Si-MWPC tracking and momentum reconstruction for SRC-2022 experiment

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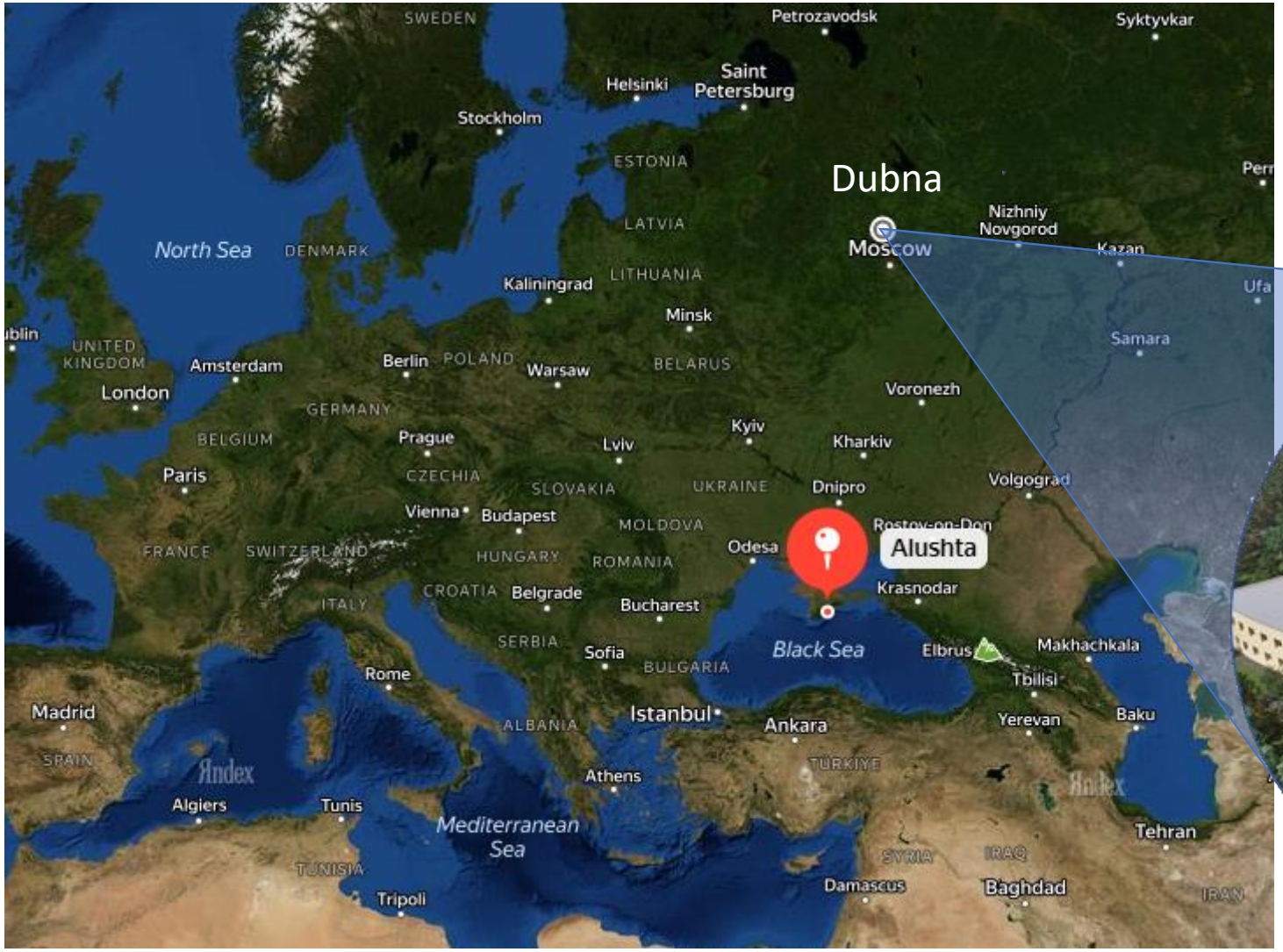
The XIV Annual Scientific Conference of Young Scientists and Specialists "Alushta-2025"

Where?

