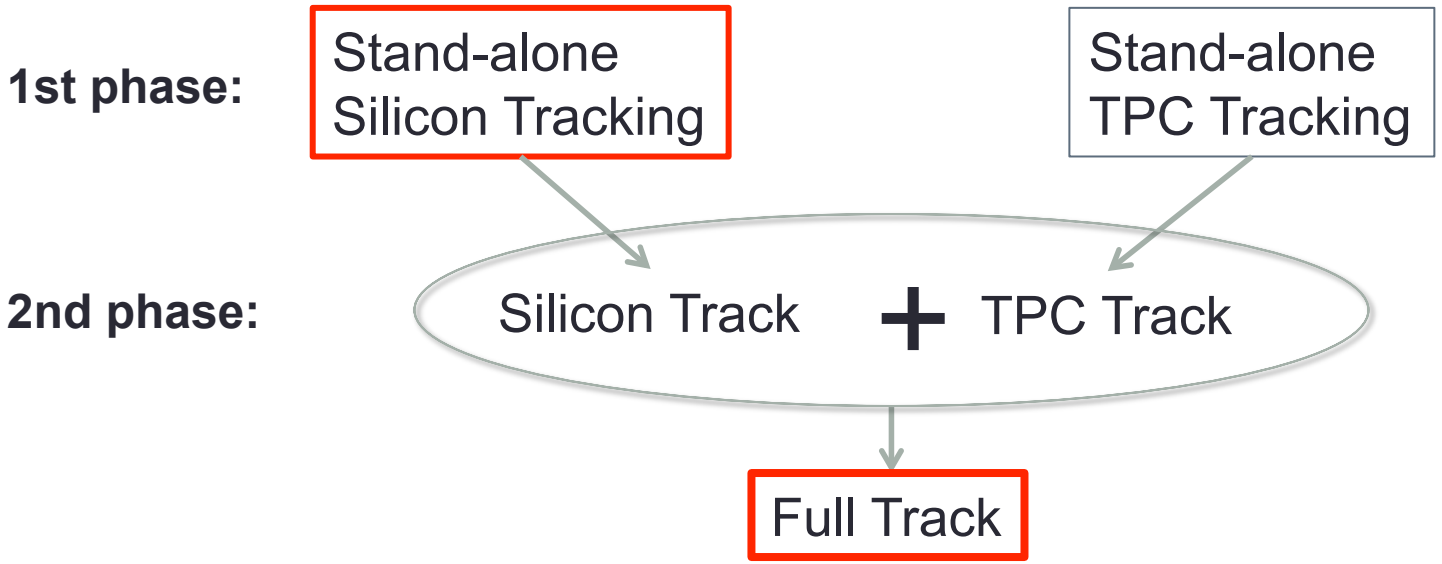
FPCCD TRACK FINDER

Software Meeting
September 6, 2013

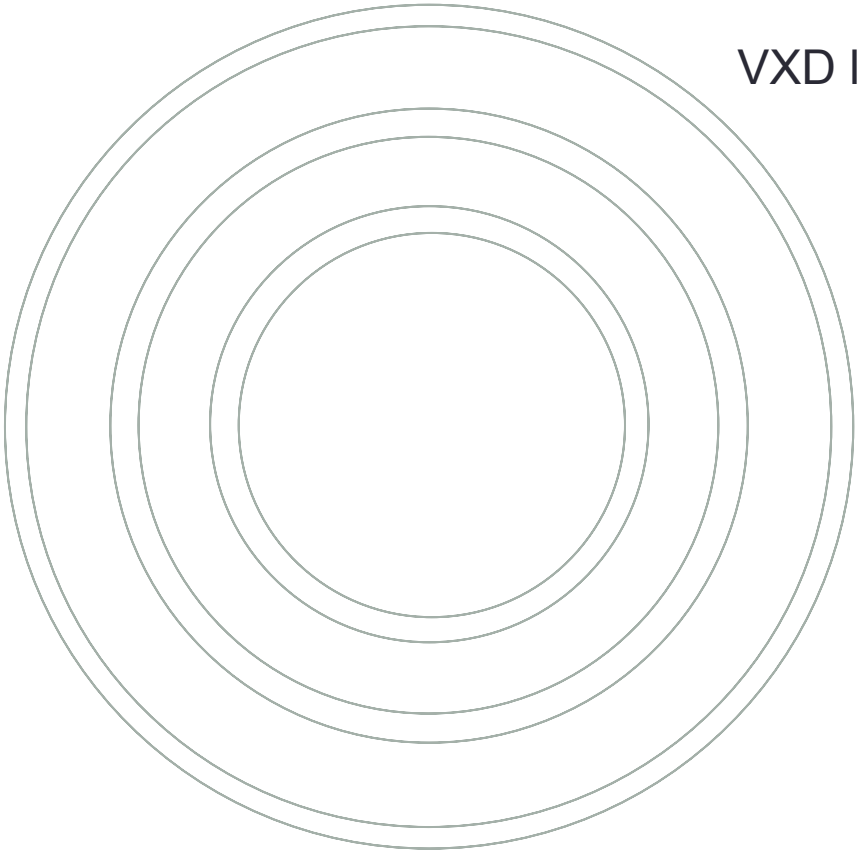
Tohoku Univ.
Tatsuya Mori

Track Finder (DBD ver.)



Silicon Tracking

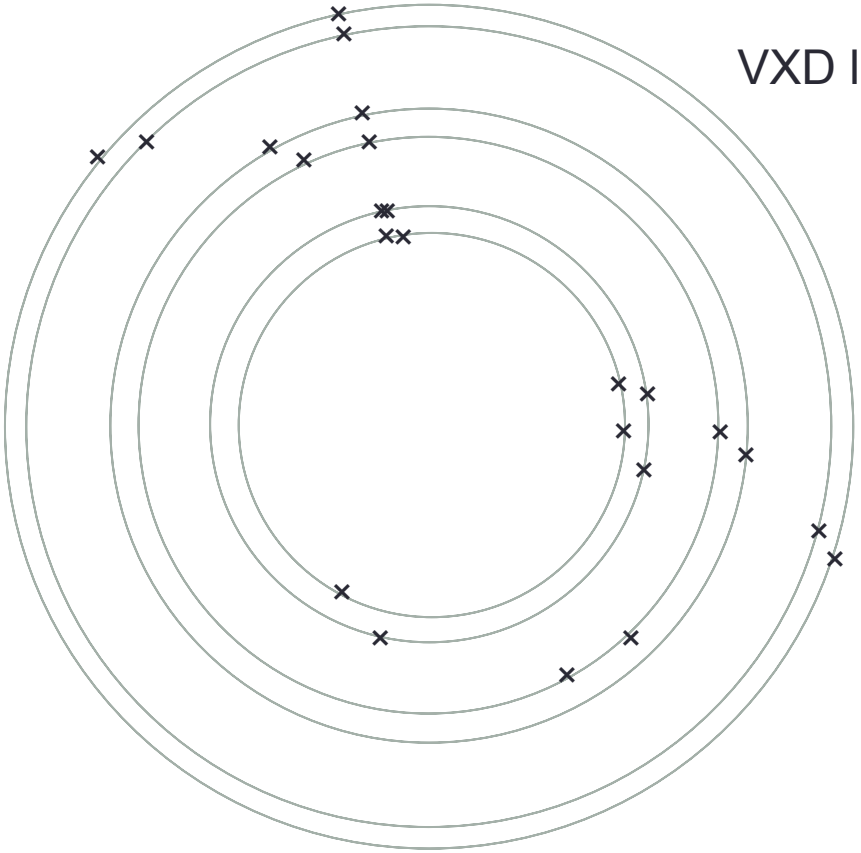
Although Silicon Tracking uses SIT and FTD, for ease we consider only VXD layers.



For ease we approximate VXD layers as cylindrical form

Silicon Tracking

Loading VXD



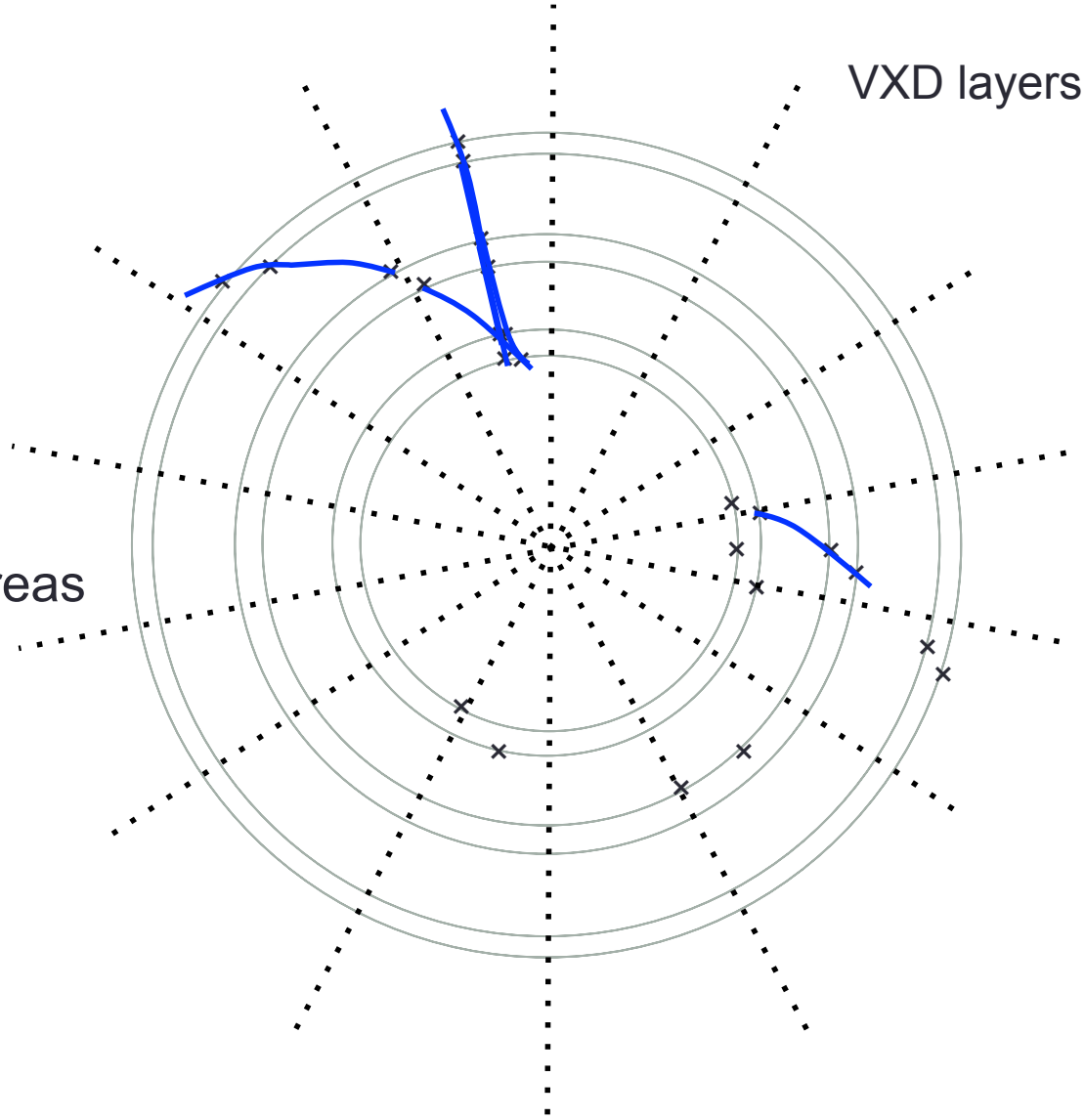
Silicon Tracking

Loading VXD

↓

track seed

We generate track seeds from
3 hits on some combinations of
3 layers and within one of the areas
divided in φ-direction



