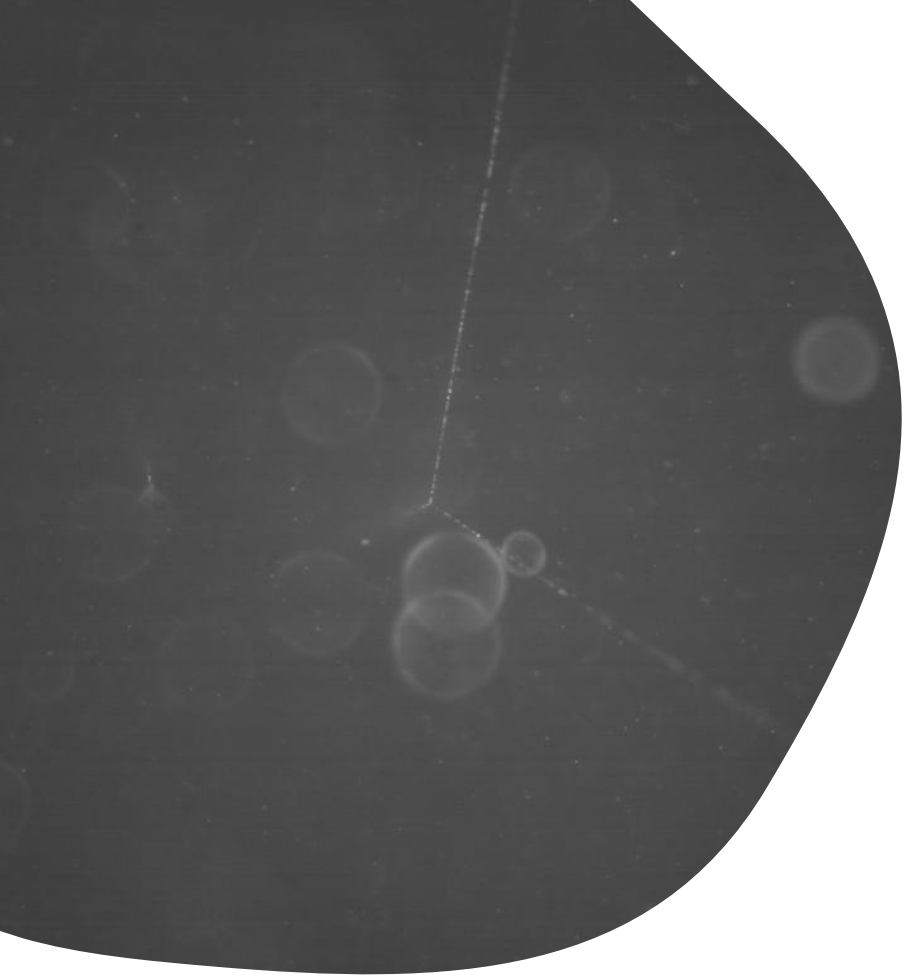

FOOT & DAMON experiments

11th Astroparticle Physics Science Fair 2024/2025

INFN LNGS
Istituto Nazionale di Fisica Nucleare
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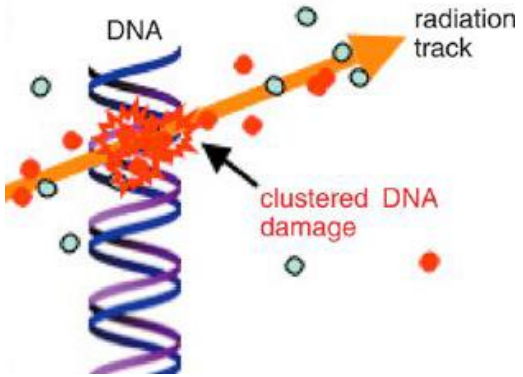
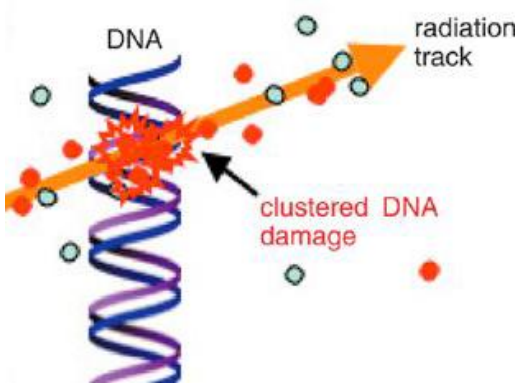
Charged particle therapy for tumor treatments