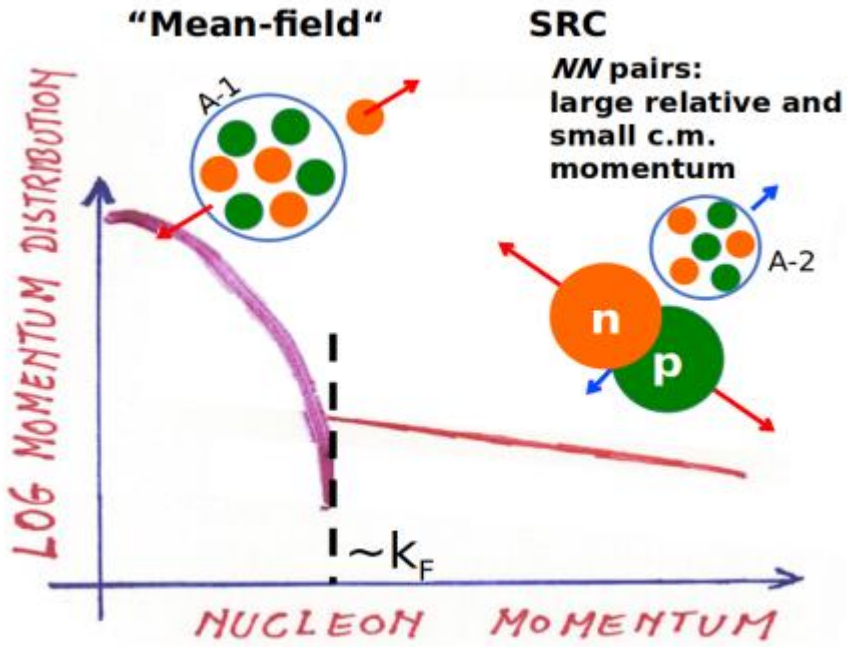
2018 – 1st SRC experiment at BM@N

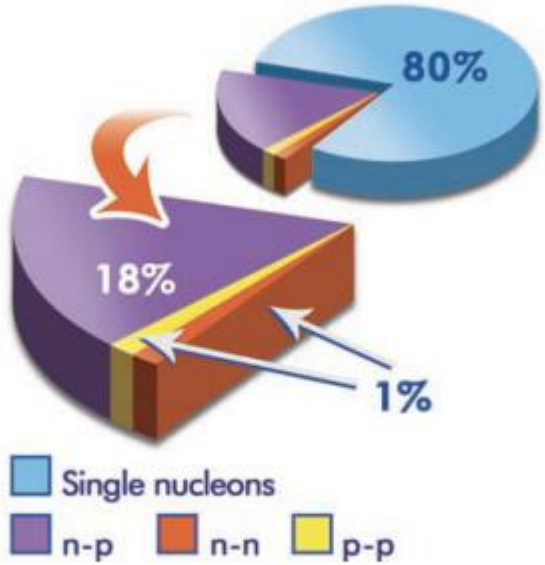
2022 – 2nd SRC experiment at BM@N

The next experiments are planned at HyperNIS



What?





SRC: n-p dominance

A. Tang et al., Phys. Rev. Letters (2003)
E. Piasetzky et al., Phys. Rev. Letters (2006)
R. Shneor et al., Phys. Rev. Letters (2007)
R. Subedi et al., Science 320, 1476 (2008)

MF: $^{12}C(p,2p)^{11}B$

SRC: $^{12}C(p,2p)^{10}B,^{10}Be$

Feeling sad and lonely? Become a nucleon! After all, 80% of nucleons are free and looking for their pair!

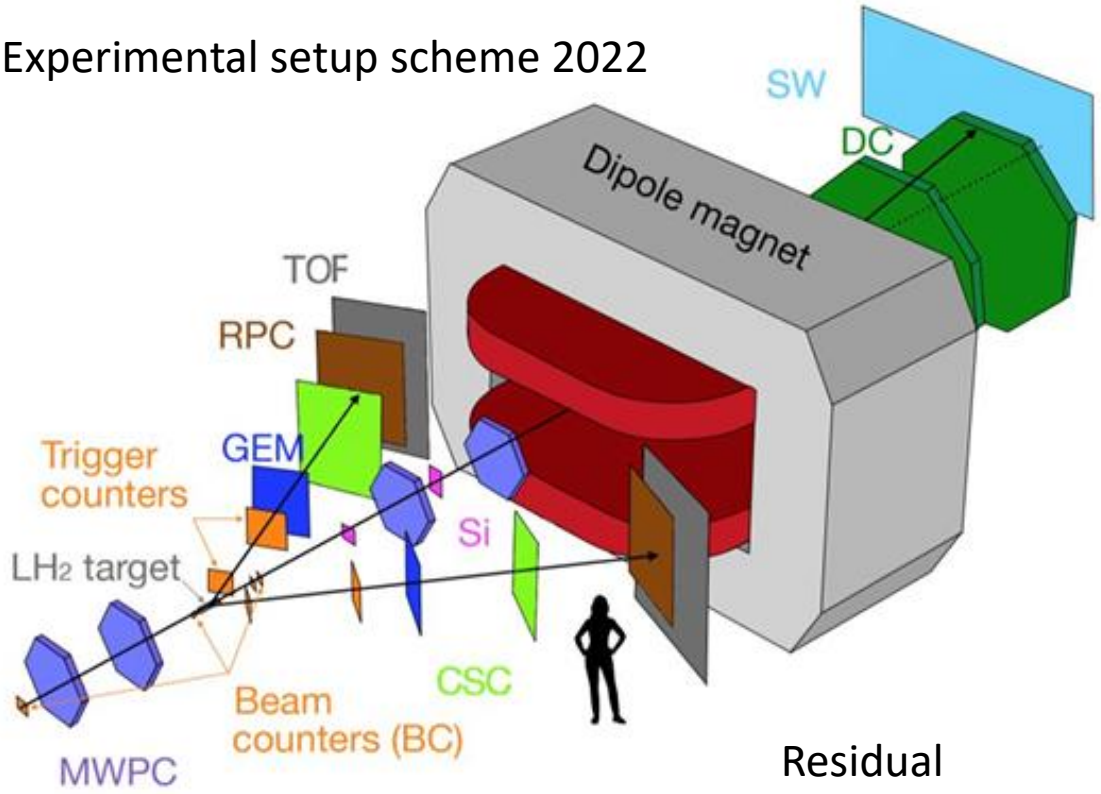
How?

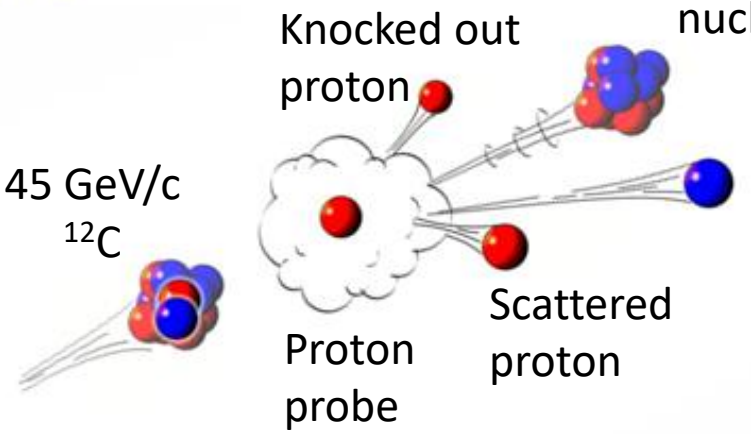
45 GeV/c **^{12}C beam** momentum
(3.7 GeV/c/nucleon)

Inverse kinematics:
✓unstable nuclei
✓pmiss, pn
✓p probe:
  ✓larger cross-section
  ✓(compared to e-scattering)
✓fragment ID + pA-2

Main goal: reactions cross section measurements and studying fragment properties

Experimental setup scheme 2022





Breaking news: Atoms have started studying humans for the first time. It turns out that 99% of people can't pass through walls, but 1% can — by breaking them down.

