Positron Source Layout

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Two Schemes of Positron Source

- As everybody knows, there are still 2 possible schemes for the ILC positron source
  - Undulator scheme (baseline)
  - e-Driven scheme (backup)
- The final choice of the scheme will require some more R&D works for couple of years
  - Terunuma-san will suggest a possible timeline to the final choice in his talk right after my talk
- The first thing to do after approval is the CFS design to the level that we can invite tenders for detailed design.
  - The time limit will be a year or so from now as Terunuma san will suggest.
  - The ILC management level is generous. Allow a few different designs to go in parallel in this stage.

- What is urgent now is the CFS design of ILC250GeV.
- But a view for future upgrade must be taken into account. Possible upgrades are
  - Luminosity (doubled number of bunches)
  - Energy
  - Positron polarization if start with the e-driven source
- In this respect possible choices for CFS for now are not only 2
  A) Undulator scheme, forever
  B) e-Driven scheme, forever
  C) Start with e-Driven scheme and later replace it with undulator scheme
  D) Start with e-Driven scheme and later add undulator scheme
- Presumably we can reject B)
- C) and D) have sub-choices
- Process
  - We have to consider all possible layouts now, and
  - Compare them and down select to a few candidates in a year or so
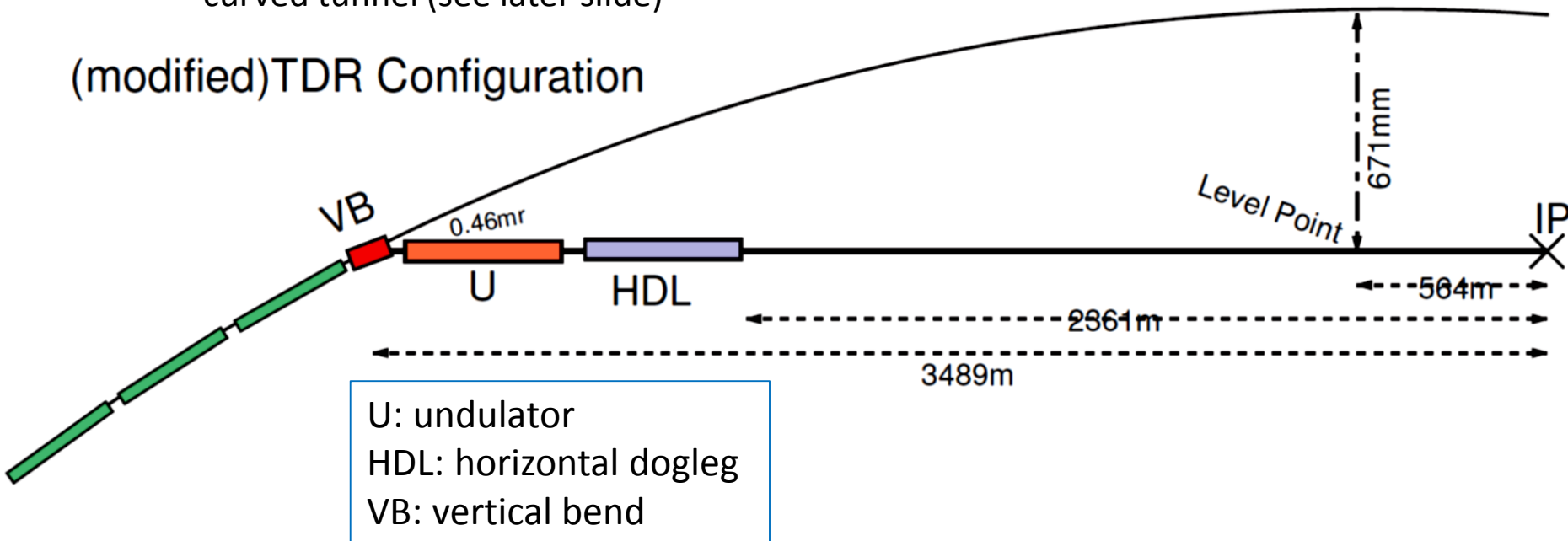
Undulator Scheme