Silicon Tracking

Loading VXD

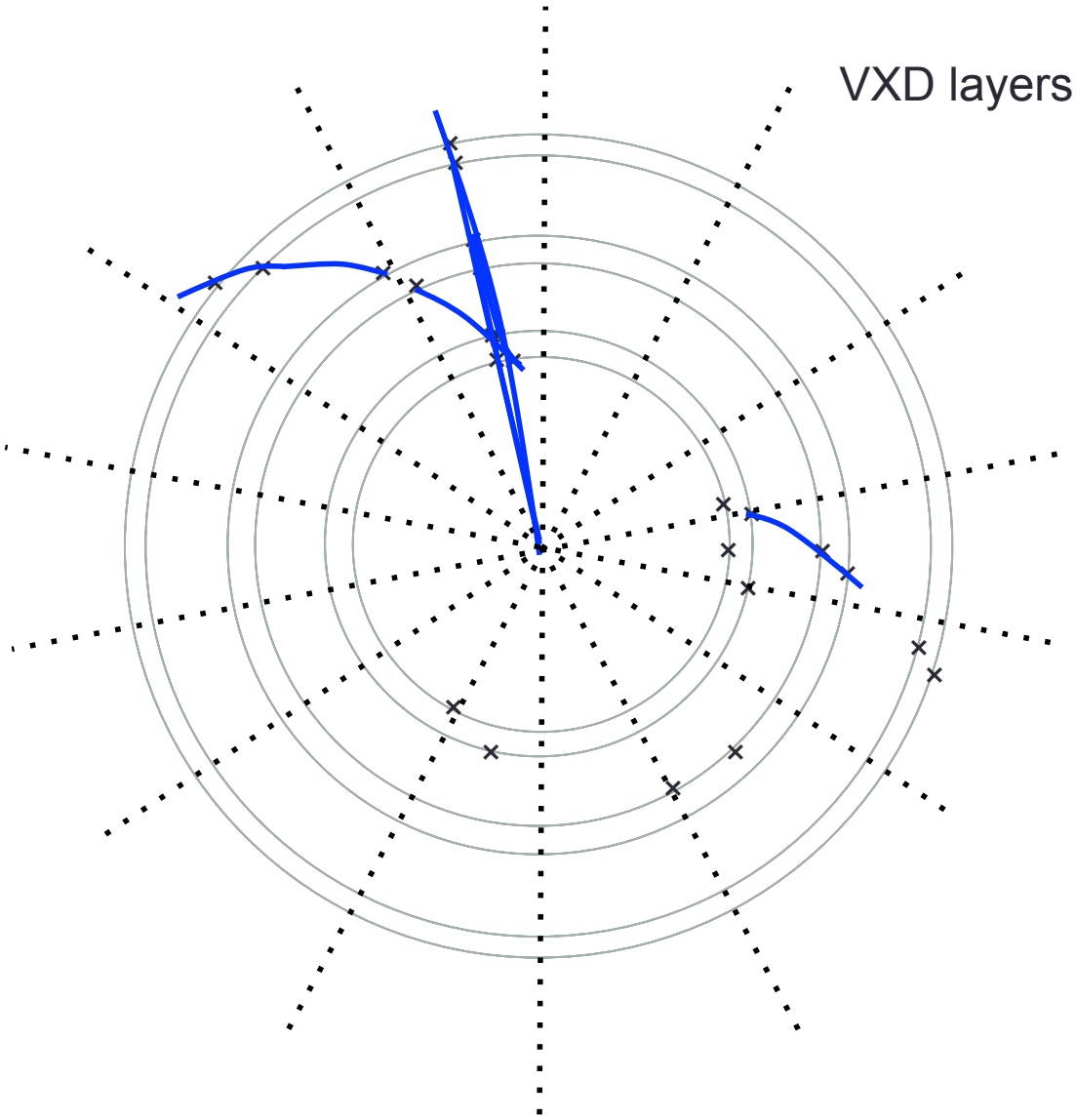
↓

track seed

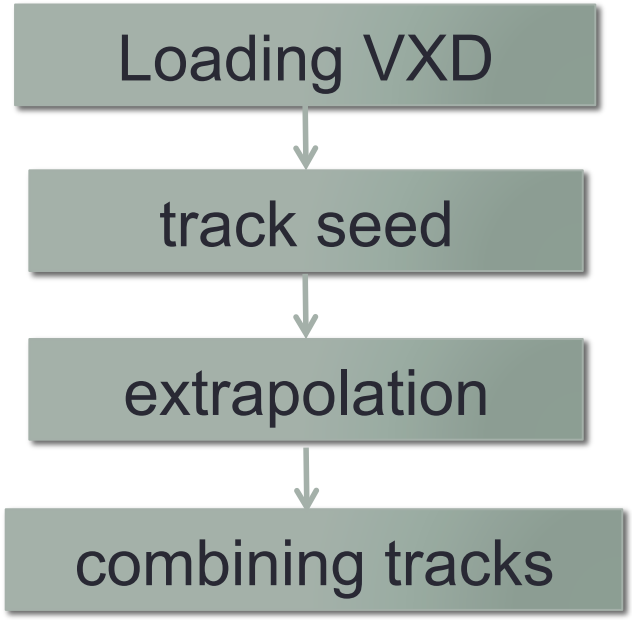
↓

extrapolation

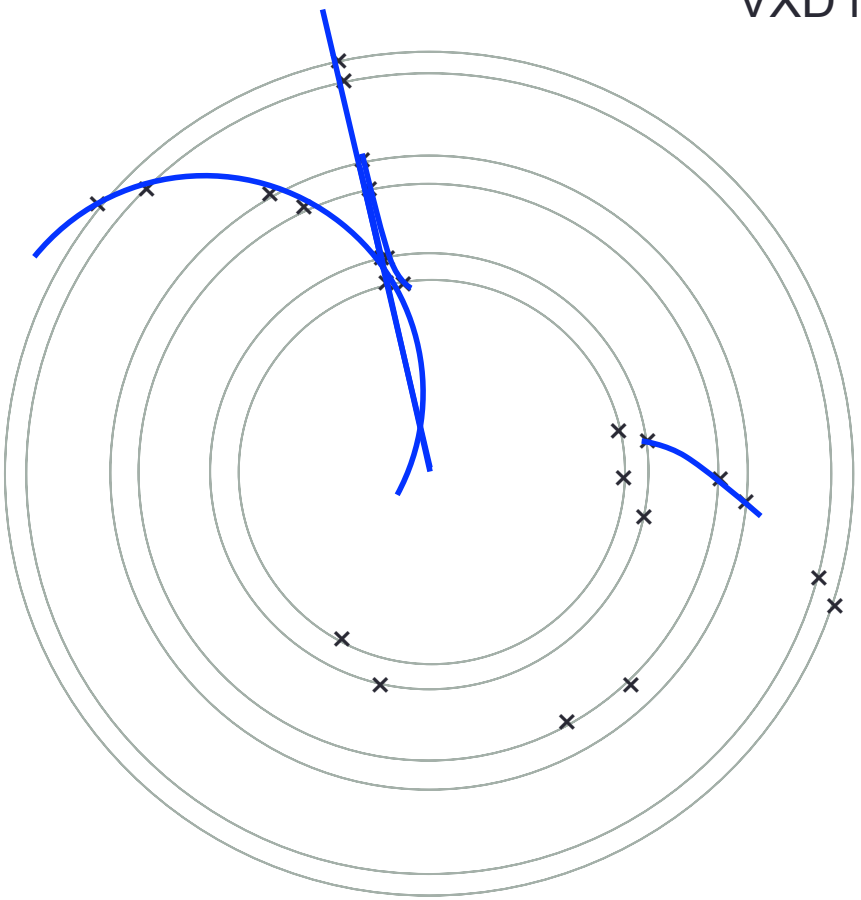
In the same area divided in φ-direction, we extrapolate hits one by one



