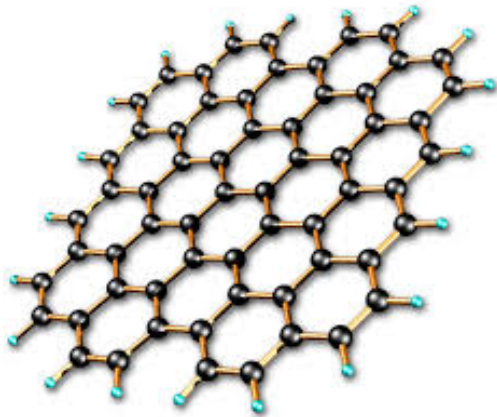
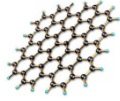


# La Fisica del Grafene

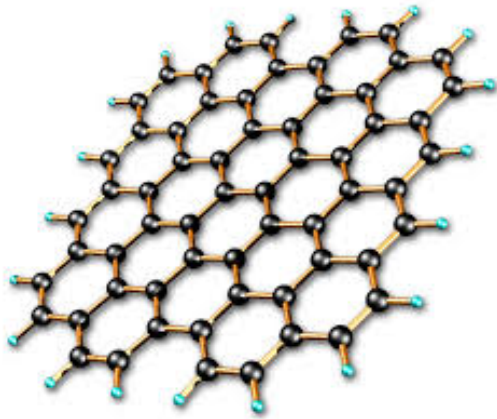
**Il grafene è il  
singolo  
strato di atomi  
di carbonio**



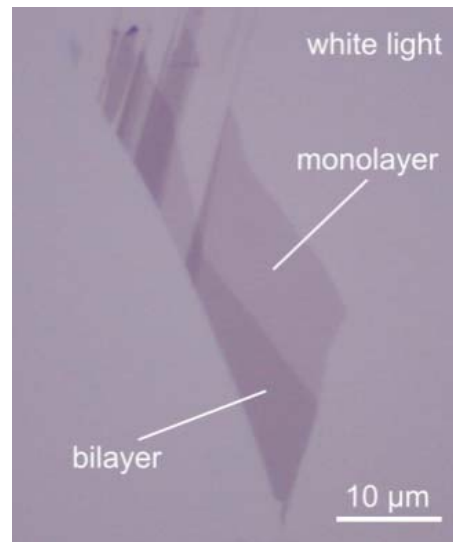


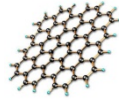
# La Fisica del Grafene

**Il grafene è il  
singolo  
strato di atomi  
di carbonio**



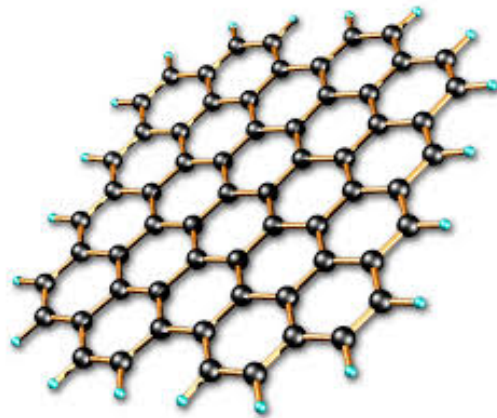
**Si può produrre**



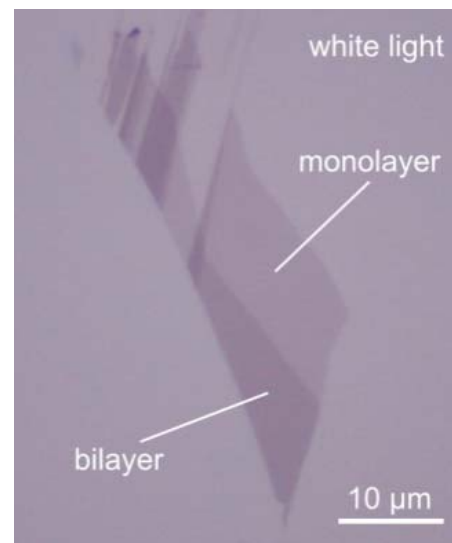


# La Fisica del Grafene

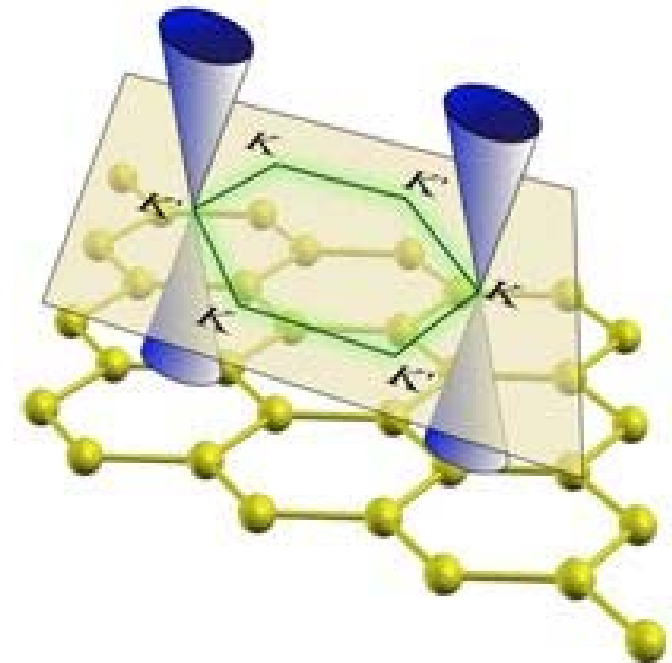
**Il grafene è il  
singolo  
strato di atomi  
di carbonio**

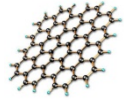


**Si può produrre**



**Gli elettroni obbediscono  
ad un comportamento  
relativistico**



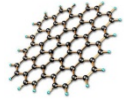


# La Fisica del Grafene

Produzione col metodo dello  
scotch

Grafite  
naturale





# La Fisica del Grafene

## Produzione col metodo dello scotch

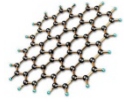
Grafite naturale



+

Schotch





# La Fisica del Grafene

## Produzione col metodo dello scotch

Grafite naturale



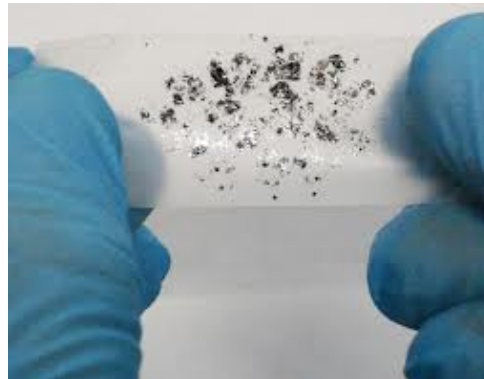
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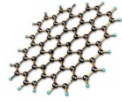
Schotch



+

Manualità





# La Fisica del Grafene

## Produzione col metodo dello scotch

Grafite naturale



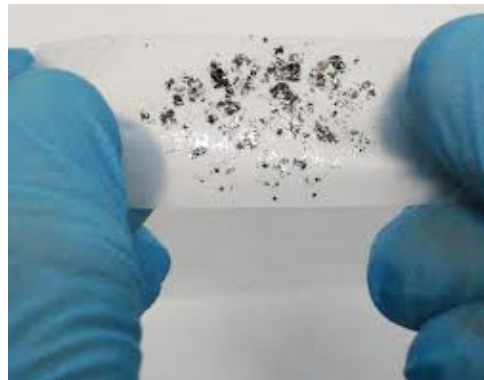
+

Schotch



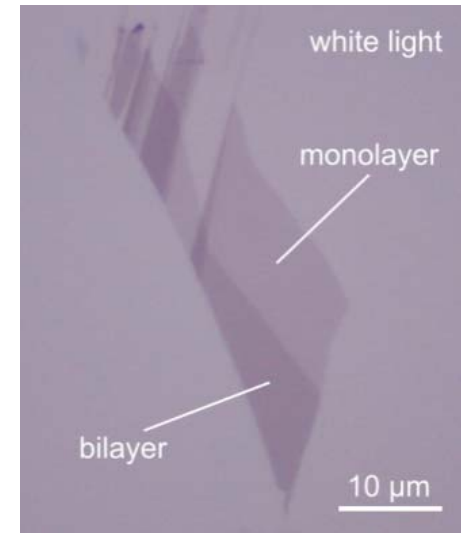
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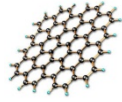
Manualità



