

## フェルミ粒子

	第1世代	第2世代	第3世代
クォーク	u アップ クォーク	c チャーム クォーク	t トップ クォーク
	d ダウントク クォーク	s ストレンジ クォーク	b ボトム クォーク
レプトン	e 電子	$\mu$ ミュー粒子	$\tau$ タウ粒子
	$\nu_e$ 電子 ニュートリノ	$\nu_\mu$ ミュー ニュートリノ	$\nu_\tau$ タウ ニュートリノ

## ゲージ粒子



Pre-preparatory Phase

Main Preparatory Phase

Construction / Operation Phase

政府間議論

政府間交渉

ILC Laboratory

European Strategy for  
Particle Physicsのアップデート

日本学術会議のマスタープラン

ILCの活動

- LCB / LCC
- KEK Planning Office for ILC etc.

政府間交渉の開始

政府間合意

ILC準備研究所

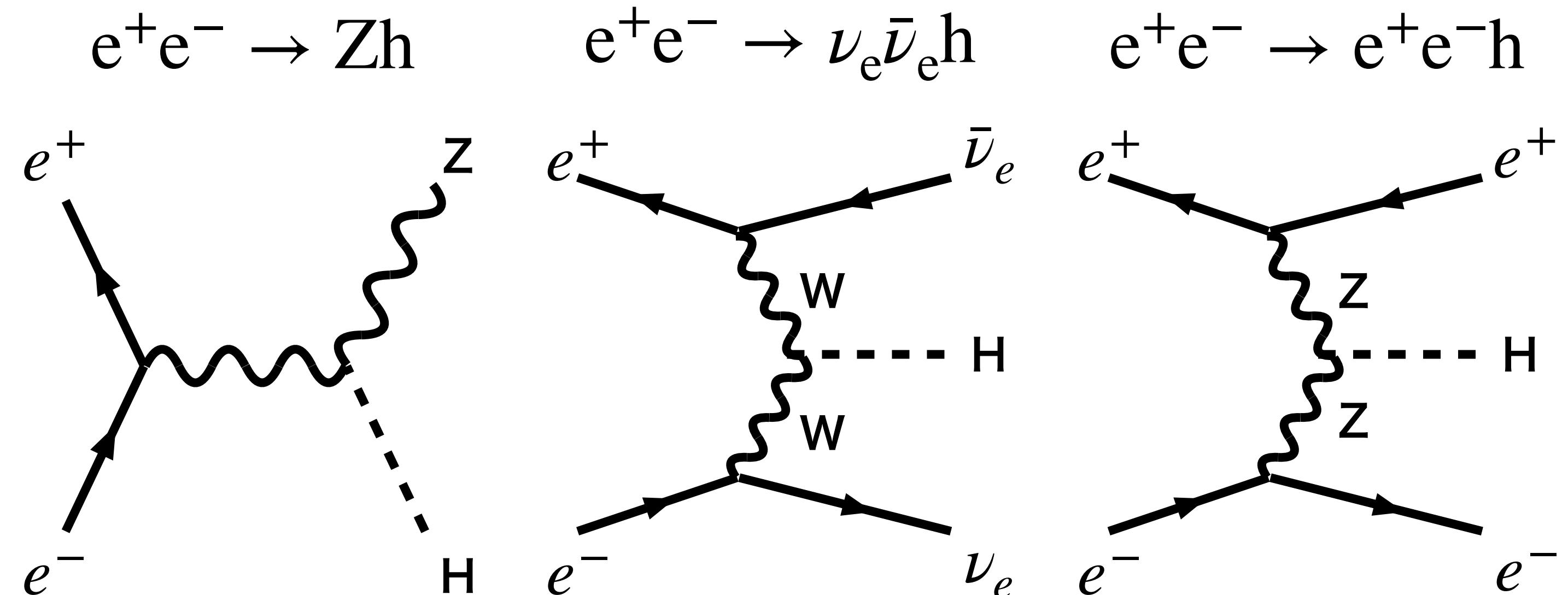
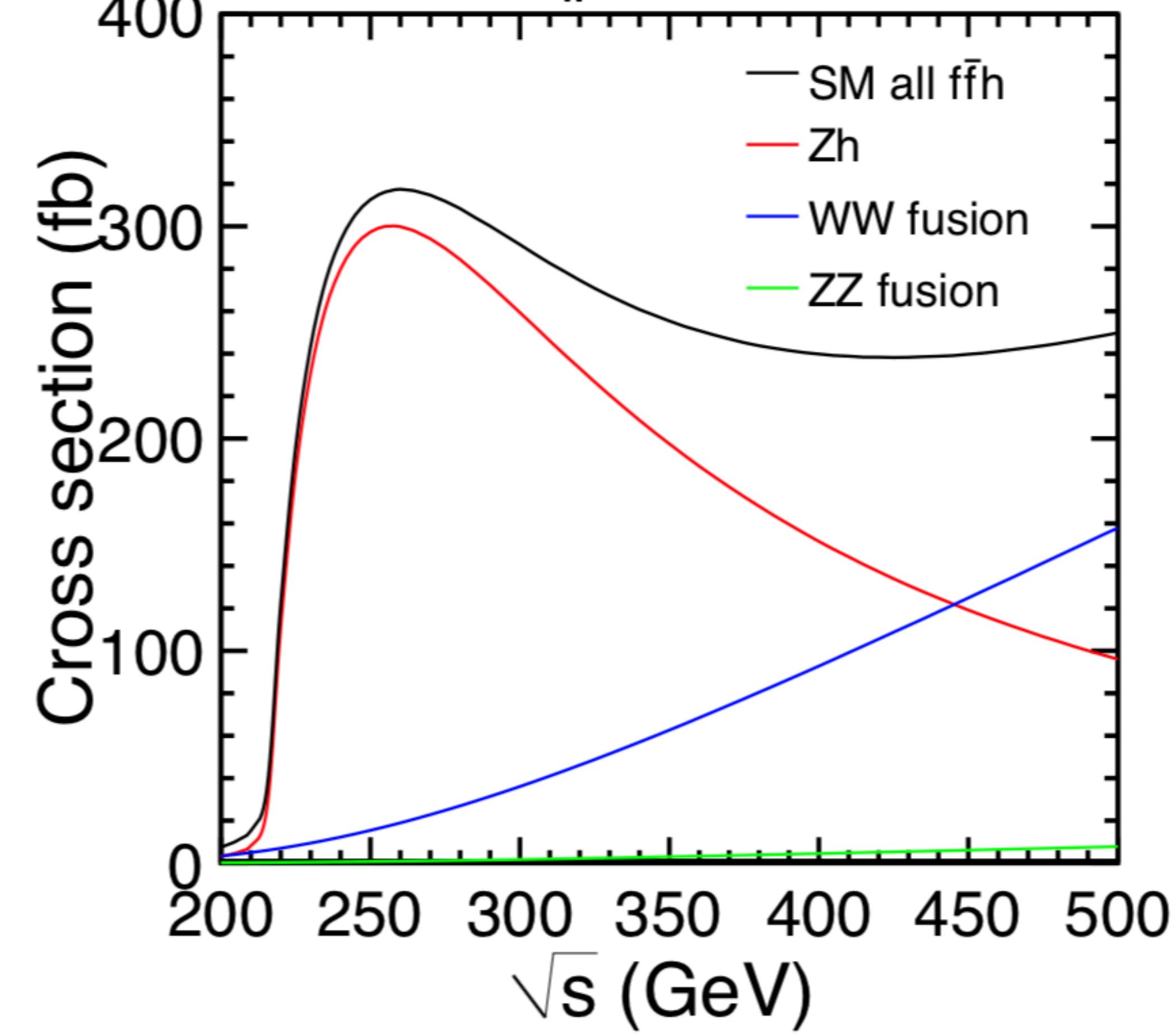
Light-weight  
MoUs

