

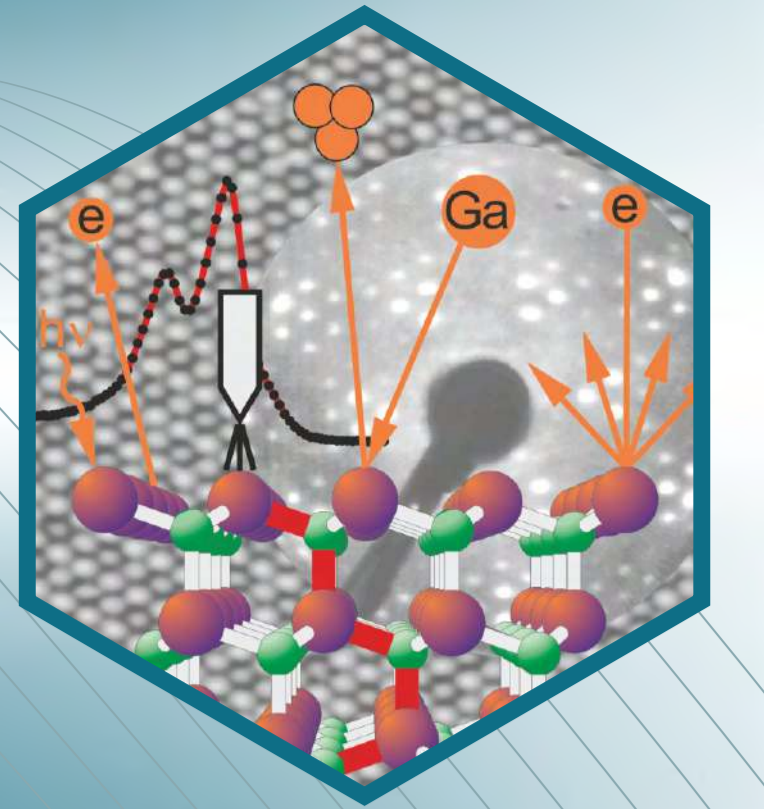


# Momentum microscopy of Pb-intercalated graphene on SiC: charge neutrality and electronic structure of interfacial Pb

Bharti Matta<sup>1</sup>, Philipp Rosenzweig<sup>1</sup>, Olaf Bolkenbaas<sup>1,2</sup>, Kathrin Küster<sup>1</sup>, and Ulrich Starke<sup>1</sup>

<sup>1</sup> Max-Planck-Institut für Festkörperforschung, 70569 Stuttgart, Germany

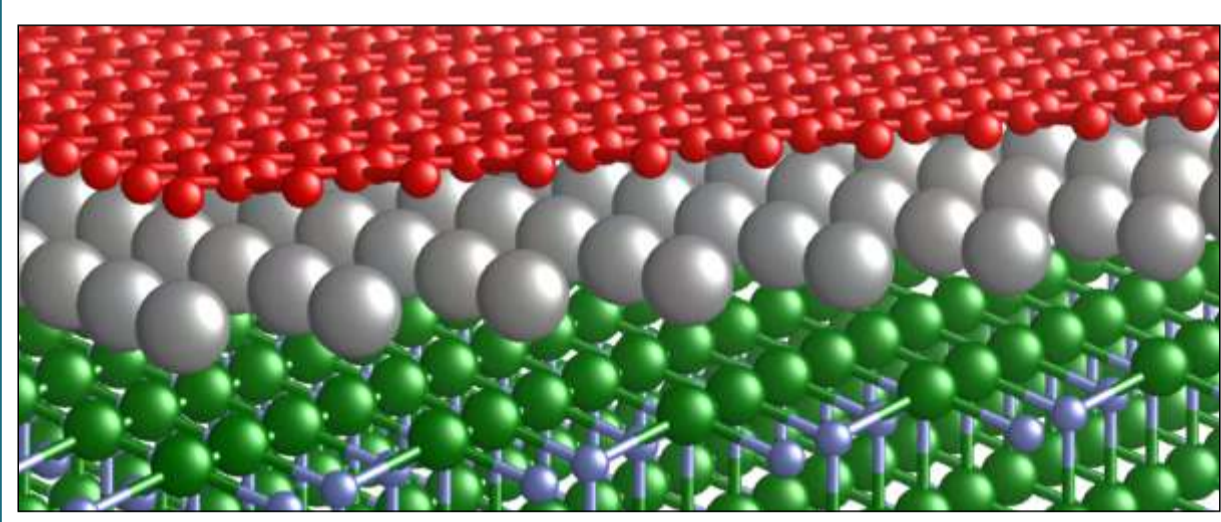
<sup>2</sup> Department of Applied Physics, Eindhoven University of Technology, 5600 MB Eindhoven, The Netherlands