- The simplest case

- Timing condition must be satisfied, of course

- A change since TDR is expected (not : Change Request yet) : Photon Dump
  - in TDR a pressurized water dump as the photon dump is located at a few 10's of meters after the target
  - Probable candidates (water-curtain dump or graphite dump) now both prefer far-away (> 1km) location
  - Must re-evaluate the required distances
    - Positron line
    - Photon line
    - Electron BDS line

target | capture section

photon dump

BDS

target | capture section

photon dump

BDS
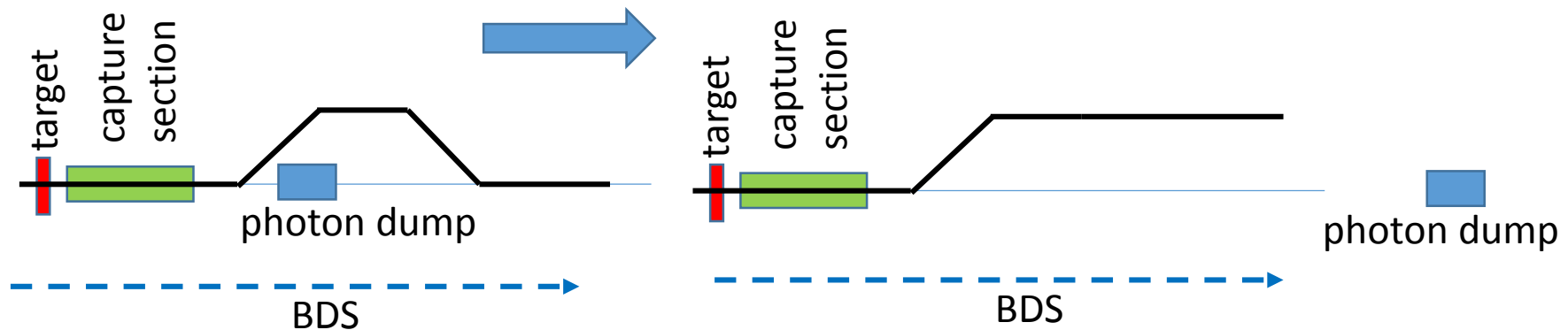
Undulator Scheme (continued)

- Vertical layout
- TDR : laser-straight tunnel from electron ML end to positron ML end
- Asymmetric w.r.t. IP due to U and HDL
- VB is not shown in TDR but later designed by Okugi san
- Choices:
  - IP tilted (0.088mrad = ~1mm/10m)   (see figure) or
  - Flat IP but different geoid level for electron and positron ML
  - Another possible choice is to make the tunnel symmetric by placing U & HDL in curved tunnel (see later slide)

