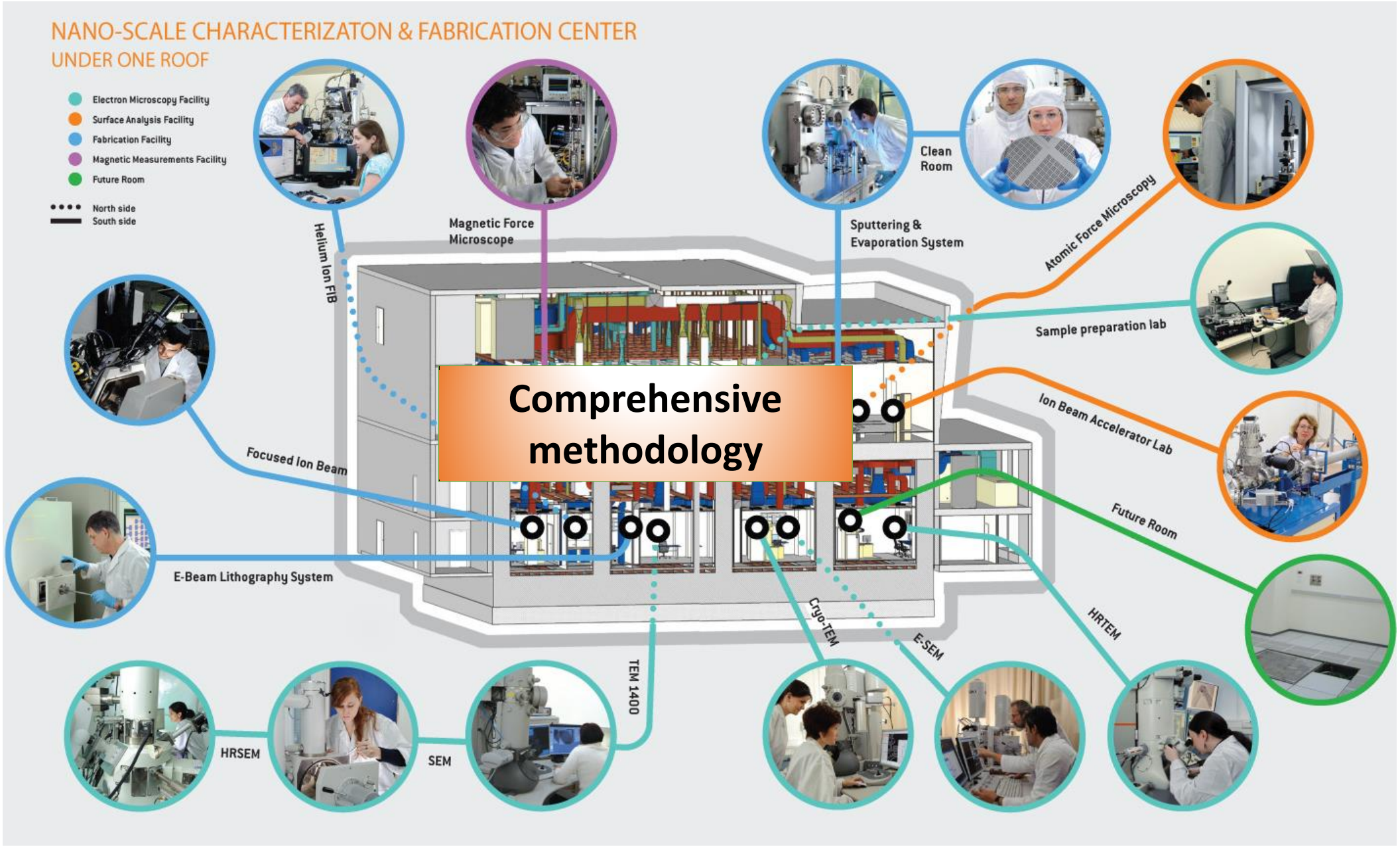
Equipment infrastructure



Ion beam specifications:

- Accelerator terminal voltage tunable from 80 kV to 1.7 MV (source injection voltage is up to 30 kV).
- H^+, He^+ and He^{++} beams in standard configuration with maximum energies of 3.4 and 5.1 MeV, respectively.
- ^3He, ^{15}N and ^{16}O beams are also available
- Beam spot size is 1 mm - 4 mm.
- Beam current on target up to a few tens to hundred nA depending on ion species and energies.

- Test of electrical properties during ion beam irradiation
- Ion Beam Induced conductivity (IBIC) measurements
- Cryogenic sample stage, liquid-nitrogen cooled (to reduce beam damage of organic samples)
- Ion Beam Analysis

1.7 MV Tandem Pelletron Accelerator
Model 5SDH (NEC, USA)

Previous field experience

1. CRP F11020: Ion beam induced spatio-temporal structural evolution of materials: Accelerators for a new technology era
2. Collaboration with A. Haran (SRNC) and I. Shlimak (BIU) “Defect formation mechanisms in irradiated graphene”

Dr. Olga Girshevitz, BINA, Israel

Ion Beam Analysis (IBA) laboratory

Why the use of Ion Accelerators for Materials R&D?