- Charged Particle therapy is a tumor treatment employing protons or heavy ions (^{12}C, ^{16}O, ...)

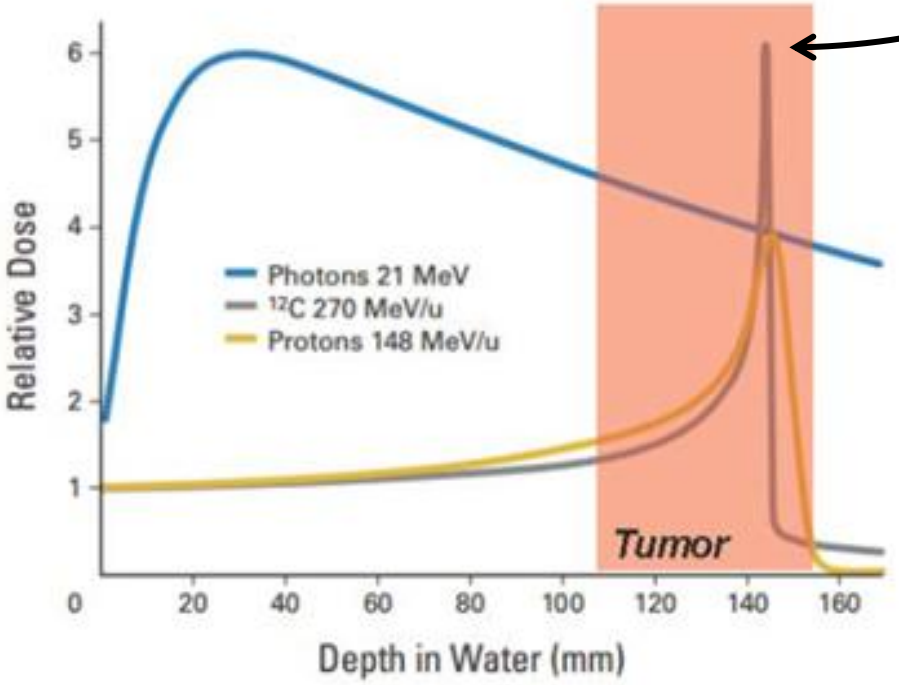


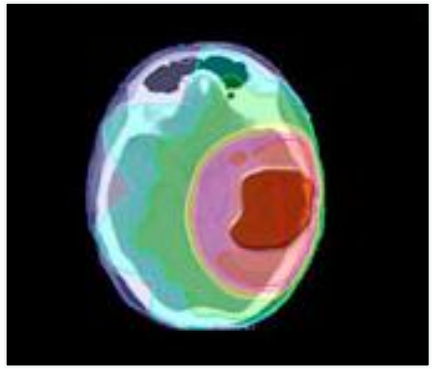
Charged particle therapy for tumor treatments

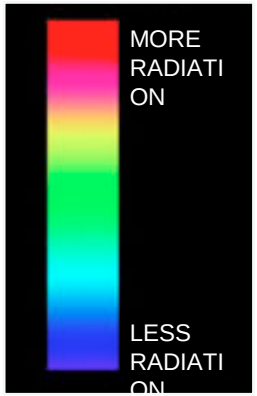
- Charged Particle therapy is a tumor treatment employing protons or heavy ions (^{12}C, ^{16}O, ...)
- Respect to conventional radio therapy,
  peak of dose released at the end of the track (**Bragg Peak**),
  precise dose localization for deep tumors, allows sparing the healthy tissues

