

# Update on WP3

**WP3 Positron source: target and capture system**

# First WP3 meeting

16/07/2020



## Agenda

<https://indico.cern.ch/event/938292/>

WP3 structure. Main parameters. *I. Chaikovska (IJCLab)*

FCC-ee positron source. Simulation studies. *Y. Han (IJCLab)*

R&D on the Flux Concentrator and NC solenoid. *P. Martyshkin (BINP)*

Injector optimization for FCC-ee positron production. *B. Bai (IJCLab)*

Reoptimization of the crystal for Hybrid scheme @FCC-ee *L. Bandiera (INFN-Ferrara)*

Status and challenges of the SuperKEKB positron source. *Y. Enomoto (KEK)*

CLIC positron source (available expertise for FCC-ee). *S. Doebert (CERN)*

R&D on the Flux Concentrator for CLIC. *H. Bajas (CERN)*

Discussion

**The regular WP3 meetings to be started from September**

27/08/2020

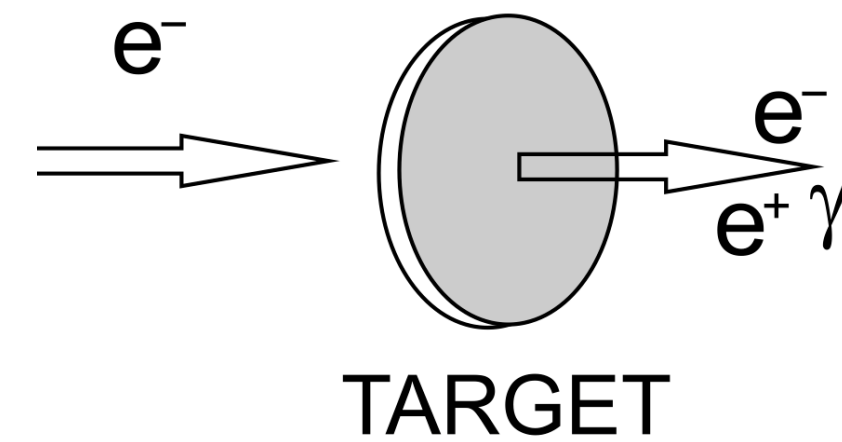
*I. Chaikovska IJCLab/IN2P3/CNRS*

# Summary of the studies up to now

## Production schemes

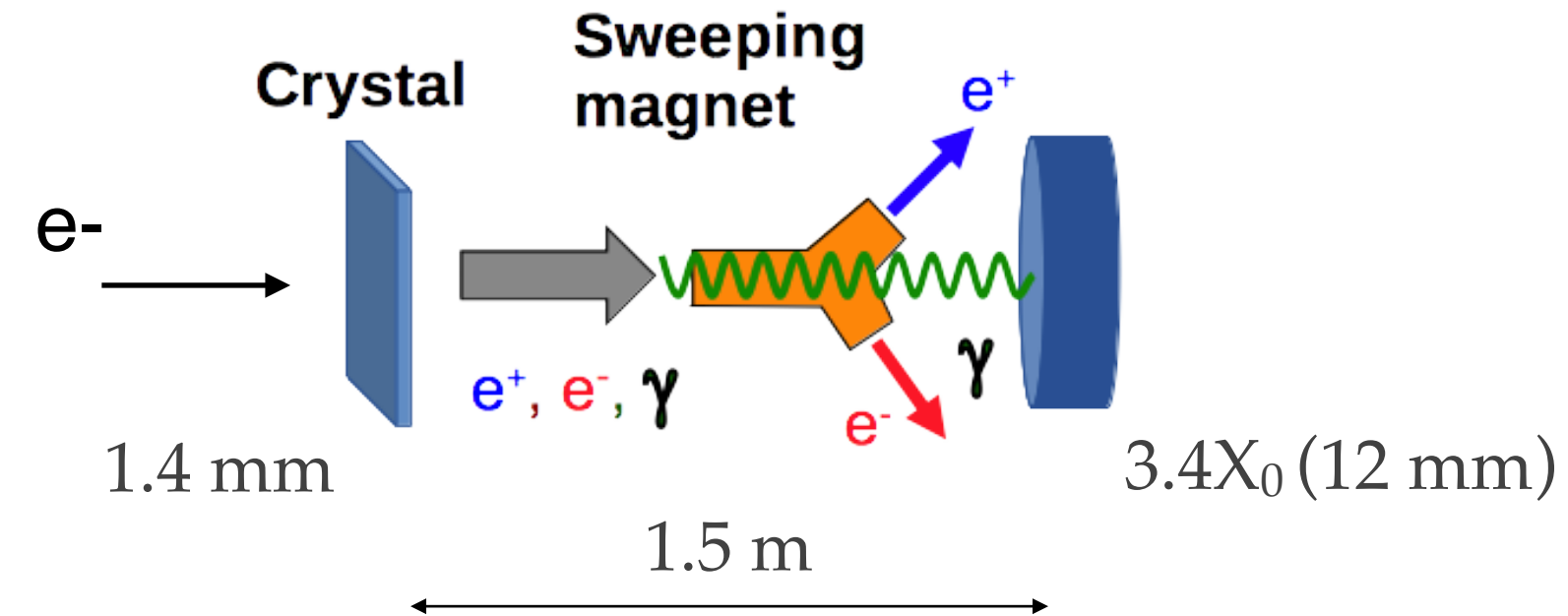
Two schemes under study. Final choice to be done based on the simulated performances.