Detailed  
MoUs

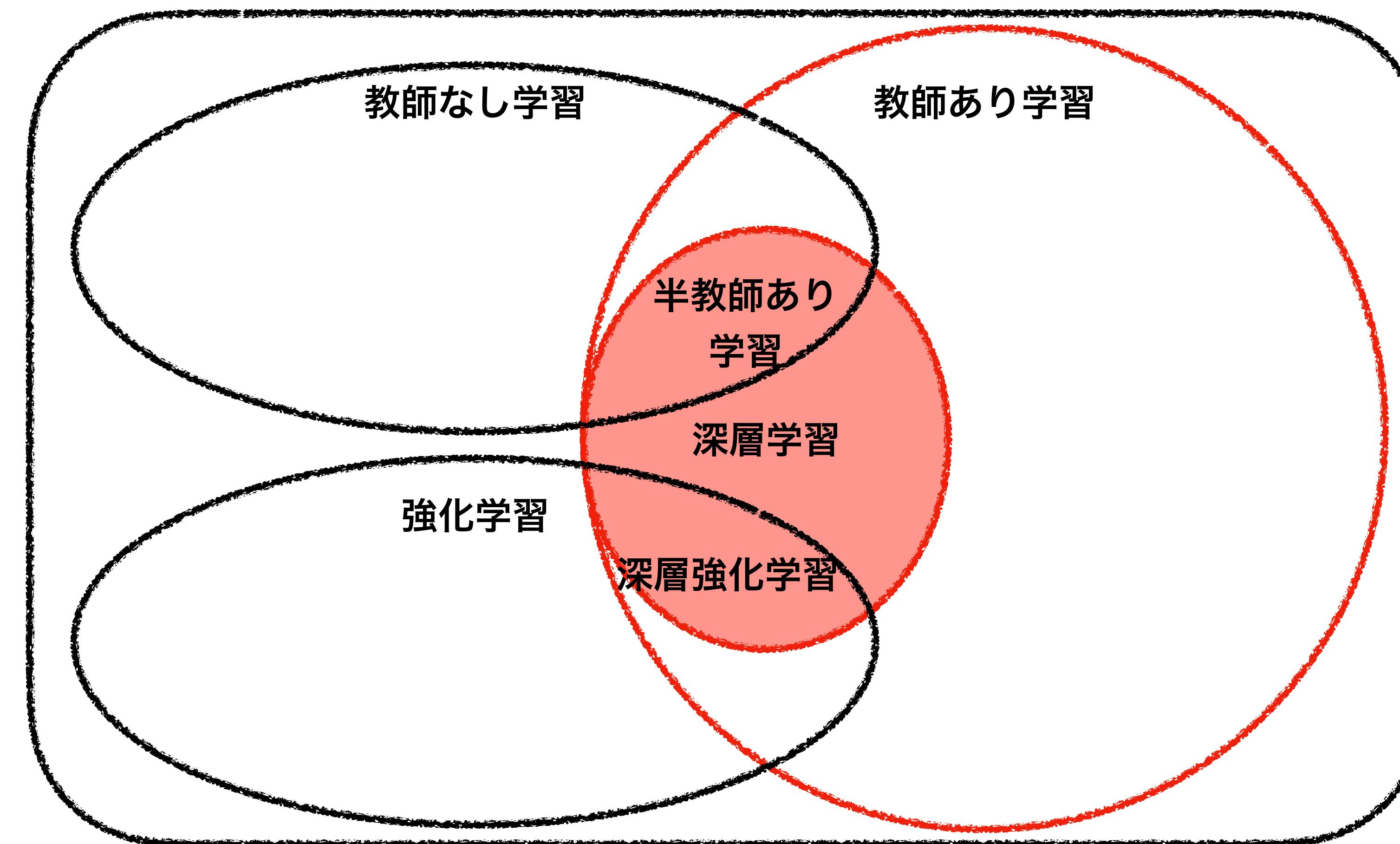
建設

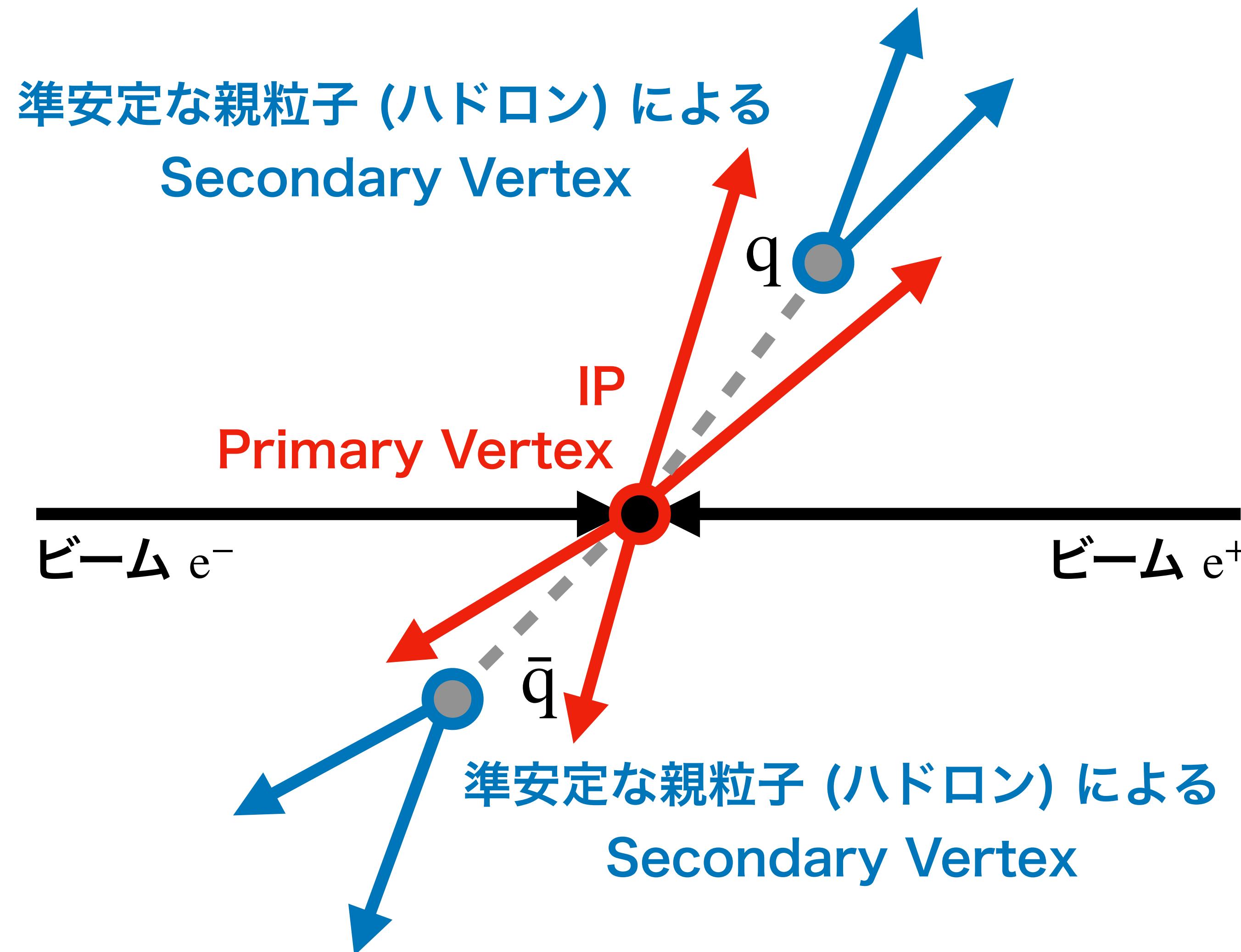
運転

$P(e^-, e^+) = (-0.8, 0.3)$ ,  $M_h = 125 \text{ GeV}$

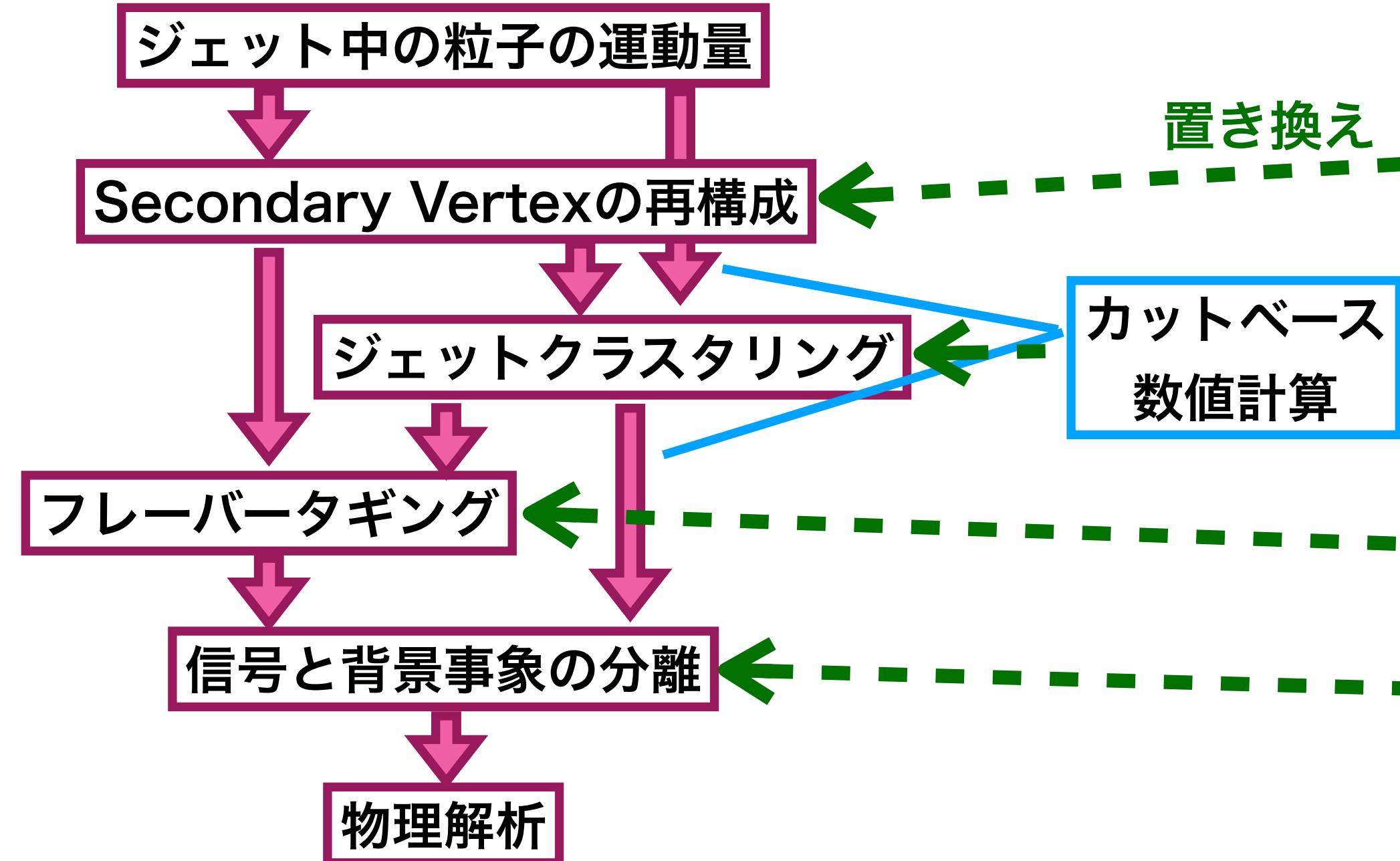


# 機械学習

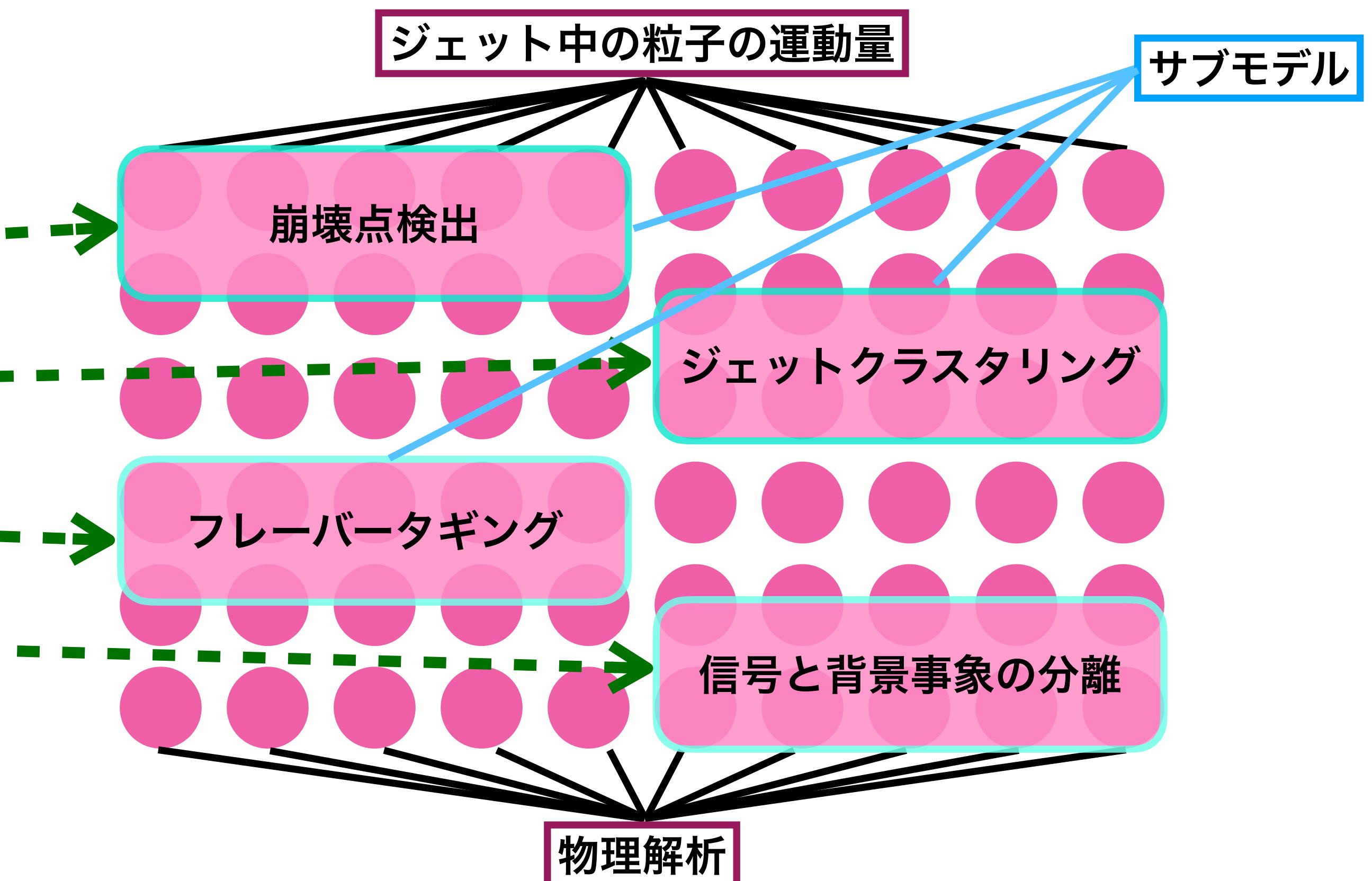


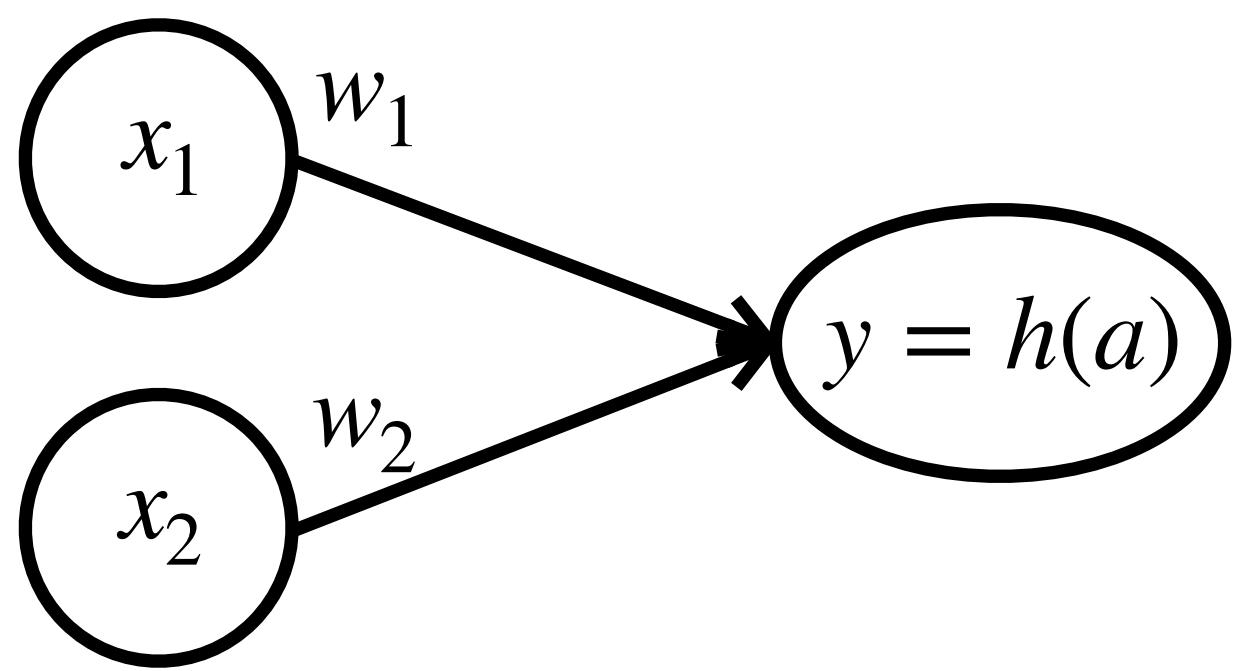


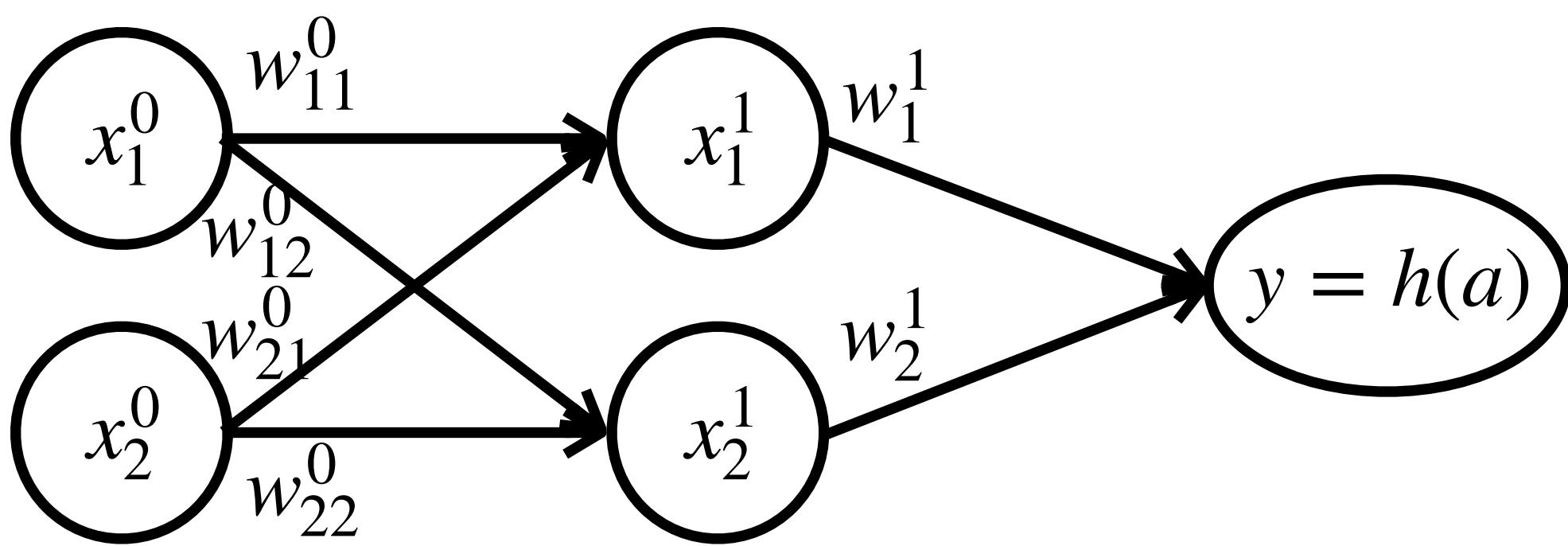
## 現行の手法



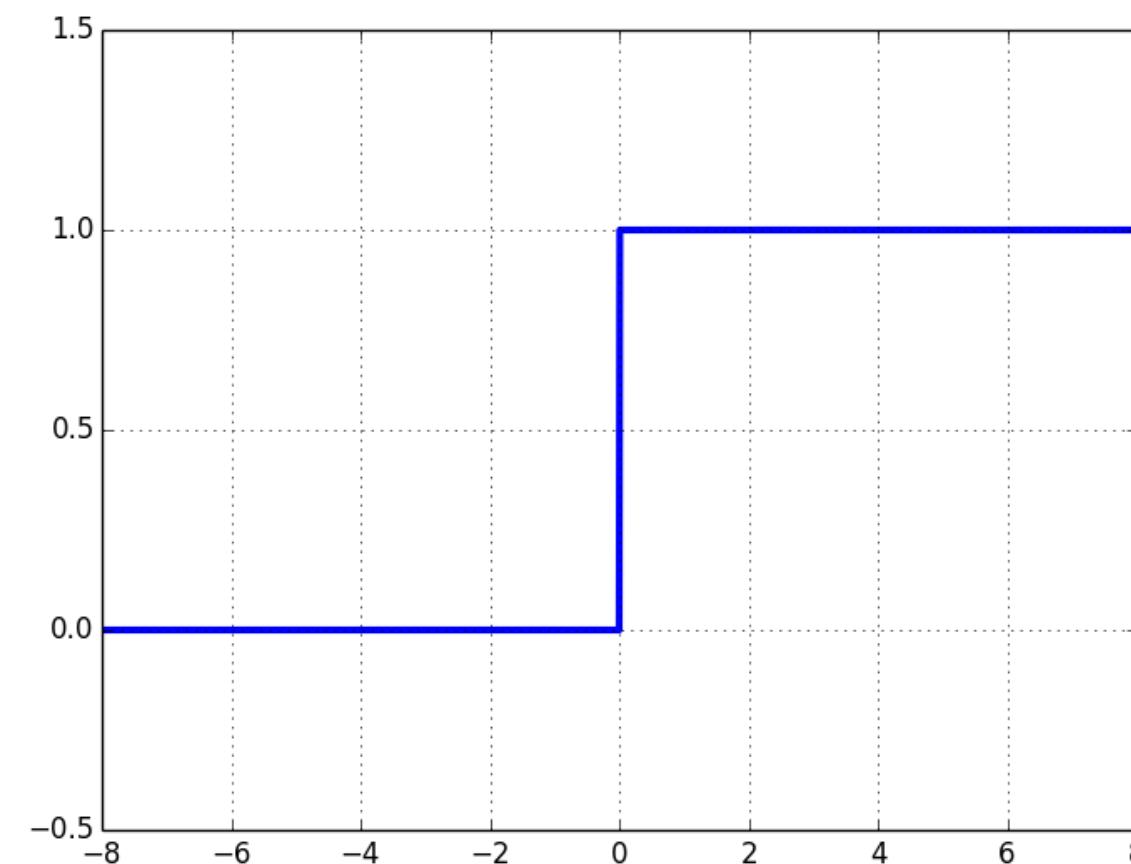
## 深層学習



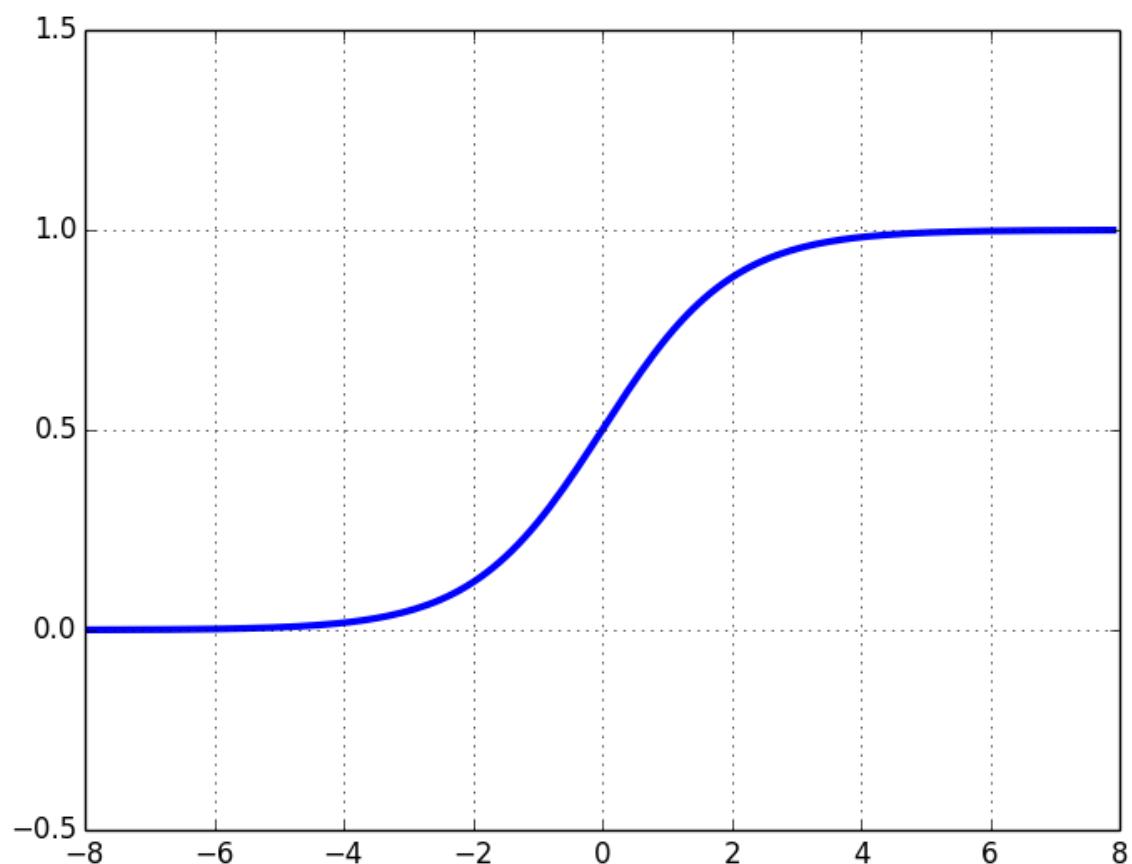




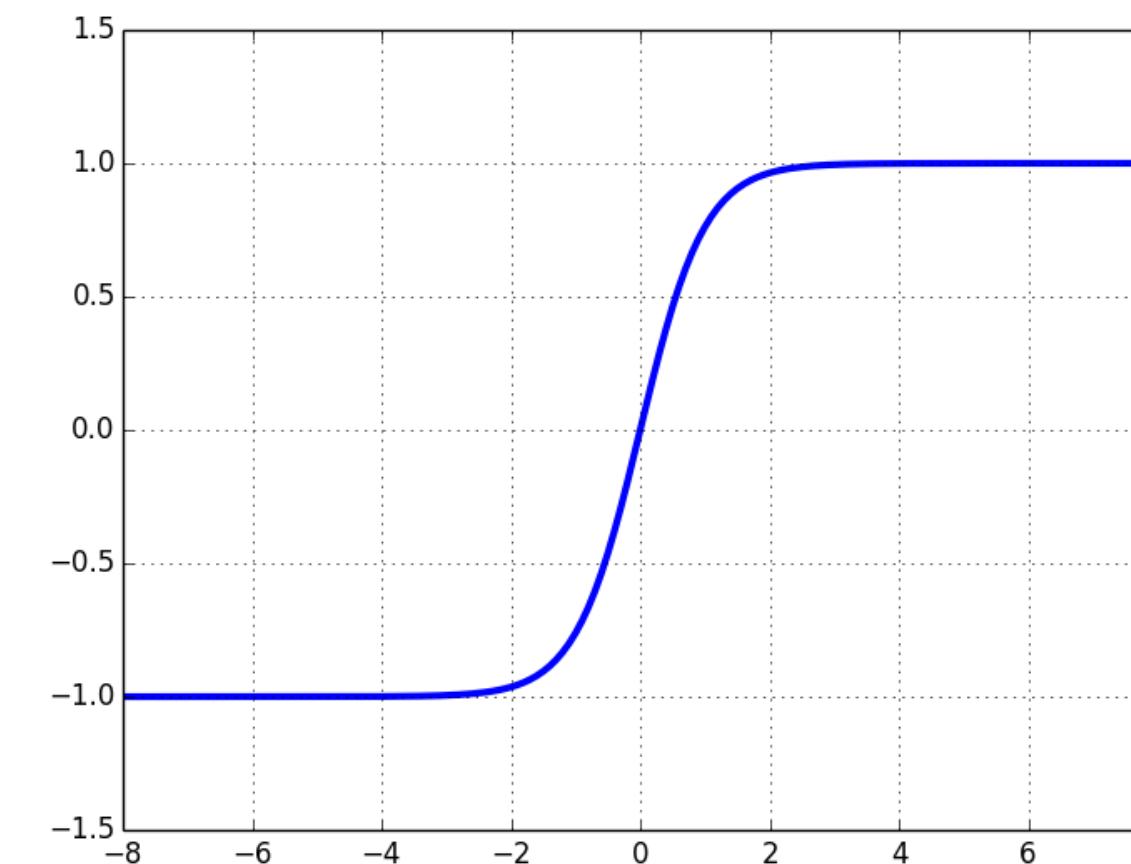
階段関数



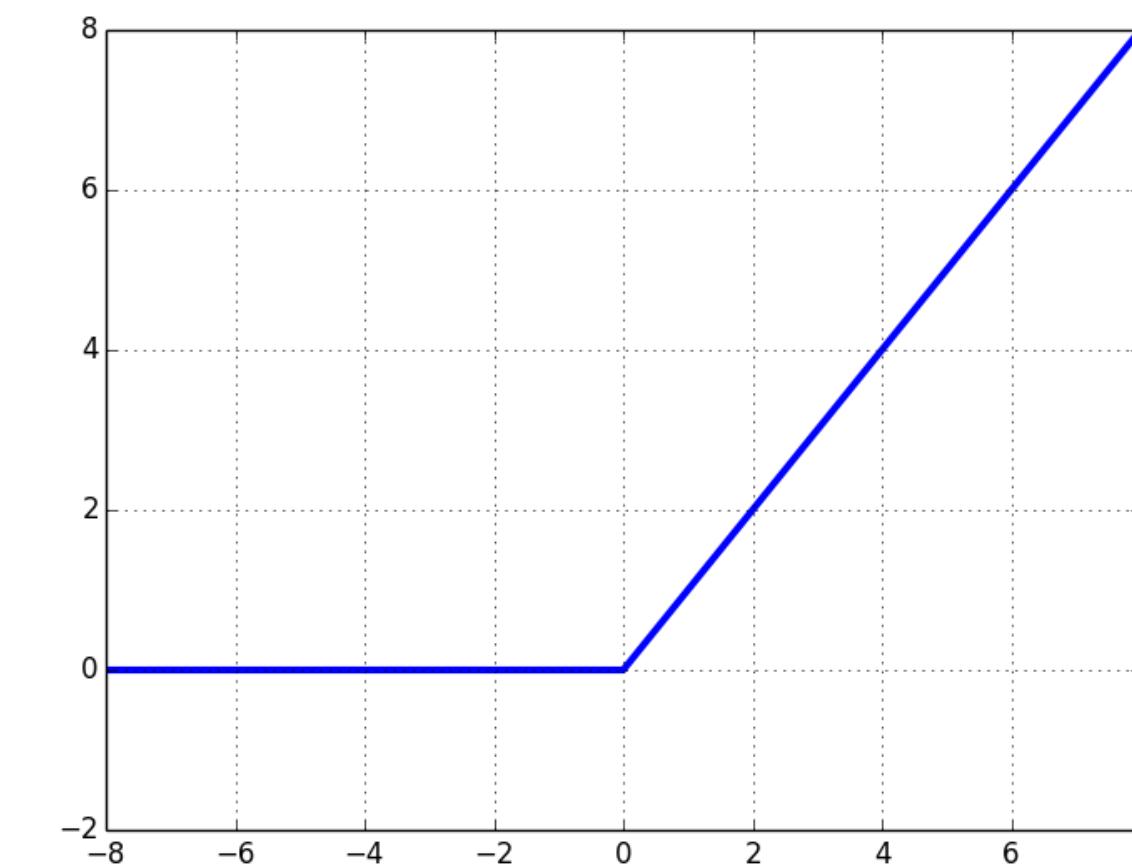
シグモイド関数

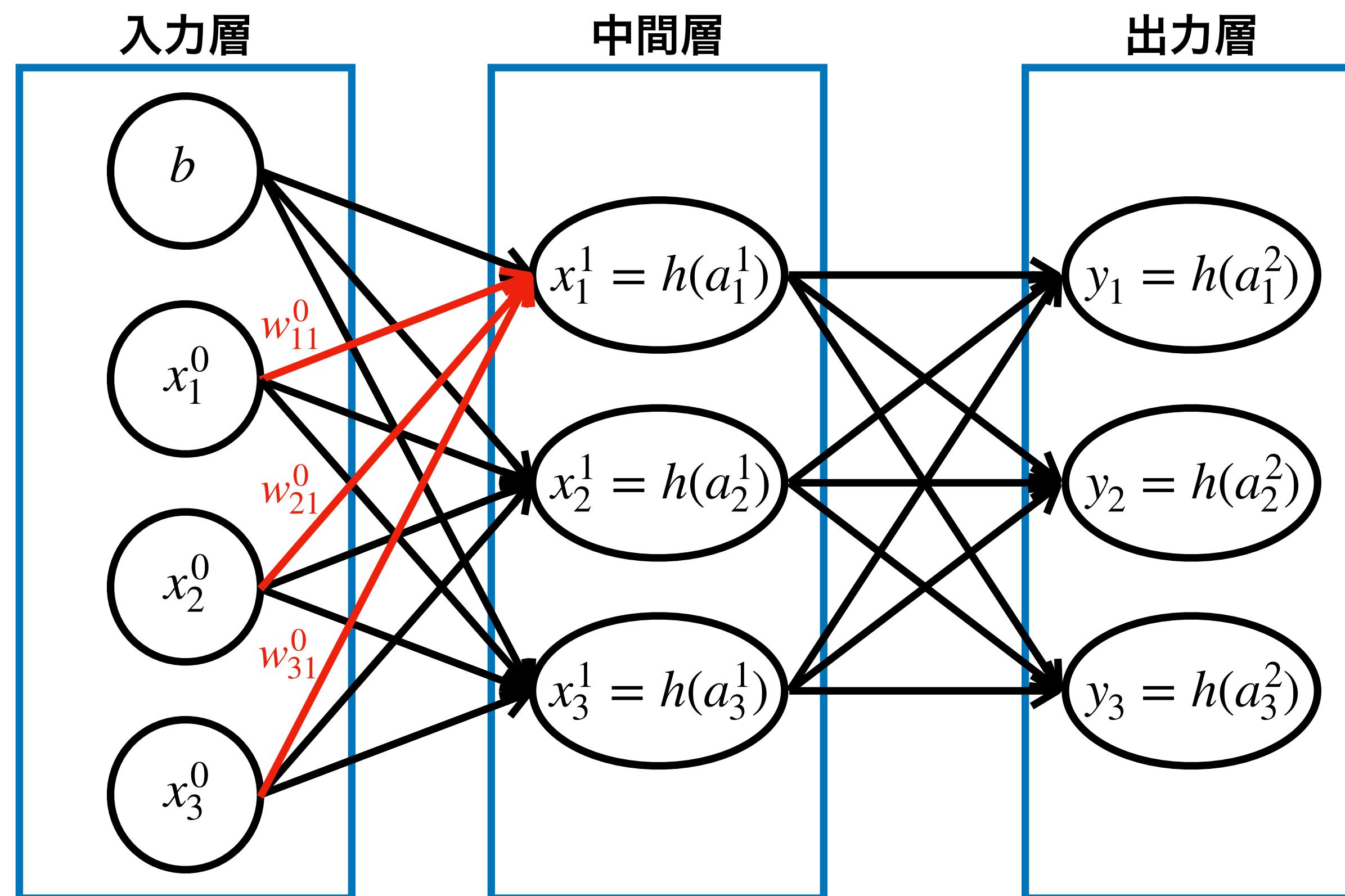


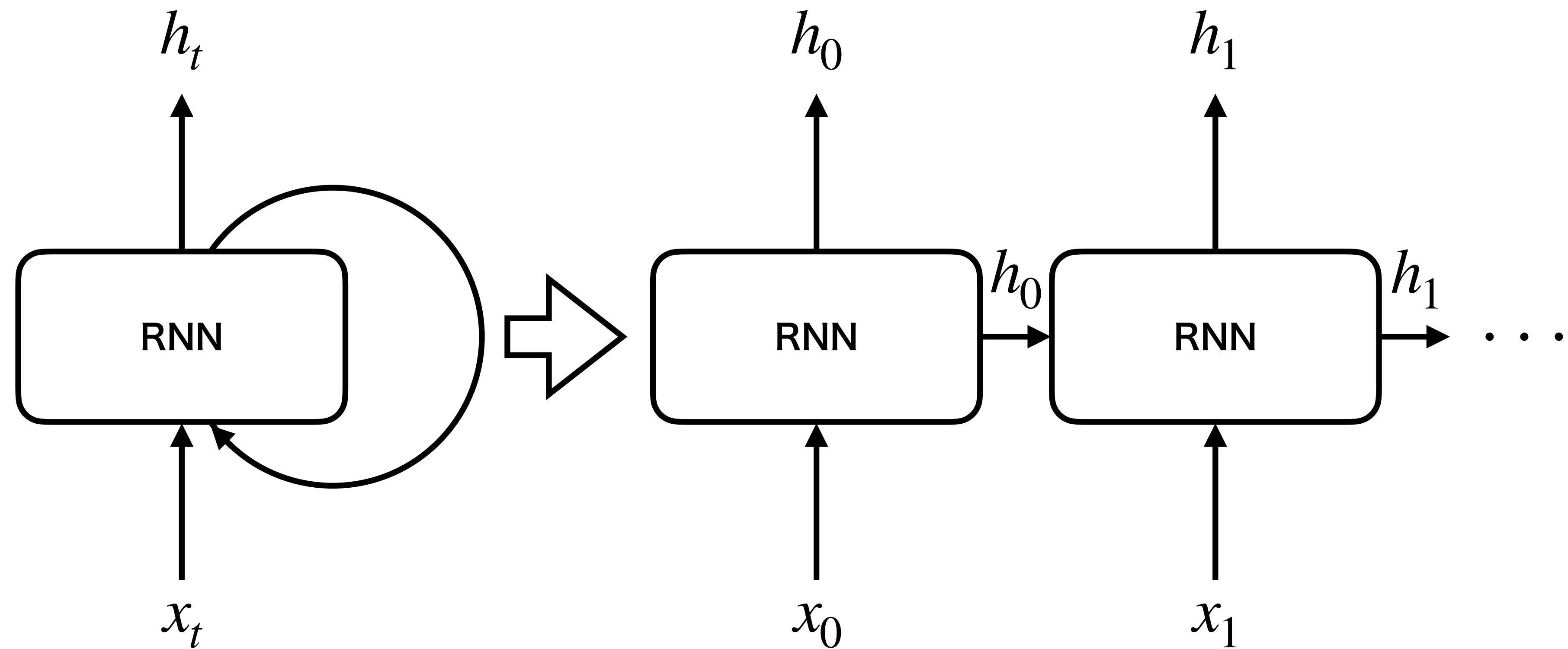
tanh関数

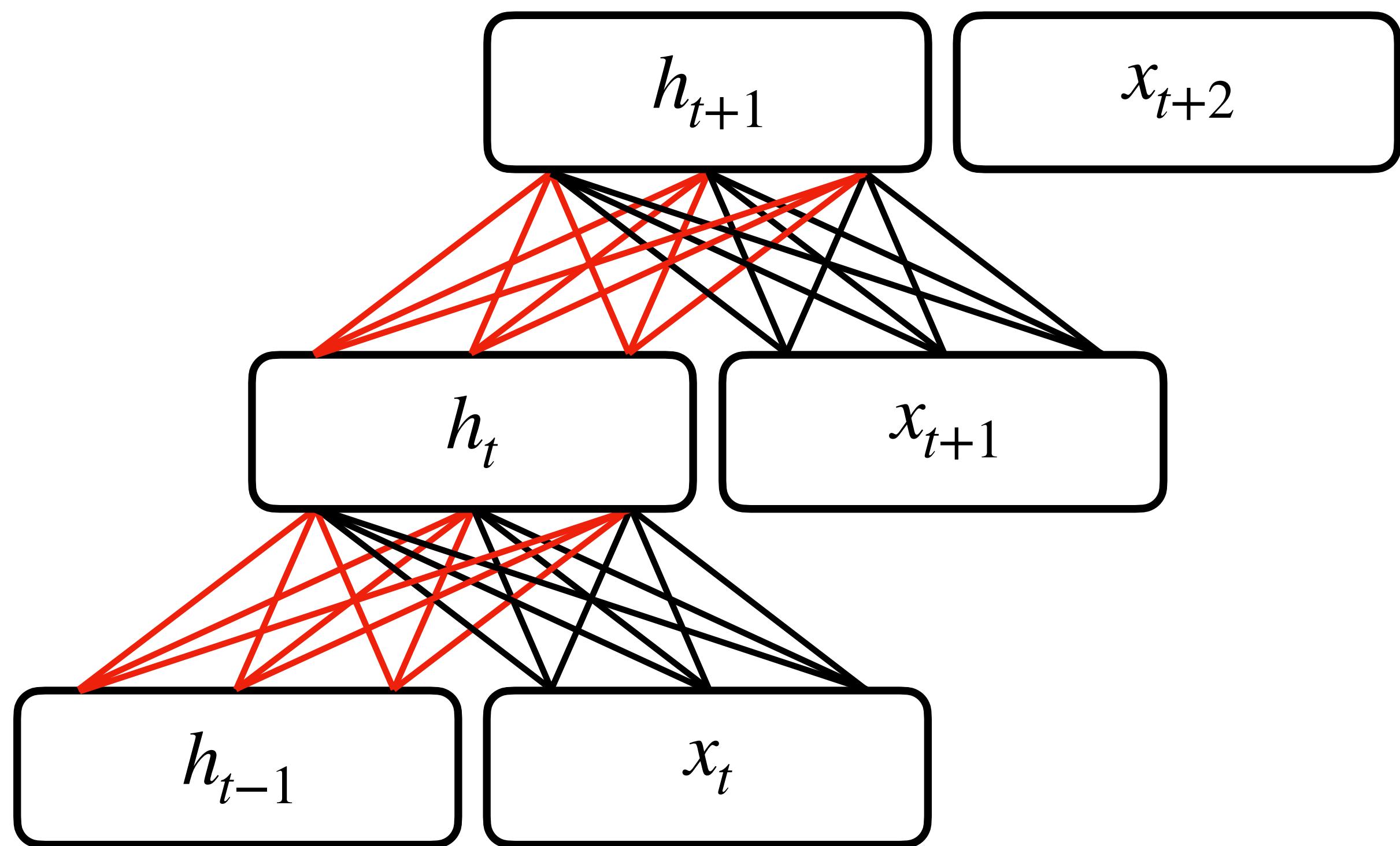


ReLU関数

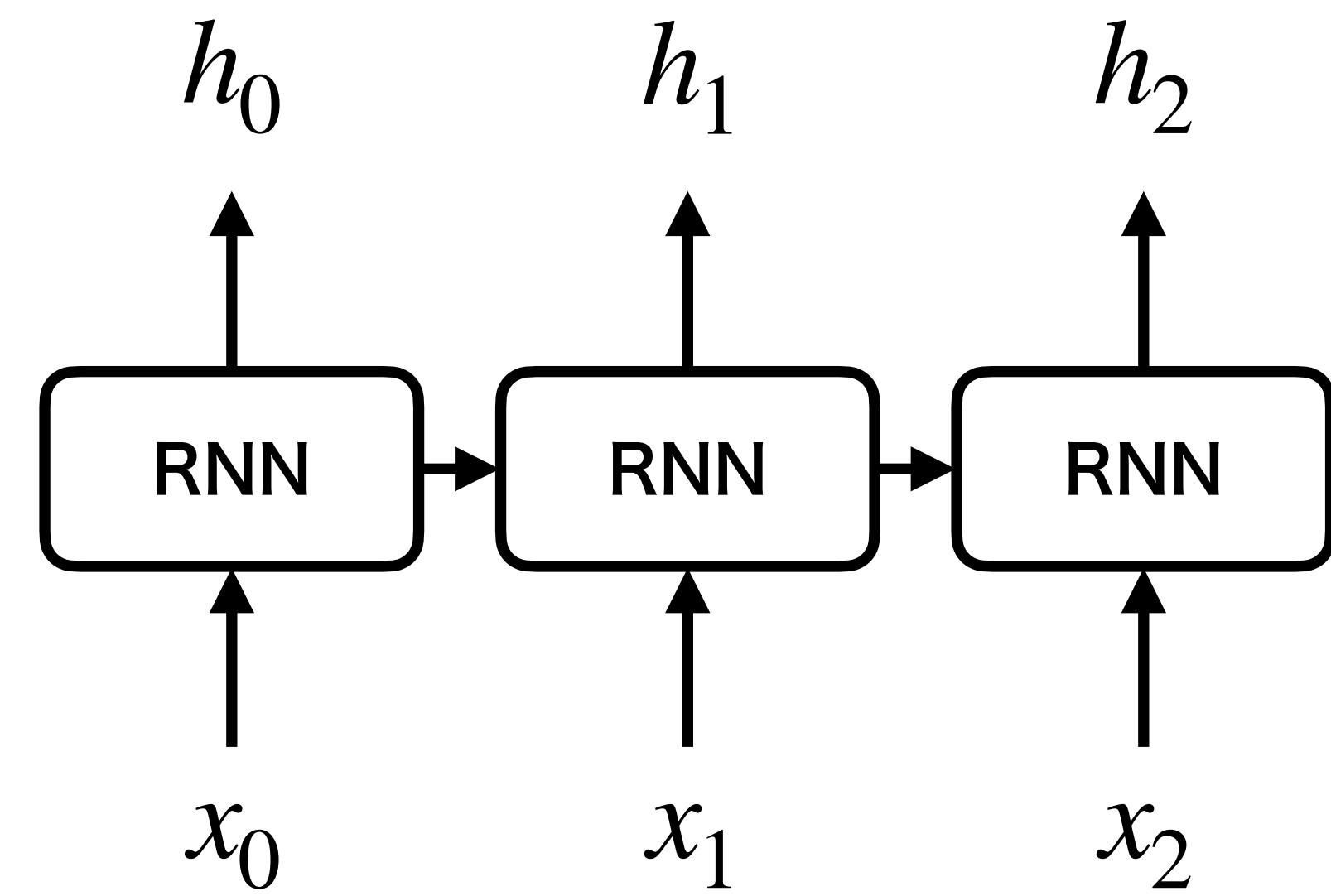




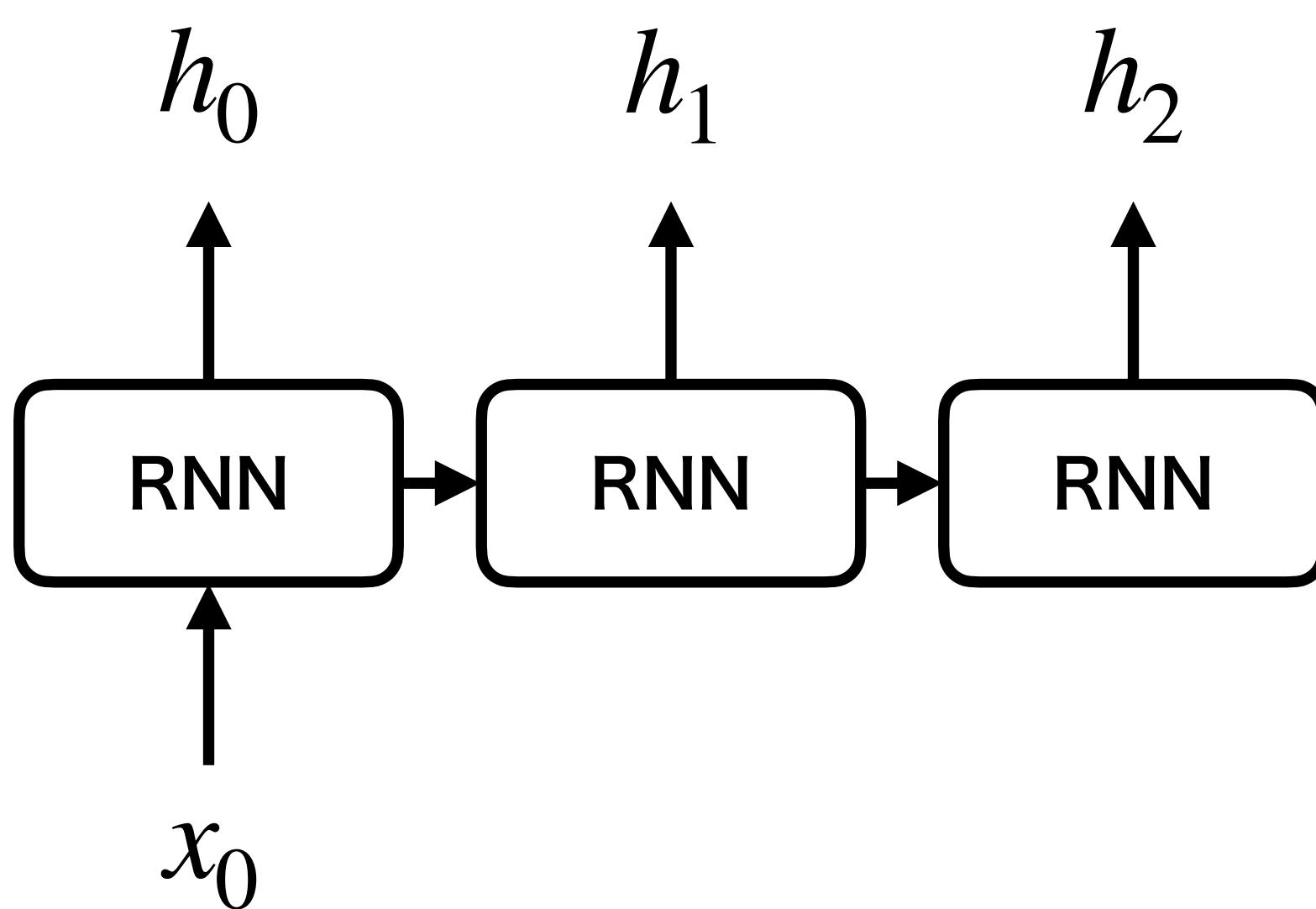




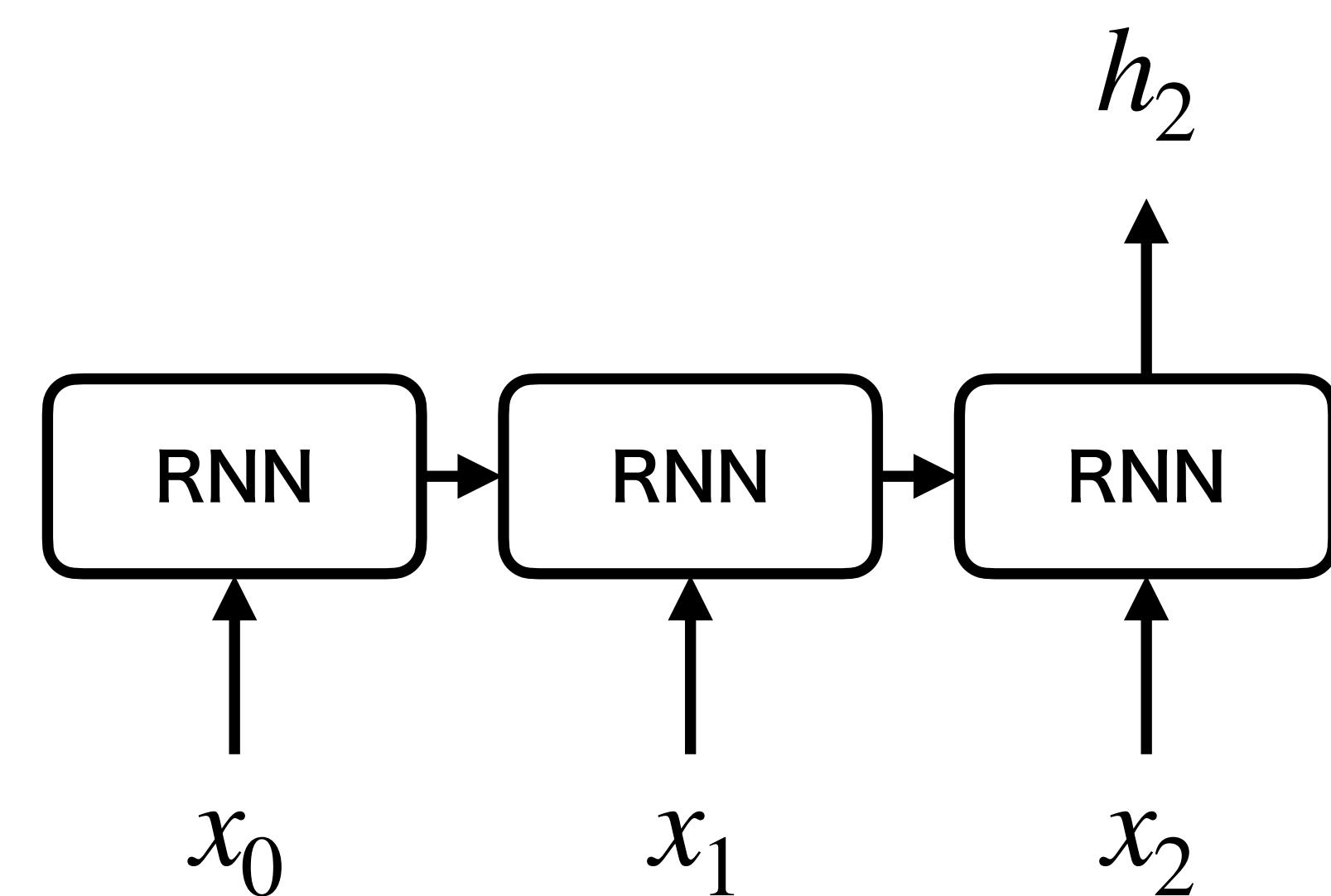
**Many to Many**

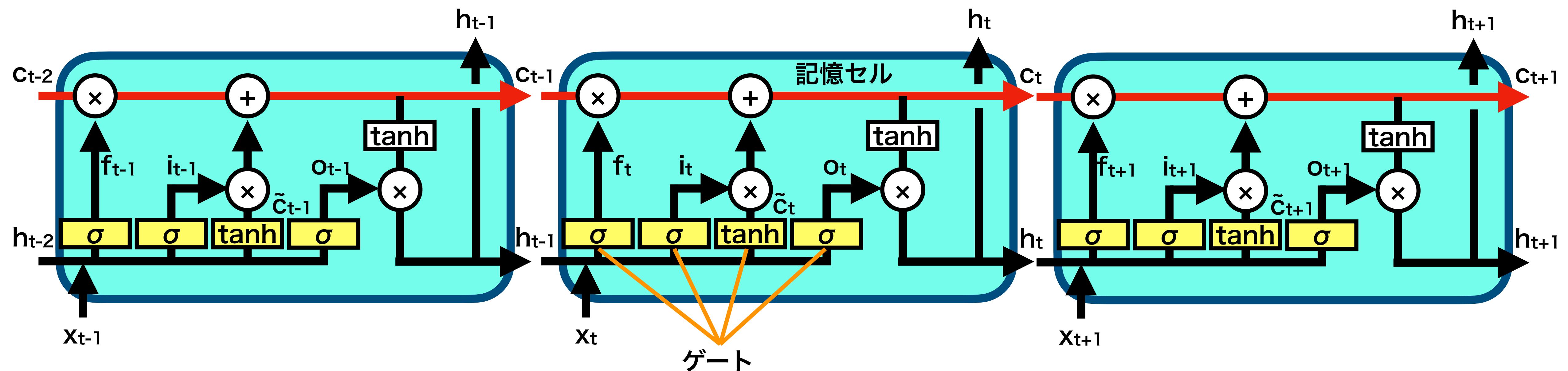


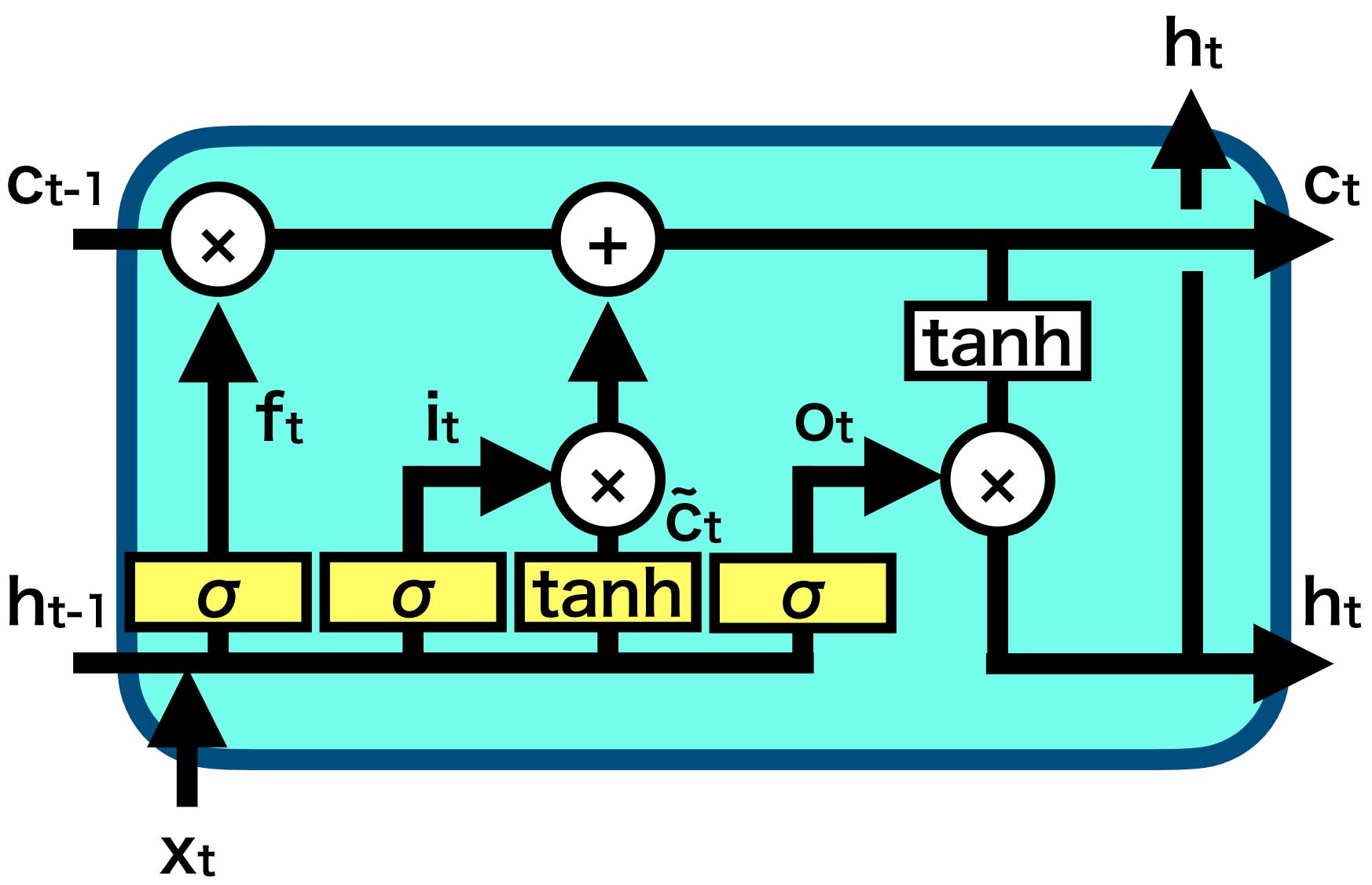
**One to Many**

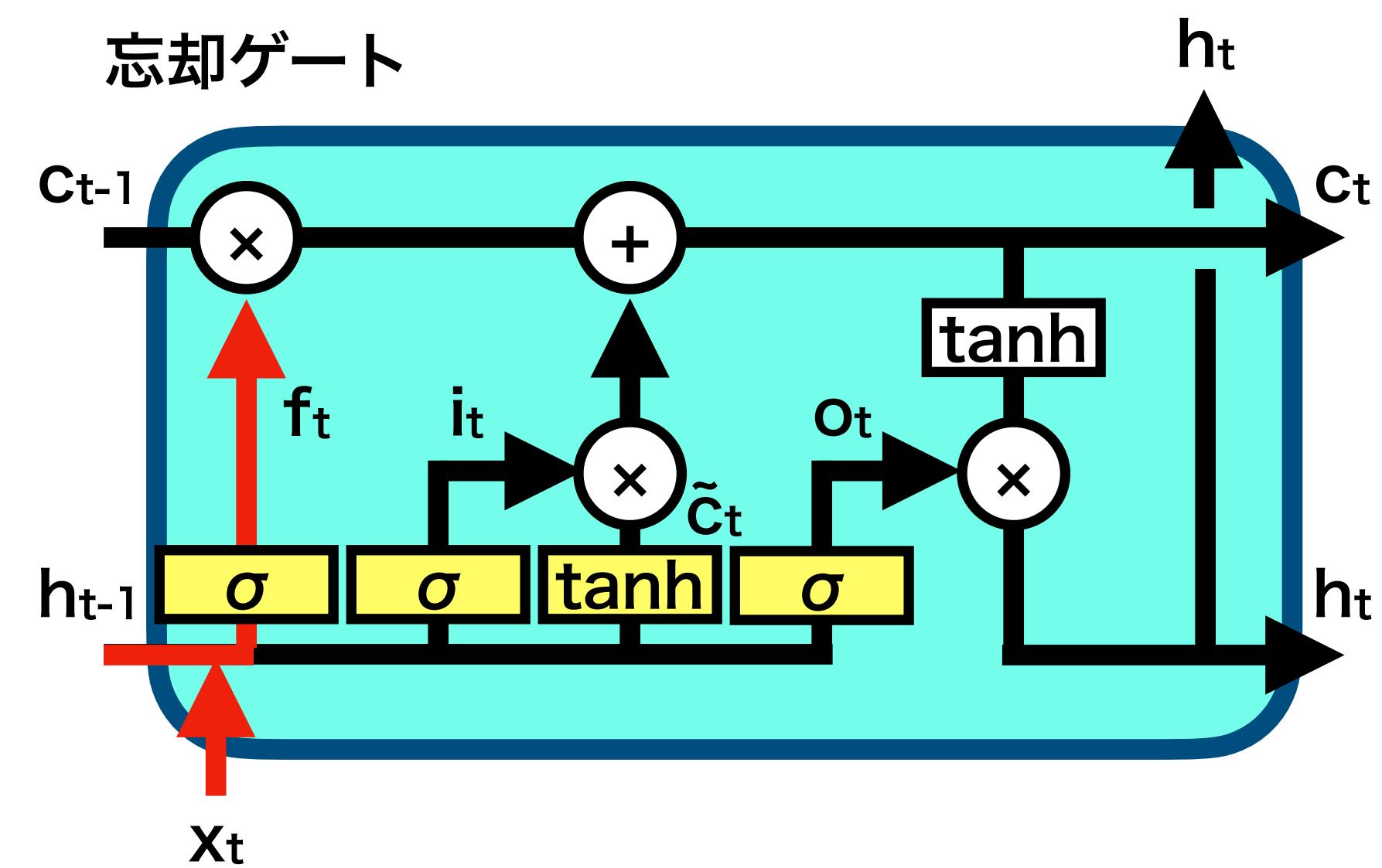


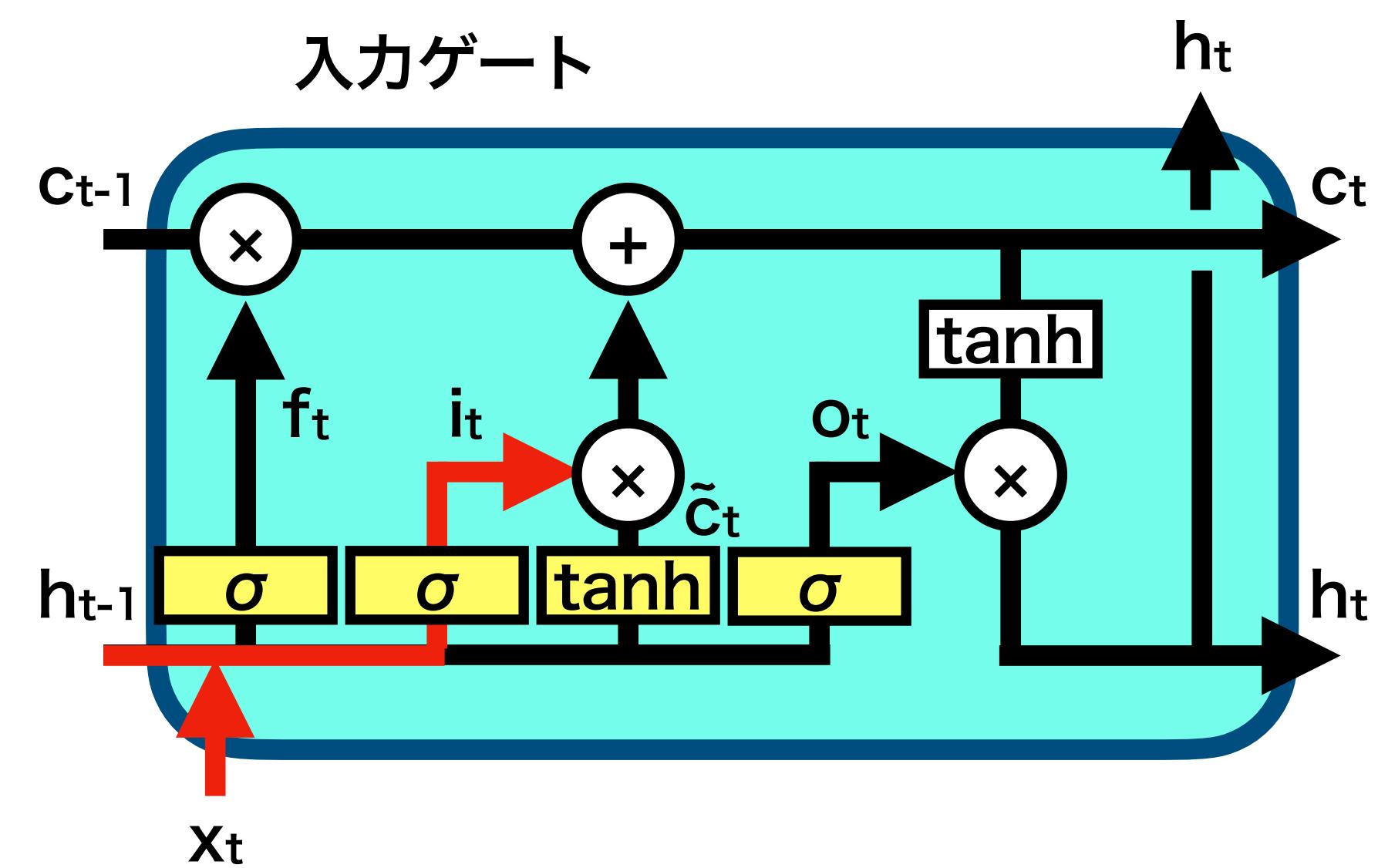
**Many to One**

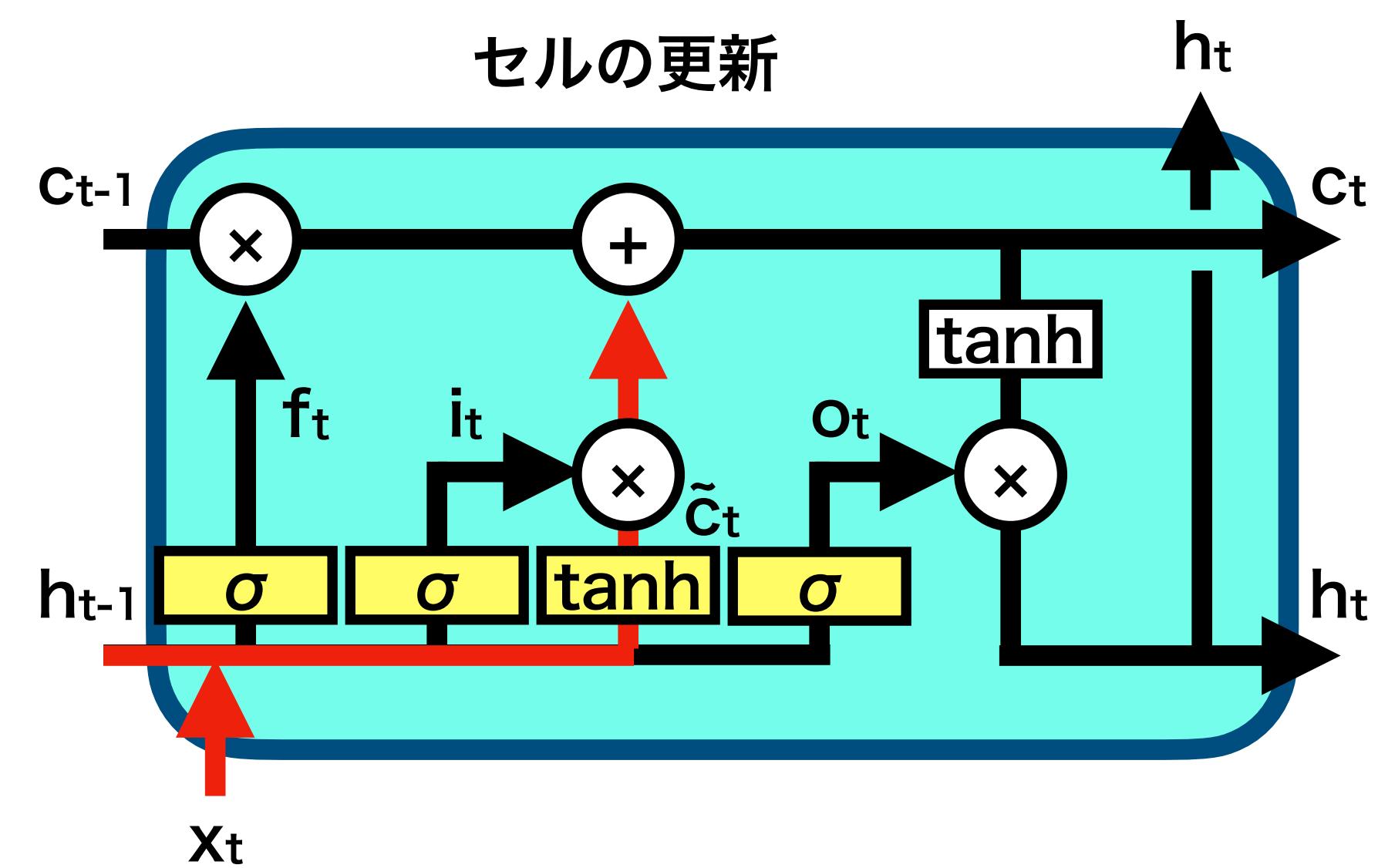


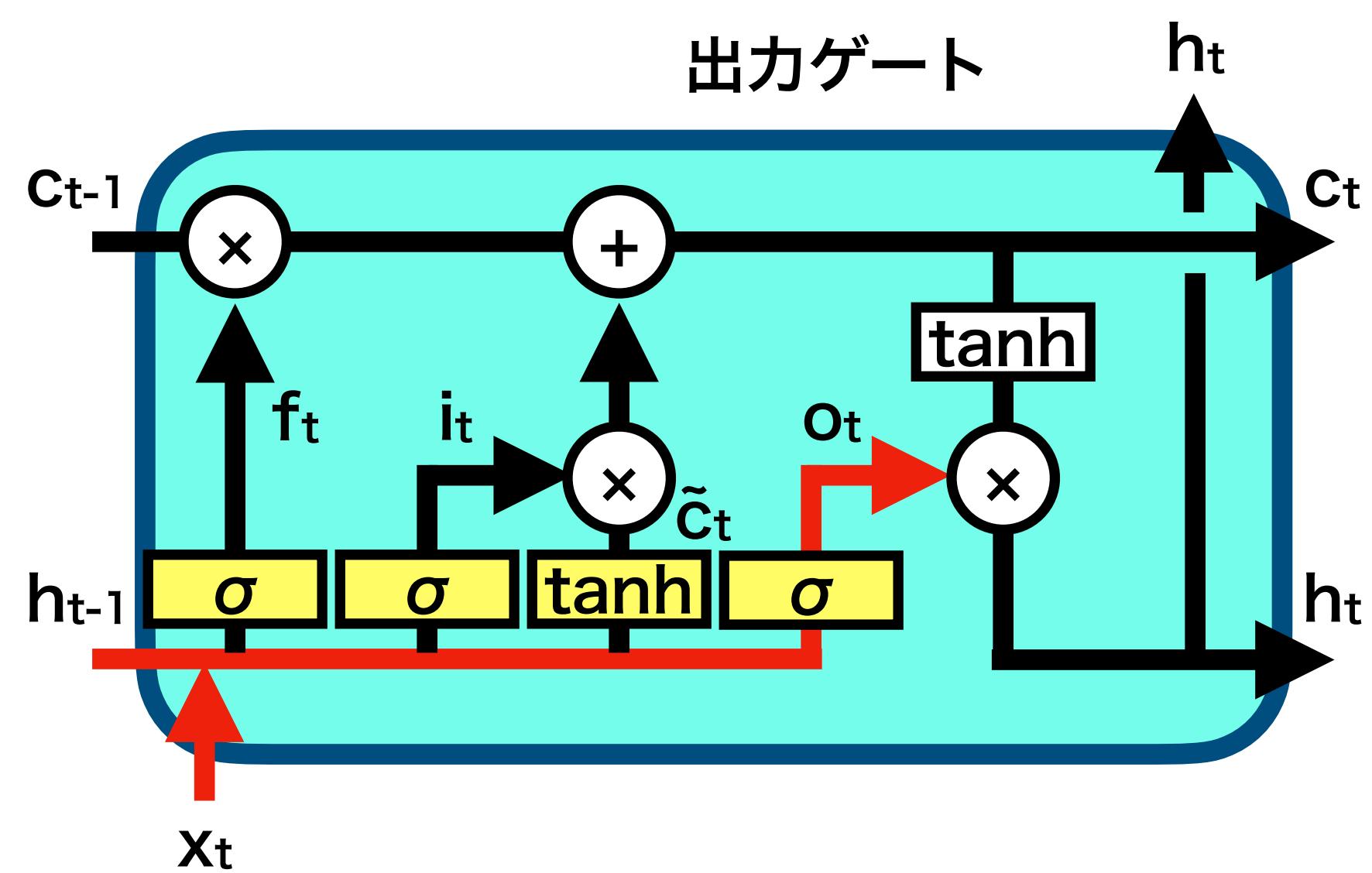


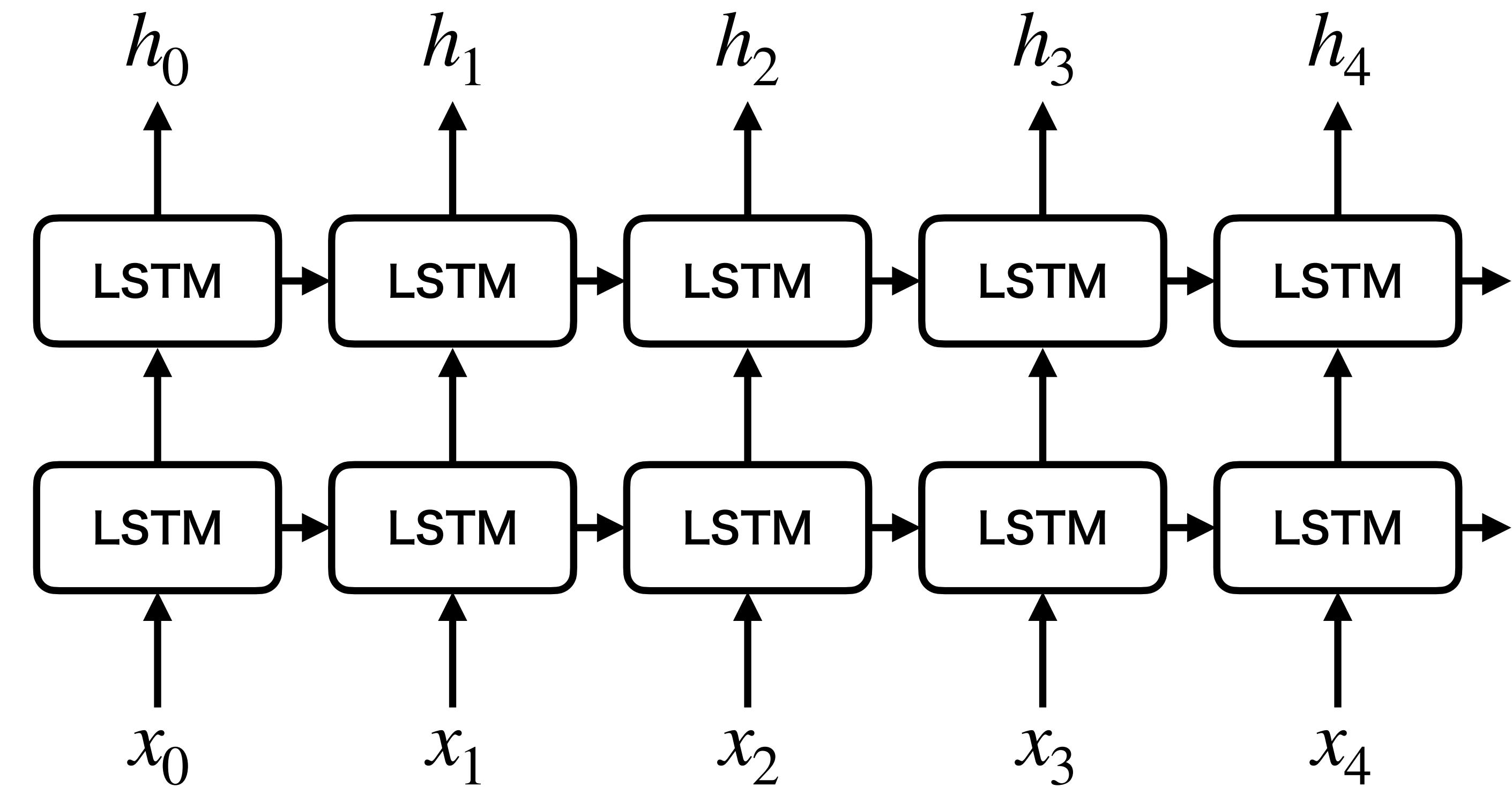


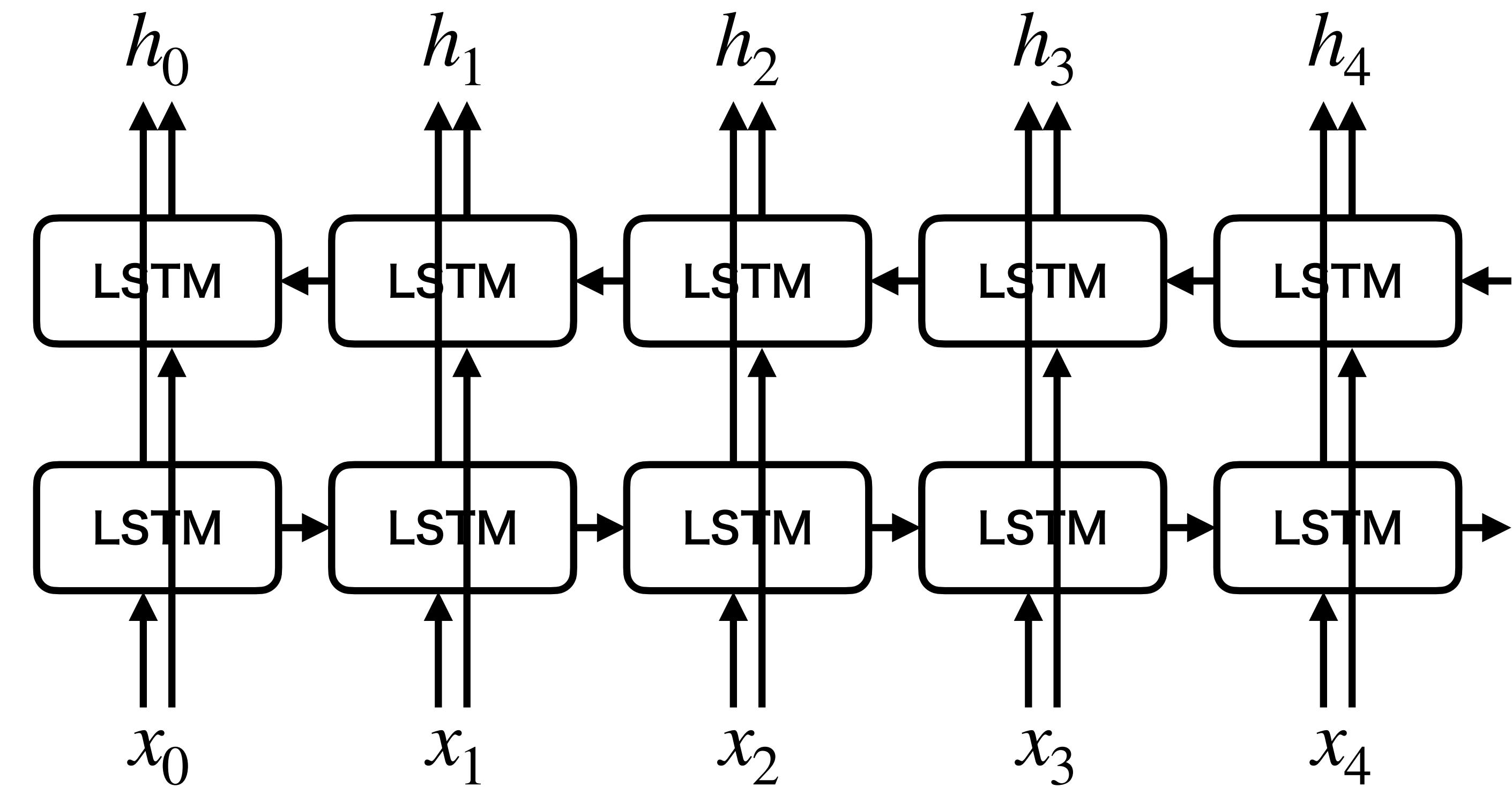


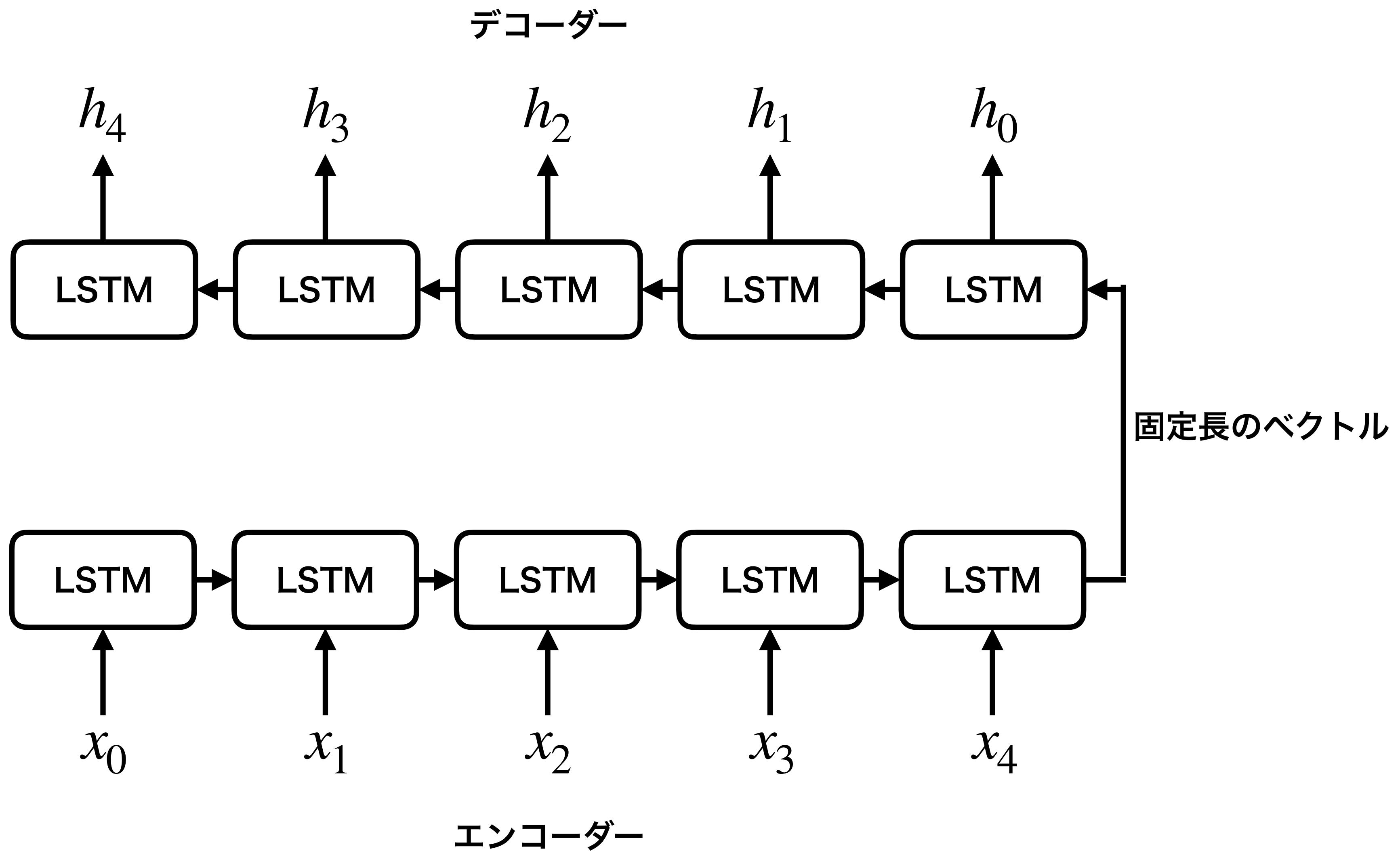


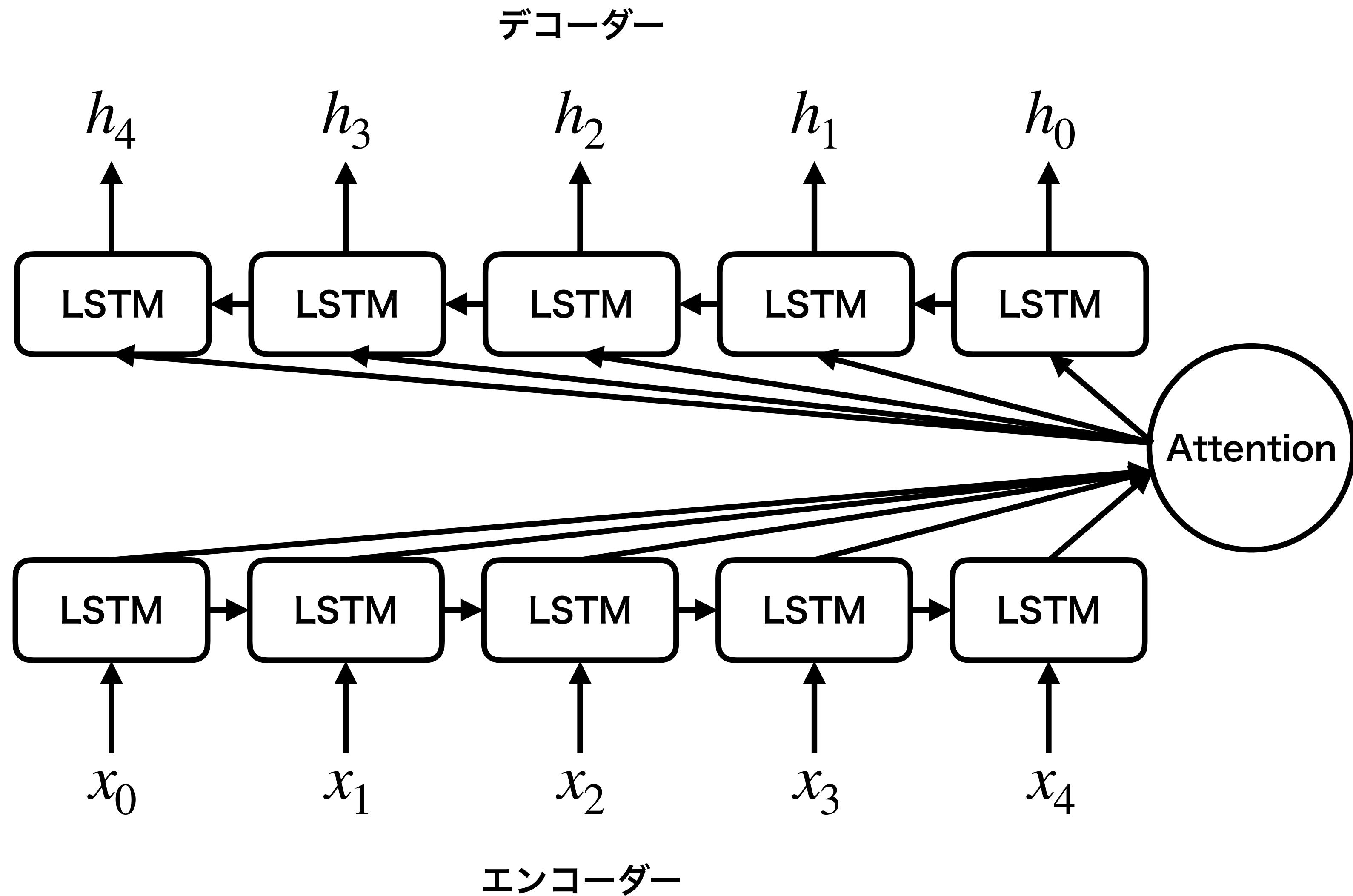


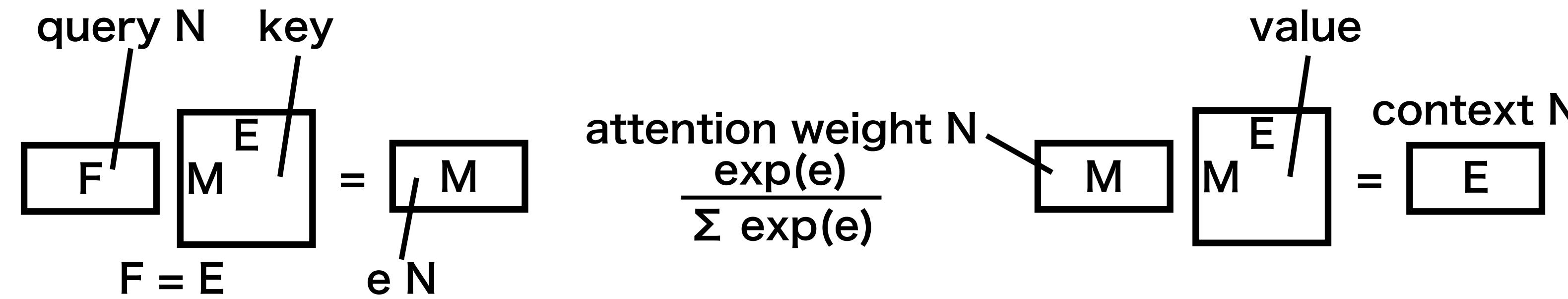
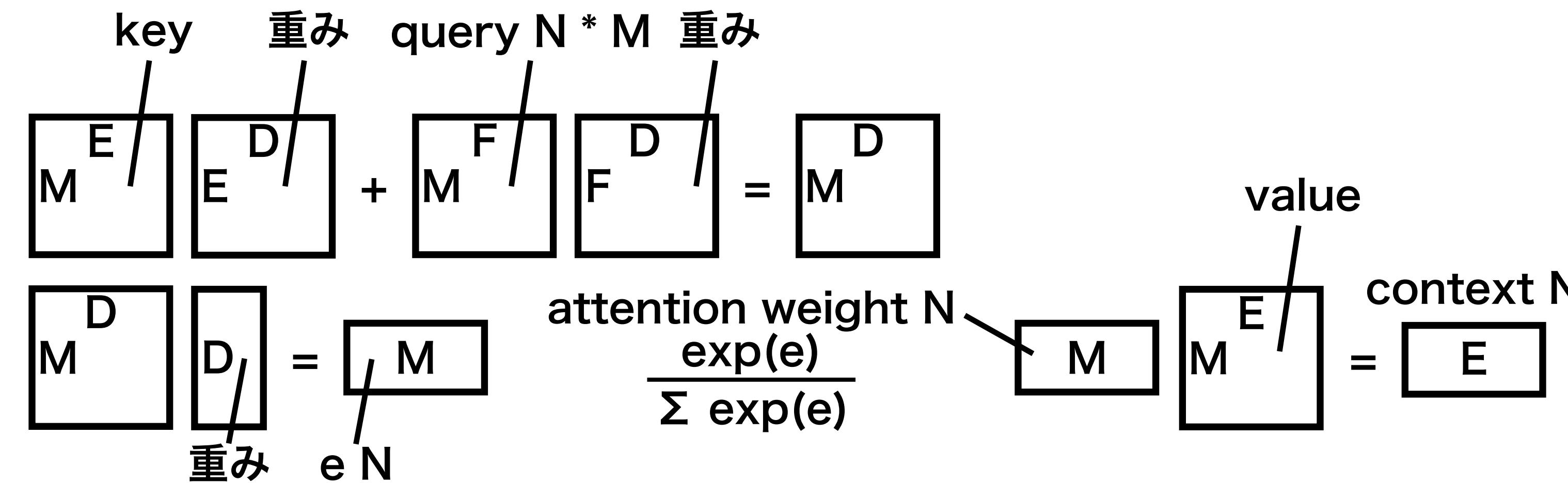


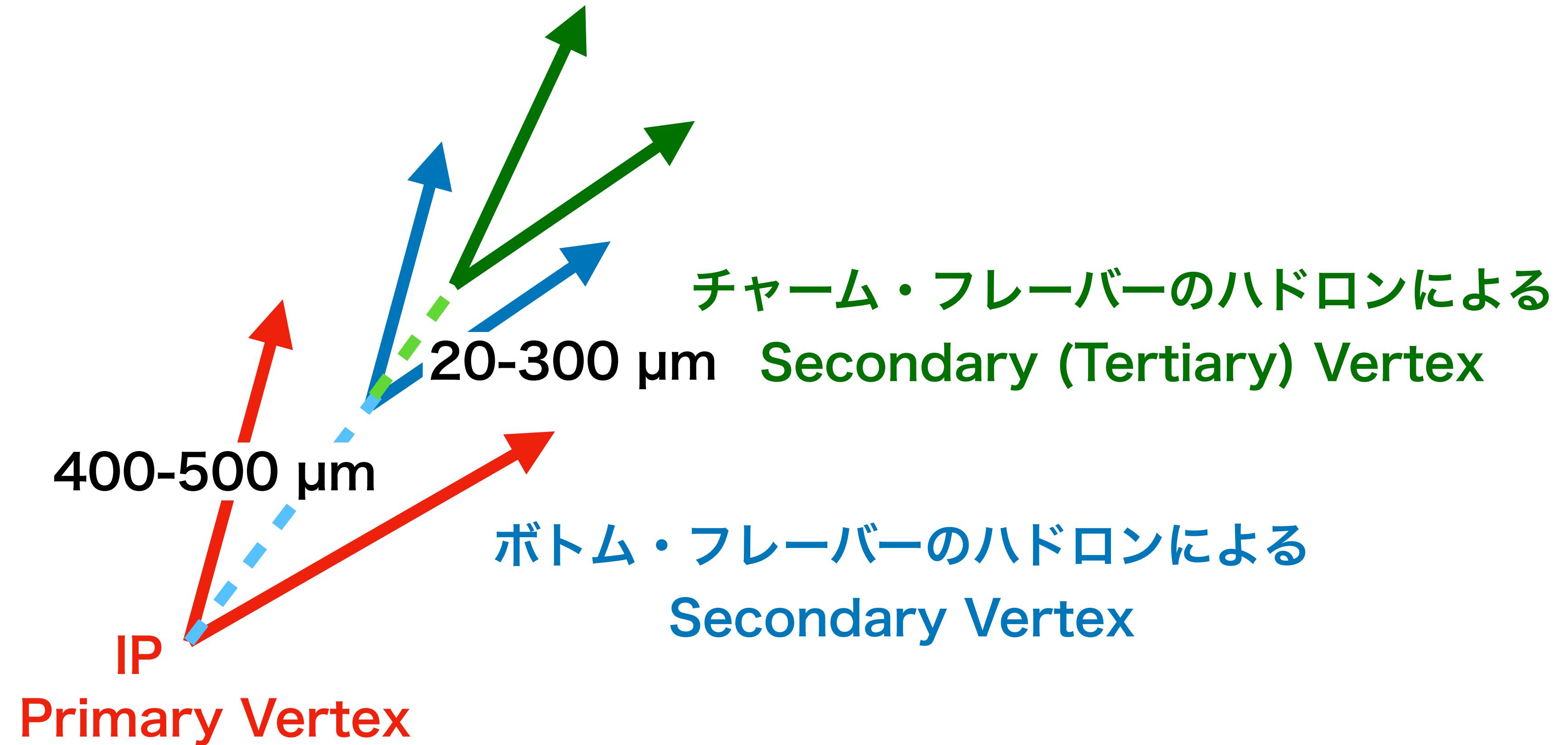


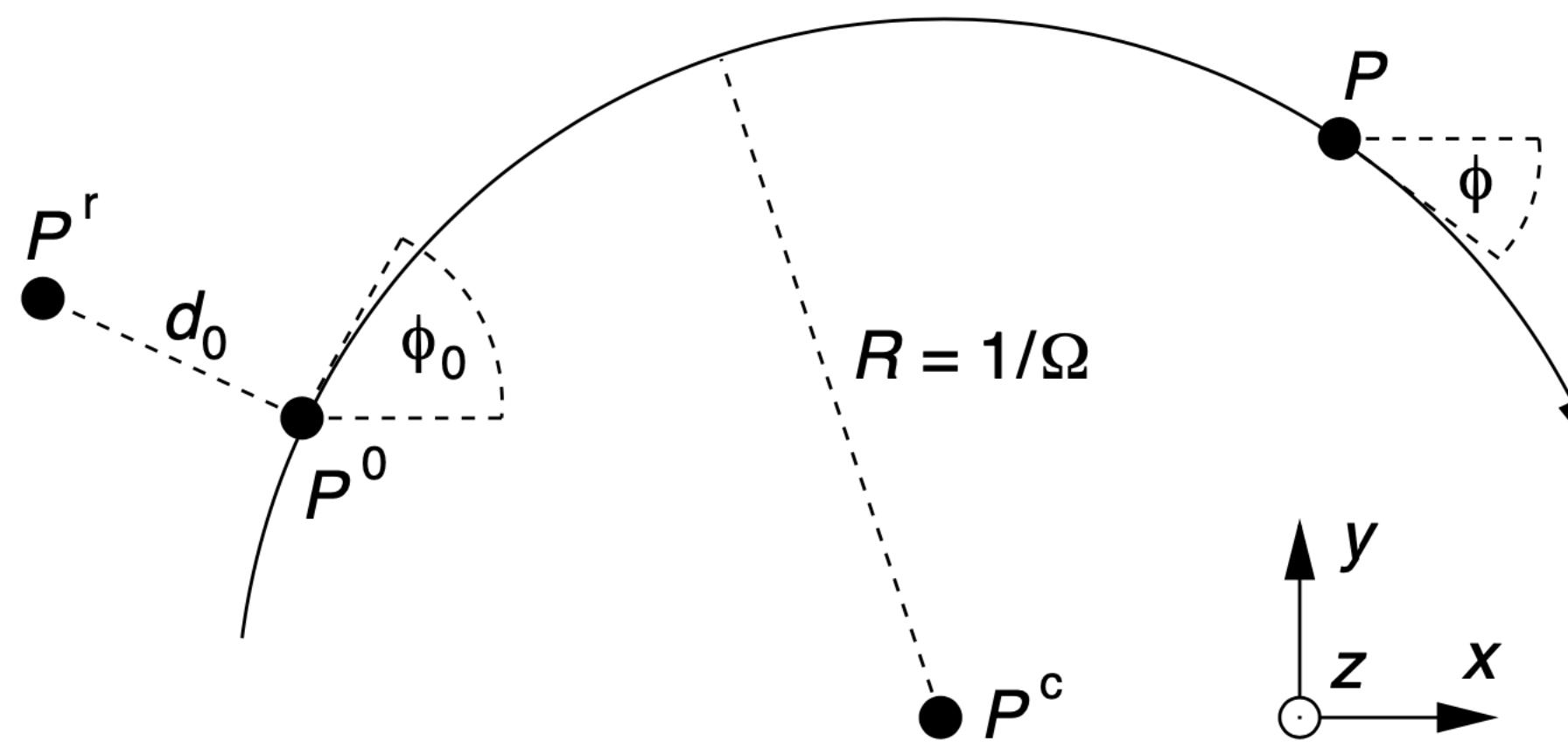




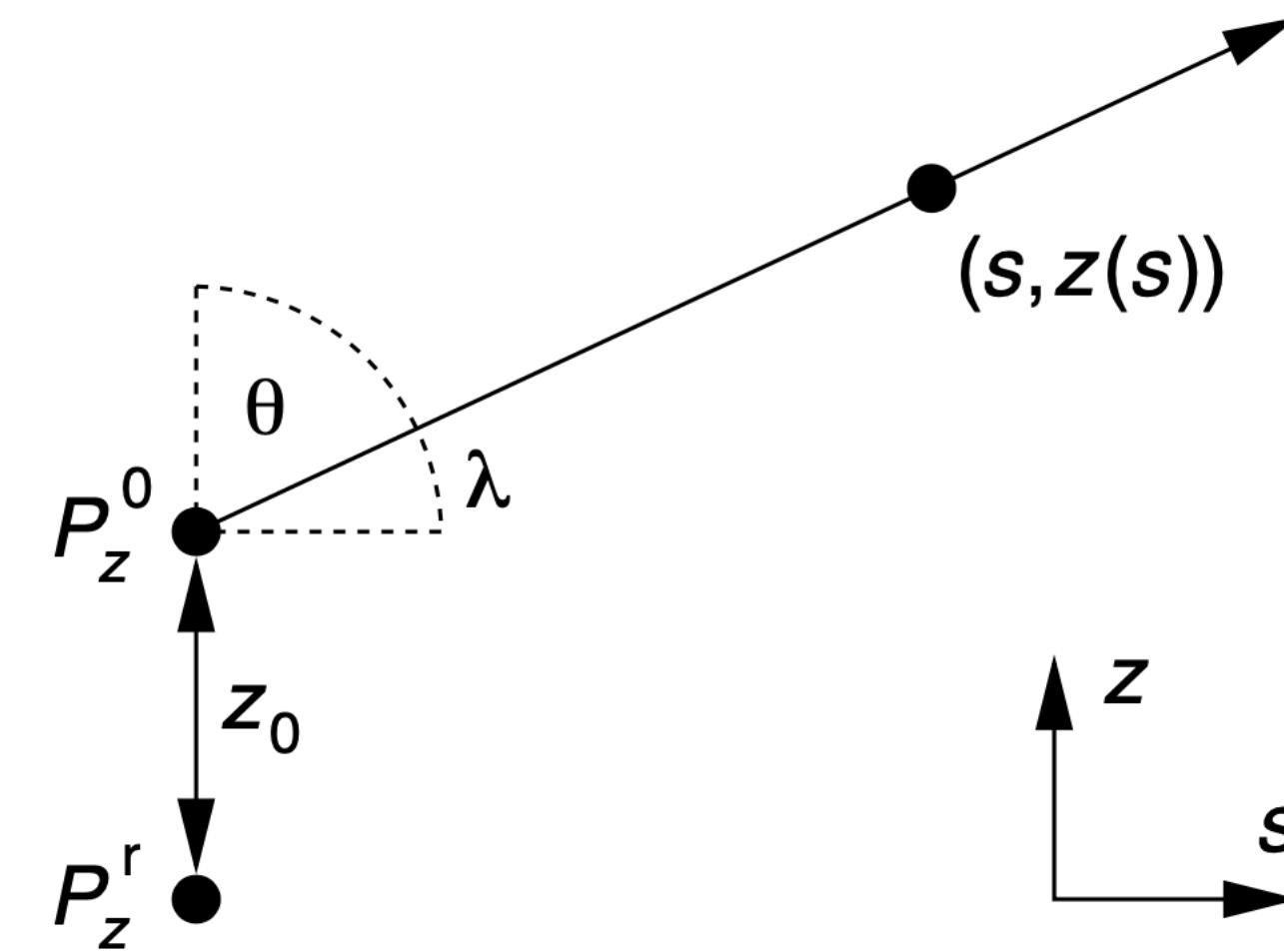






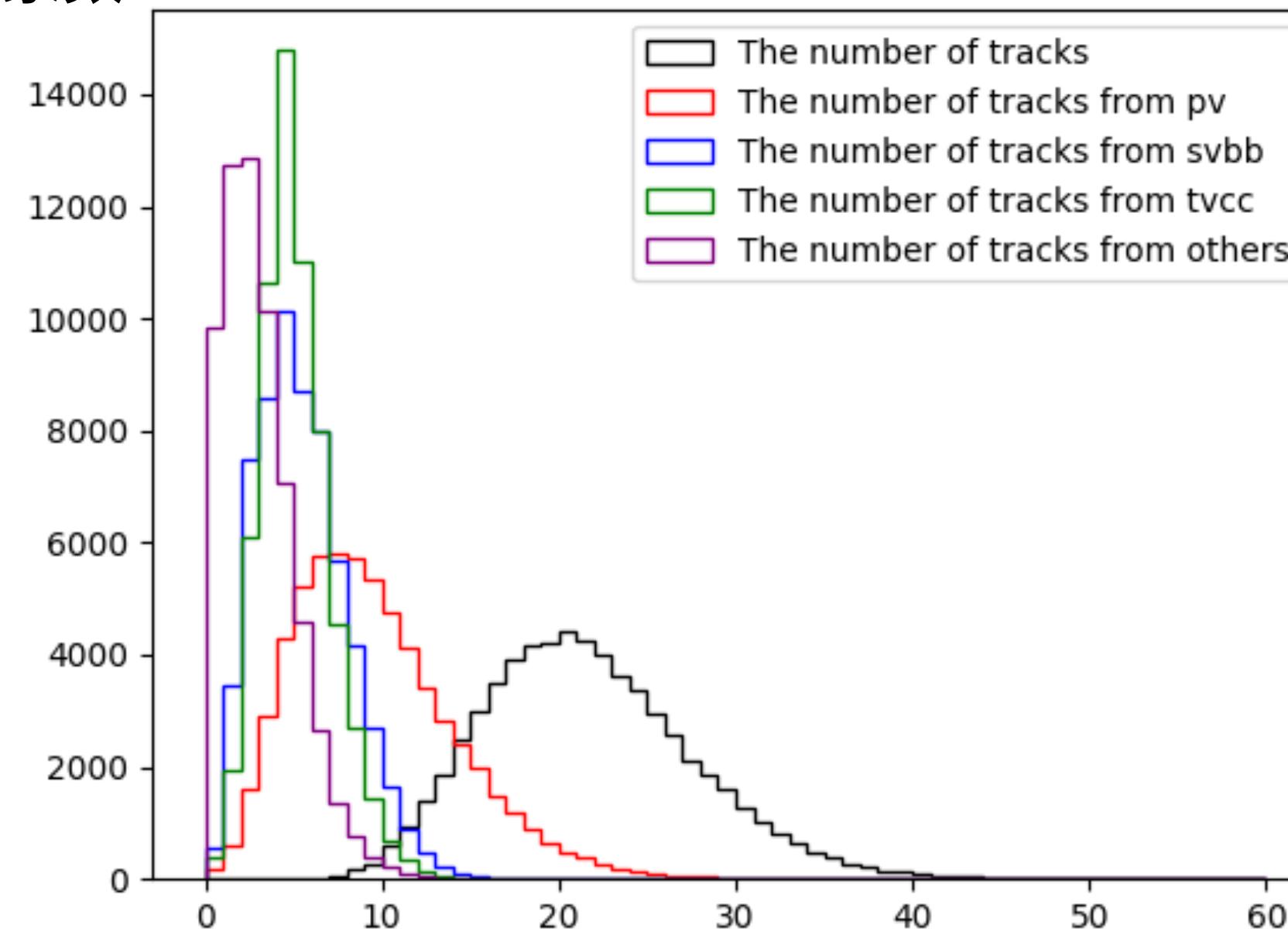


**Figure 1:** The projection of a helix segment in the  $xy$  plane is a part of an arc with centre  $\mathbf{P}^c$  and radius  $R$ . The direction of the particle is shown with the arrow at the arc. All track parameters are given relative to the reference point  $\mathbf{P}^r$ .

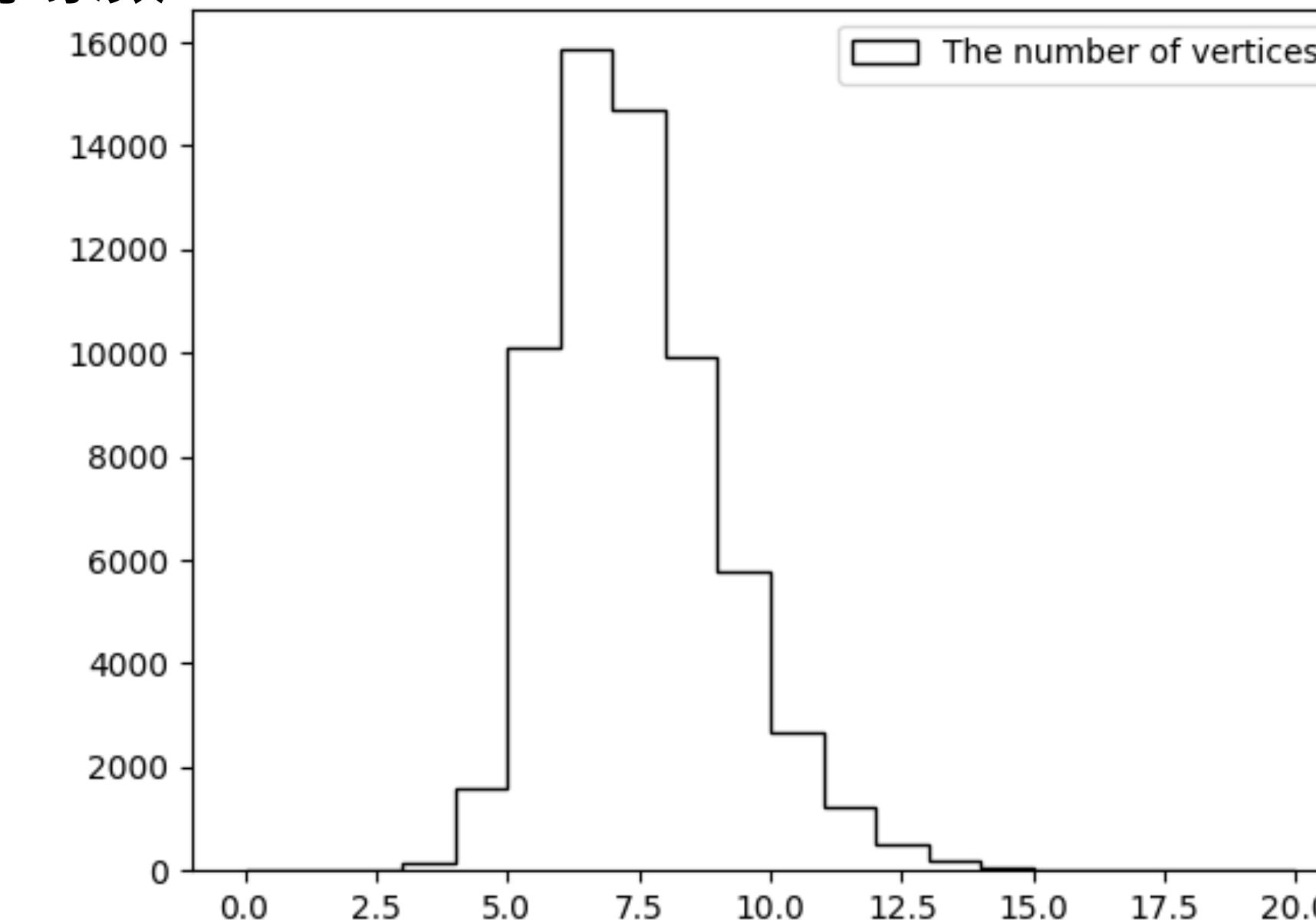


**Figure 2:** The projection of a helix in the  $sz$  plane is a straight line (see Eq. 10). The variable  $s$  at a point  $\mathbf{P}$  is the arc length in the  $xy$  plane from  $\mathbf{P}^0$  to  $\mathbf{P}$ . This also implies that  $s = 0$ , if  $z = z_0$ .