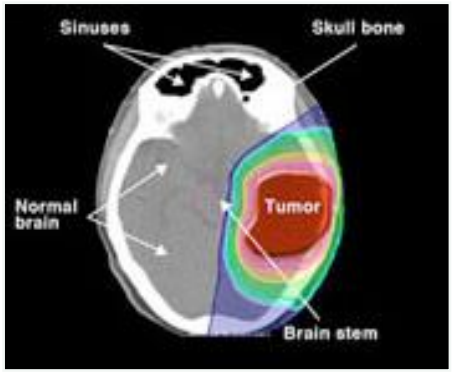


From: Dilmanian et al., Frontiers in Oncology 5(3), 2015







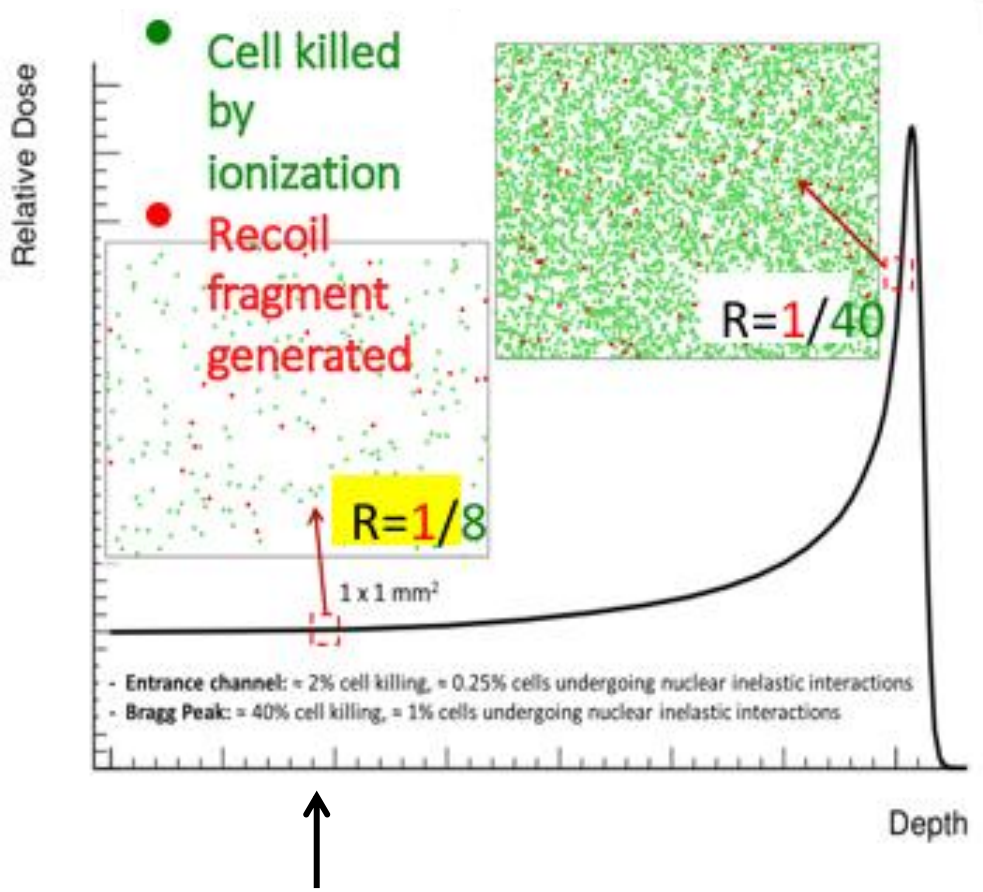


→CONVENTIONAL RADIOTHERAPY

→CHARGED PARTICLE THERAPY

Charged particle therapy for tumor treatments

- Uncertainties: **Relative Biological Effectiveness** (RBE) due to the production of highly-ionizing, short-ranged secondary fragments through nuclear interactions due to **target fragmentation**.
- Significant impact in the entrance channel, where healthy tissues are located