=

Grafene



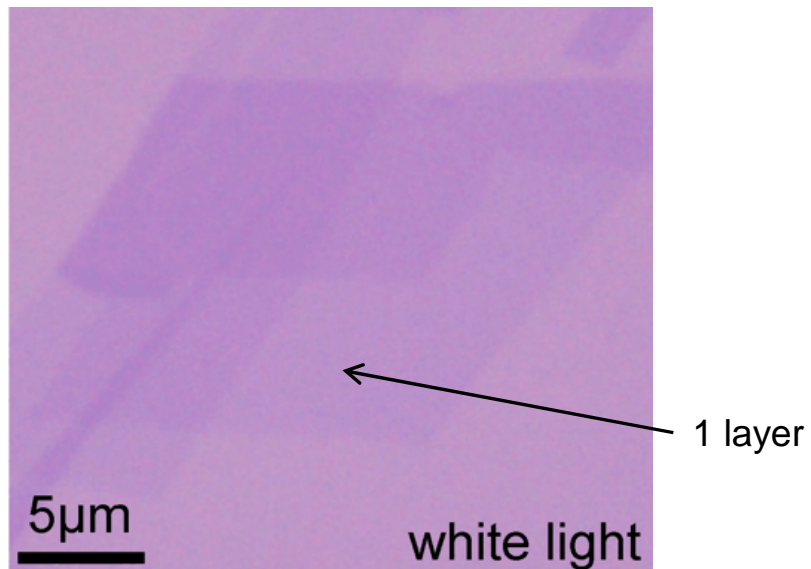


# La Fisica del Grafene

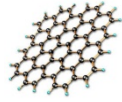
## Produzione del grafene



The University of Manchester





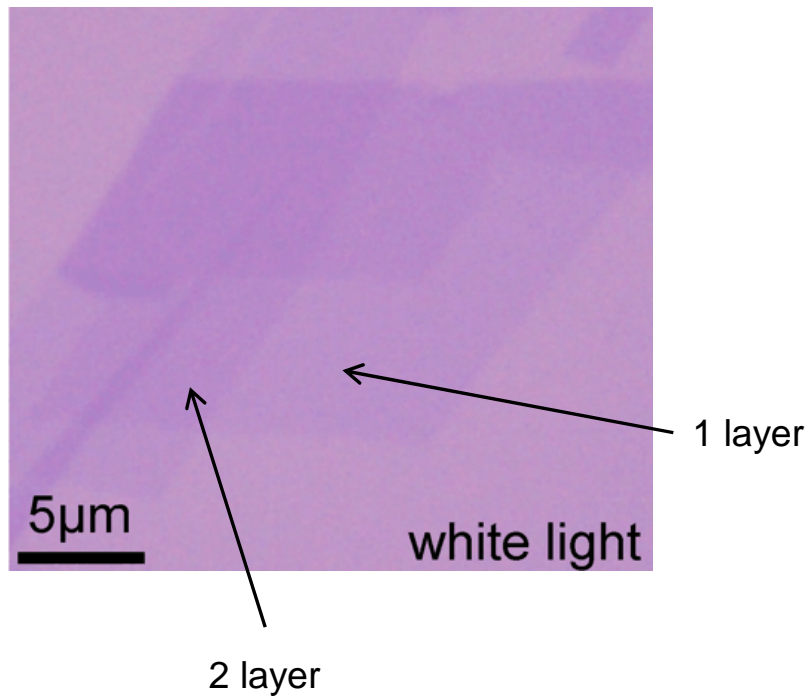


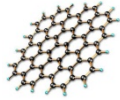
# La Fisica del Grafene

## Produzione del grafene



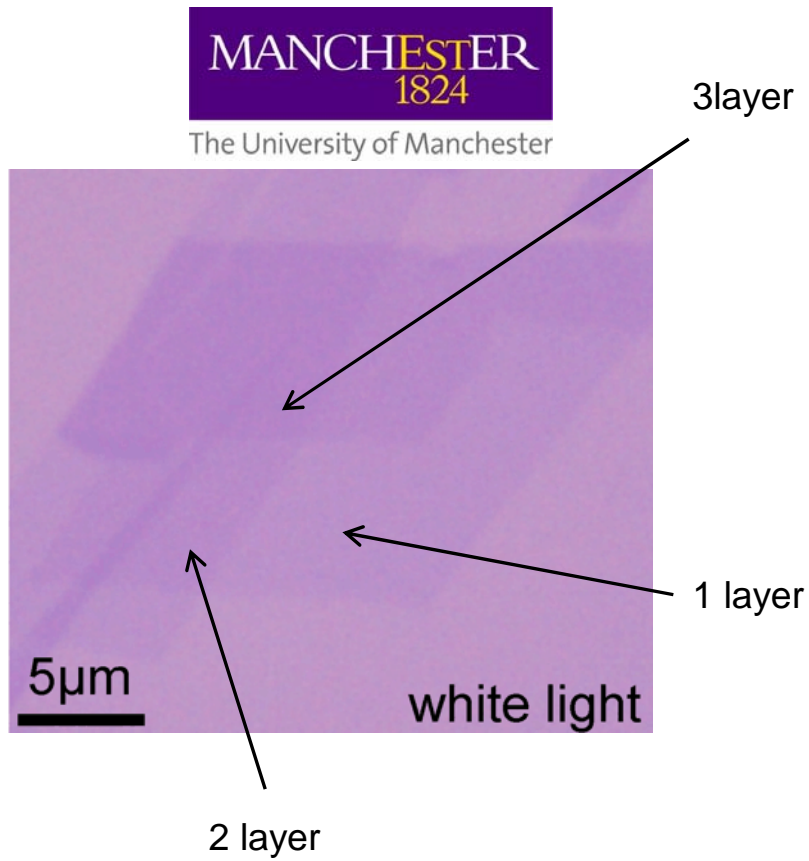
The University of Manchester

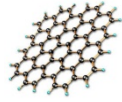




# La Fisica del Grafene

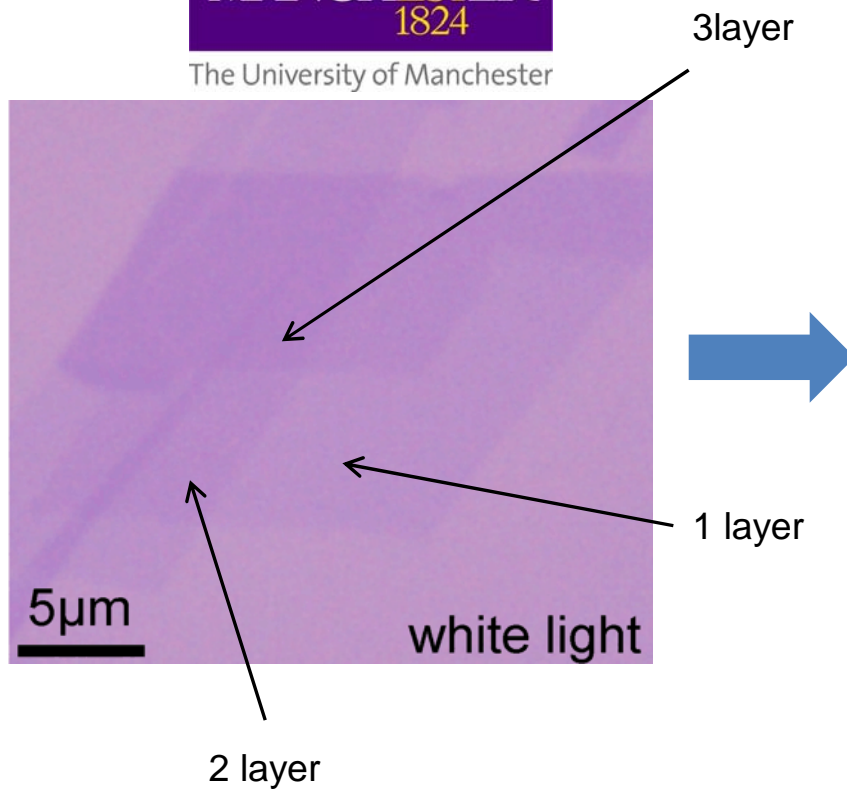
## Produzione del grafene

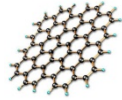




# La Fisica del Grafene

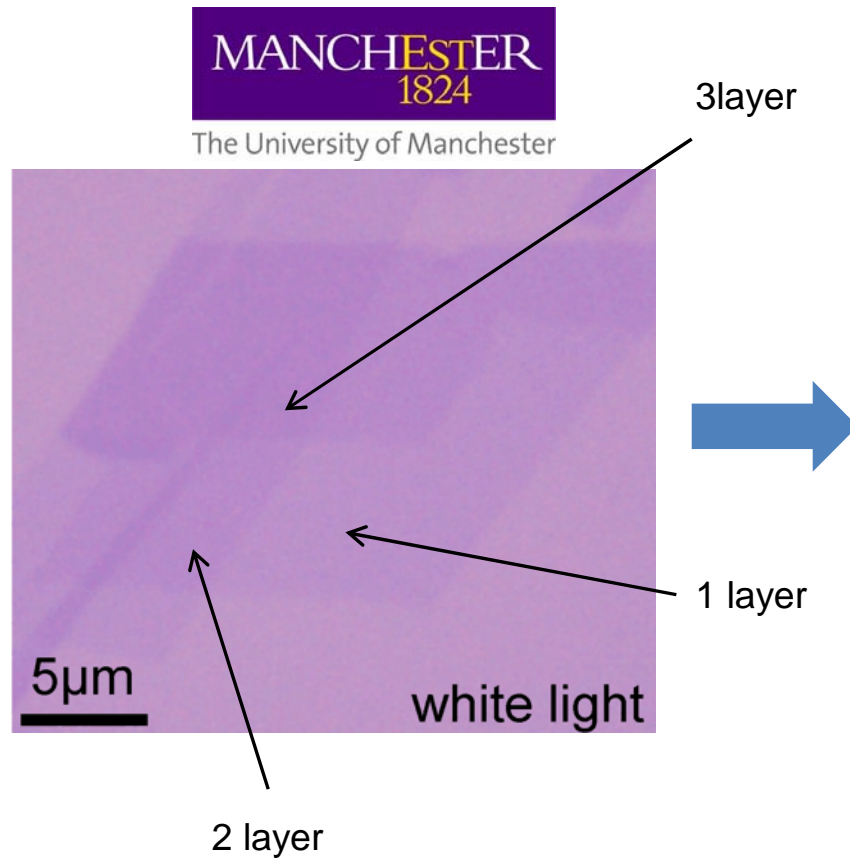
## Produzione del grafene





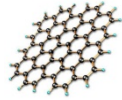
# La Fisica del Grafene

## Produzione del grafene



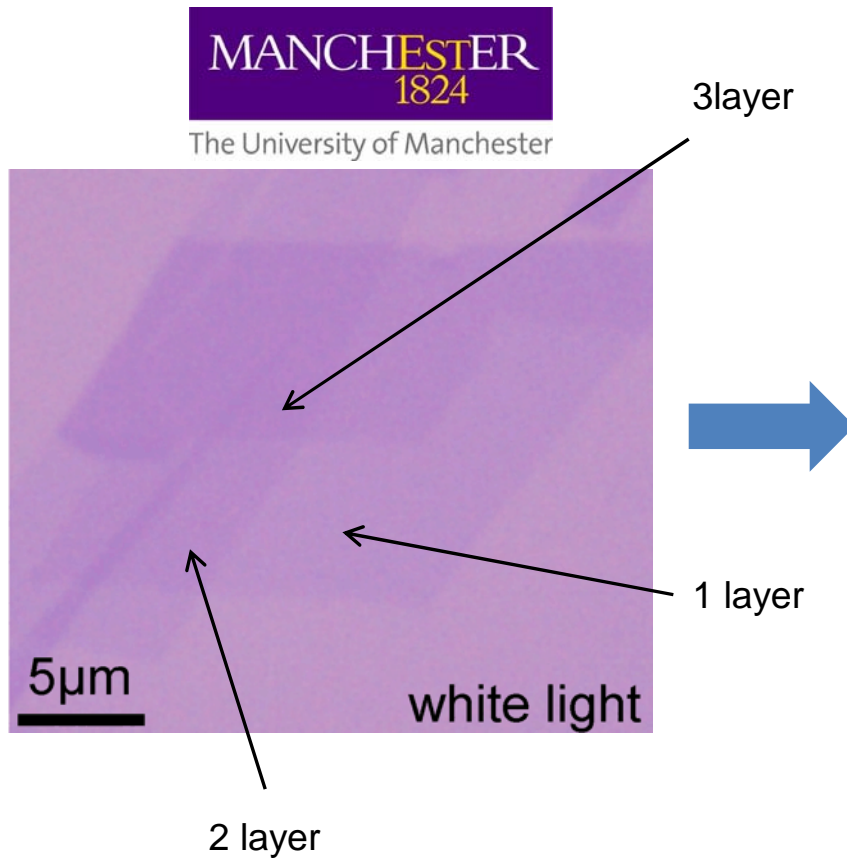
## Studio Raman



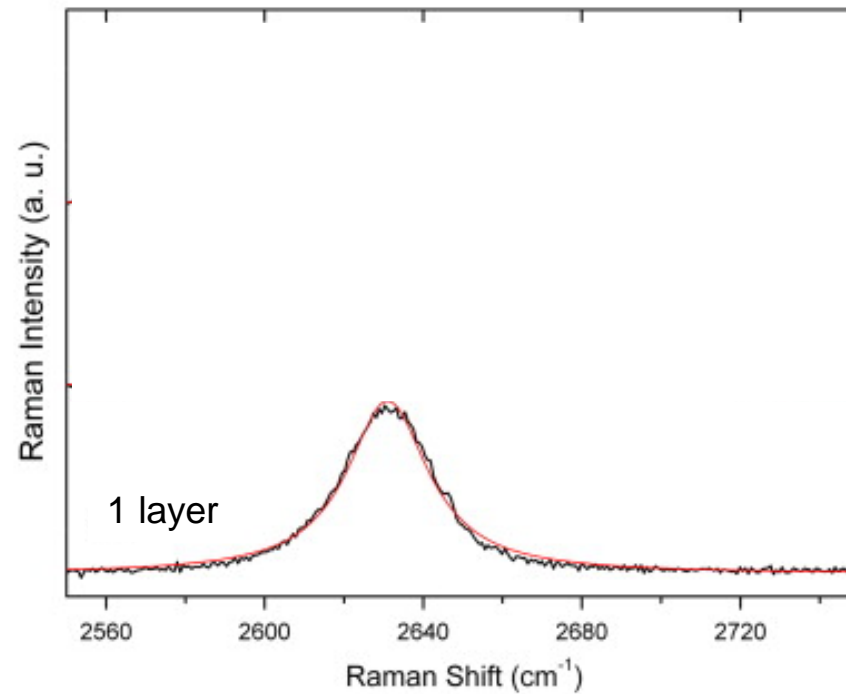