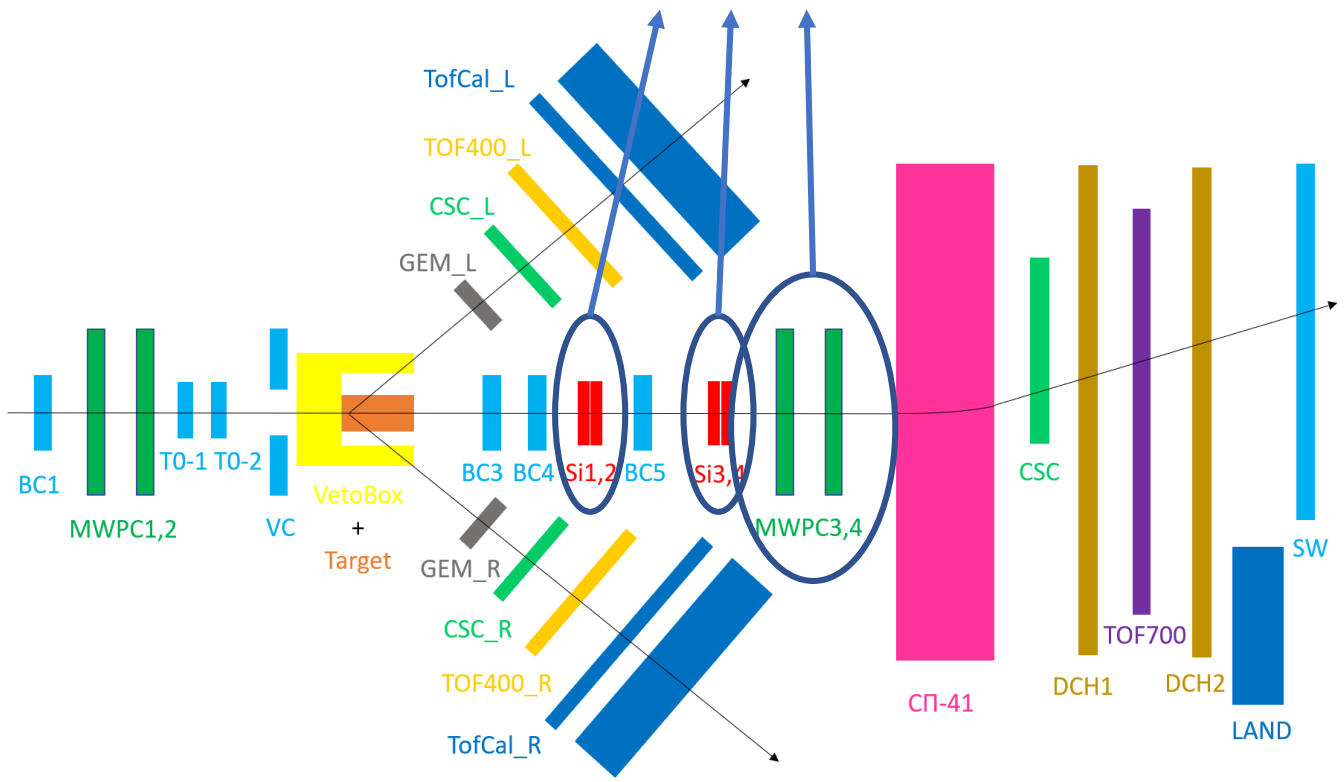
Upstream tracks

Input:
- Si digits (clustered points in local coordinate system)
- MWPC3, 4 track segments (tracks combined in the chamber itself)

alignment ↓ tracking

Output:
- UpStream Tracks (X, Y, Z, Tx, Ty)
- Coordinate resolution at target center ~1mm
- Angular resolution at target center ~0.6mrad
- Efficiency 83%

Detectors used for tracking: Si1-4, MWPC3,4



Momentum reconstruction with MDF

Step 1:

Simulation

Input:

Wide beam + wide momentum

Unreacted nuclei

Track before magnet

Track after magnet

Known momentum

Output:

P/q (X_0, Y_0, Z_0, Tx_0, Ty_0, X_1, Y_1, Z_1, Tx_1, Ty_1)

$Tx_{\text{before magnet}}$ (X_0, Y_0, Z_0, Ty_0, X_1, Y_1, Z_1, Tx_1, Ty_1)

Step 2:

Momentum reconstruction

Input:

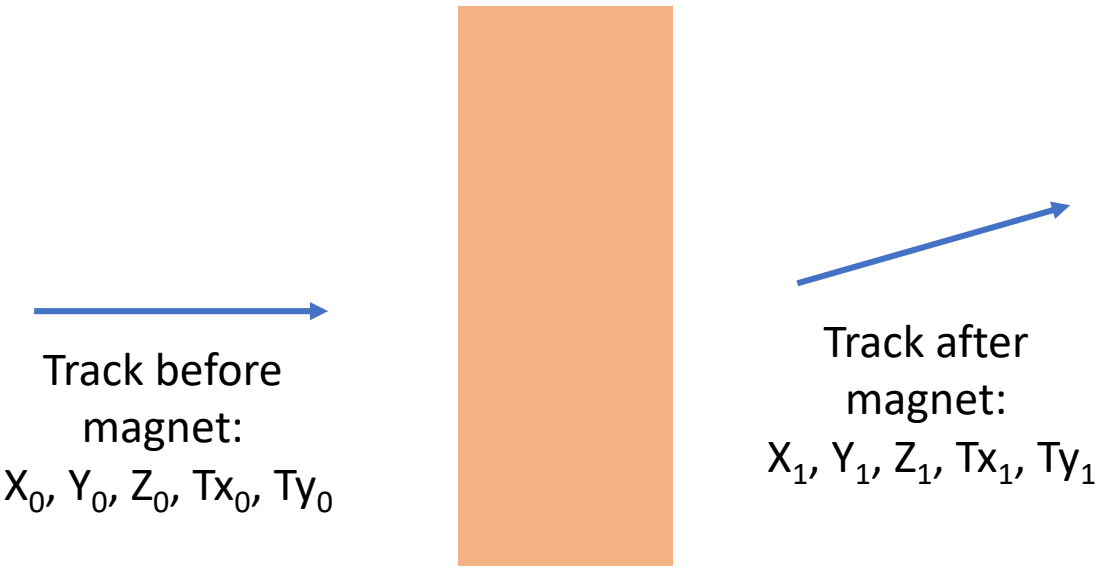
Track before magnet

Track after magnet

Matching conditions (ΔTx, ΔTy)

Output:

P/q

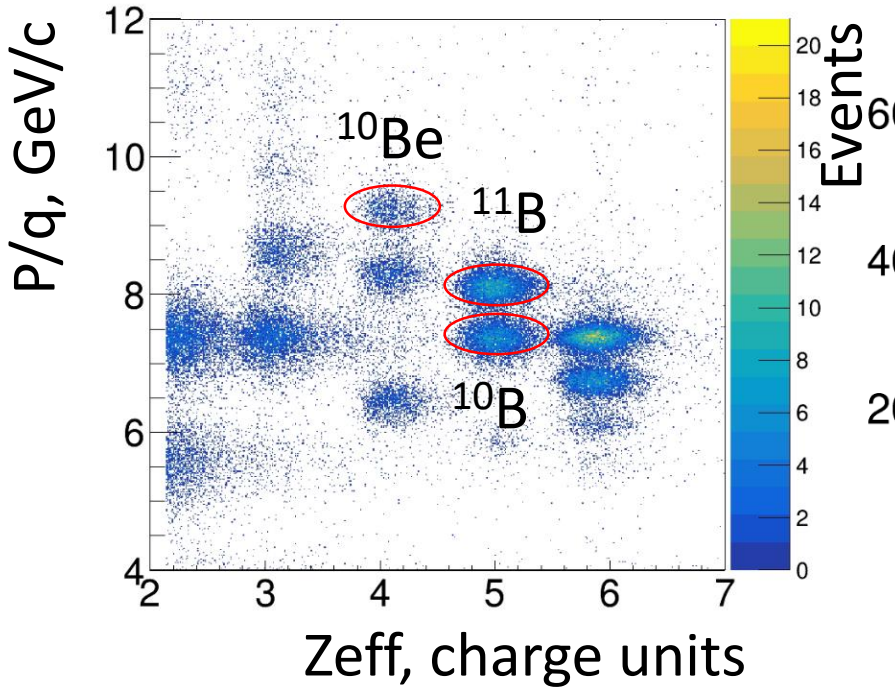


— What's in the black box?
— A cat.
— And what state is it in?
— Hopefully not in the ground!