- **Growing demand for new materials with tailored properties in all fields of applied science**

- **Ion beams – a dual purpose: provide the means to modify and to characterise materials**

- **Ion Beam Modification: precise control of composition; location; non-equilibrium processes; etching; single ion implantation; radiation damage;**

- **Ion Beam Characterisation: X-rays, Gamma rays; Scattered & recoil particles; (PIXE; PIGE; RBS; ERDA; NRA; IBIC; IBIL)**

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Defect engineering of 2D materials by ion beam technology

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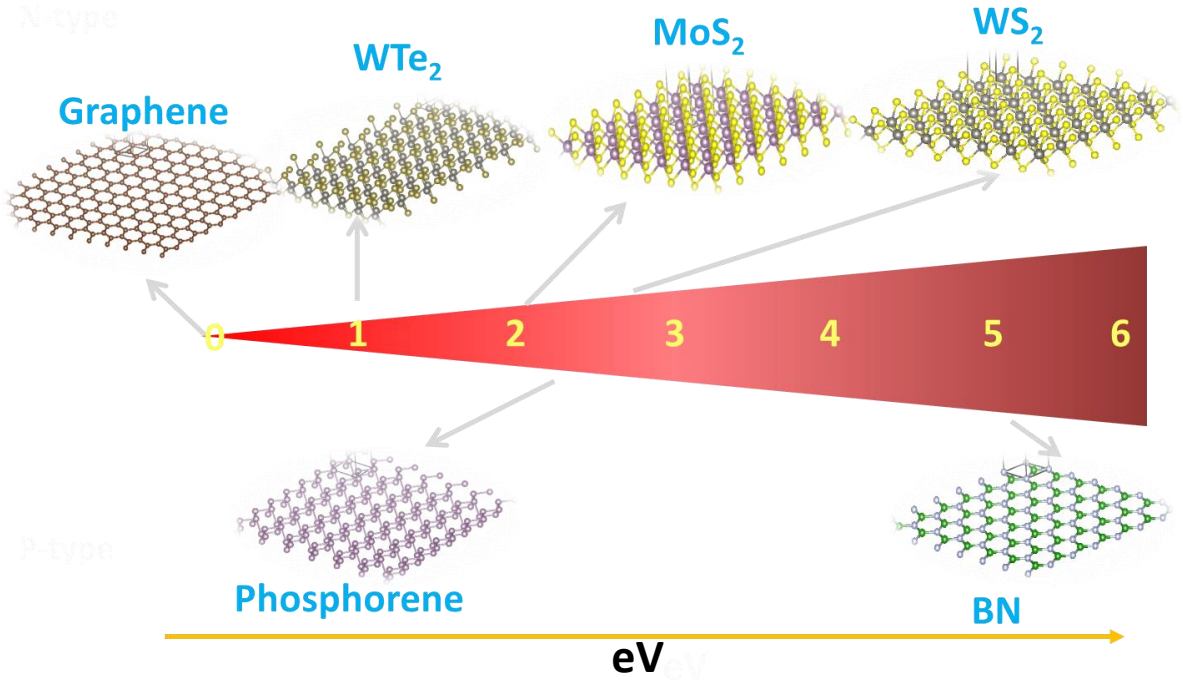
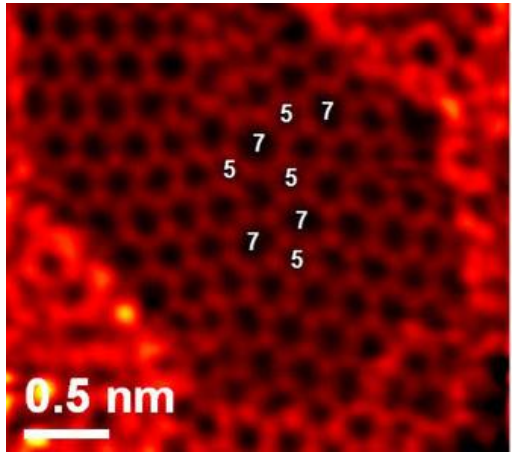
Motivation:

- ability of the 2D lattice to reorganize its structure near vacancy,
- outstanding thermal (10^6 W/m/K) and electrical transport (carrier mobility ~10^6 $cm^2/s/V$
- Radiation Hardness - Space applications of graphene based devices





Monolayer graphene after 30 keV He^+ irradiation
Sci. Rep. 4 (2014) 6334

Radiation damage in inorganic 2D materials will be quite different from uni-element material such as in graphene
- more complex layered structure and multi-element chemical composition