The FOOT (FragmentatiOn Of Target) experiment

FOOT aims at measuring **nuclear fragmentation cross section** to improve Treatment Planning System for proton and ion therapy

Also for radio protection in space …

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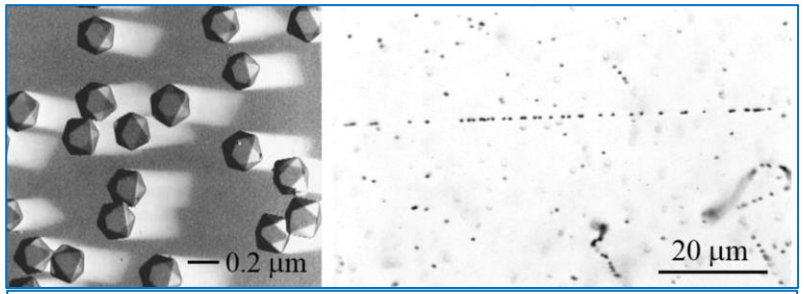
Simone Masci (simone.masci@lngs.infn.it)

The FOOT (FragmentatiOn Of Target) experiment

- Electronic detectors setup
- Nuclear emulsion setup

Example of a track in a nuclear emulsion



From: G. De Lellis et al., Journal of Instrumentation

Fragments with low Z and at large angles

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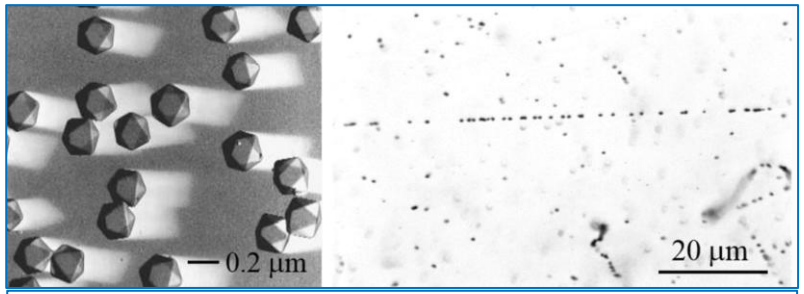