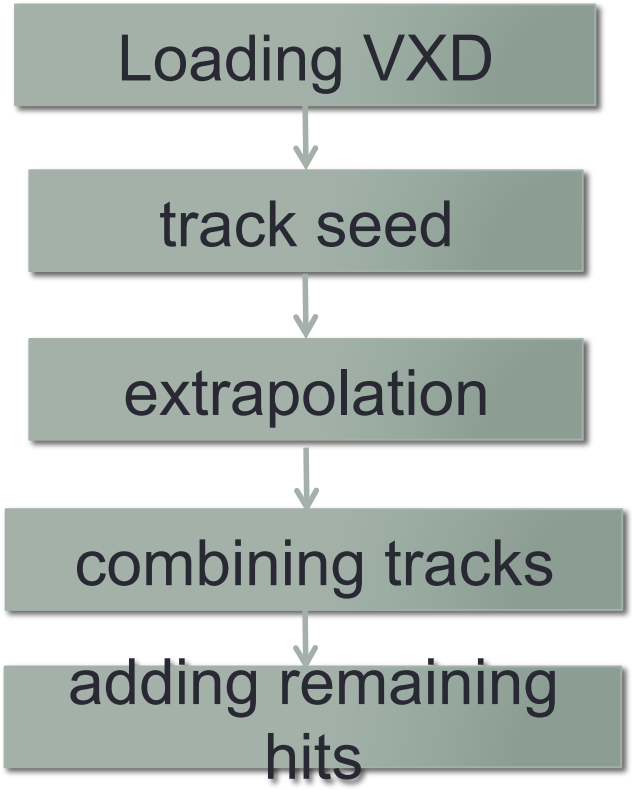
Silicon Tracking



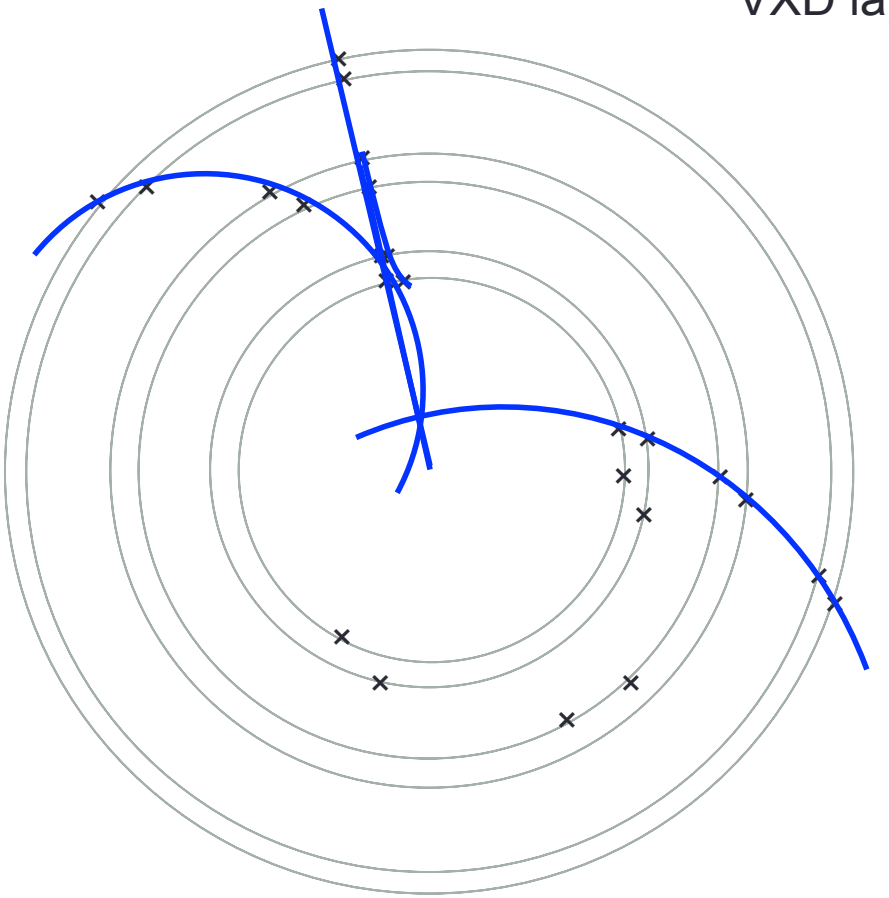
If possible, we combine
one track with another track



Silicon Tracking

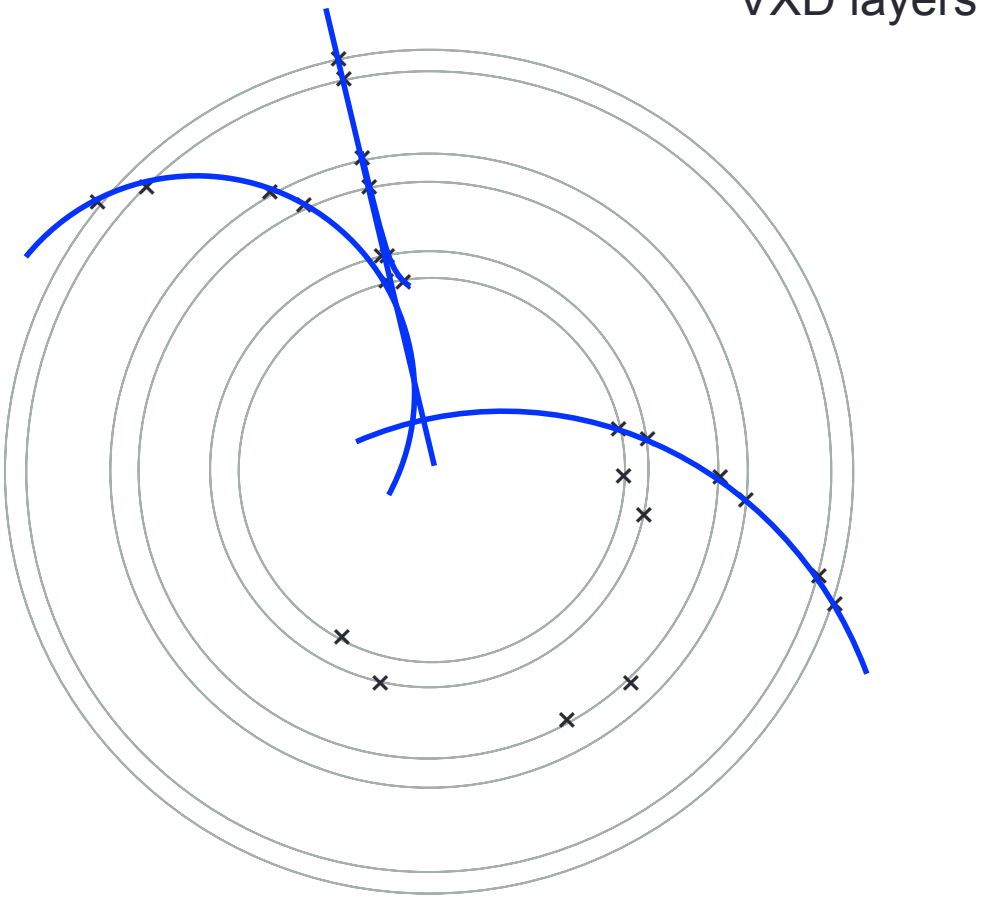


If possible, we add remaining hits to tracks



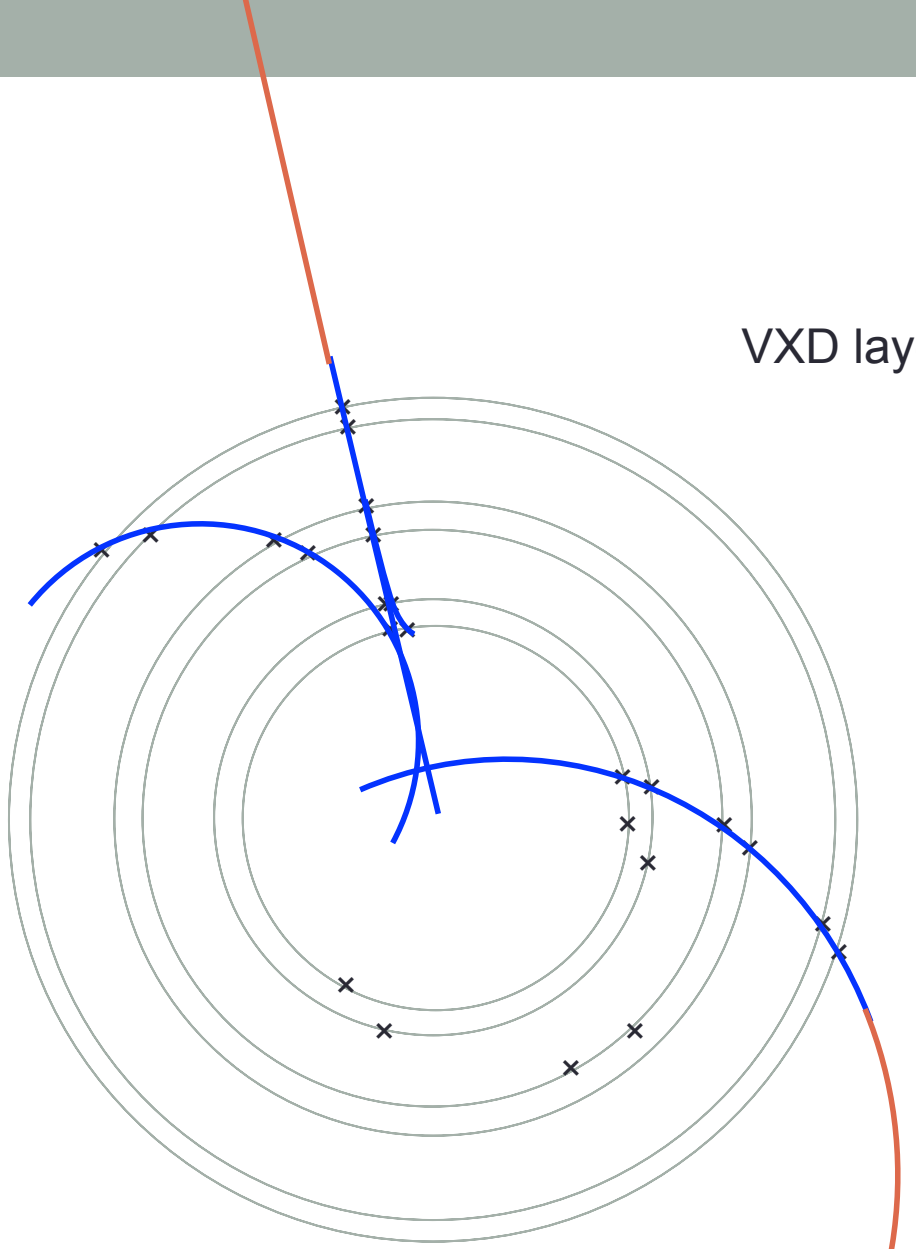
Silicon Tracking

- Loading VXD
- track seed
- extrapolation
- combining tracks
- adding remaining hits
- refit using Kalman Filter



Full Track

- Loading VXD
- track seed
- extrapolation
- combining tracks
- adding remaining hits
- refit using Kalman Filter
- combining TPC tracks with Si tracks



If possible, we combine one TPC track with one Si track and next refit using Kalman Filter