b.matta@fkf.mpg.de

www.fkf.mpg.de/ga

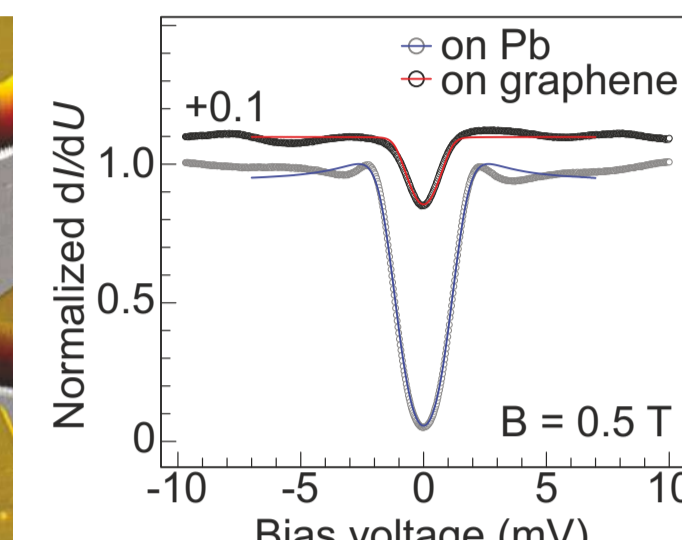
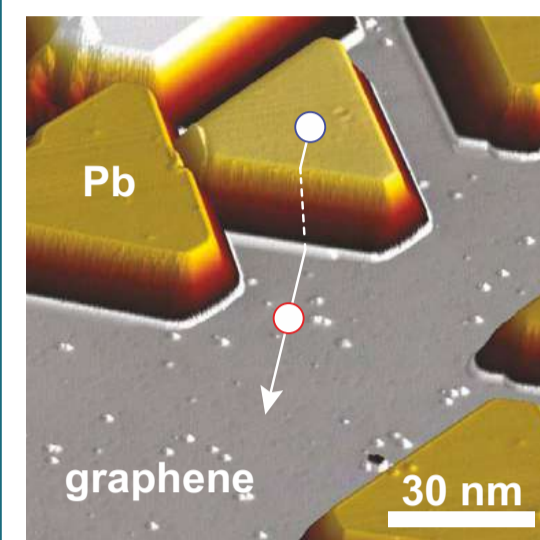
## Motivation



gr  
2D  
Pb  
SiC

Lead (Pb), a heavy element superconductor

Possible proximity superconductivity and spin-orbit coupling effects in graphene



Proximity superconductivity with a limited lateral extent in H-intercalated graphene on SiC was shown with Pb islands decorated on top. F. Paschke *et al.*, Adv. Quantum Technol. 3, 2000082 (2020).

Intercalation of Pb at the graphene/SiC interface could be a possible way to induce uniform proximity superconductivity in graphene.

I. I. Klimovskikh *et al.*, Spin-orbit coupling induced gap in graphene on Pt (111) with intercalated Pb monolayer, ACS Nano 11, 368 (2017).

