



SHERPA

*“Slow High-efficiency Extraction
from Ring Positron Accelerator”*



P.I.:

Marco Garattini



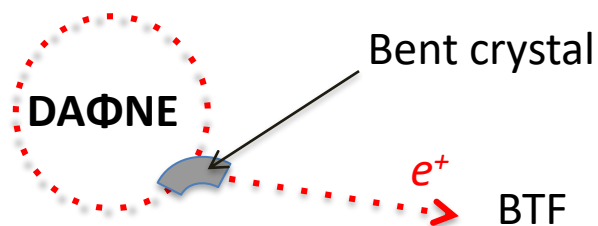
Istituto Nazionale di Fisica Nucleare

SHERPA



(CSN5 Young Researcher Grant 2020-2022 - P.I.: Dr. M. Garattini)

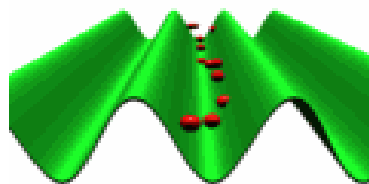
R&D study to extract a high-quality e^+ (or e^-) beam from one of the DAΦNE rings
The idea is to use coherent processes in a bent crystal to steer the positron beam



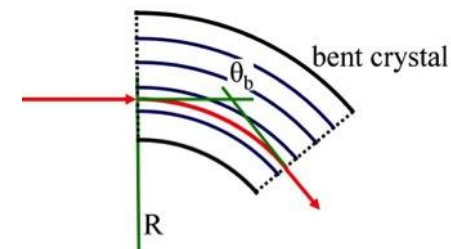
Target spill parameters:

- Energy spread: $\Delta p/p < 10^{-3}$
- Emittance: $\varepsilon < 10^{-6} \text{ rad}\cdot\text{m}$
- **Length: $\Delta t \sim \text{ms}$**

Channeling



VS



Current BTF spill parameters:

- Energy spread: $\Delta p/p < 0.5 \times 10^{-2}$
- Emittance: $\varepsilon < 10^{-5} \text{ rad}\cdot\text{m}$
- **Length: $\Delta t \sim 300 \text{ ns}$**

Conceptually similar to that already demonstrated by UA9 for crystal extraction at the SPS

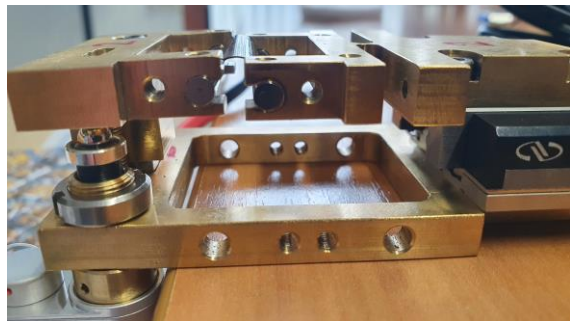
Immediate application:

With the **SHERPA beam**, **PADME** (“Positron Annihilation into Dark Matter Experiment”) could increase the **statistics by a factor $\sim 10^4$** and its **sensitivity by a factor $\sim 10^2$** , largely extending the discovery potential