事象数

飛跡数（終状態  $b\bar{b}$  ）

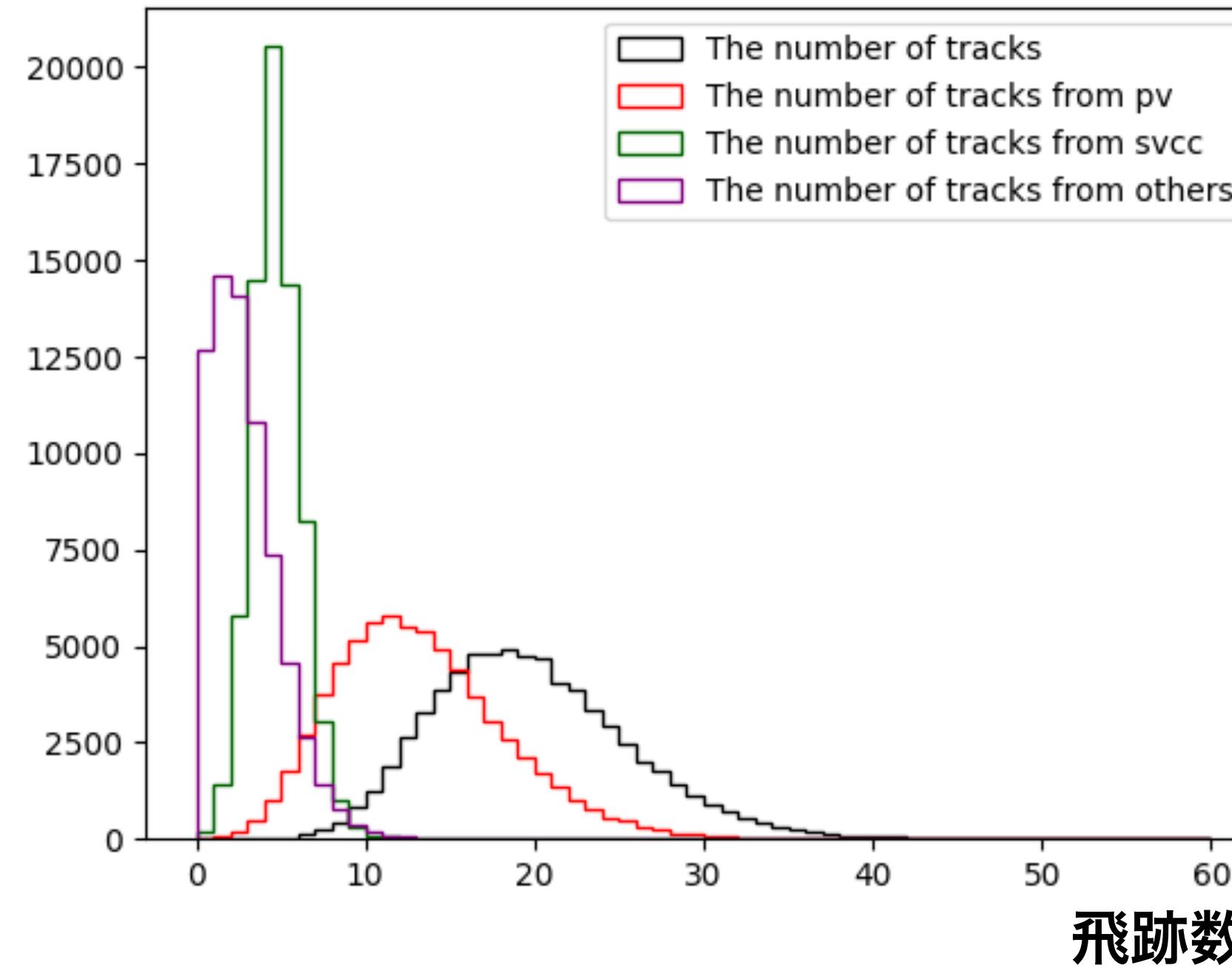
事象数

崩壊点数（終状態  $b\bar{b}$  ）

事象数

飛跡数（終状態  $c\bar{c}$  ）

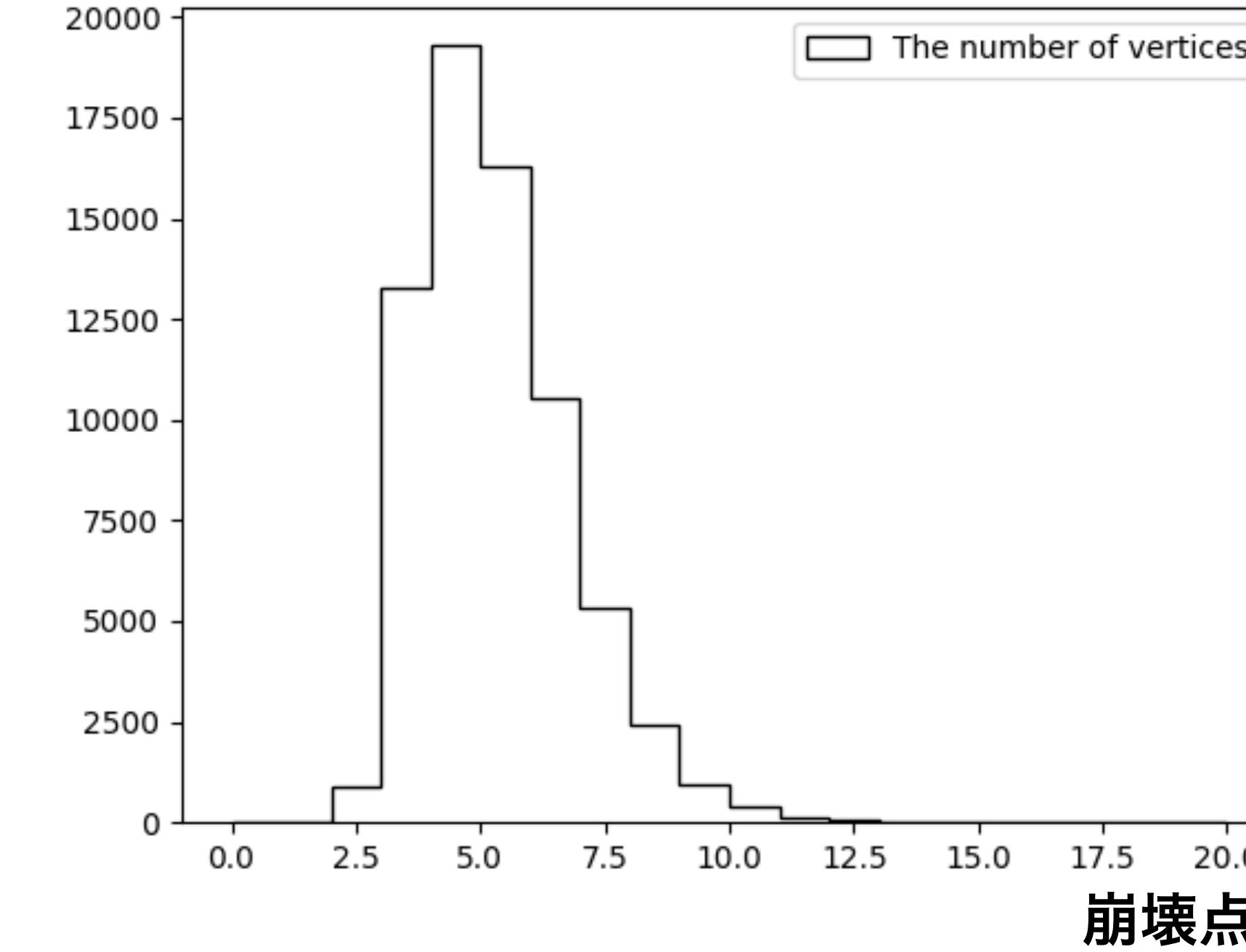
飛跡数



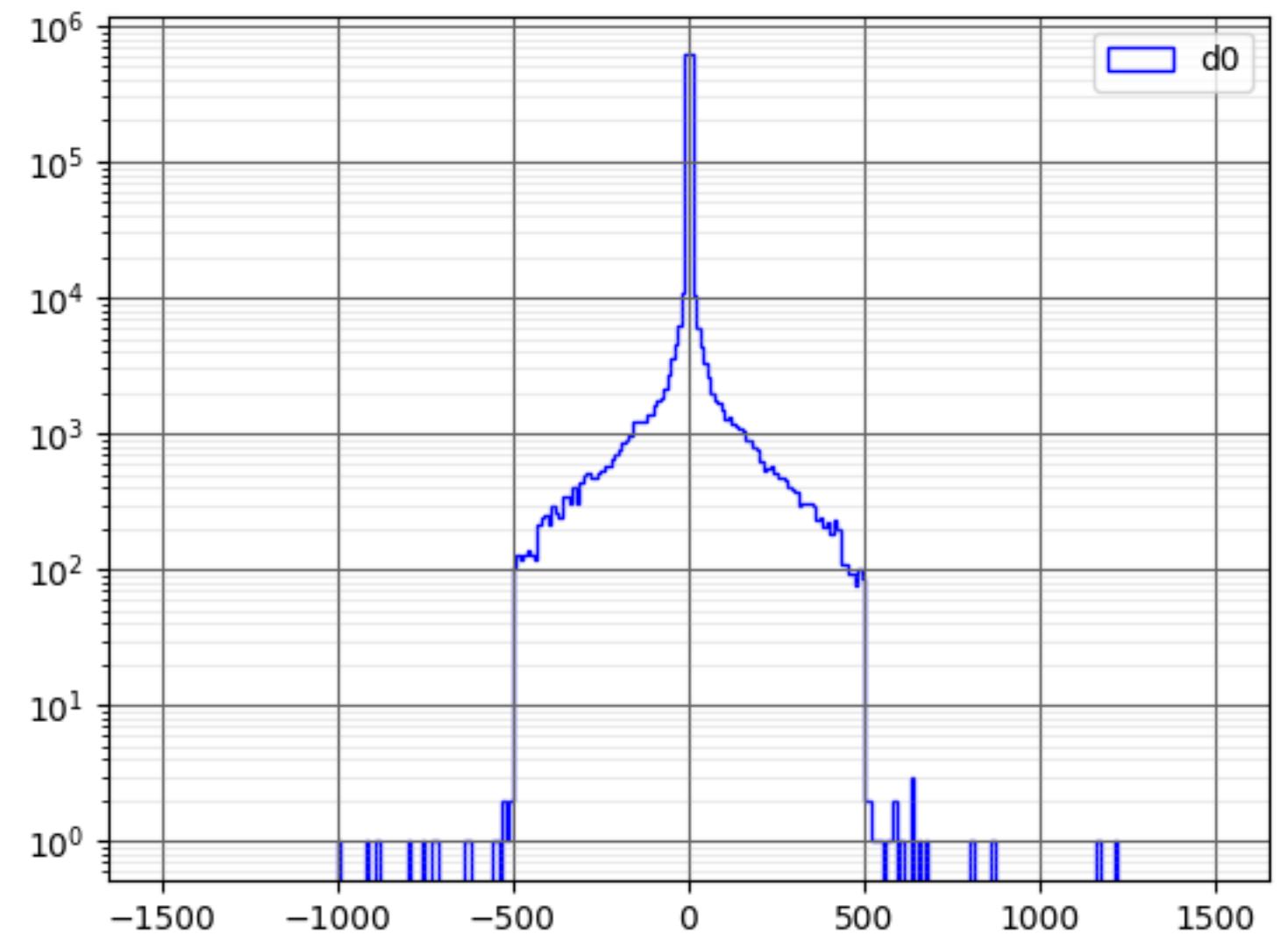
事象数

崩壊点数（終状態  $c\bar{c}$  ）

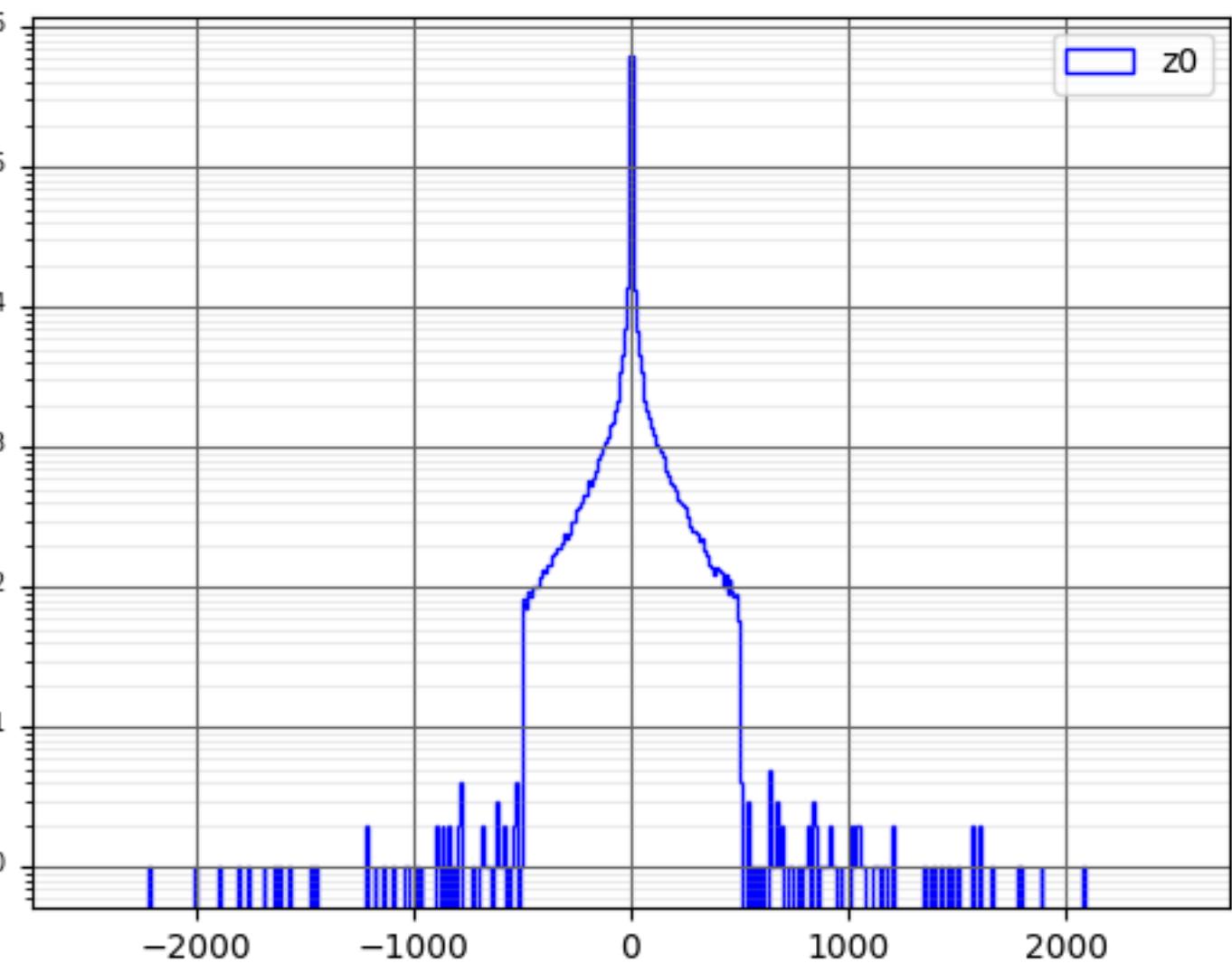
崩壊点数



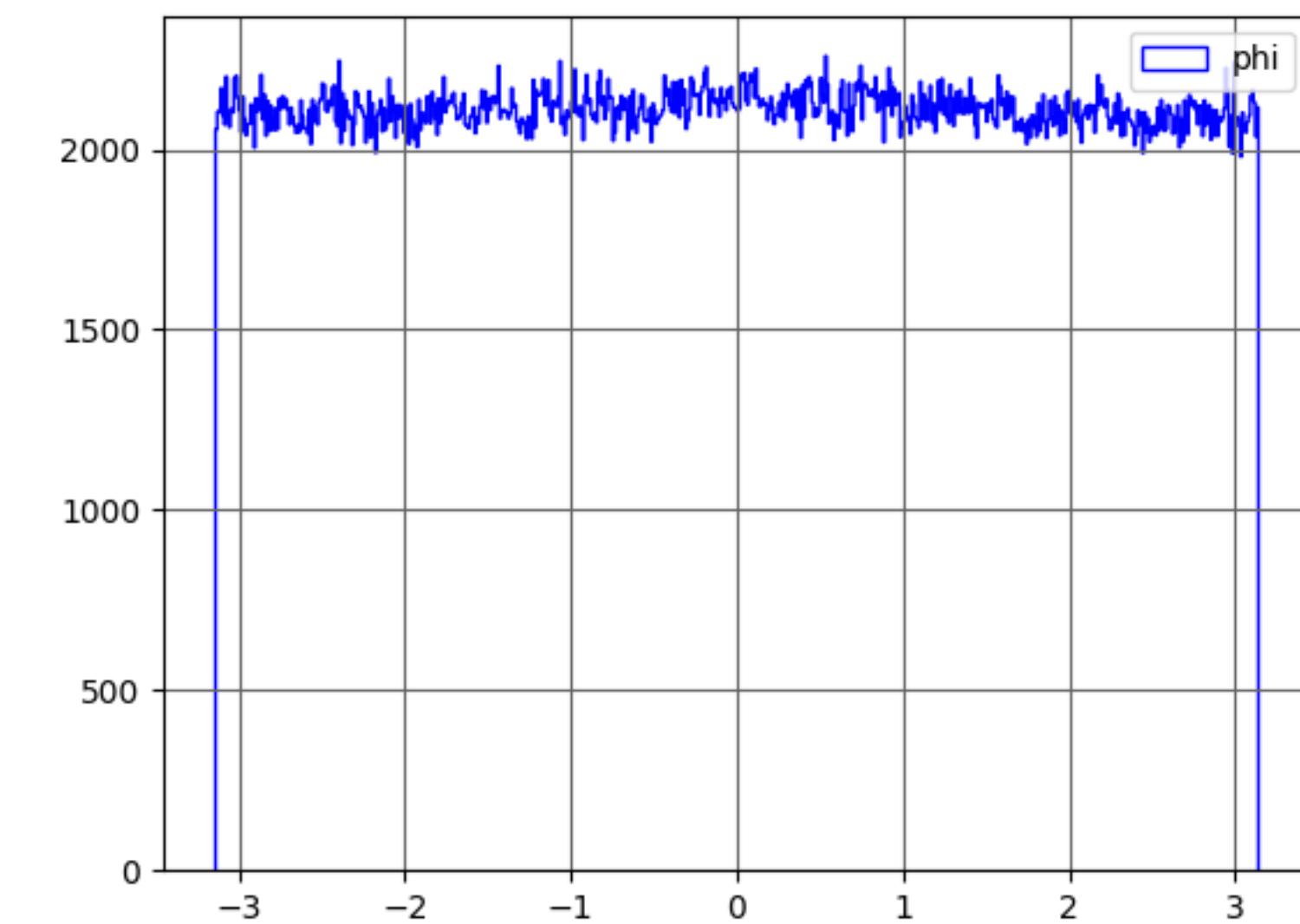
## 終狀態 $b\bar{b}$



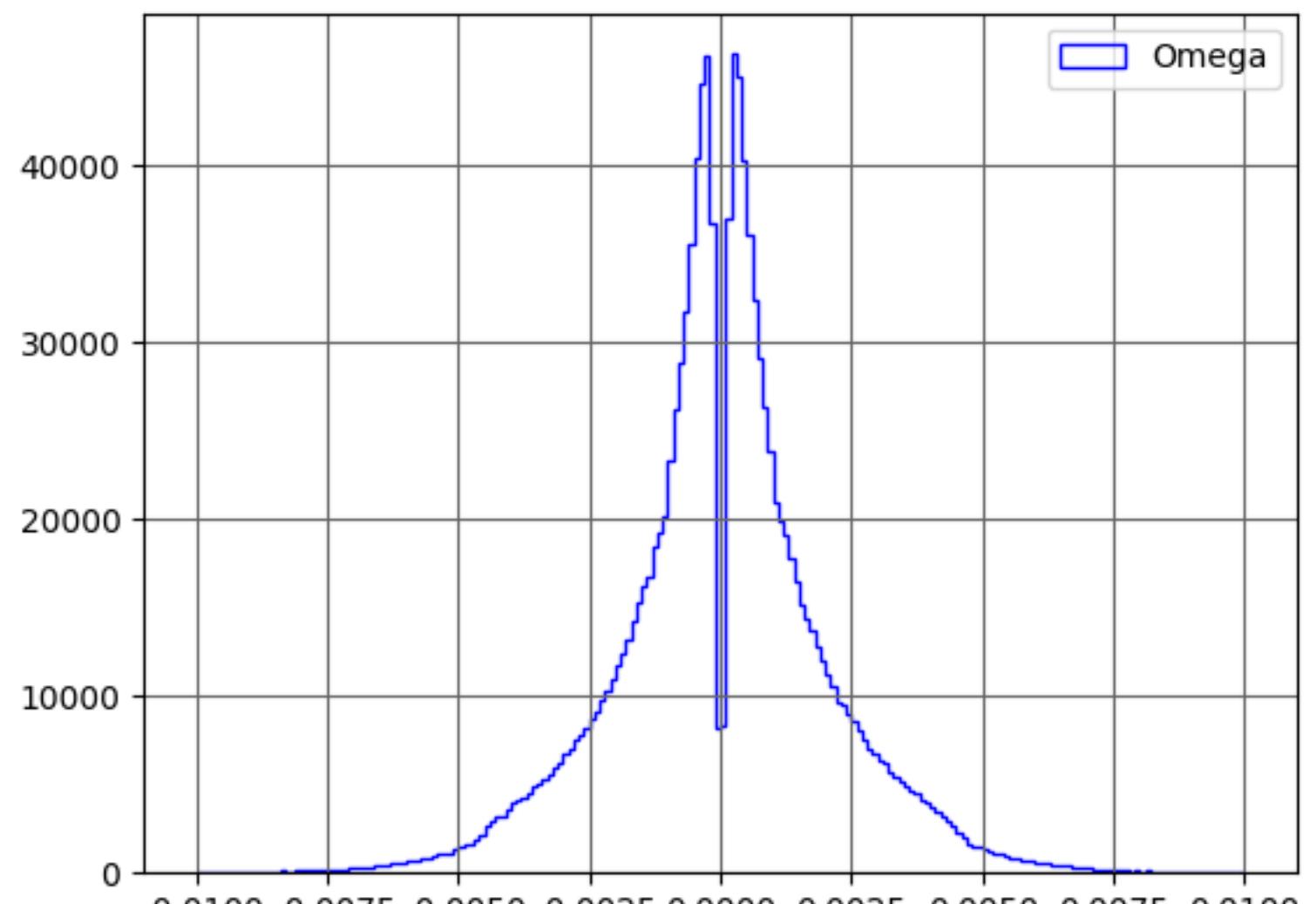
$d_0$



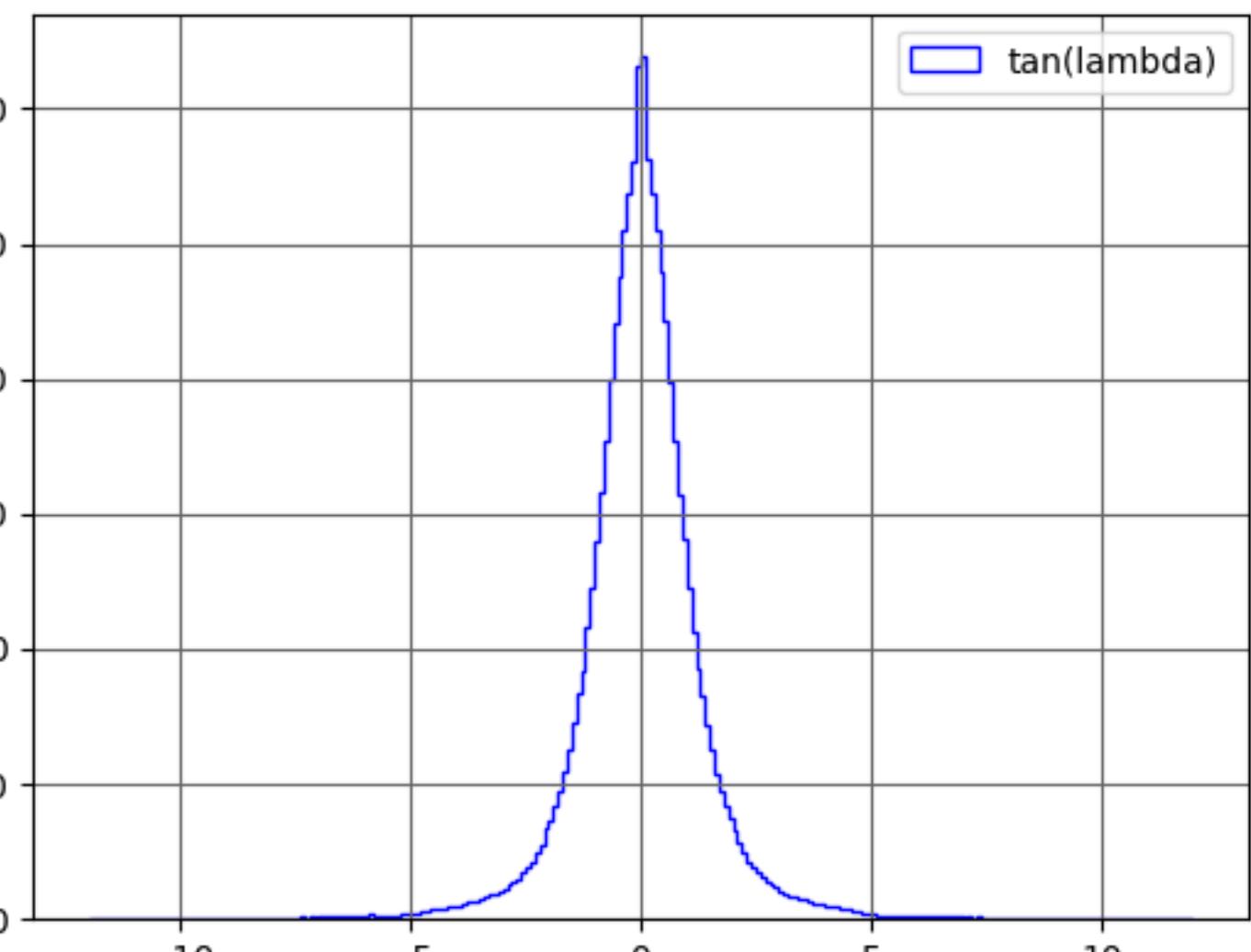
$z_0$



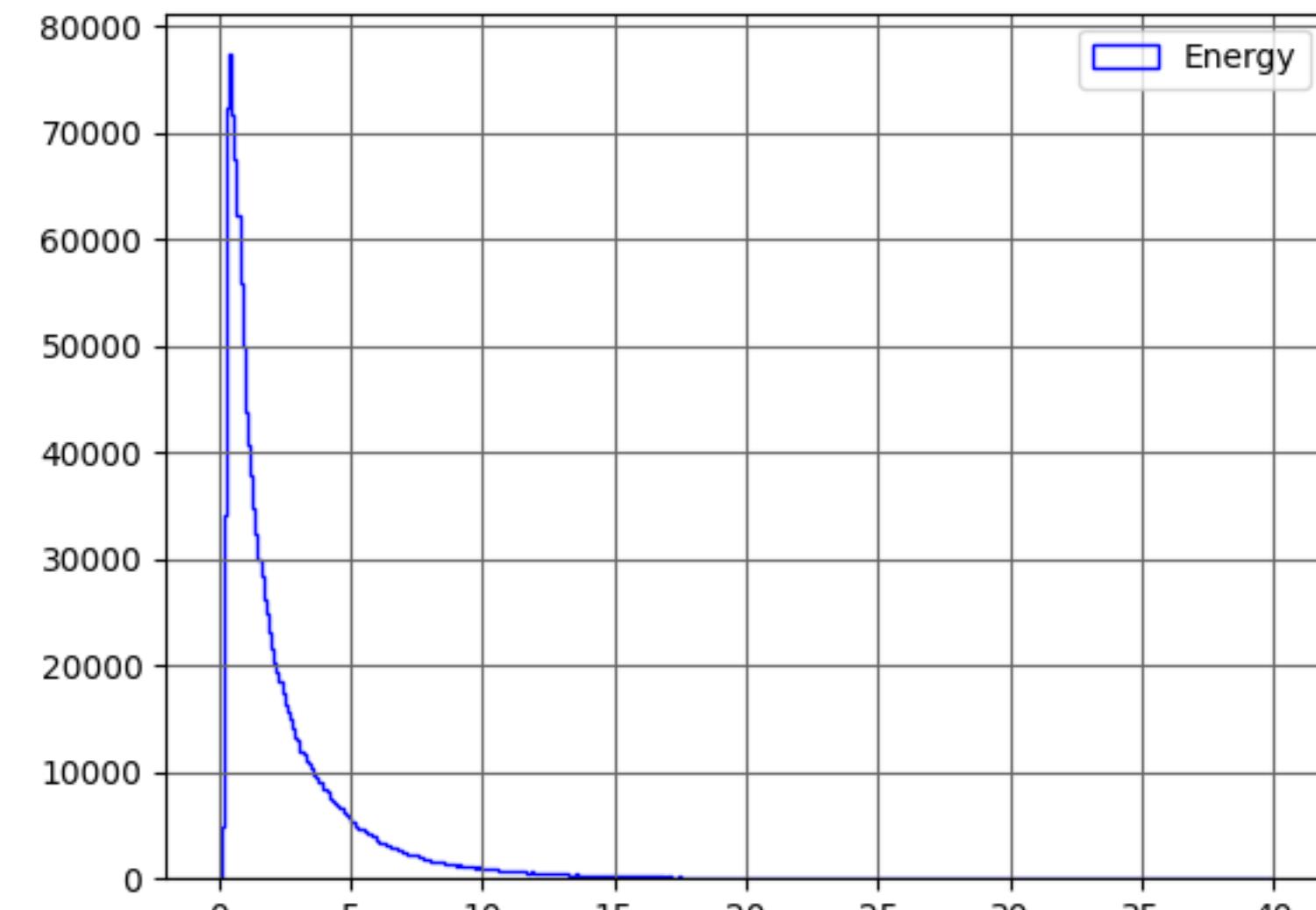
$\phi$



$\Omega$

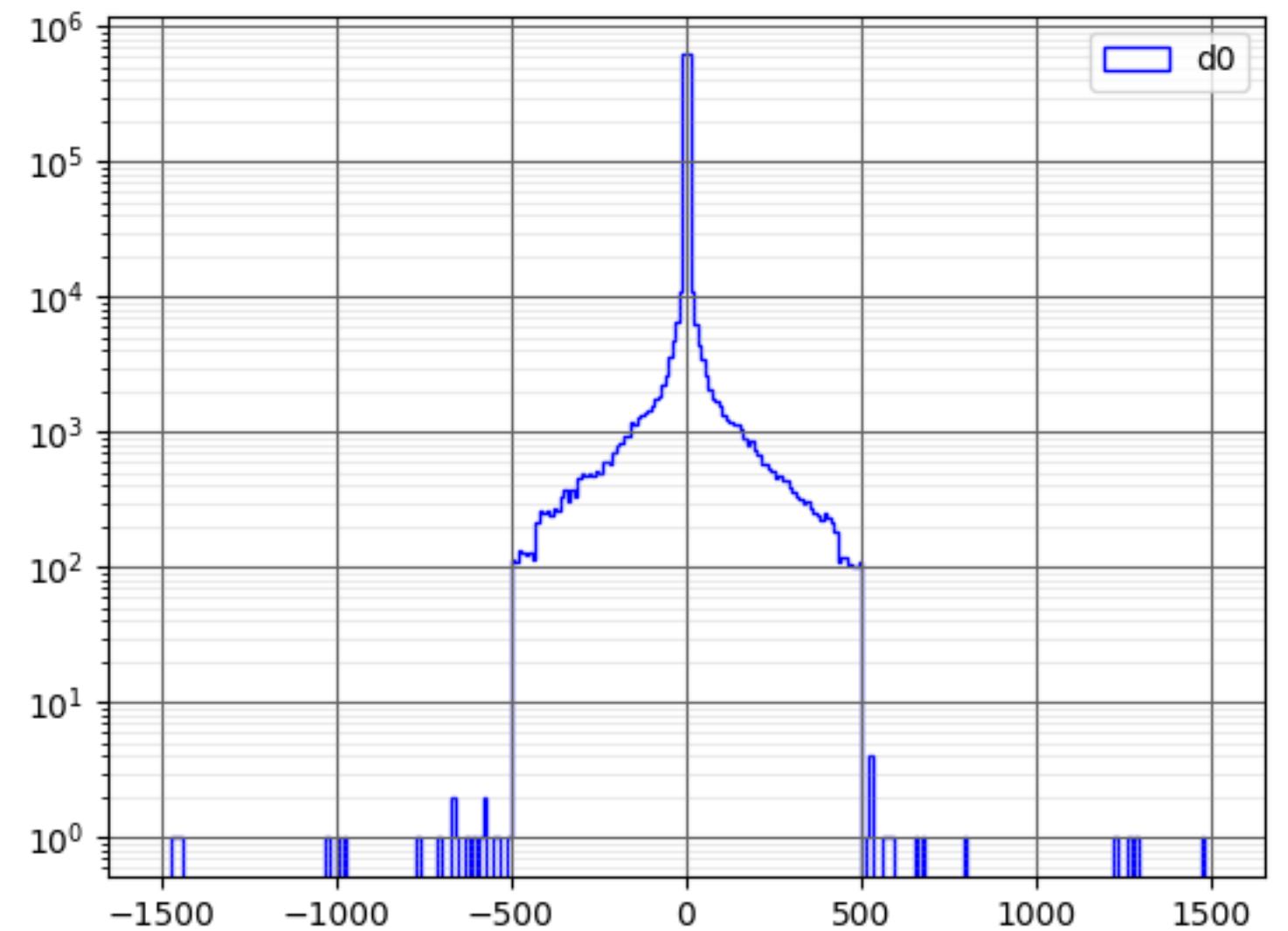


$\tan(\lambda)$

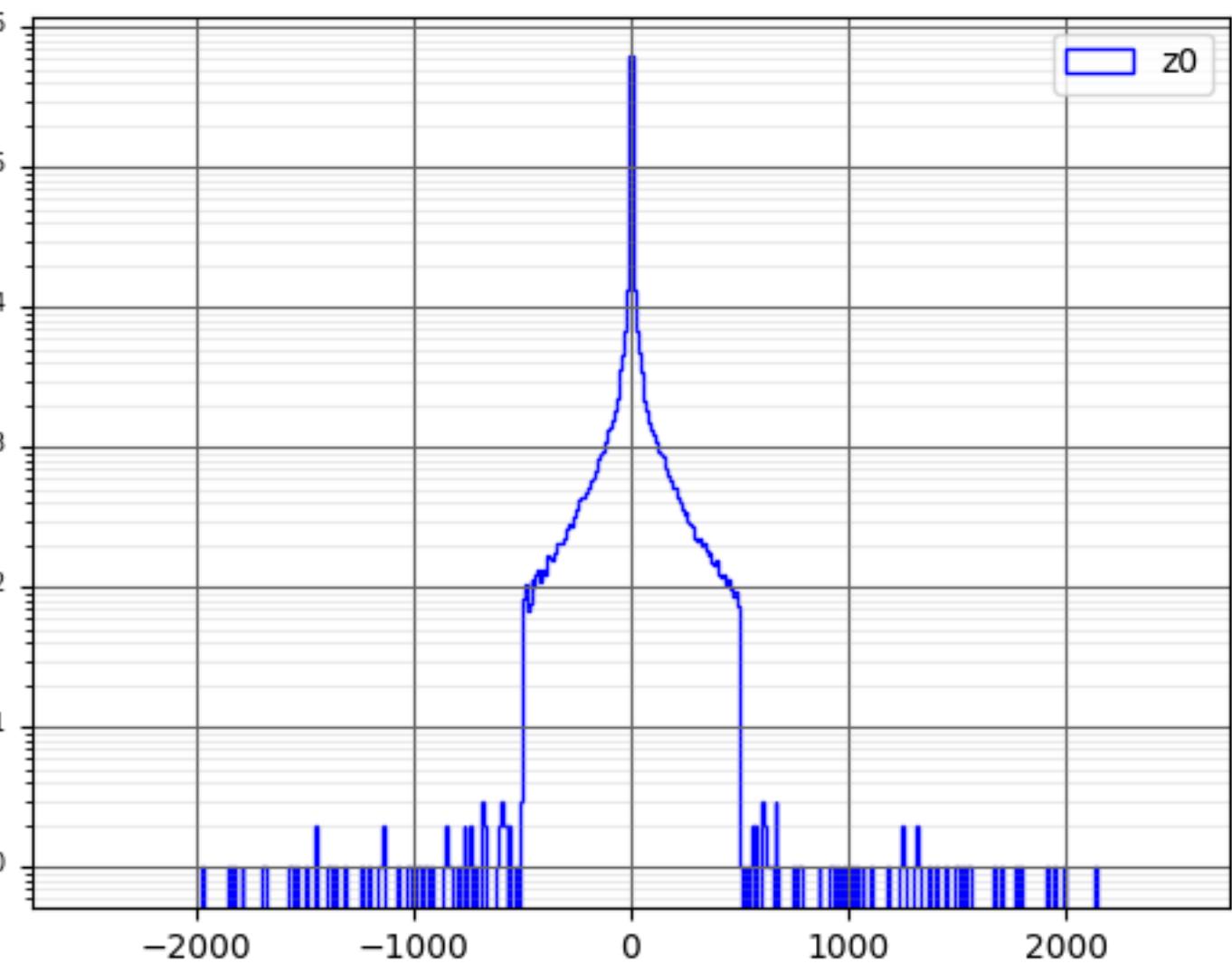


Energy

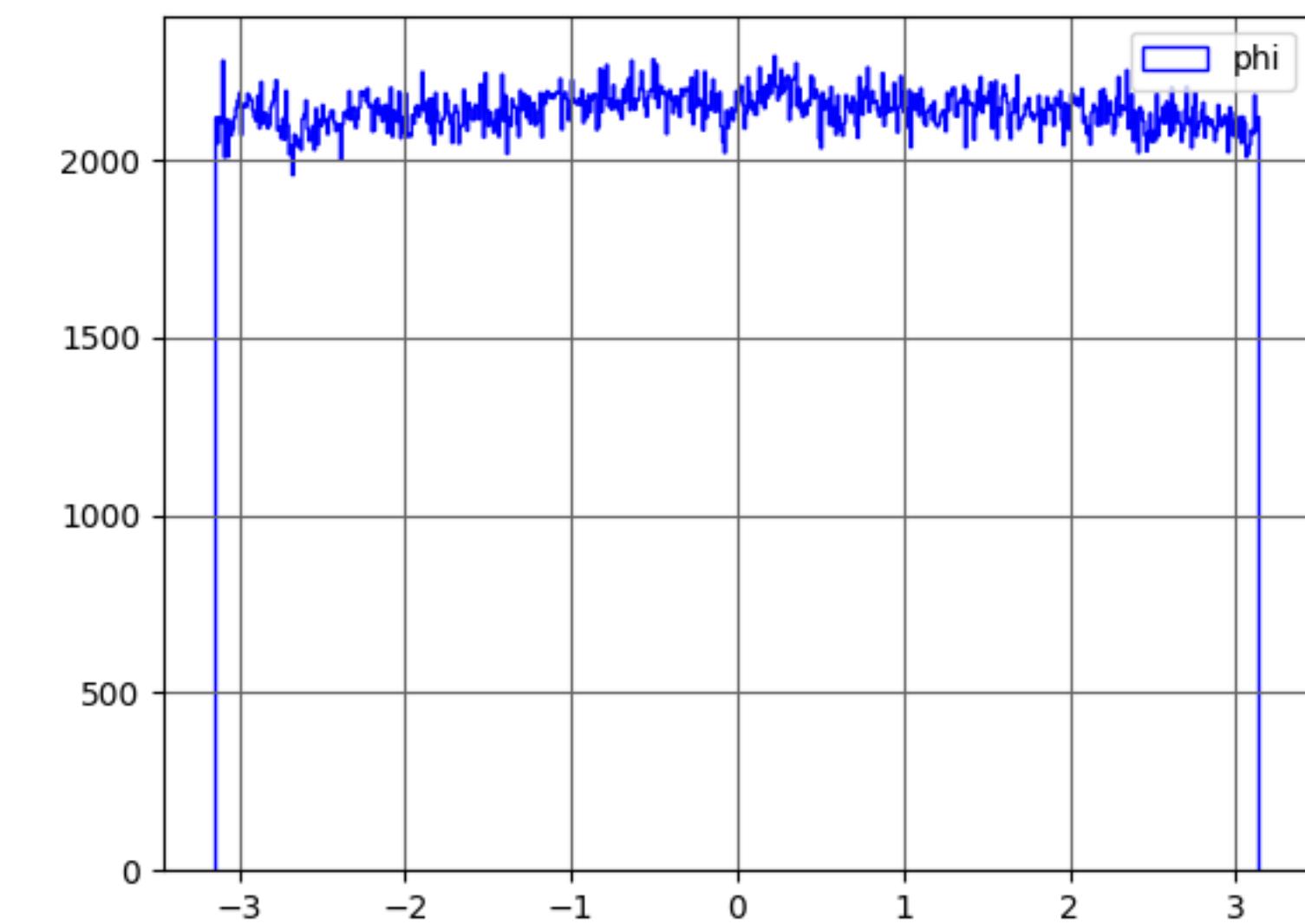
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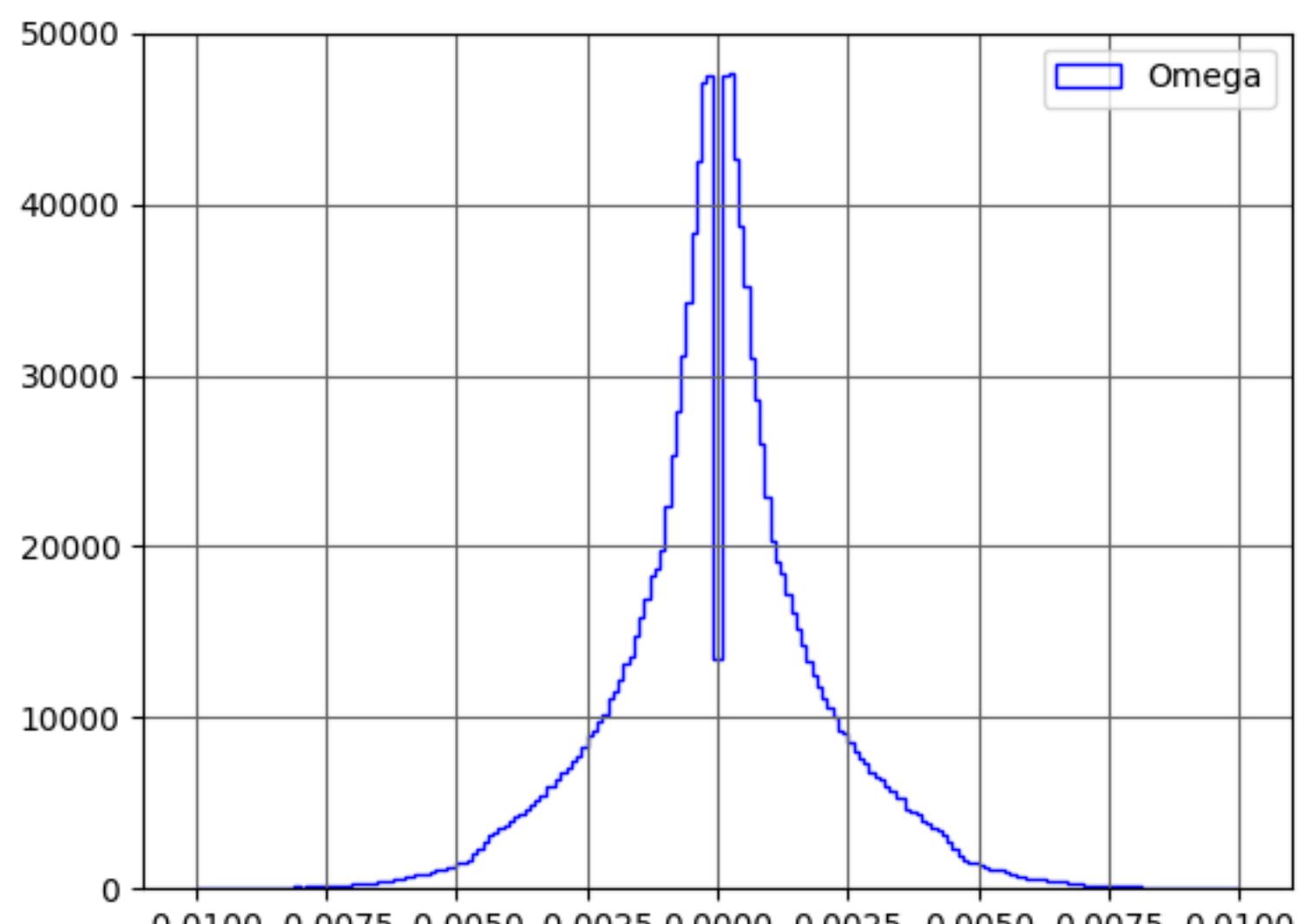
$d_0$



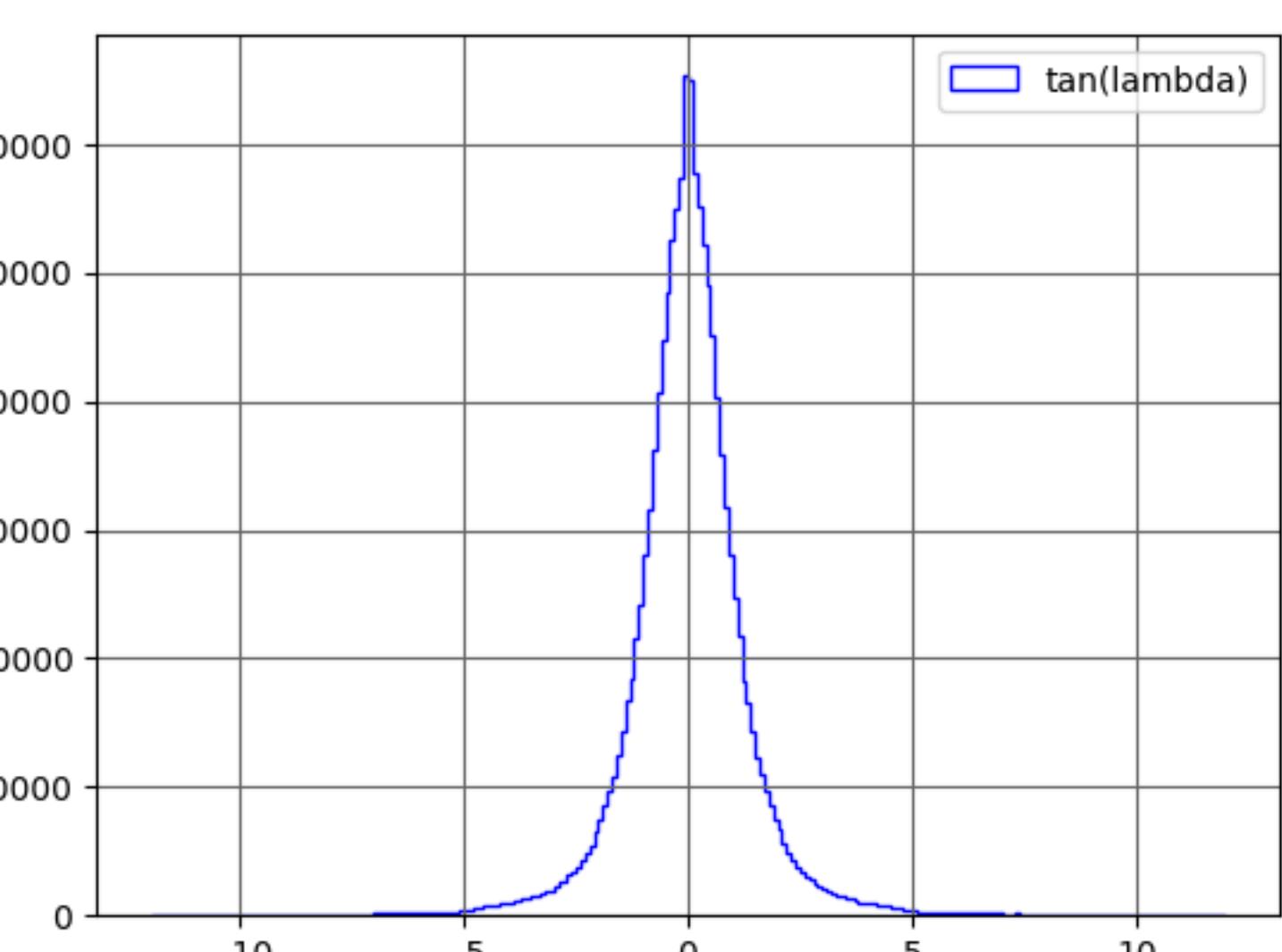
$z_0$



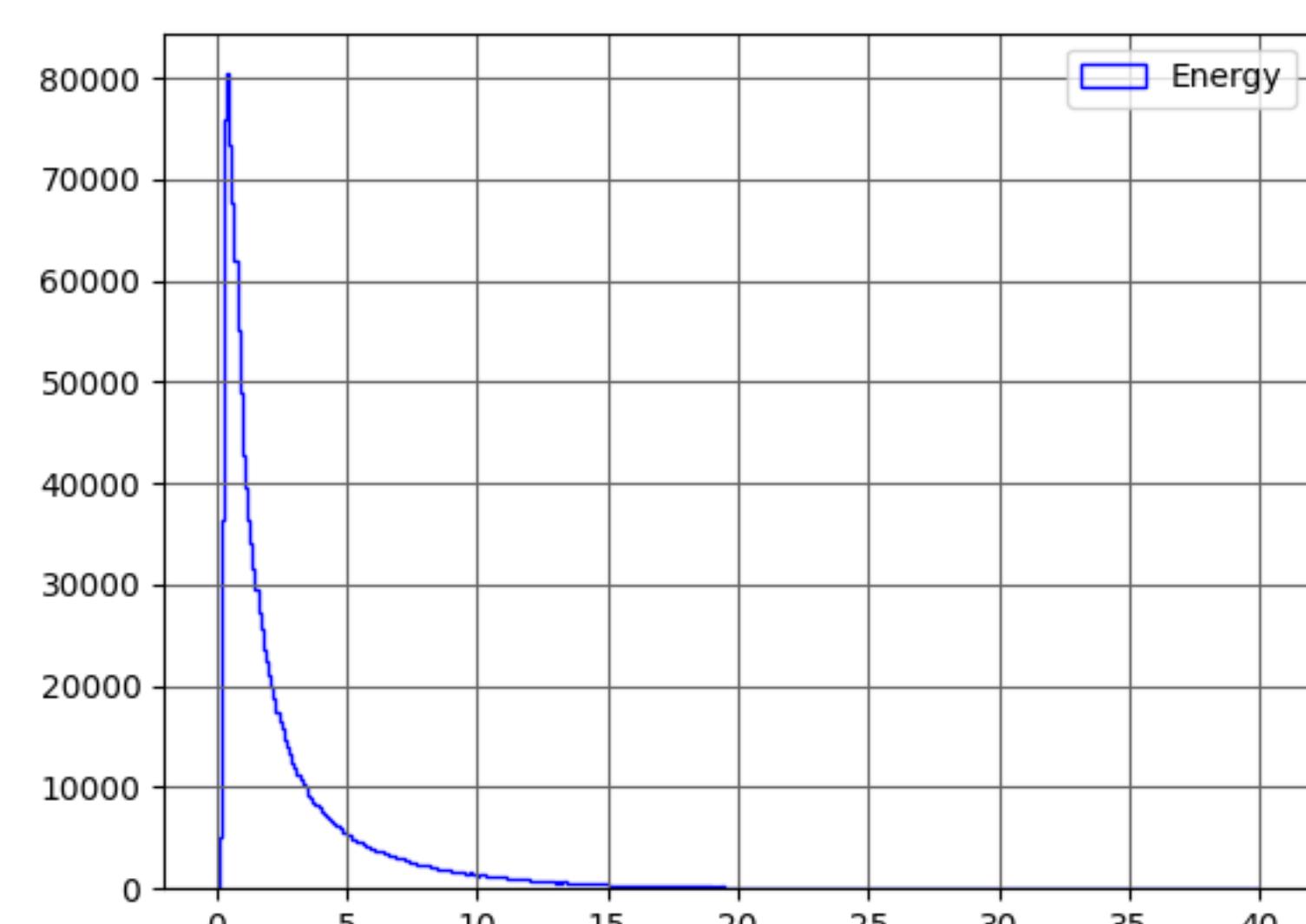
$\phi$



$\Omega$

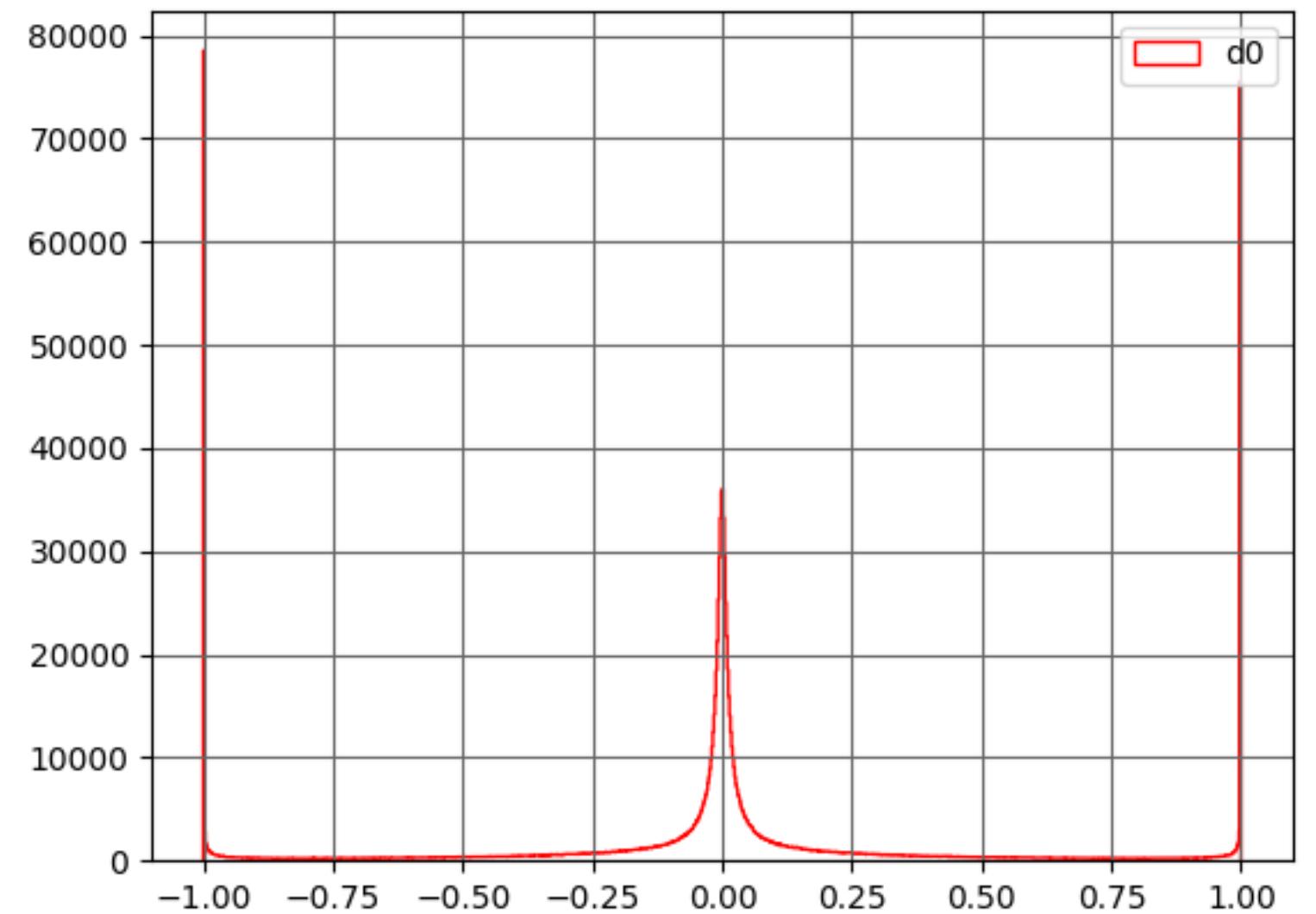


$\tan(\lambda)$

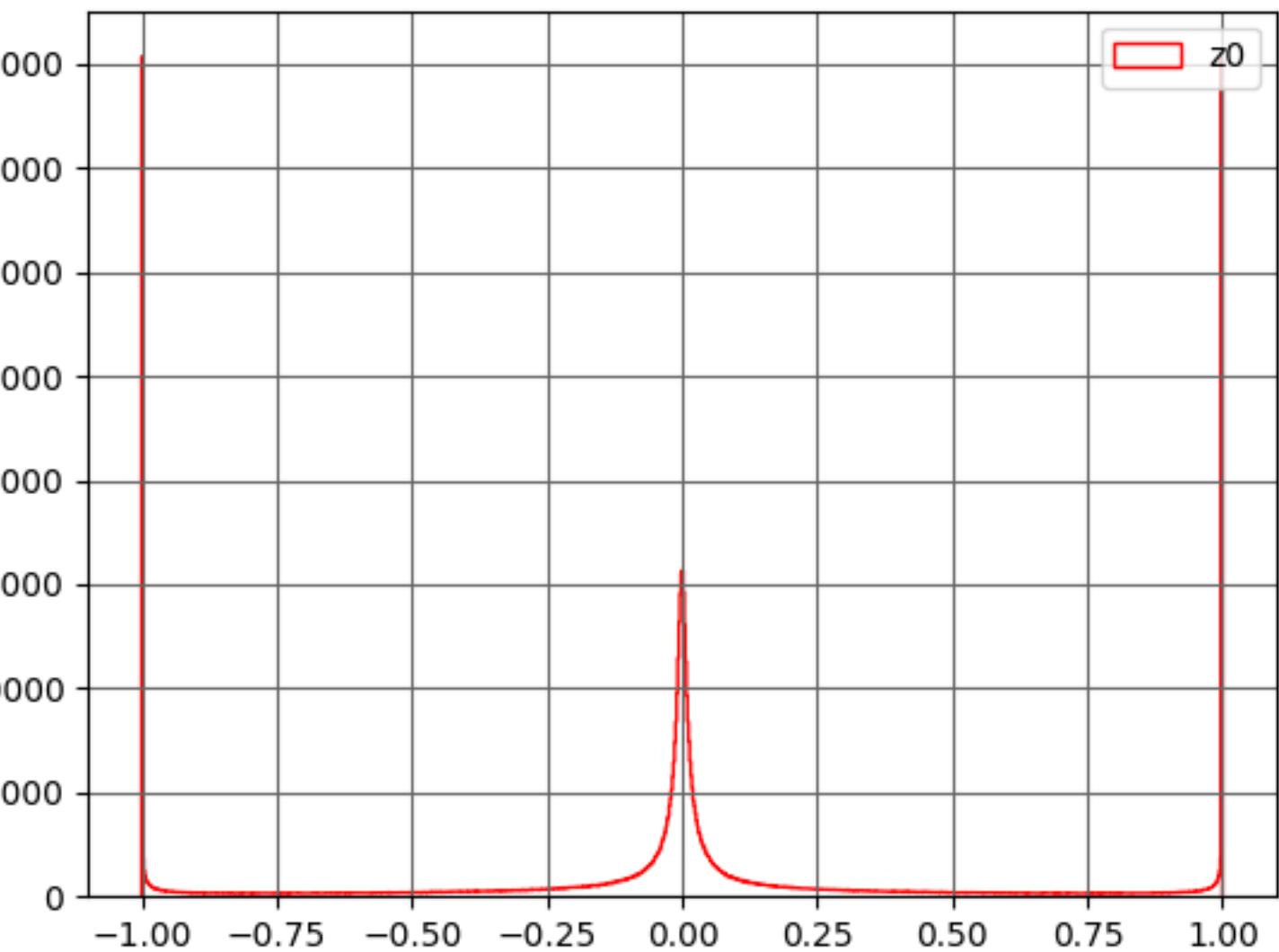


Energy

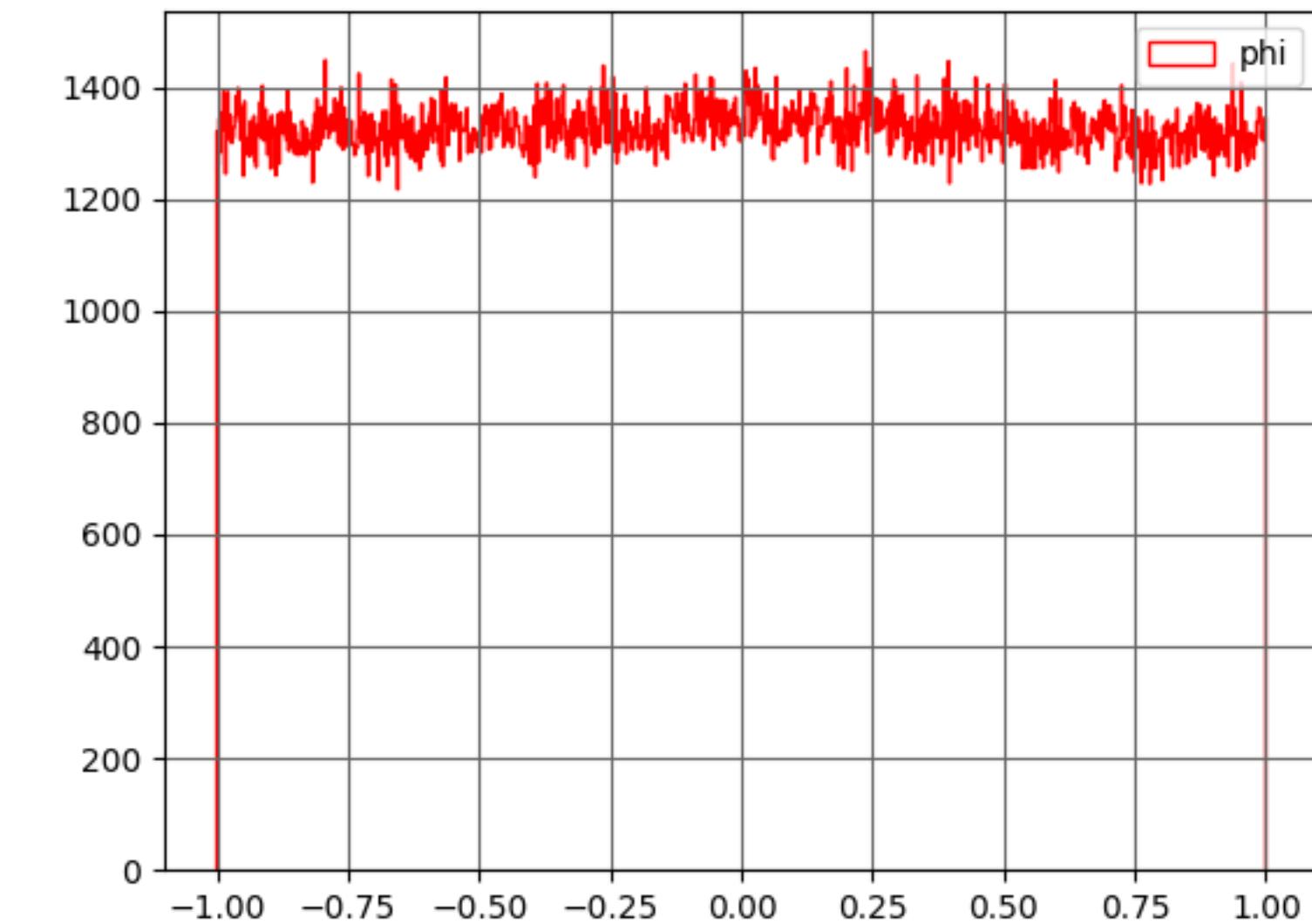
## 終狀態 $b\bar{b}$



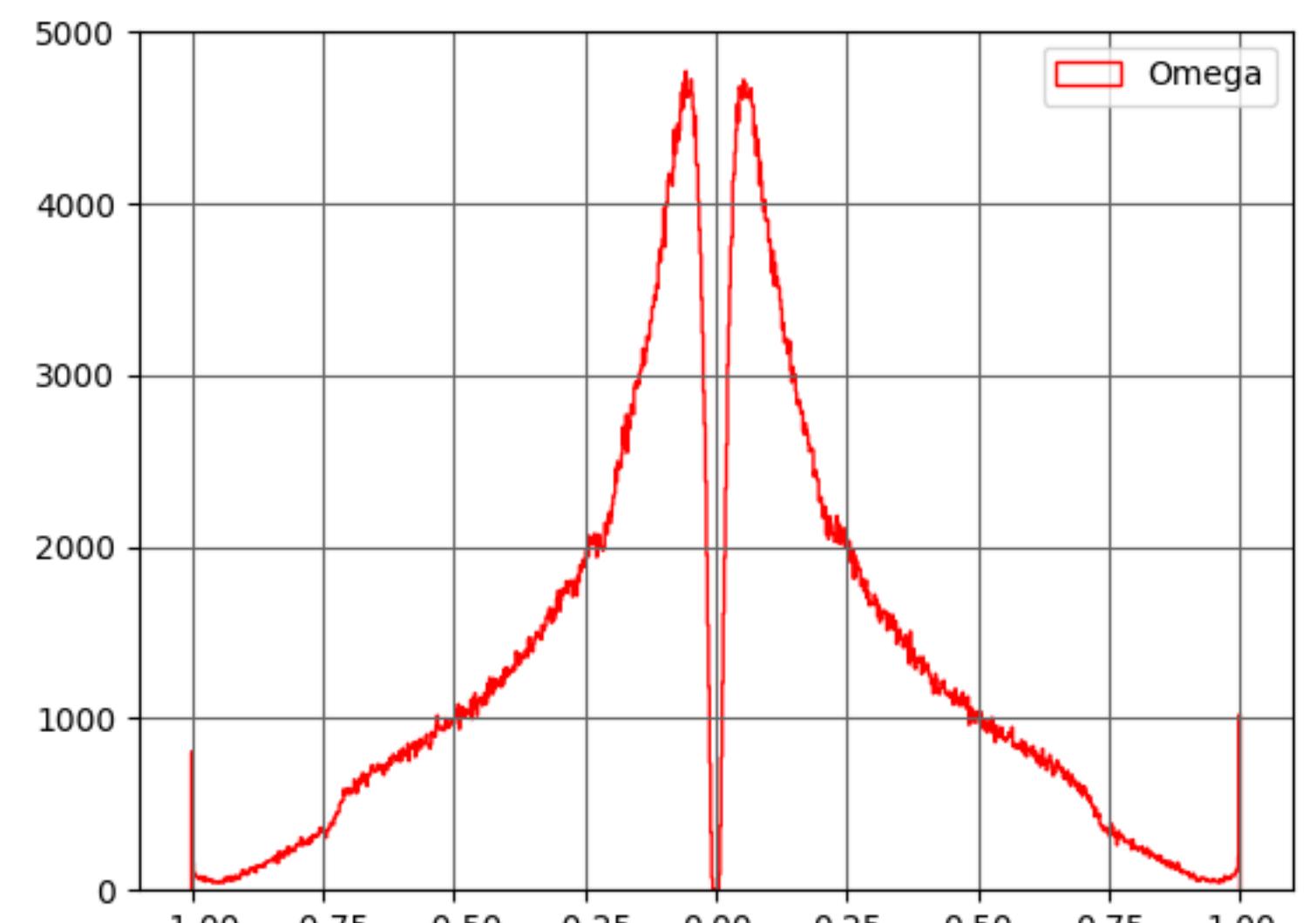
$d_0$



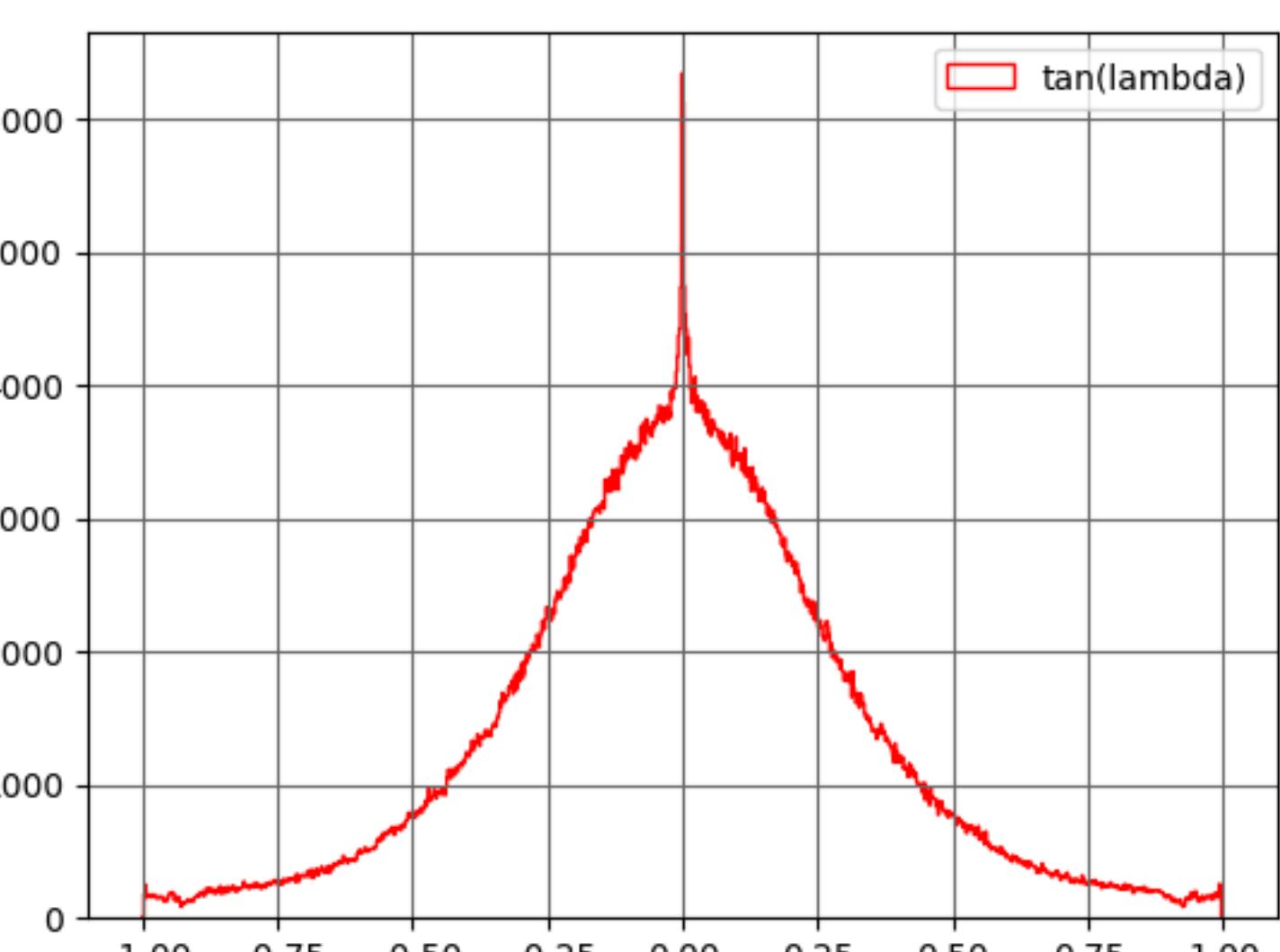
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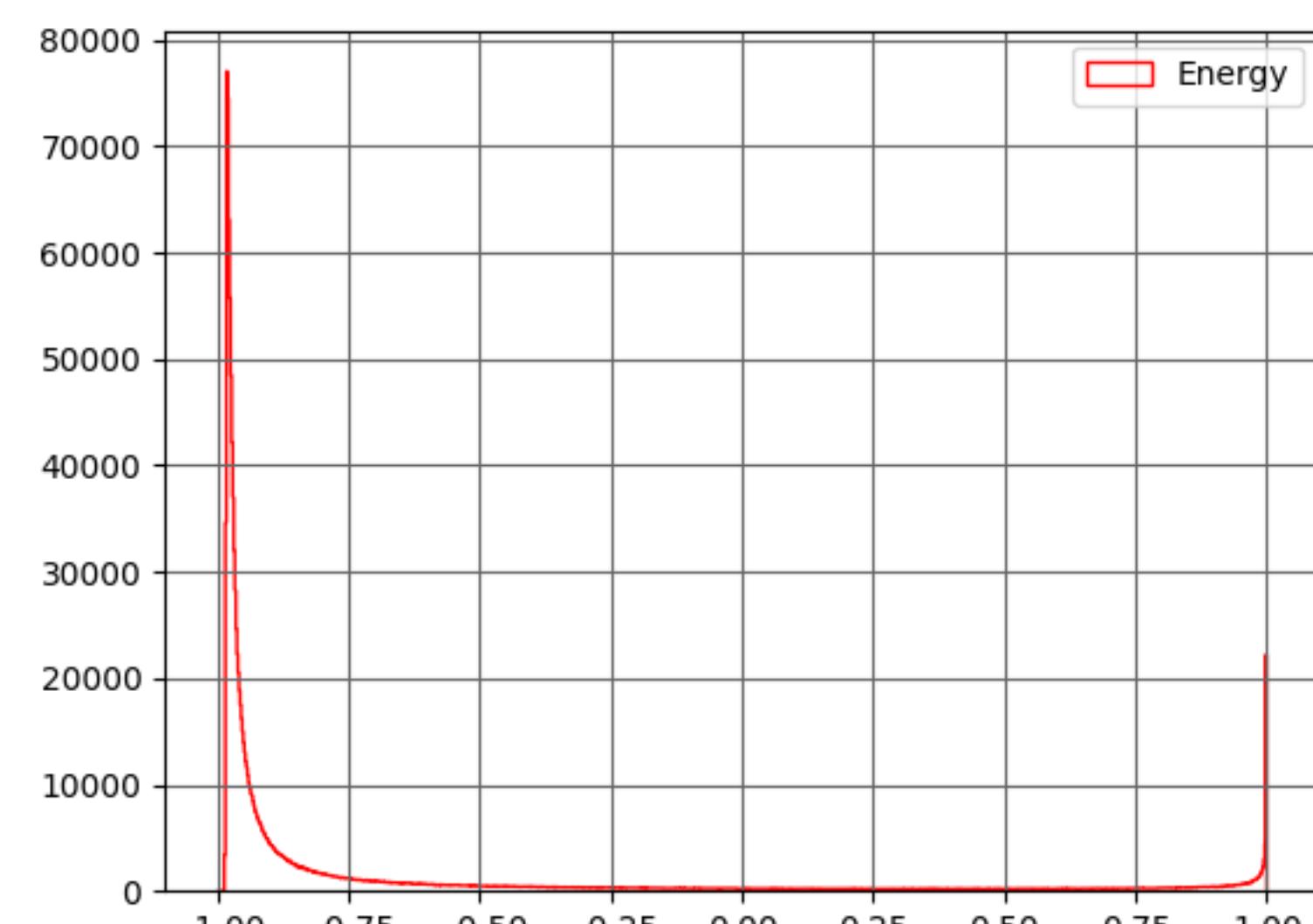
$\phi$



$\Omega$

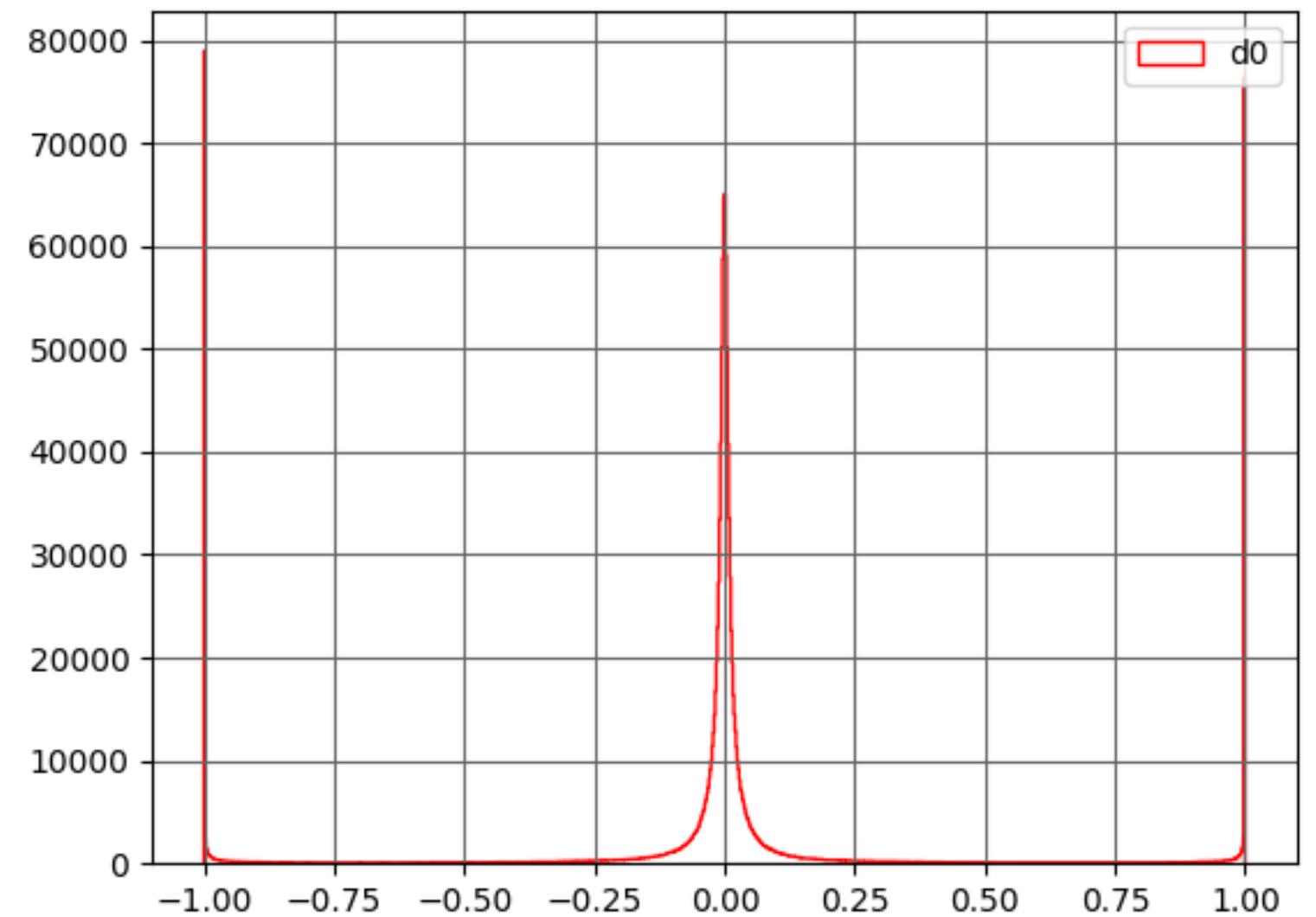


$\tan(\lambda)$

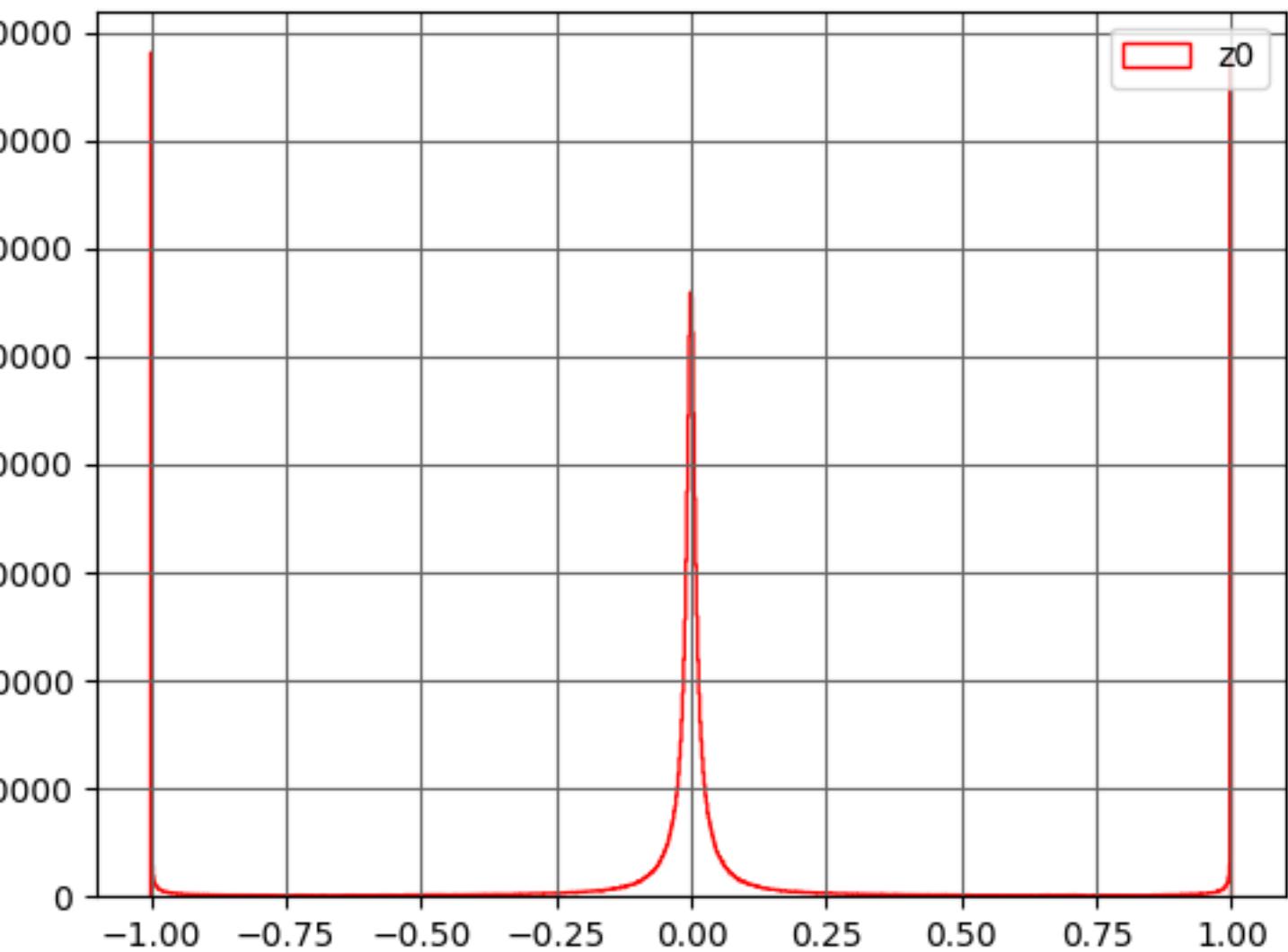


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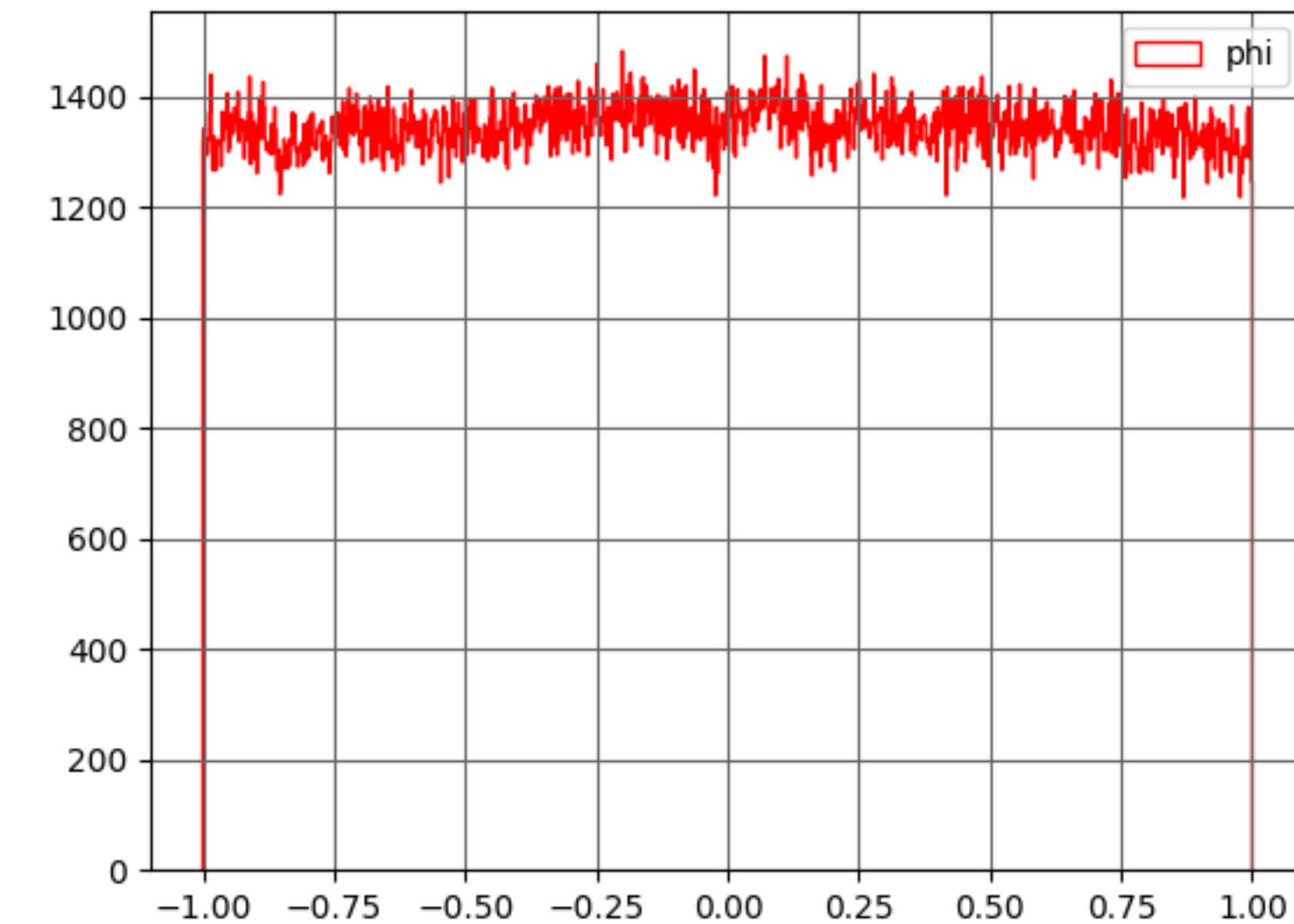
## 終狀態 $c\bar{c}$



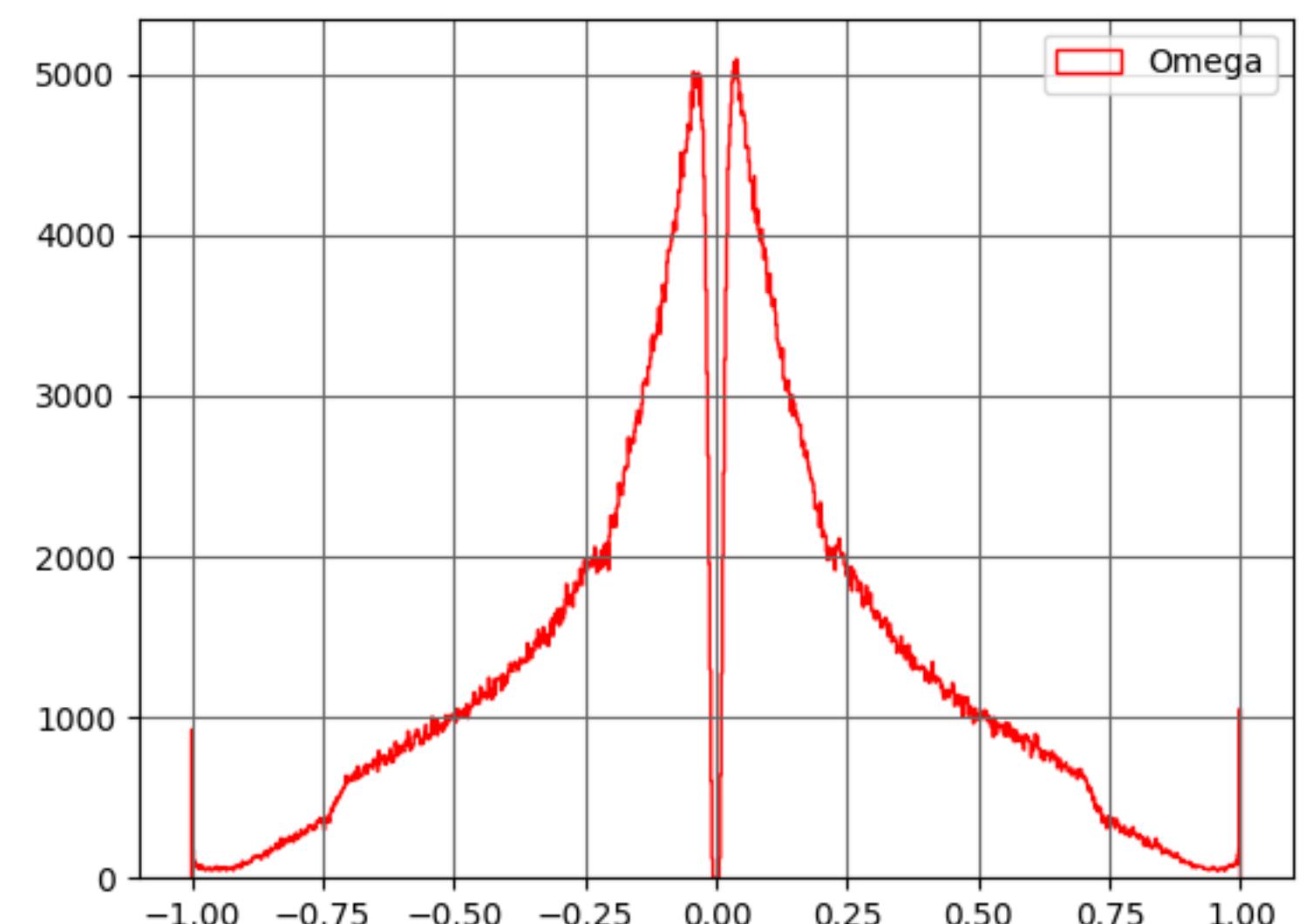
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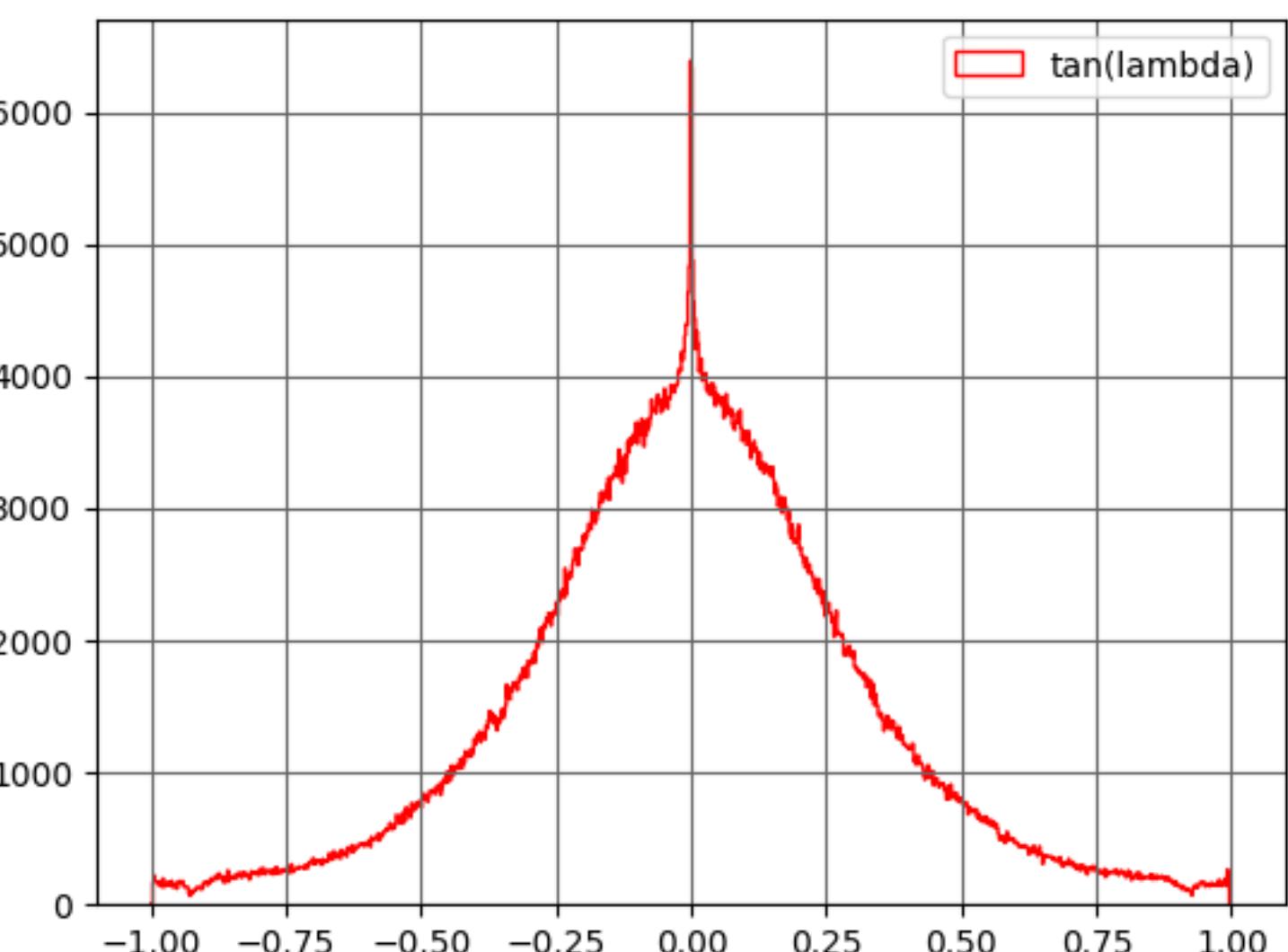
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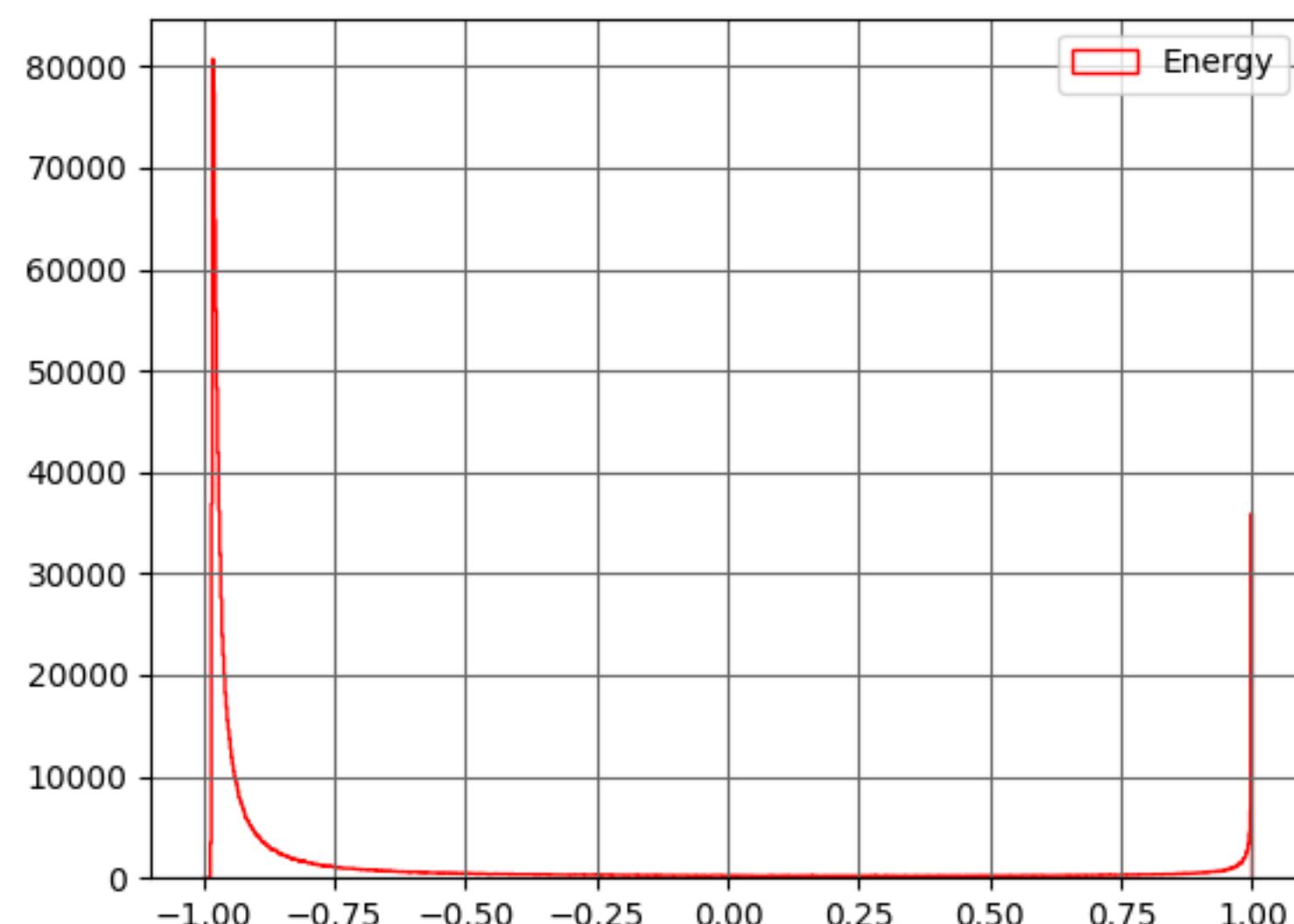
$\phi$



