The design of the DESY II Booster Synchrotron proof-of-principle experiment for a crystal-based extraction of electrons

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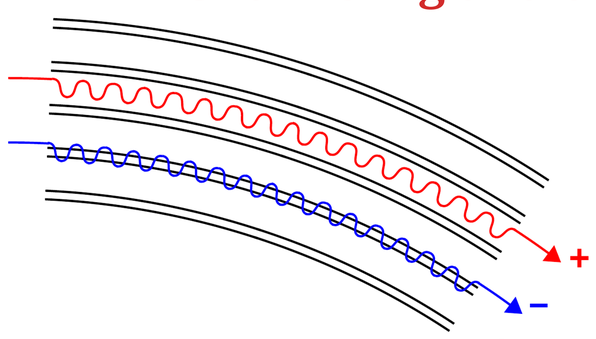
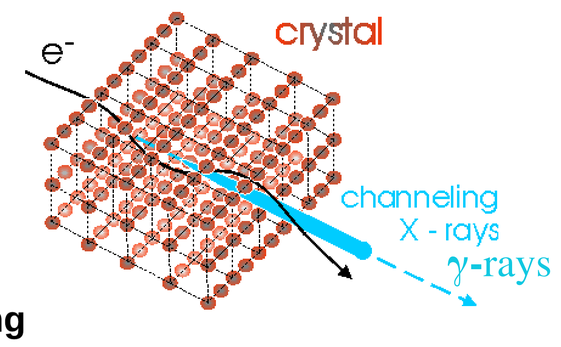
Motivation

- Unlike HE proton beams, **crystal-based extraction** of an **e⁻** beam[1] from an accelerator has been **never done** before.
- Recent experiments[2,3] showed **high enough** (up to 40 %) deflection **efficiency** of sub- and few GeV electron beam by a bent crystal.
- Few **GeV** energy is **typical** for **electron synchrotrons** existing in the world. Such beams are of interest for testing of **nuclear** and **particle physics** detectors and **generic detector R&D**.
- The **extraction line** including septum magnets already **exists** at **DESY II**.

Channeling and channeling radiation

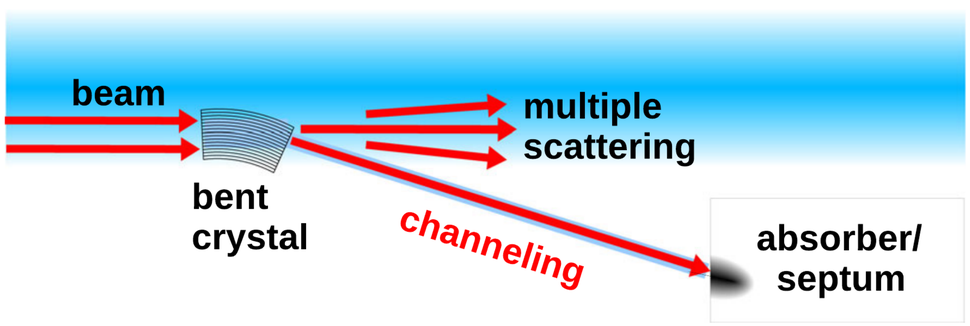




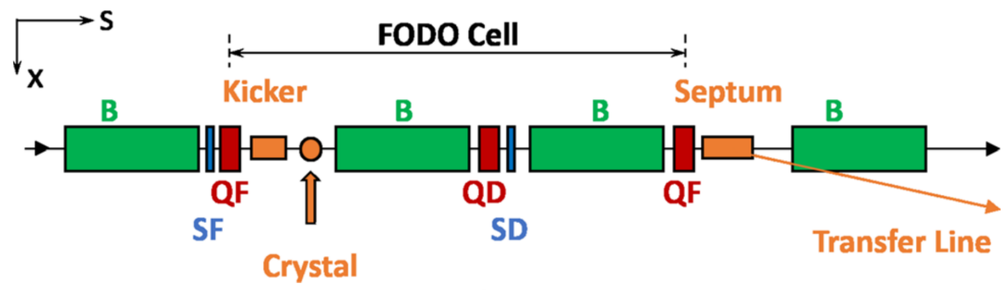
Proposal of a proof-of-principle experiment at the DESY II Booster Synchrotron[1]

The idea

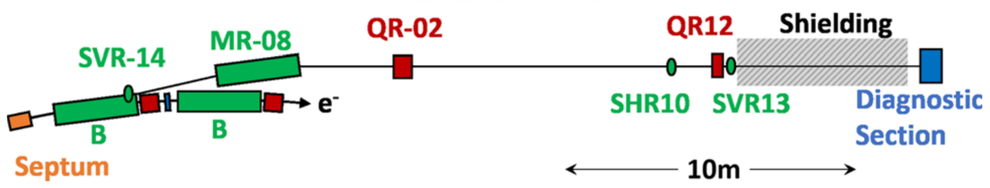
Crystal-based extraction[1] of charged particles from an accelerator (similar to crystal-based collimation[4])