Methodology and contribution of different groups in the proposed work

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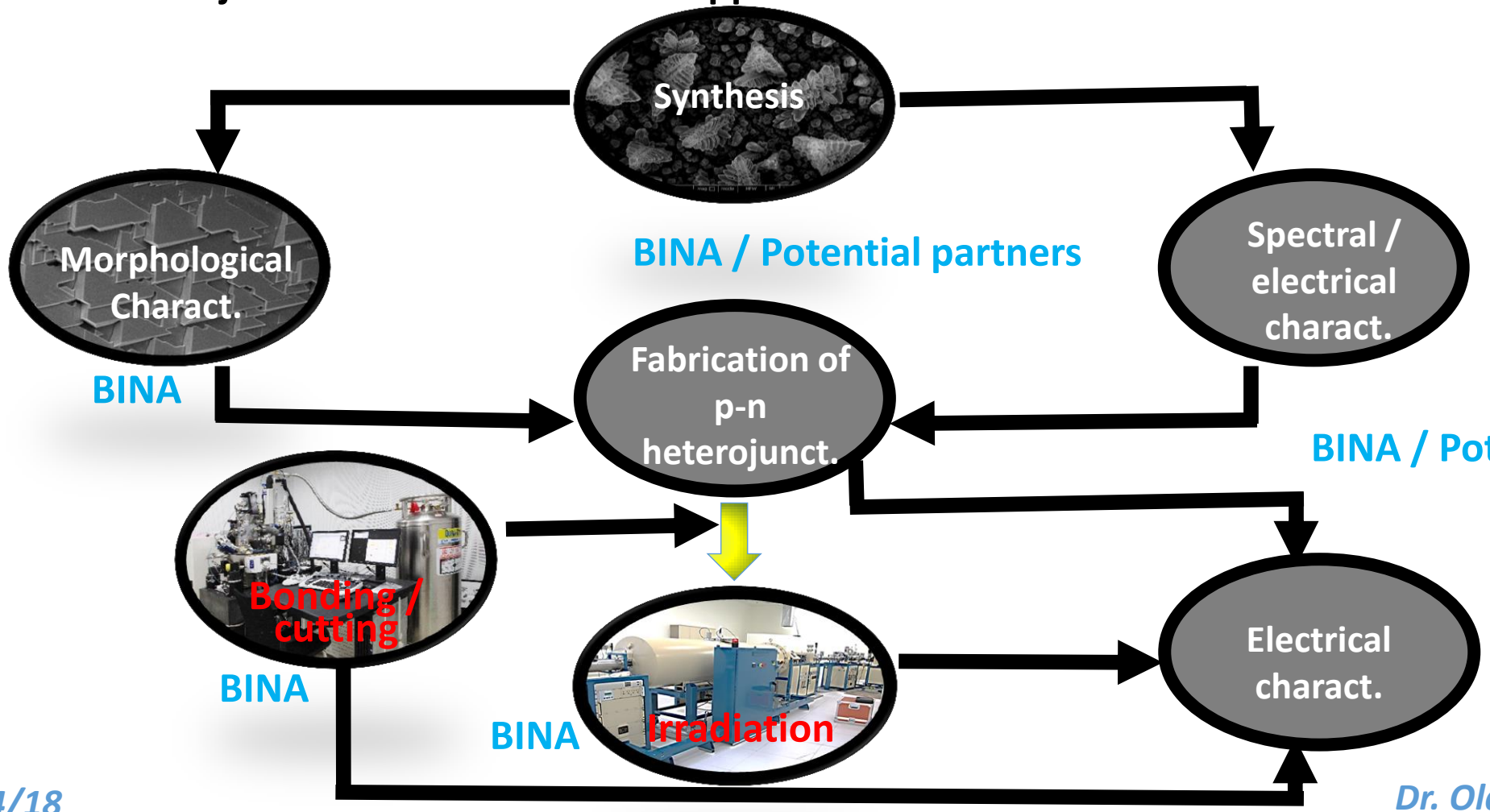
Objective

Ion Beam tailoring of structural, optical and electrical properties of mono-and multilayered 2D Chalcogenides and their heterojunctions for novel device applications.



Dr. Olga Girshevitz, BINA, Israel

Defect engineering of 2D materials by ion beam technology

What are the common points for us and other groups in this project

Generate data and validation of defects evolution results for both suspended and on-substrate few layers 2D materials by theoretical calculations

1. **Systematic comparison of the electrical and optical properties of Graphene *vs* other 2D layered materials (MoS_2? WS_2?. CuS_2?...) before and after irradiation**
2. **Potential collaboration on irradiation of other samples (2d material devices and radiation dosimeters)**
3. **Potential collaboration with other 2D materials groups**