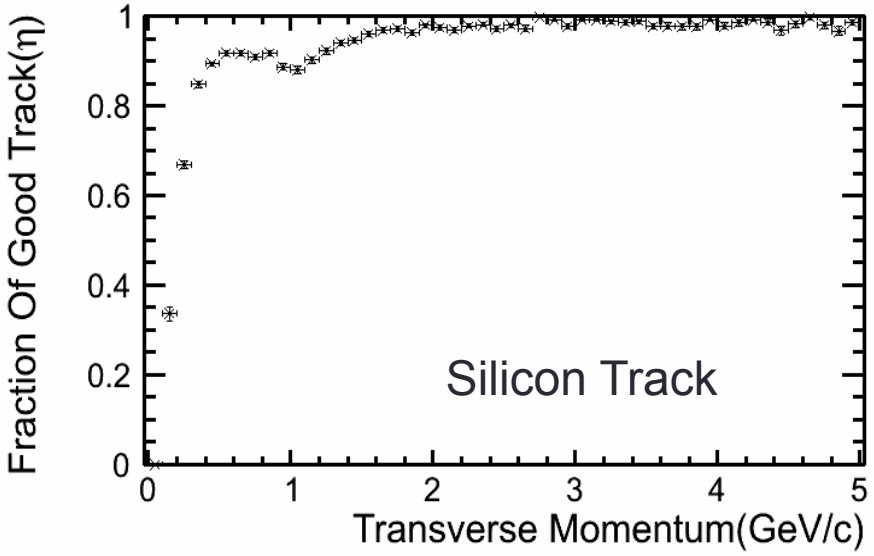
DBD ver. tracking + FPCCD

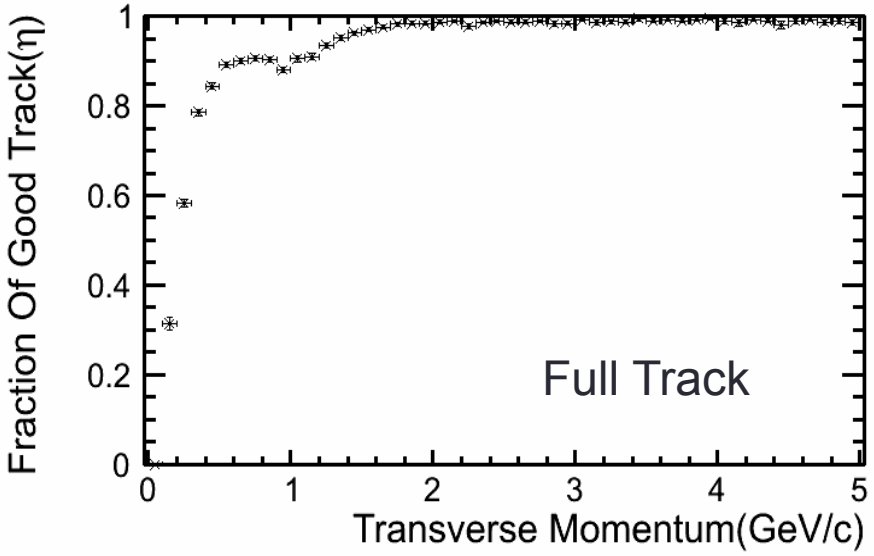
Fraction of Good Track : η ≡

$$\frac{\text{\# of tracks satisfying VXD hits >= 5 \&\& purity > 75\%}}{\text{\# of MCParticles creating VXD (SIT) hits >= 6 (4)}}$$

DBD ver. tracking + FPCCD vertex detector

sample: ttbar @ 350 GeV





That of Full Track becomes lower below 1.7GeV/c

About process time

Fraction of Good Track should finally be evaluated while pair BG is taken into accout

If we use KEKCC,

sample	processed evt	process time of tracking
ttbar @ 350GeV	1000	3h
ttbar + pair BG @ 350GeV	1	more than 2h (lower limit)

→ We need more efficient tracking algorithm

FPCCD Track Finder

goals :

1. η ~ 99% below P_T ~ 1.7GeV/c
2. decreasing process time

development policy :

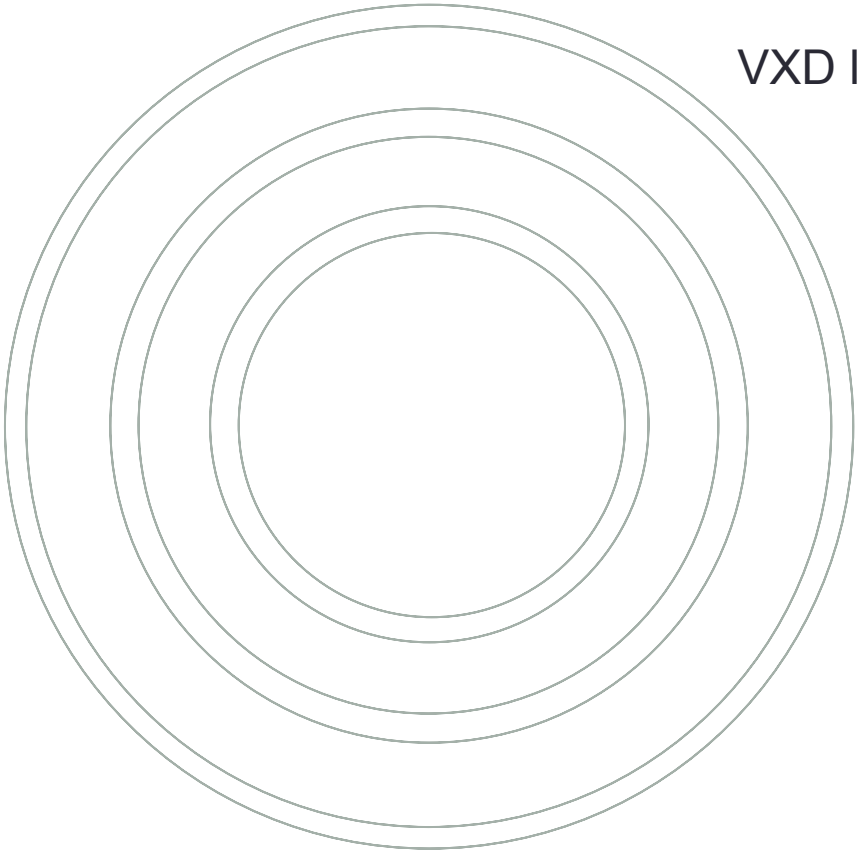
We assume Full Tracking be wrong, for Silicon Tracking is wrong.

We are developing Silicon Tracking

1. The way of dividing area in φ-direction →The more hits exists, The larger process time is
   - We change processes of track seed and extrapolation
2. Fitter used in extrapolation : Simple Helix Fit
   - Instead of this, we use Kalman Filter
3. Cluster information of FPCCD is unused until now
   - It is used in FPCCD Track Finder

FPCCD Track Finder

Although Silicon Tracking uses SIT and FTD, for ease we consider only VXD layers.