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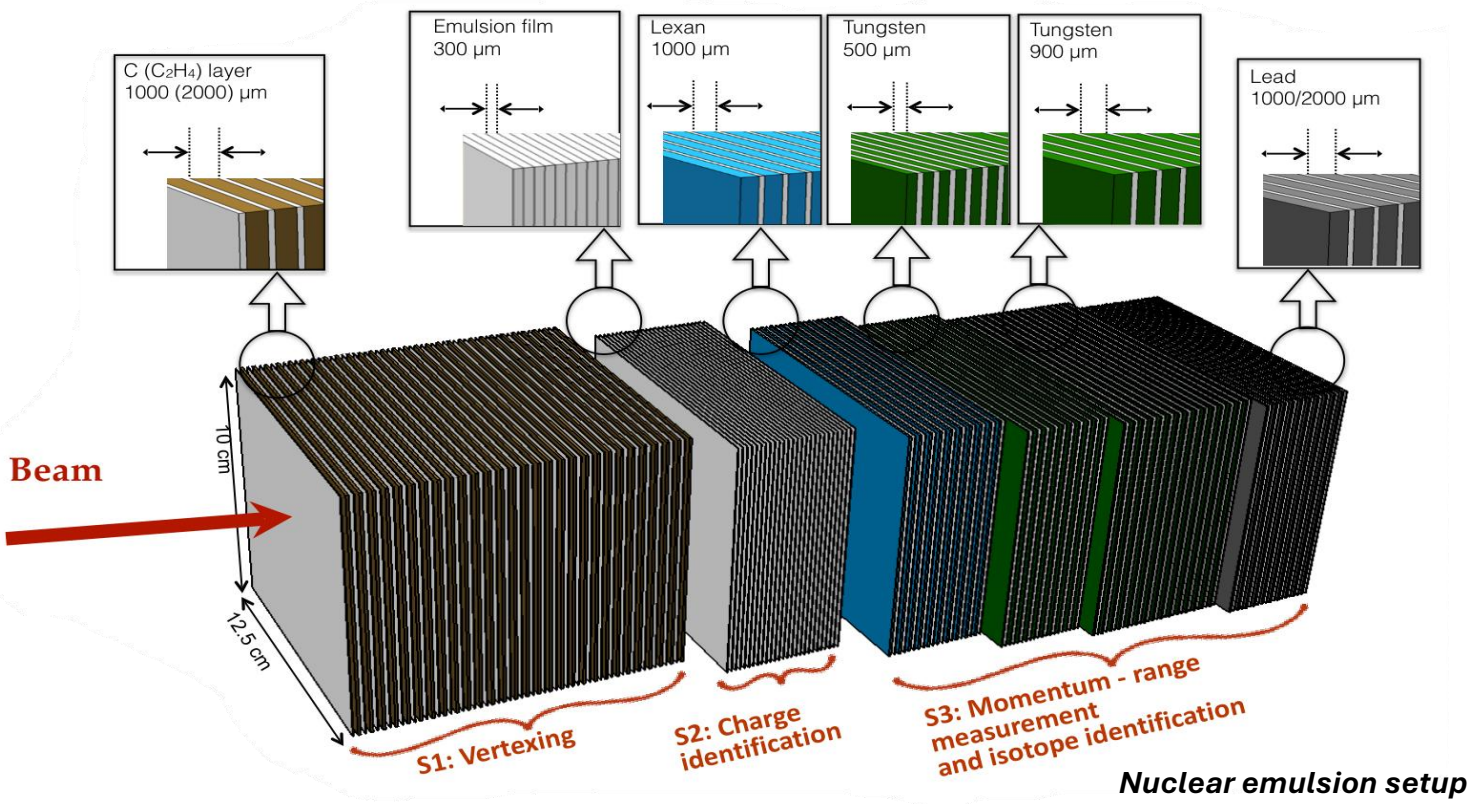

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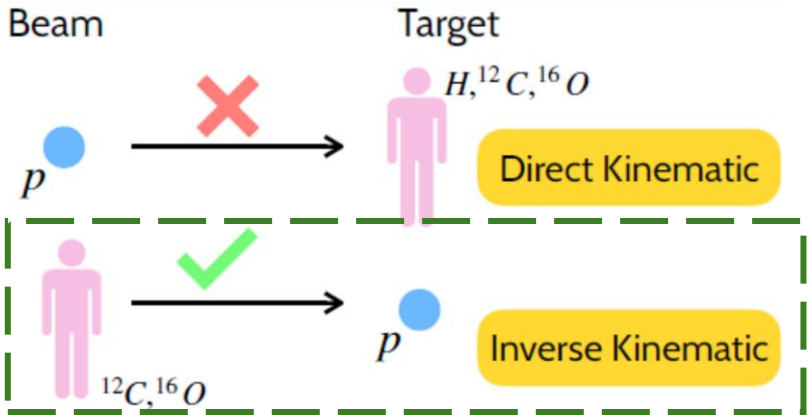

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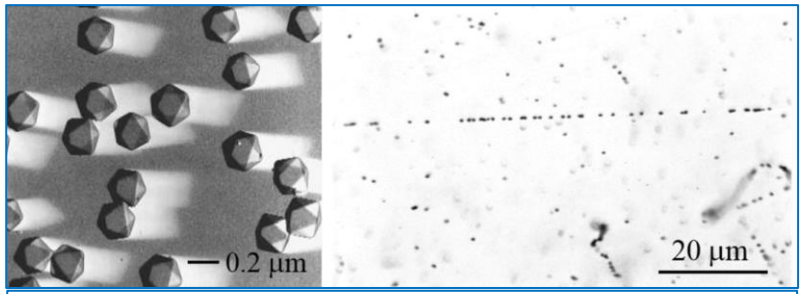

