On the Positron WG Report

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History

- The WG started to write the report in mid March, the first compiled version appeared early April.
- After big discussion the final version (ver.7) was released on May 24. Uploaded to EDMS:
  - https://edmsdirect.desy.de/item/D000000001165115
  - login is not needed
- Will be in a public domain after agreement of TCMB
- Thanks to all the members of the WG and also the contributors

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Introduction Chapter

Summary of pros and cons
Principle only, not go to hardware detail
Intended for general readers

The advantages of the undulator scheme

(A) Positron polarization

(B) Thin target
- (B1) less total energy deposit on the target
- (B2) lower radiation level in the target region
- (B3) less demanding dynamic aperture of the damping ring

Disadvantages

(a) High energy electron beam needed

(b) No freedom in beam pulse structure

(c) Timing constraints

(d) Commissioning program can be complex

Introduction (continued)

- If you think of (A) and (B), the undulator scheme is no doubt overwhelming
- However, things have changed after many years R&D
- Because of (b), the required technology for undulator scheme is complex.
  - Rapidly rotating target (100m/s) needed
  - Long-flattop (~1ms) flux concentrator needed
- Improvement of DR dynamic aperture minimized the merit of (B3)
- Hence, it is not obvious the undulator scheme is overwhelming
- This is why the two schemes are still competitive
- (A) is now the major advantage of undulator scheme
  - (B2) is still an advantage

Caveats

- Introduction
  “This report is a snap shot of our studies as of spring 2018.. We tried to give consistent parameters as far as we could but it is inevitable that some of the parameters contain small inconsistencies.”

Summary Chapter

- As the summary I introduced a table showing the technology status (next page)
- Finally, I stated

  “As the table shows, the technology for neither scheme is ready now. Among the two the e-driven scheme seems to be closer to realization, judging from the present status of prototype development. On the otherhand, the baseline scheme, i.e., the undulator scheme, if feasible, has an advantage of the positron polarization. Therefore, the primary question for the choice of the scheme is

  - Is the undulator scheme feasible?
  - If so, can the feasibility be firmly verified by the time of design finalization?

Table 6.1: Summary of the technology status of the two schemes

	Undulator Scheme		e-Driven Scheme	
Target	Further consideration on wheel design, cooling calculation, mechanical performance (magnetic bearing), and Ti-Cu contact needed. Prototype shoud be built.	C	Further test of vacuum seal needed. W-Cu contact must be studied.	B
Matching device	FC has the problems of time-dependent field and PEDD.	D	Improvement from superKEKB and BINP. Design of cooling needed.	B
	QWT: yield marginal. Hardware design still required.	B		
Capture cavity	TDR design almost sufficient	A	Further consideration on thermal deformation and cavity cooling design needed	B
Beam dump	Photon dump still requires detailed design.	C	Beam dump is not an issue but radiation shielding must be studied instead.	B

Issues of Controversy

- Positron yield calculation
  - Undulator scheme
    In an early draft I wrote
    "The obtained yield e+/e- was 1.36.
    TDR adopted the design yield 1.5 including the margin. The above value is a little lower than this. If everything works as calculated, 1.0 is sufficient, of course. If the above value 1.36 is judged not to be enough, the length of the undulators must be increased by ~10%, which also means an increase of the heat load on the target. "
    This was criticized saying consistent parameters must be given.
    I added some more words for target load increase by 10%
  - e-Driven case
    Gives the yield 2.1. Criticized that other calculation showed 1.57. Some caveats added.

Issues of Controversy (2)

- Transient beam-loading in e-driven scheme
  - Beam current is much higher than in undulator scheme (O(A) compared with O(10mA))
  - Loading compensation in the ravelling wave part using amplitude modulation seems to be reasonable, though some more fine calculation needed)
  - Standing-wave part (first few capture cavities) is controversy
  - Some caveats for further estimation were added
- Temperature variation in the first capture cavity
  - Frequency change due to temperature variation
- All these issues suggest lower `ranking' "B"→"C"

Issues of Controversy (3)

- “ranking table” in the summary
- Lots of voices in the level of change “B” ←→ “C”
- After a debate, it was needed to add
  “Note, however, this table does not mean that every member agrees on the status evaluation of individual items. Some of them suggest to assign severer scores for some items. Re-evaluation of the table is inevitable in the near future by the time to downselect the scheme. But it is more important to make a complete "ToDoList" for each item as stated above.”