$\Omega$

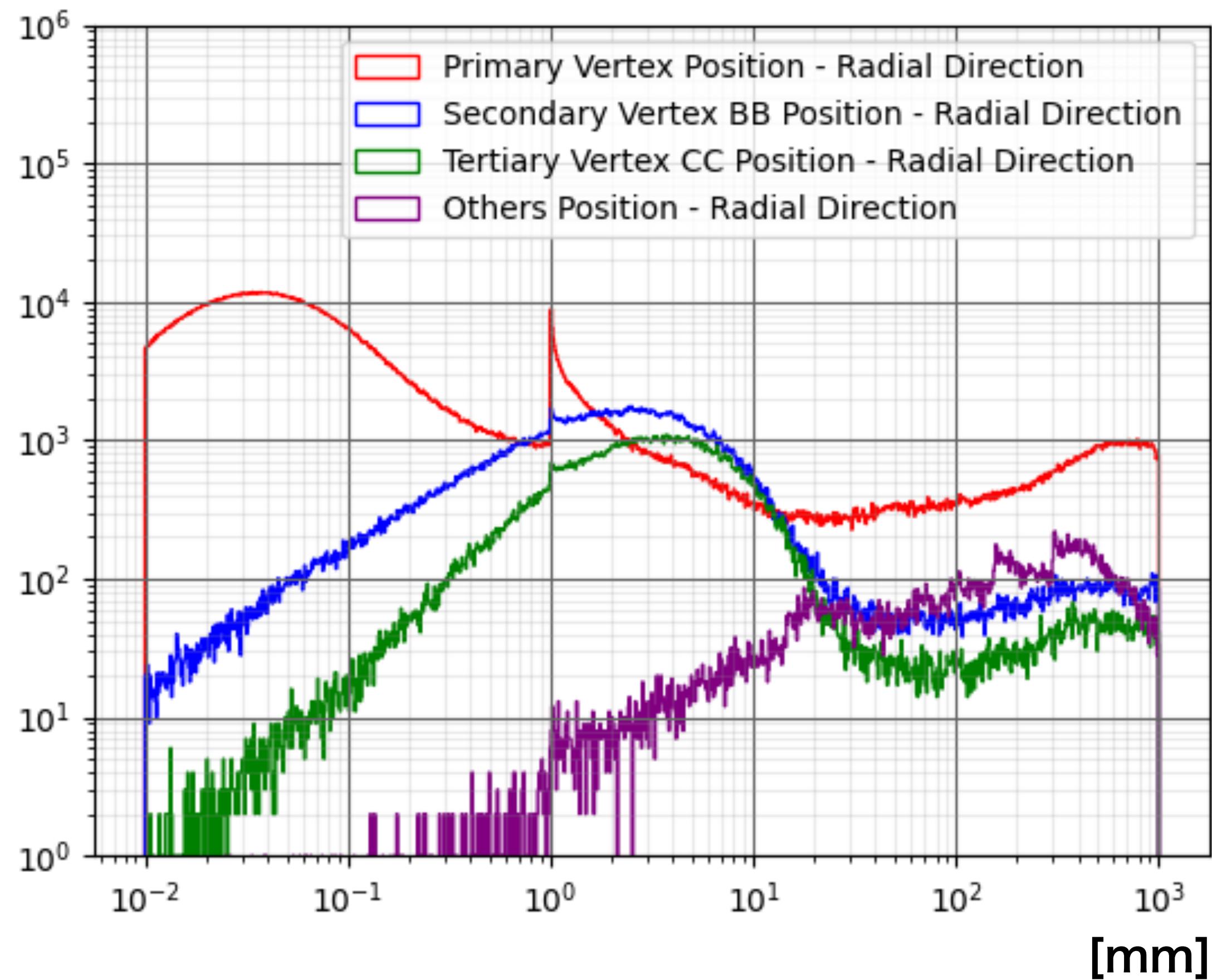


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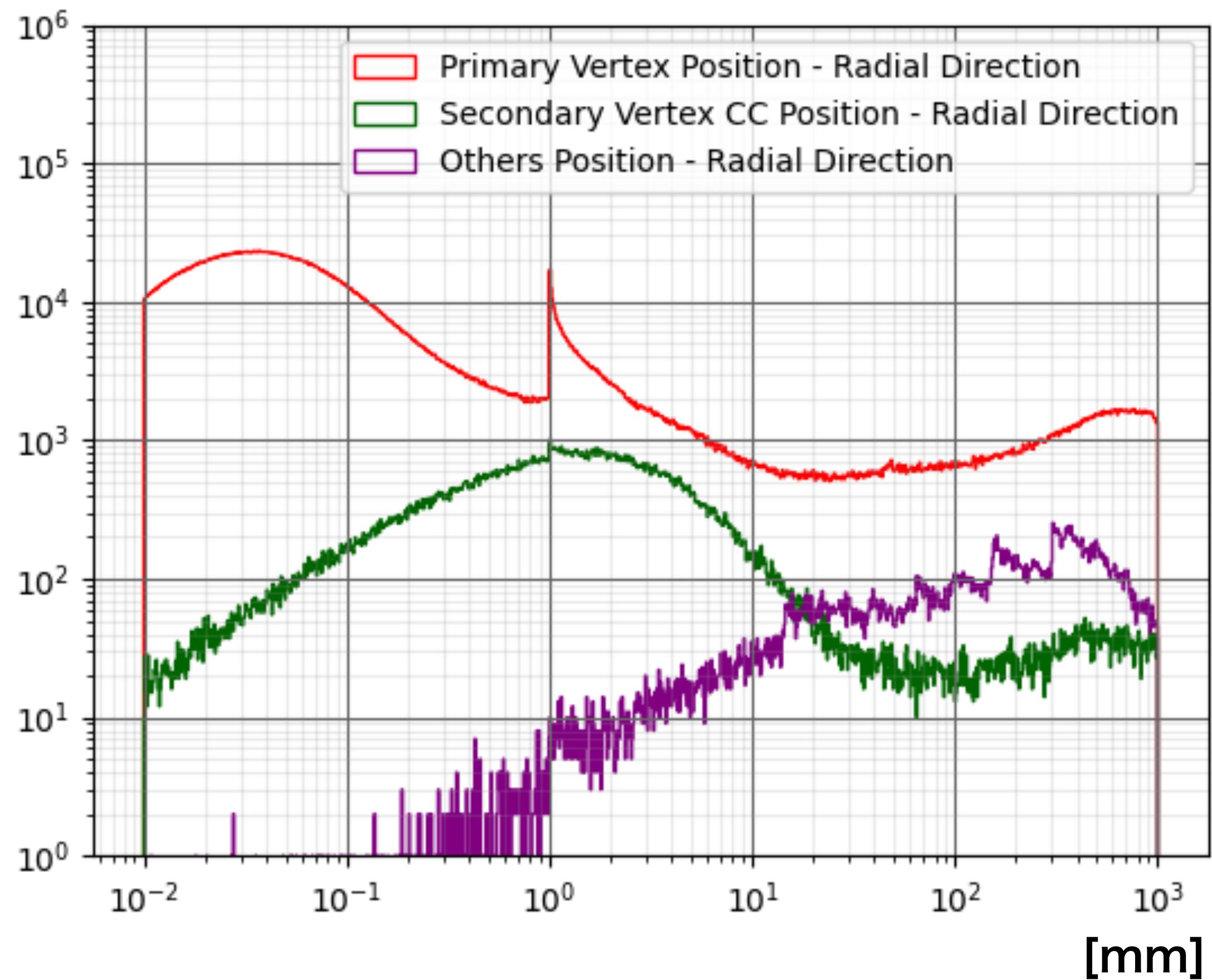


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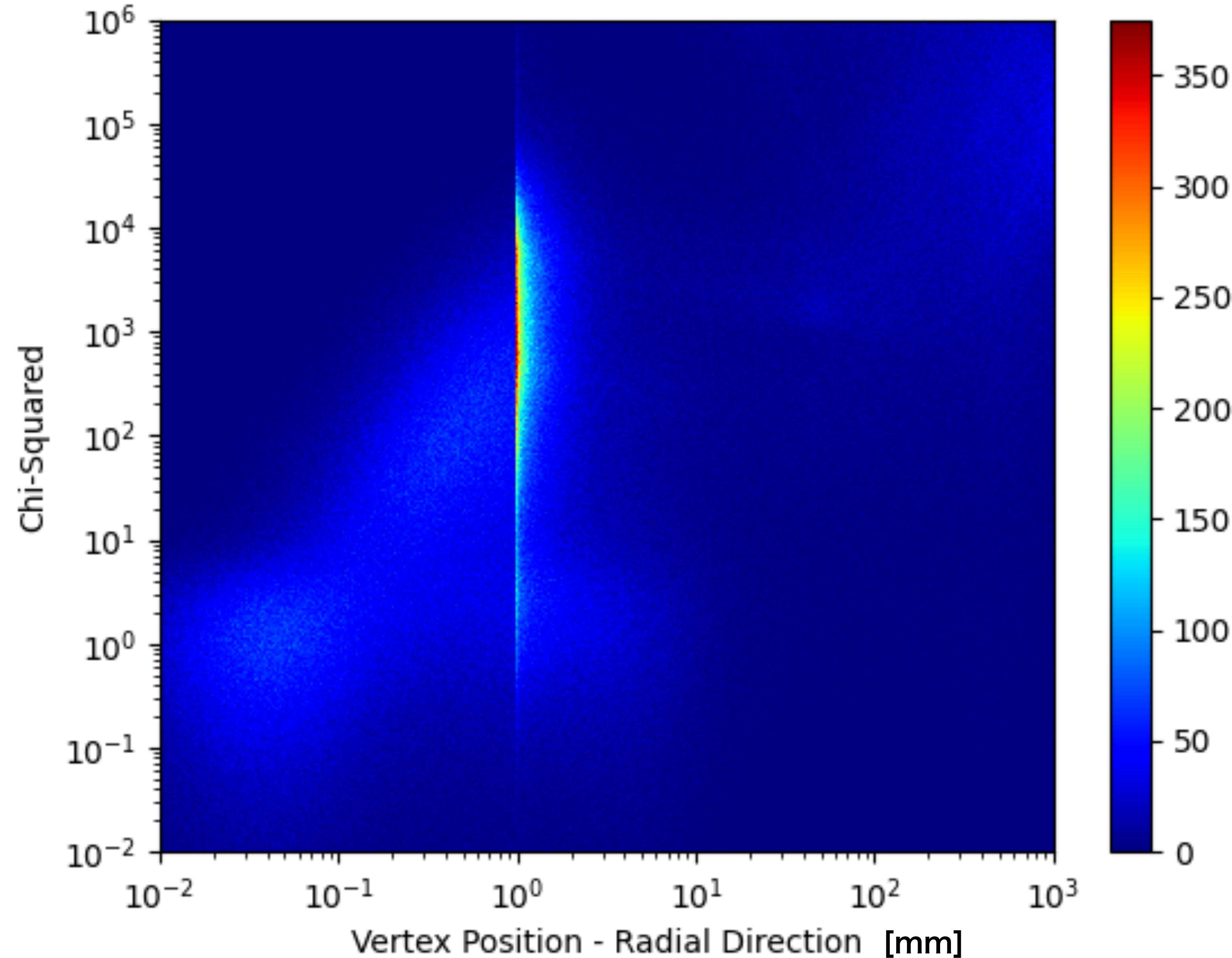
終状態  $b\bar{b}$



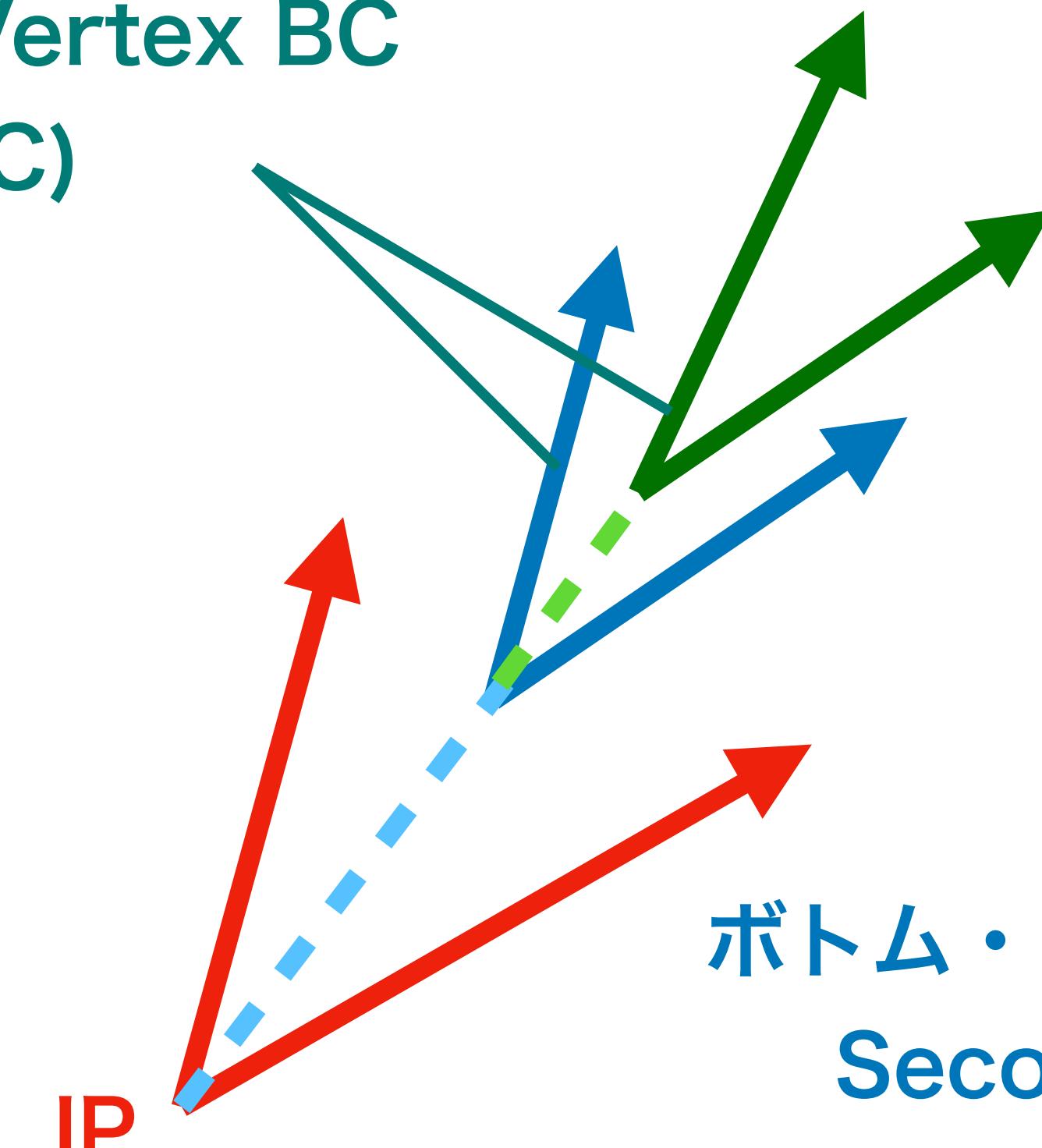
終状態  $c\bar{c}$



# 終状態 $b\bar{b}$



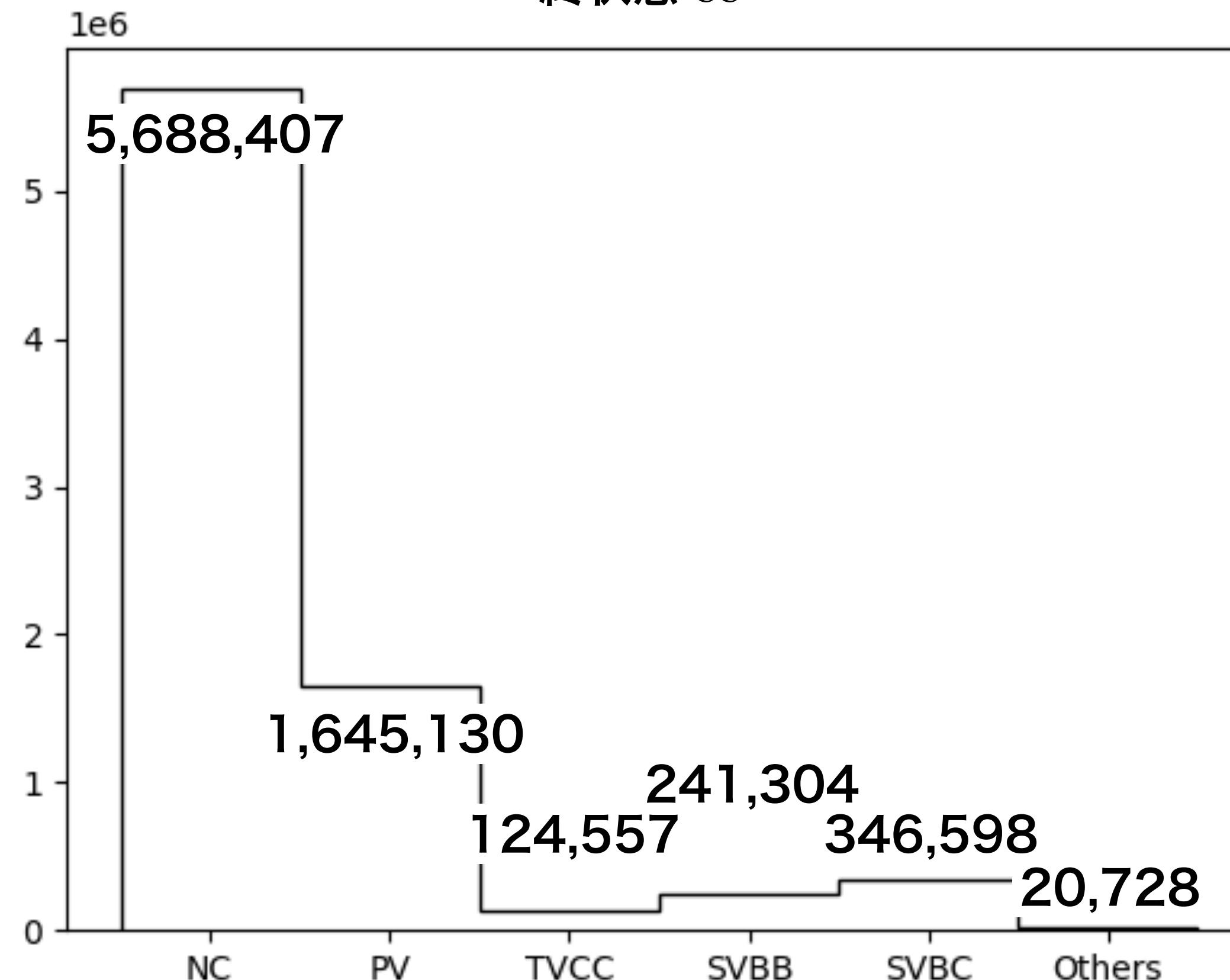
Secondary Vertex BC  
(SVBC)



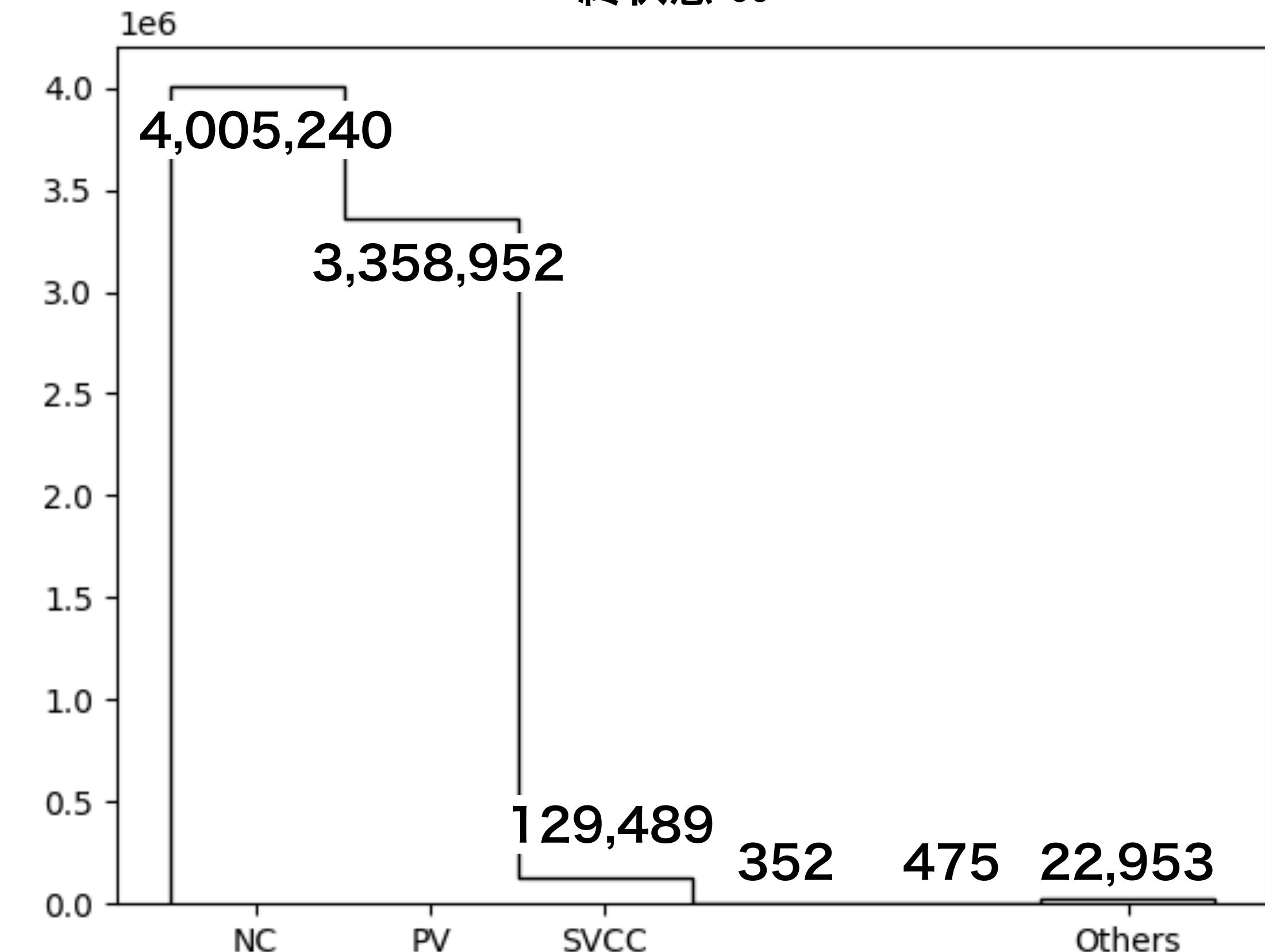
チャーム・フレーバーのハドロンによる  
Tertiary Vertex (TBCC)

ボトム・フレーバーのハドロンによる  
Secondary Vertex (SVBB)

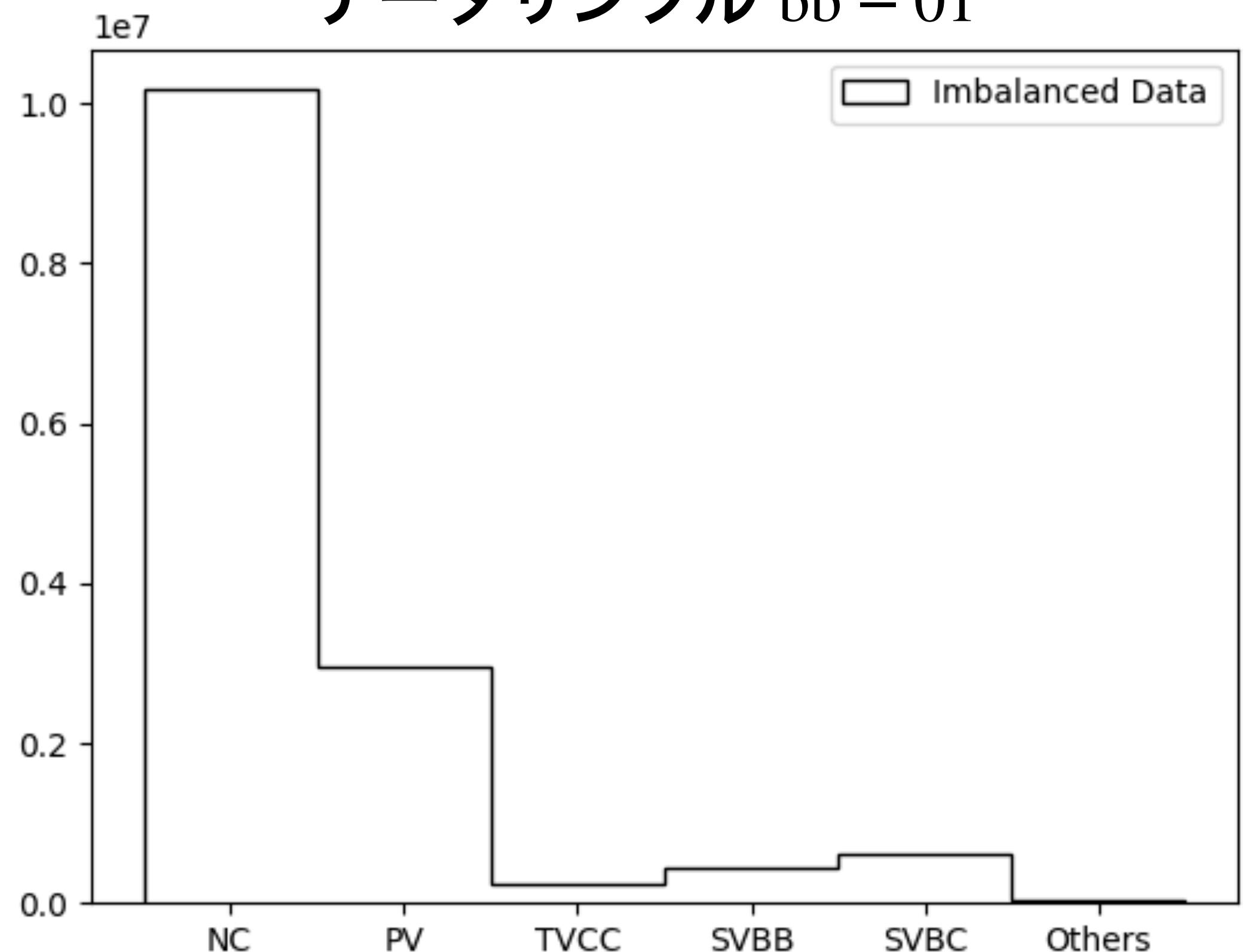
終状態  $b\bar{b}$



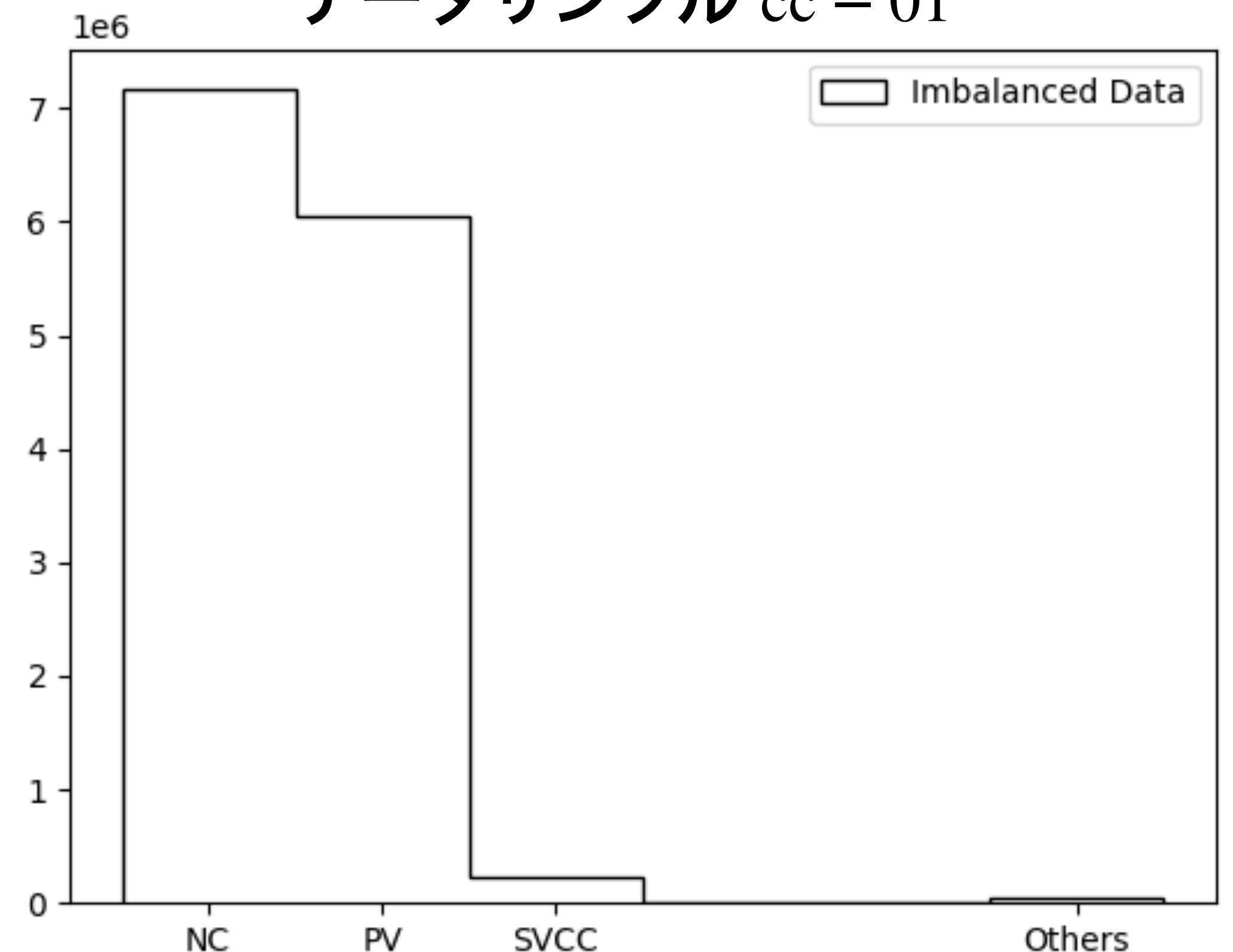
終状態  $c\bar{c}$



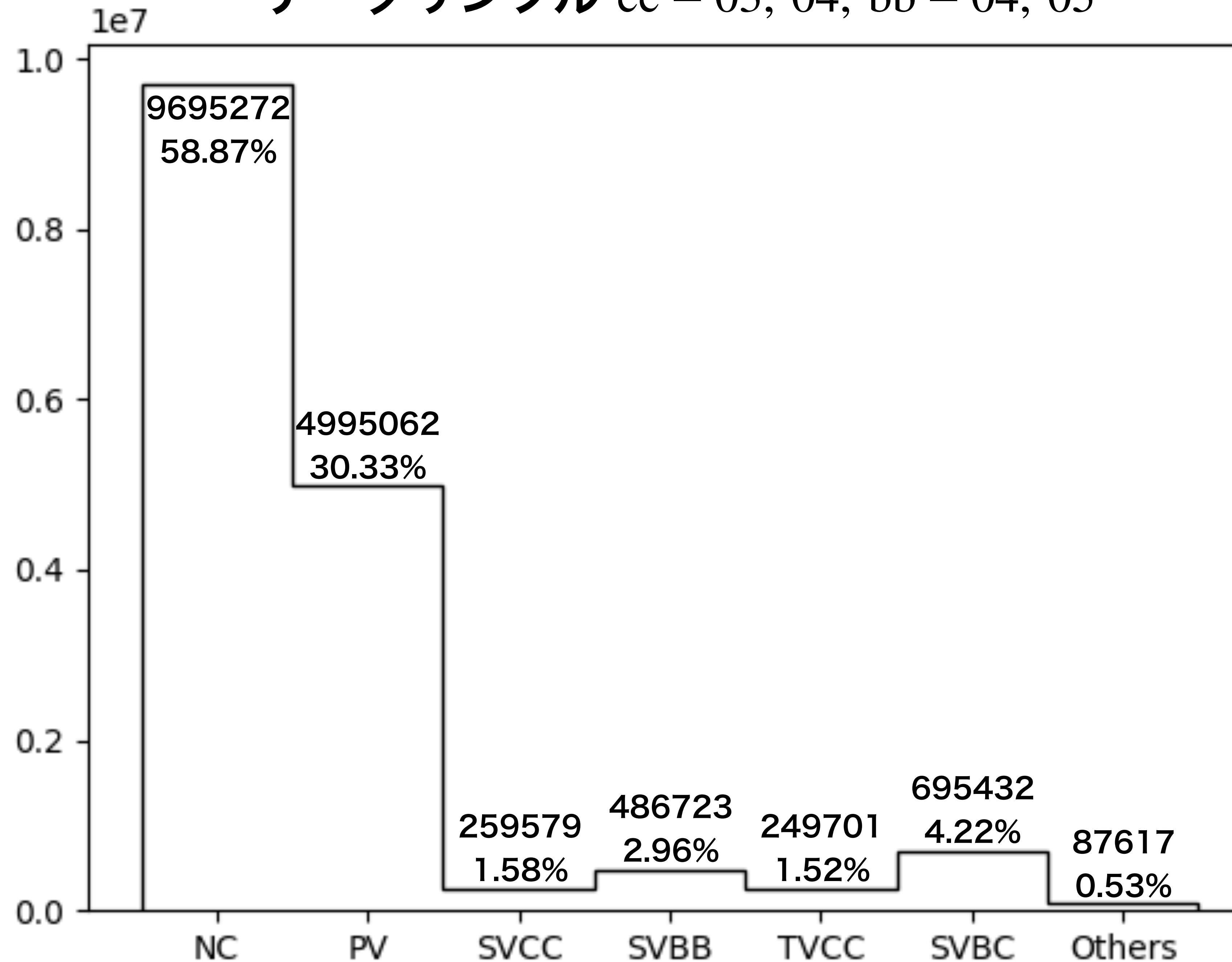
データサンプル  $b\bar{b}$  – 01

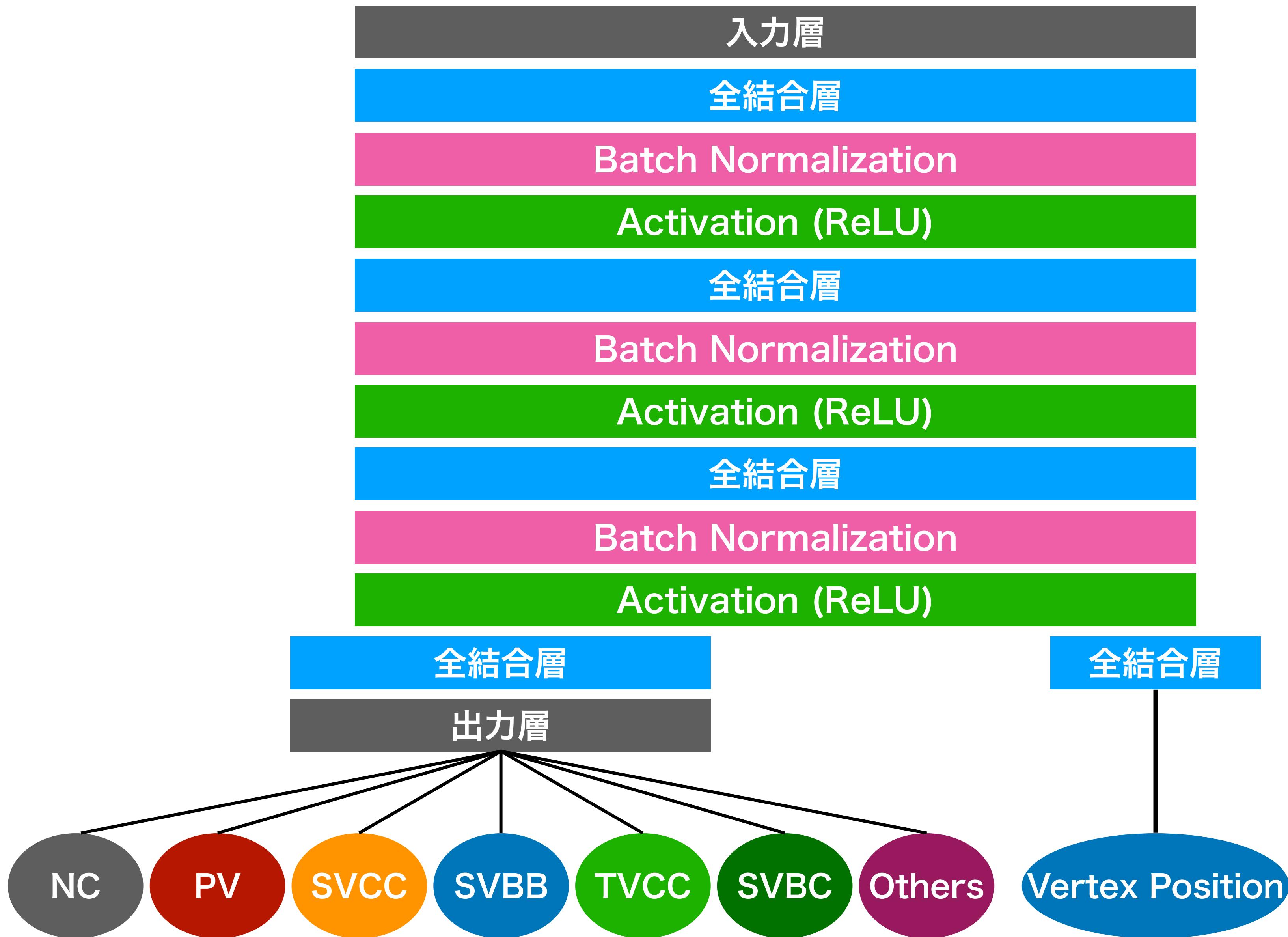


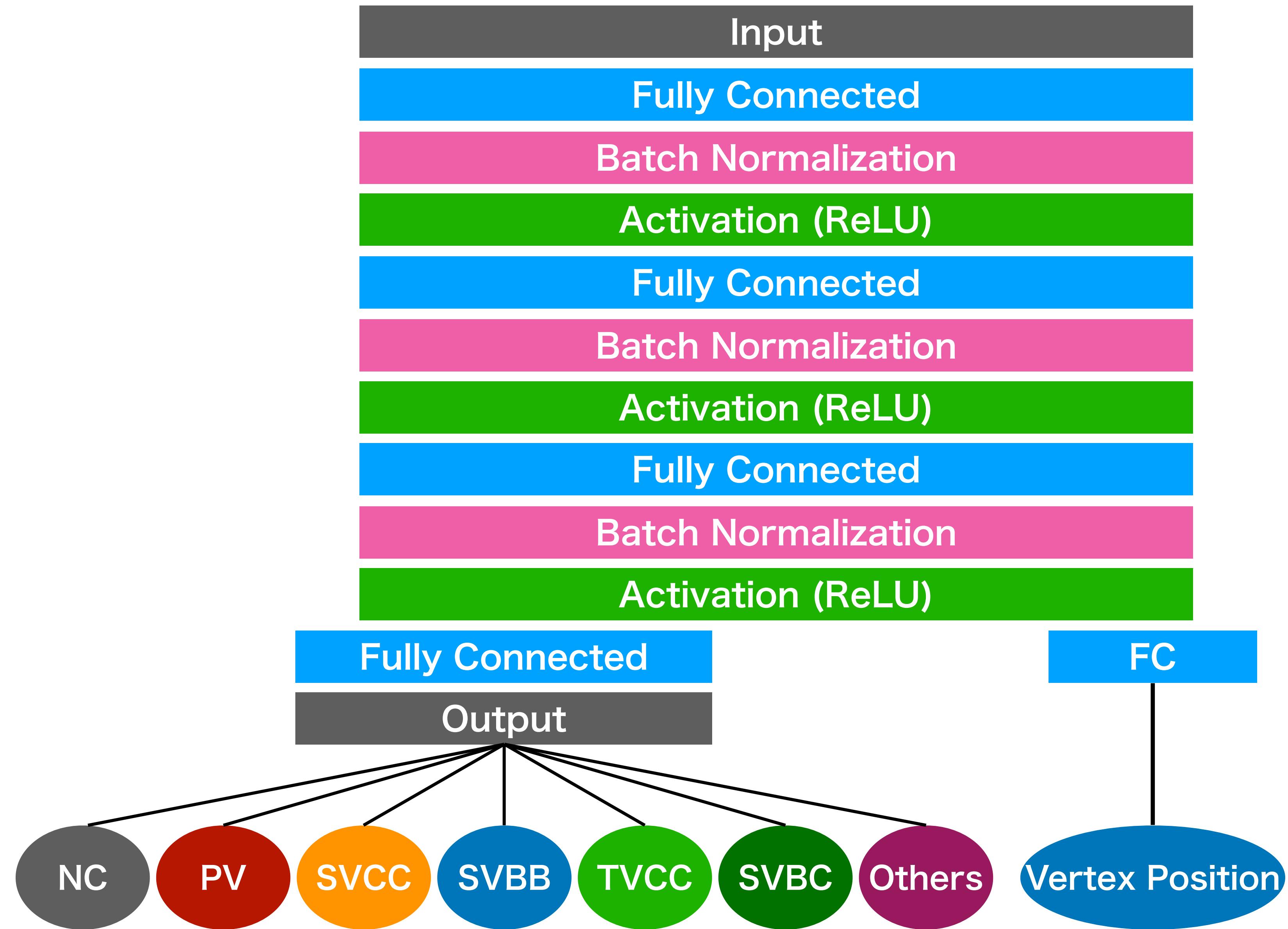
データサンプル  $c\bar{c}$  – 01

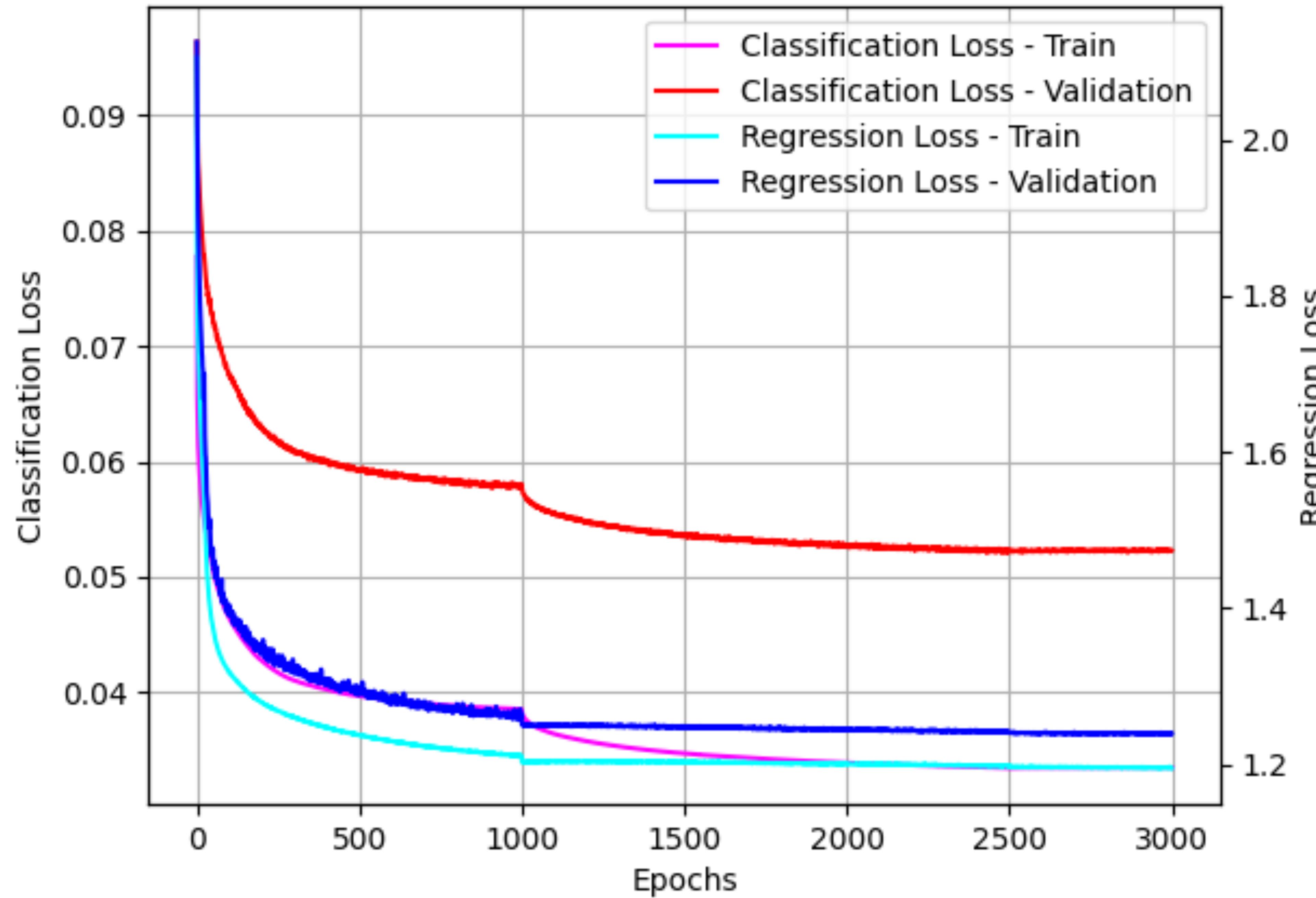


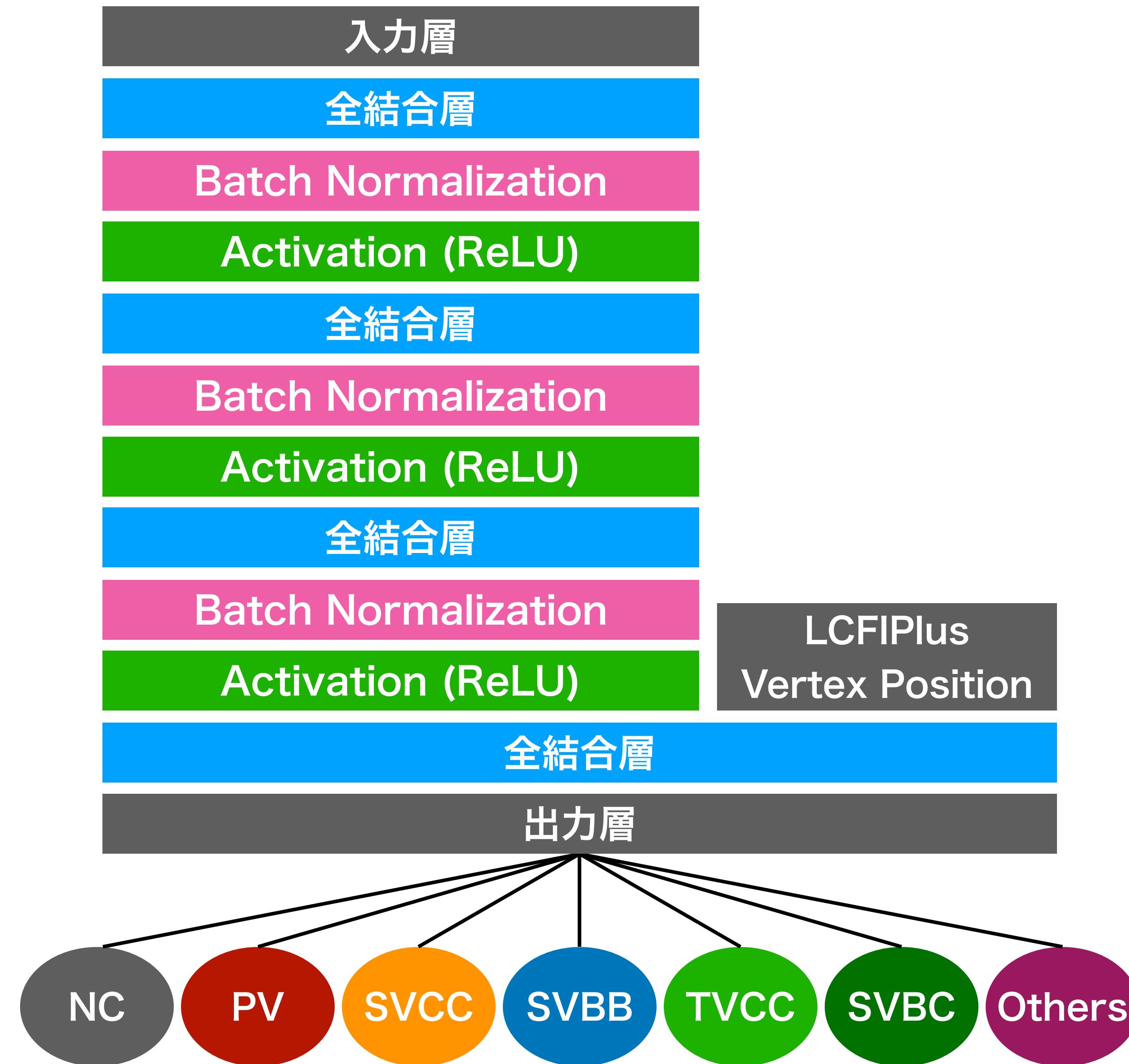
# データサンプル $c\bar{c}$ – 03, 04, $b\bar{b}$ – 04, 05