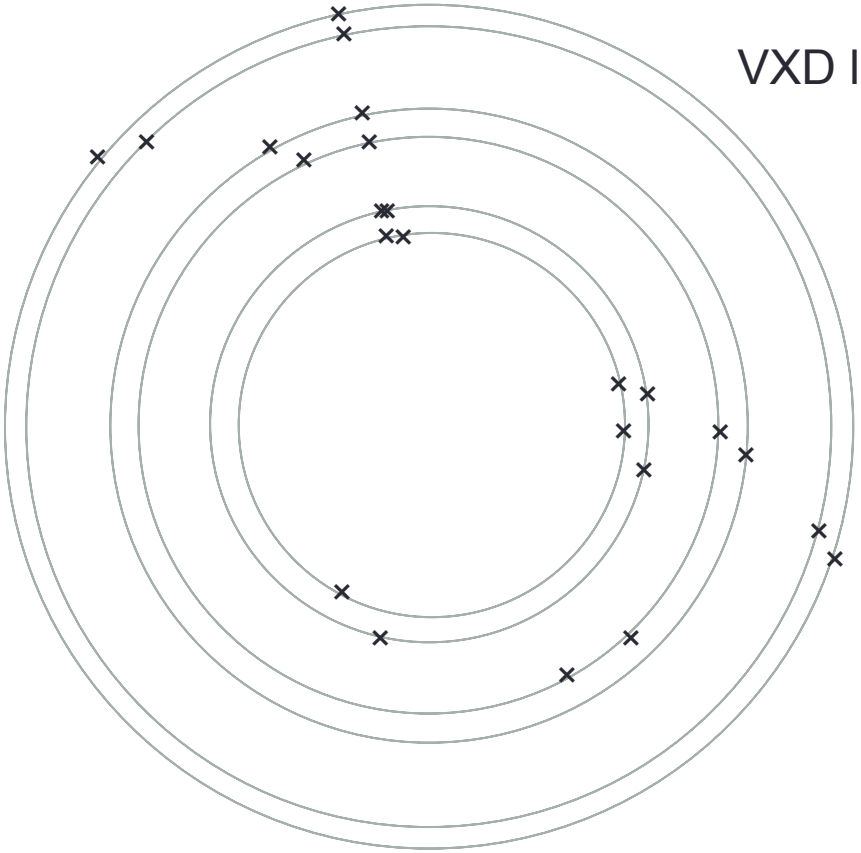


VXD layers

For ease we approximate VXD layers as cylindrical form

FPCCD Track Finder

Loading VXD



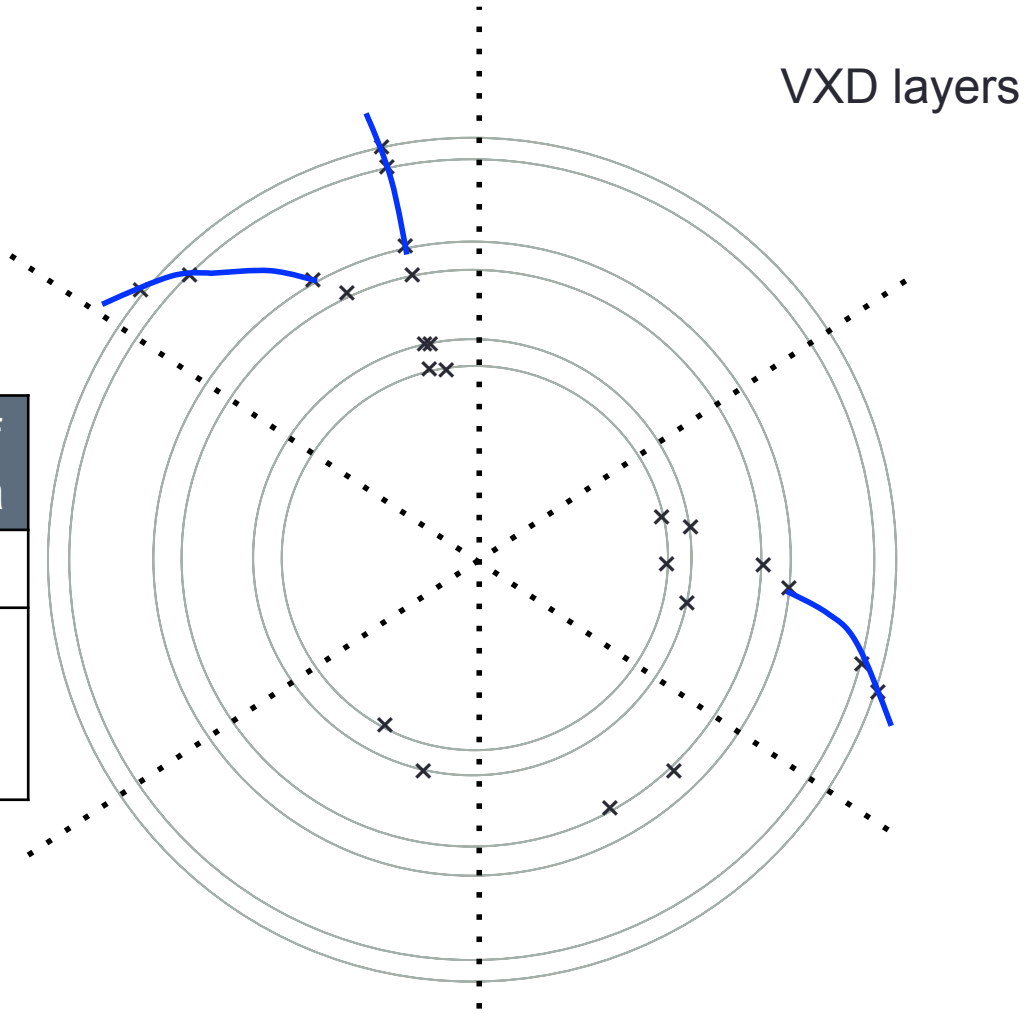
FPCCD Track Finder

Loading VXD

↓

track seed

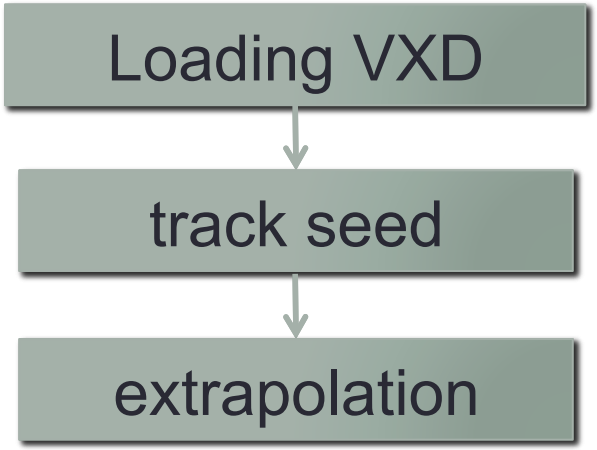
Track Finder	layers used to make seeds	φ width of each area
DBD ver	all	4.5°
FPCCD TF	outer 3 layers of VXD (※1)	changable(※2)

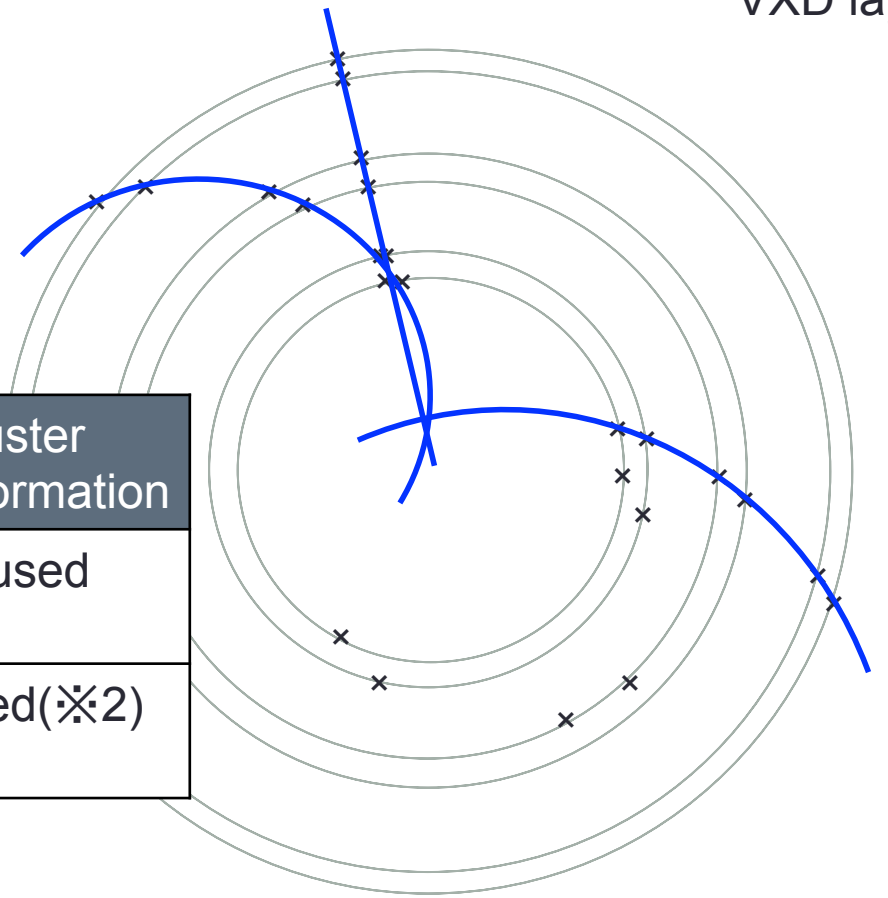


※1 : これに加え実際にはSITのレイヤーも使うが簡単のため省略。現行版も同様 (Appendix : A)

※2 : P_T > 0.18GeV/cのトラックを拾うために必要なφ幅になるよう変動 (Appendix : B)

FPCCD Track Finder

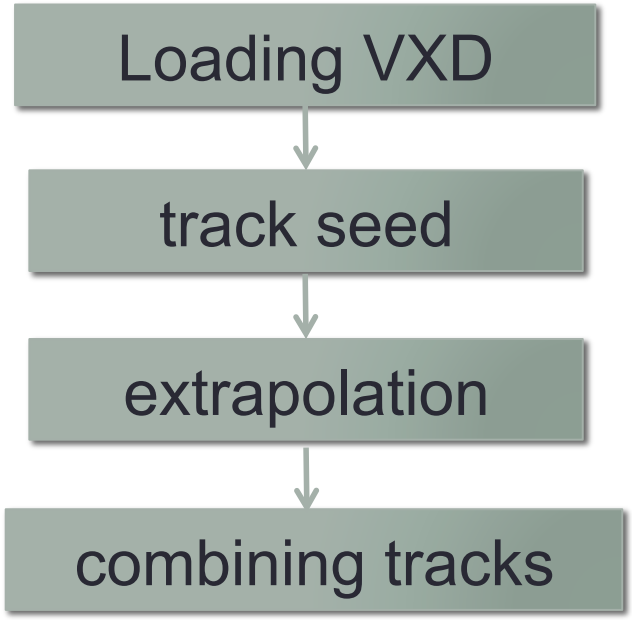




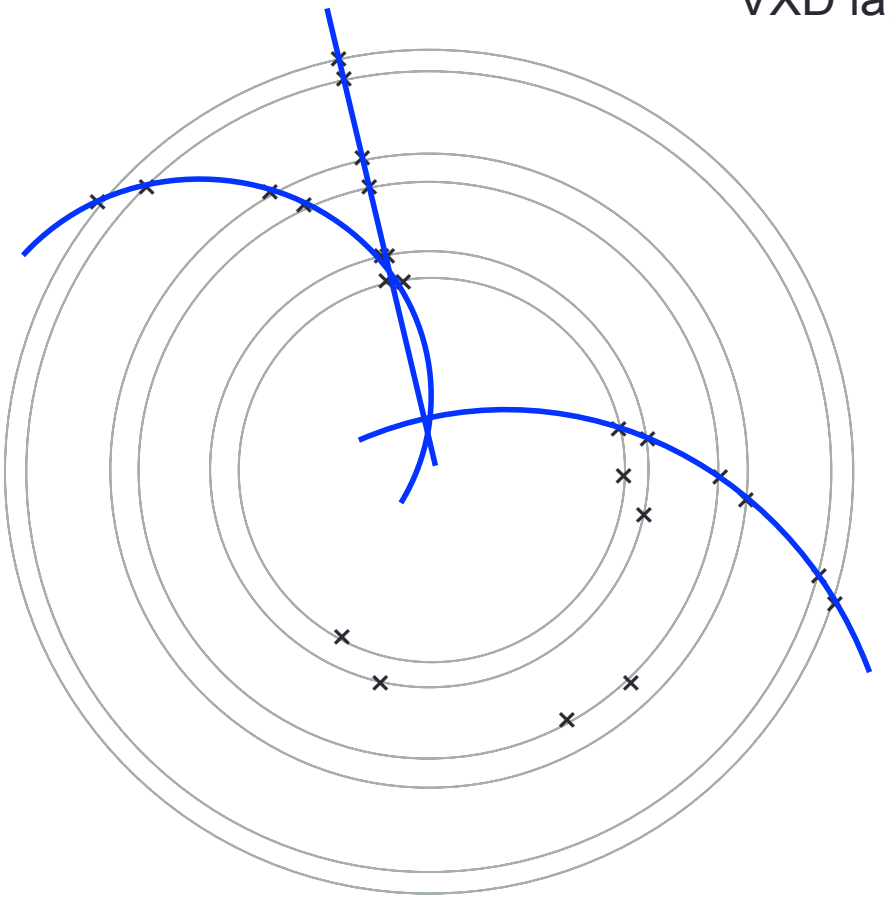
Track Finder	Fitter	region for extrapolation	Cluster information
DBD ver.	Simple Helix Fit	in each φ area	unused
FPCCD TF	Kalman Filter	changable(※1)	used(※2)

※1：1ヒットを外挿する度にフィッターから得られるトラックパラメター
とその誤差から次の外挿エリアを決定 (Appendix : C)
※2：外挿候補のクラスターの形状から間違ったヒットを外挿する確率を減らす (Appendix : D)