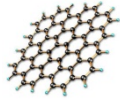
# La Fisica del Grafene

## Produzione del grafene



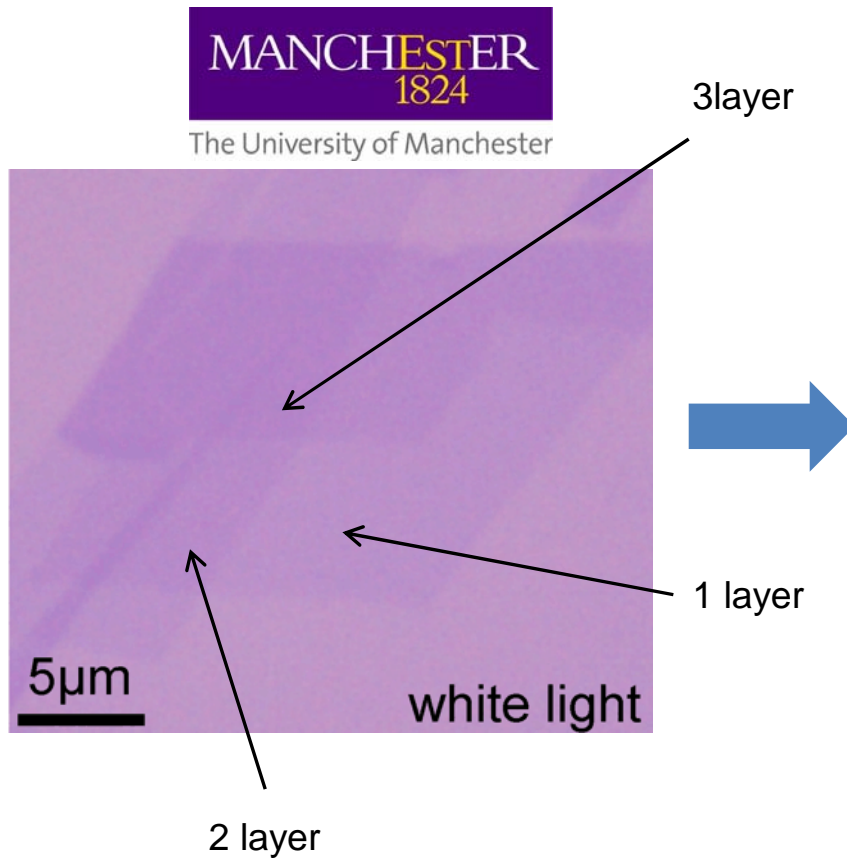
## Studio Raman



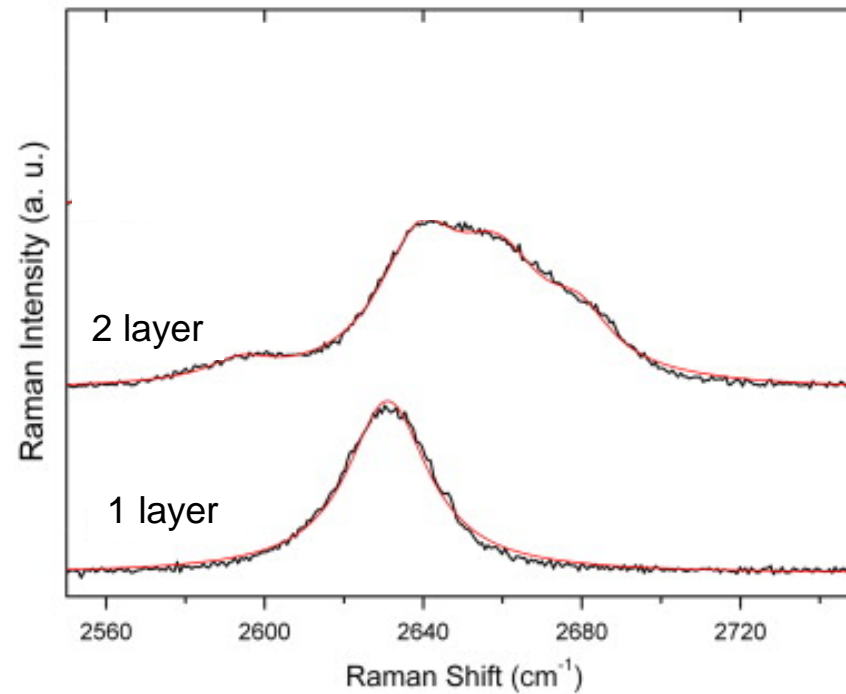


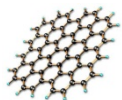
# La Fisica del Grafene

## Produzione del grafene



## Studio Raman



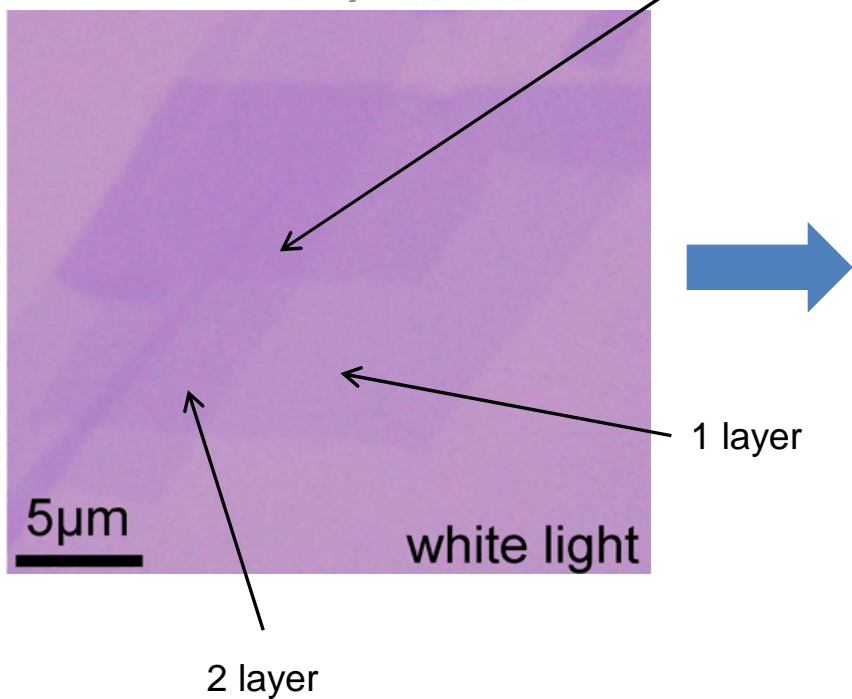


# La Fisica del Grafene

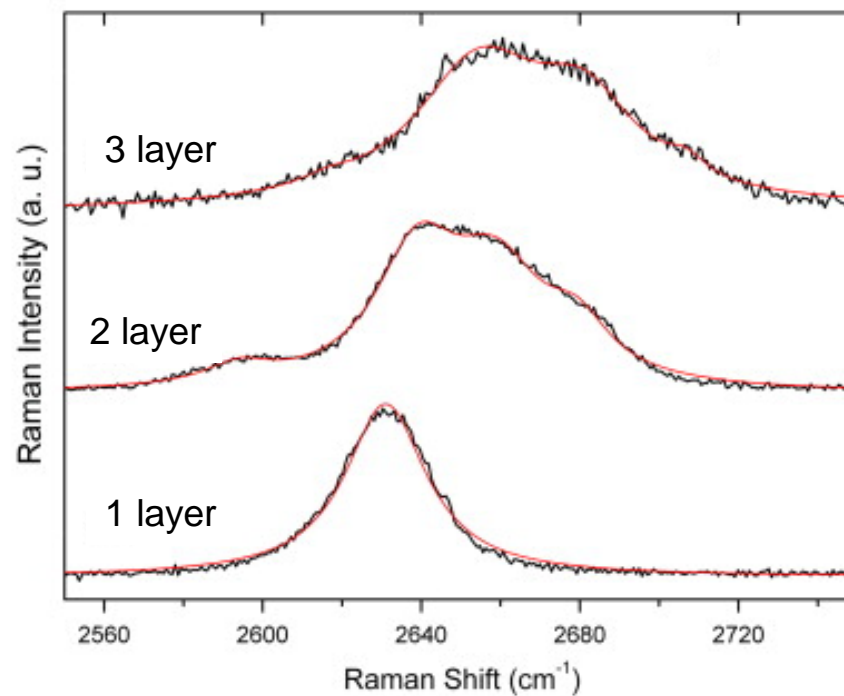
## Produzione del grafene

MANCHESTER  
1824

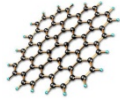
The University of Manchester



## Studio Raman





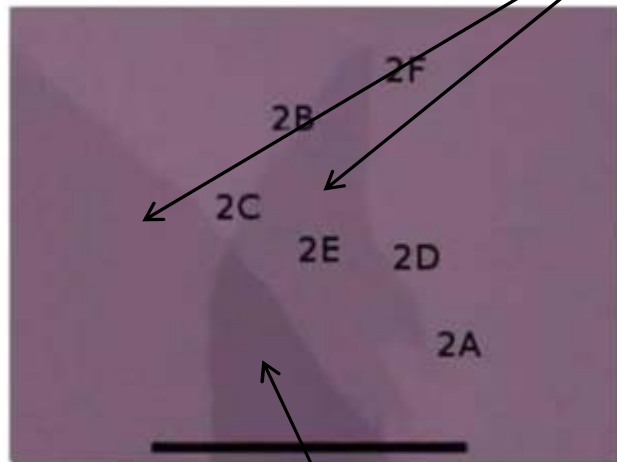


# La Fisica del Grafene

## Produzione del grafene



The University of Manchester

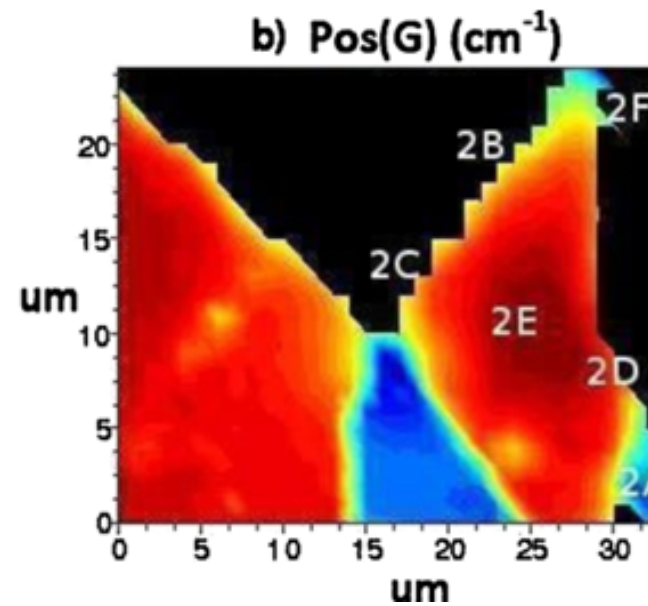


1 layer

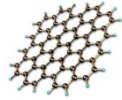


2 layer

## Studio Raman





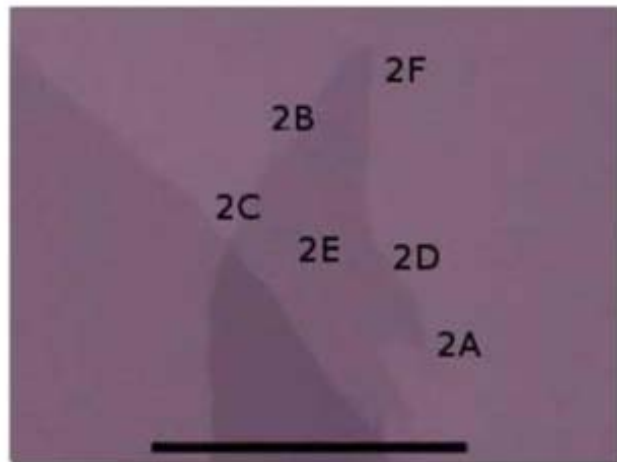