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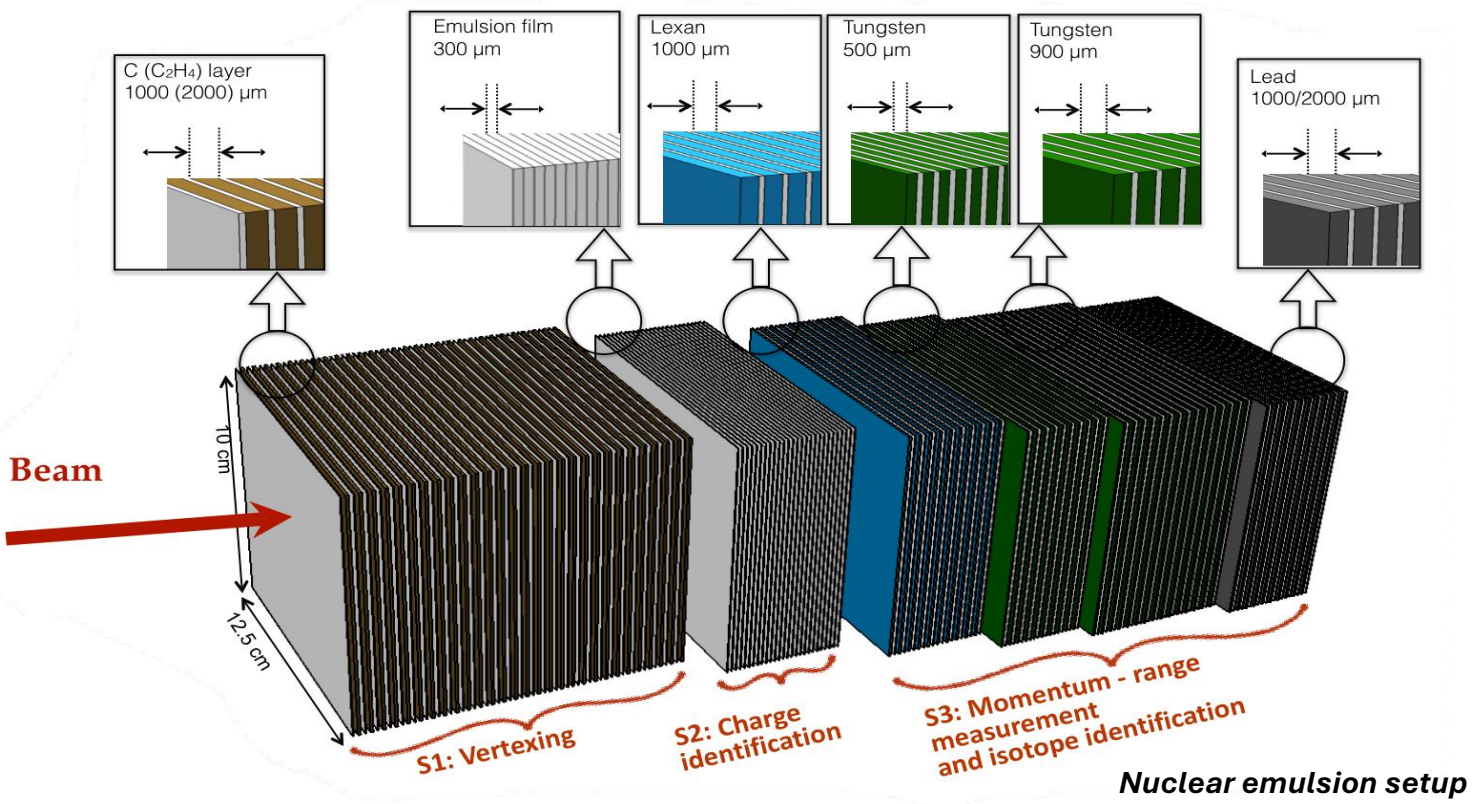

