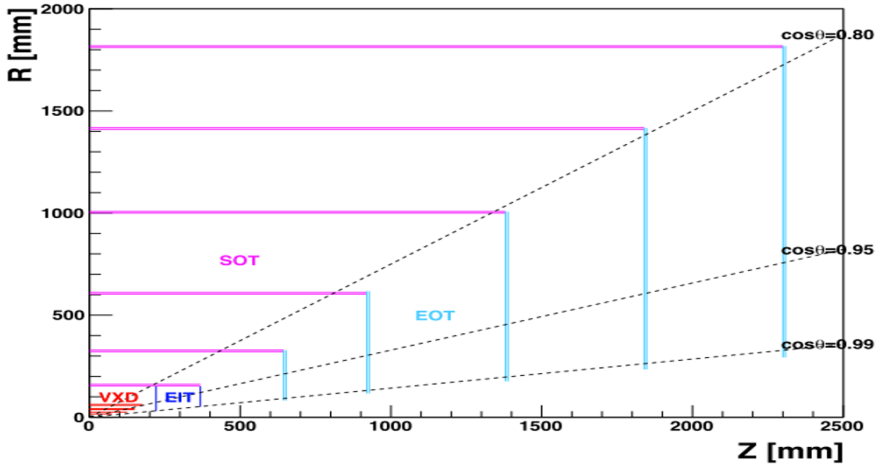
On Silicon Drift chamber Tracker (SDT)

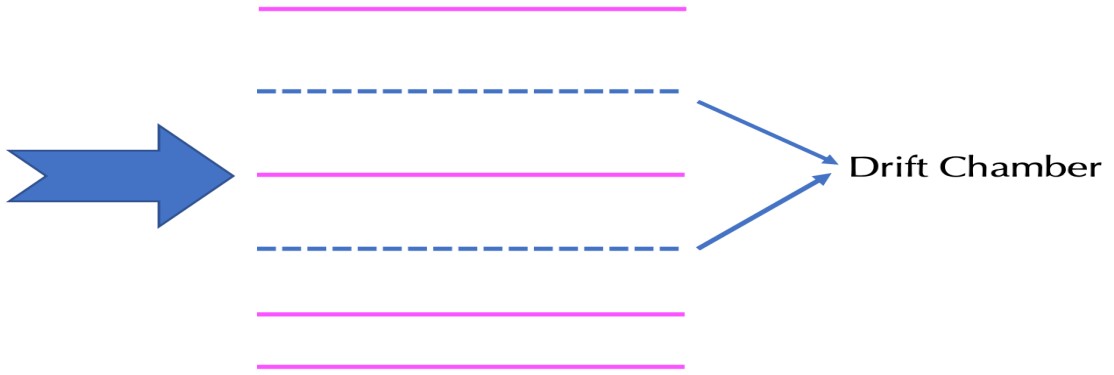
FST&FST2 tracker for CEPC

- Full silicon tracker: pixel and strip, not many measured hits but very precise.
- Good resolutions of impact parameter and momentum
- But someone worries about track finding efficiency

- More hits …

Hybrid design





2

- A hybrid design of silicon and drift chamber proposed
- We need to evaluate it performance with respect to FST(2) and the baseline TPC designs
- Fast simulation might be a suitable tool

LDT: a fast simulation tool

- LDT: LiC Detector Toy 2.0
  - MATLAB based: GUI, display, manual, examples, …
  - Support various types of tracker: pixel, strip, TPC, but seems not MDC ??
  - Simple geometry & material description
  - Fast simulation with multi-scattering effect
  - Kalman track fitting
  - Results & plots --- fast iteration

Some consideration inspired by Xin

- v0.1: define baseline concept and geometry (TPC or FST? Barrel only or complete tracker with forward part)
- v0.2: validate it by comparing with CDR results (σ_{IP}, σ_p vs pt, slightly better expected)
- v0.3: remove TPC, change the position and number of layer of Si-Strip, demonstrate the degrading of performance
- V0.4 add wire chamber according to suggestion of Mingyi
- ...
- v1.0: a preliminary design
- V1.x … optimizing …
  - Compare tracking performance of SDTv1.0 with FST, FST2
  - Optimization points: material, dE/dx(number of hits), overall volume, S/D layers,...
  - Report at CEPC detector plenary, response … next

Technical issues?