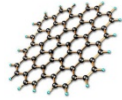
# La Fisica del Grafene

## Produzione del grafene



The University of Manchester



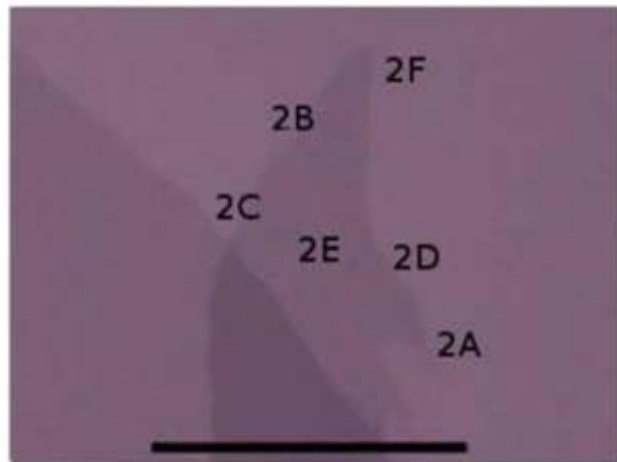


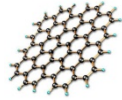
# La Fisica del Grafene

## Produzione del grafene



The University of Manchester





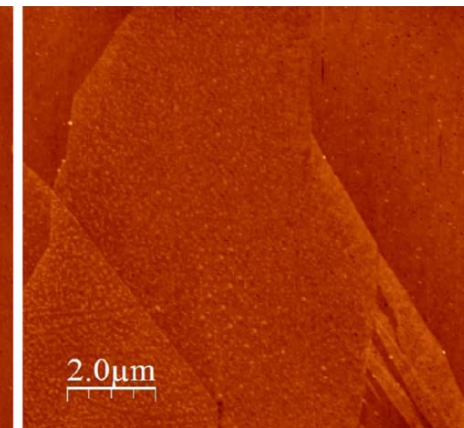
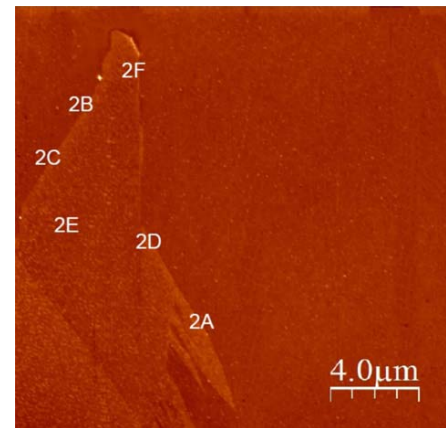
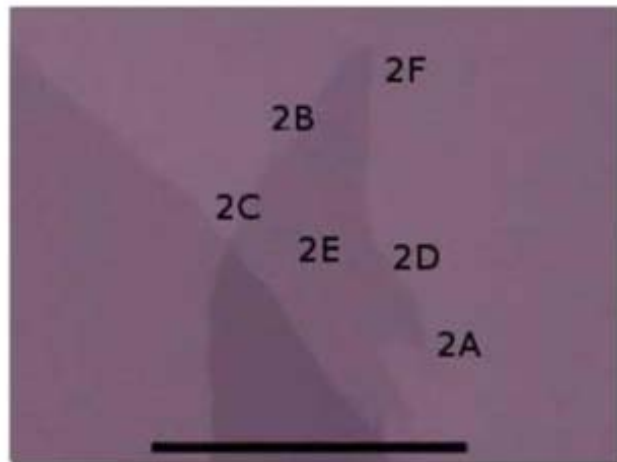
# La Fisica del Grafene

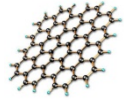
## Produzione del grafene



The University of Manchester

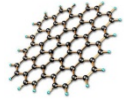
## Studio microscopia forza atomica





# La Fisica del Grafene

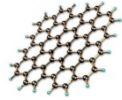
**Produzione di  
composti al  
grafene**



# La Fisica del Grafene

Produzione di  
composti al  
grafene