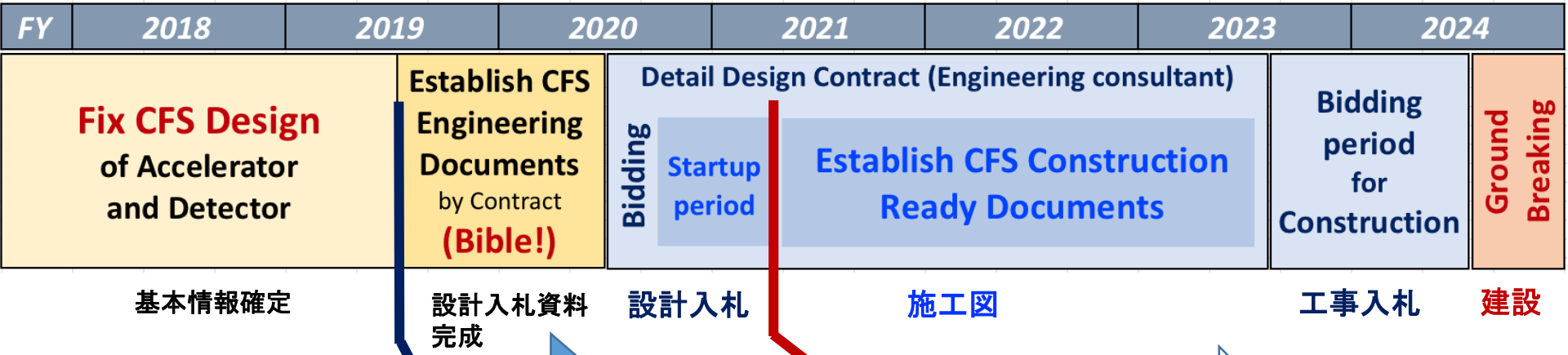
Issues of Controversy (4)

- Finally, I stated in the summary
  "As the table shows, the technology for neither scheme is ready now. Among the two the e-driven scheme seems to be closer to reality. However, the undulator scheme, if feasible, is obviously better owing to the positron polarization. Therefore, the primary question for the choice of the scheme is
  - Is the undulator scheme feasible?
  - If so, can the feasibility be verified by the time of design finalization?
- I received critics from both sides.
- "is obviously better owing to the positron polarization. "
  → "has an advantage of the positron polarization.
- "firmly" verified
- "closer to reality, judging from the present status of prototype development."

Timeline

- Terunuma san presented a possible timeline of ILC preparation phase this morning, assuming “green sign” this year (next slide)
- According to this chart, the positron team is given a special allowance of the timeline:
  - (A) Mid JFY2019: CFS layout (including power supply etc) should be fixed for possible scenarios in parallel
    - This will initiate detailed study with industries
  - (B) Final selection of the scheme in the first half of JFY2021
- (A) is urgent, in a year from now. Technology detail is not necessary. Note: As I stated this morning, this is not simply a competition of the 2 schemes. Scenarios such as e-driven followed by undulator must be studied.
  - Need to form a team?
- (B) is ~3 years away from now. ~2 year R&D after getting some R&D budget (hopefully).

CFS timeline on “Pre- and Preparation Phase”



(A) Basic Design linked to CFS should be fixed.

- **Accelerator layout**
  - beamline
  - power supplies
- **Requirement of Utilities**
  - specification and route

(B) Selection of Positron Source Scheme

Exception: Positron Source

- **Prepare designs for all possible schemes by (A)**
- **Scheme choice should be done by (B)?**

Note:
This timeline has been discussed and reached a consensus by the KEK LC-CFS members.

- M. Miyahara,
- H. Hayano,
- N. Terunuma,
- S. Michizono,
- K. Yokoya

To-Do-List

- As I stated in the summary, what is more important for (B) now is to make a complete To-Do-List (than the evaluation)
- Peter Sievers sent us a draft of the To-Do-List
  - It is uploaded in the timetable of this workshop
- It is an excellent start for us
  - Some issues are missing such as yield calculation, loading compensation, etc.
- Can we discuss on it (now and emails) and make a complete version?
  - What about making it as a attached document of our report?