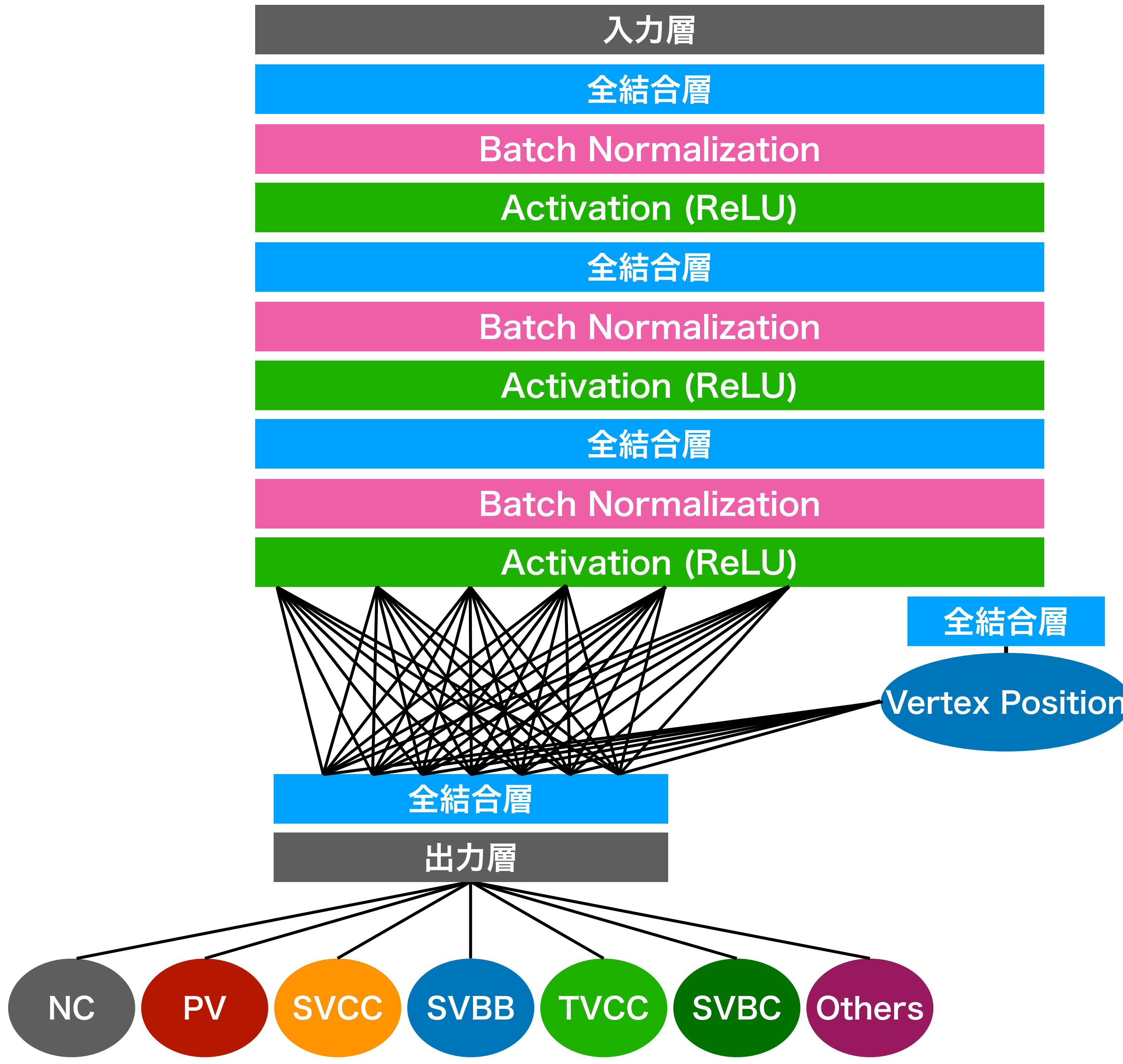


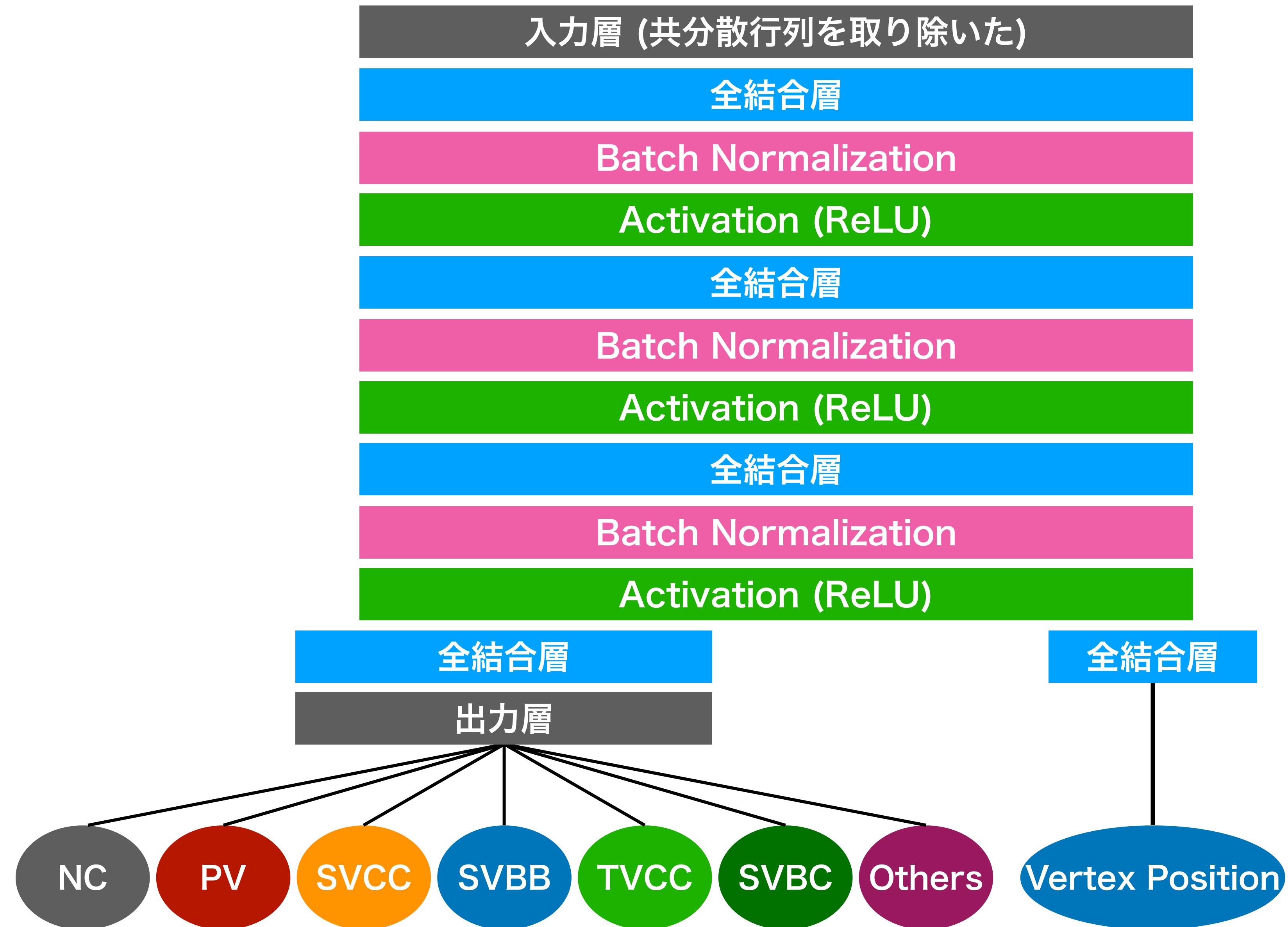


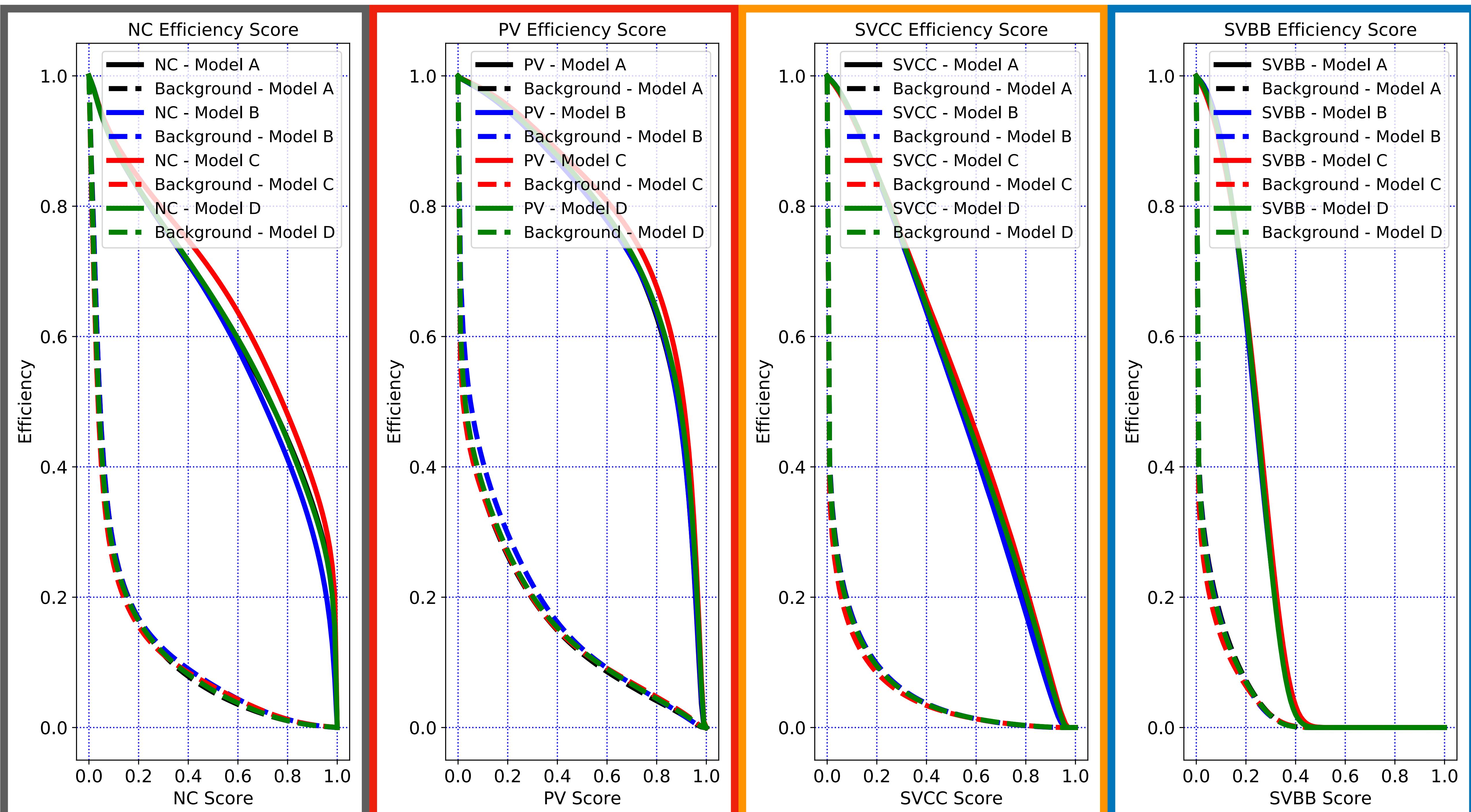


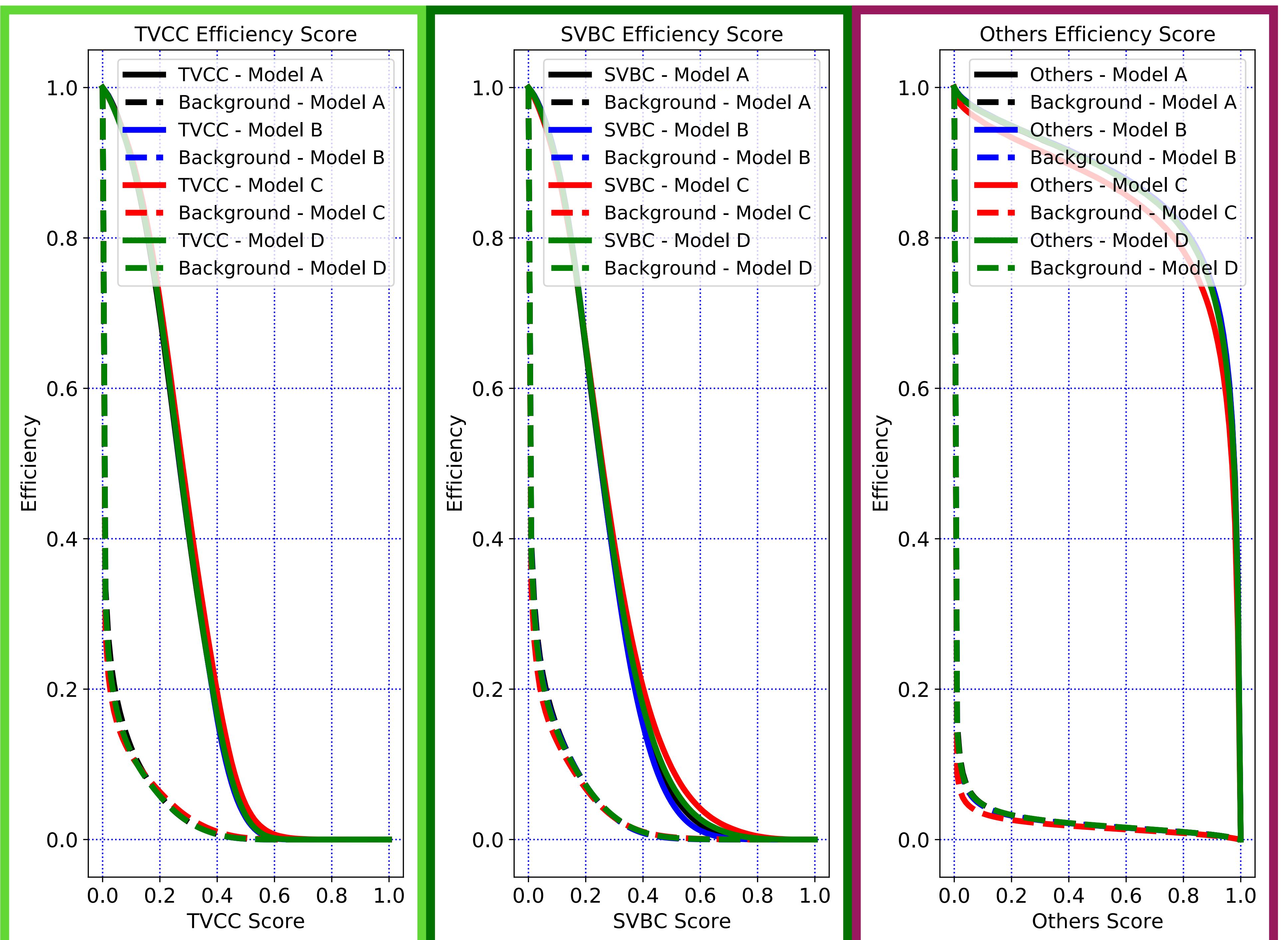


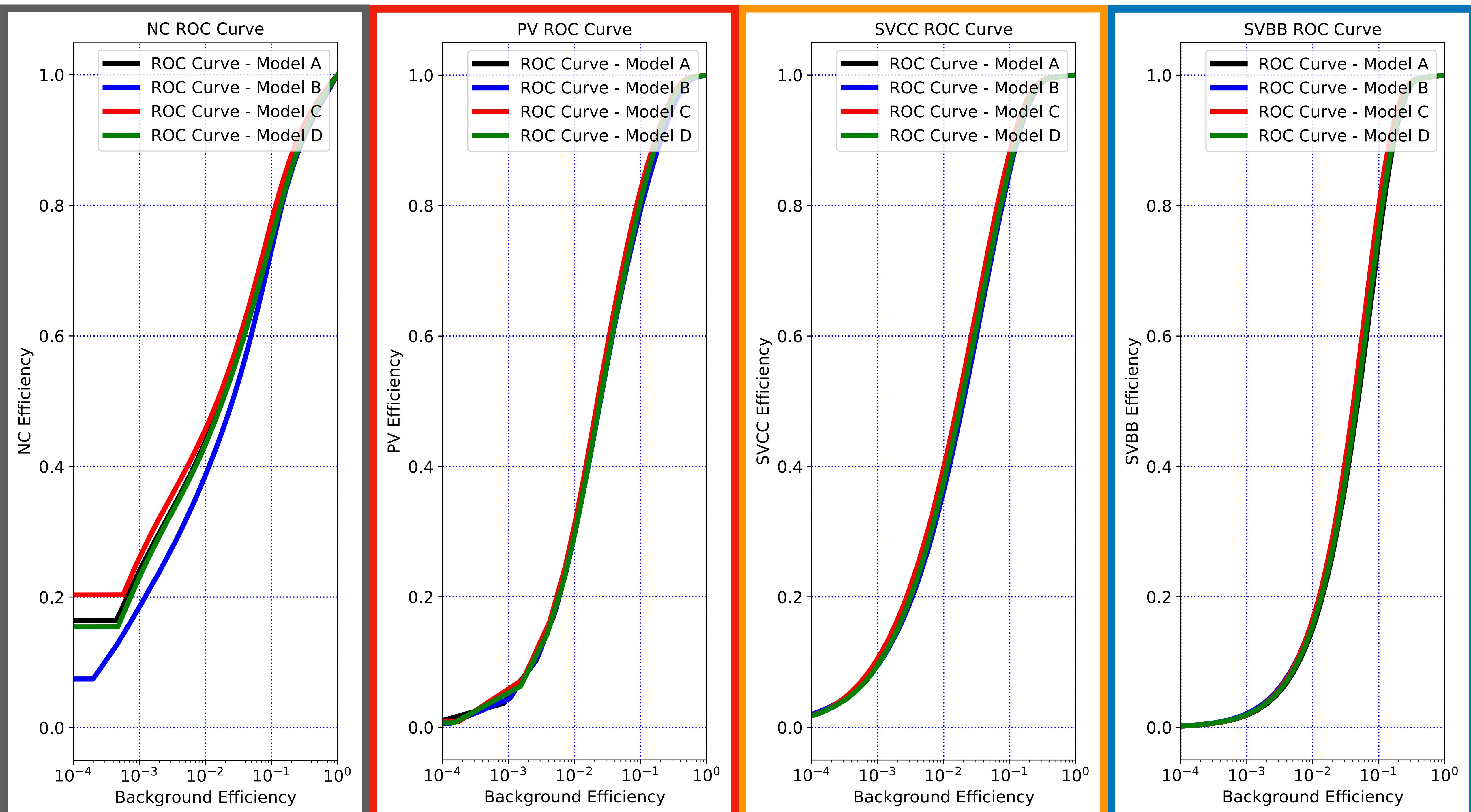


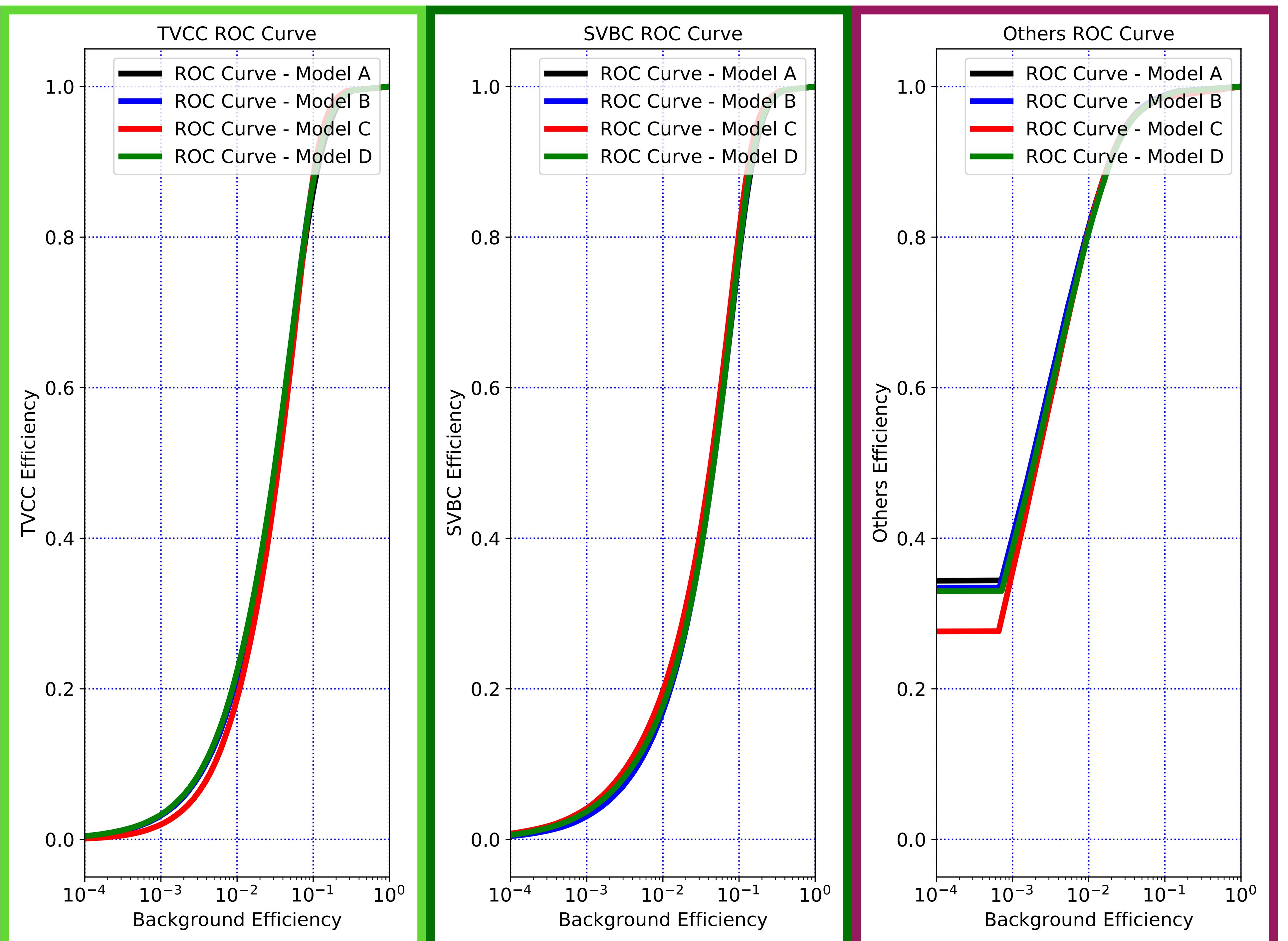


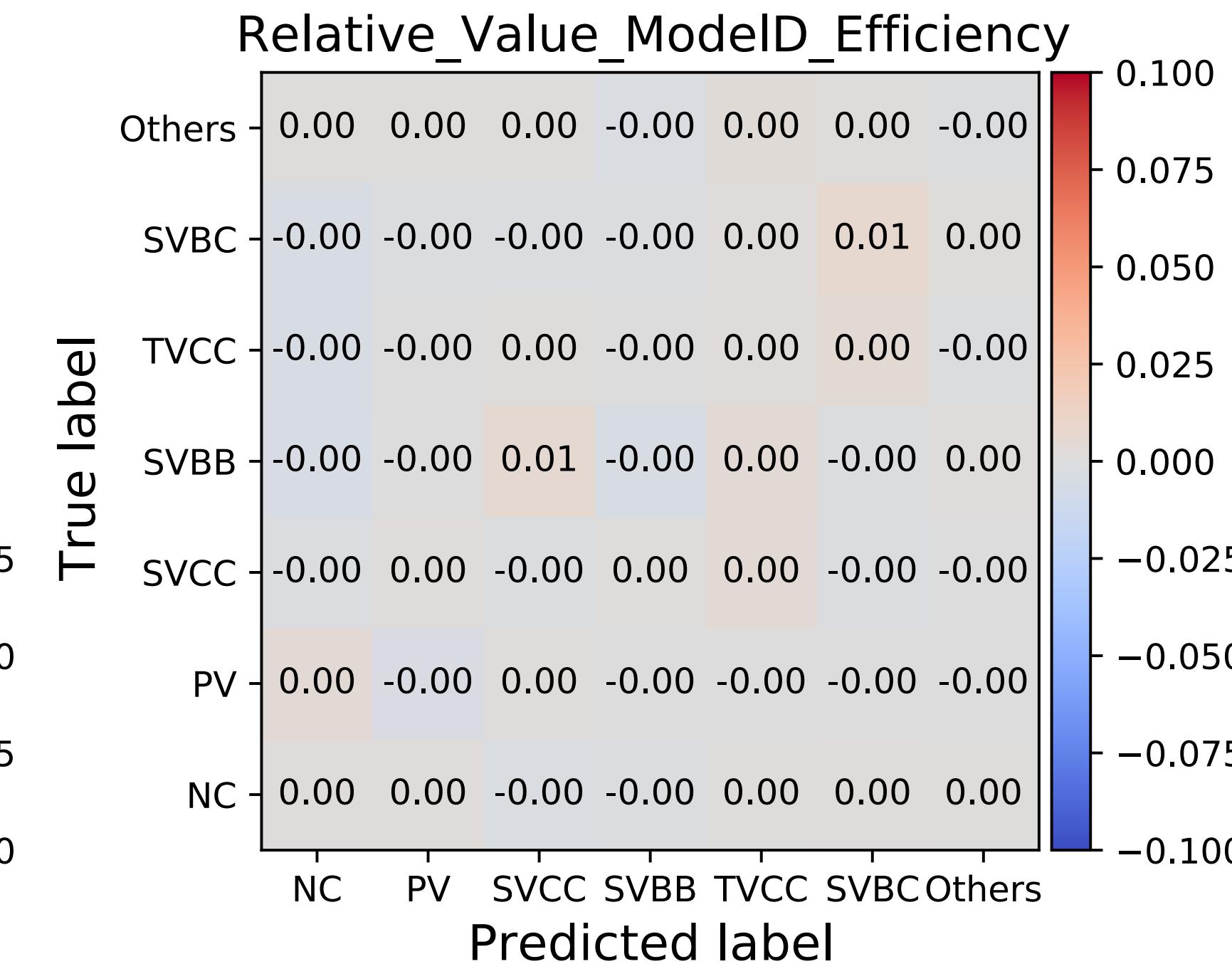
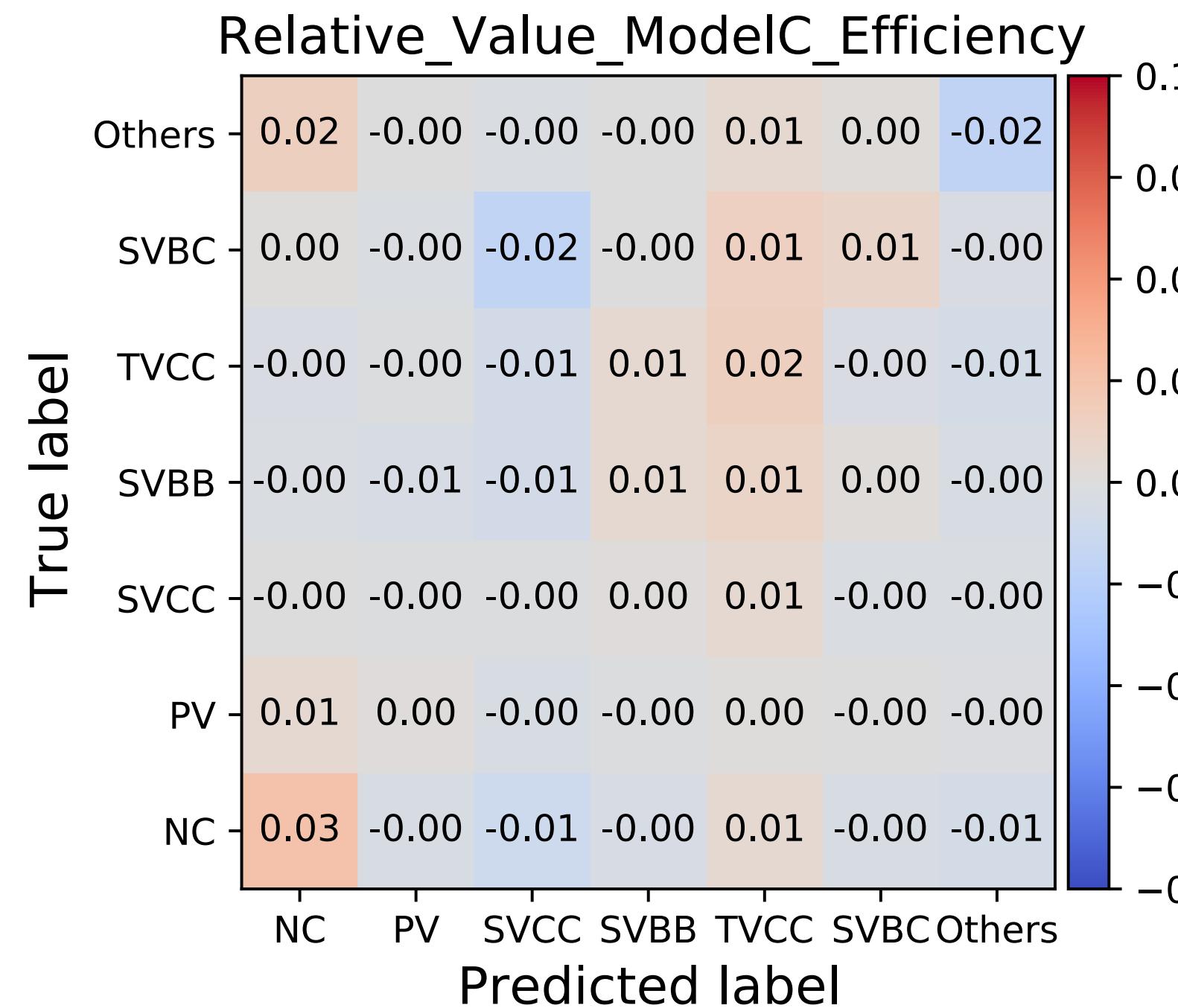
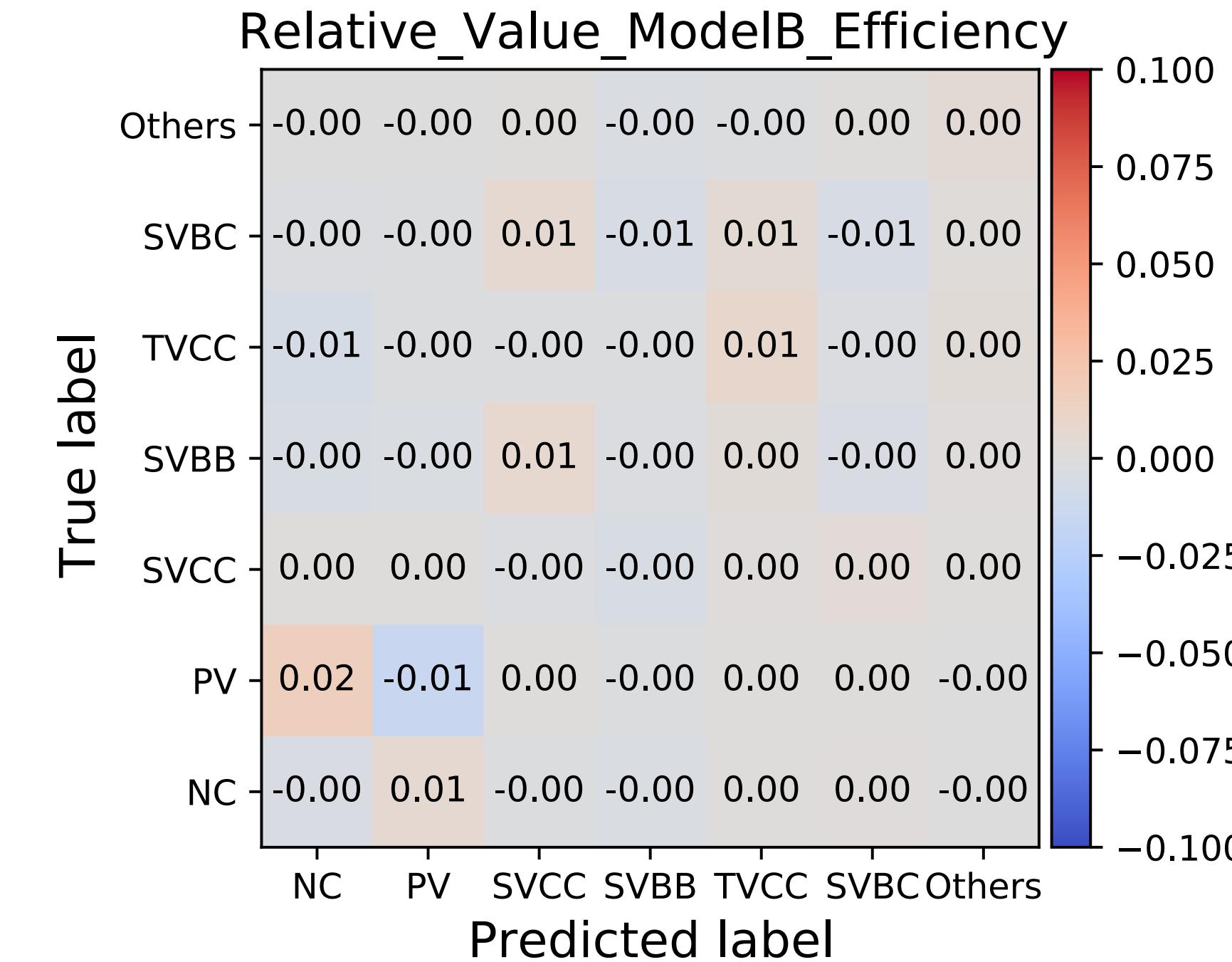
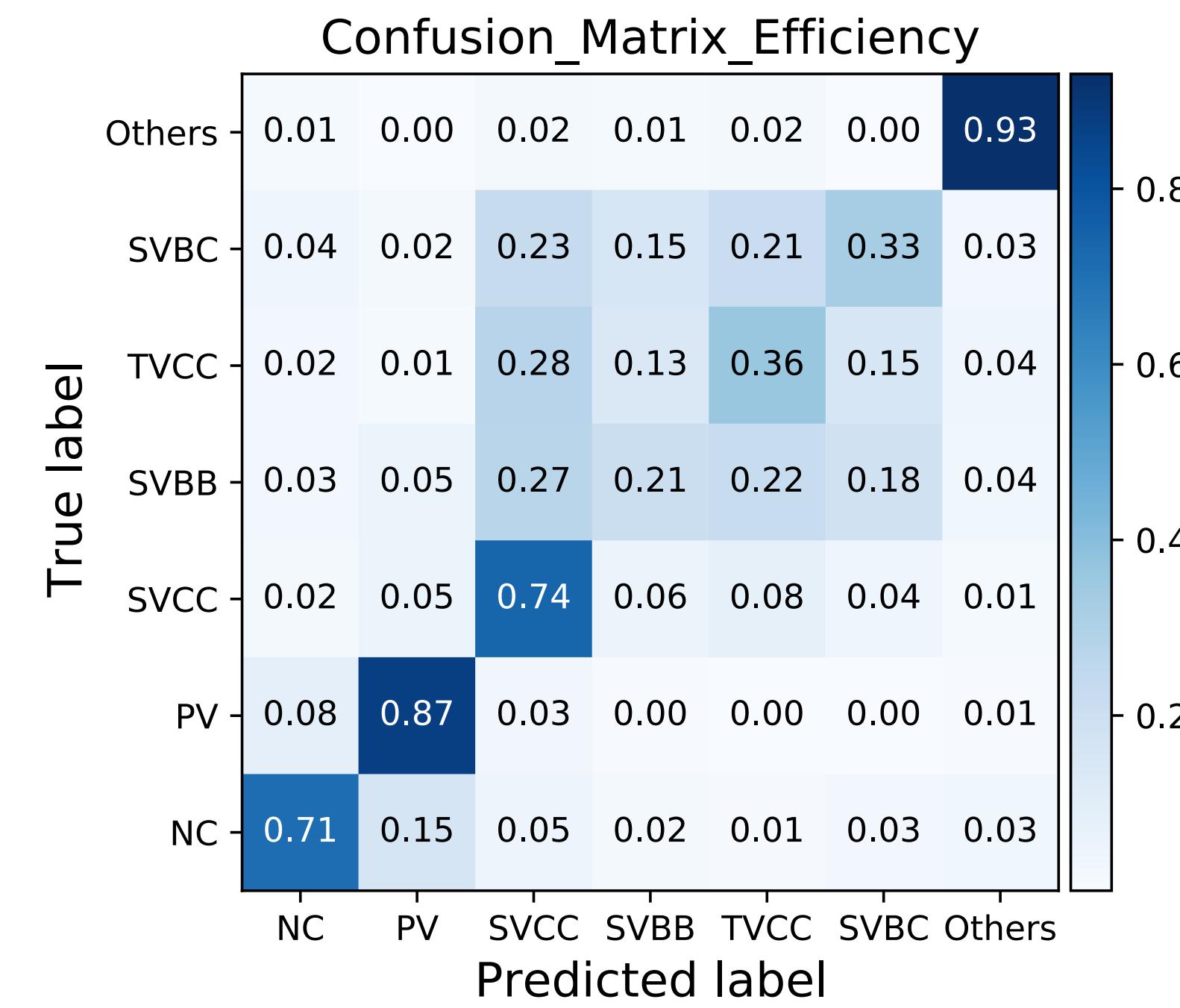


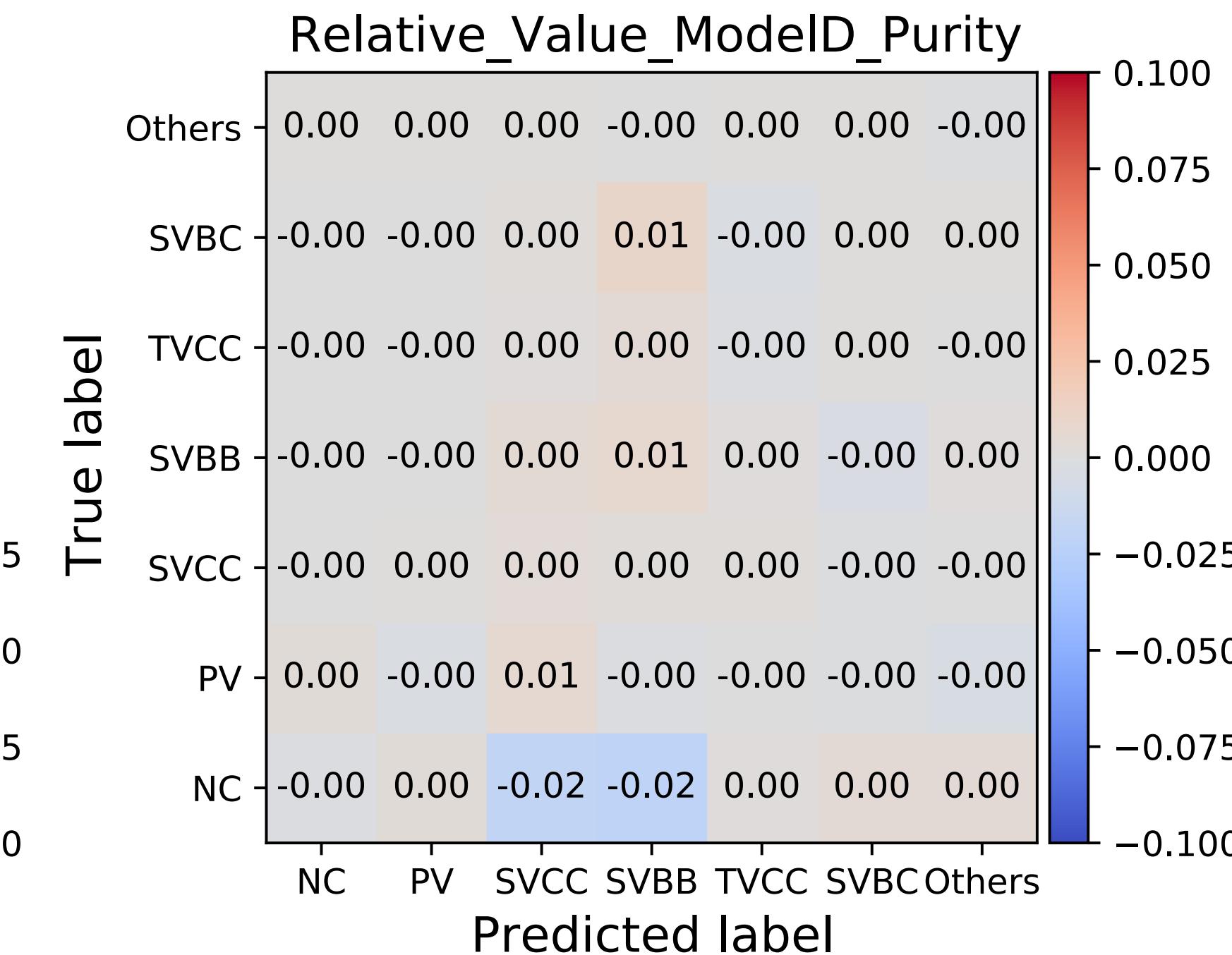
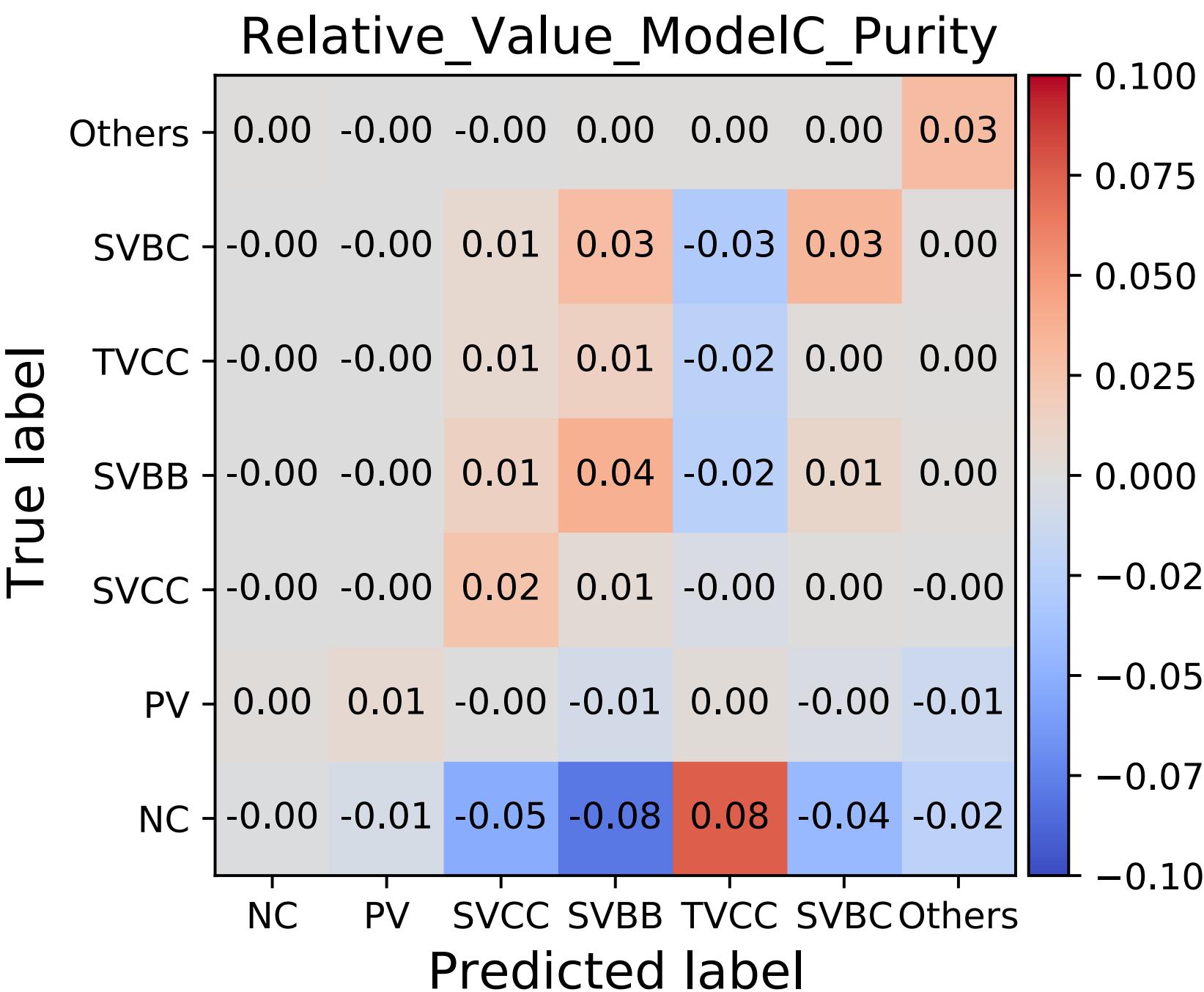
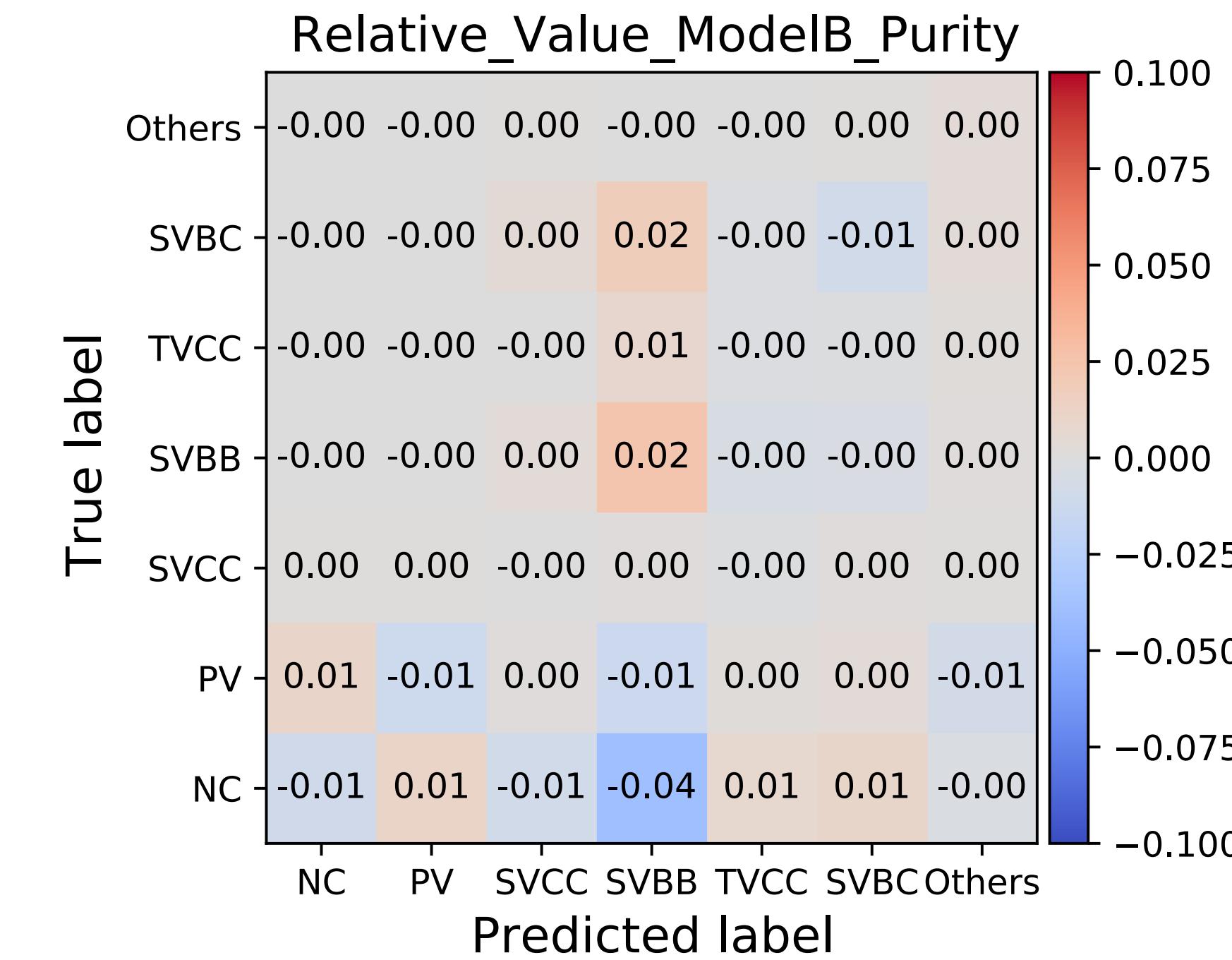
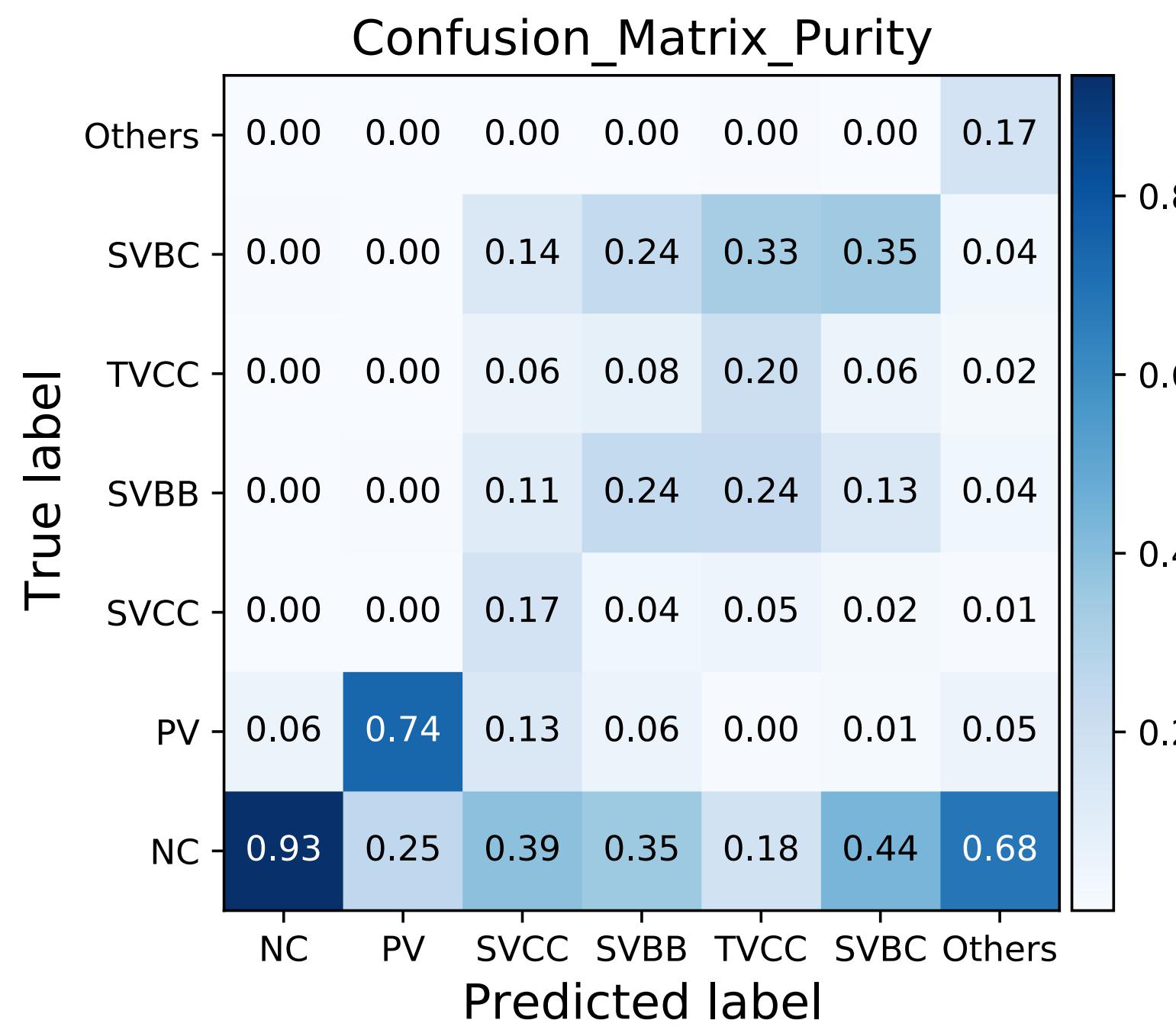




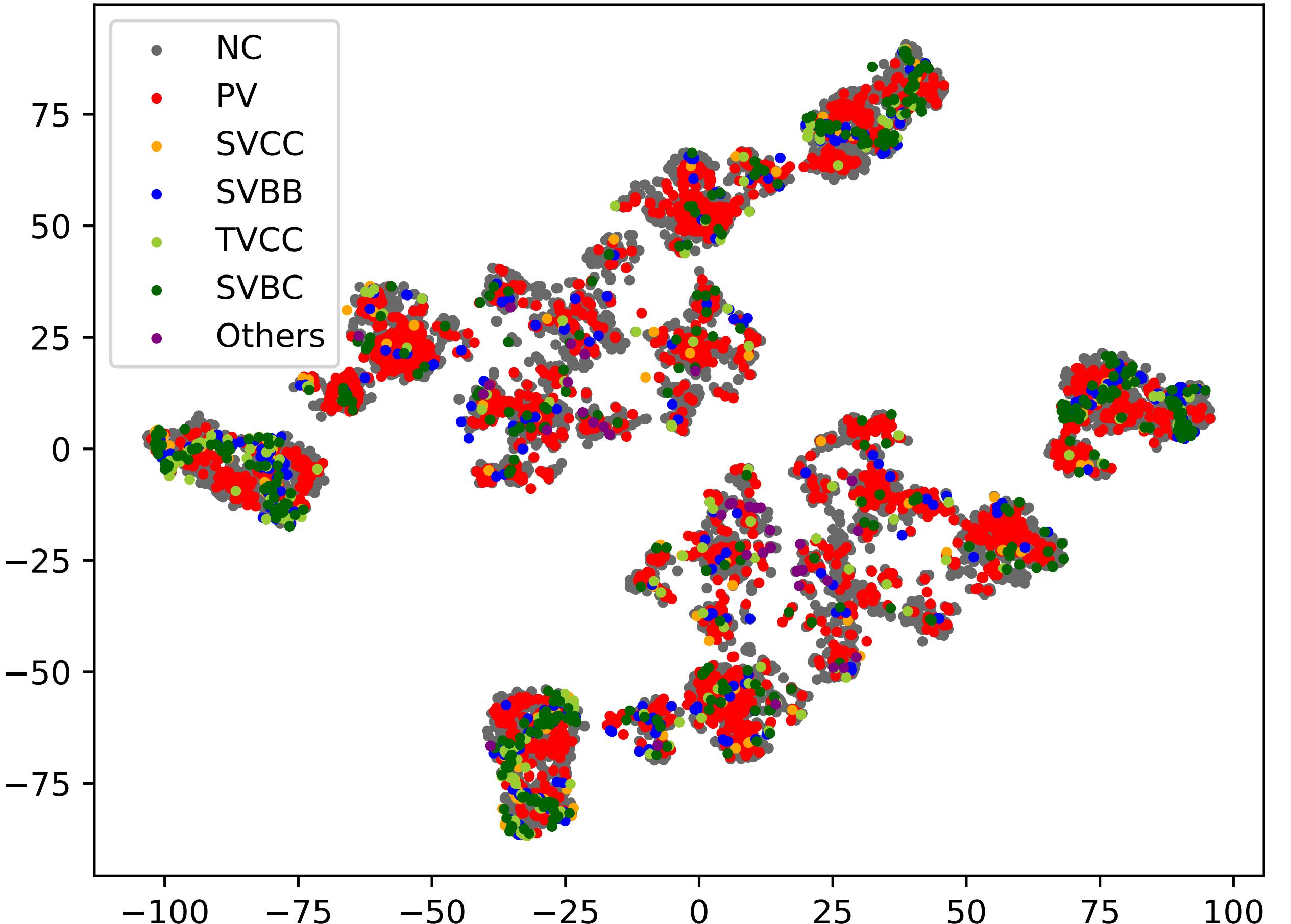




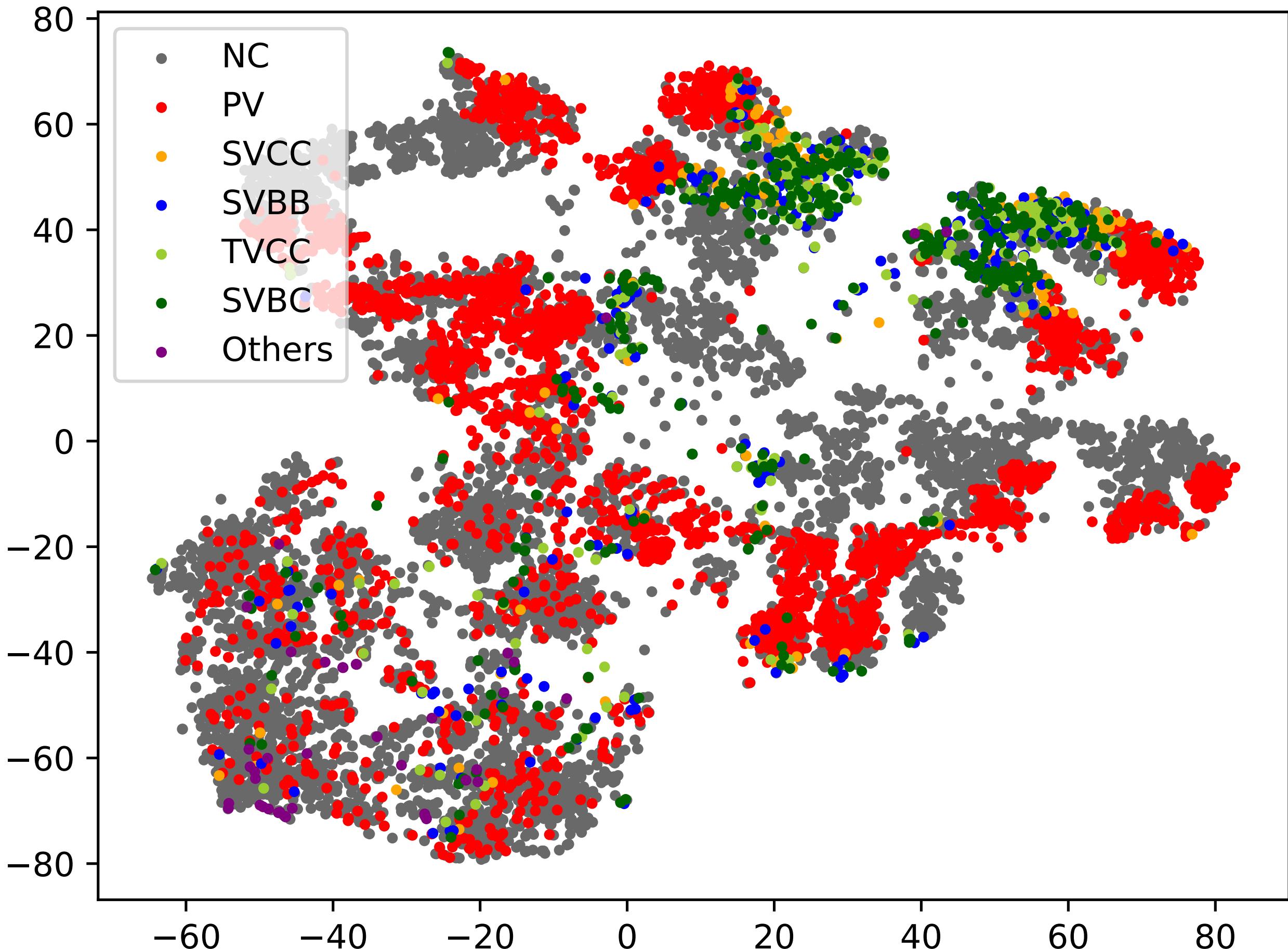


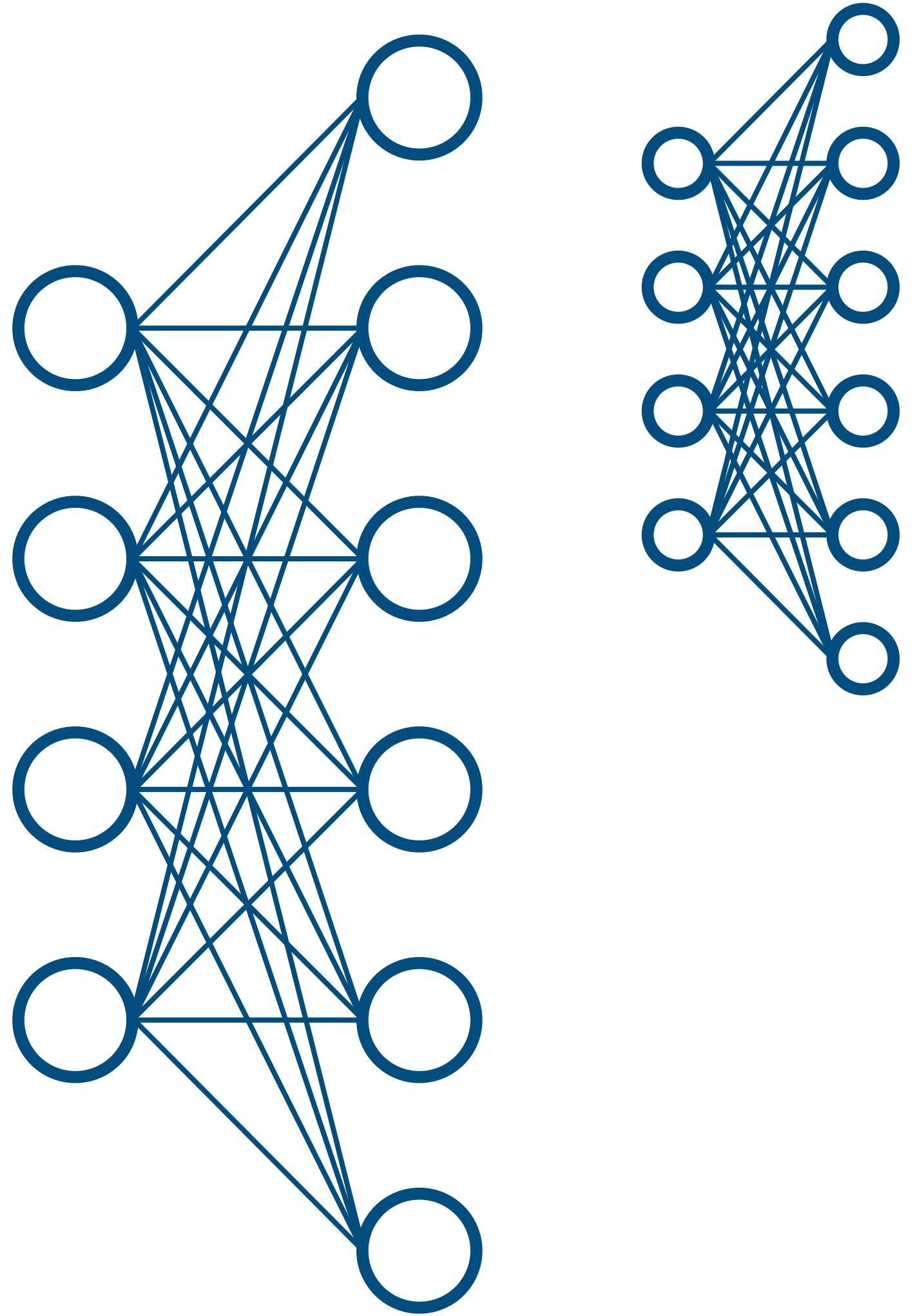


## 入力変数

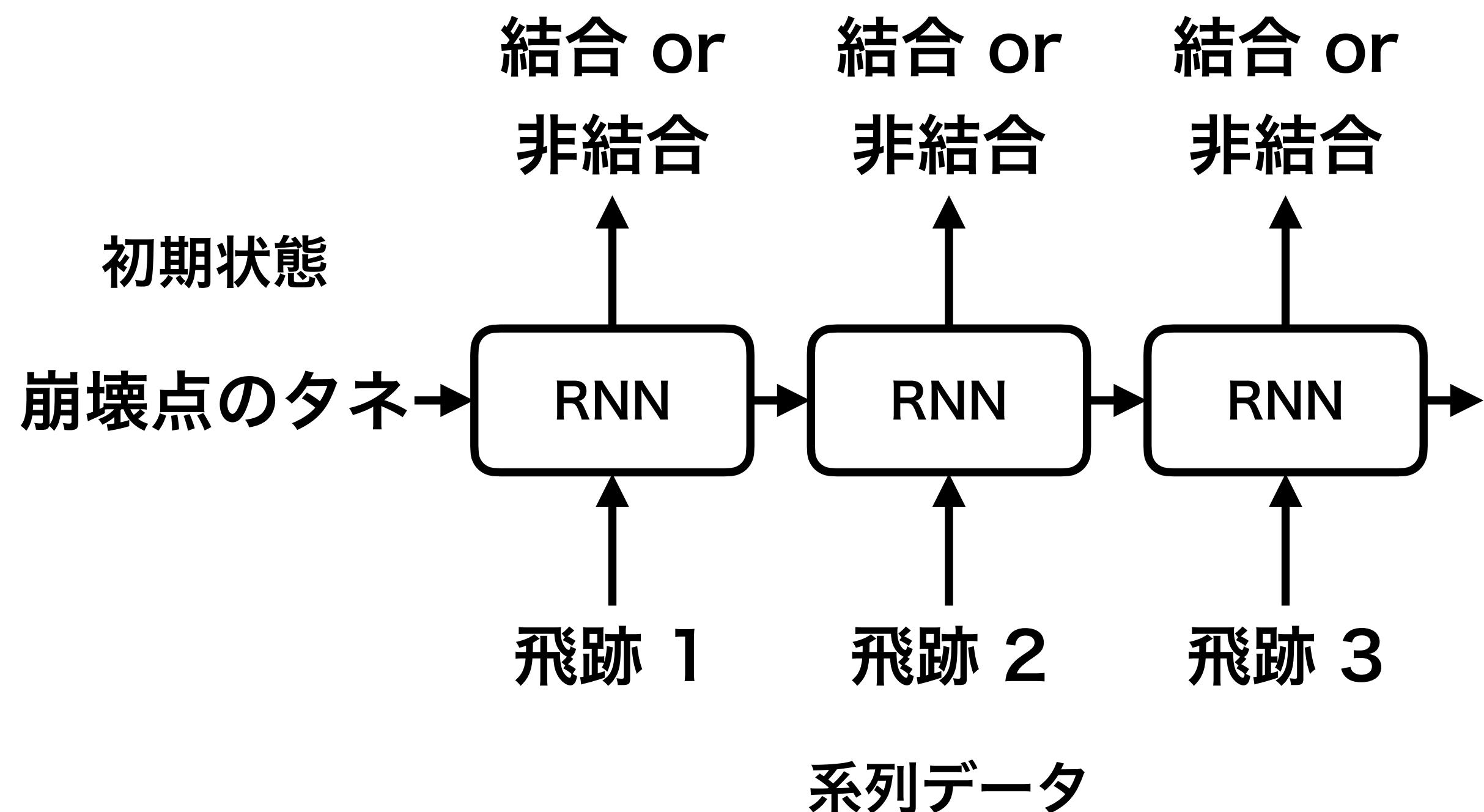


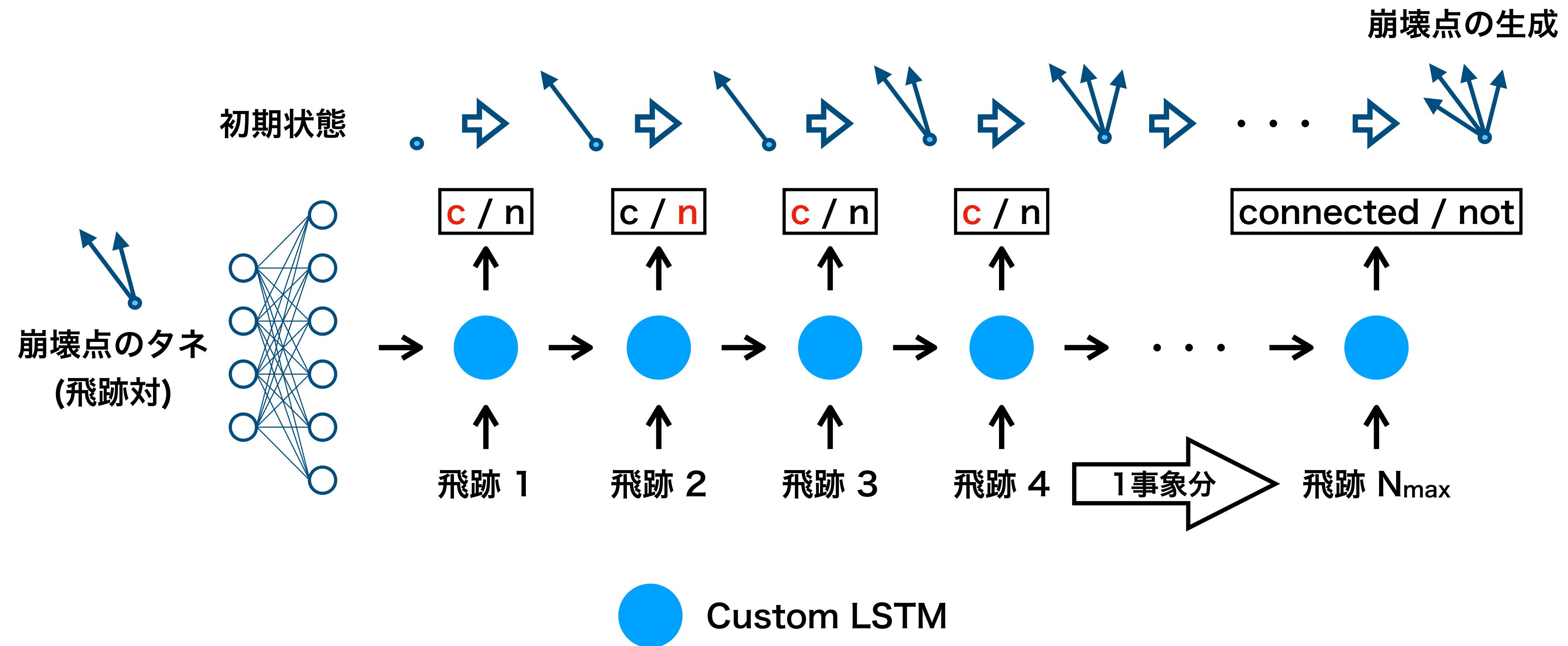
## 出力の直前の全結合層

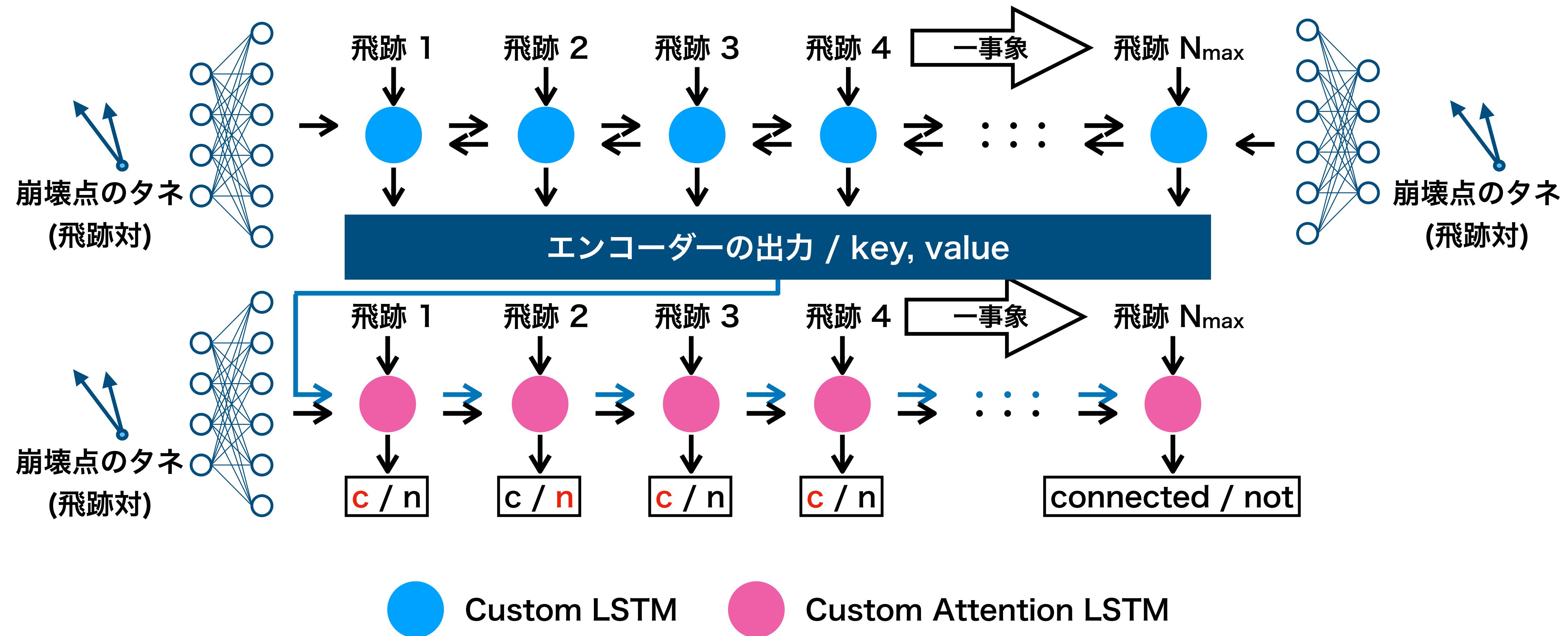




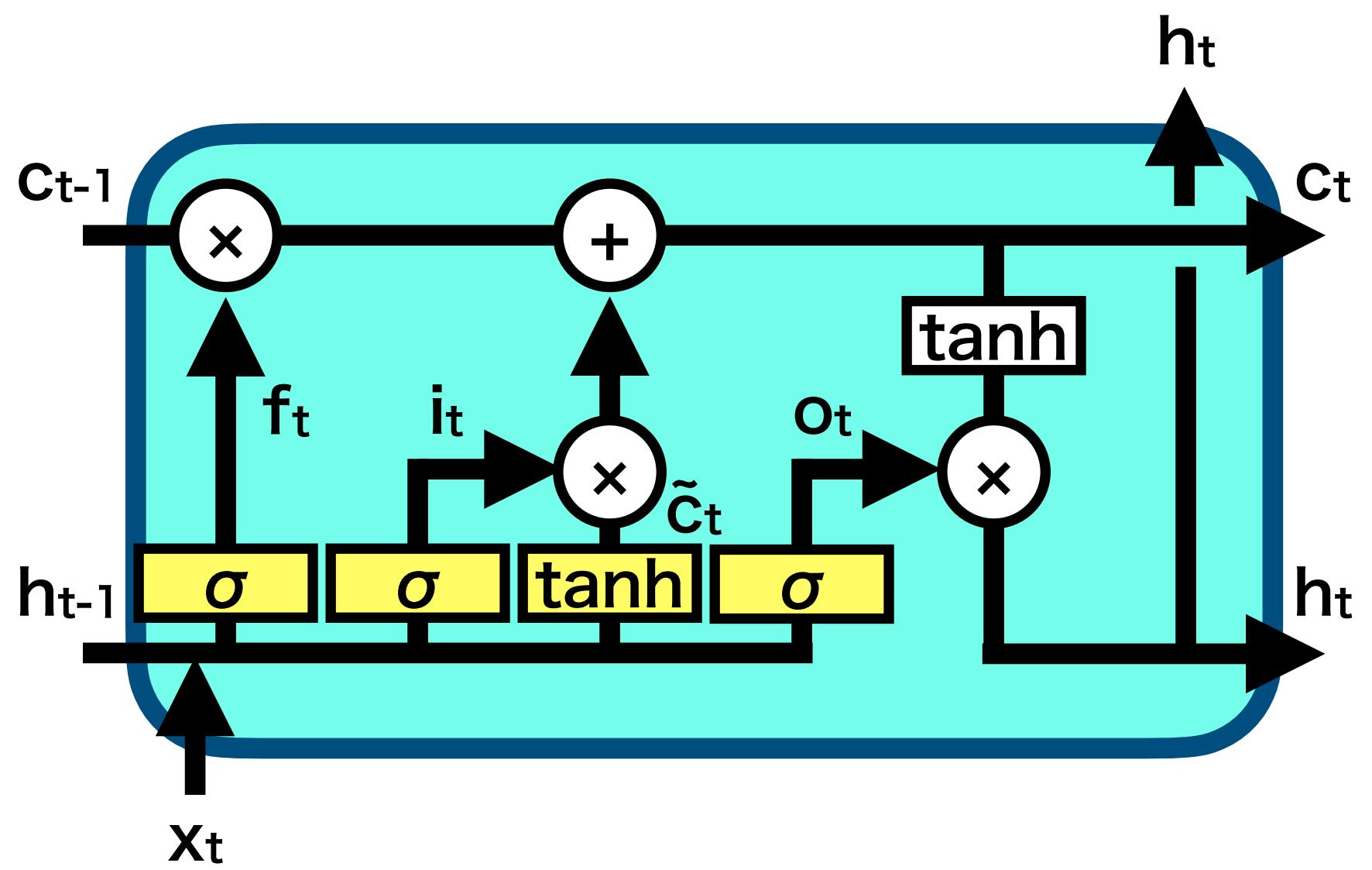
## Many to Many



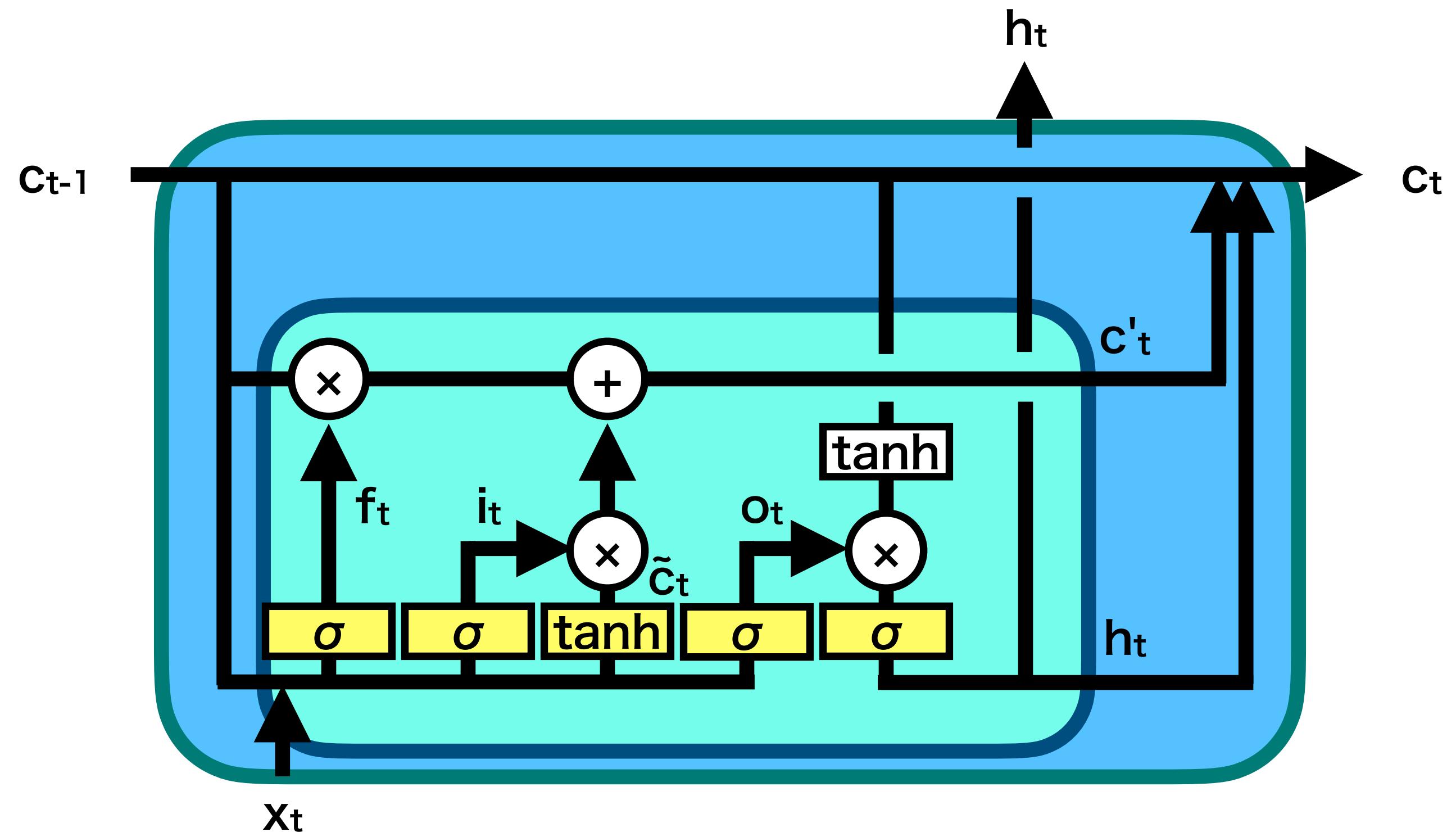


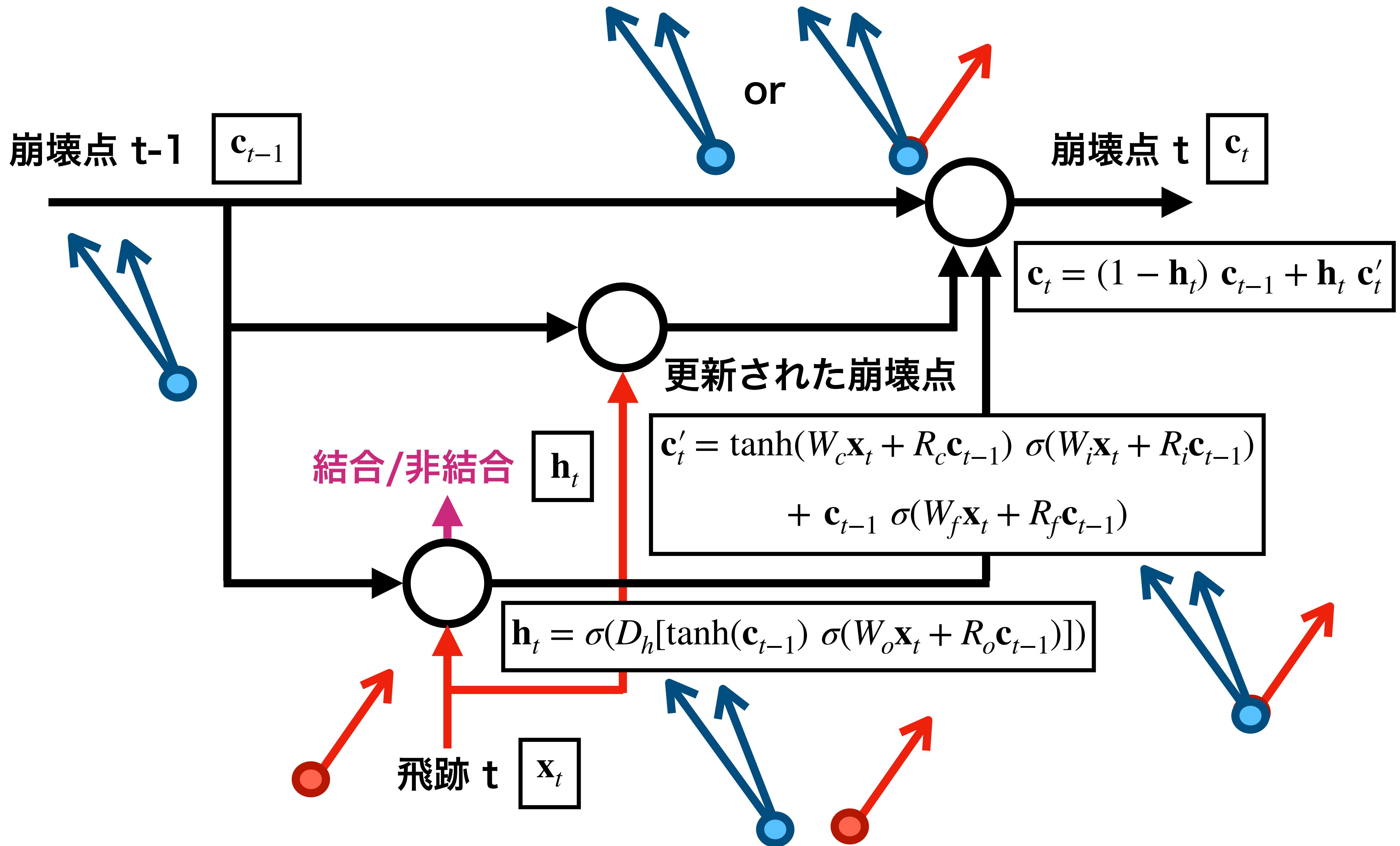


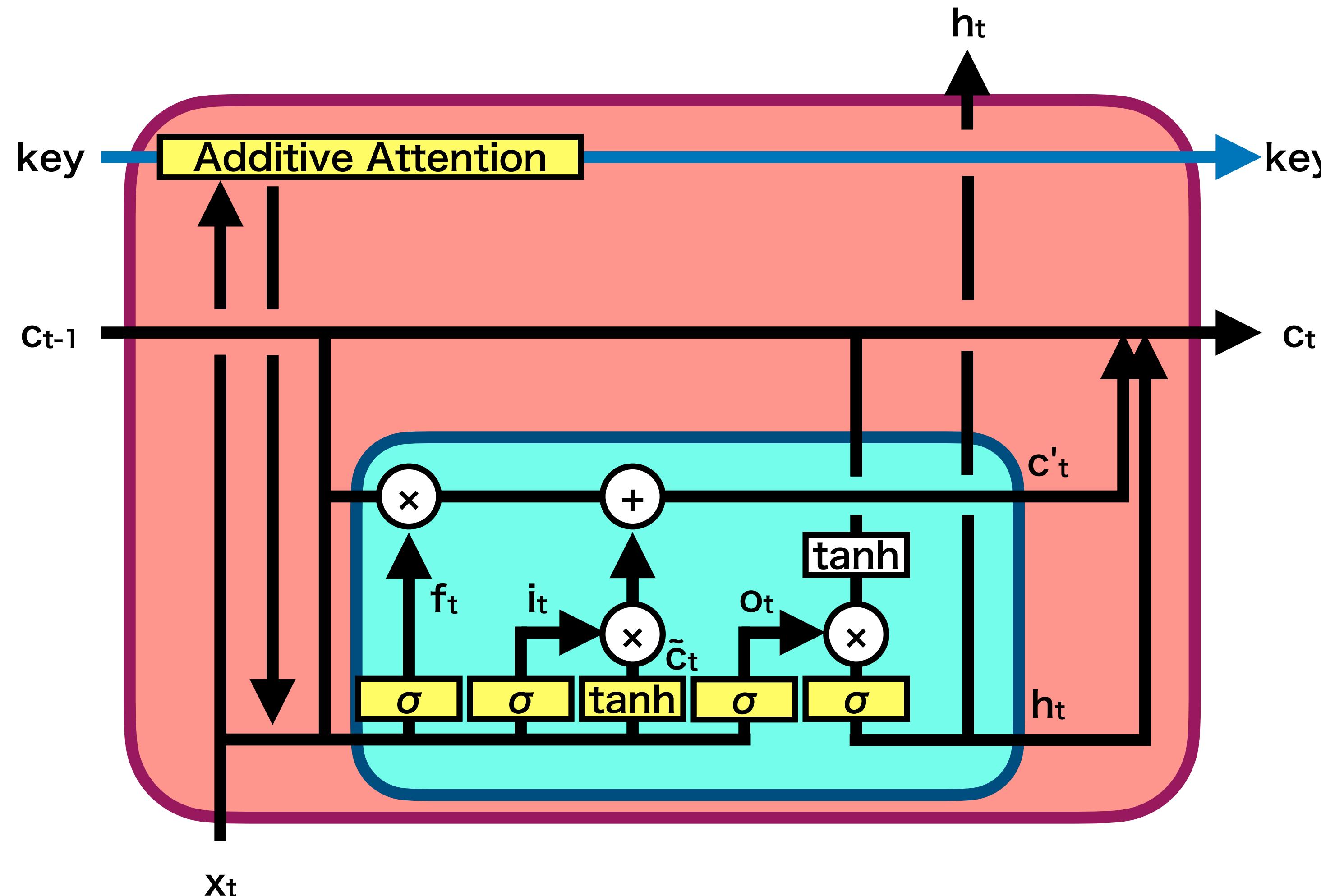
LSTM



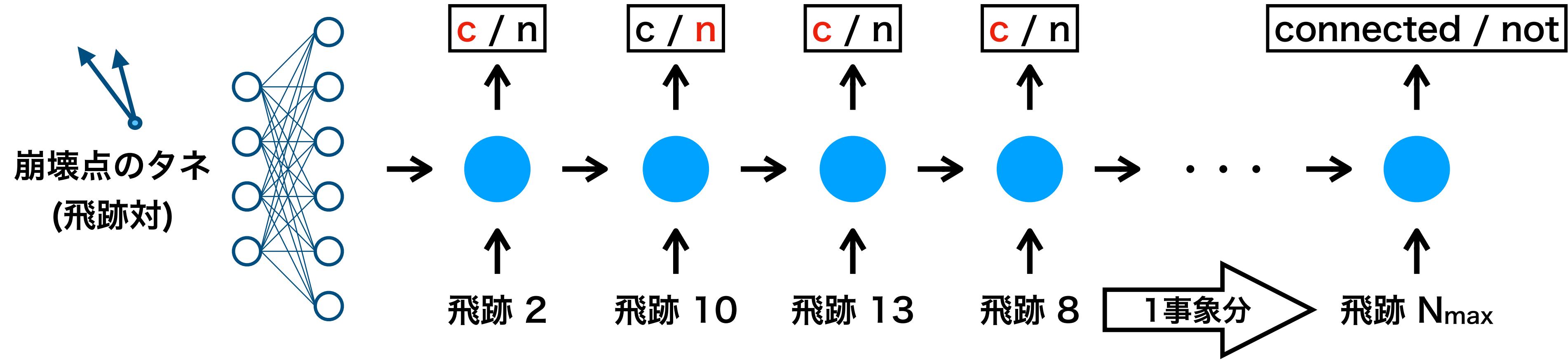
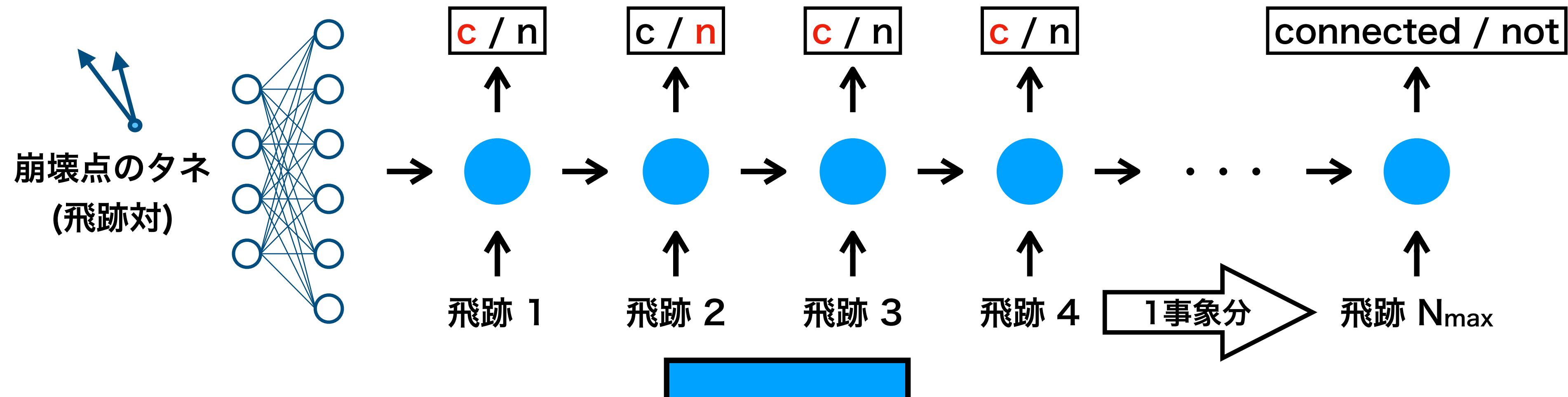
崩壊点生成のための  
リカレントニューラルネットワーク