# La Fisica del Grafene

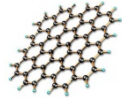
Produzione di  
composti al  
grafene



Nano-  
particelle di  
 $\text{Fe}_2\text{O}_3$



+



# La Fisica del Grafene

Produzione di  
composti al  
grafene



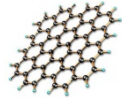
Nano-  
particelle di  
 $\text{Fe}_2\text{O}_3$



+



grafene



# La Fisica del Grafene

Produzione di  
composti al  
grafene



Nano-  
particelle di  
 $\text{Fe}_2\text{O}_3$

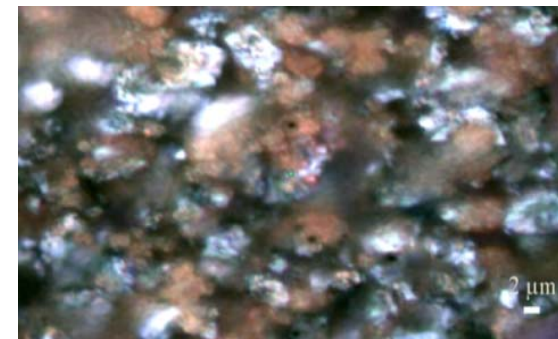


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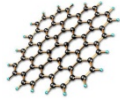


=

composto ibrido







# La Fisica del Grafene

Produzione di  
composti al  
grafene



Nano-  
particelle di  
 $\text{Fe}_2\text{O}_3$



+

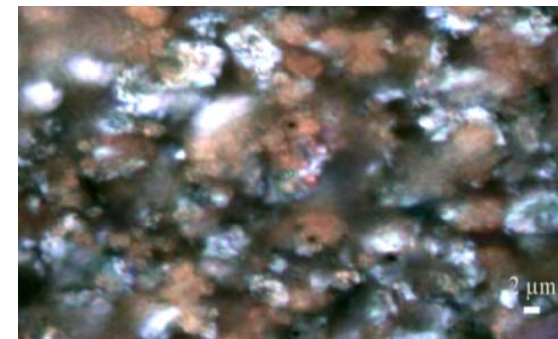


grafene



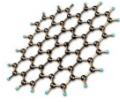
=

composto ibrido



Applicazioni:

- Elettrodi in batterie  
al Litio

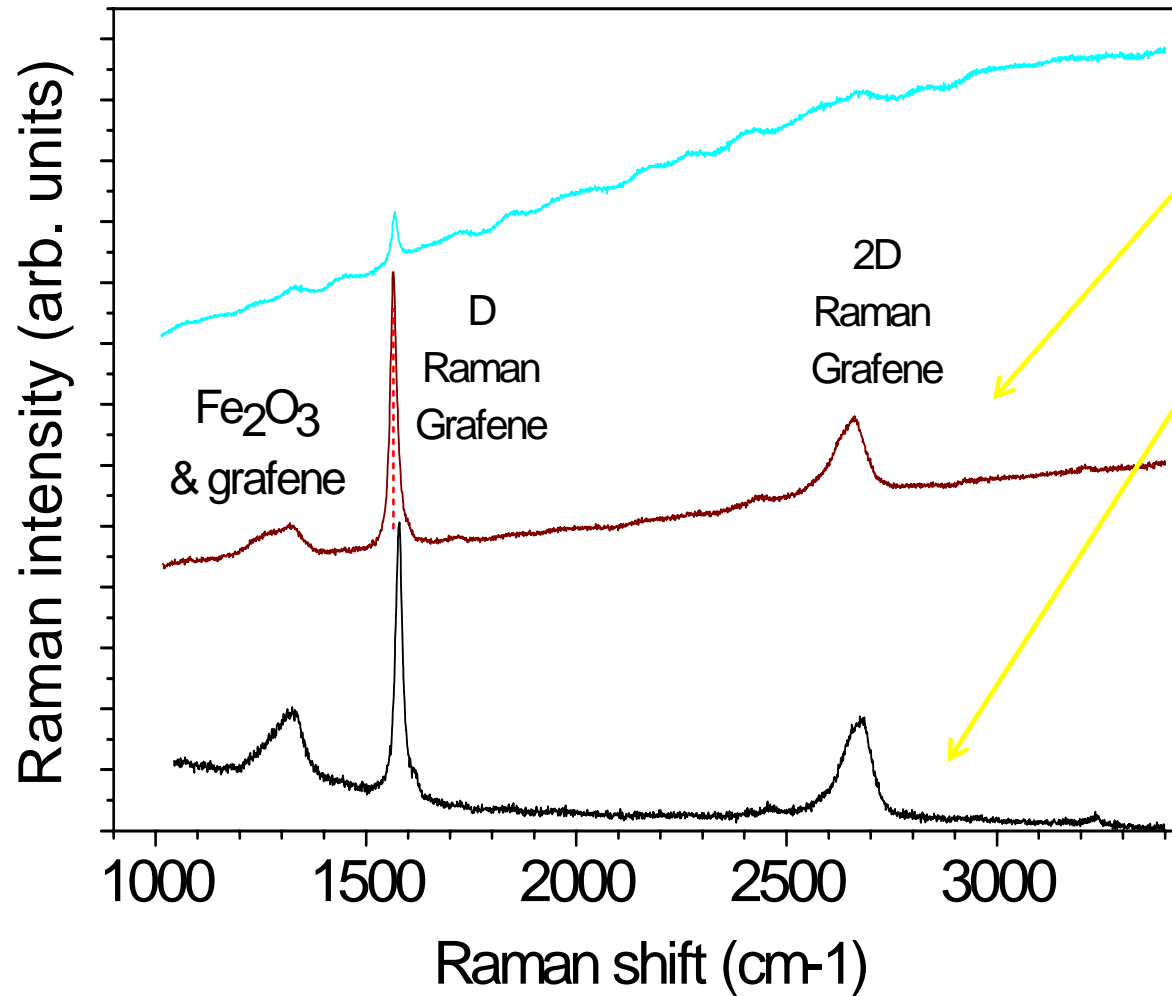
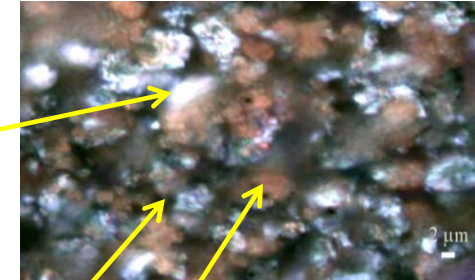


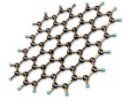
# La Fisica del Grafene



UNIVERSITÀ DI PAVIA

**Composto ibrido  
contenete grafene**

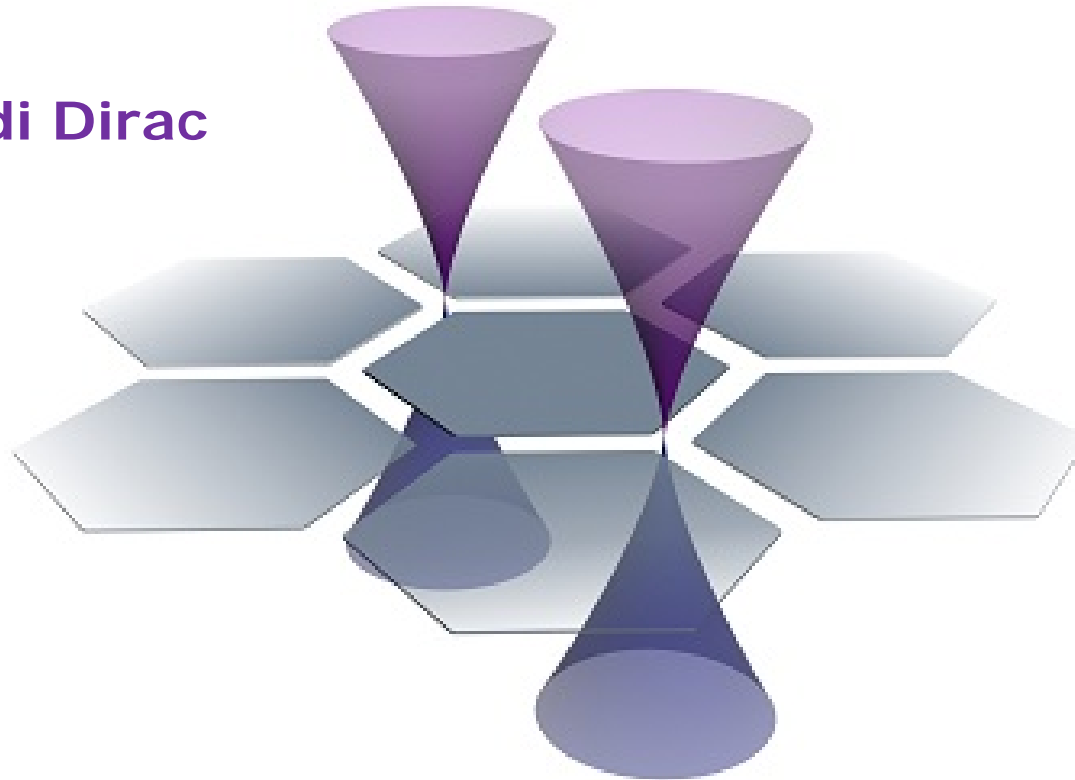


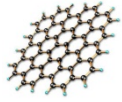


# La Fisica del Grafene

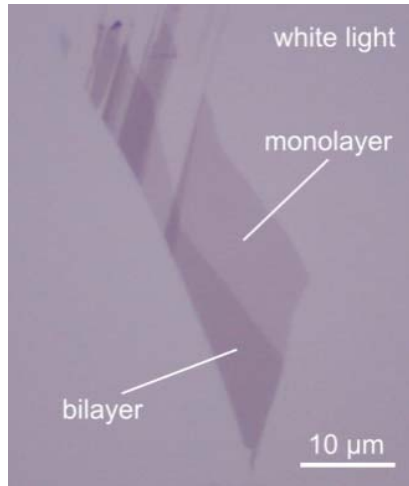
*Comportamento relativistico degli elettroni nel grafene*