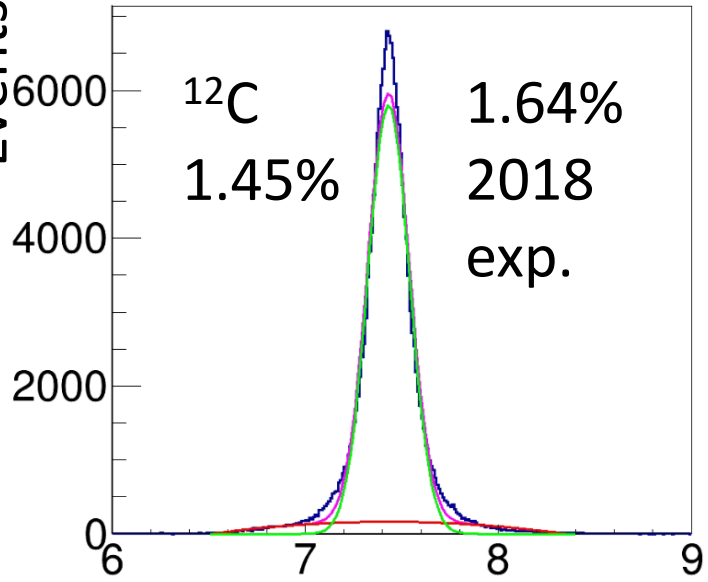
Heavy-fragment identification

MF: $^{12}C(p,2p)\ ^{11}B$

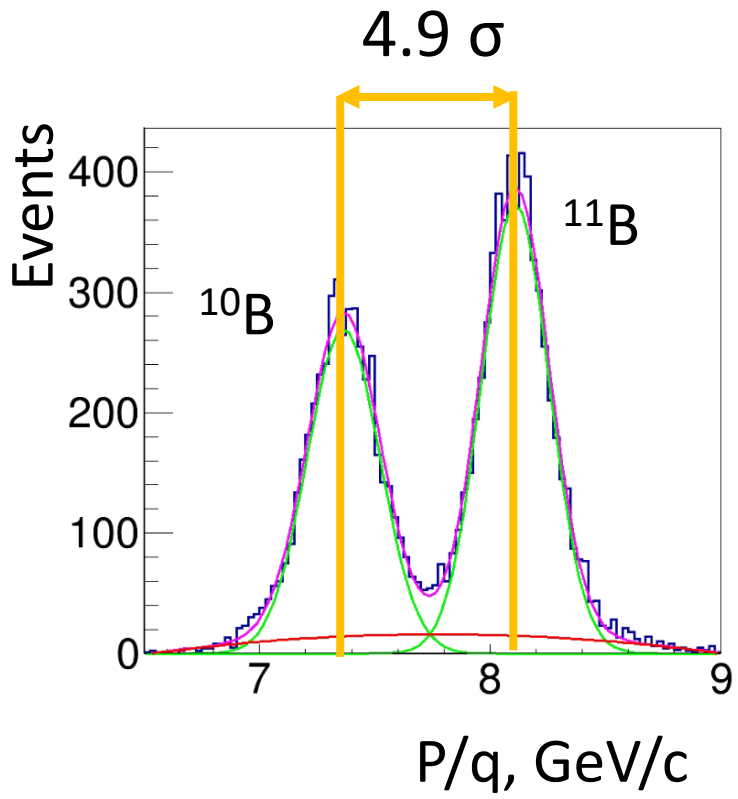
SRC: $^{12}C(p,2p)\ ^{10}B,^{10}Be$



Fragment identification



Beam momentum resolution



Boron isotopes separation

Conclusion and summary

- Tracking berofe magnet 
- Fragment momentum reconstruction 

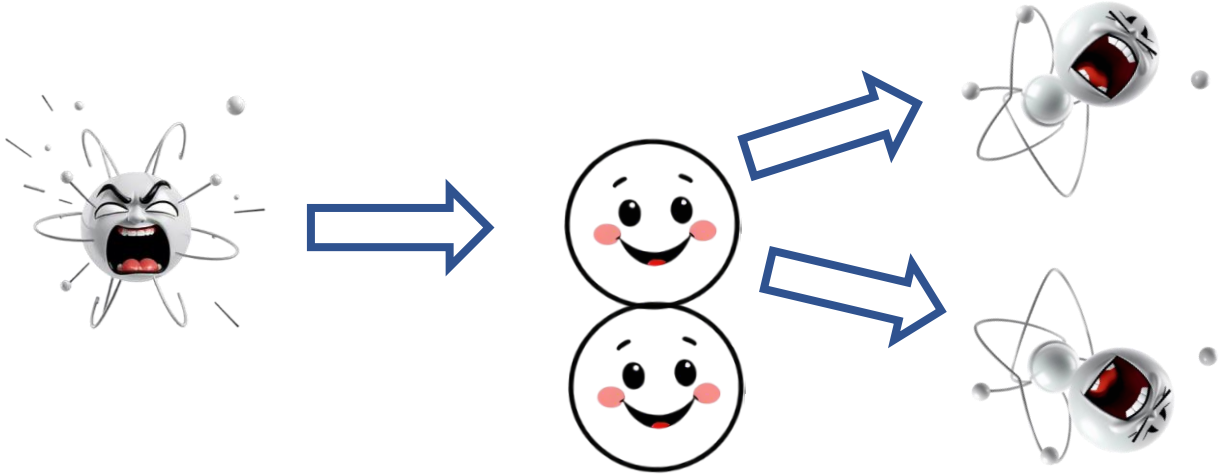
Current analysis status:

Nucleon momentum before interaction = Fragment momentum +
+ Protons momentum in arms – Target momentum

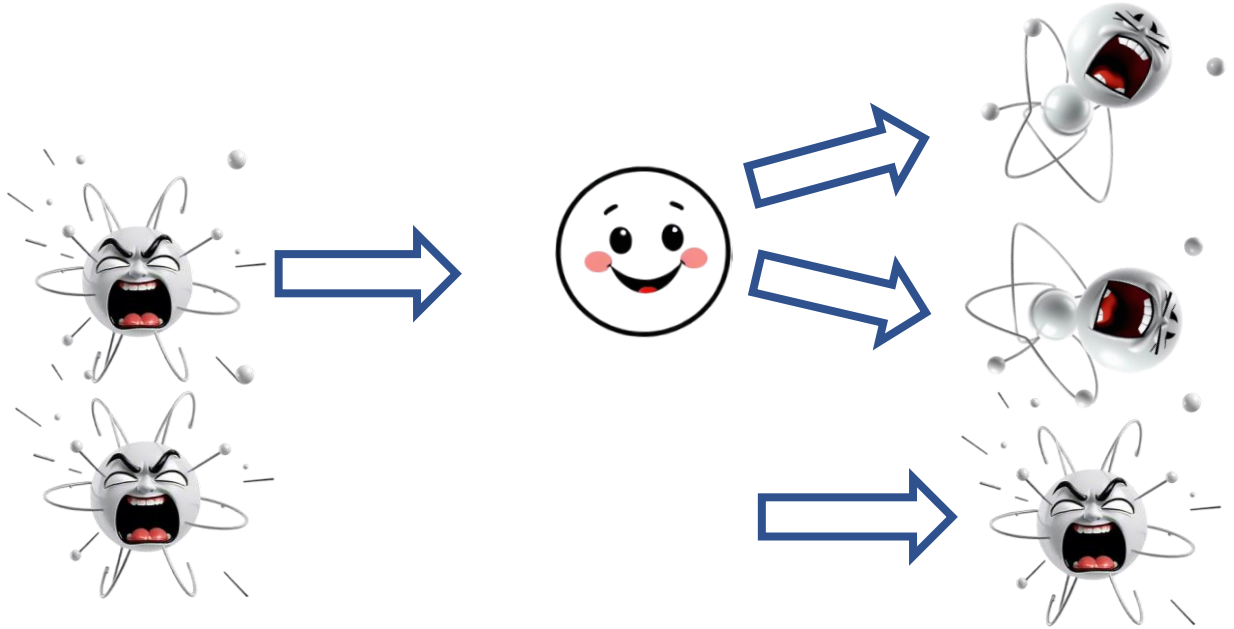
The cat escaped from the box, adding some text to my presentation; apparently, it was in an excited state

Thank you for attention!