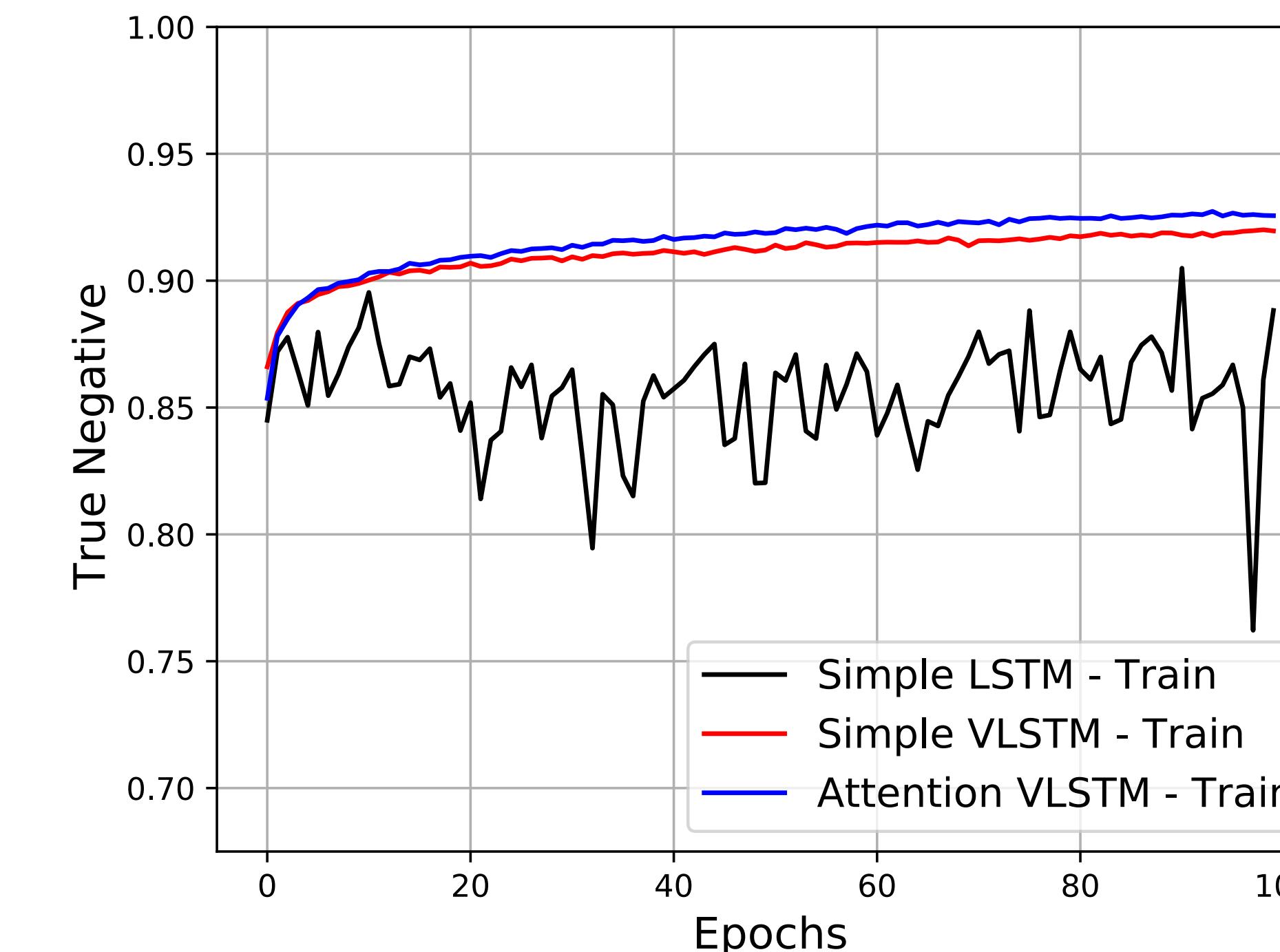
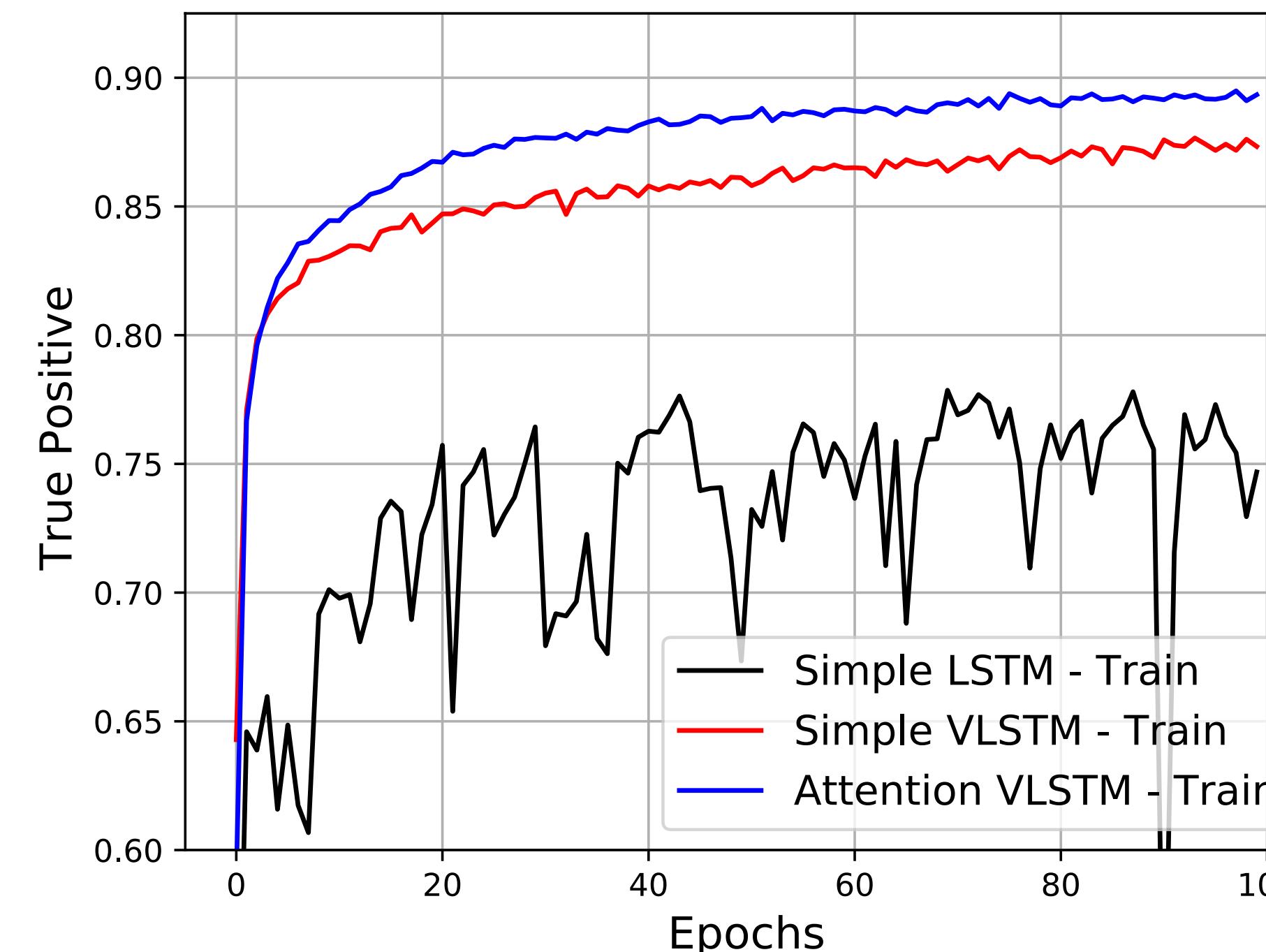
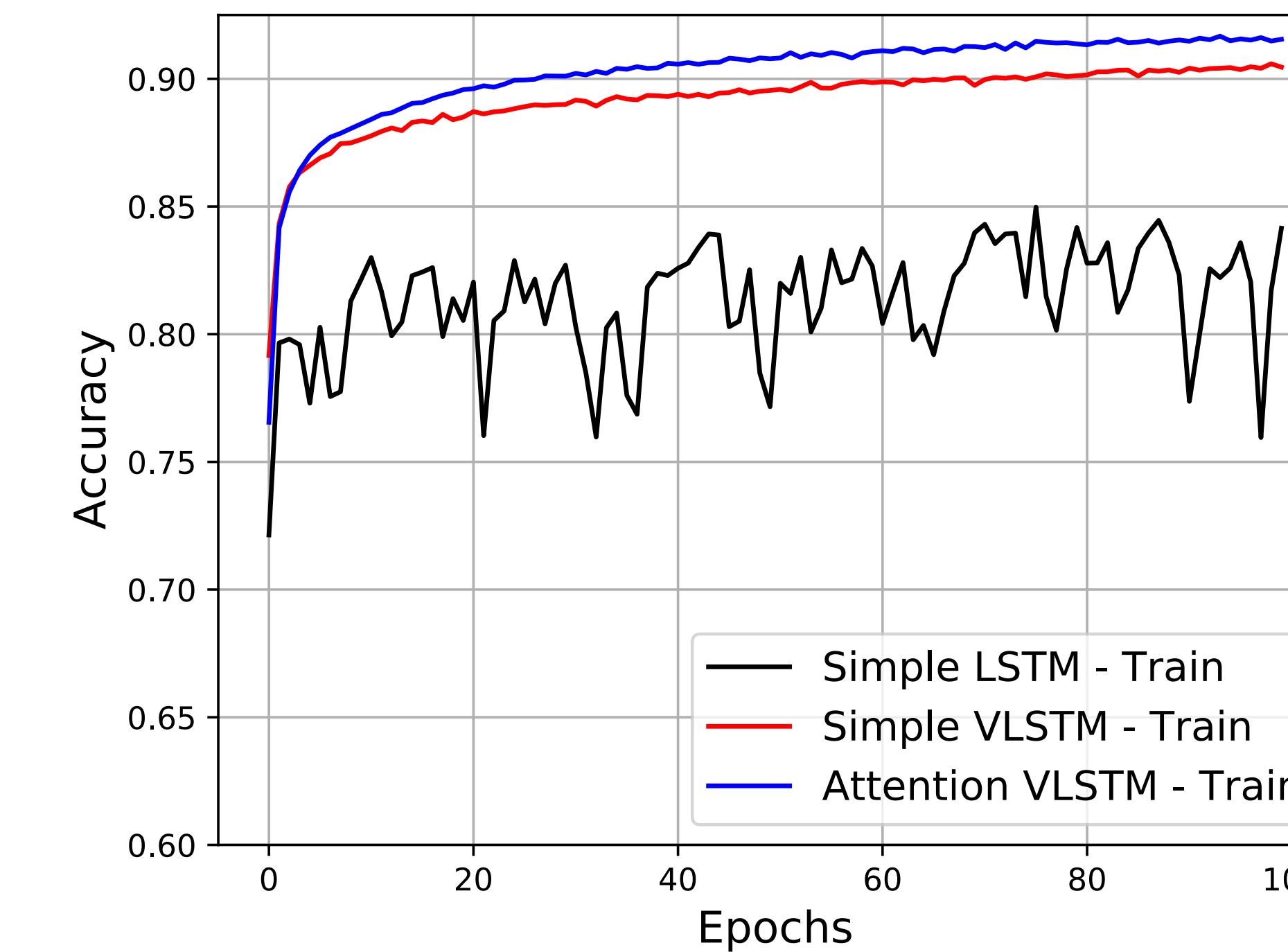
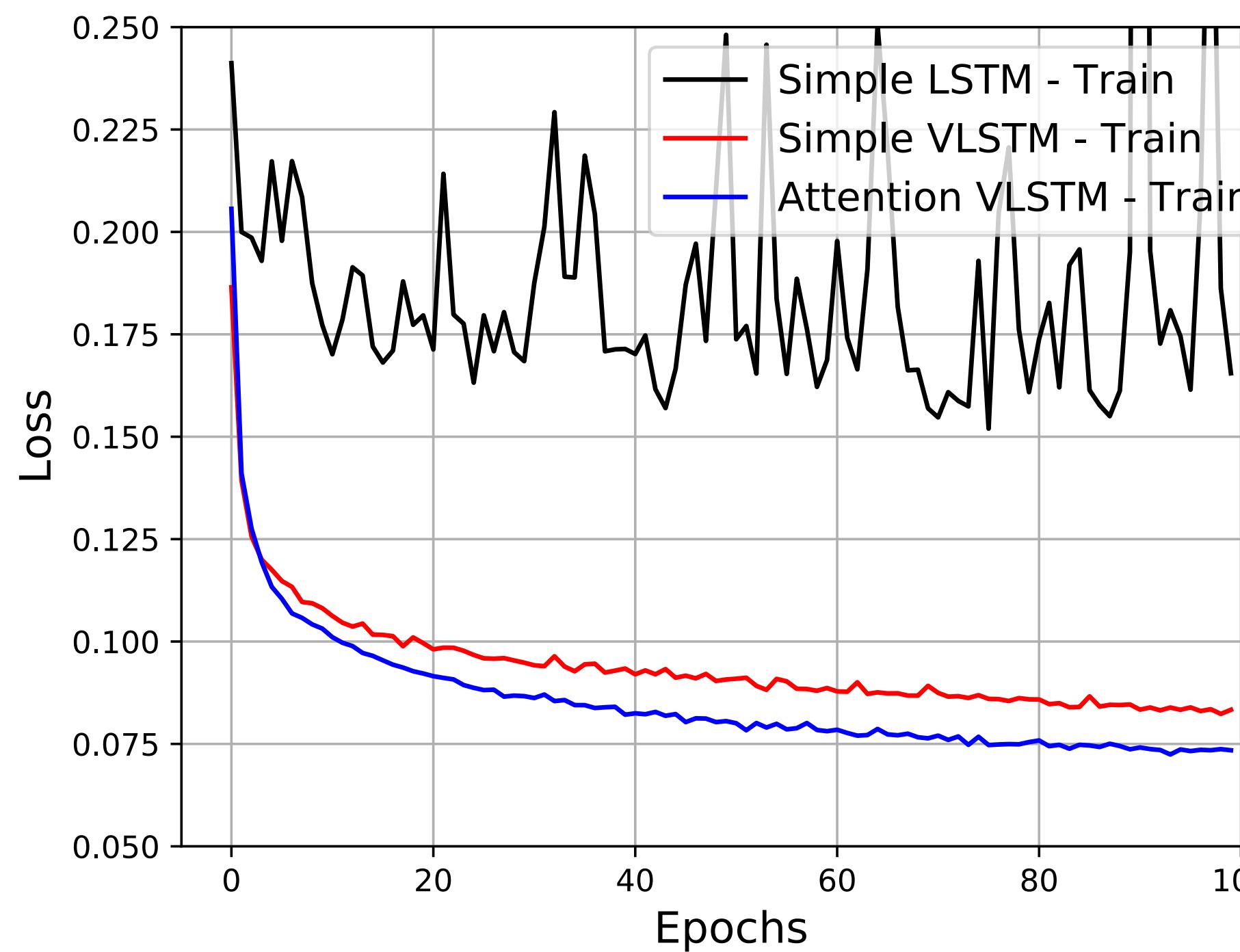


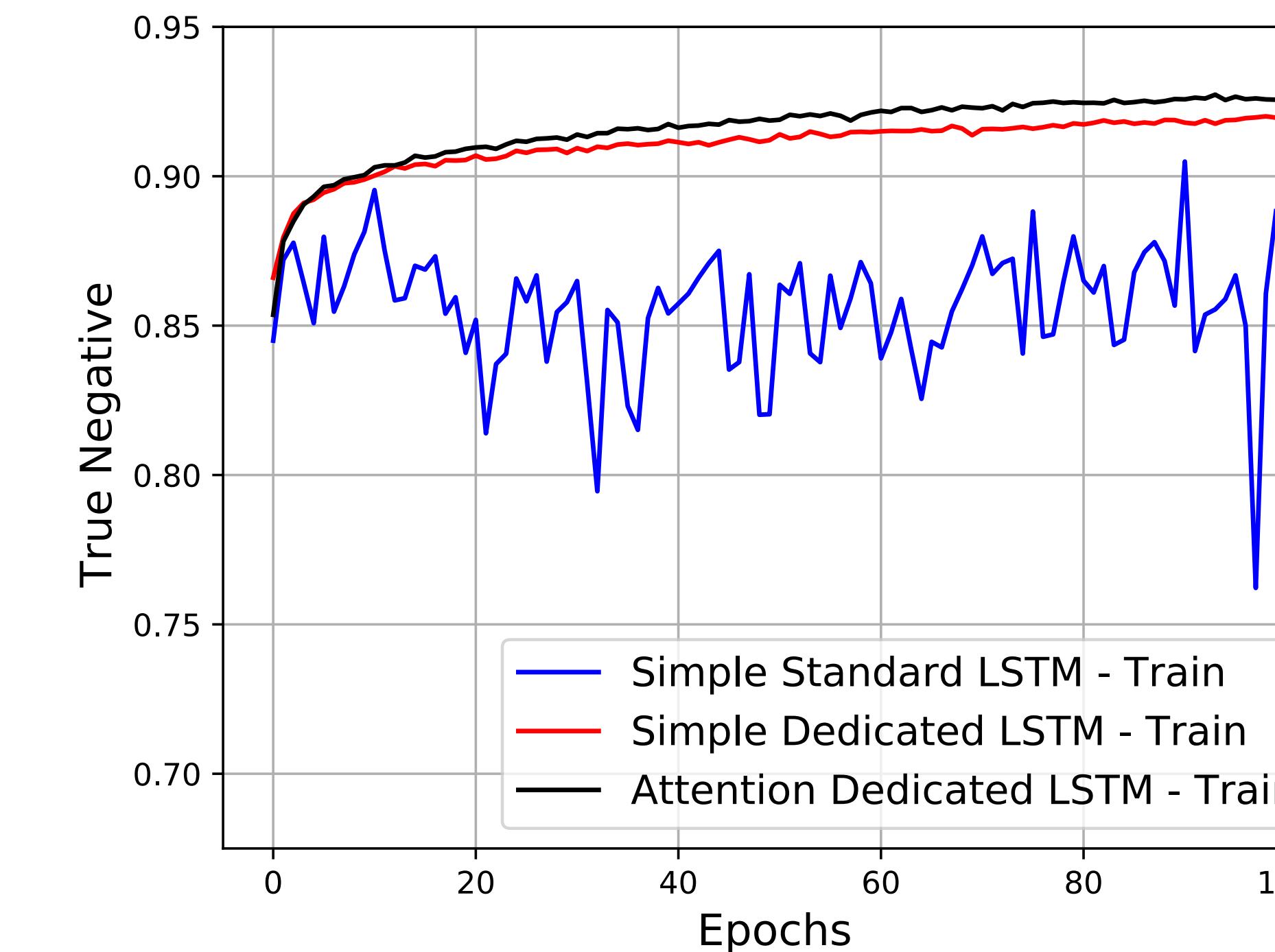
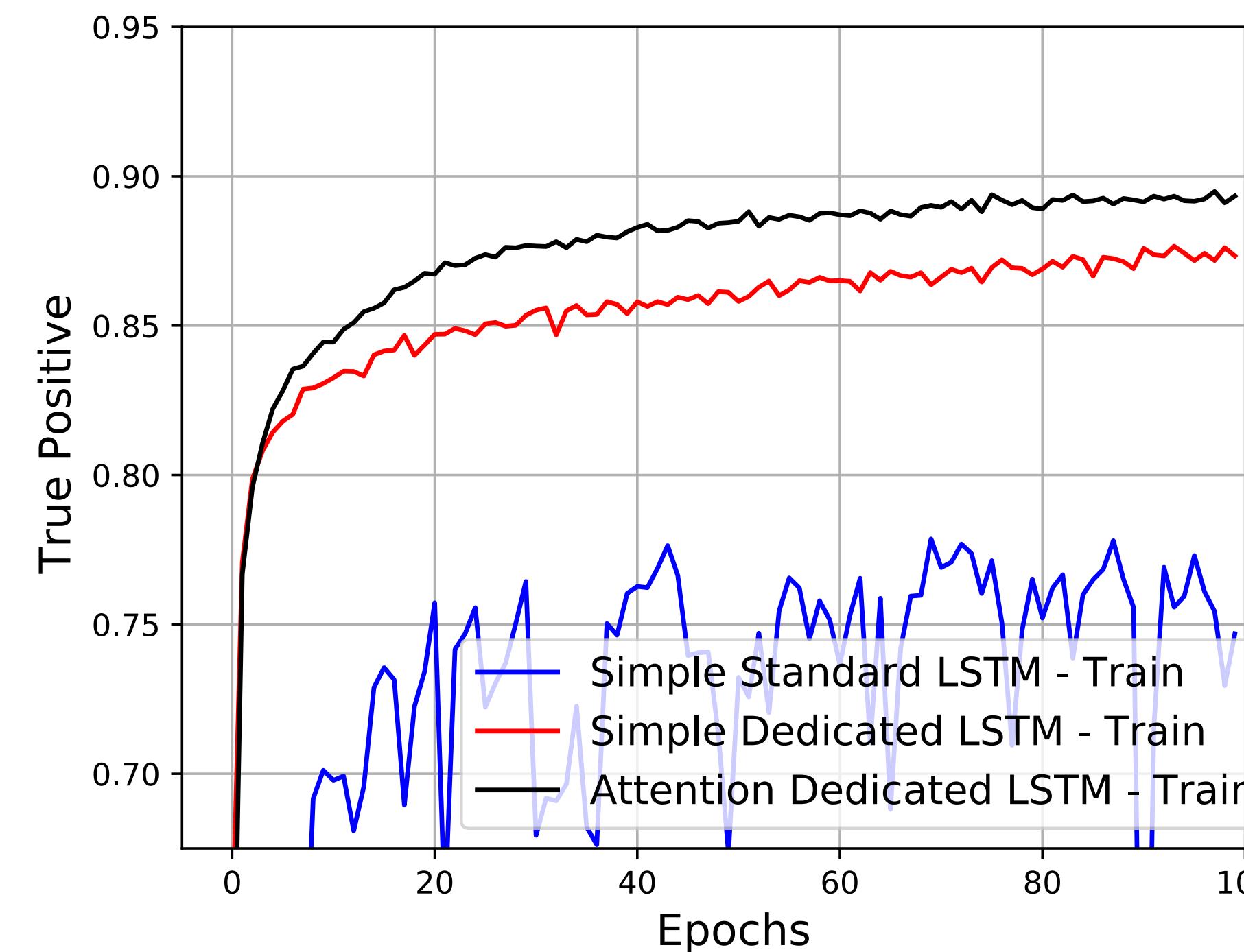
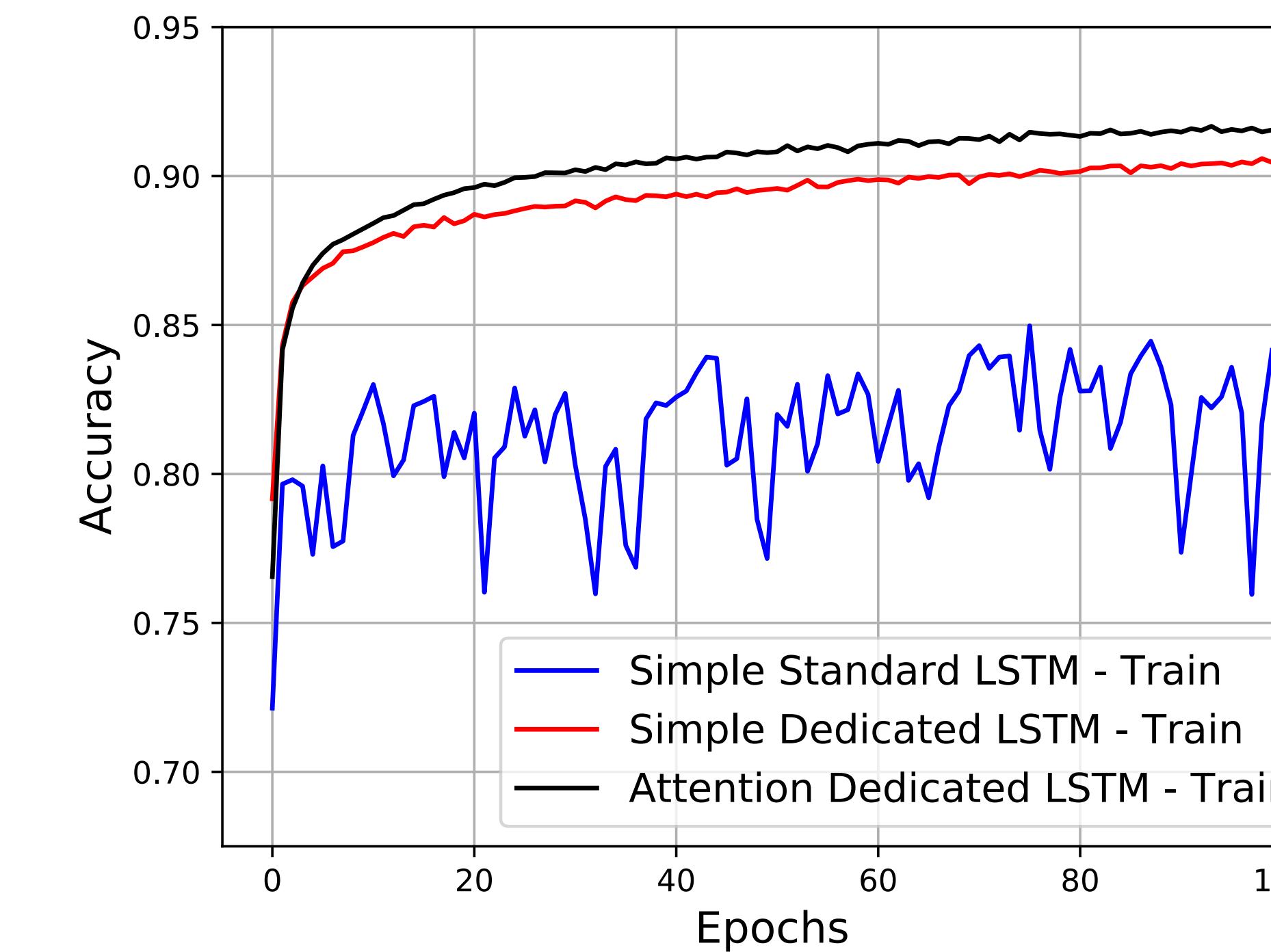
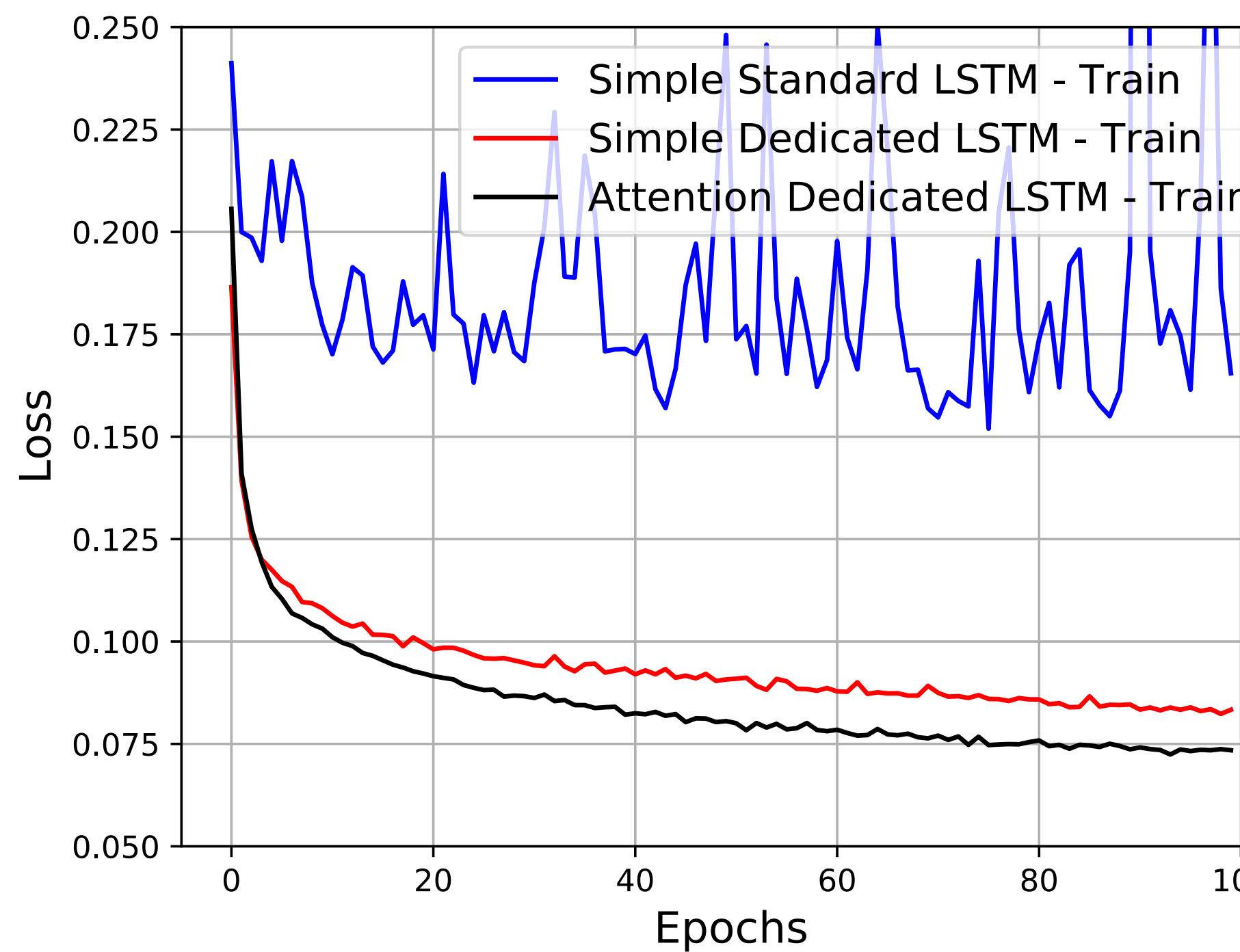


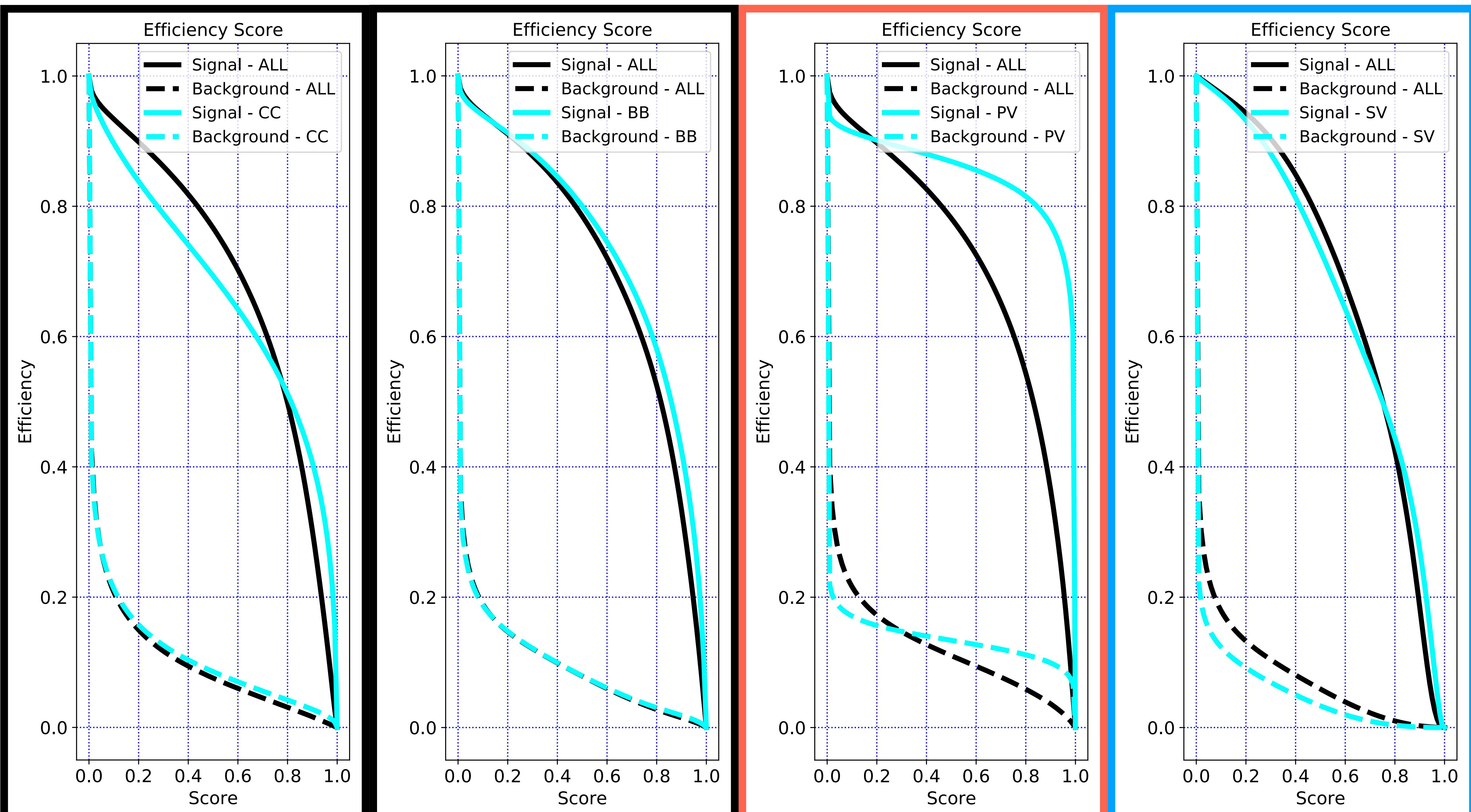
$$\begin{aligned}
 & \left( \mathbf{u}_{\text{energy}} \right) \left[ \begin{pmatrix} \text{key} \\ \mathbf{K} \\ \text{value} \\ \mathbf{v} \end{pmatrix} \left( \mathbf{U}_{\text{key}} \right) + \begin{pmatrix} \text{query} \\ \mathbf{x}_t \\ X_t \\ \text{value} \\ \mathbf{v} \end{pmatrix} \left( \mathbf{U}_{\text{query}} \right) \right] = \left( \mathbf{e}_t \right) \\
 & \left( \sigma(\mathbf{e}_t) \right) = \left( \alpha_t \right) \left( \mathbf{v} \right) = \left( \gamma_t \right)
 \end{aligned}$$

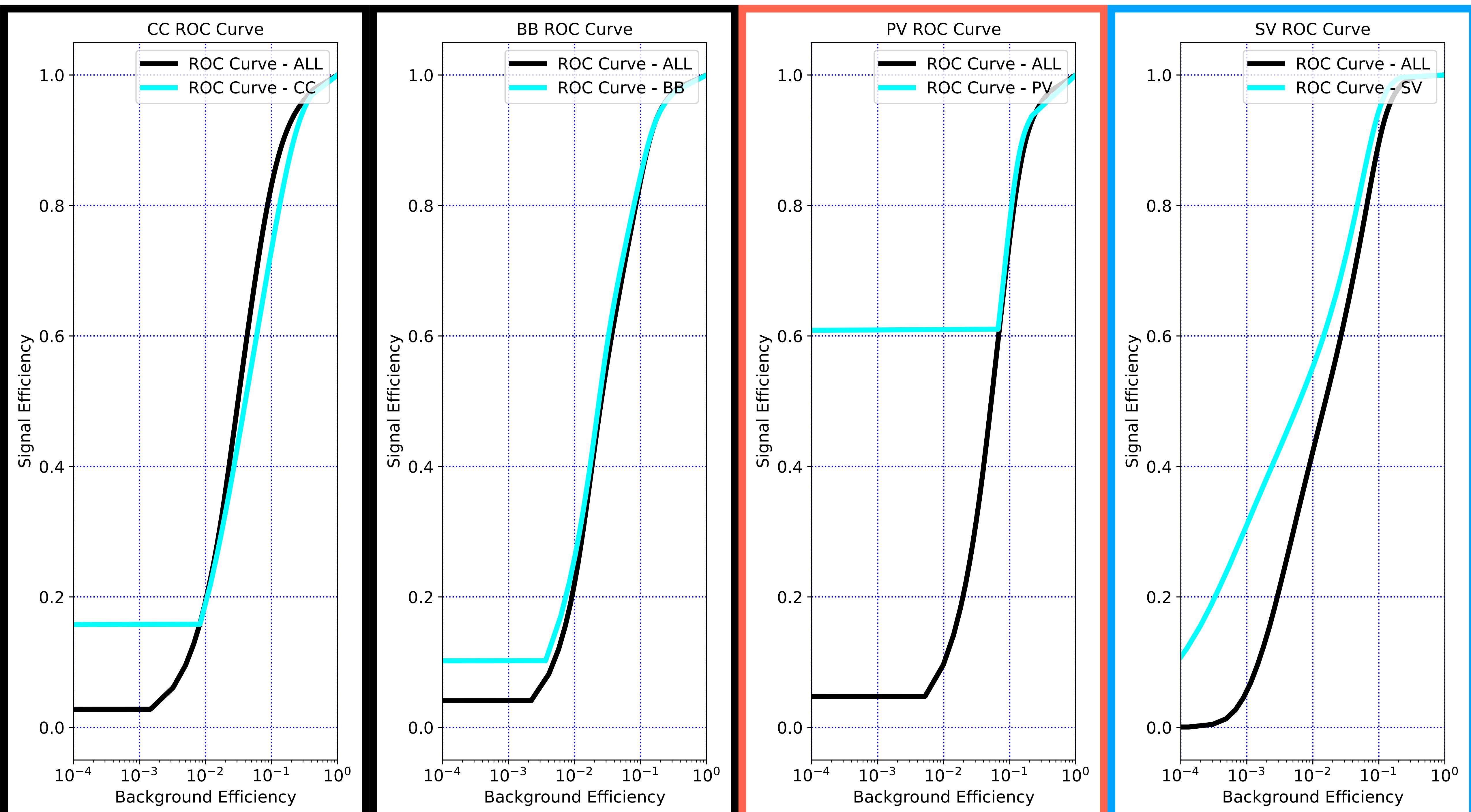


飛跡順のシャッフル





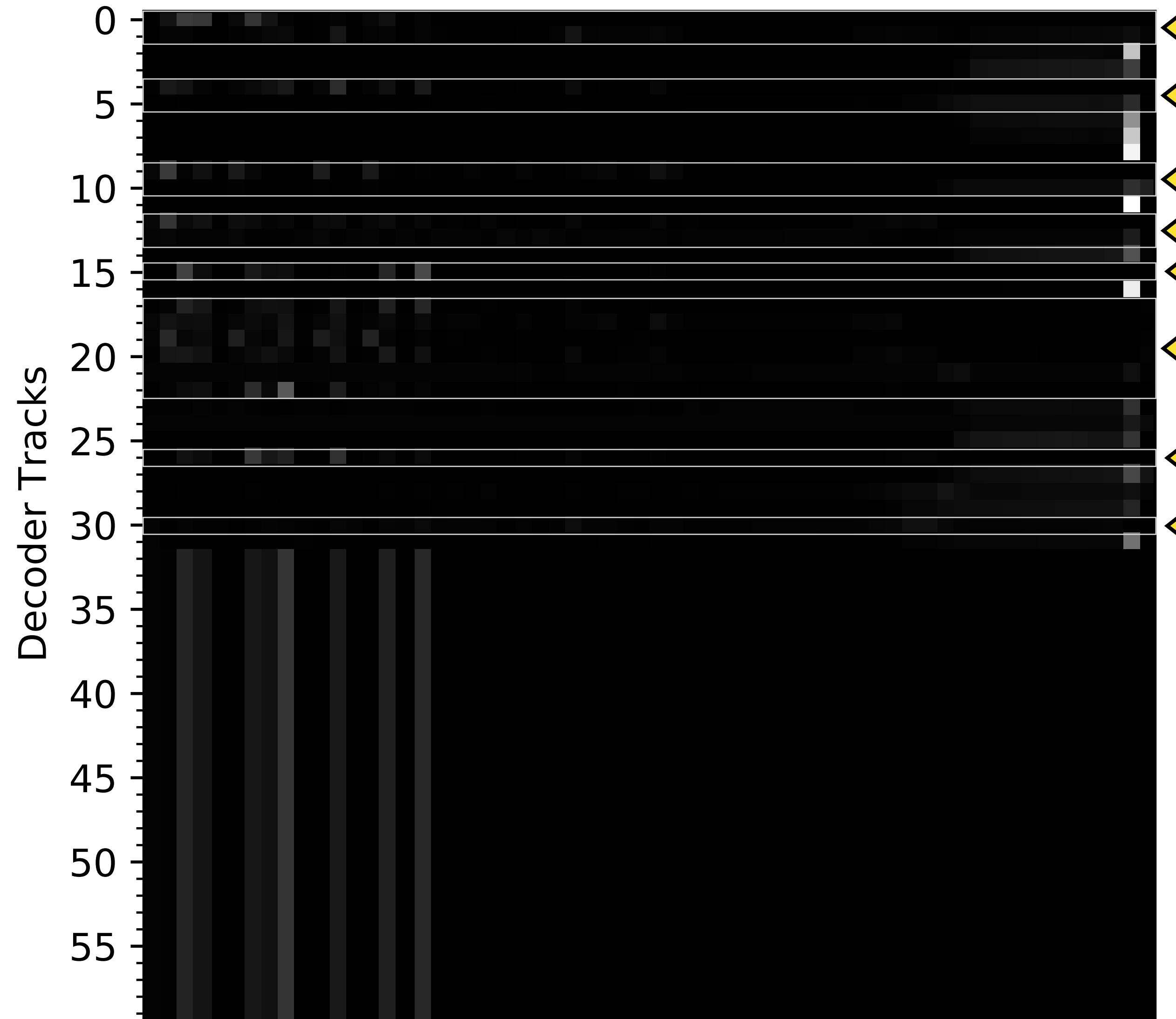




# Attention Weight Map

Connected tracks are

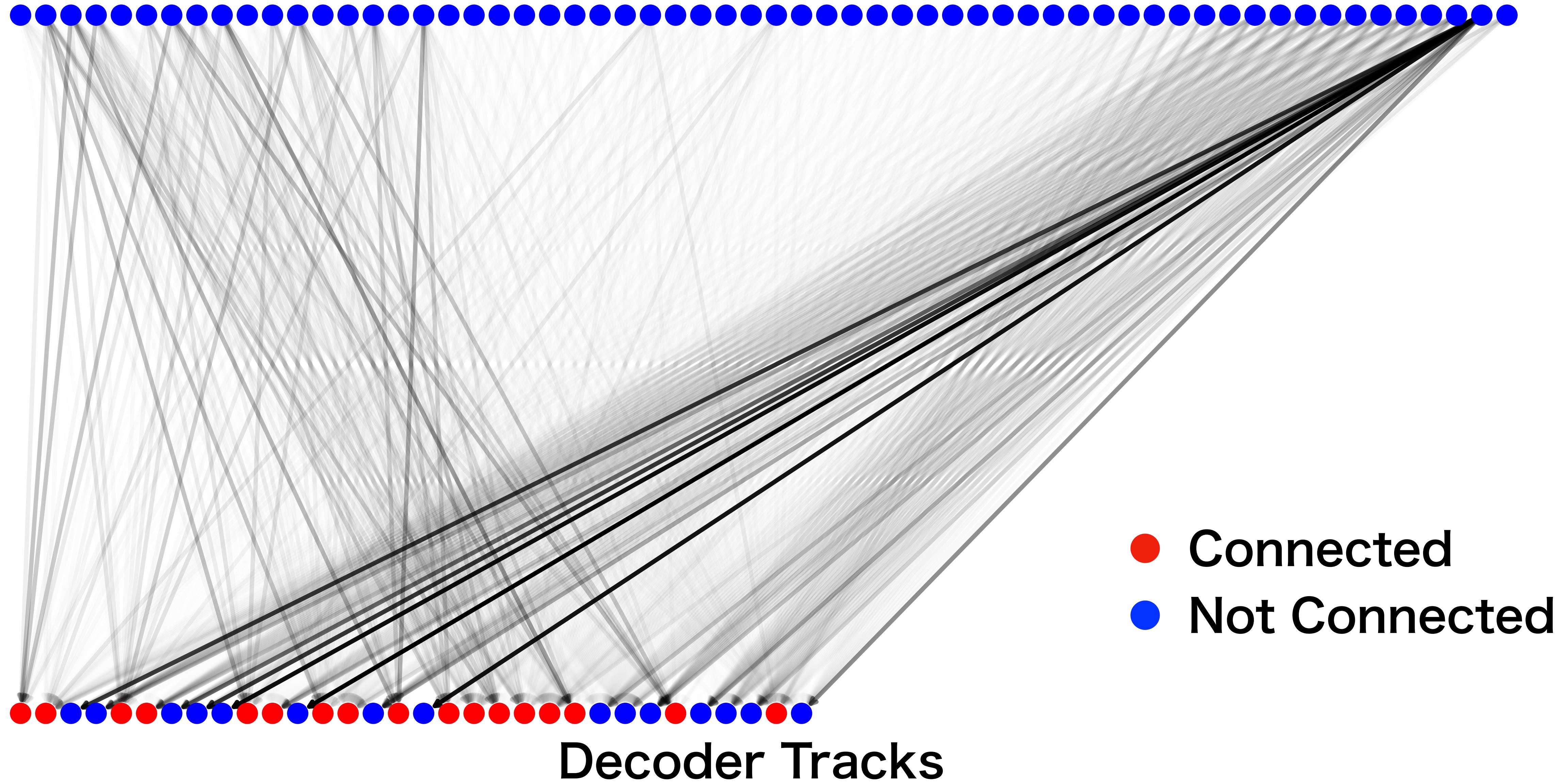
0 1 4 5 9 10 12 13 15 17 18 19 20 21 22 26 30

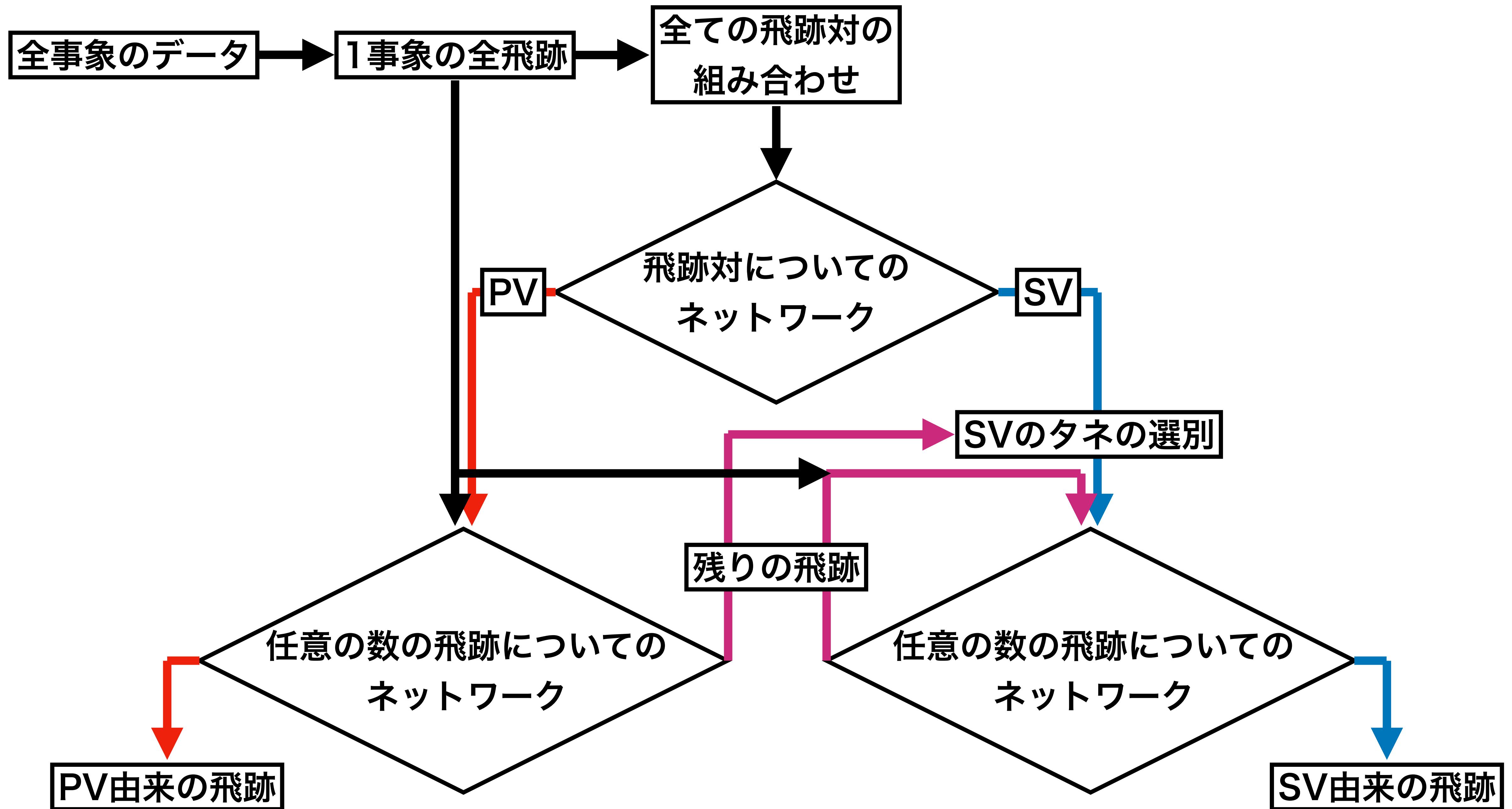


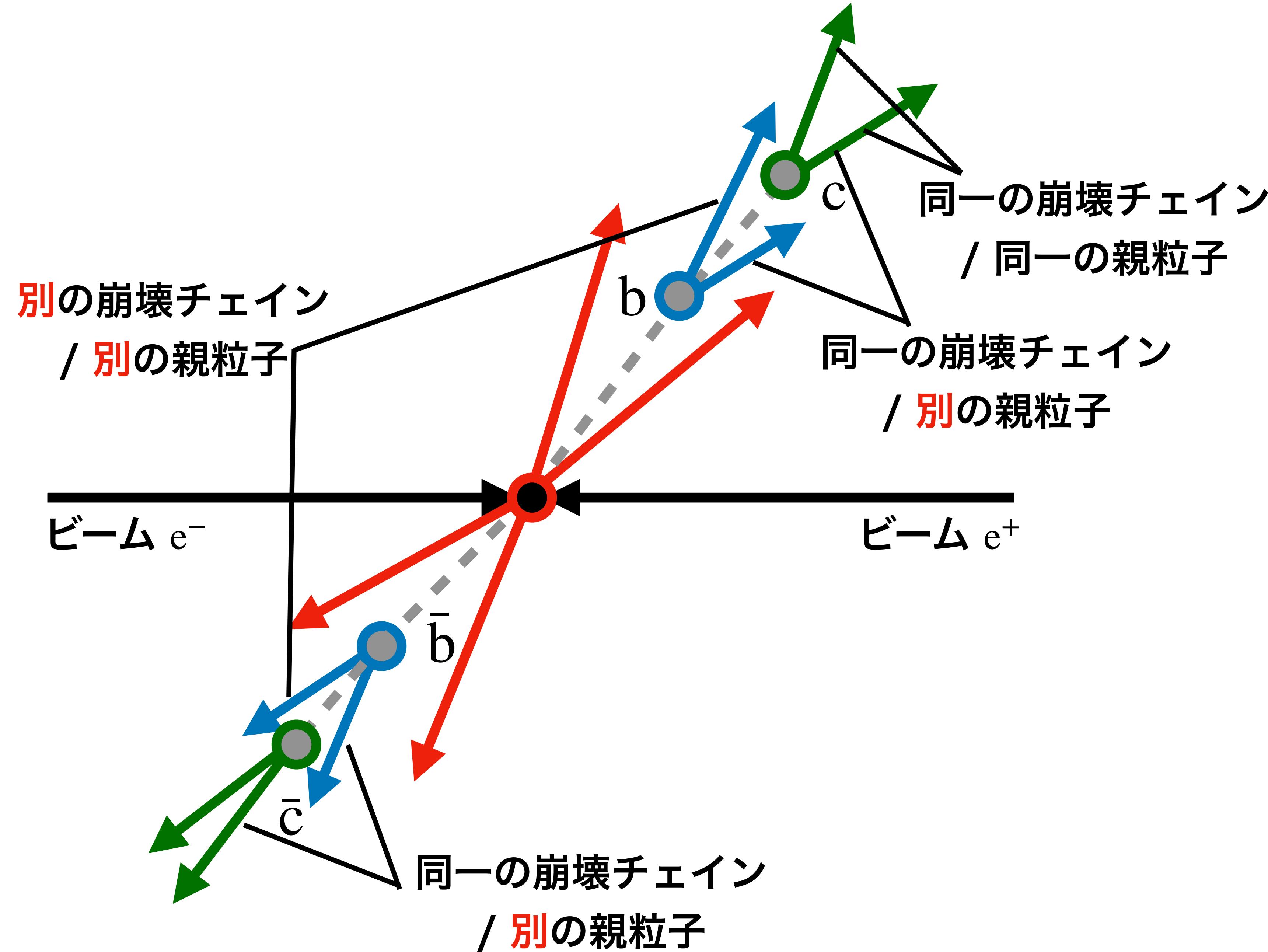
Encoder Tracks

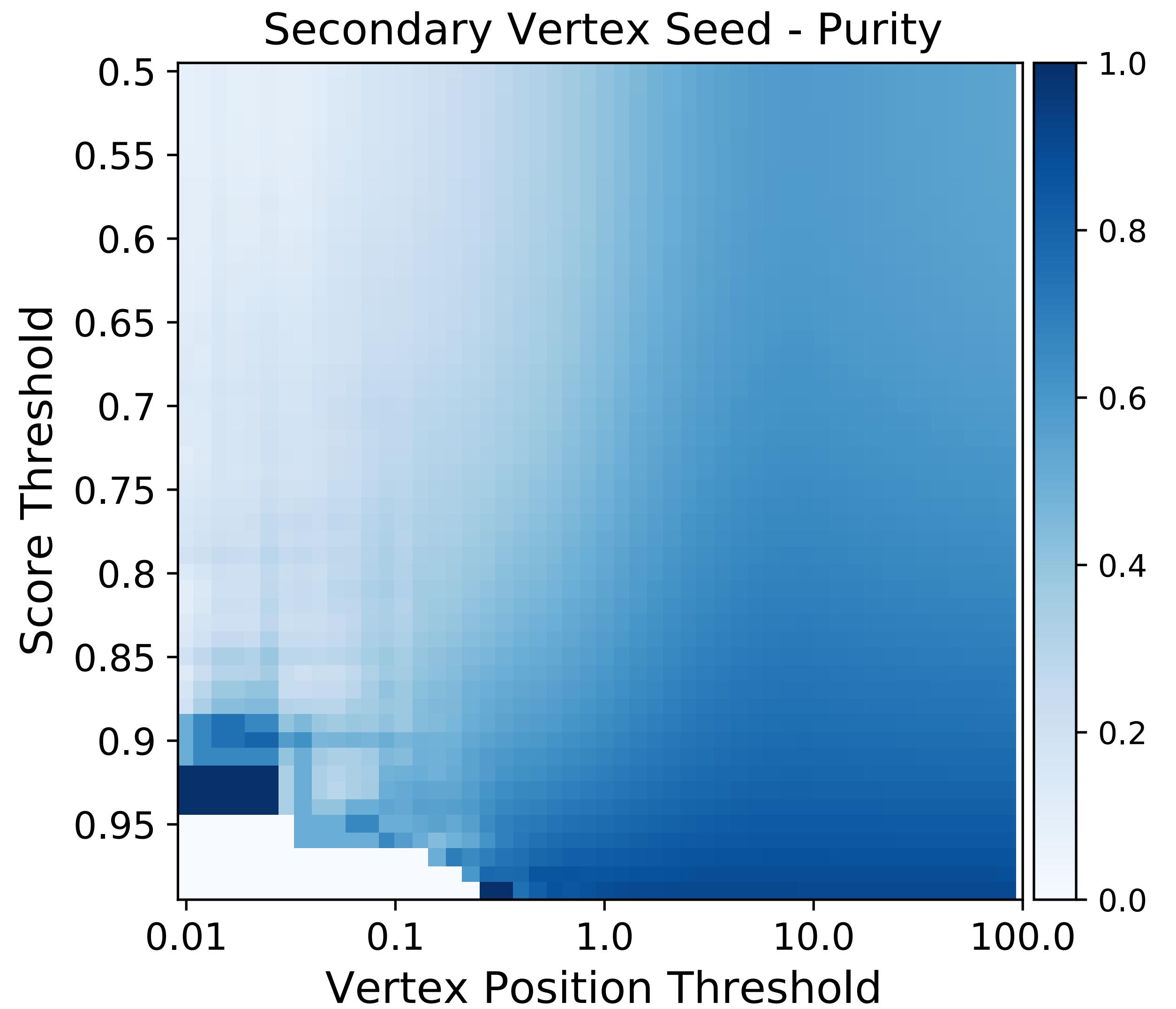
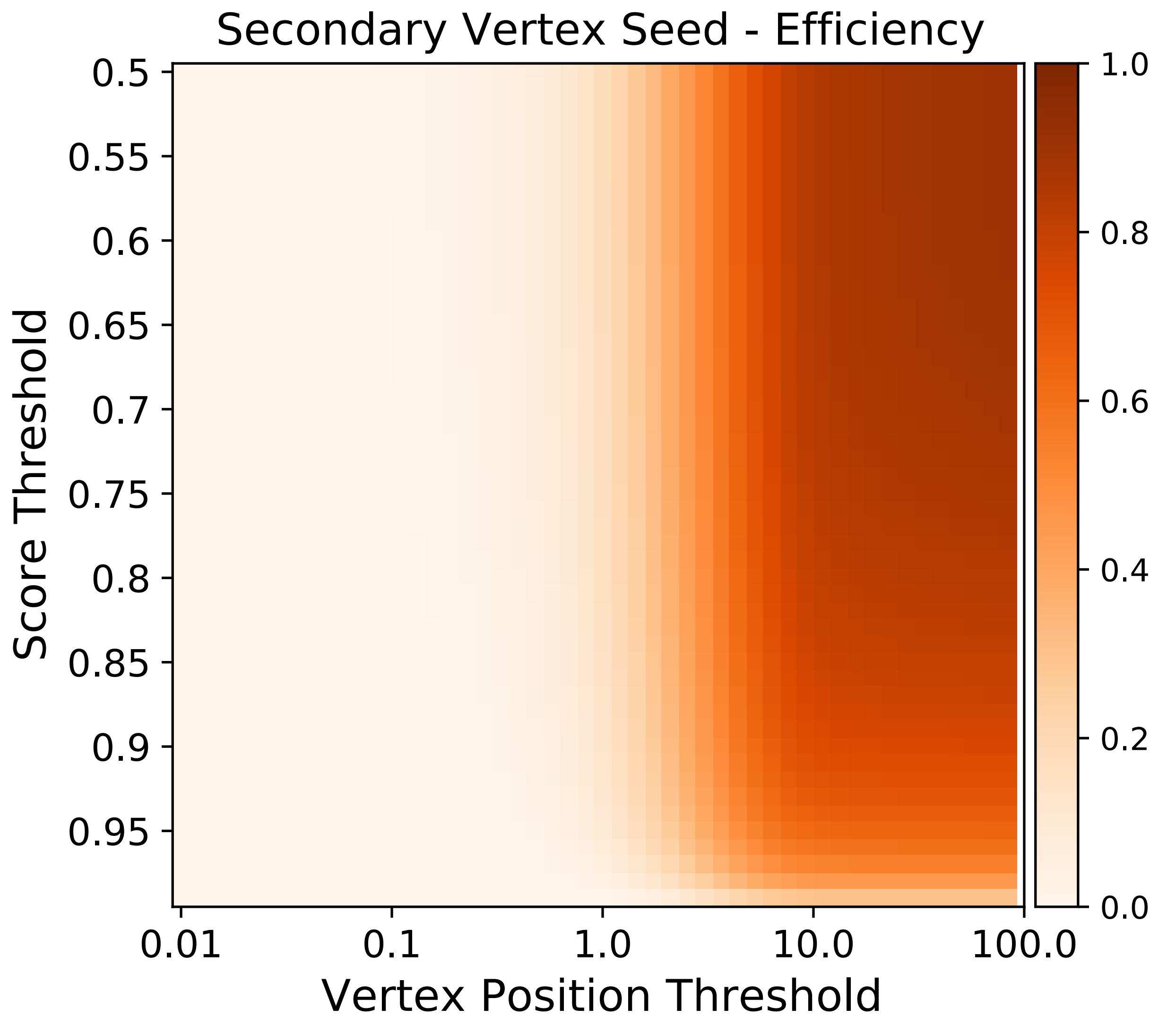
# Attention Weight Graph