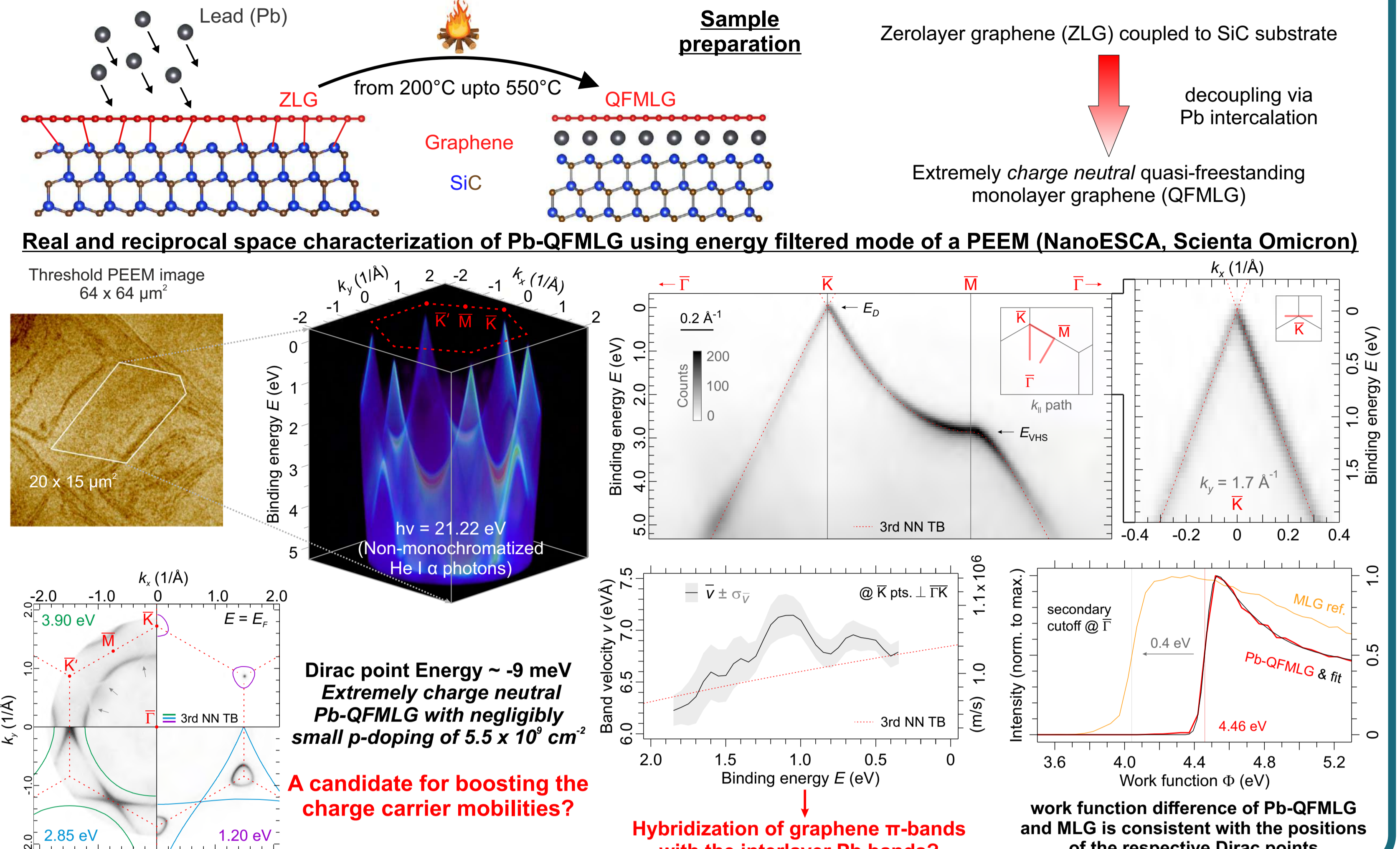
M. M. Otrokov *et al.*, Evidence of large spin-orbit coupling effects in quasi-free-standing graphene on Pb/Ir (111), 2D Mater. 5, 035029 (2018).

Proximity spin-orbit coupling effects were shown in Pb intercalated graphene on metallic substrates like Platinum and Iridium. However, it would be worthwhile to investigate these effects in graphene on SiC, which is technologically a more practical substrate.