(modified)TDR Configuration

VB

0.46mr

U

HDL

Level Point

671mm

IP

564m

2361m

3489m

U: undulator
HDL: horizontal dogleg
VB: vertical bend

e-Driven and, Later Undulator

- There are many choices
- In e-driven stage
  - Should the dogleg be there?
  - Should the timing constraint be statisfied?
  - Or, the minimum length for e-driven?
- Undulator stage
  - Should the undulator system replace e-driven or be added?
  - If to be added, is the target region (especially, the target replacement space) be prepared from the beginning (e-driven stage)
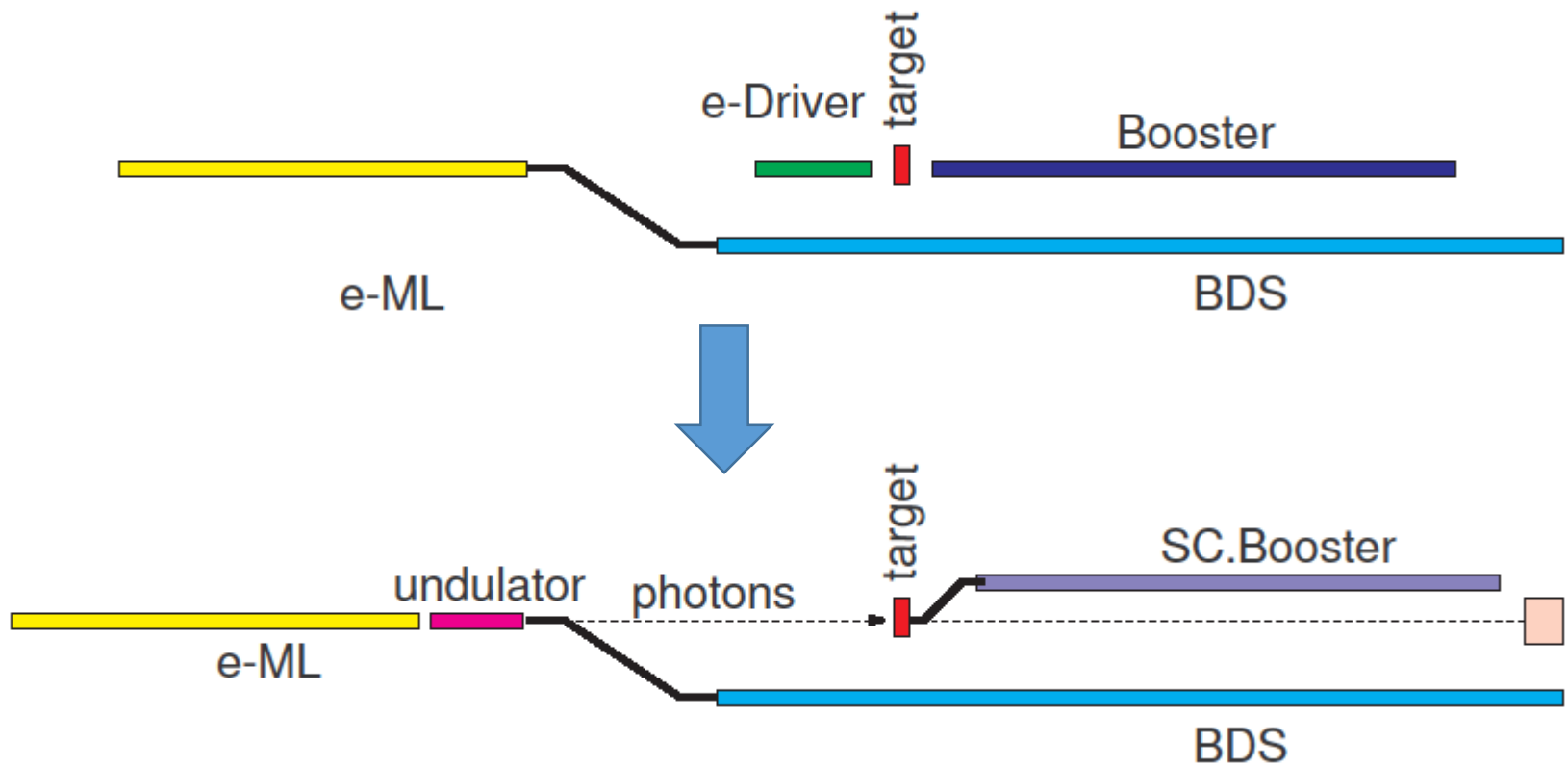- Following pages show some of the examples.