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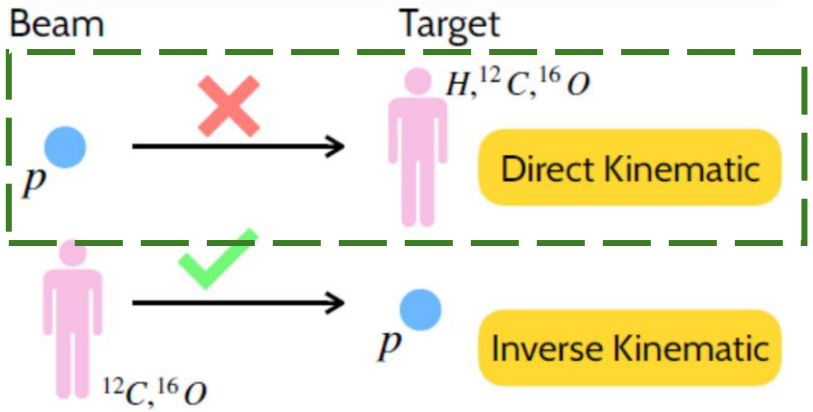

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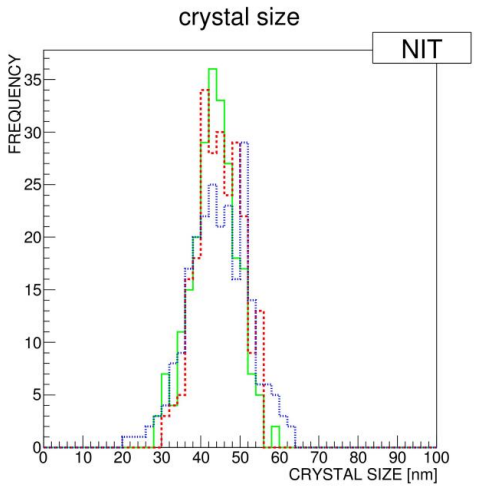
Undeveloped NIT sample

LNGS Gel Production Machine



From: Asada T. et al. Prog. Theor. Exp. Phys. 2015

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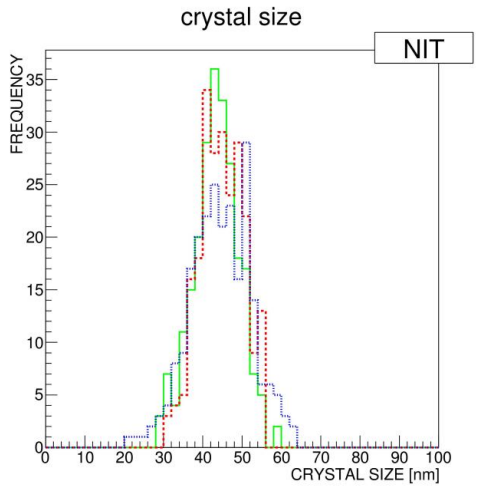

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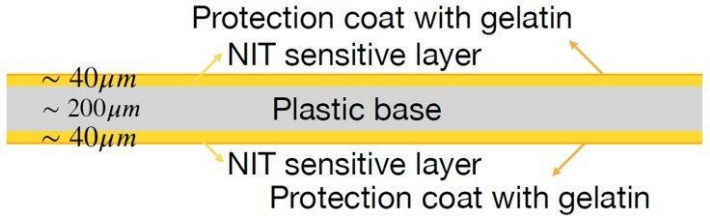