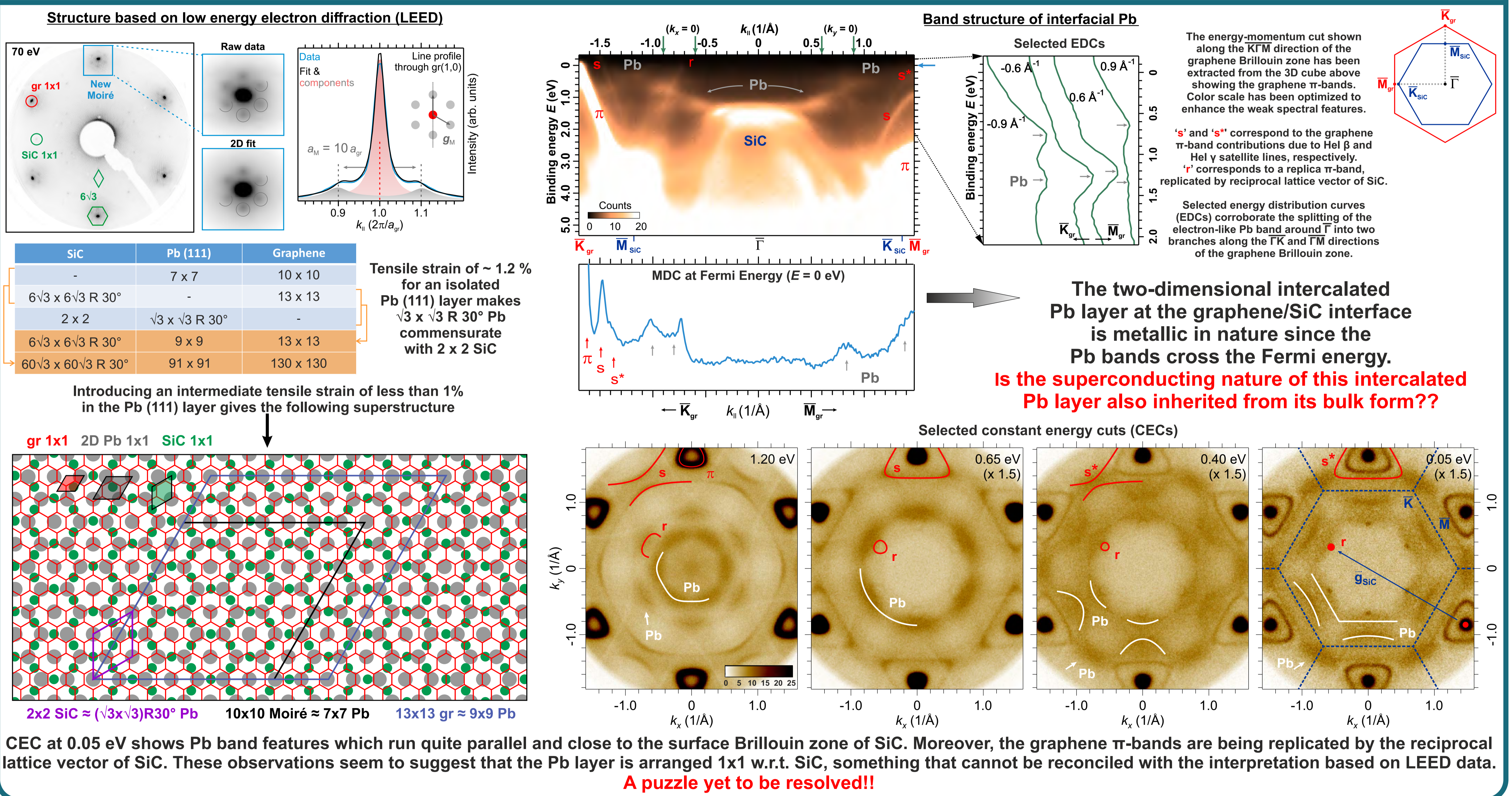
Recently, a non-trivial momentum space spin texture has been predicted for a Pb monolayer on SiC. K. Yang *et al.*, Momentum-Space Spin Antivortex and Spin Transport in Monolayer Pb, Phys. Rev. Lett. 128, 166601 (2022).

Detailed studies of the Pb intercalated graphene on SiC could further help corroborate such theoretical findings and lay a stronger foundation for further theoretical assessment of this system.