example 1

- Minimum length in e-driven stage
- Requires 2 doglegs when undulator system is introduced
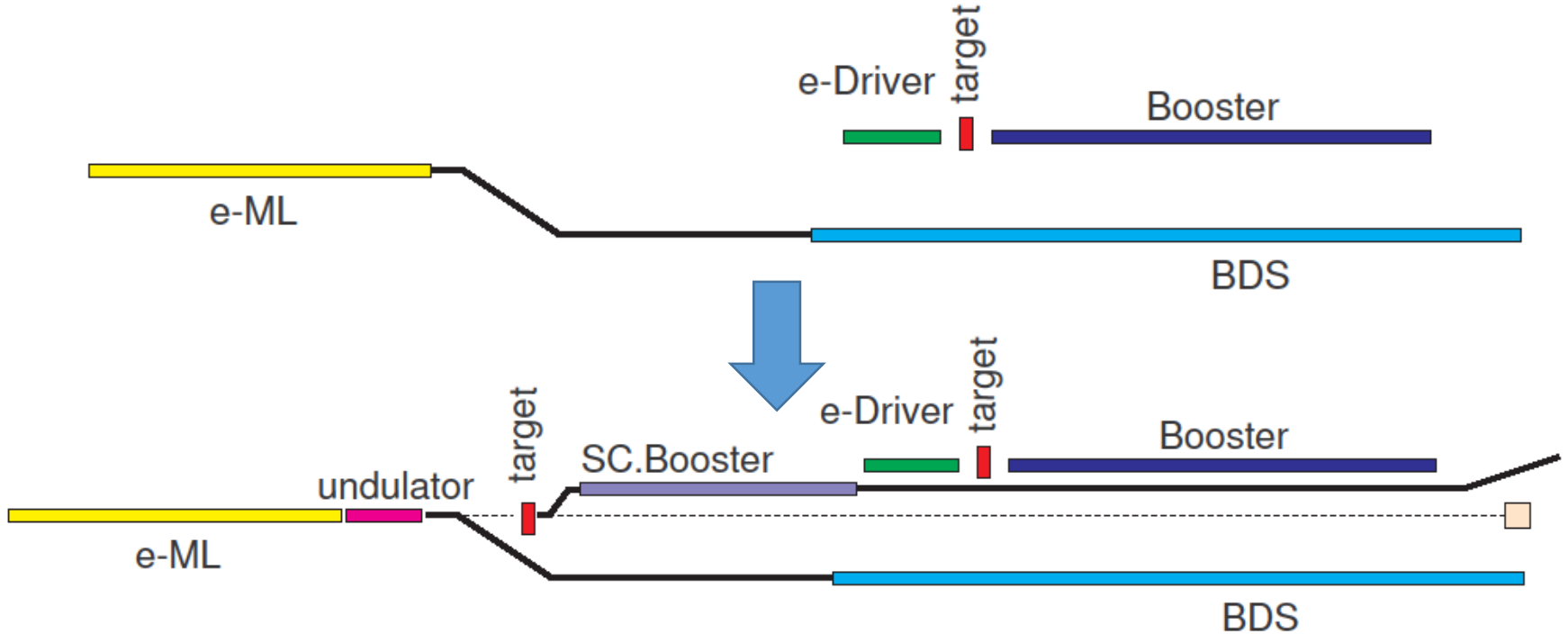- Target location should not change (shielding for e-driven is larger)
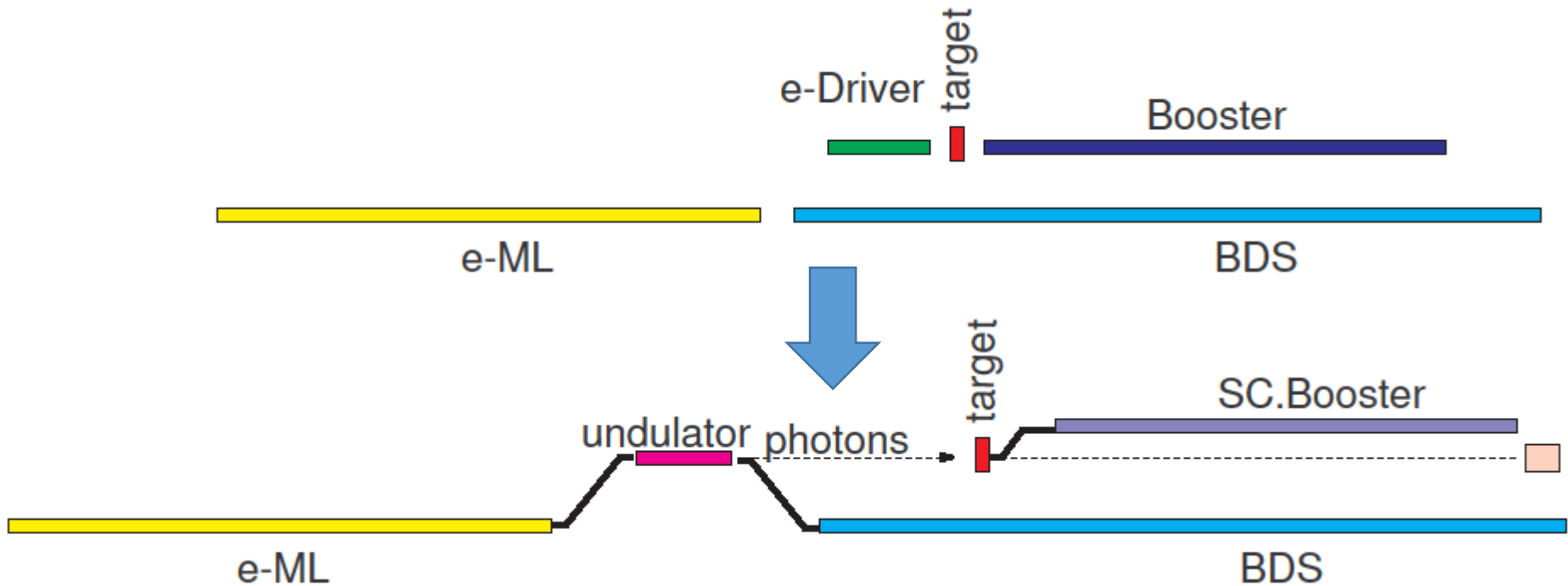
example 2