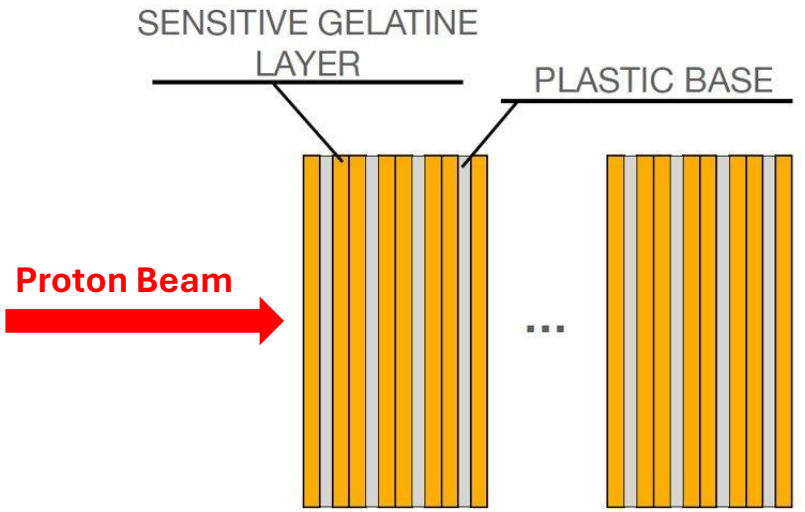

target and the tracking device coincide

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- Scanning: automated optical microscopes
- Tracks shorter than $\sim 200\ nm$ can not be resolved due to the optical diffraction limit

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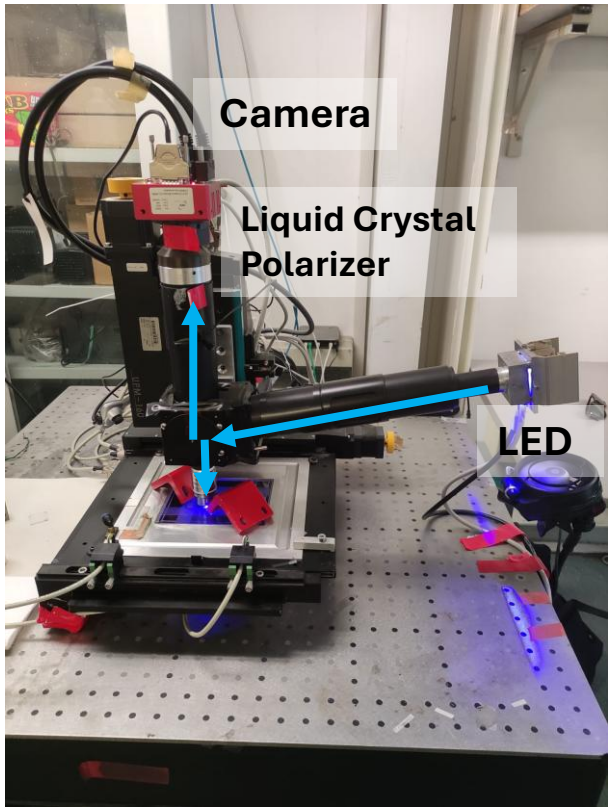
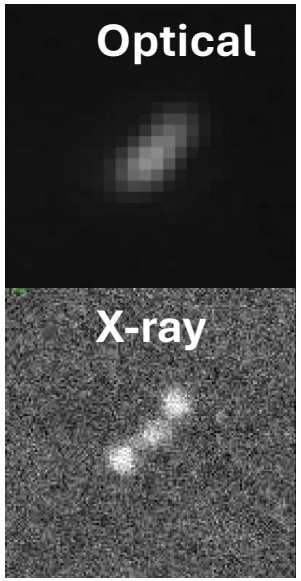
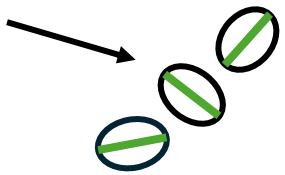


From: Alexandrov et al. Scientific Reports volume 13, Article number: 22813 (2023)

Super Resolution LSPR Optical Microscope





Taking in account the polarization of the reflected light, possible to resolve close structures!