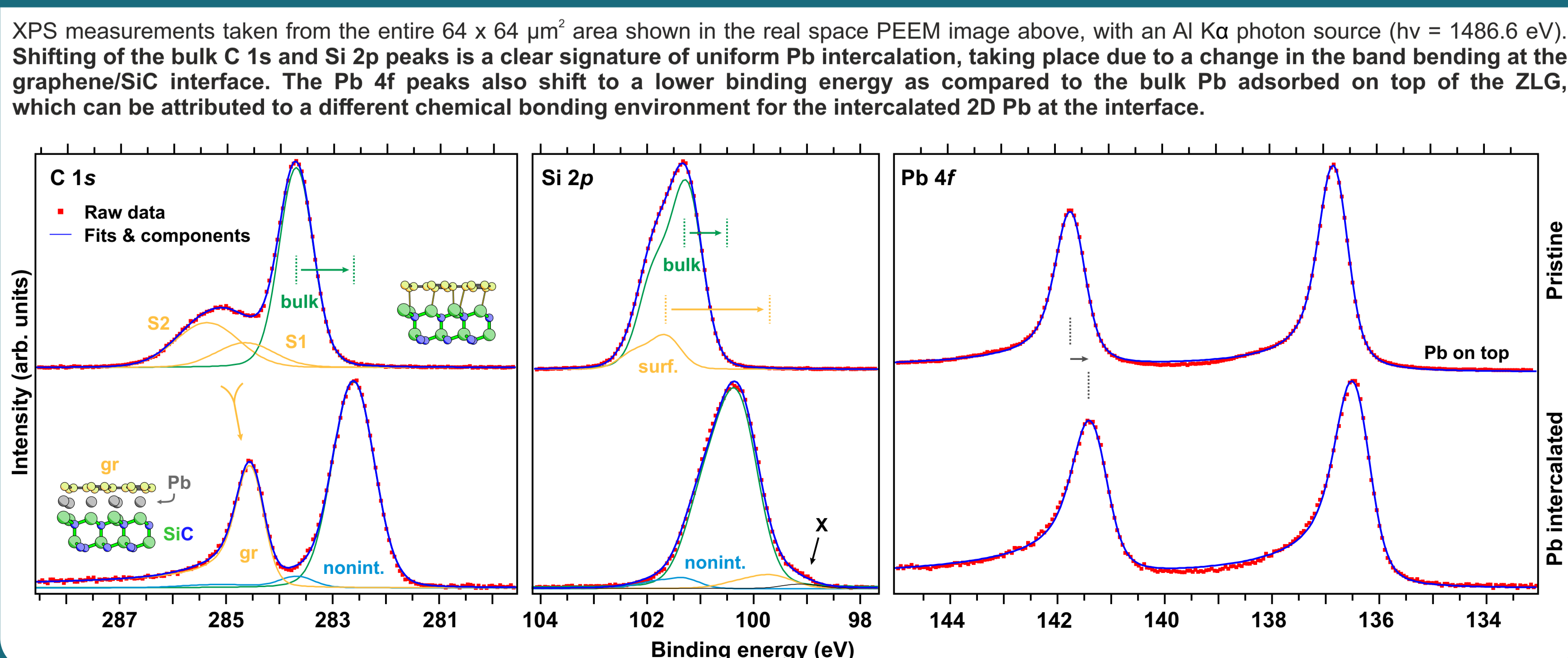
## Pb-intercalated graphene on SiC



## Structural interpretation of Pb-QFMLG and electronic band structure of intercalated 2D-Pb



## X-ray photoelectron spectroscopy (XPS)



## Summary and Outlook

- Pb intercalation of epitaxial zerolayer graphene on SiC yields practically charge neutral quasi-free-standing monolayer graphene.
  - The interlayer Pb bands cross the Fermi energy, showing the metallic nature of the intercalated 2D-Pb layer.
- Future aspects involve:
- Finding the connection between the LEED Moiré pattern and the electronic structure of Pb-QFMLG: synchrotron ARPES measurements at different photon energies.
  - Low temperature transport measurements to look for signatures of superconductivity.
  - Spin-resolved ARPES measurements to seek signatures of spin-orbit coupling effects.
- B. Matta *et al.*, Physical Review Research 4, 023250 (2022)