- **MATLAB: LDT could be used as blackbox**
- **TPC vs MDC**
- **Detector description**
- **…**

```
01 LiC Detector-Toy (barrel)
02 LDC-basic-Japan
03 Version:                    120208
04 Vertex Detector (VTX)
05
06 Number of layers            :   14
07 Description (optional)      : |-Beamt.-|-----------------------------------Vertex detector-----------------------------------------------------------------------|
08 Names of the layers (opt.)  :   XBT,      VTX1,      XVTX1,     XVTX2,     VTX2,      VTX3,      XVTX3,     XVTX4,     VTX4,      VTX5,      XVTX5,     VTX6,      XVTX6,     XVTXSHELL
09 Radii [mm]                  :   14.5,     15.95,     16,        17,        18,        36.95,     37,        38,        39,        57.95,     58,        59,        60,        65
10 Upper limit in z [mm]       :   4225,     62.5,      62.5,      62.5,      62.5,      125,       125,       125,       125,       125,       125,       125,       125,       145
11 Lower limit in z [mm]       :  -4225,     -62.5,     -62.5,     -62.5,     -62.5,     -125,      -125,      -125,      -125,      -125,      -125,      -125,      -125,      -145
12 Efficiency RPhi             :   0,        0.99,      0,         0,         0.99,      0.99,      0,         0,         0.99,      0.99,      0,         0,         0.99,      0
13 Efficiency 2nd coord. (eg. z):  -1
14 Stereo angle alpha [Rad]    :   pi/2
15 Thickness [rad. lengths]    :   0.0014,   0.00053,   0.00098,  0.00098,   0.00053,   0.00053,  0.00098,  0.00098, 0.00053,  0.00053,  0.00098, 0.00053,  0.00098,   0.0014
16 error distribution          :   0
17 0 normal-sigma(RPhi) [1e-6m] :            2.8,                6,                     4,                 4,                 4,                 4,
18          sigma(z)    [1e-6m] :            2.8,                6,                     4,                 4,                 4,                 4,
19 1 uniform-d(RPhi) [1e-6m]   :
20           d(z)    [1e-6m]   :
21
22 Silicon Inner Tracker (SIT)
23
24 Number of layers            :   9
25 Description (optional)      : |-----------------------------------------------Inner tracker-----------------------------------------------|TPC inner wall|
26 Names of the layers (opt.)  :   SIT1,        XSIT1,       XSIT2,       SIT2,        SIT3,        XSIT3,       XSIT4,       SIT4,          XTPCW1
27 Radii [mm]                  :   152.9,       153.1,       154.4,       155.4,       299.9,       300.1,       301.4,       302.4,         329
28 Upper limit in z [mm]       :   368,         368,         368,         368,         644,         644,         644,         644,           2350
29 Lower limit in z [mm]       :   -368,        -368,        -368,        -368,        -644,        -644,        -644,        -644,          -2350
30 Efficiency RPhi             :   0.99,        0,           0,           0,           0.99,        0,           0,           0,             0
31 Efficiency 2nd coord. (eg. z):   0,          0,           0,           0.99,        0,           0,           0,           0.99,          0
32 Stereo angle alpha [Rad]    :   7*(pi/180),  7*(pi/180),  7*(pi/180),  7*(pi/180),  7*(pi/180),  7*(pi/180),  7*(pi/180),  7*(pi/180),   7*(pi/180)
33 Thickness [rad. lengths]    :   0.00213,     0.00468,     0.00468,     0.00213,     0.00213,     0.00468,     0.00468,     0.00213,       0.0051
34 error distribution          :   0
35 0 normal-sigma(RPhi) [1e-6m] :   7
36          sigma(z)    [1e-6m] :   7
37 1 uniform-d(RPhi) [1e-6m]   :
38           d(z)    [1e-6m]   :
```

```
39
40 Time Projection Chamber (TPC)
41 sigma^2=sigma0^2+sigma1^2*sin(beta)^2+Cdiff^2*6mm/h*sin(theta)*Ldrift[m]
42 Number of layers             :   222
43 Radii [mm]                   :   384,1716
44 Upper limit in z [mm]        :   2225
45 Lower limit in z [mm]        :  -2225
46 Efficiency RPhi              :   1
47 Efficiency z                 :   1
48 Thickness [rad. lengths]     :   0.00005194
49 sigma0(RPhi) [1e-6m]         :   50
50 sigma1(RPhi) [1e-6m]         :   900
51 Cdiff(RPhi)  [1e-6m/sqrt(m)] :   25
52 sigma0(z)    [1e-6m]         :   400
53 sigma1(z)    [1e-6m]         :   0
54 Cdiff(z)     [1e-6m/sqrt(m)] :   80
55
```