**Coni di Dirac**



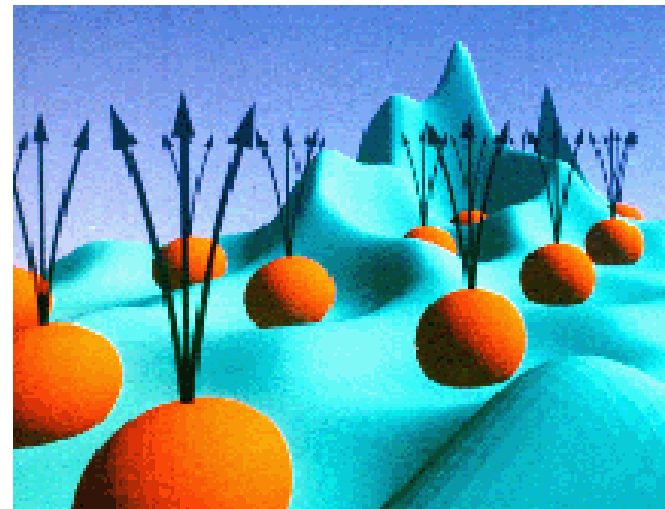


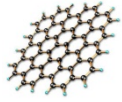
# La Fisica del Grafene e di altri sistemi quantistici



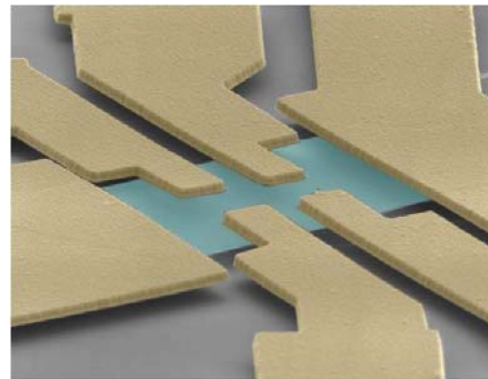
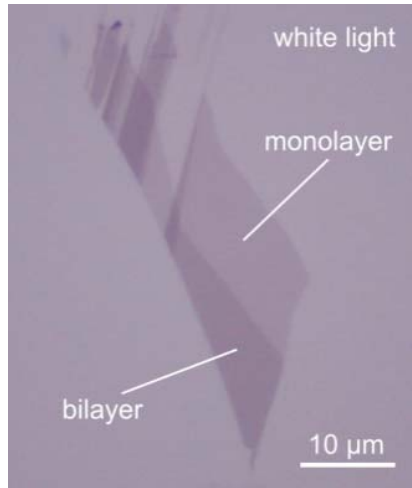
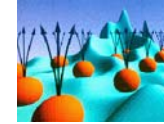
## Altre proprietà quantistiche:

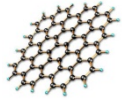
- *Elettroni relativistici (velocità  $c/300$ )*
- *Correnti di spin*
- *Stati con carica frazionaria*



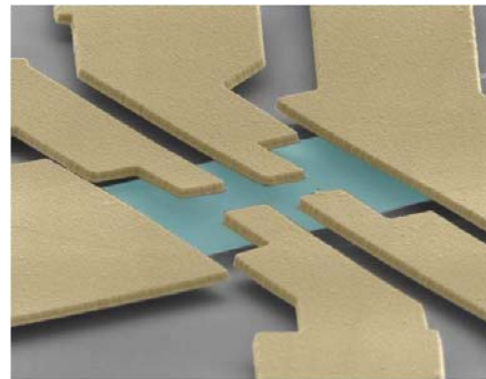
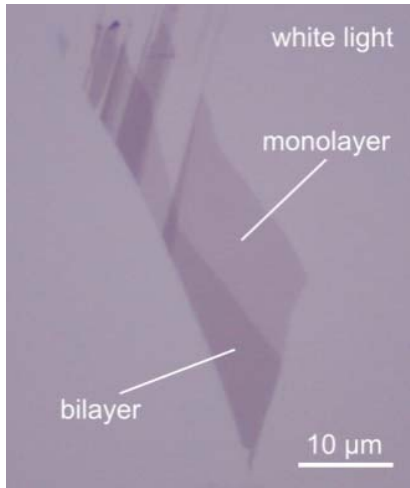


# La Fisica del Grafene e di altri sistemi quantistici

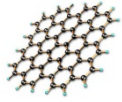




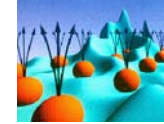
# La Fisica del Grafene e di altri sistemi quantistici





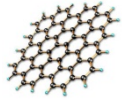


# La Fisica del Grafene e di altri sistemi quantistici

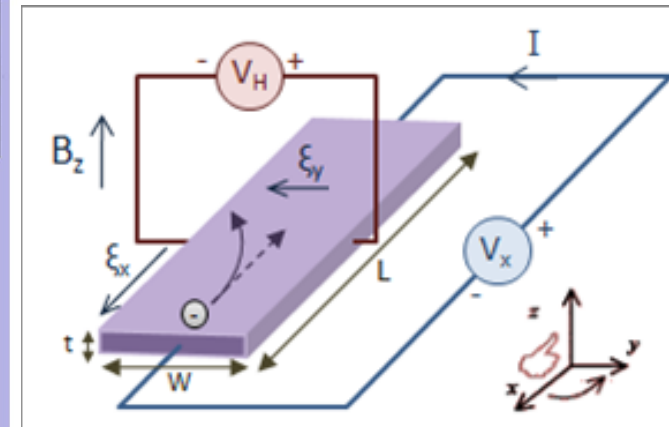
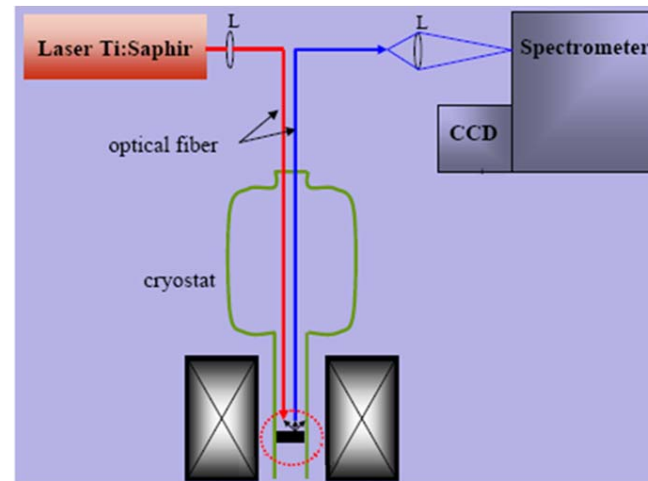
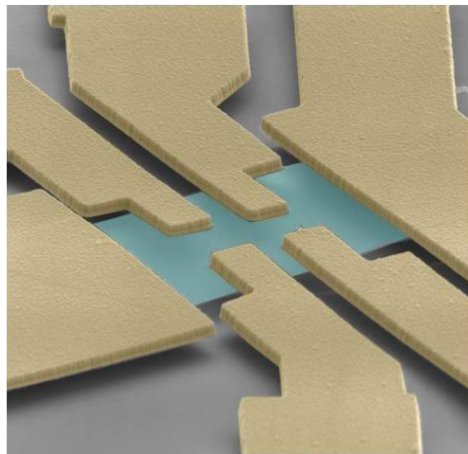
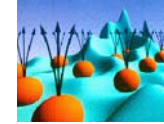


European Magnetic Field Laboratory





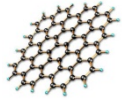
# La Fisica del Grafene e di altri sistemi quantistici



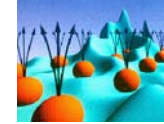
## *Condizioni sperimentali:*

- Temperature basse fino a 20 milli Kelvin
- Campi magnetici fino a  $5 \times 10^4$  Gauss