SRC in direct kinematics



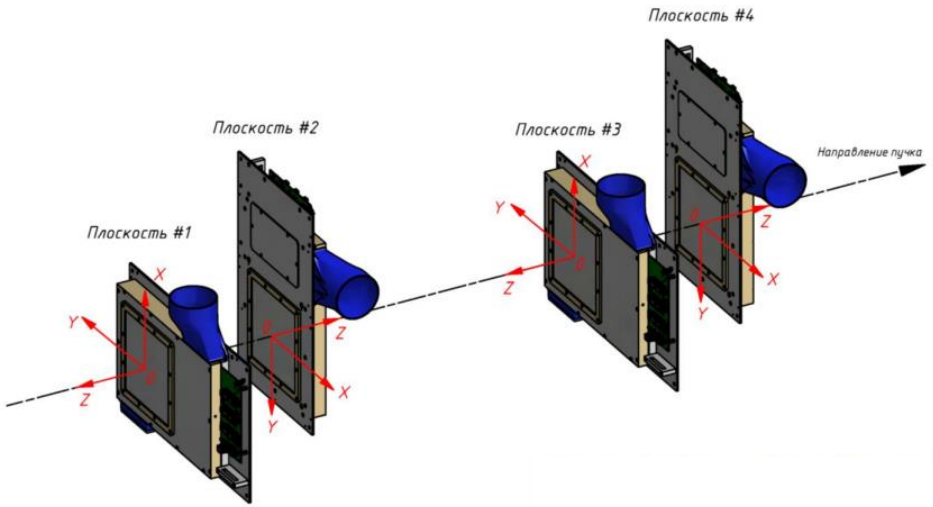
SRC in inverse kinematics



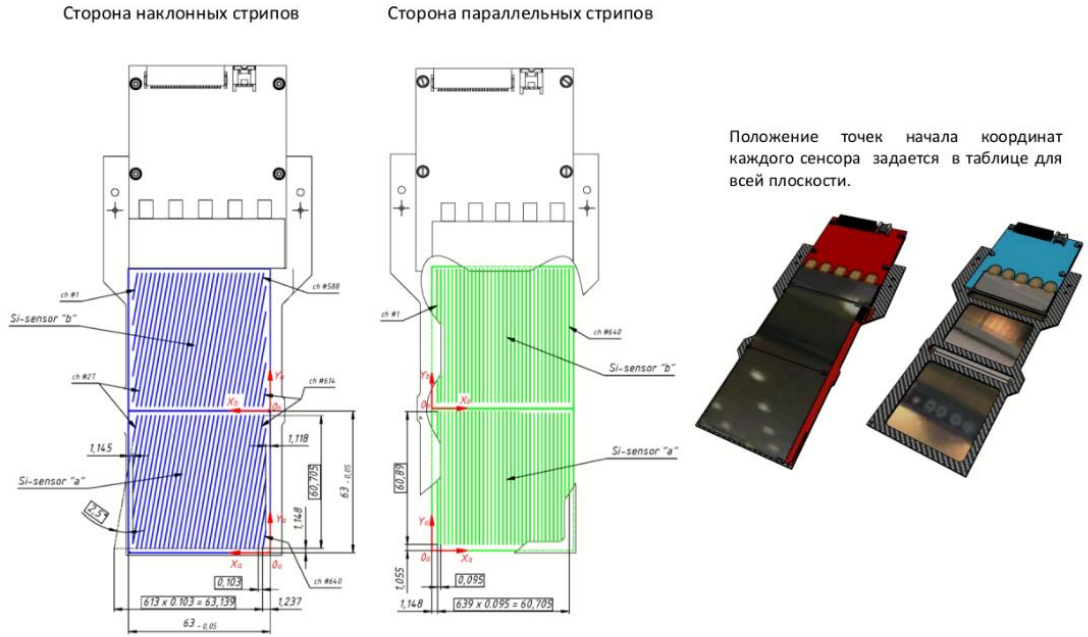
BackUp

Геометрическое выравнивание кремниевых детекторов.

Ориентация 4-х плоскостей в сеансе SRC-2021



Положение стрипов в Si-сенсорах модуля (SRC-2021).



Для каждой станции восстанавливаются X и Y координаты, образующие хиты.