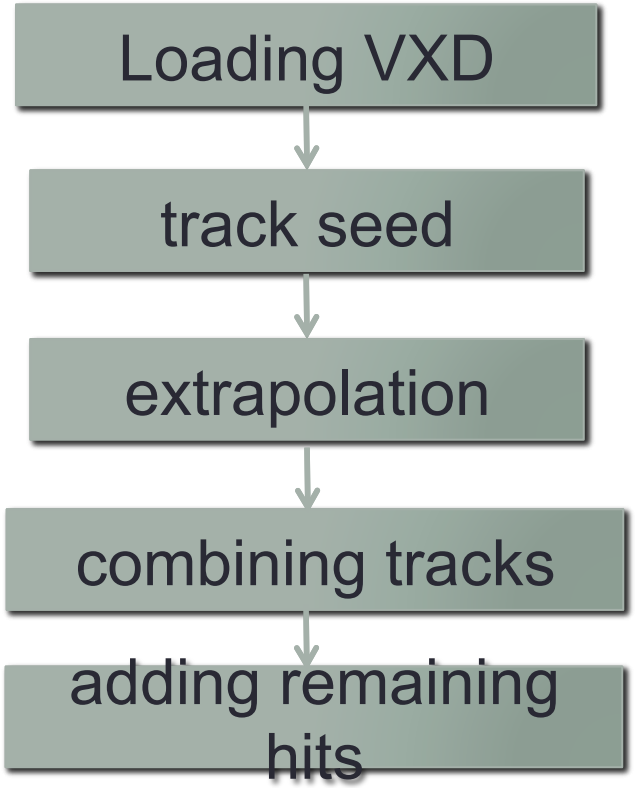
FPCCD Track Finder

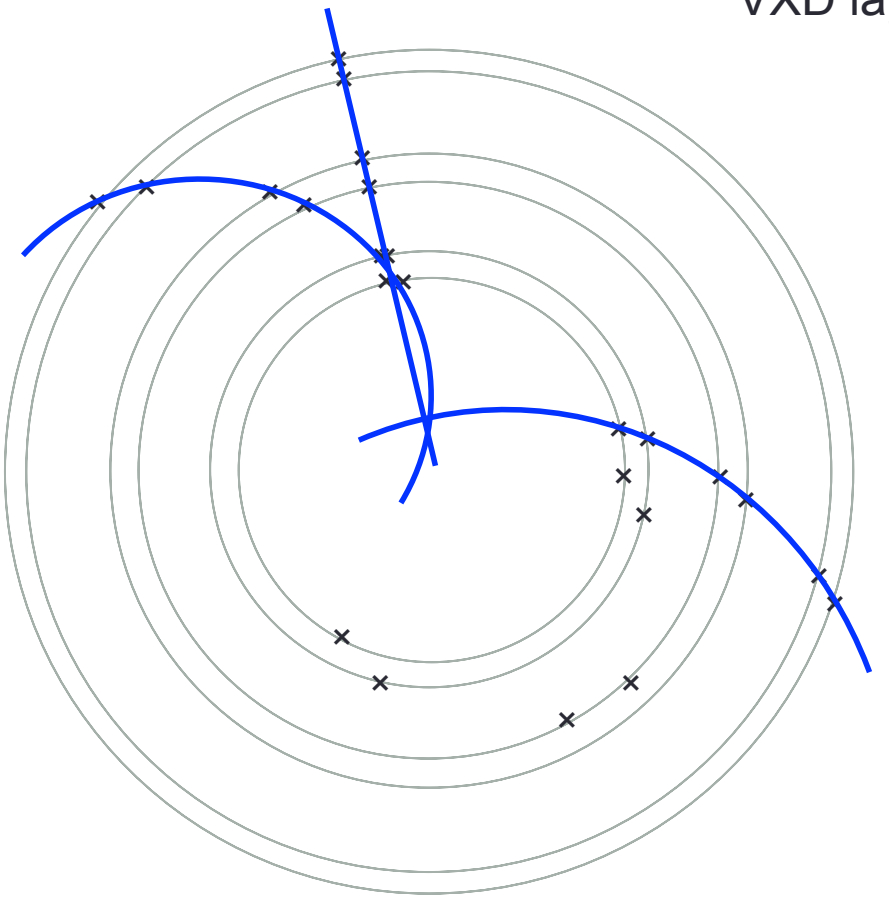


This is same as DBD ver. except that crucial bug is removed (Appendix : E)



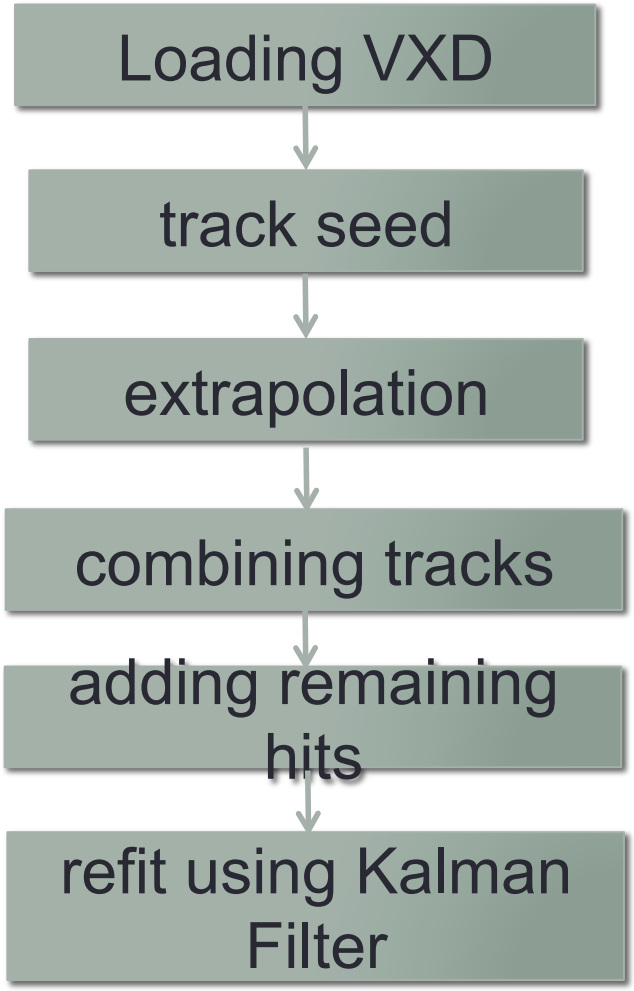
FPCCD Track Finder

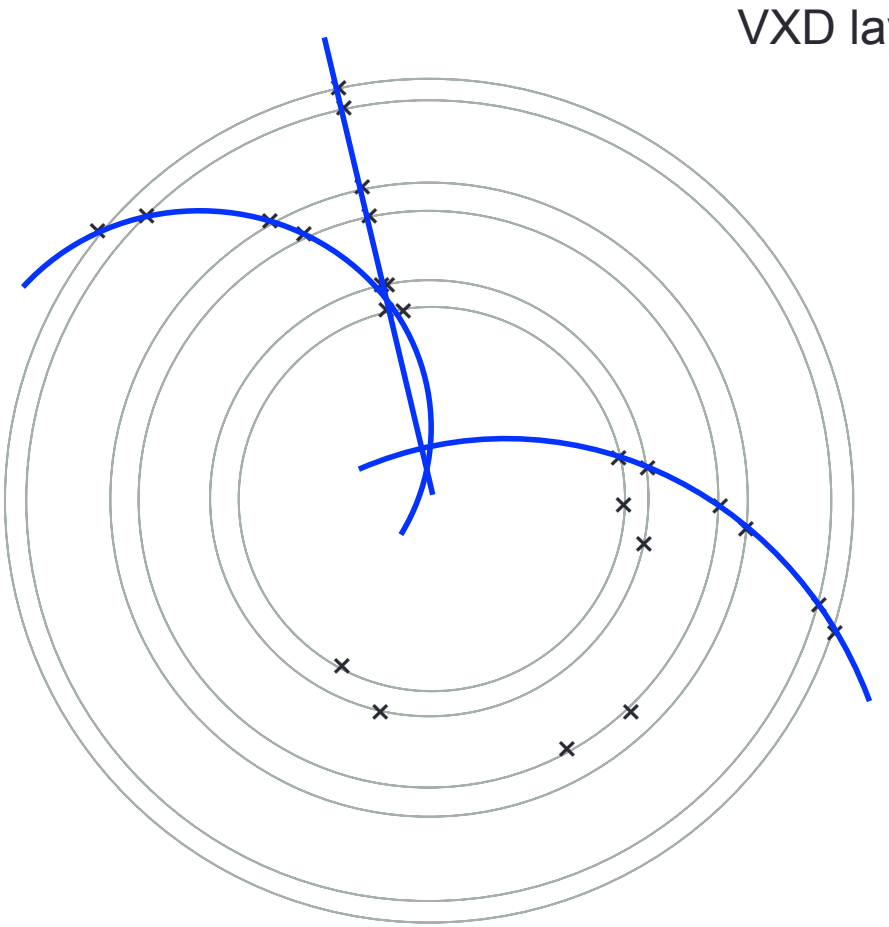




This part is same as that of DBD ver.