## Encoder Tracks

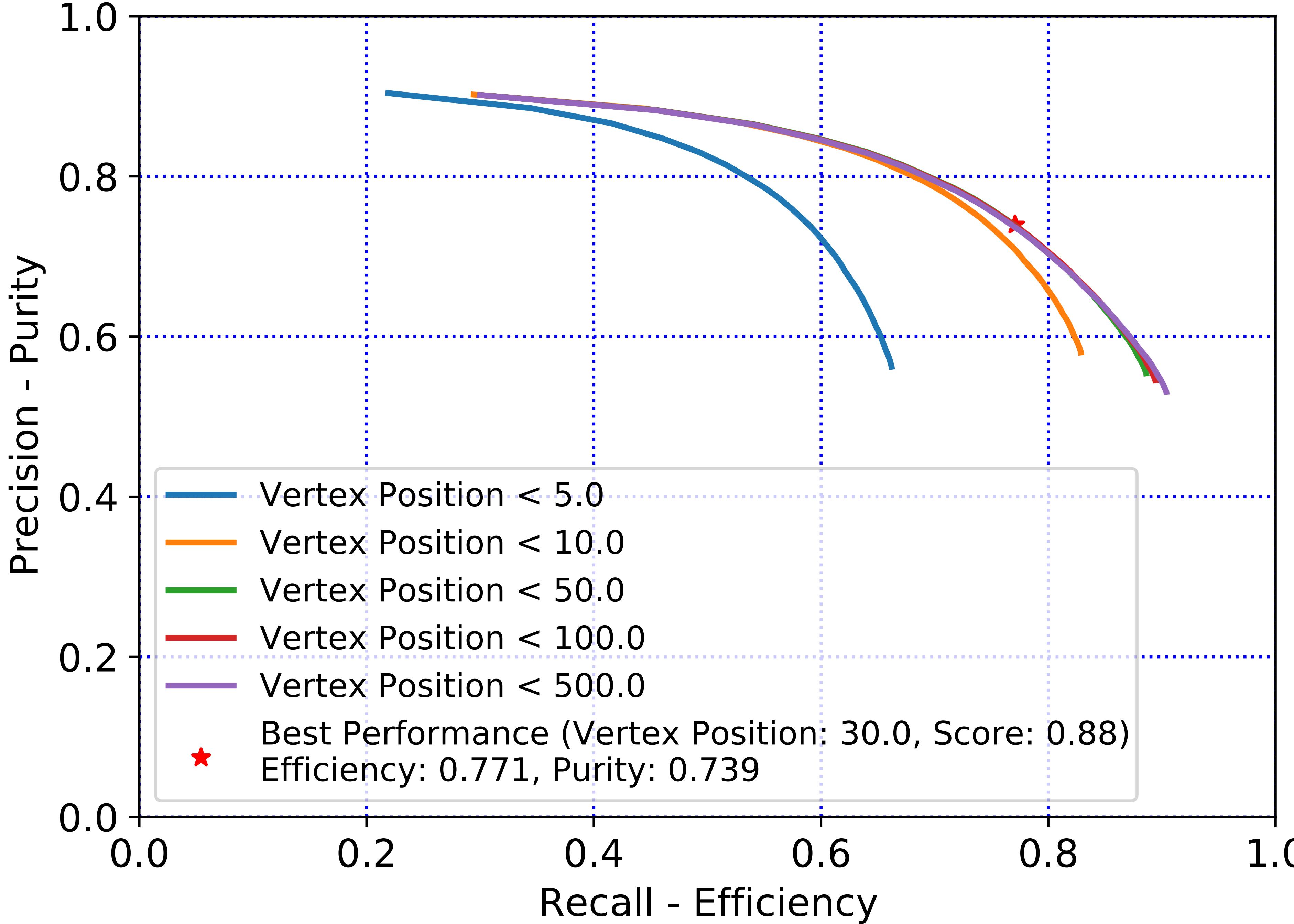


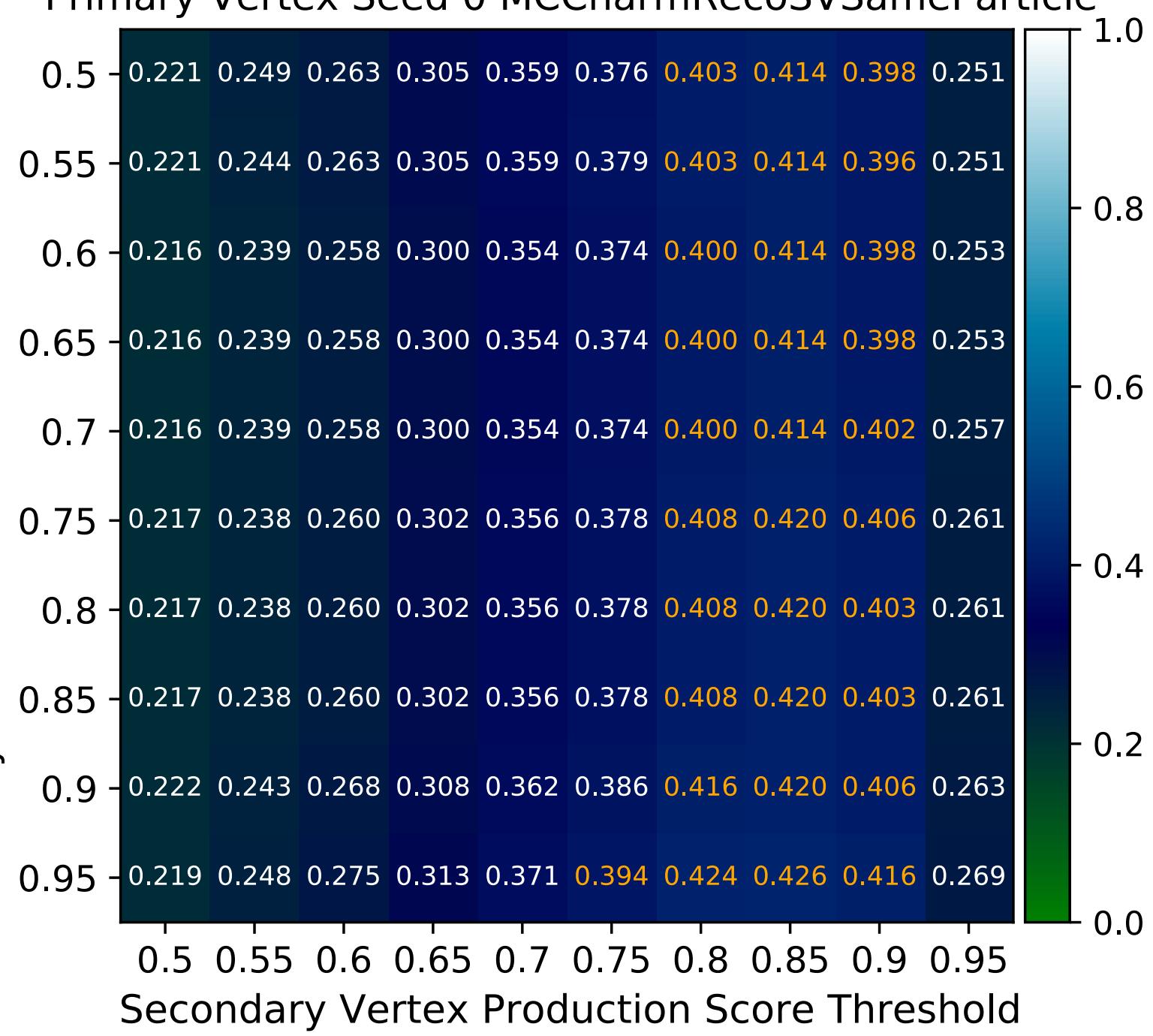
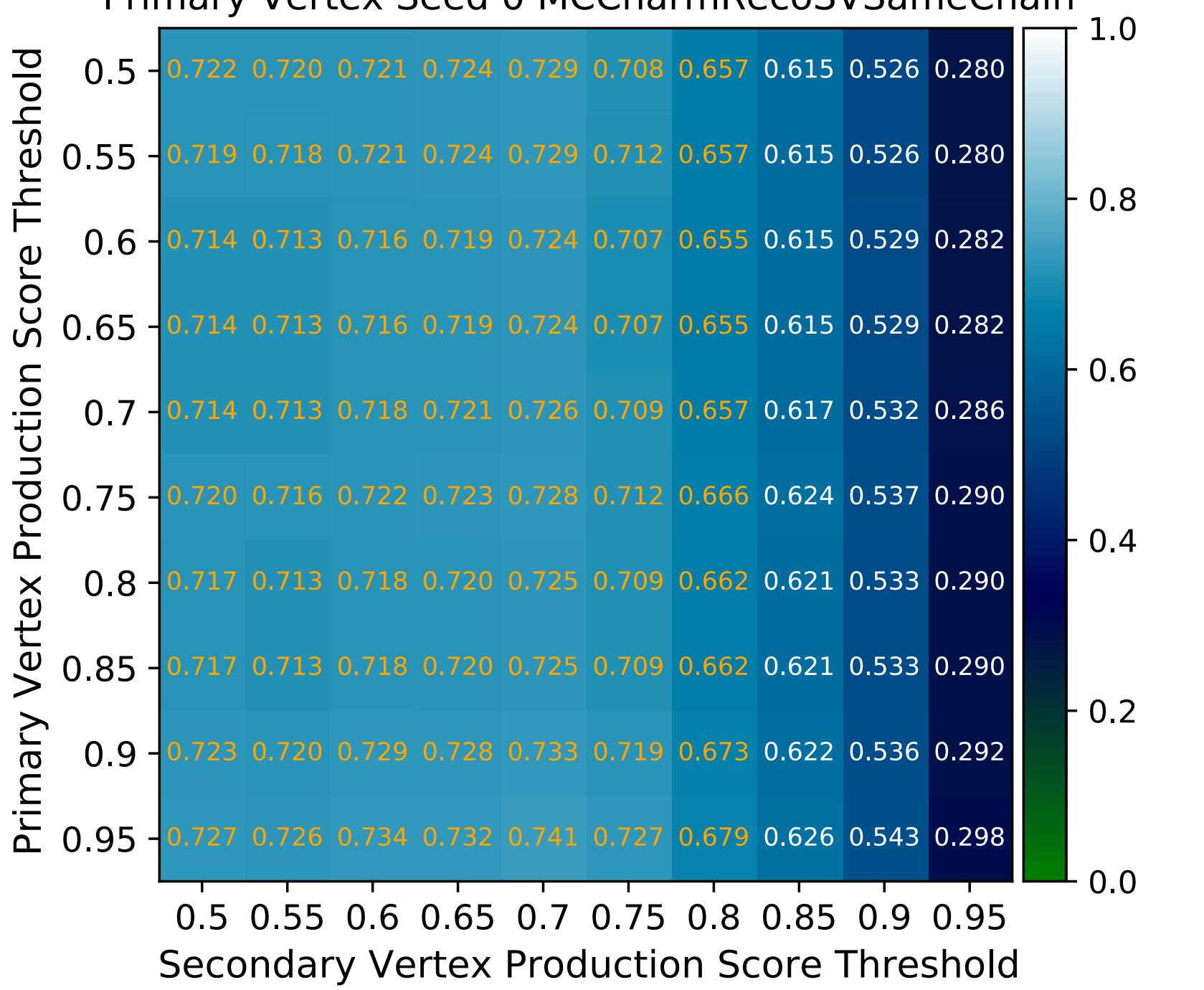
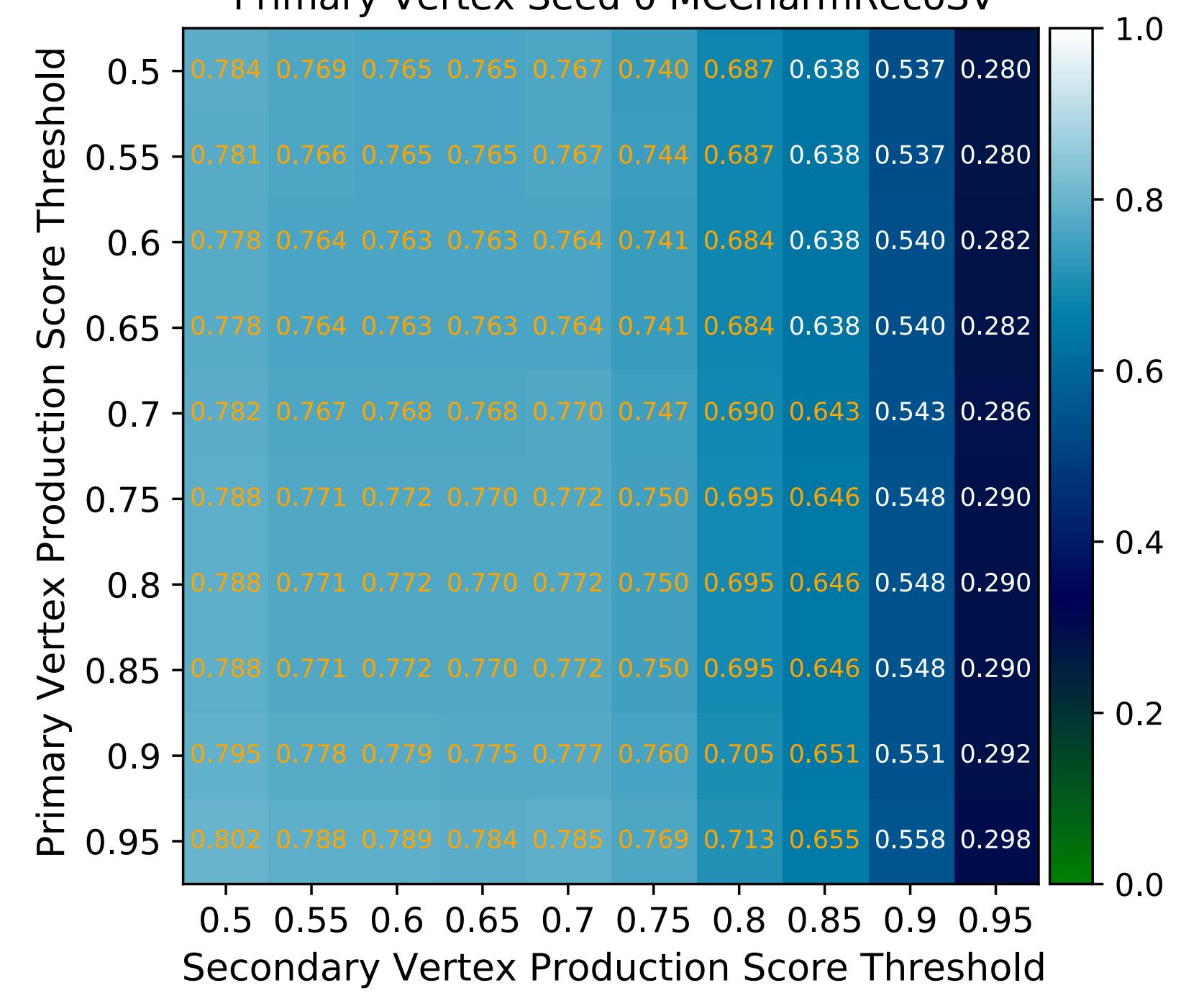
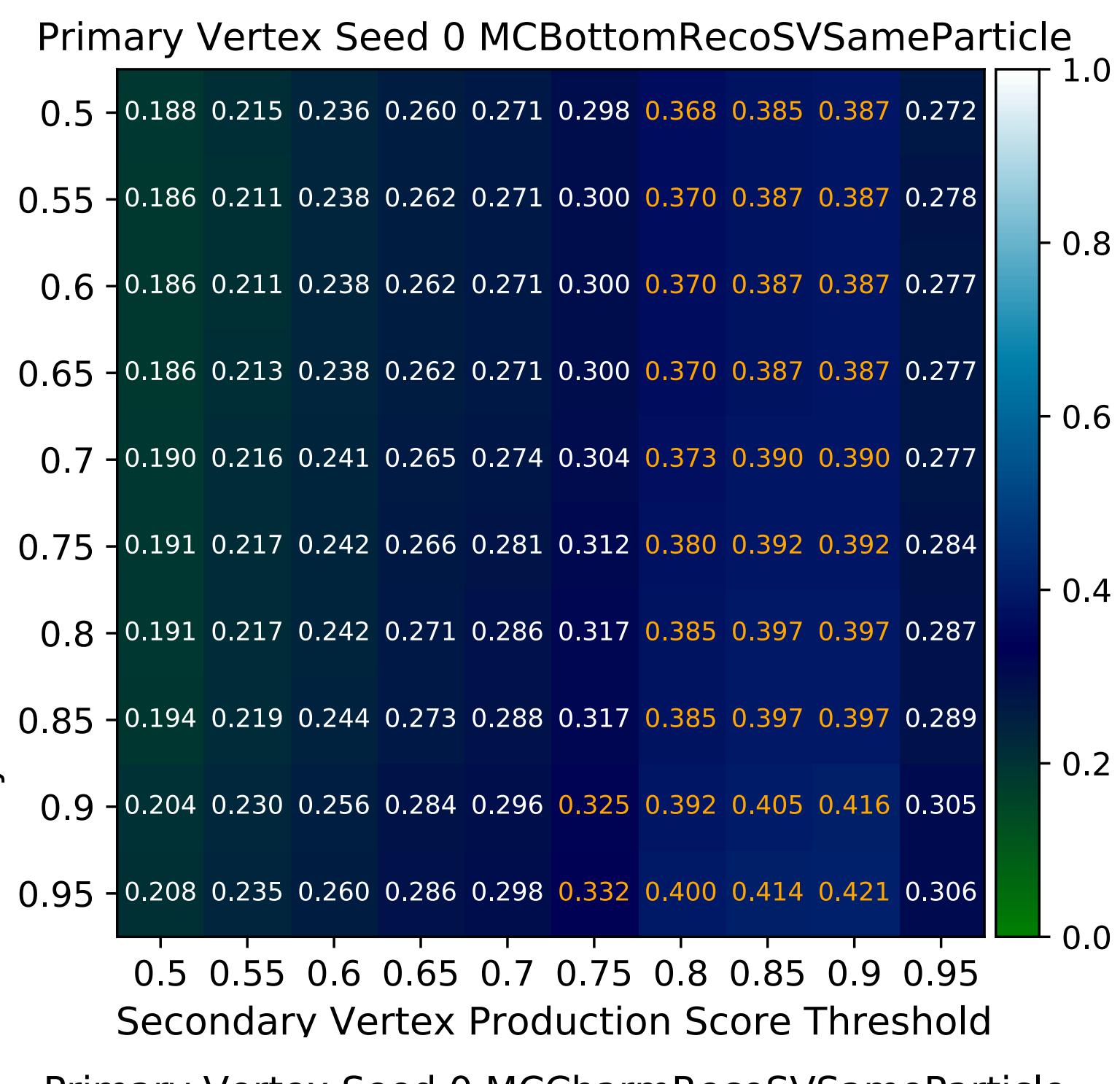
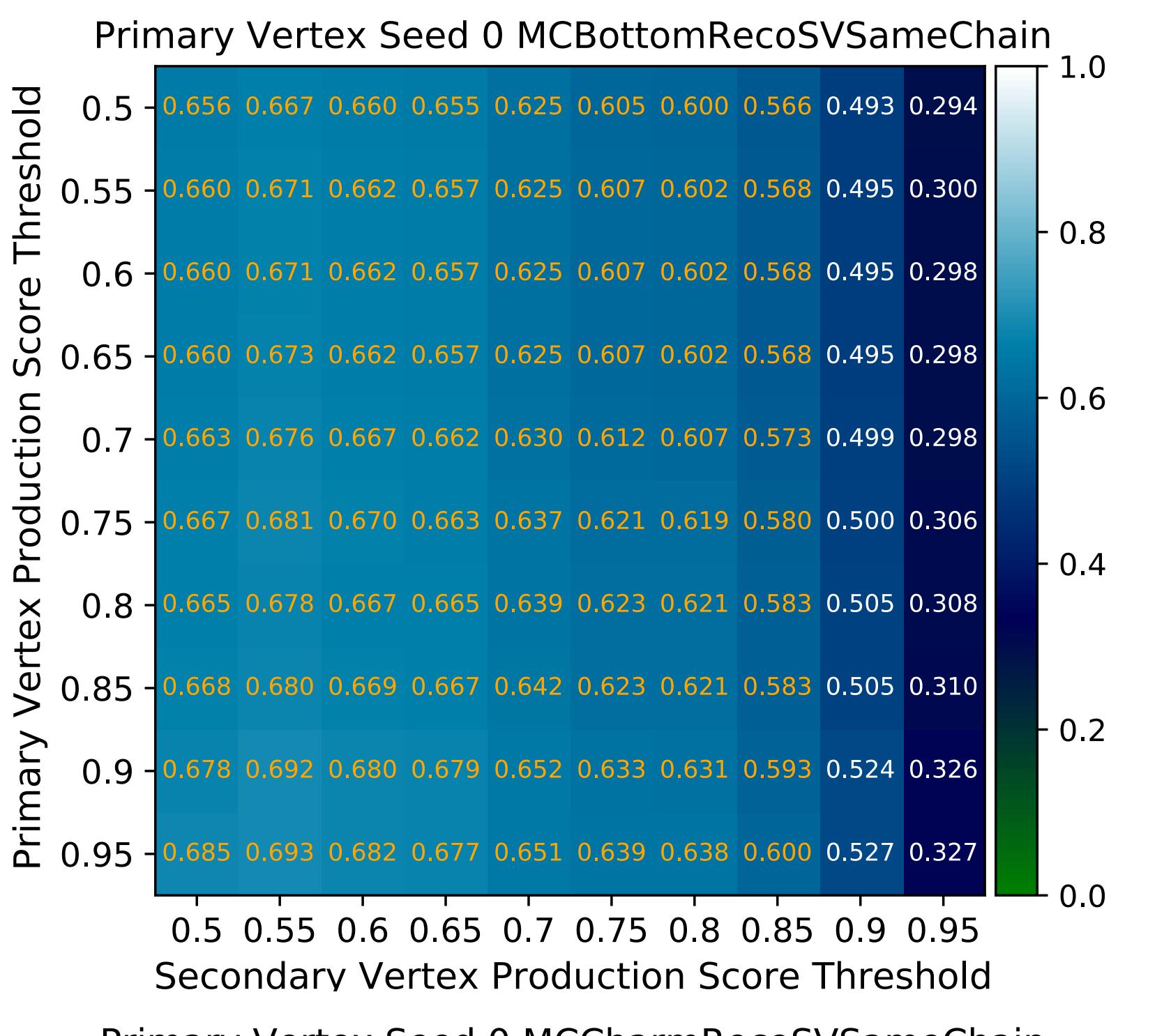
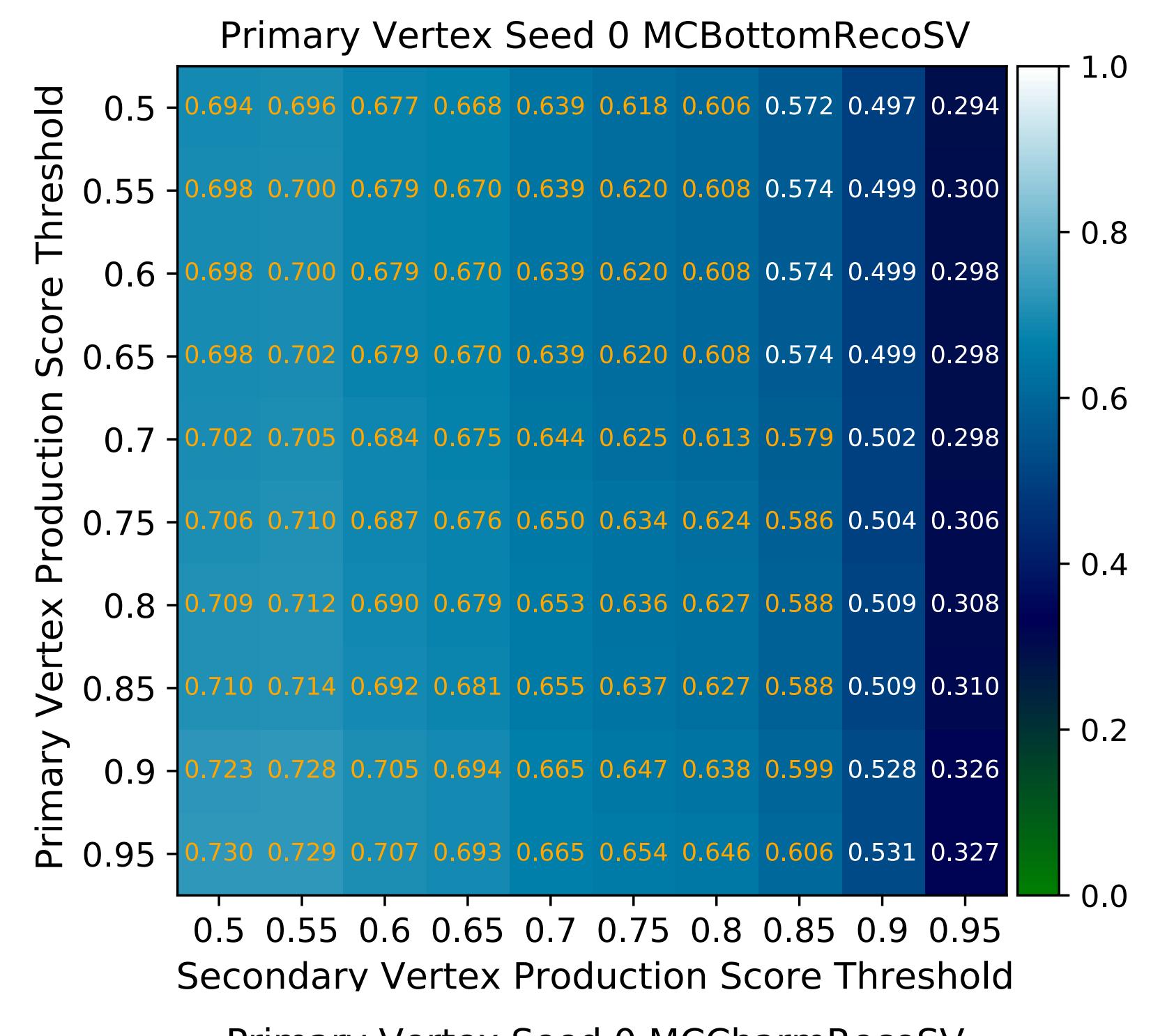


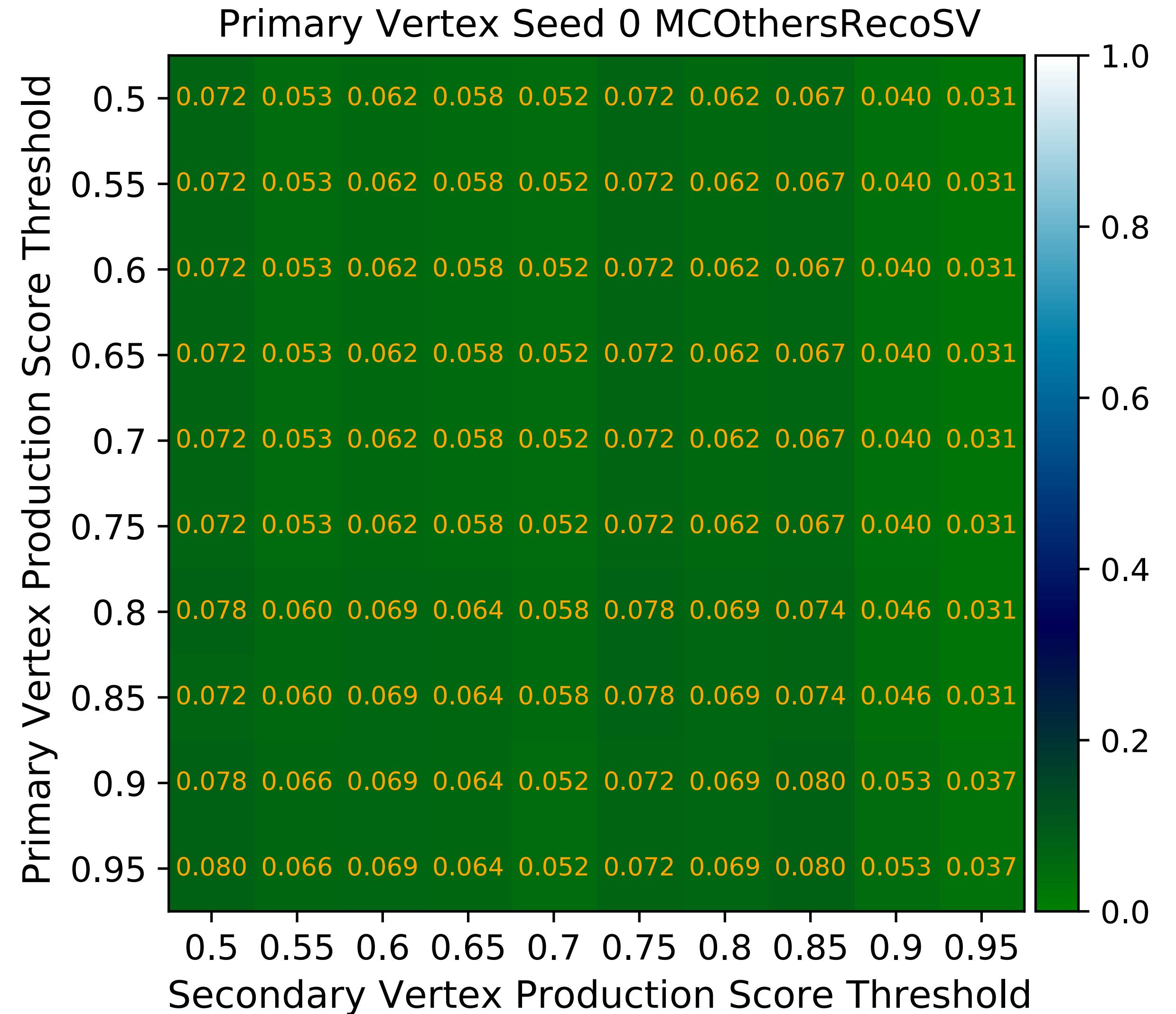
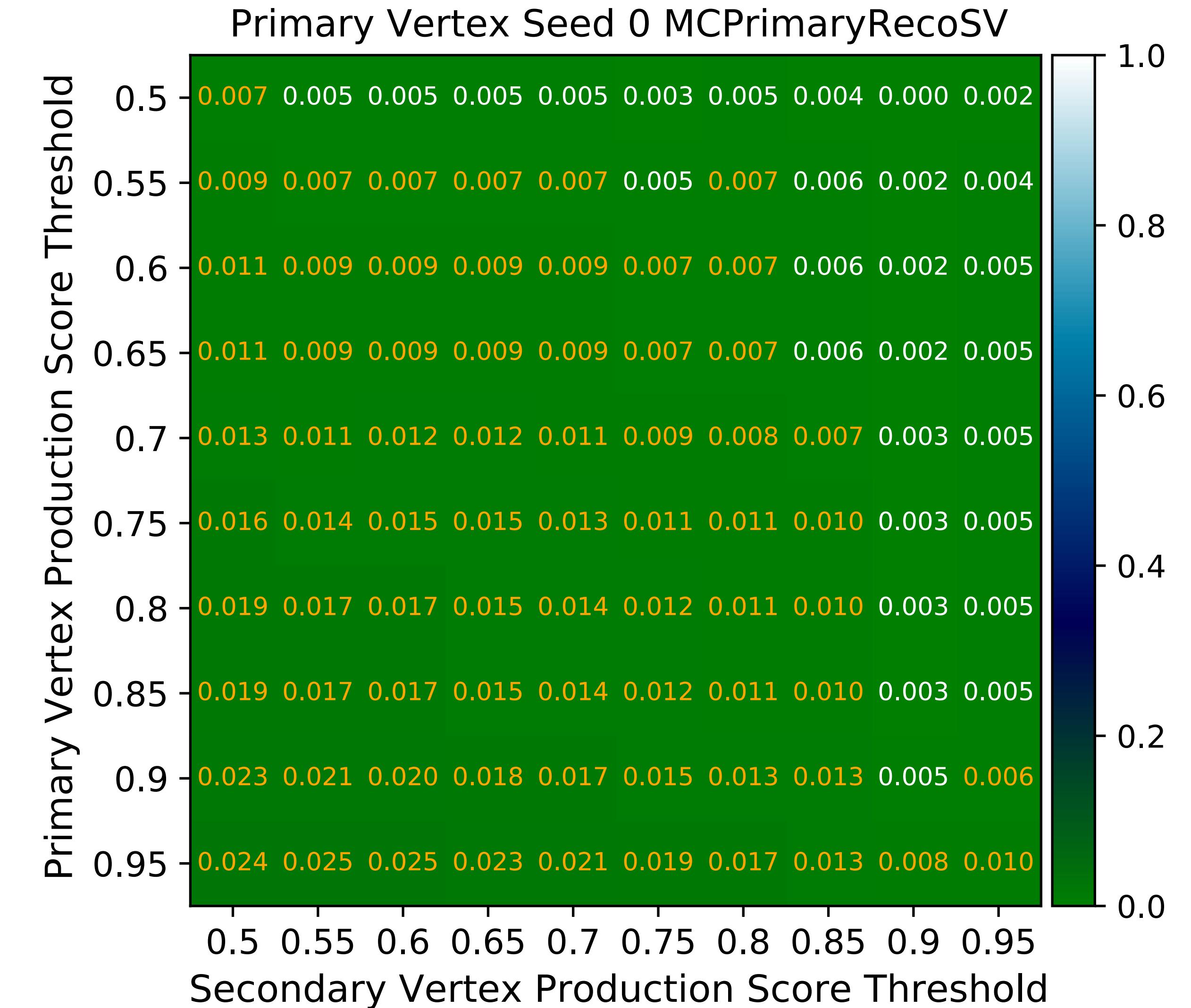


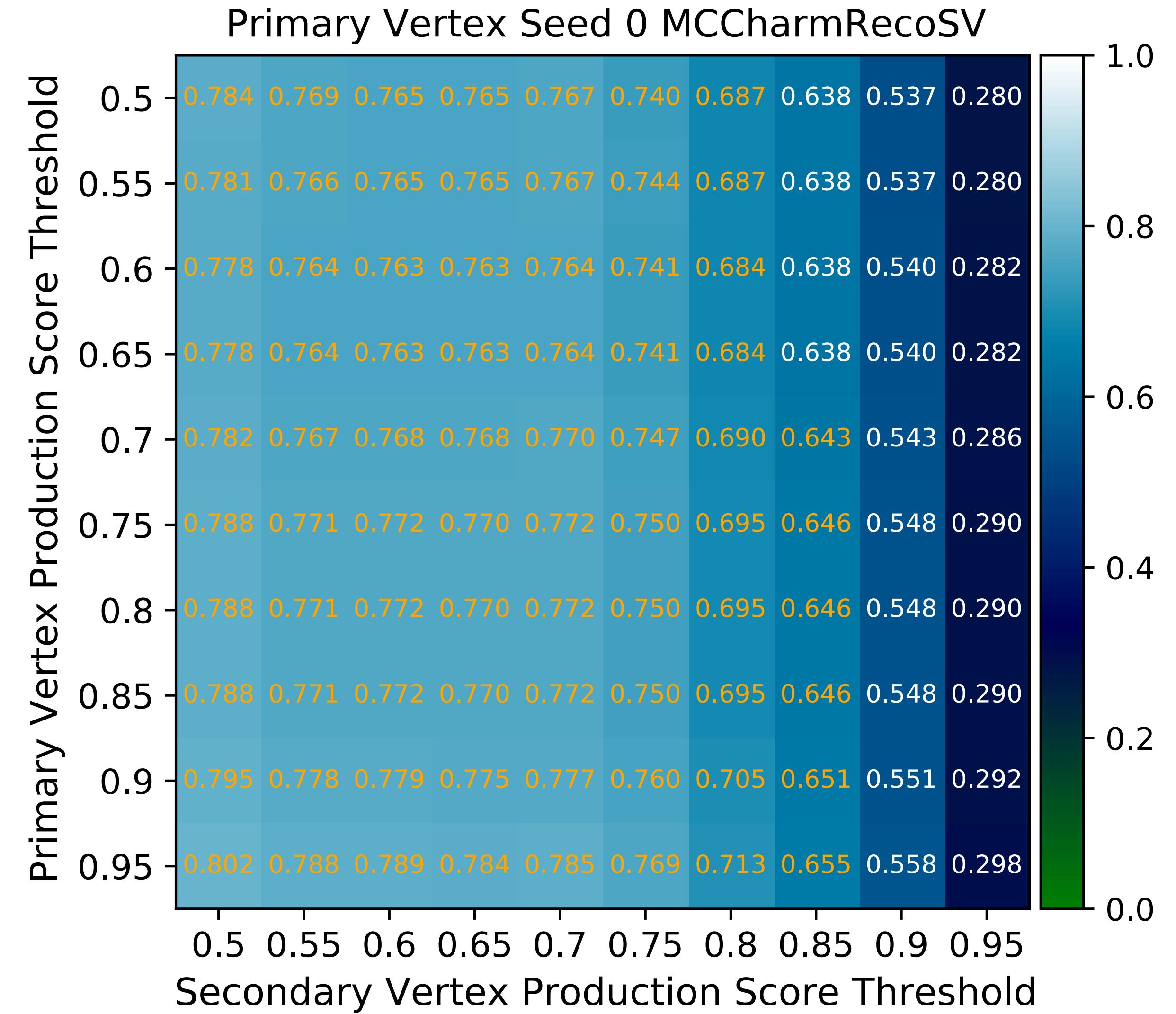
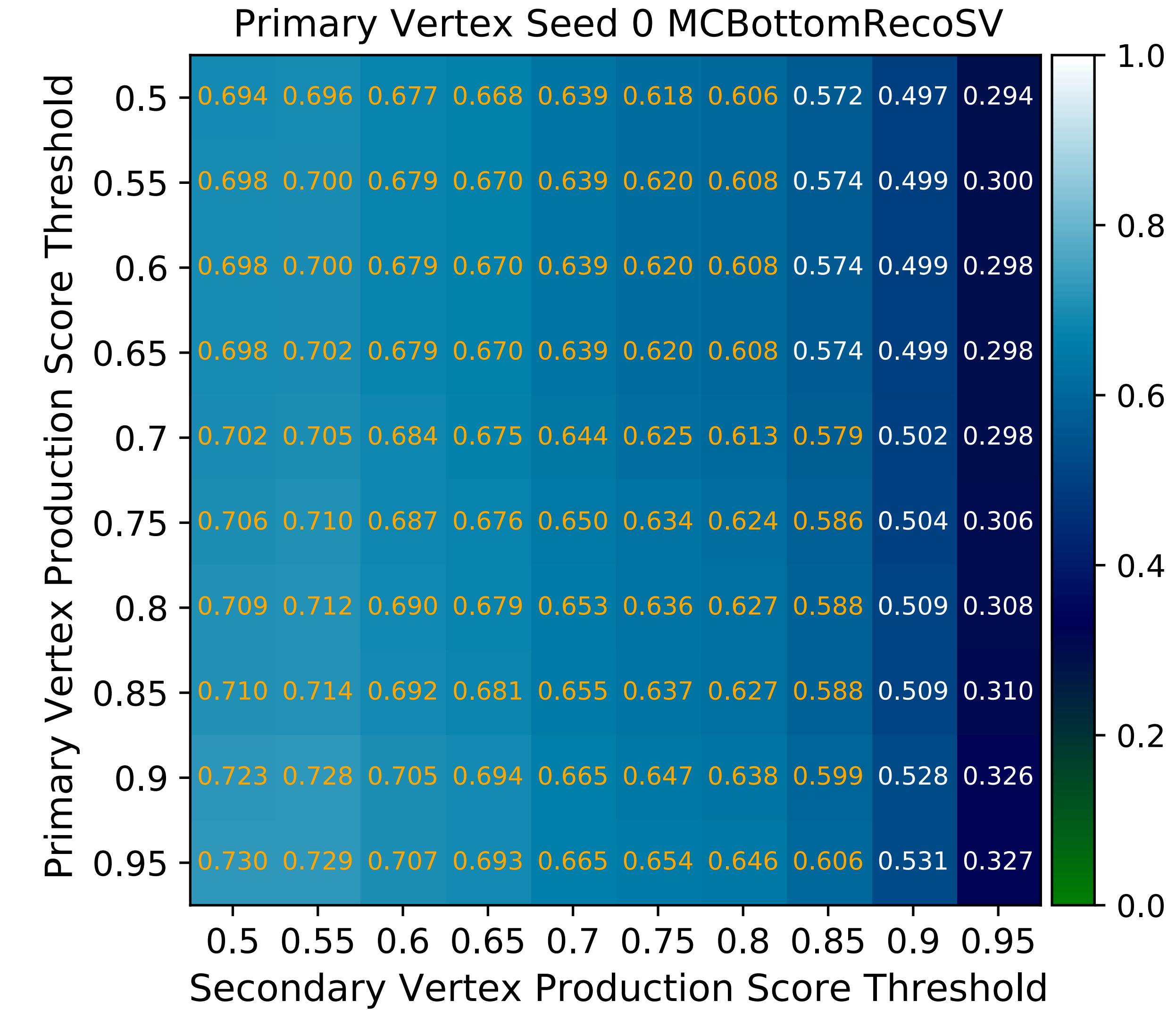


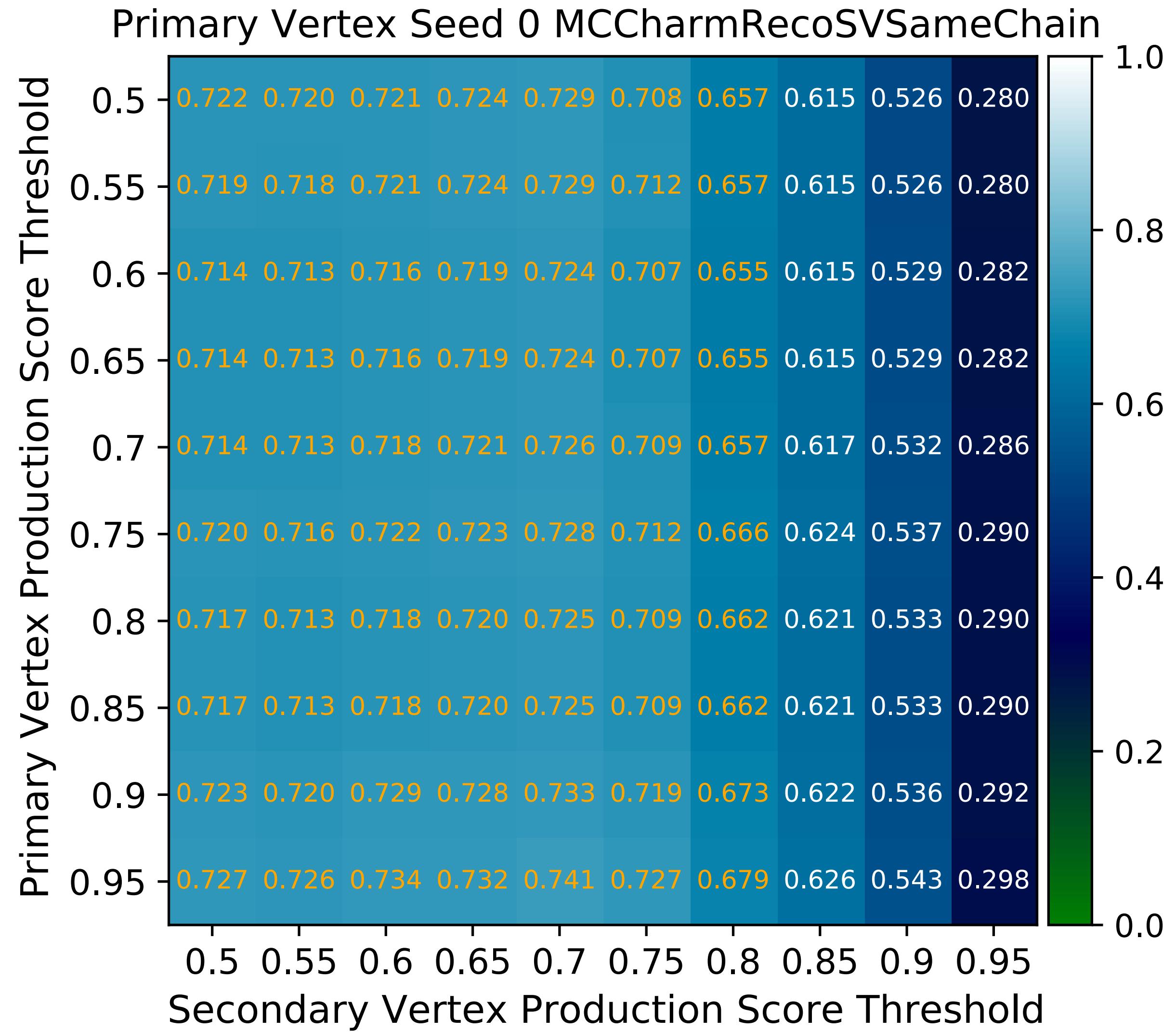
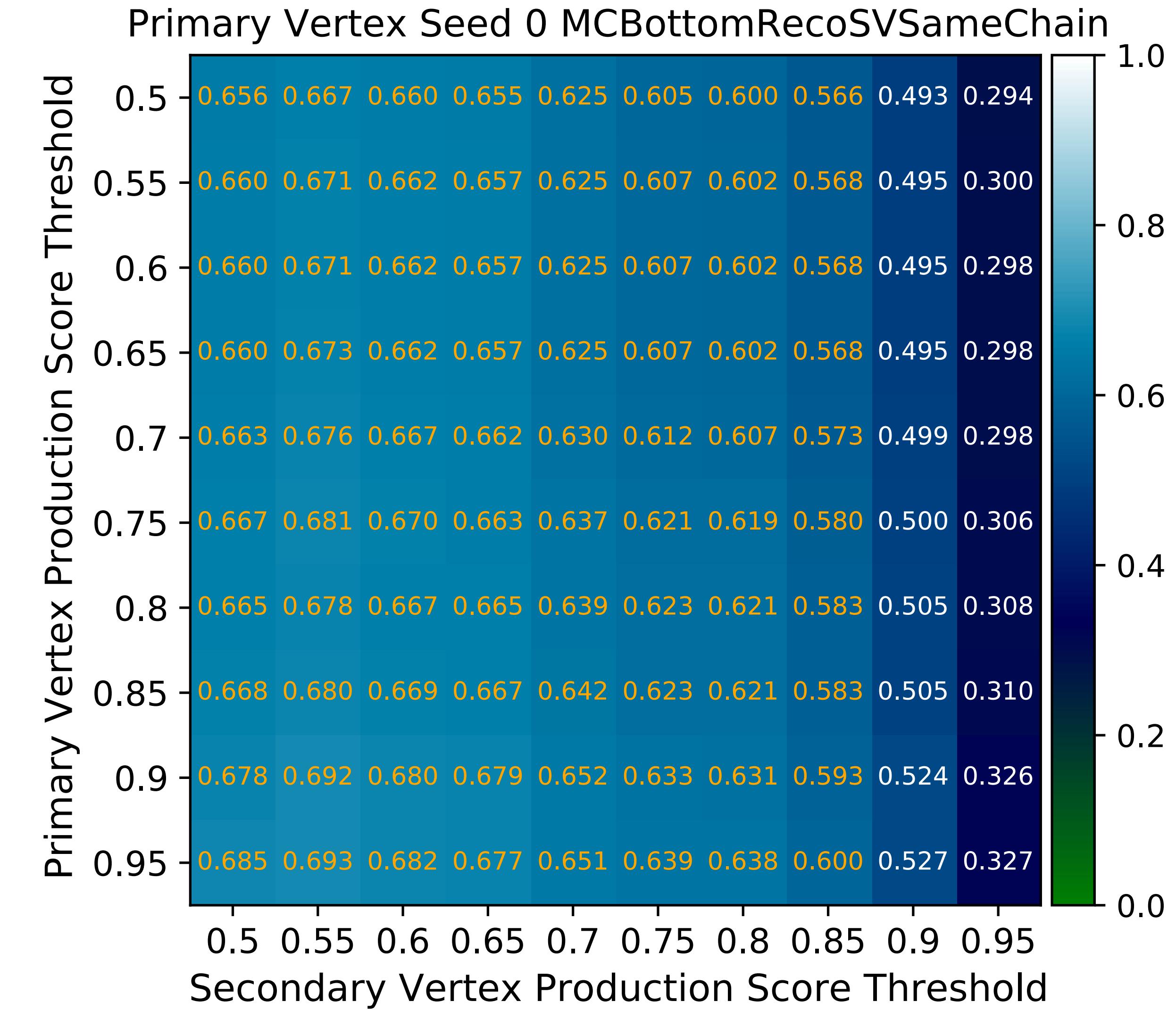
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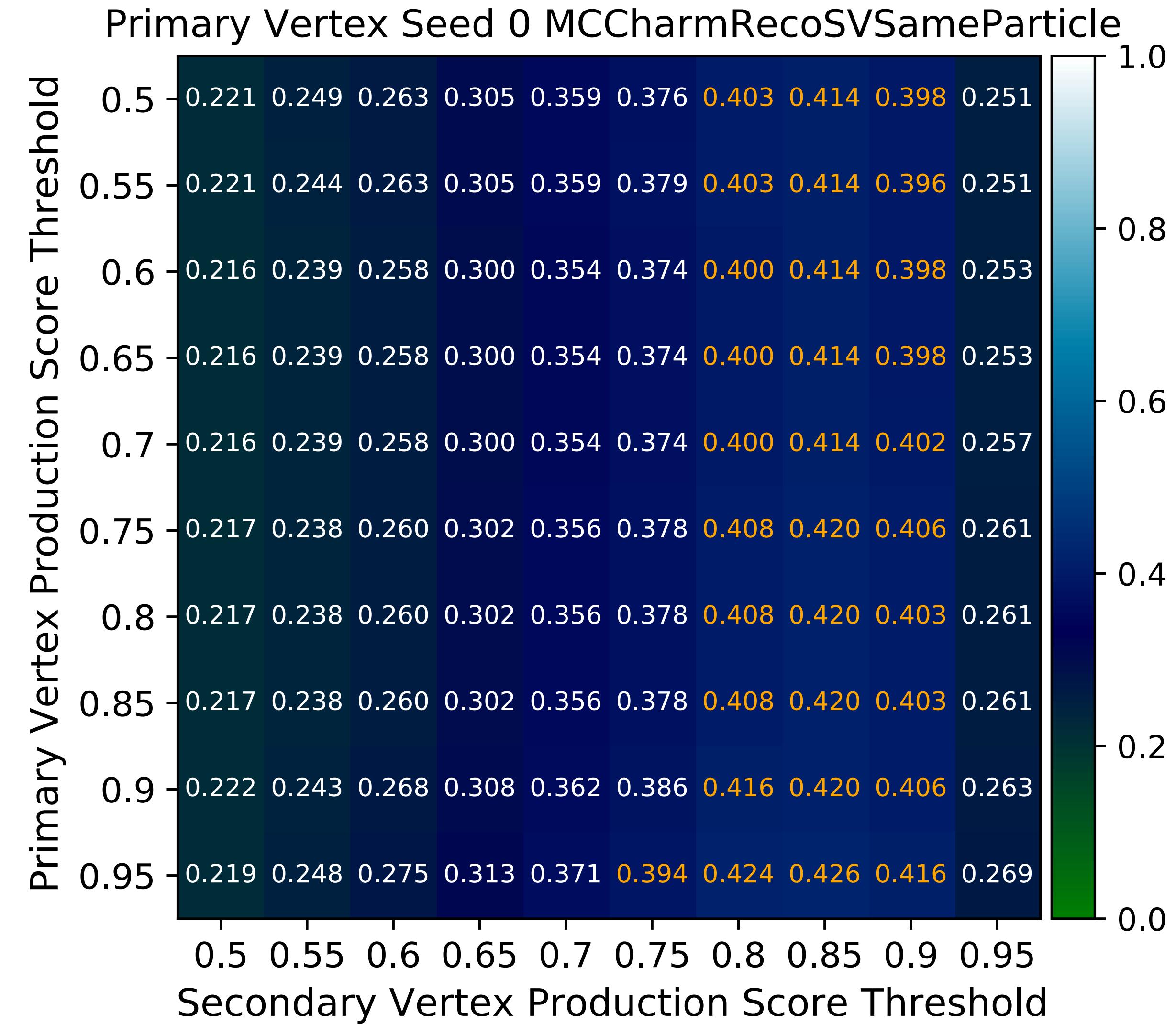
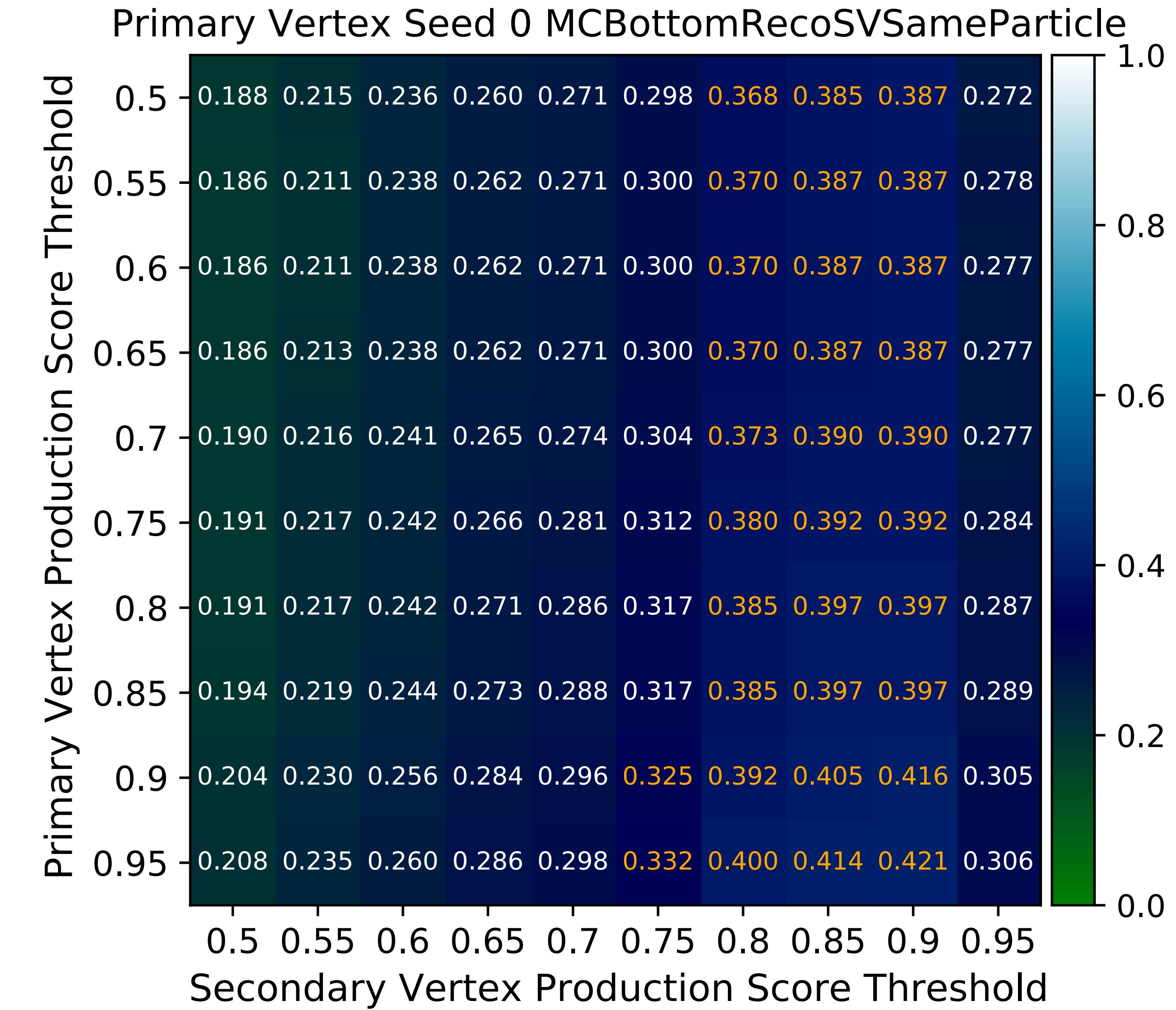


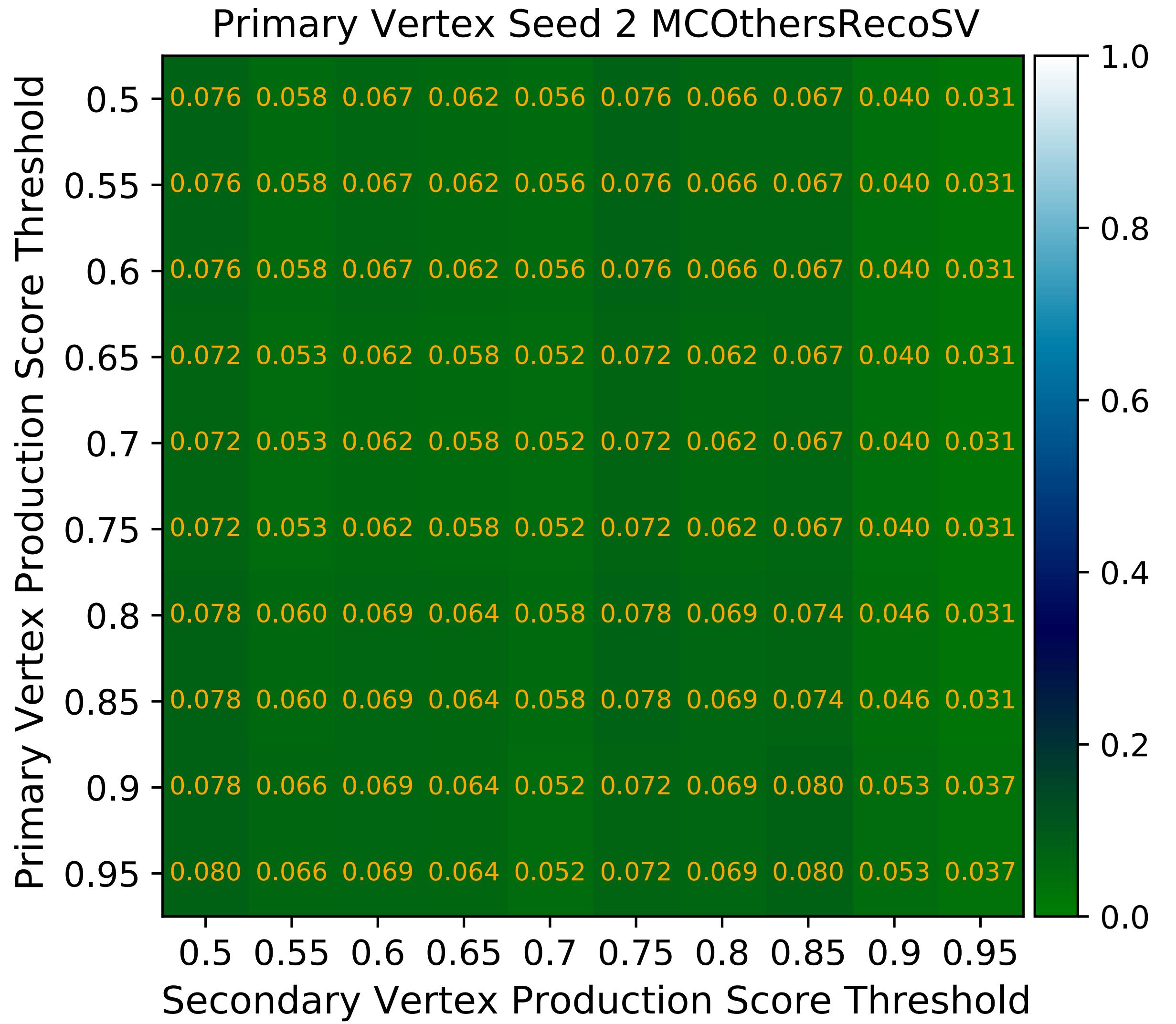
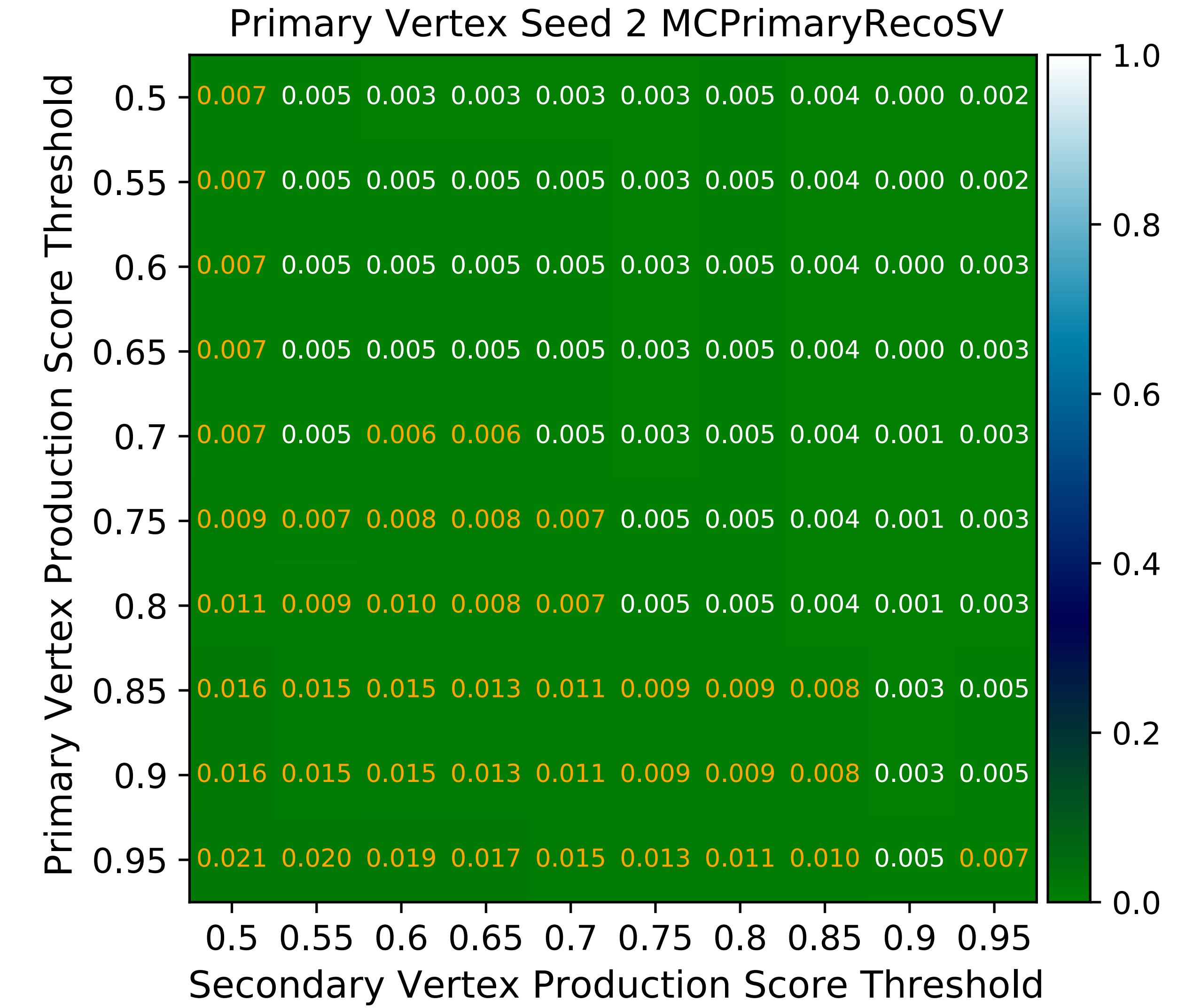


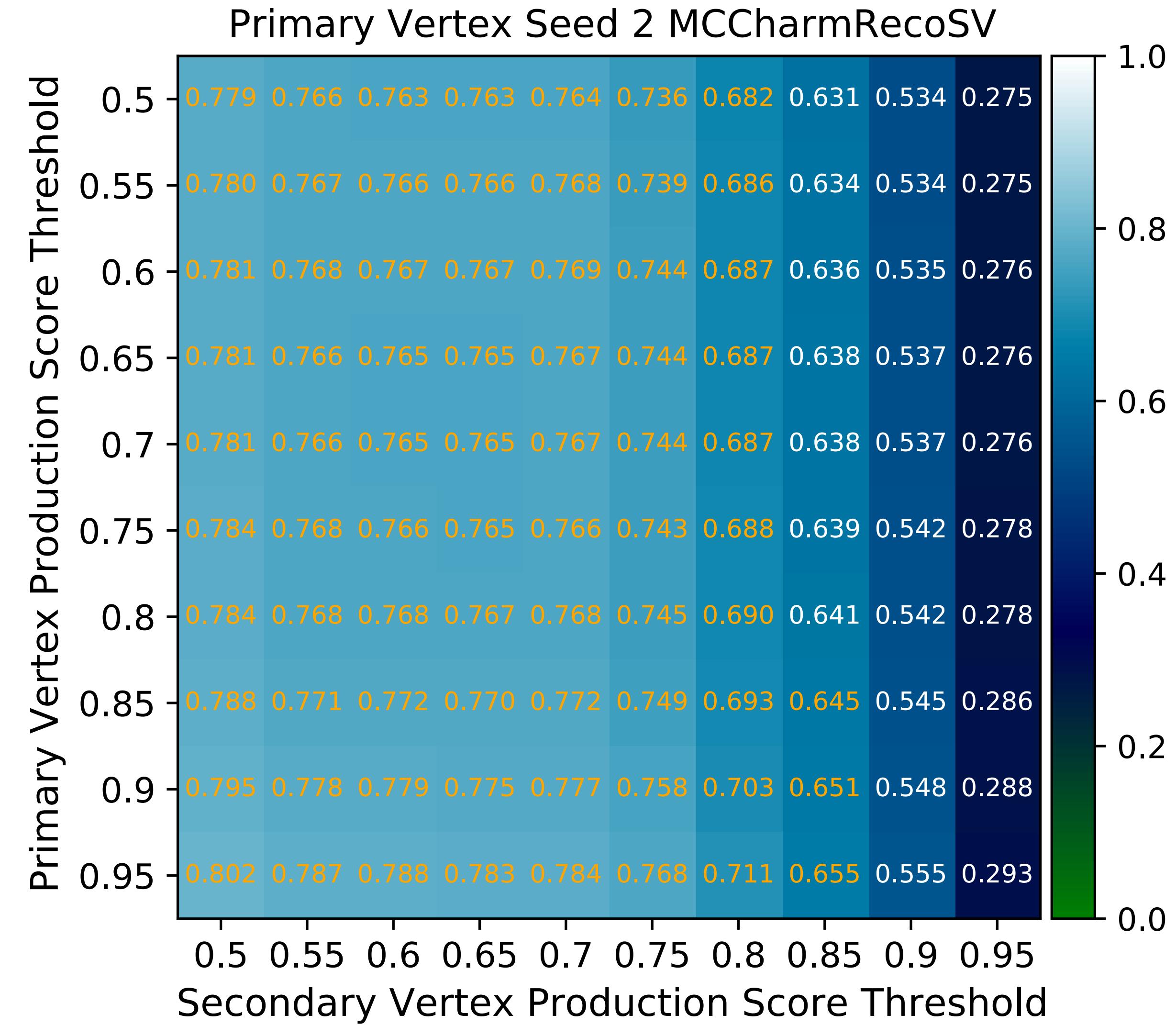
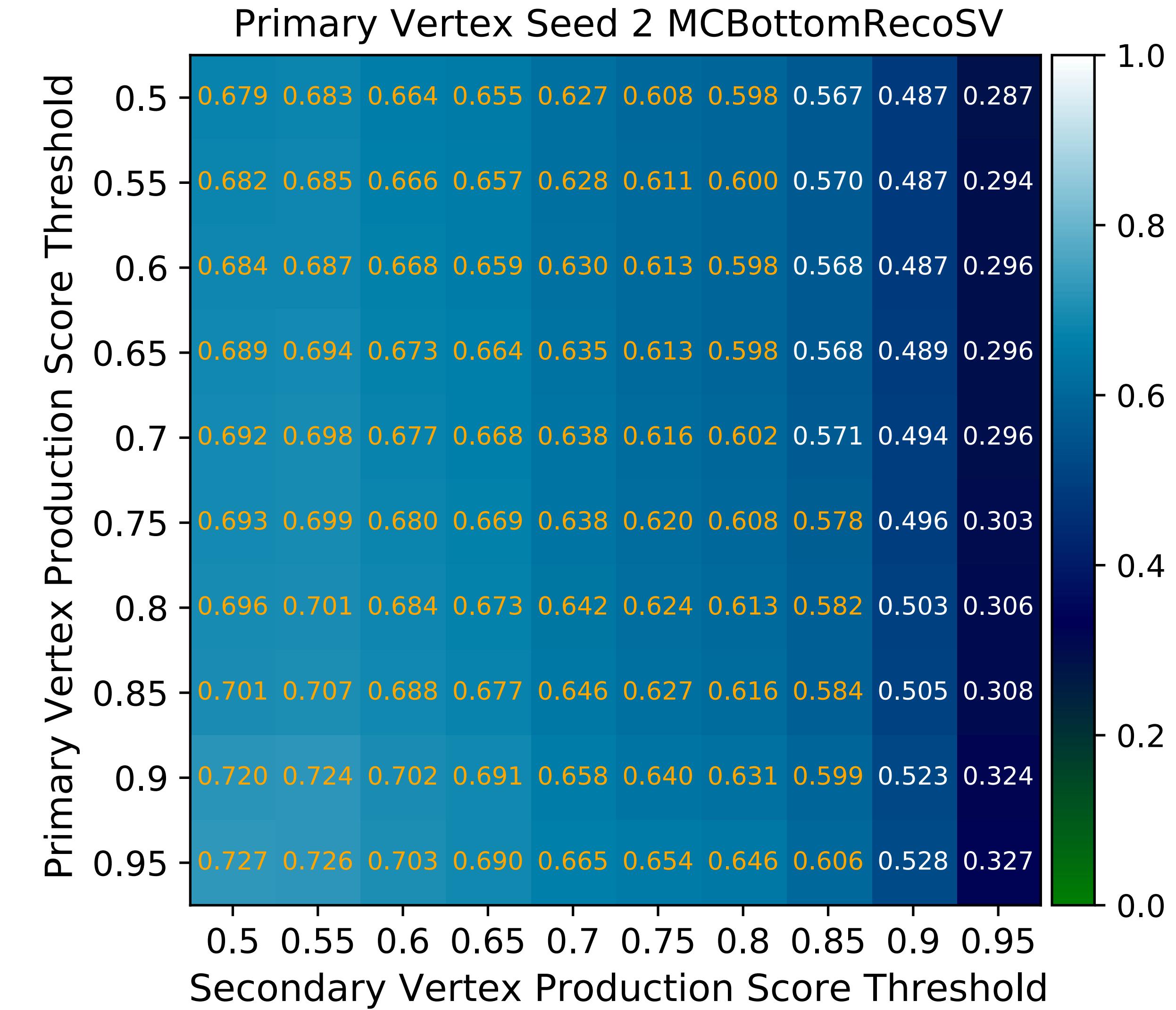


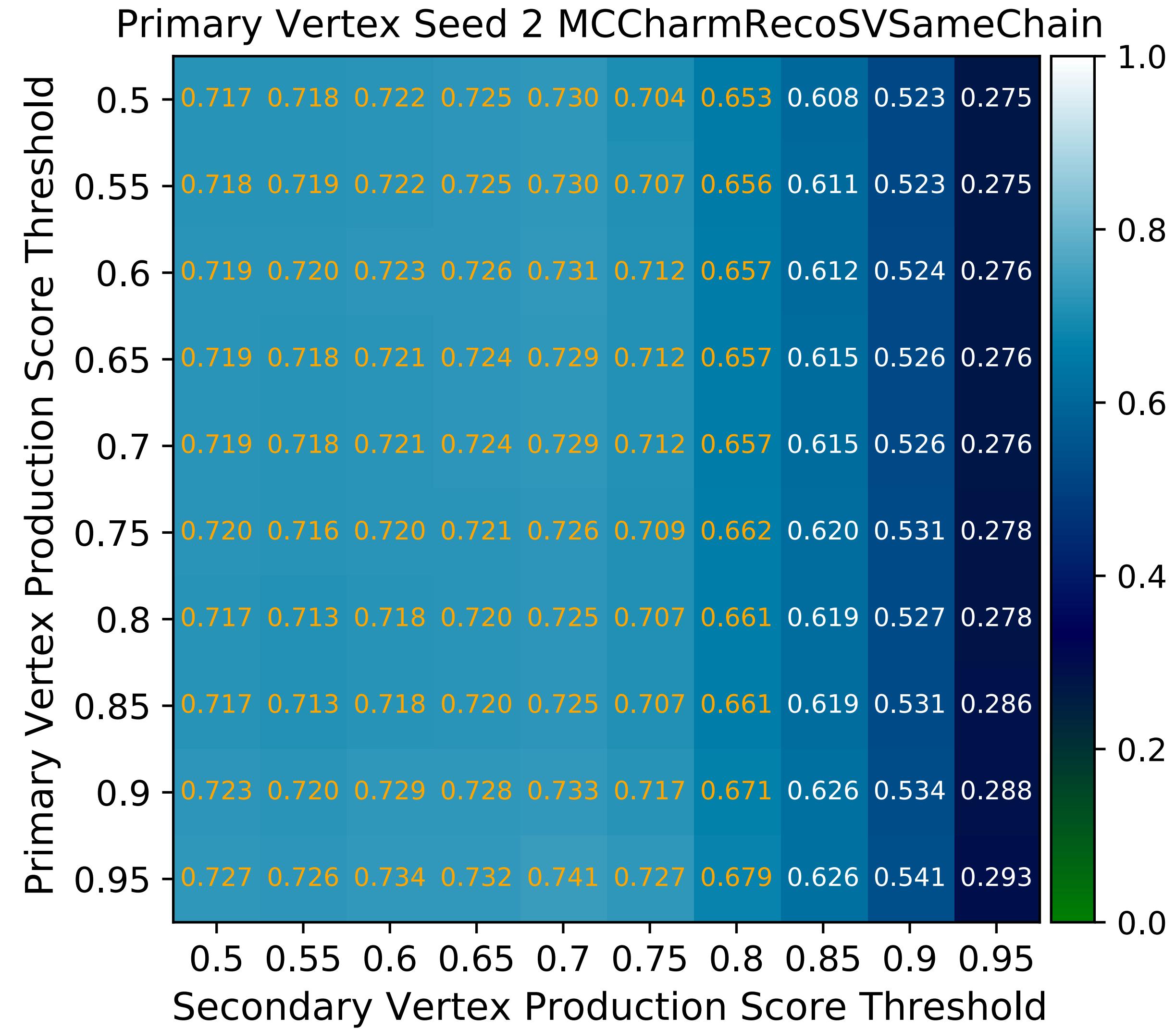
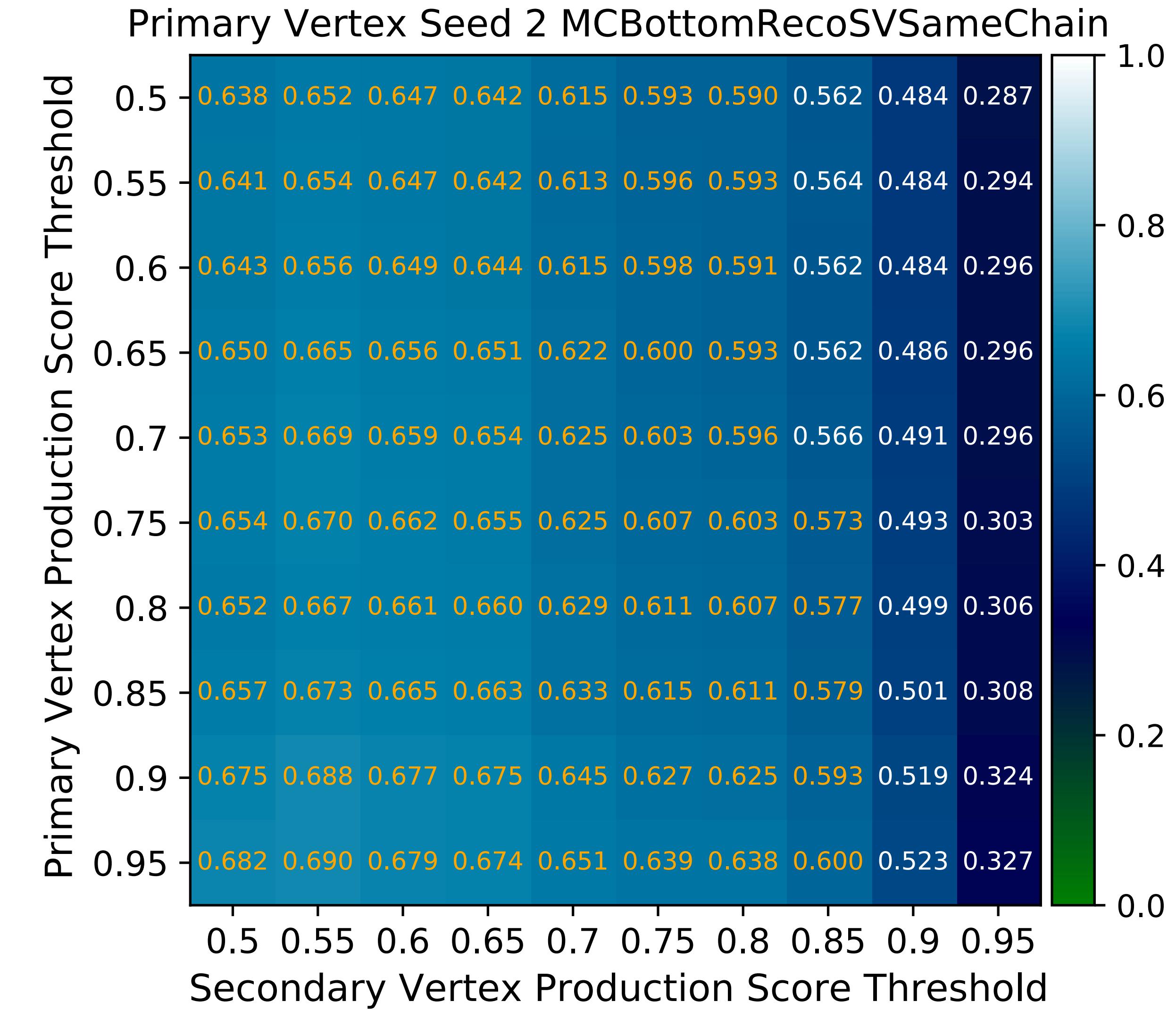