### 1) Conventional target



$4.5X_0$  (16 mm)

### 2) Hybrid target



## Capture section

- ➡ Flux Concentrator and SC solenoid (very preliminary) as matching device.
- ➡ 1.5 meter long 16 MV/m 2 GHz L-band structures,  $\varnothing 40$ mm (CLIC design).
- ➡ 3 meters long 20 MV/m 3 GHz large aperture S-band structures,  $\varnothing 30$ mm.
- ➡ The capture linac is encapsulated inside a solenoid with the axial magnetic field of 0.5-0.7 T.

## Injector layout for positron production

Several options are under study (dogleg, chicane, arc schemes). Simulations up to the DR.

### Primary e- beam

Beam energy	4.46 GeV
Bunch charge	$4.2 \times 10^{10} e^-$
Bunch length (rms)	2 mm (1mm*)
Bunch transv. size (rms)	0.5 mm
Bunch separation	~few tens of ns
Nb of bunches per pulse	2
Repetition rate	200 Hz
Beam power	12 kW
Beam energy	61 J

# SuperKEKB and CLIC $e^+$ source

- Positron source @SuperKEKB: highest intensity positron source in operation. A lot of R&D ongoing.
- The SuperKEKB positron source and experience/expertise of the KEK team are of great importance for FCC-ee positron source studies.
- Experience with SC-solenoid : beam tests in the KEKB linac (2009 - 2011).
- Available expertise of CLIC team at CERN:
  - Positron source optimization for CLIC
  - R&D on the Flux Concentrator for CLIC
  - Beam dynamics simulations.

# WPO.2 meeting

20/08/2020

Meeting #04: Positron production: layout and key parameters

<https://indico.cern.ch/event/947119/>

## 👉 Discussion of the possible injector layouts and requirements on the e- beam parameters

We fix  $e^+$  bunch charge ( $2.1e10$ )  $\Rightarrow$  by increasing beam energy, we can decrease the  $e^-$  bunch population required.

- Drive beam energy and charge choice: 4.5 GeV and  $\sim 7$  nC (present baseline). Now up to 20 GeV. Bunch charge: preferably keep not much higher than  $2.1e10$ .
- Drive beam time structure: 2 bunches and 200 Hz (present baseline). Now number of bunches per  $\sim 1\mu s$  pulse up 100 bunches and frep 50 Hz  $\Rightarrow$  based on PEDD and power deposited in the target and FC choose the reasonable  $e^-$  beam time structure.

**The first version of the parameter table summarising requirements for e- beam parameters is in preparation by WP3 now  $\Rightarrow$  input for WP 0.2 and other studies**

## WP3. Positron source: target and capture system – I. Chaikovska

### Task 3.1 Physics design of the positron target and capture system (optimization of the positron source: fixed/movable, conventional/hybrid, bypass line, beam energy) – I. Chaikovska

IJCLab: I. Chaikovska, A. Faus-Golfe, PhD, Postdoc

CERN: S. Doebert

PSI: R. Zennaro, H. Braun, PhD

BINP: P. Martyshkin

*Collaborators: KEK, INFN/Ferrara, INP-Minsk, IP2I-Lyon*

### Task 3.2 Capture system: Concepts of a SC solenoid and/or of flux concentrator – S. Sanfilippo

IJCLab: I. Chaikovska, PhD/Postdoc

CERN: S. Doebert

PSI: S. Sanfilippo, Postdoc (magnet group)

BINP: P. Martyshkin

### Task 3.3 Capture system: Design of the RF structures and NC solenoids – R. Zennaro

PSI: R. Zennaro, P. Craievich, R. Fortunati, PhD

BINP: P. Martyshkin

#### **IJCLab**

*I. Chaikovska, A. Faus-Golfe => permanent staff, R. Chehab (retired)*

*Postdoc Y. Han => until 01/09/2020. Try to convert the rest of the money to PhD or find a new postdoc to start in autumn*

*PhD B. Bai => finishing PhD, a few months engagement possible*

#### **PSI**

*PhD and Postdoc (magnet group) => from January/February 2021*

*R. Zennaro, H. Braun, S. Sanfilippo, P. Craievich, R. Fortunati*

#### **CERN**

*CERN fellow => from fall 2020*

*S. Doebert, A. Latina, S. Gilardoni, M. Calviani*

*BINP: P. Martyshkin*

### Task 3.4 Capture system beam dynamics – R. Zennaro

PSI: R. Zennaro, P. Craievich, PhD

IJCLab: I. Chaikovska, PhD/postdoc

CERN: A. Latina

BINP: P. Martyshkin

### Task 3.5 Target area shielding – S. Gilardoni

CERN: M. Calviani

### Task 3.6 Target thermo-mechanical studies – S. Gilardoni

CERN: S. Gilardoni, CERN fellow, I. Chaikovska (IJCLab) + PhD/postdoc (IJCLab)