FPCCD Track Finder

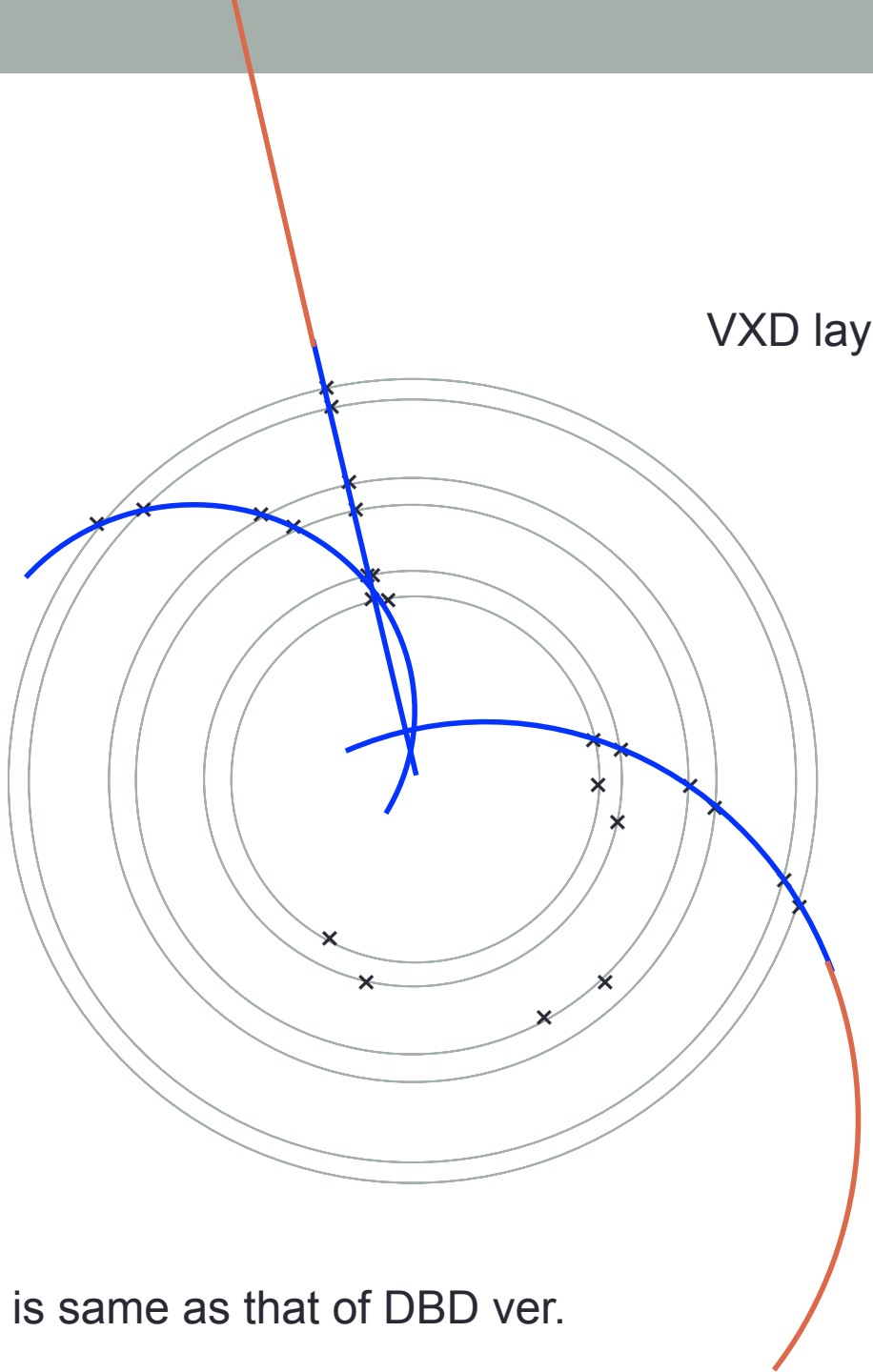




This part is same as that of DBD ver.

FPCCD Track Finder

- Loading VXD
- track seed
- extrapolation
- combining tracks
- adding remaining hits
- refit using Kalman Filter
- combining TPC tracks with Si tracks



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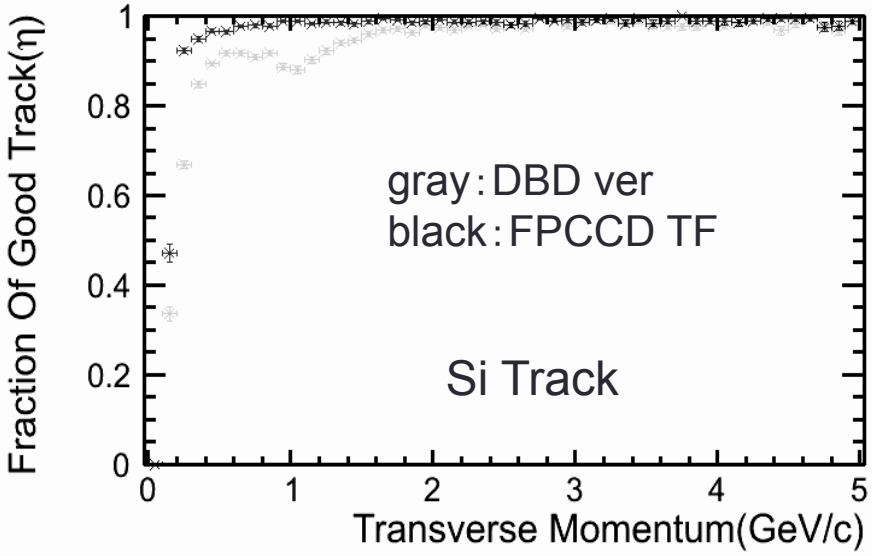
Performance of FPCCD Track Finder

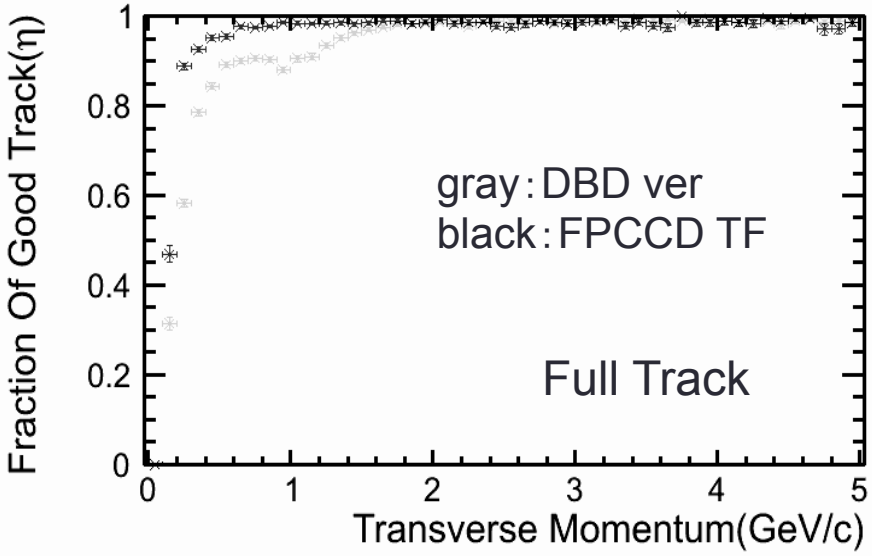
Fraction of Good Track : η ≡

$$\frac{\text{\# of tracks satisfying VXD hits >= 5 \&\& purity > 75\%}}{\text{\# of MCParticles creating VXD (SIT) hits >= 6 (4)}}$$

FPCCD Track Finder + FPCCD Vertex Detector

Sample: ttbar @ 350 GeV





Full Track keeps η ~ 99% until 0.6 GeV/c

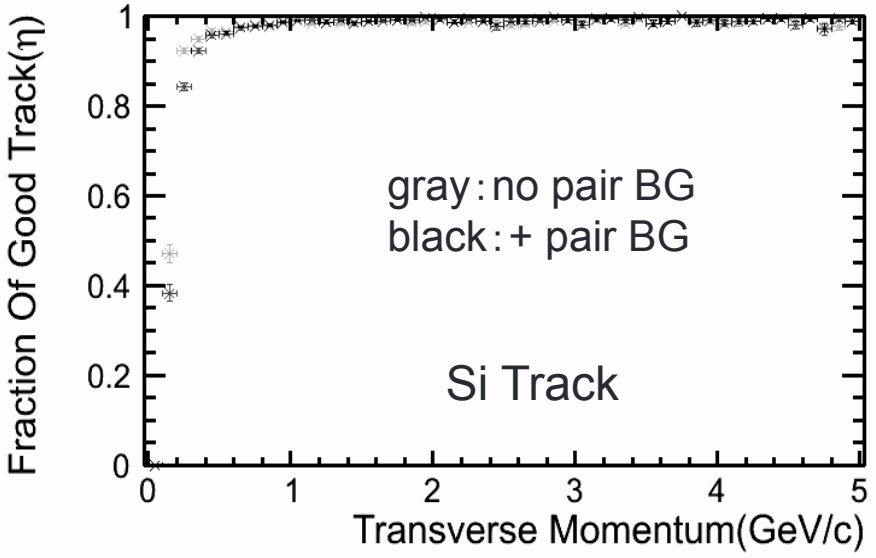
Performance of FPCCD Track Finder

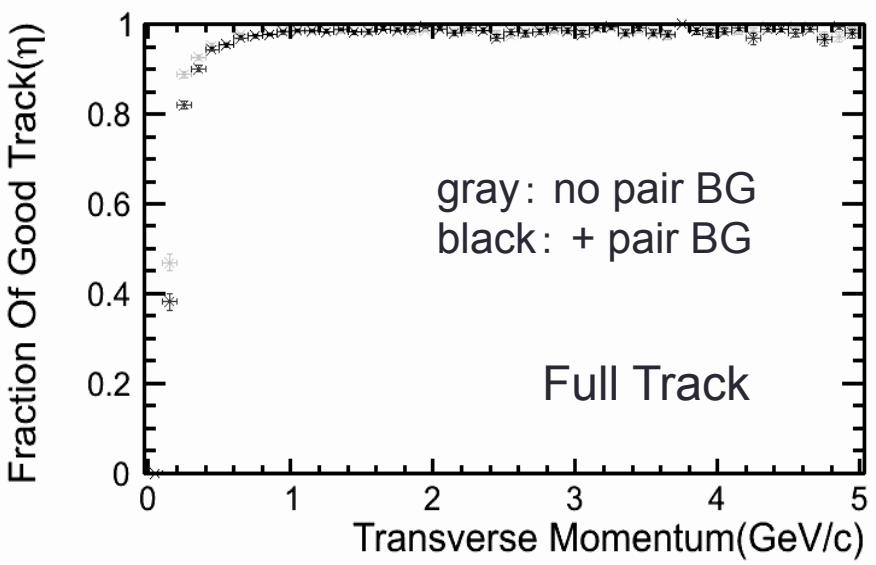
Fraction of Good Track : η ≡

$$\frac{\text{\# of tracks satisfying VXD hits >= 5 \&\& purity > 75\%}}{\text{\# of MCParticles creating VXD (SIT) hits >= 6 (4)}}$$

FPCCD Track Finder + FPCCD Vertex Detector

Sample: ttbar + pair BG @ 350 GeV





Some deterioration can be seen in low P_T region

Performance of Flavor Tagging

- Now being prepared
- For practice and bug check, at first Z->qq (91.2GeV) will be evaluated

To do list for now
- Z->qq (Ecm = 250GeV)
- + pair BG
- ttbar (Ecm = 350GeV)
- + pair BG

Summary & Plan

- FPCCD Track Finder improved Fraction of Good Track
  - The development will be continued

- We plan to evaluate Flavor Tagging with FPCCD Track Finder

Appendix

Appendix : A
トラックシード生成に使うレイヤーの組み合わせ

レイヤーID	衝突点からの距離（半径）[mm]	検出器の種類
0	16	VXD
1	18	VXD
2	37	VXD
3	39	VXD
4	58	VXD
5	60	VXD
6	153	SIT
8	300	SIT

現行のスタンドアロン・シリコントラッキング
8 6 5　8 6 4　8 6 3　8 6 2
8 5 3　8 5 2　8 4 3　8 4 2
6 5 3　6 5 2　6 4 3　6 4 2
6 3 1　6 3 0　6 2 1　6 2 0
5 3 1　5 3 0　5 2 1　5 2 0
4 3 1　4 3 0　4 2 1　4 2 0
(計24通り)