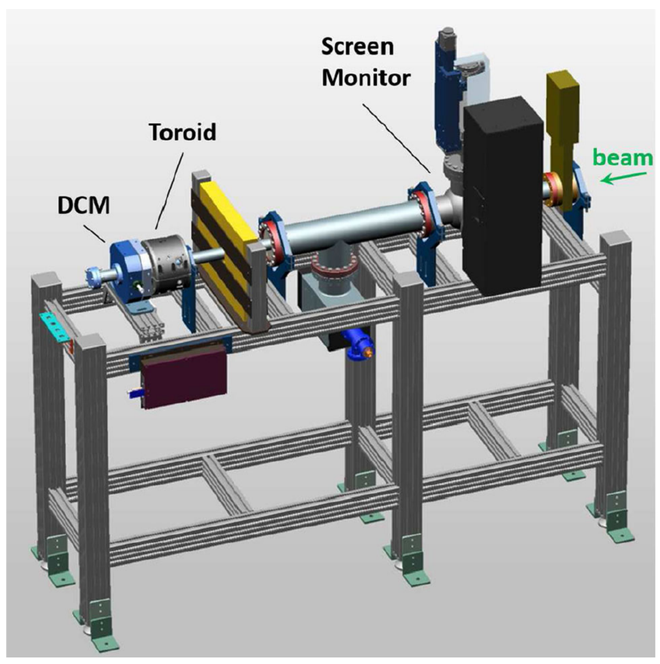
Experimental setup[1]



Transfer line

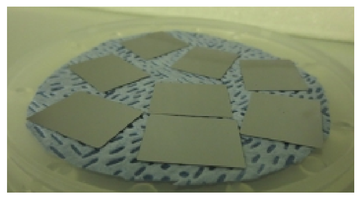


Diagnostic station[1,5]



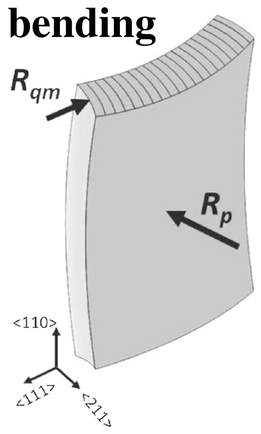
Bent crystal fabrication[1,6]

silicon wafers



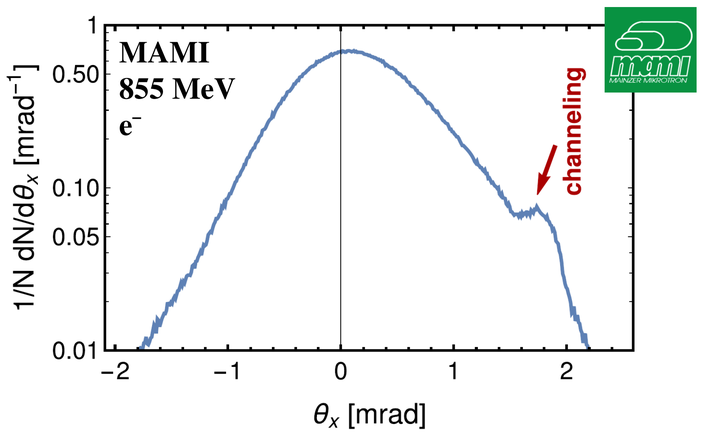
Crystal parameters:
Si (111)
Bending angle: **1.75 mrad**
Crystal length: **0.175 mm**
Crystal transverse thickness: **1 cm**

bending



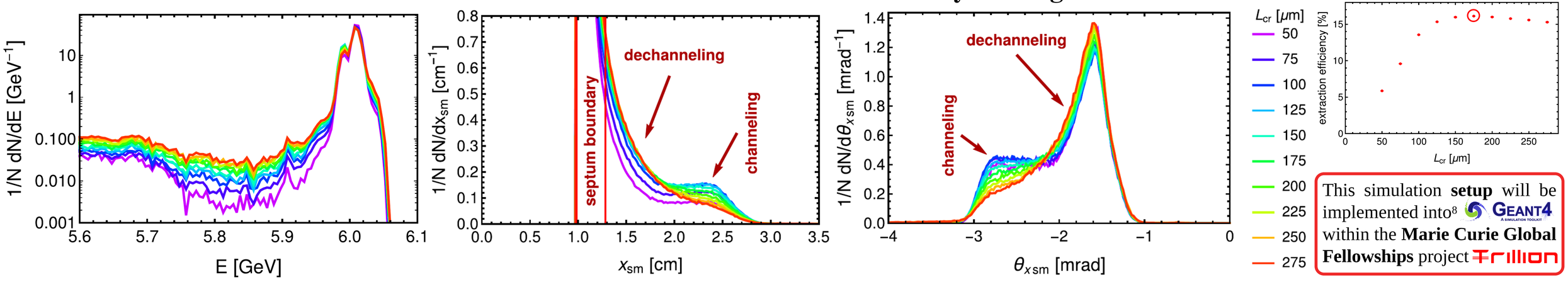
Bent crystal characterization[1]

(simulations with the CRYSTALRAD[7] code at Mainz Mikrotron MAMI conditions[2])



Simulation results[1]

Distributions of extracted 6 GeV e⁻ beam from DESY II for different crystal length values



Extraction efficiency up to 16 %

This simulation **setup** will be implemented into[8] GEANT4 within the **Marie Curie Global Fellowships** project TRILLION

Conclusions

- The **first design** of a crystal-based **extraction** of **6 GeV electrons** from the **DESY II booster synchrotron** has been proposed, elaborated and simulated.
- This technique will open up **new prospects** for fixed-target experiments at existing **e⁻ synchrotrons** worldwide and future **e⁺e⁻ colliders** (FCC-ee, ILC etc.)

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