SHERPA

“Slow High-efficiency Extraction from Ring Positron Accelerator”

P.I.:
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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.

Current BTF spill parameters:
- Energy spread: $\Delta p/p < 0.5 \times 10^{-2}$
- Emittance: $\varepsilon < 10^{-5}$ rad·m
- Length: $\Delta t \sim 300$ ns

Target spill parameters:
- Energy spread: $\Delta p/p < 10^{-3}$
- Emittance: $\varepsilon < 10^{-6}$ rad·m
- Length: $\Delta t \sim$ ms

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)

Apparatus scheme for crystal characterization

Silicon crystals Crystal (15 μm thick)

2D Pixel Detector (TimePix3)

Crystal chamber

Ultrathin Mylar windows (23 and 50 μm)

2 m pipe

Crystal chamber
Beam requirements

The SHERPA dream:

• Pure positrons beam
• $E = 0.5$ GeV (but also 1 GeV could be fine)
• Beam spot: $(1 \times 1)$ mm$^2$ (1 sigma)
• Beam divergence < 200 $\mu$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...