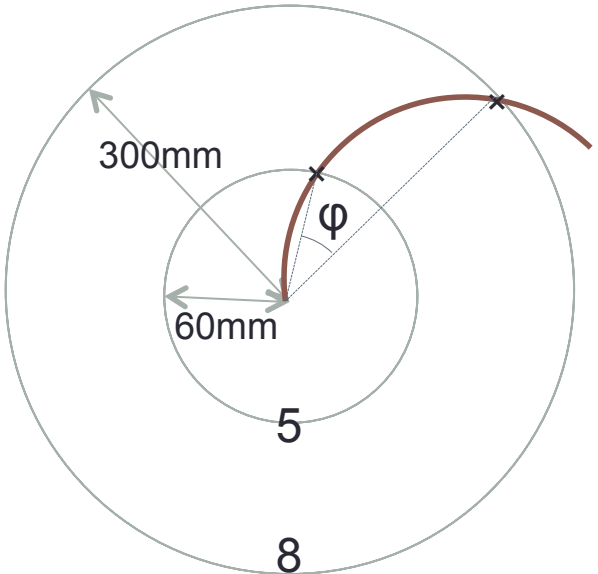
FPCCD専用トラックファインダー
8 6 5　8 6 4　8 5 4　6 5 4
5 4 3
(計5通り)

Appendix : B
トラックシードのサーチエリアのφ幅の決め方

レイヤーID	衝突点からの距離（半径）[mm]	検出器の種類
0	16	VXD
1	18	VXD
2	37	VXD
3	39	VXD
4	58	VXD
5	60	VXD
6	153	SIT
8	300	SIT

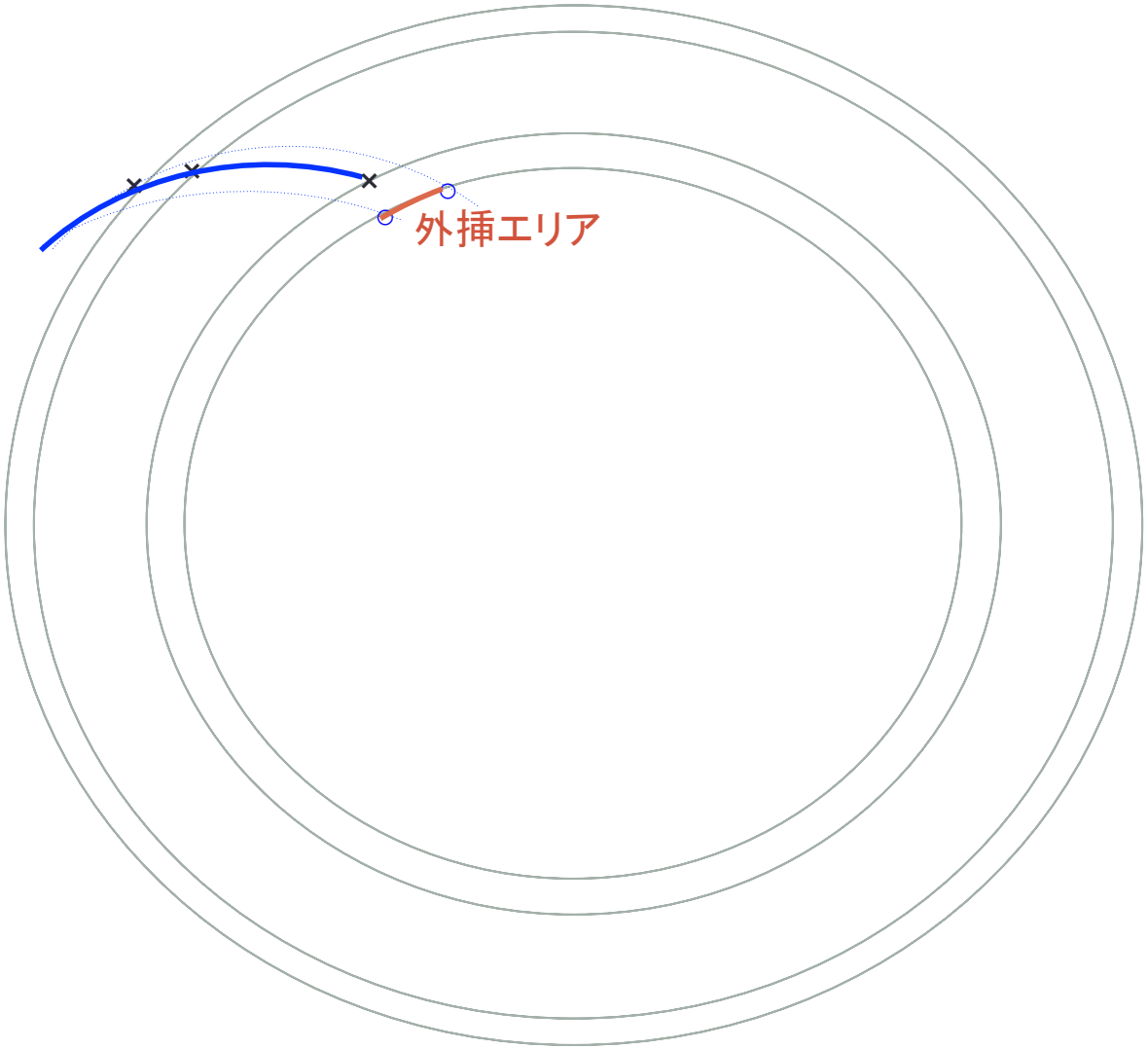
FPCCD専用トラックファインダー
8 6 5　8 6 4　8 5 4　6 5 4
5 4 3
(計5通り)

例：
8 6 5の組合せでトラックシードを作る場合、
P_T = 0.18 GeV/cの円弧と8,5のレイヤーとの交点からφ幅を決定



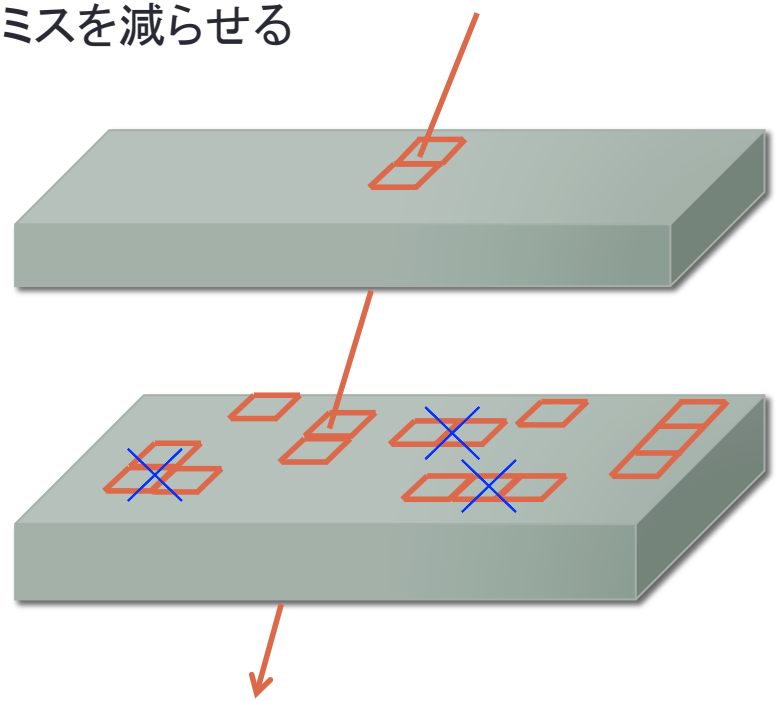
Appendix : C
外挿処理における外挿エリアの決め方

トラックパラメターの
d0, z0, omegaとその誤差
から外挿範囲を決める

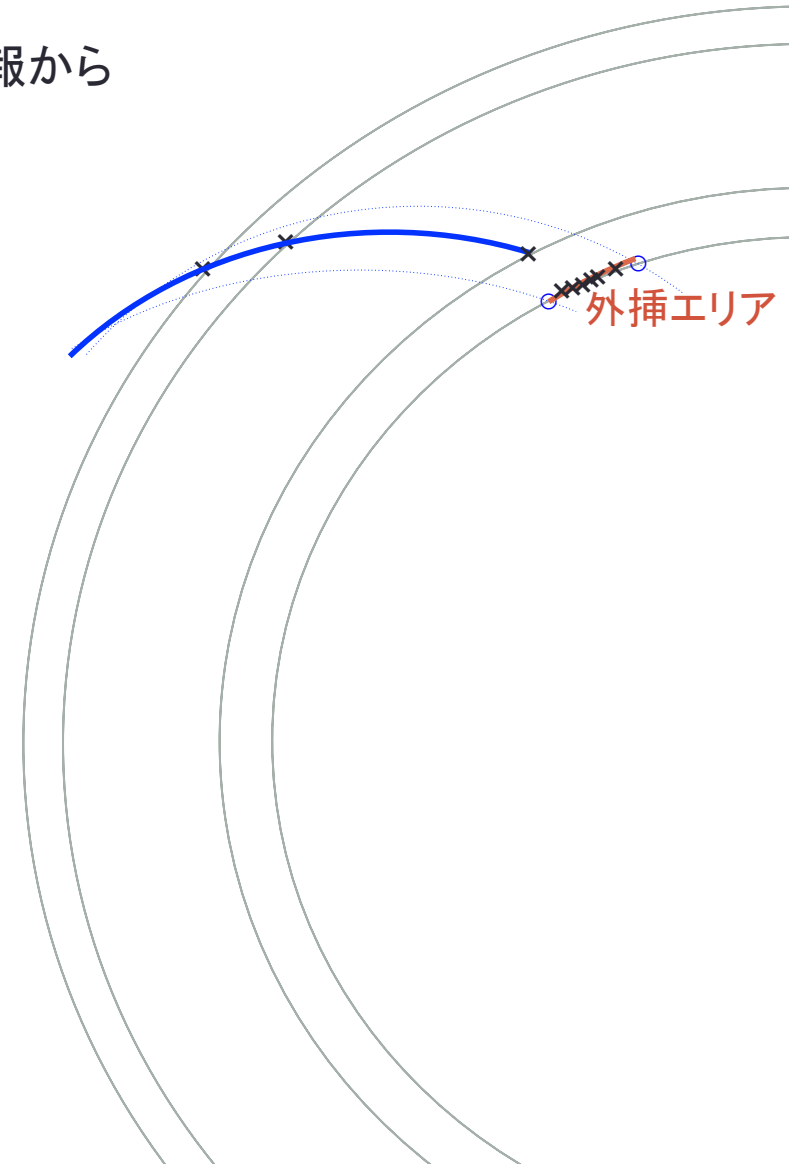


Appendix : D
クラスターの情報を活かした外挿処理

外挿エリアに多数のヒットがある場合、クラスターの情報から
外挿ミスを減らせる



外挿候補のクラスターの内、
トラックシードのクラスターと内積を
とり、0.4以下のものは候補からはずす



Appendix : E

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