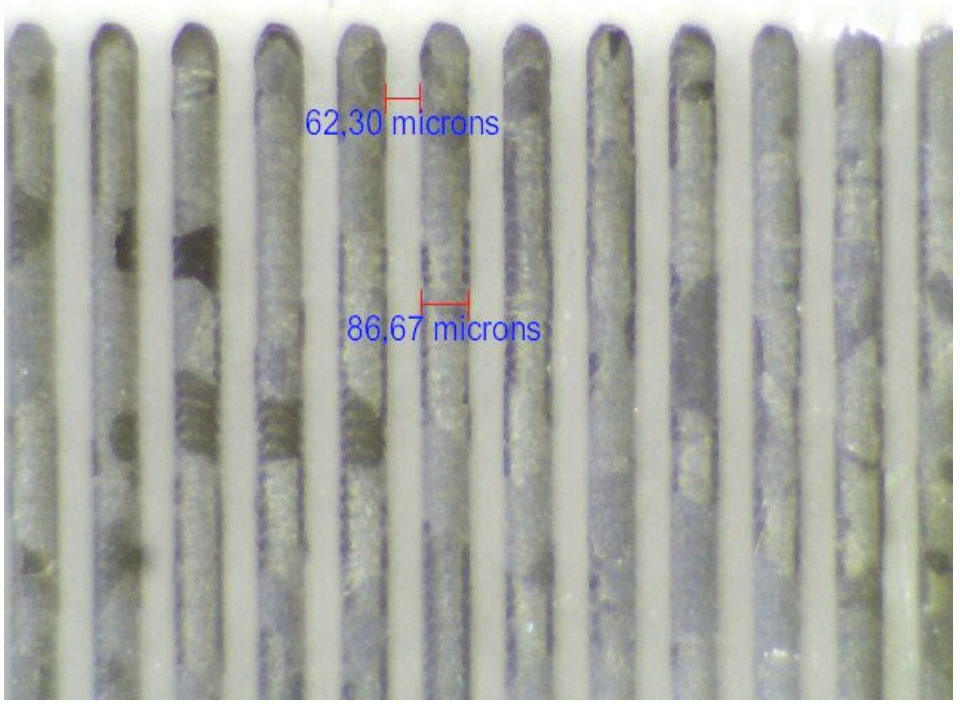


- Gamma and beta sources (Nov 11)
- Fermilab testbeam with 120 GeV p (Apr 12)
- Irradiation at LNS with 2 x 10^{15} of 68 MeV p (Jun 12)

Micro Strip Graphitized CVD Diamond

150 μm pitch strips on detector grade polycrystal CVD diamond 5x5x0.3mm3





Underway:

- Resistivity measurements along and intra strips with microprobing (!)
- AFM profile uniformity measurements
- Full instrumented strip detector

II anno DIAPIX-WP4 (2012)

Low T bonding with nanomaterial

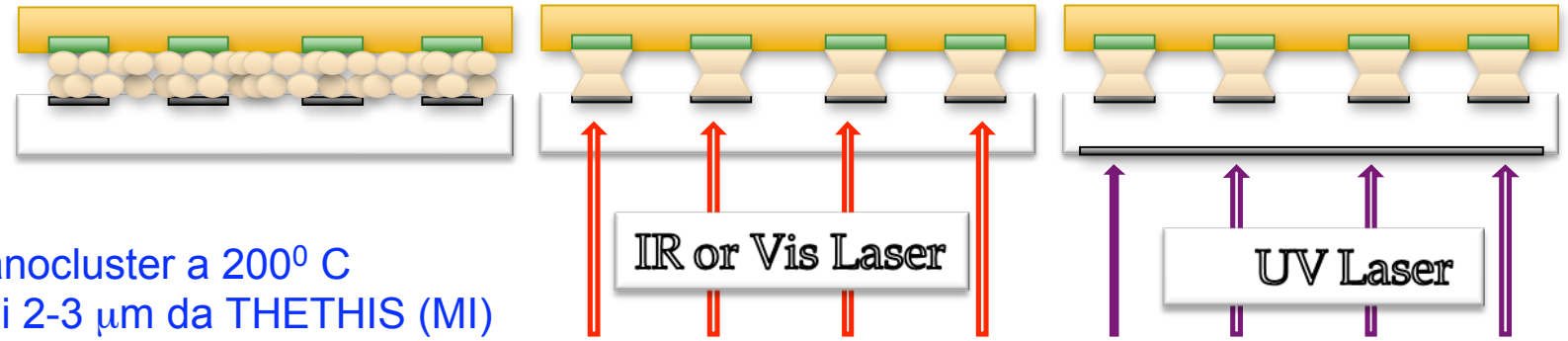
III anno
DIAPIX-WP4
(2013)