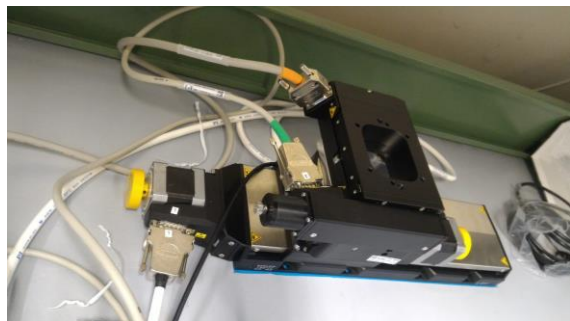
SHERPA experimental apparatus



Crystal bending holder by CINEL



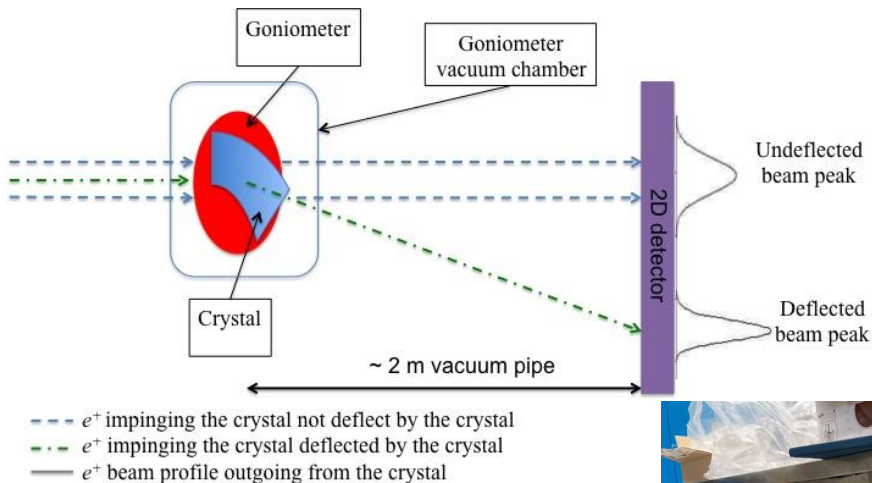
Crystal Goniometer (3axis)



2D Pixel Detector (TimePix3)



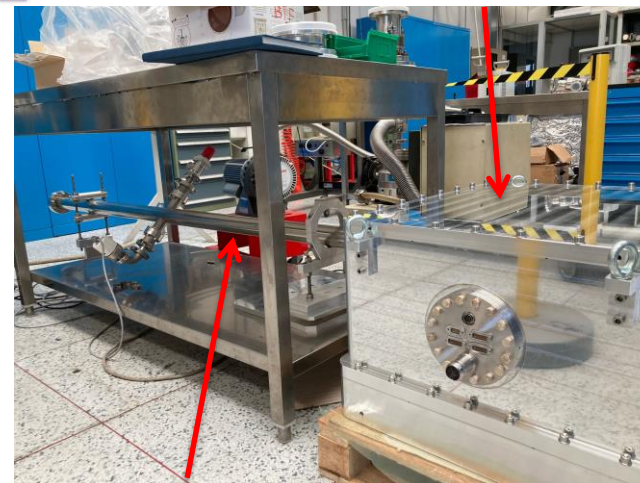
Apparatus scheme for crystal characterization



Silicon crystals Crystal
(15 μm thick)

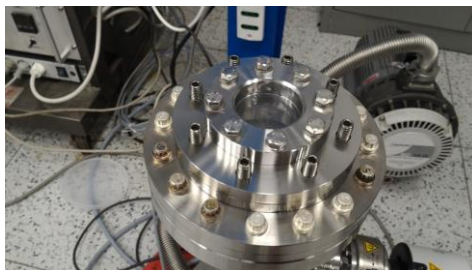


Crystal chamber



2 m pipe

Ultrathin Mylar windows
(23 and 50 μm)



Beam requirements

The SHERPA dream:

- Pure positrons beam
- $E = 0.5 \text{ GeV}$ (but also 1 GeV could be fine)
- Beam spot: $(1 \times 1) \text{ mm}^2$ (1 sigma)
- Beam divergence $< 200 \text{ } \mu\text{rad}$ (1 sigma)
- Beam intensity: as high as possible

I have preliminarily discussed these beam requirements with Johannes Bernhard before the official beam request some months ago

Infrastructure requirements

- Vacuum pipe (4-5 m long): CF63
- Vacuum connections (CF63) to mount our vacuum chamber directly on the T9 beam line
- T9 spill signal (TTL) to trigger our TimePix3 detector
- If the T9 spill signal is not available, we need high-voltage for a trigger scintillator
- Standard power supply and Ethernet connection
- Scroll vacuum pump (15 m³/h)
- Tombac KF40/KF25 mm
- A rack for electronic devices
- A support for the crystal chamber (150 Kg), possibly with vertical motion (remote movable table not strictly necessary)
- Supports for vacuum pipes

Thank you very much !!!

By the SHERPA team...