JINR pilot experiment in 2018

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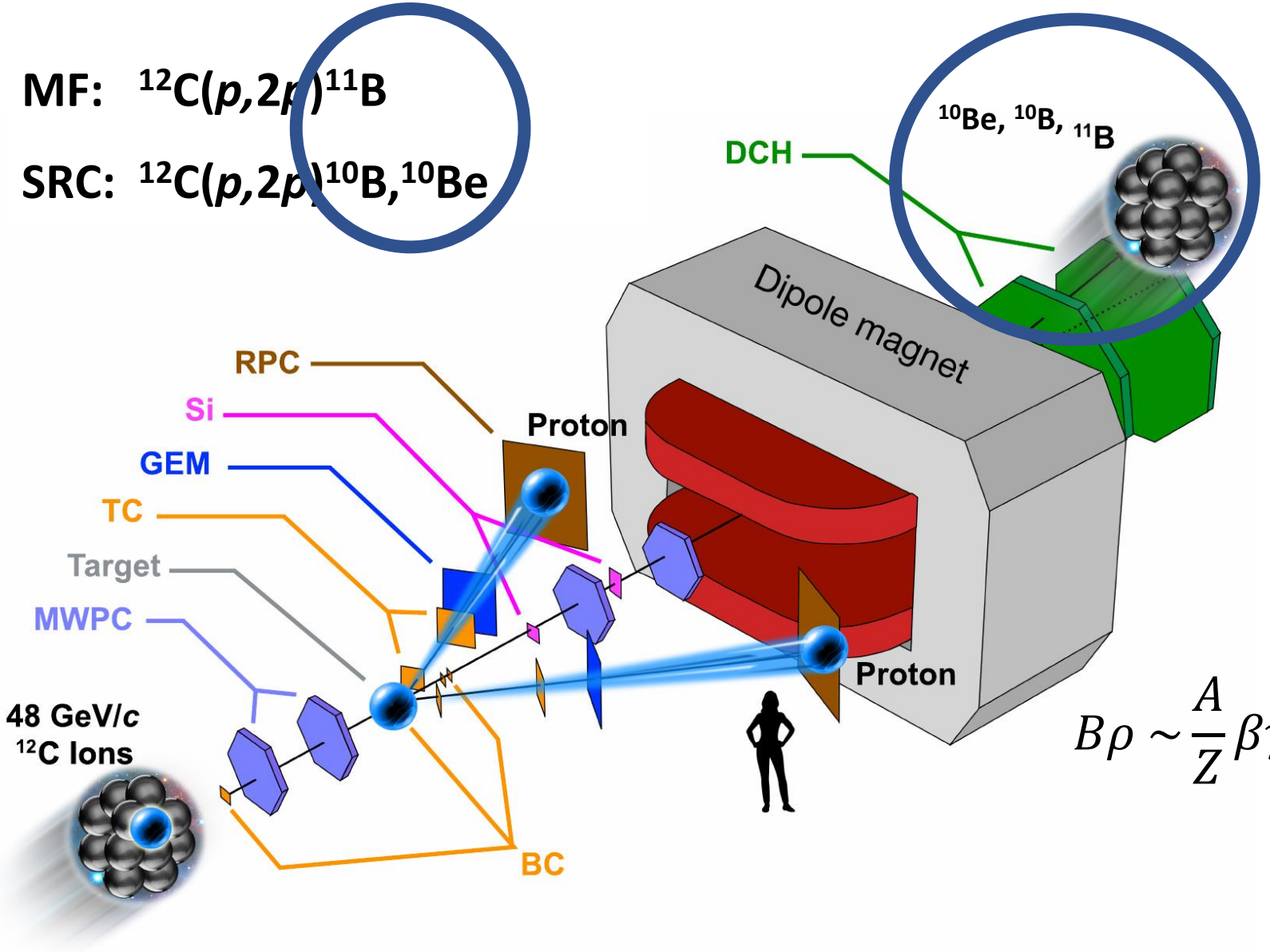