Readout chip
Nanoclusters
Diamond

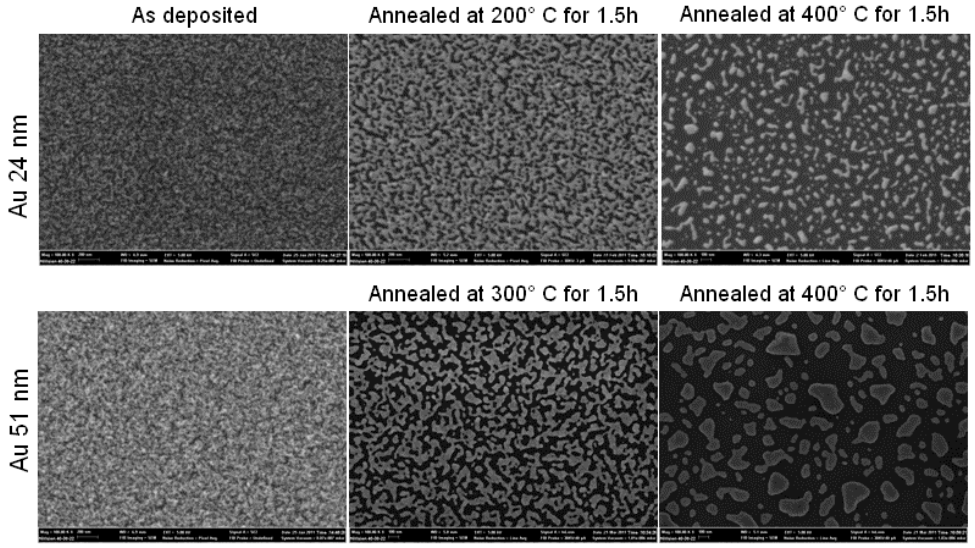
First Step:
Nano-cluster deposition

Second Step:
Bump Bonding

Third Step:
Graphite back-electrode



Melting di Au nanocluster a 200^0 C
Campioni spessi 2-3 μm da THETHIS (MI)

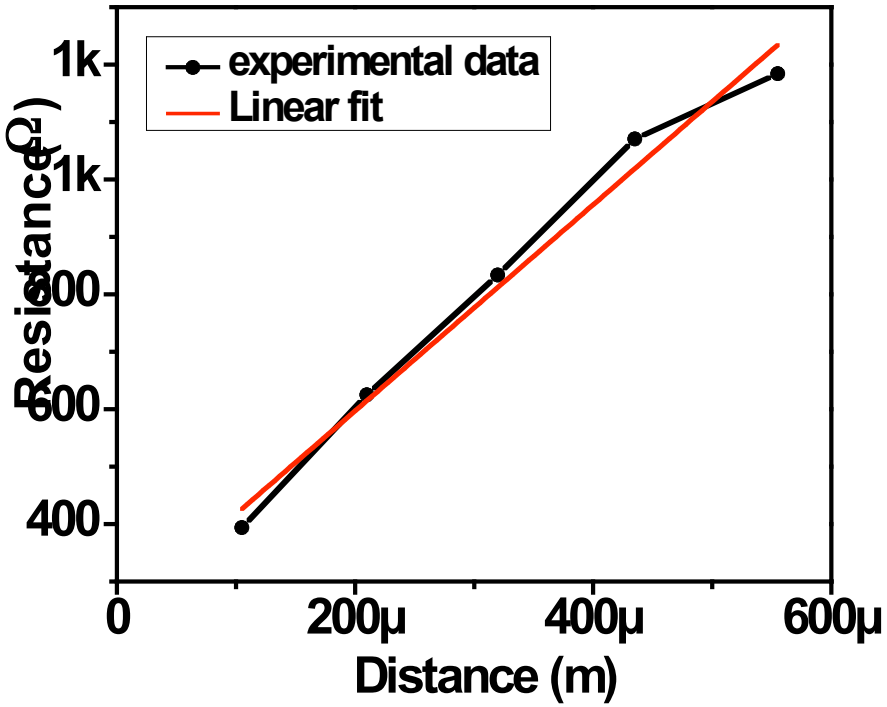


Macchina di Flip-Chip di INFN-GE usata per ATLAS pixel Indium Bumps ora a INFN-LE.
Lasers forniti da Lab L^3.