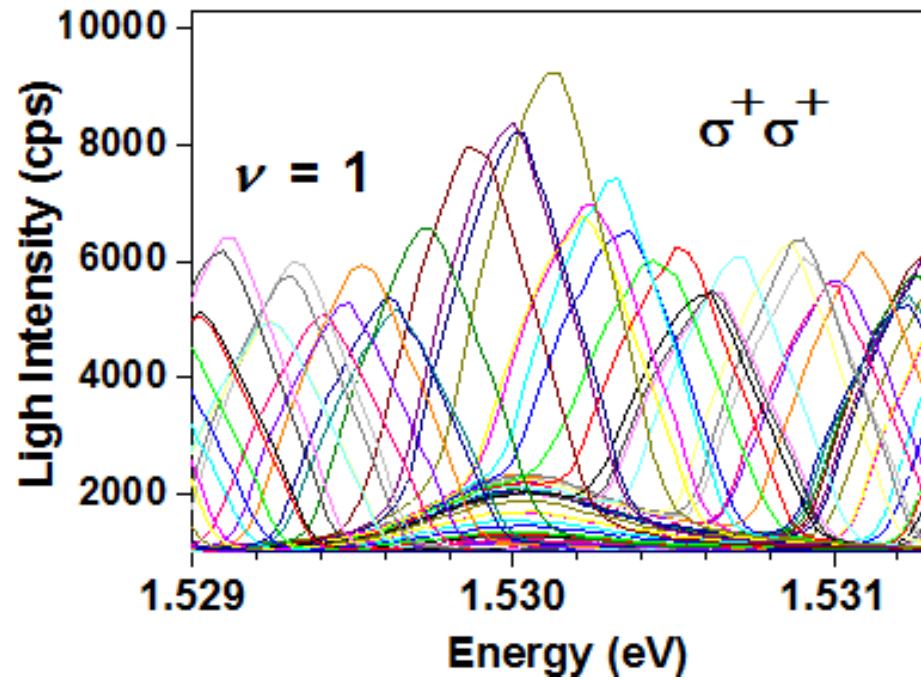




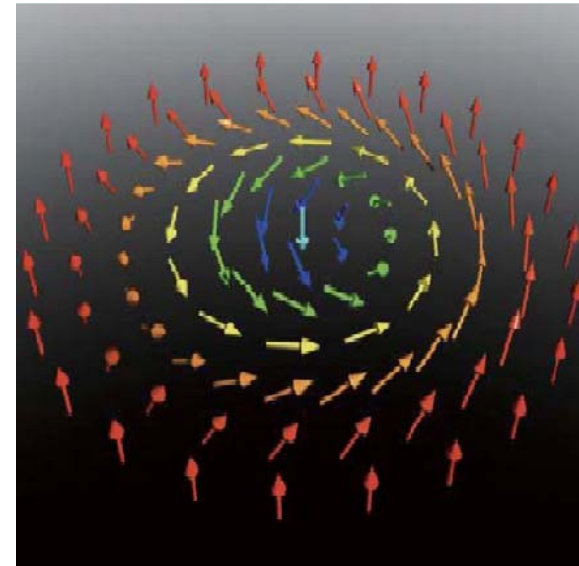
# La Fisica del Grafene e di altri sistemi quantistici

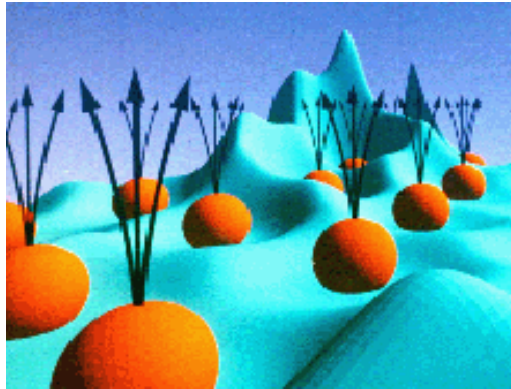


## *Scattering Raman e Rayleigh da parte degli spin*



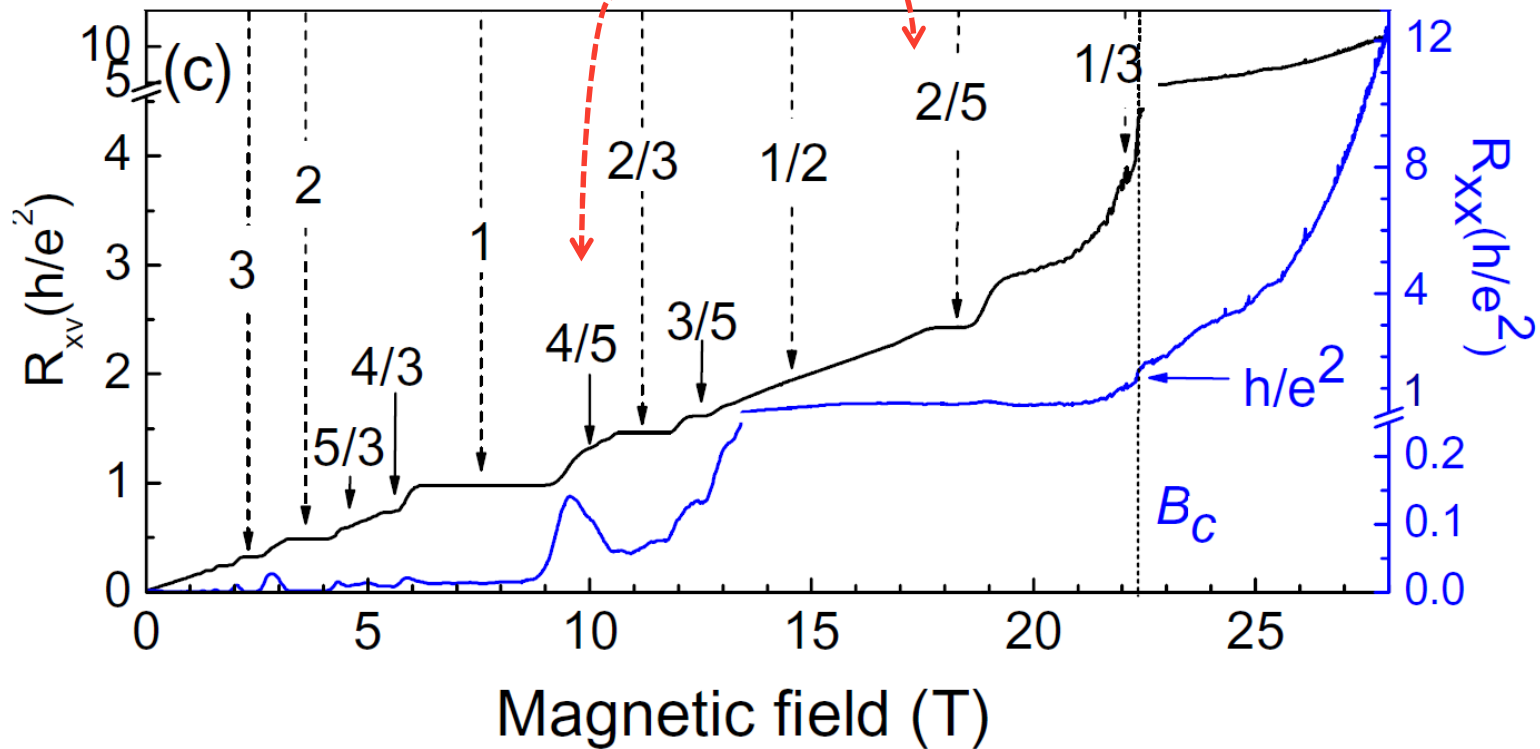
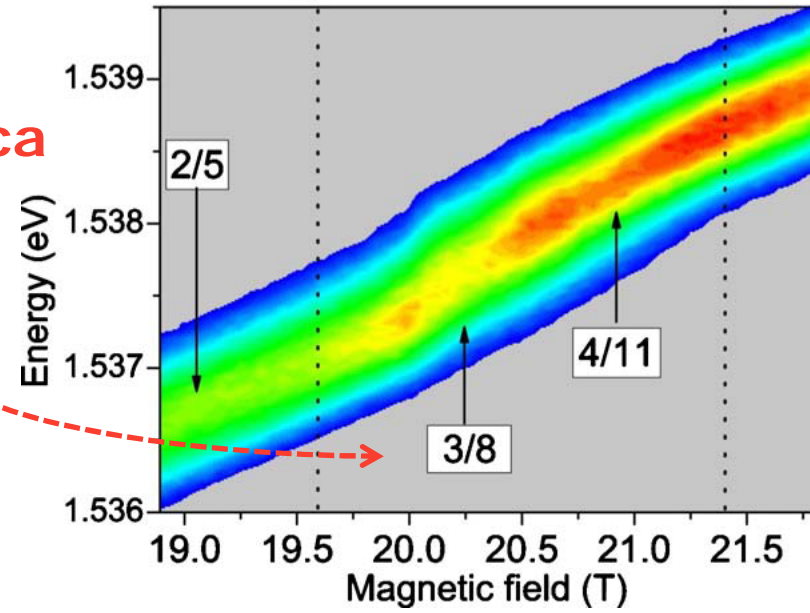
## *Skymioni*





$T \sim 40$  mK

Stati con carica frazionaria



**Per maggiori informazioni**

**<http://fisica.unipv.it/bellani/NDSC.htm>**