- A dogleg inserted at e-driven stage as in TDR

example 3

- Longest e-driven stage
- Target location for undulator system should be prepared in e-driven stage
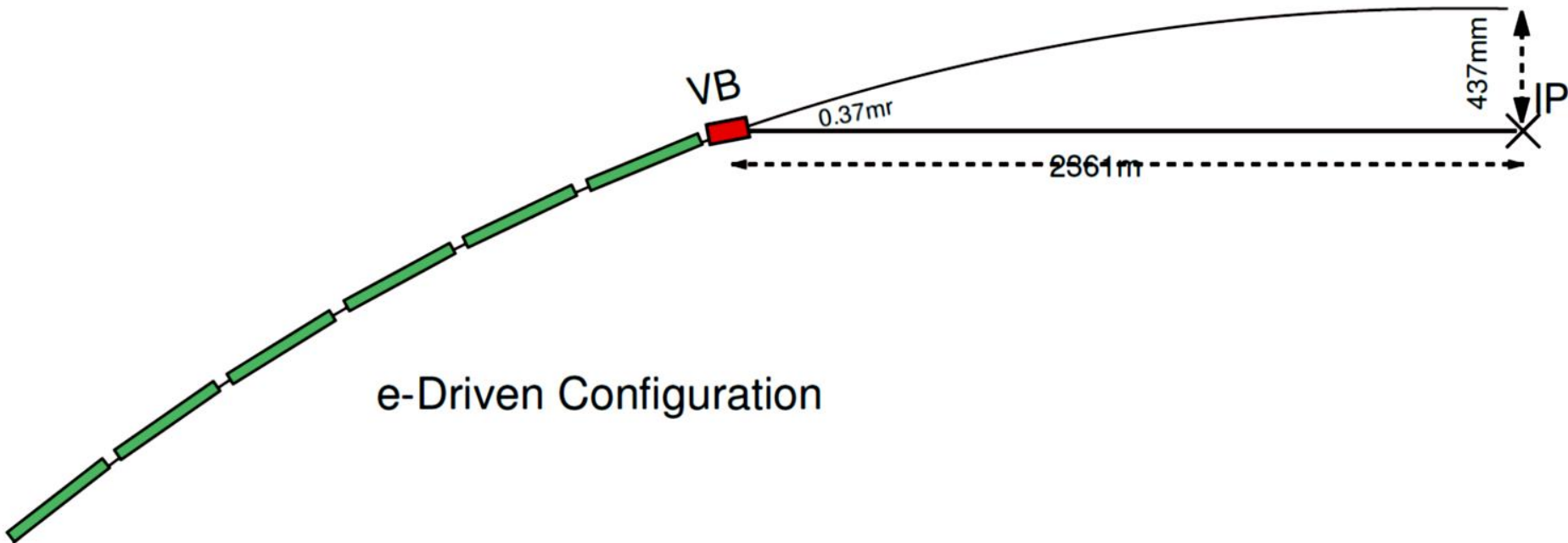
Some Critical Questions

- Can the e-driven system (in particular the driver linac and 5GeV booster) be removed?
  - Problem of residual radiation
- In case of adding undulator system later,
  - should the space for target replacement for undulator system be constructed from the e-driven stage?
    - If so, the location must be known exactly.
    - How big is it?
  - The extra length may not result in even longer tunnel?
    - Can use the space for the timing condition
- Better to know when the change e-driven → undulator should come?
  - In particular, is it before/at/after energy upgrade?

Vertical Layout

- The tunnel is laser straight from the end of e-ML to the end of p-ML including the undulator and the dogleg

- If optimized for e-driven only, e-ML should be extended to BDS entrance and the floor should be geoid-following

- Doesn't this cause a problem in the undulator stage?

- Following slides show that this is acceptable.

Vertical Layout : e-Driven

- Shortest layout
- Follow the geoid up to VB
- e-ML fills space down to VB

437mm

VB

0.37mr

IP

2361m

e-Driven Configuration

Vertical Layout : Undulator after eDriven

- Distances only tentative
- VB can be inserted at B,C,D,E. Here select only B,D
    - 2 constraints: Line AB must the same as in eDriven stage
    - Should not insert VB inside HDL (avoid complex spin motion)
- Line ED does not follow the geoid → Point D is 11.5mm above the geoid
- In the positron line there must be 0.421mrad VB somewhere (around 400MeV?)

Undulator after eDriven

Y(orbit at D)-Y(geoid)=12.5mm

Summary

- The choice, undulator or e-driven, is very important but the deadline is not now. A couple of years later.

- Before this choice we need CFS studies in somewhat in detail. Should be done in parallel.

- Must think of the scenario
  - undulator only, or
  - e-driven → undulator

- The former is simple, but many questions must be answered for the latter

- Laser-straight issue can be managed anyway