Notizie dell’ultima ora

Measurement of graphite stripes resistivity

Distance (μm)	Resistance (Ωm)
105	394
210	625
320	833
435	1071
555	1184
Resistivity (ohm*m)	3.6E-6
Rc (ohm)	119



	A	B	C	D
1	Equation	y = a + b*x		
2	Weight	No Weighting		
3	Residual Sum of Squares	6837.97579		
4	Adj. R-Square	0.97804		
5			Value	Standard Error
6	R	Intercept	237.76452	48.54691
7		Slope	1.79552E6	134153.05128

Radius tip: 20μm
Thickness of graphite stripe ≈ 50nm

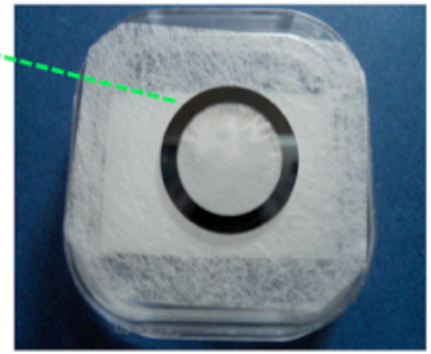
Anna Grazia Monteduro
CNR-Nano Lecce

PANDA target

Applicazione inaspettata: Recentemente contattati da Valentino Rigato (LNL) e da Felice Iazzi (TO) per valutare di nano-grafitare le due facce del bersaglio di carbonio di PANDA per evitare charge build-up.

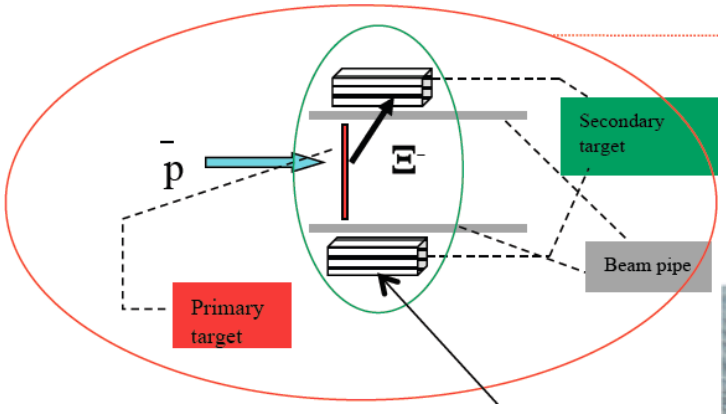
F. Iazzi INFN-Torino&Politecnico
CSN3-Firenze-2010

Diamond disk on silicon ring
(obtained by Chemical Vapour Deposition on Si ring)

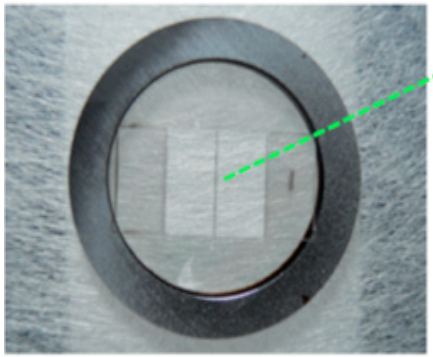


Features:
- High thermal conductivity
- High mechanical resistance
- Thickness : 3 μm (±0.5 μm) (→2 μm)
- surfaces : Polished (but slightly wavy)

Si ring:
- outer diameter = 15 mm
- outer diameter = 15 mm
- Thickness = 500μm (±100μm)



Produzione Ipernuclei a doppia stranezza con sistema a doppia targetta in PANDA



Technique to cut the diamond:
short impulse LASER

LASER Type: Femto Edge
LASER beam characteristics:
- Wavelength: 1064 nm
- Pulse duration: 100 femto-sec
- Power: 3 W

Result: Wire width =99.9 (0.5) [μm] (FESEM)
(→Wire width ≈ 80)

Conclusioni

- **Sono stati caratterizzati strati di grafite realizzati su diamante mediante trattamento laser con microRaman e SEM (Pad)**
- **Sono state scritte strip di grafite larghe decine di μm**
- **Dispositivo testato come detector nucleare**
- **Allestimento set-up bump-bonding con nanostrutture**
- **Prime misure di resistività sulle strip micrometriche**