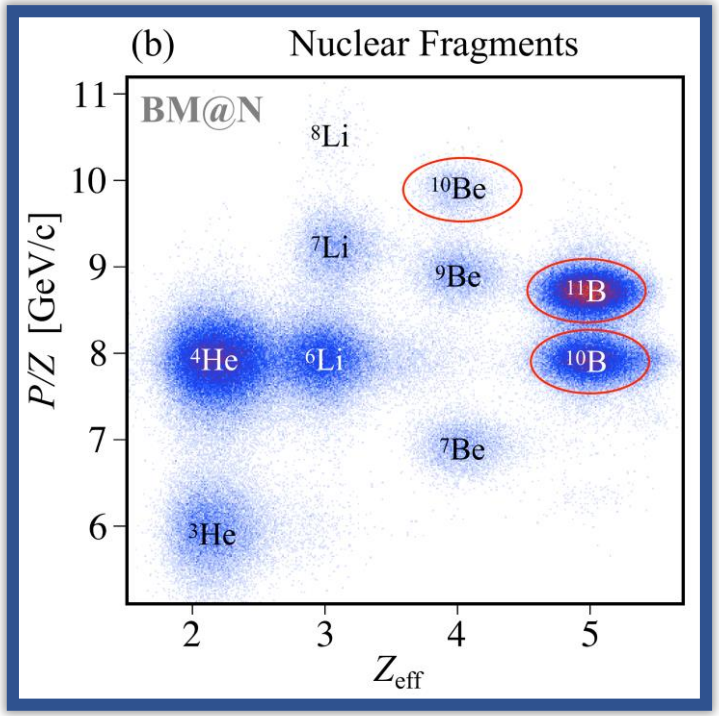

$$B\rho \sim \frac{A}{Z}\beta\gamma$$

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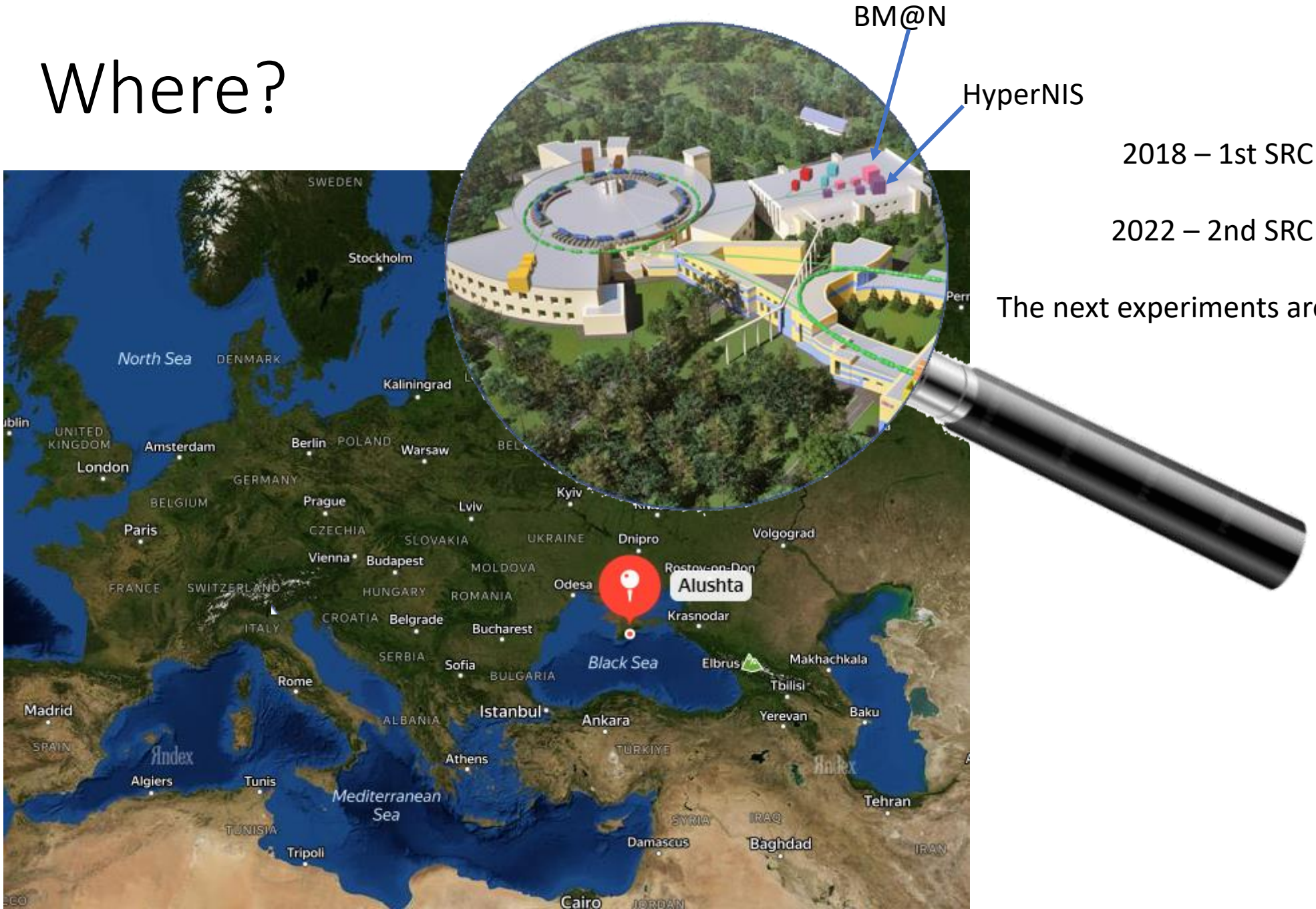

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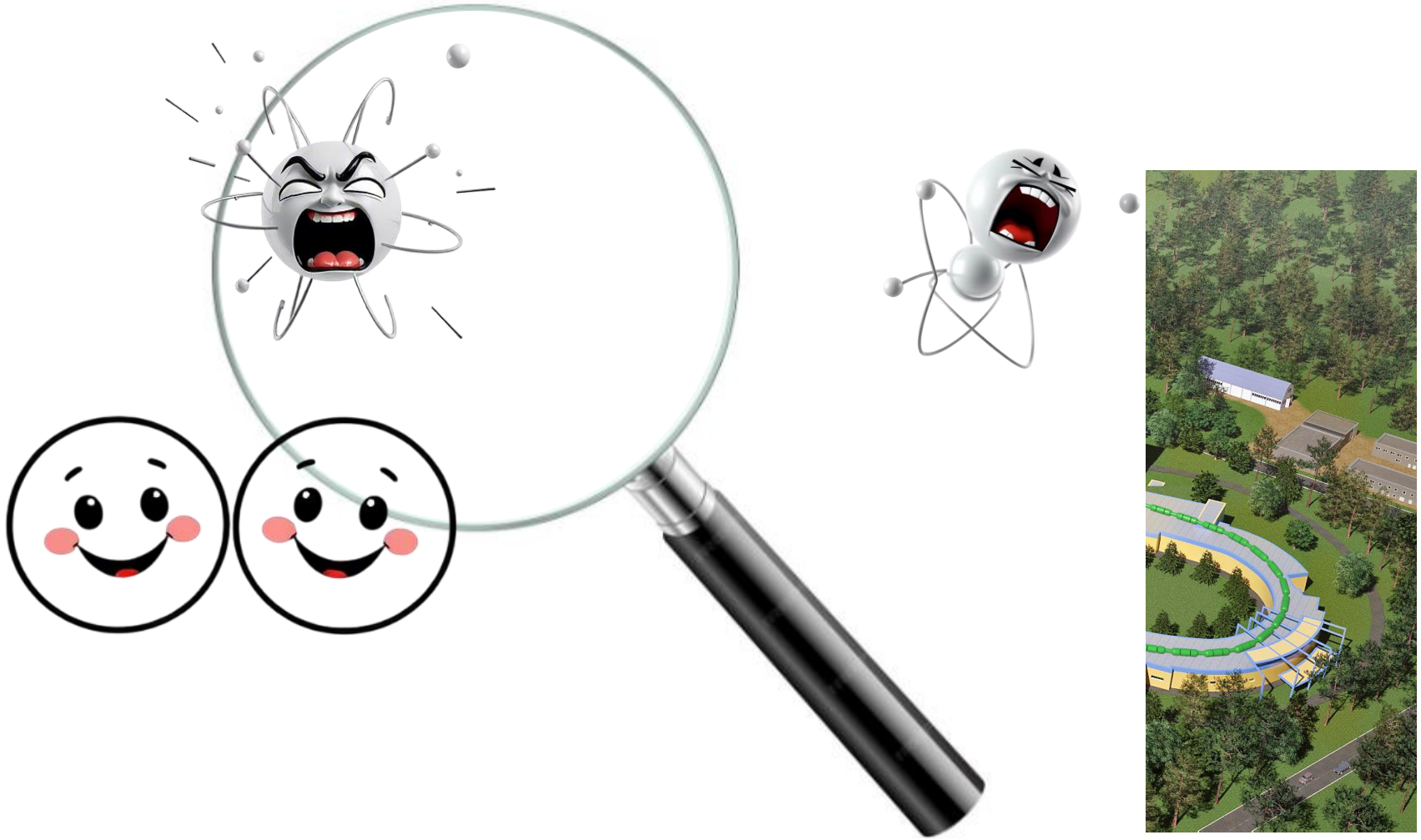


Nica