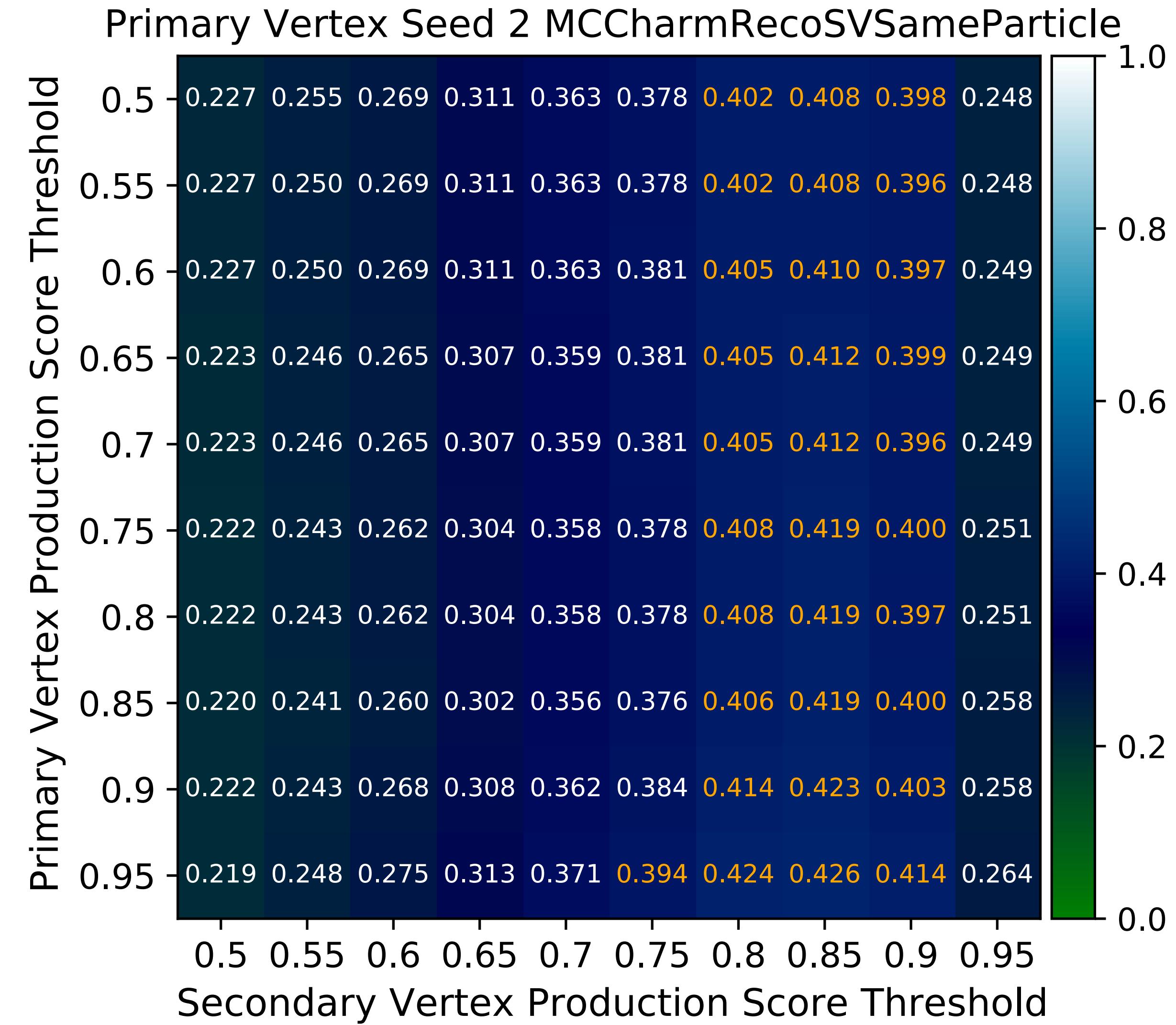
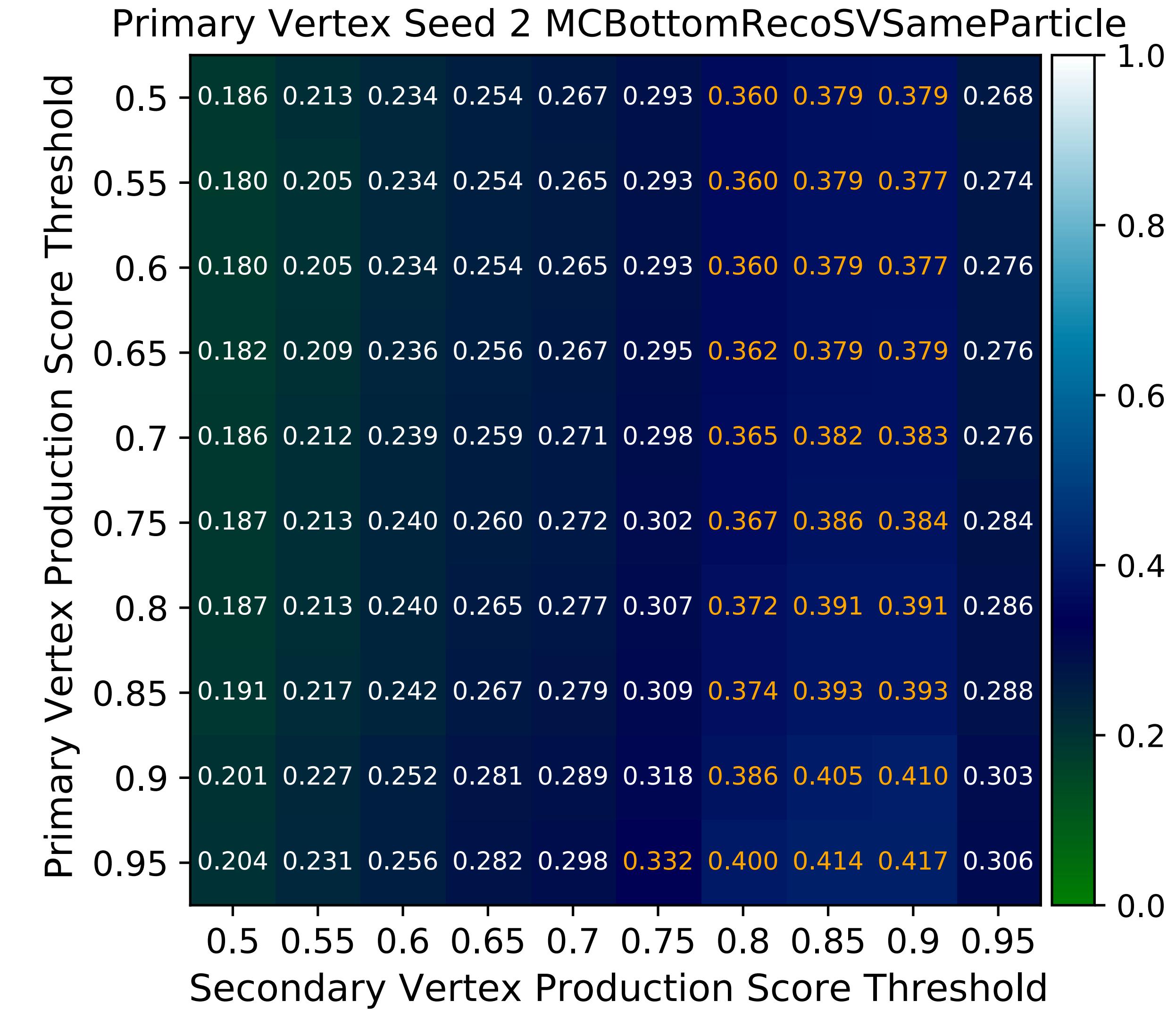




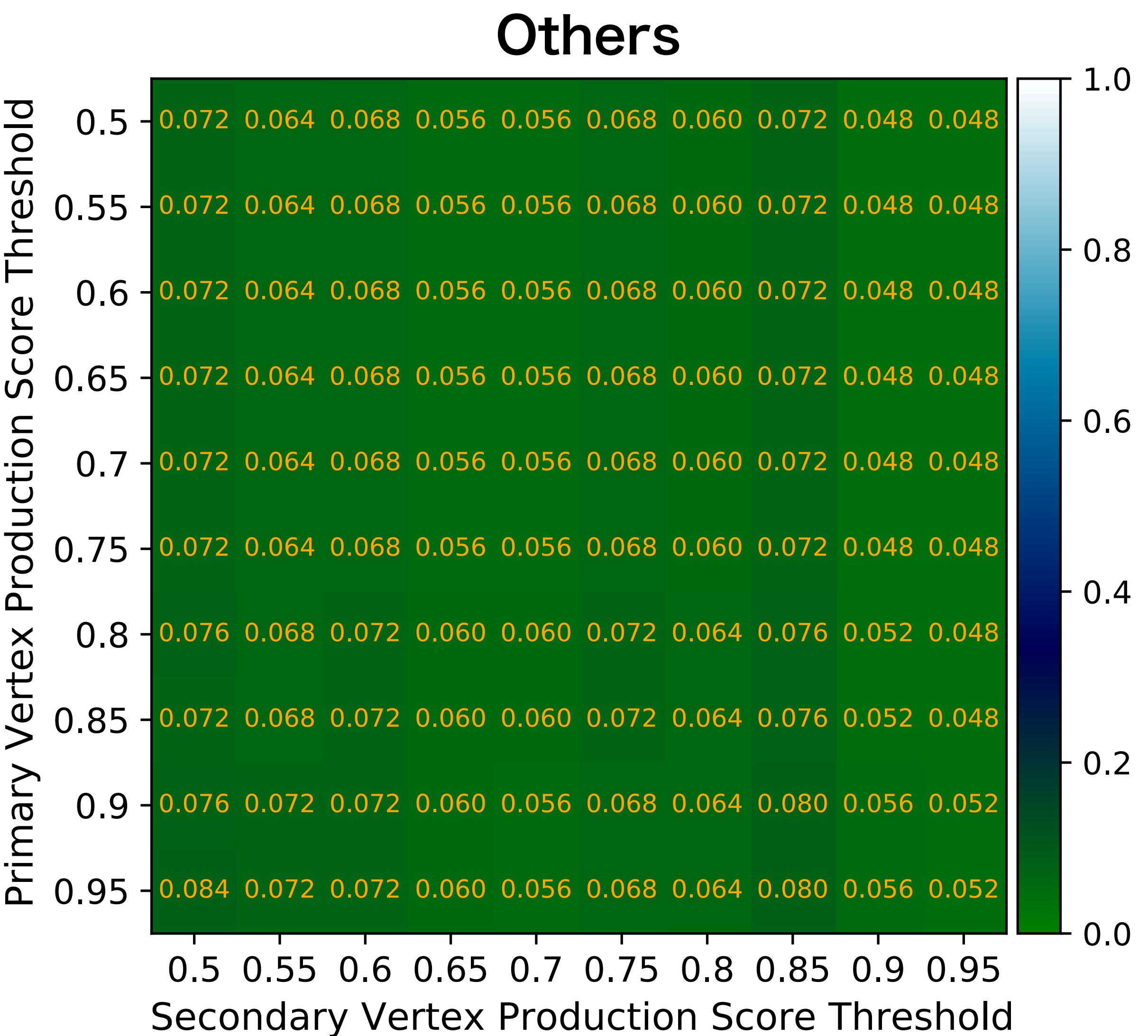
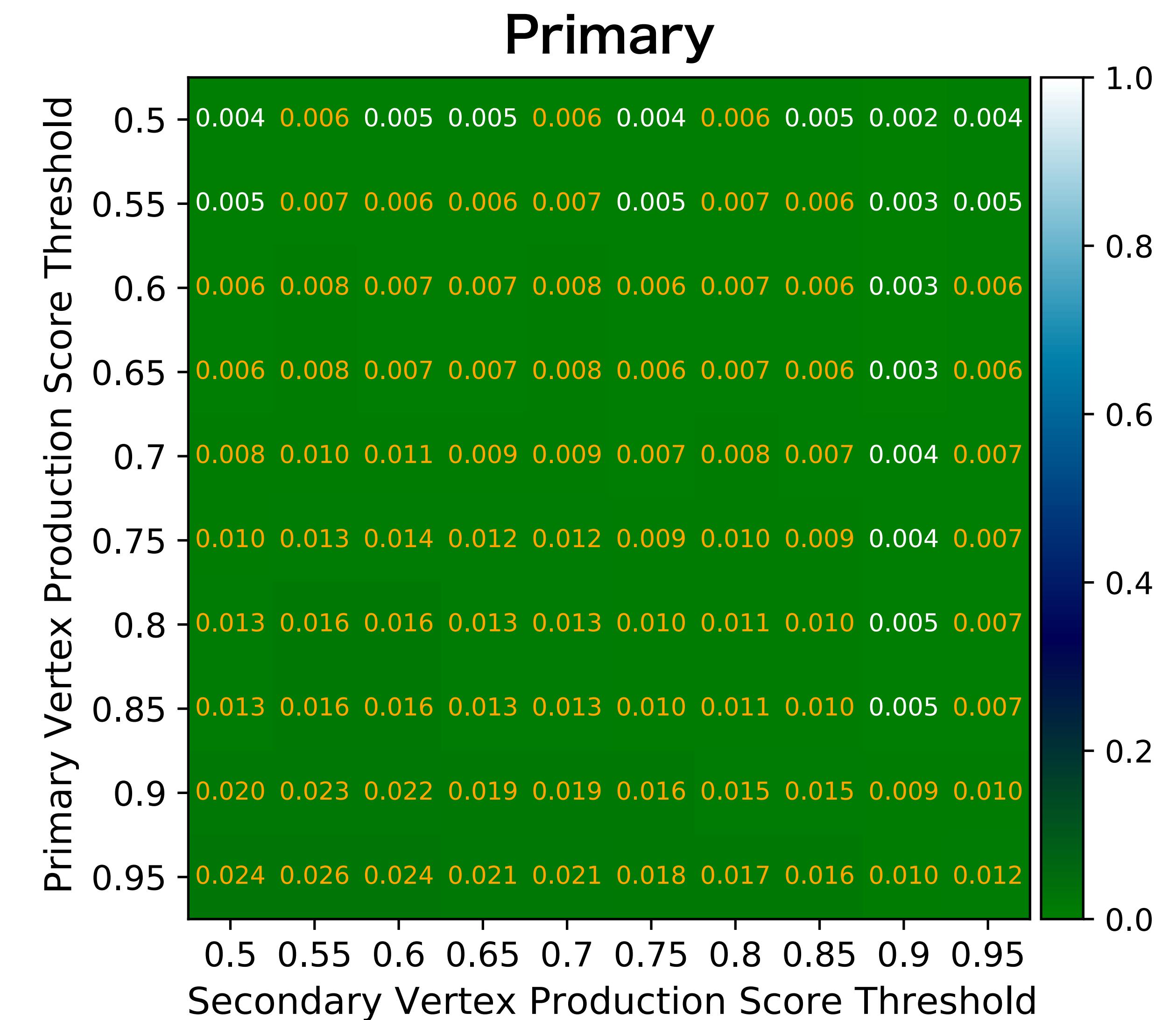




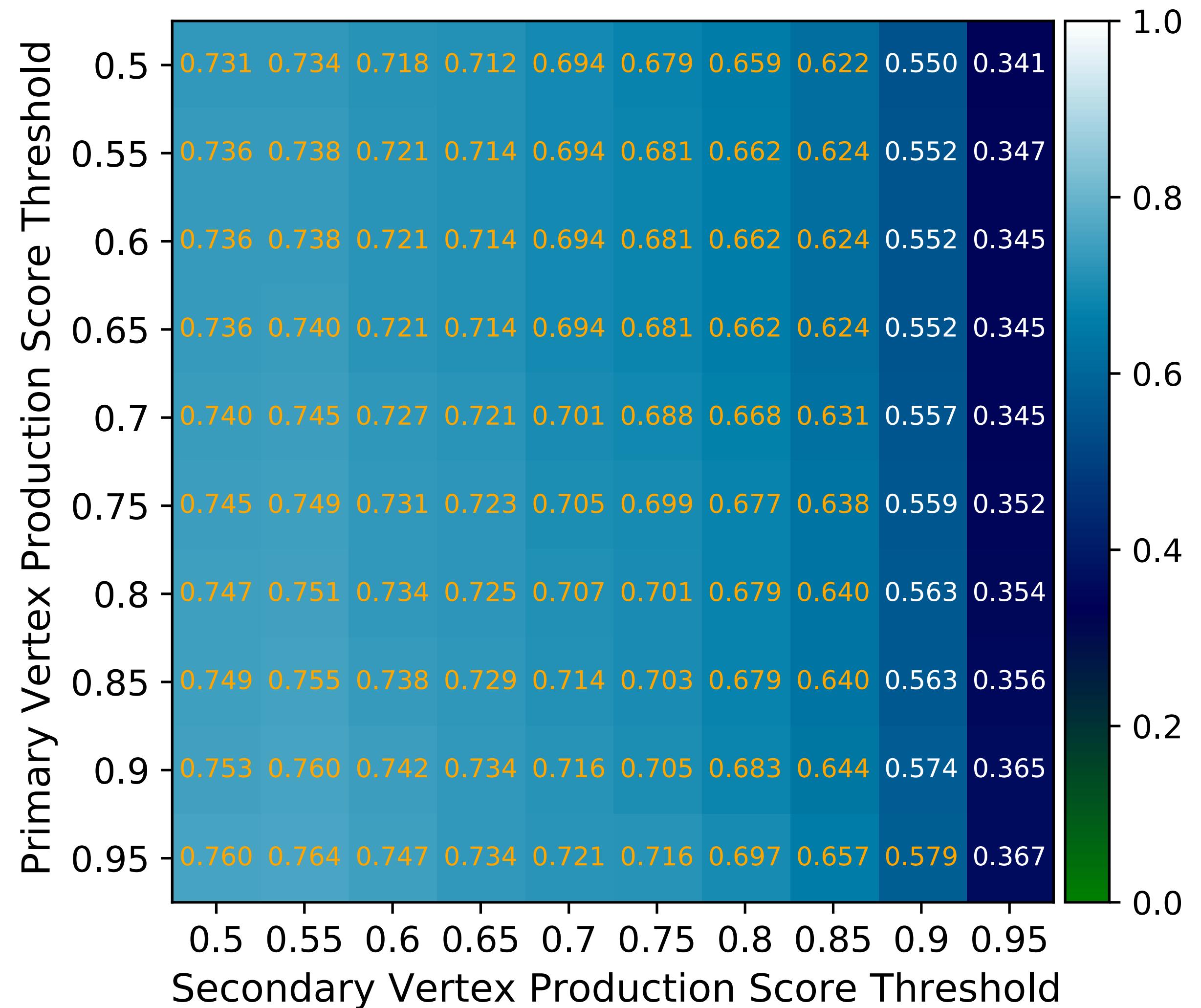




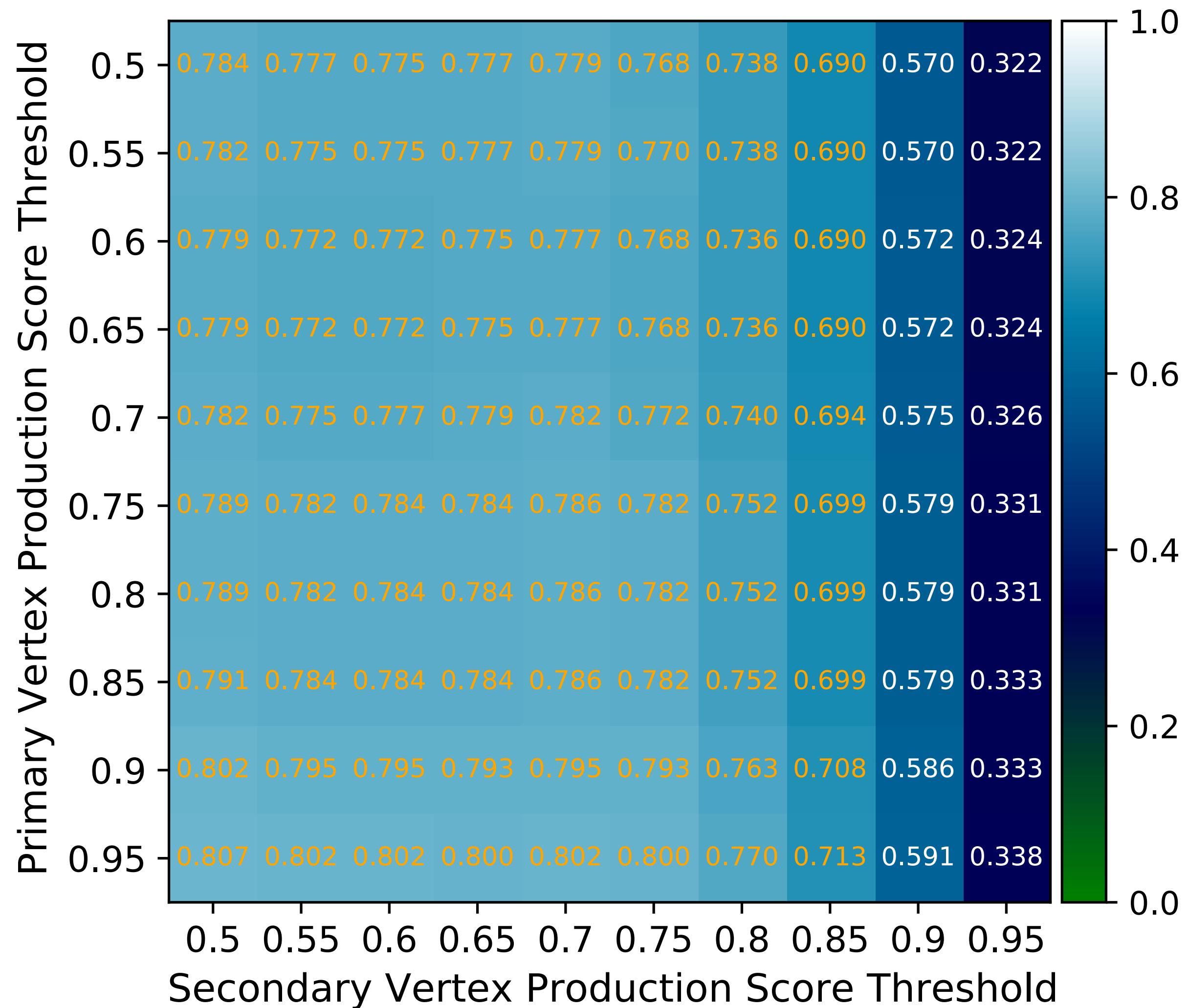
# **Track base**



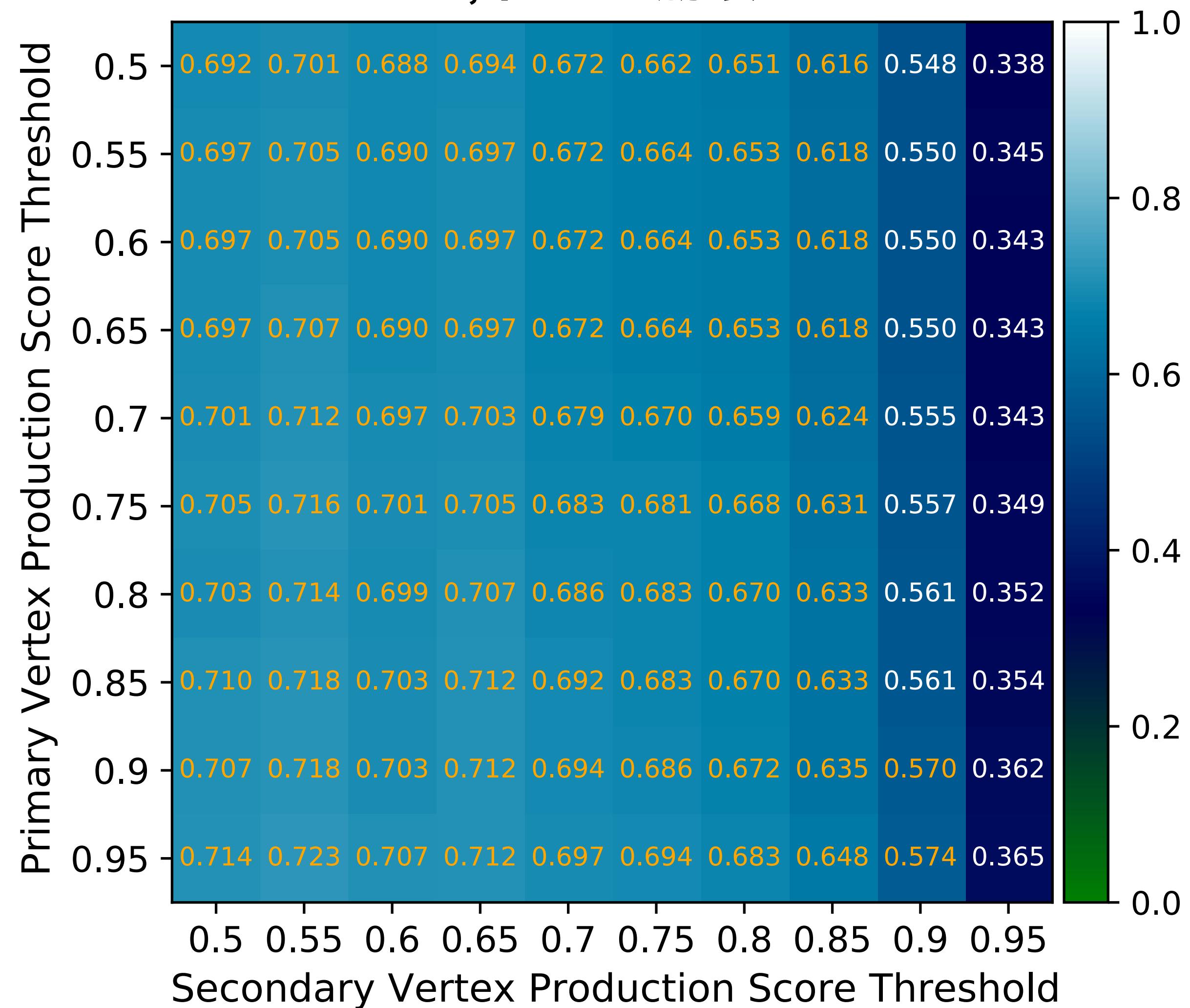
## Bottom



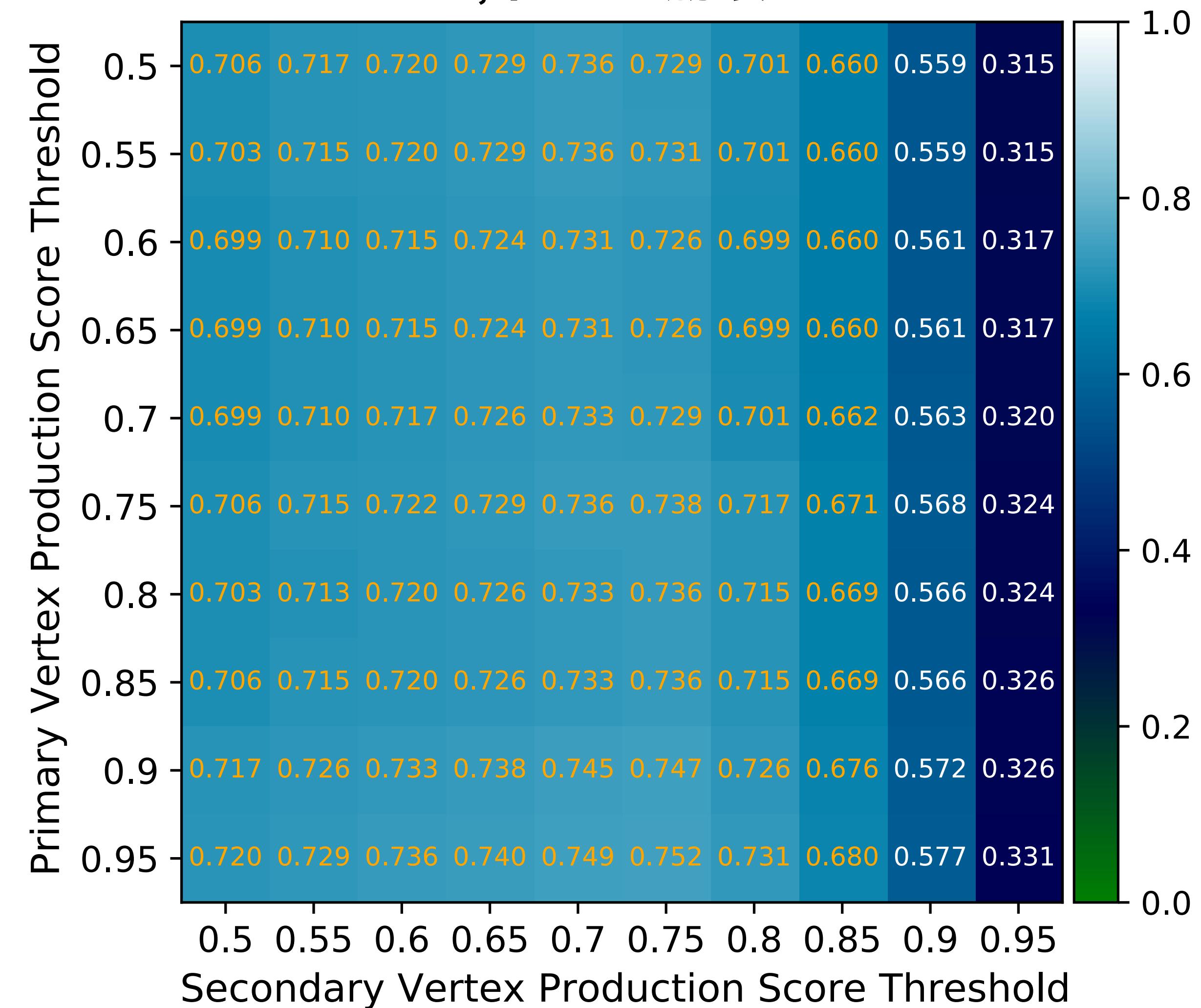
## Charm



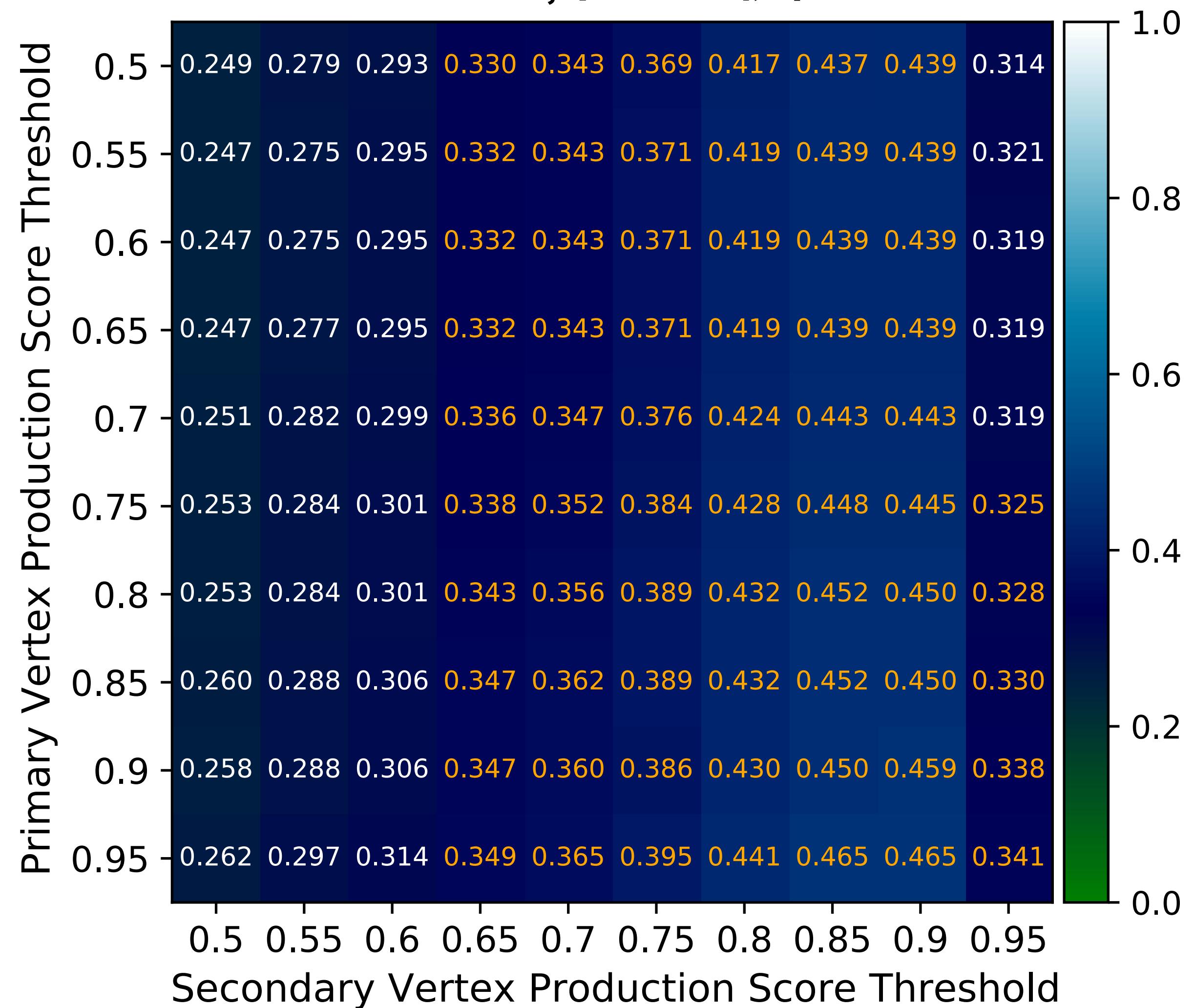
Bottom, 同一の崩壊チェイン



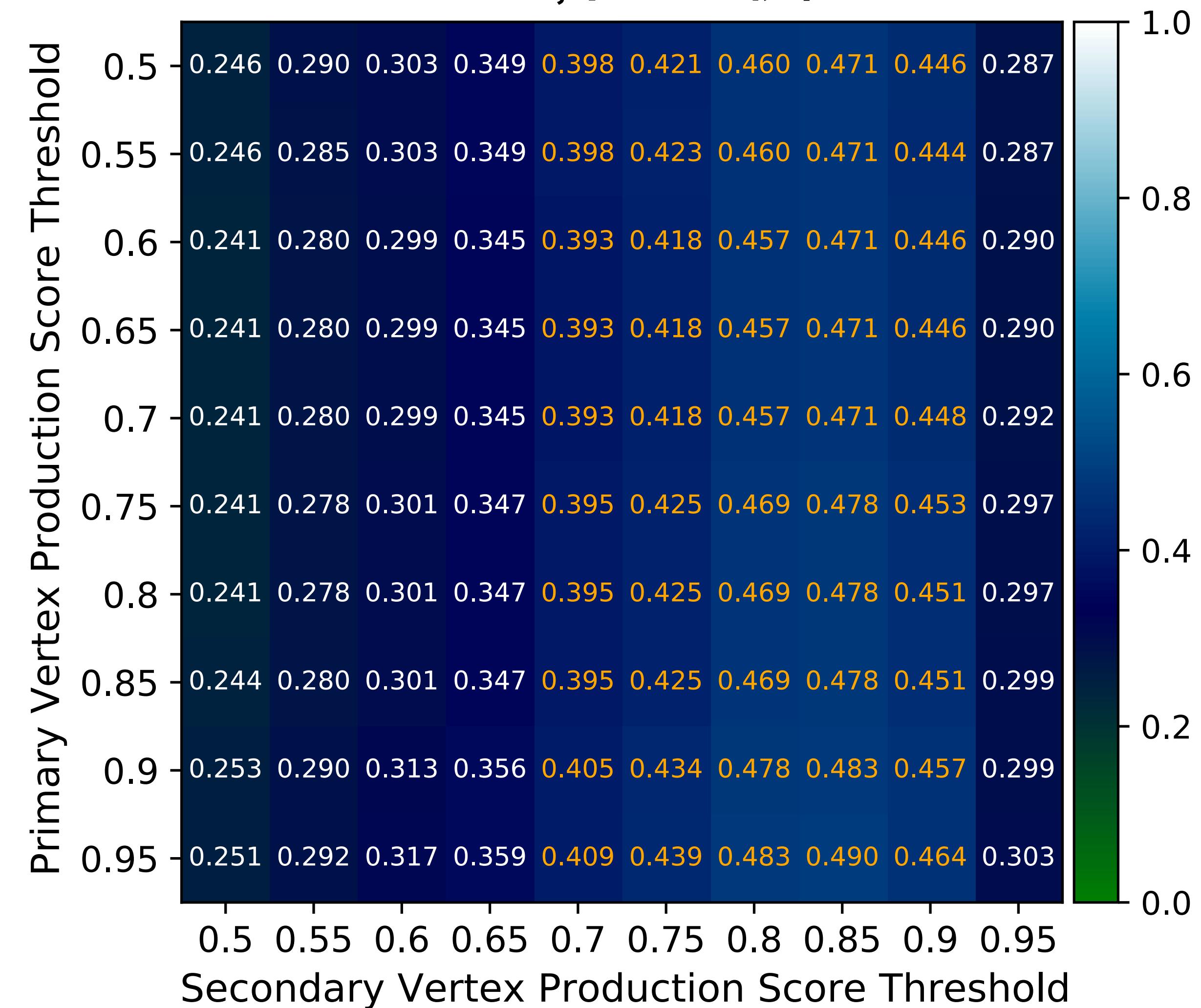
Charm, 同一の崩壊チェイン

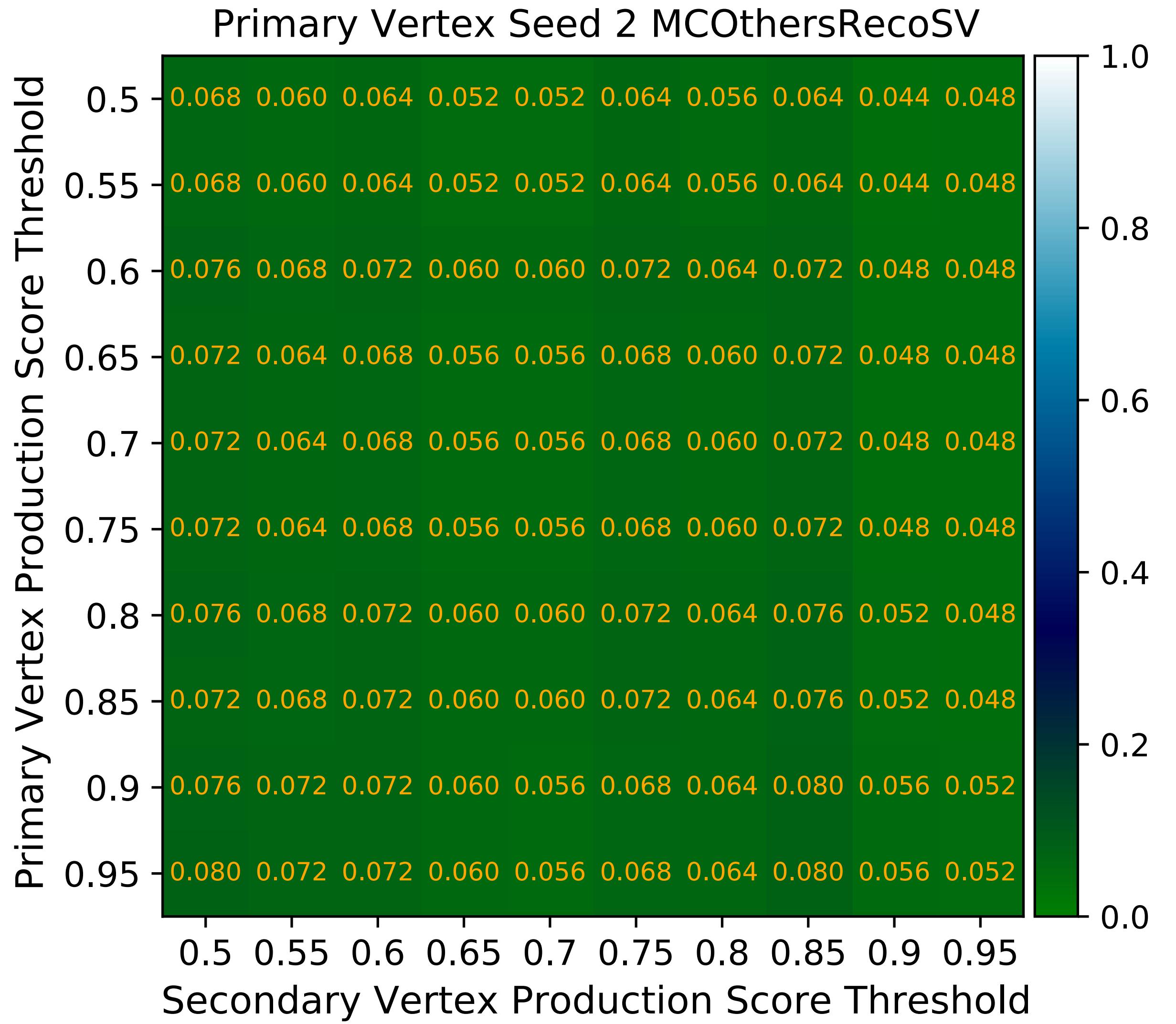
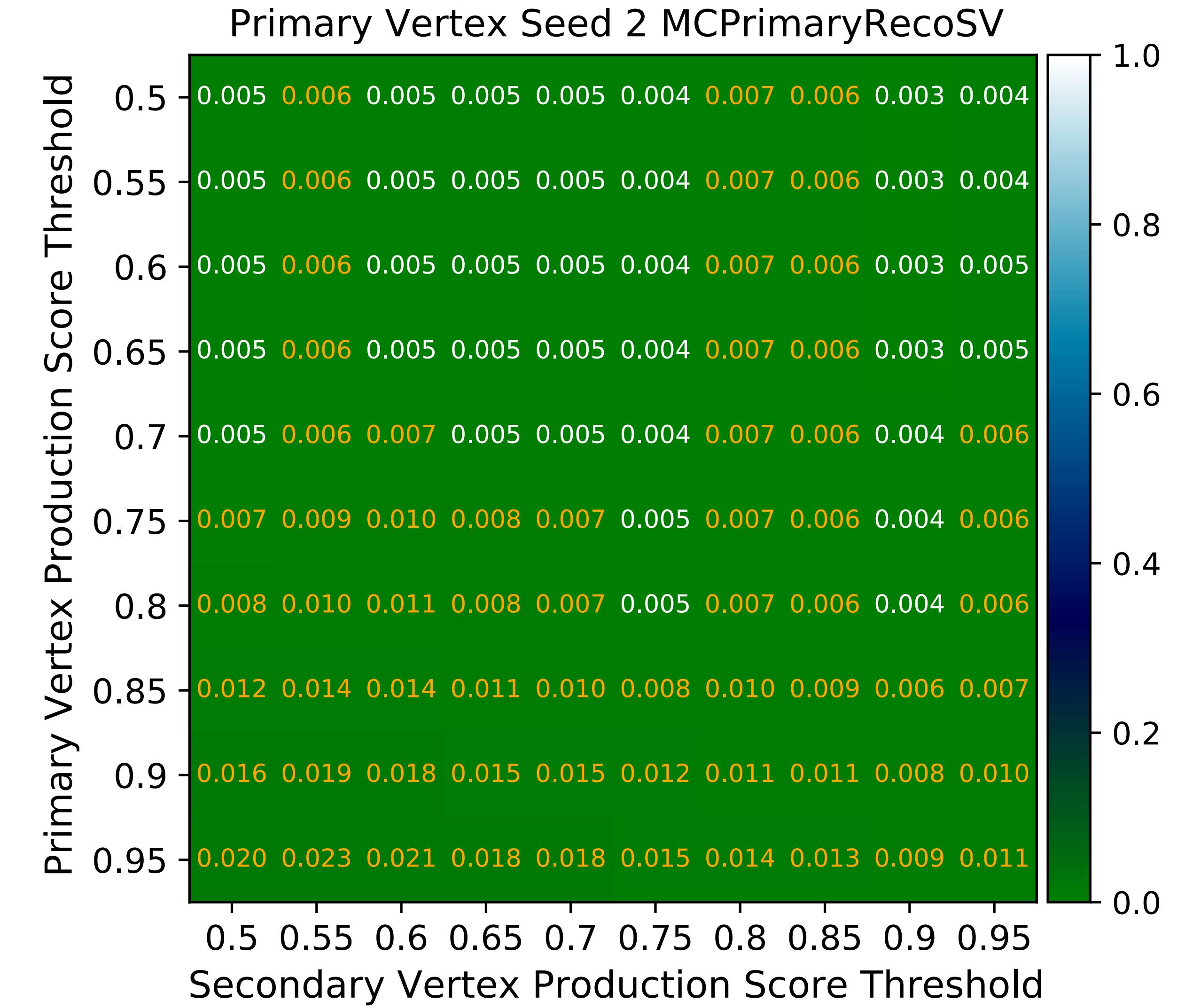


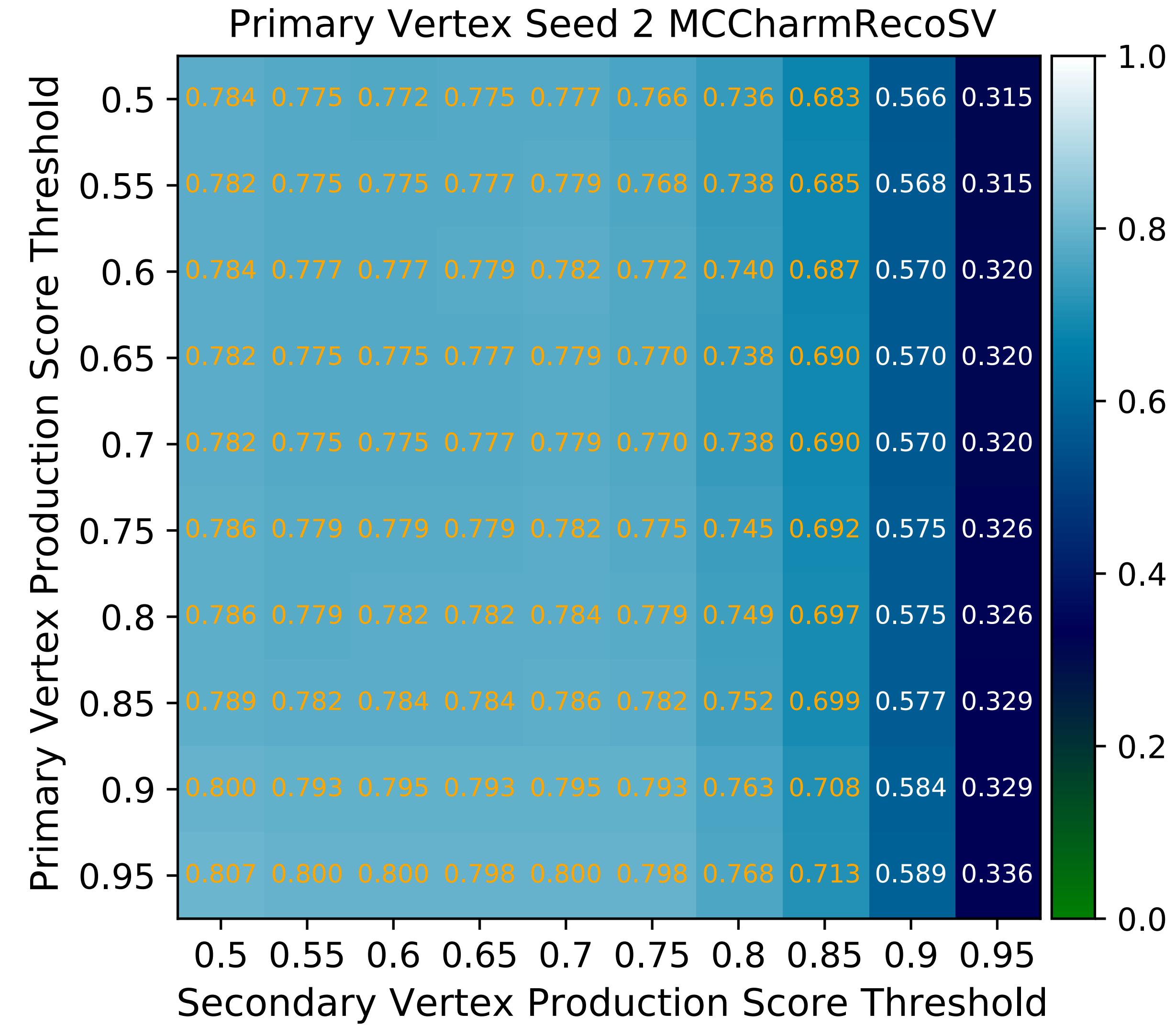
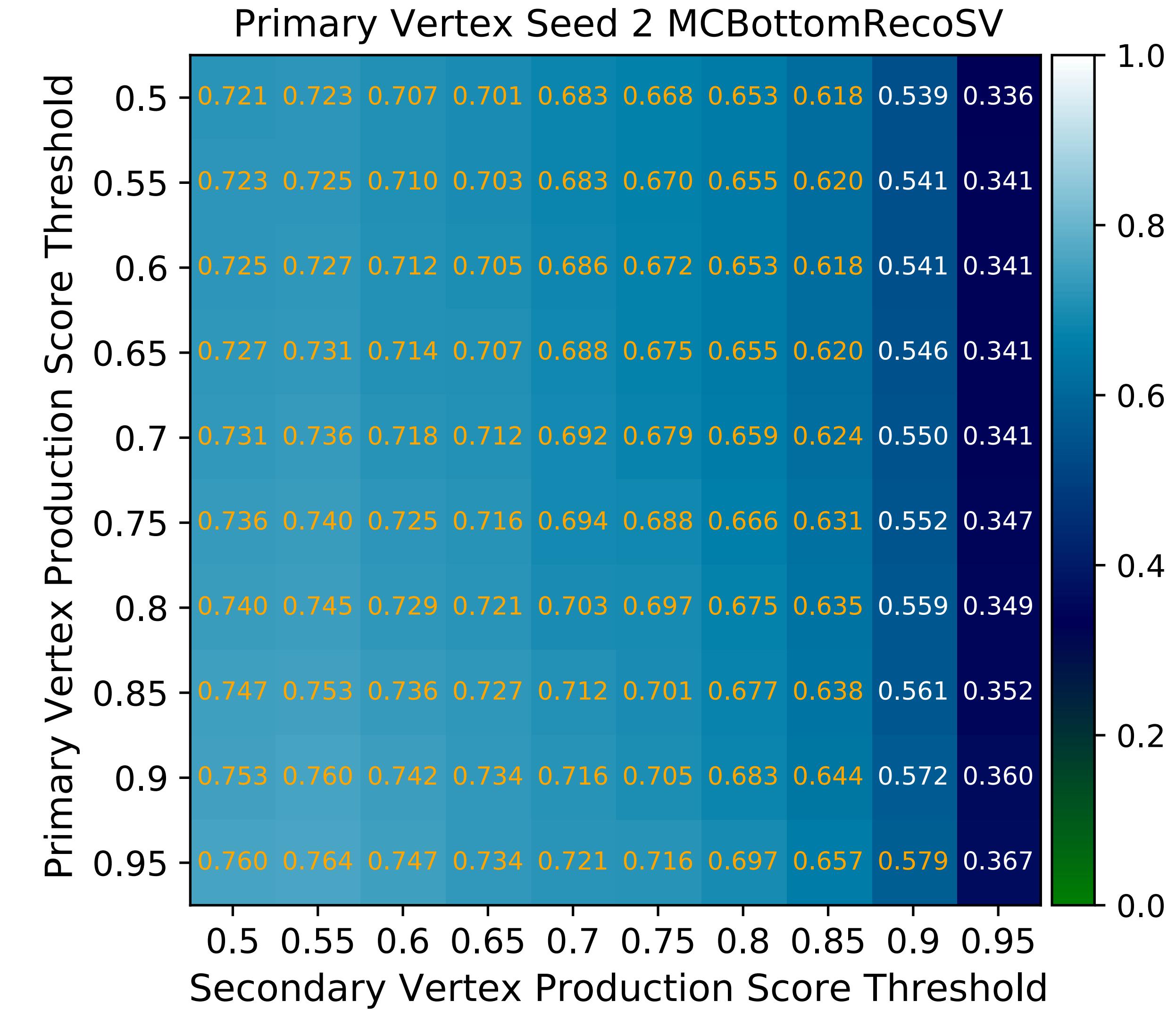
Bottom, 同一の親粒子

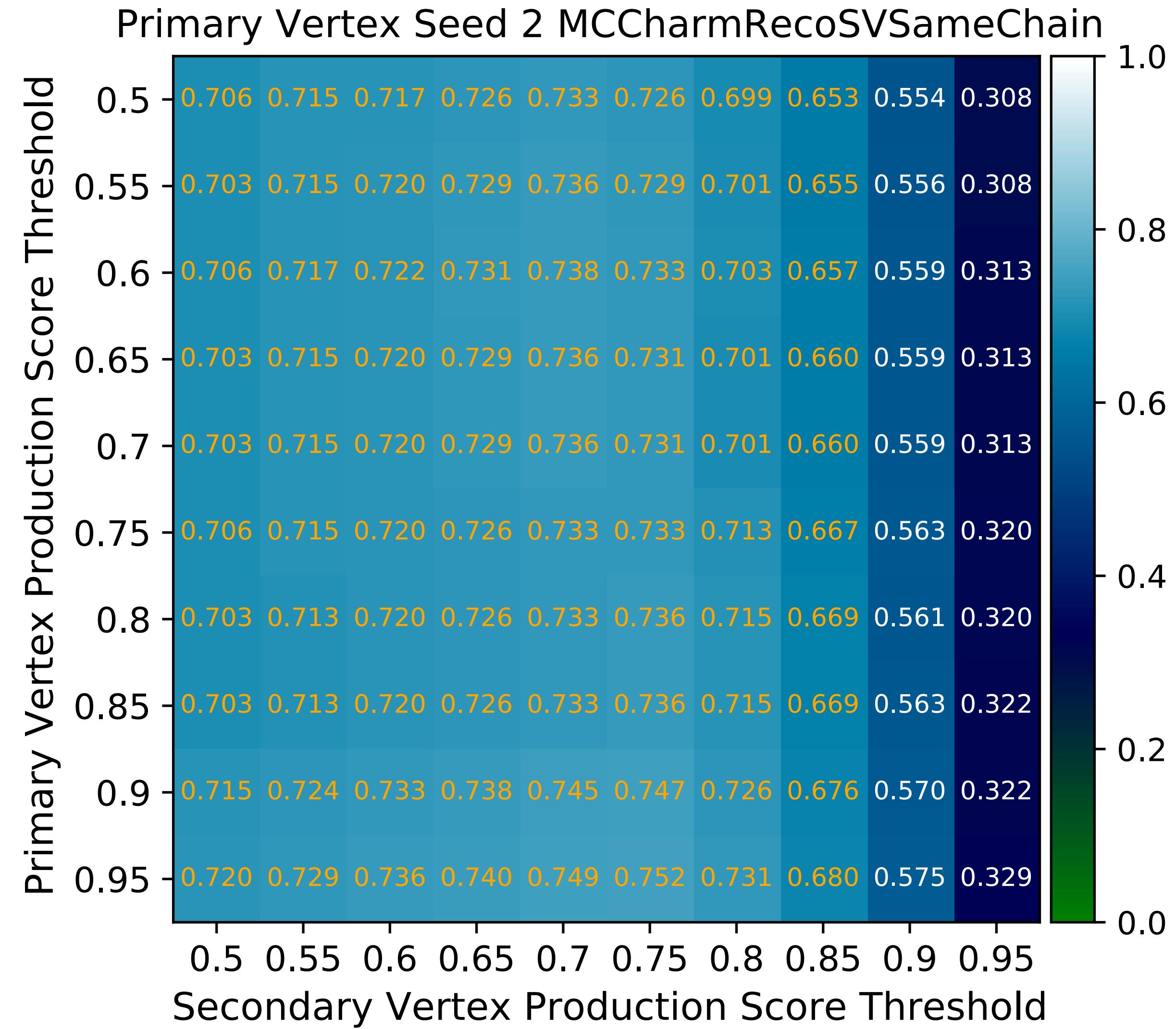
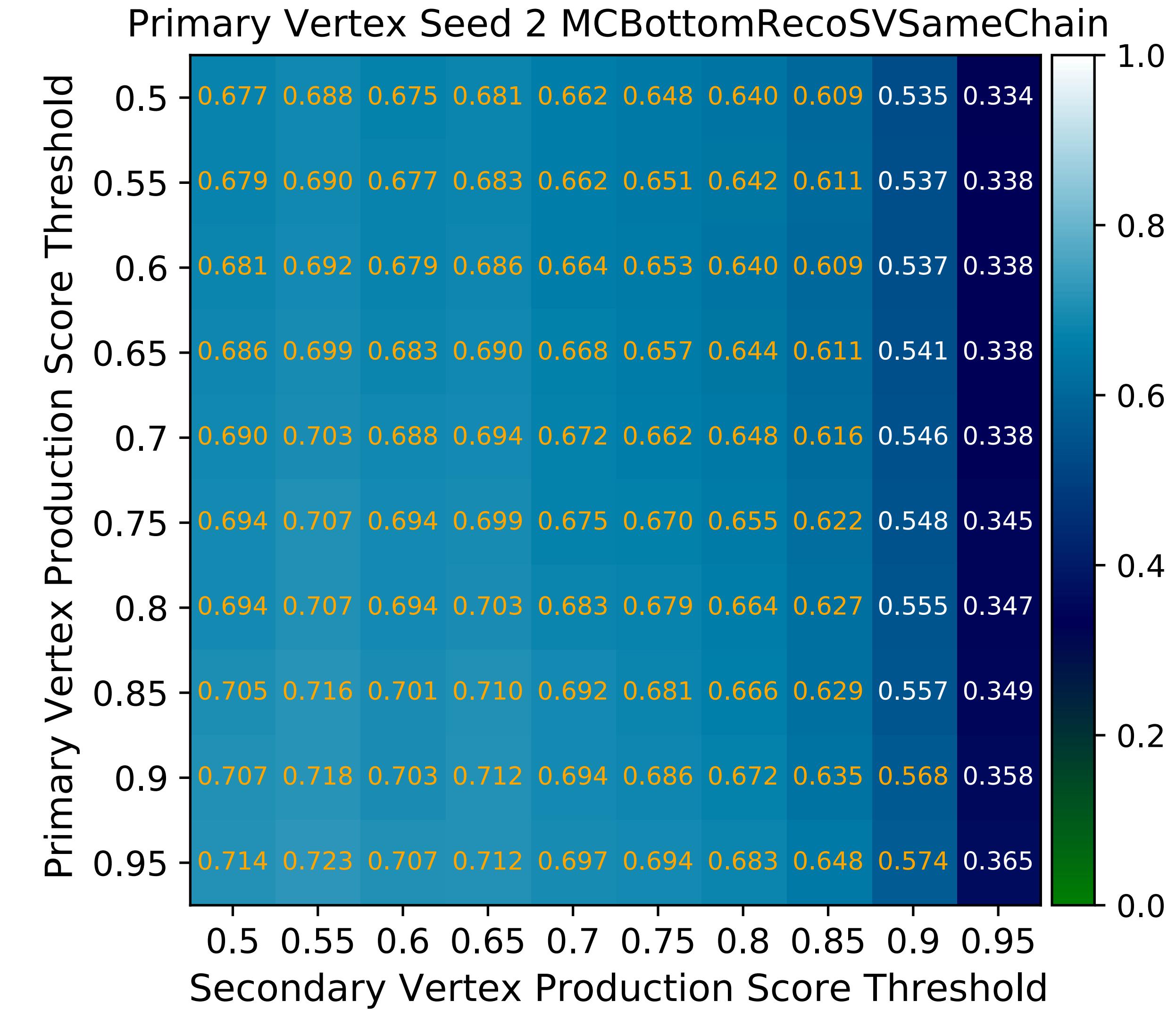


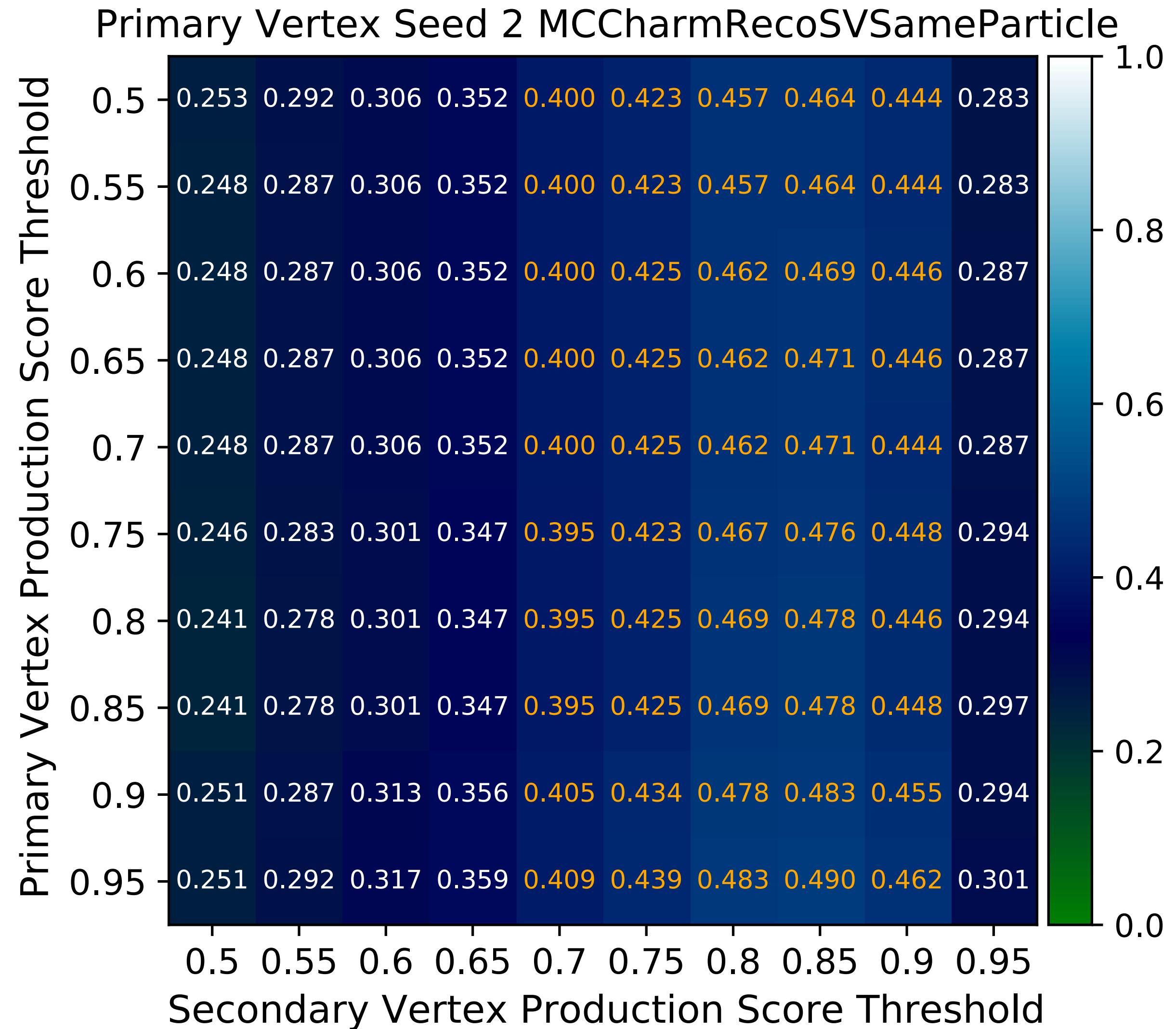
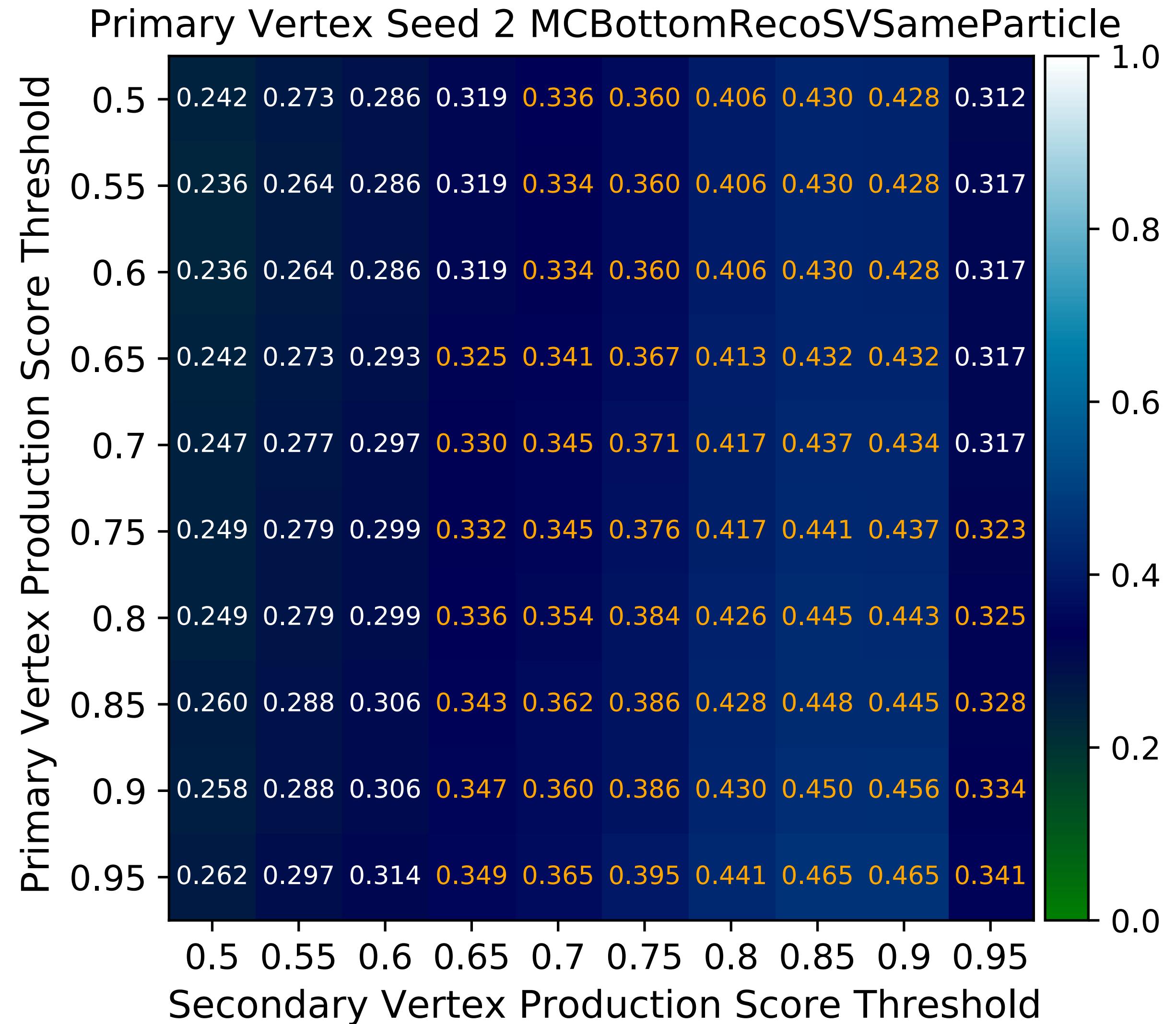
Charm, 同一の親粒子

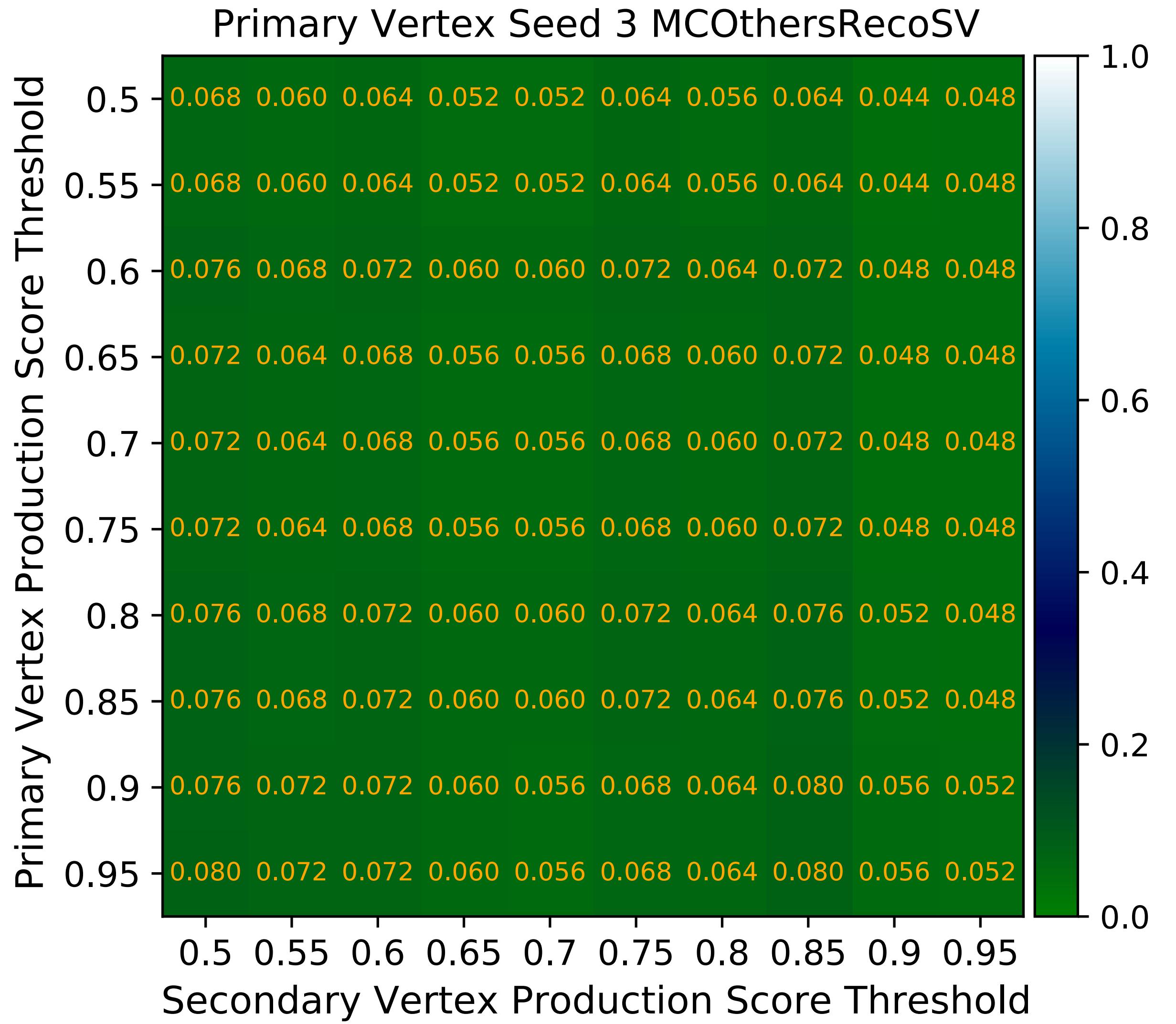
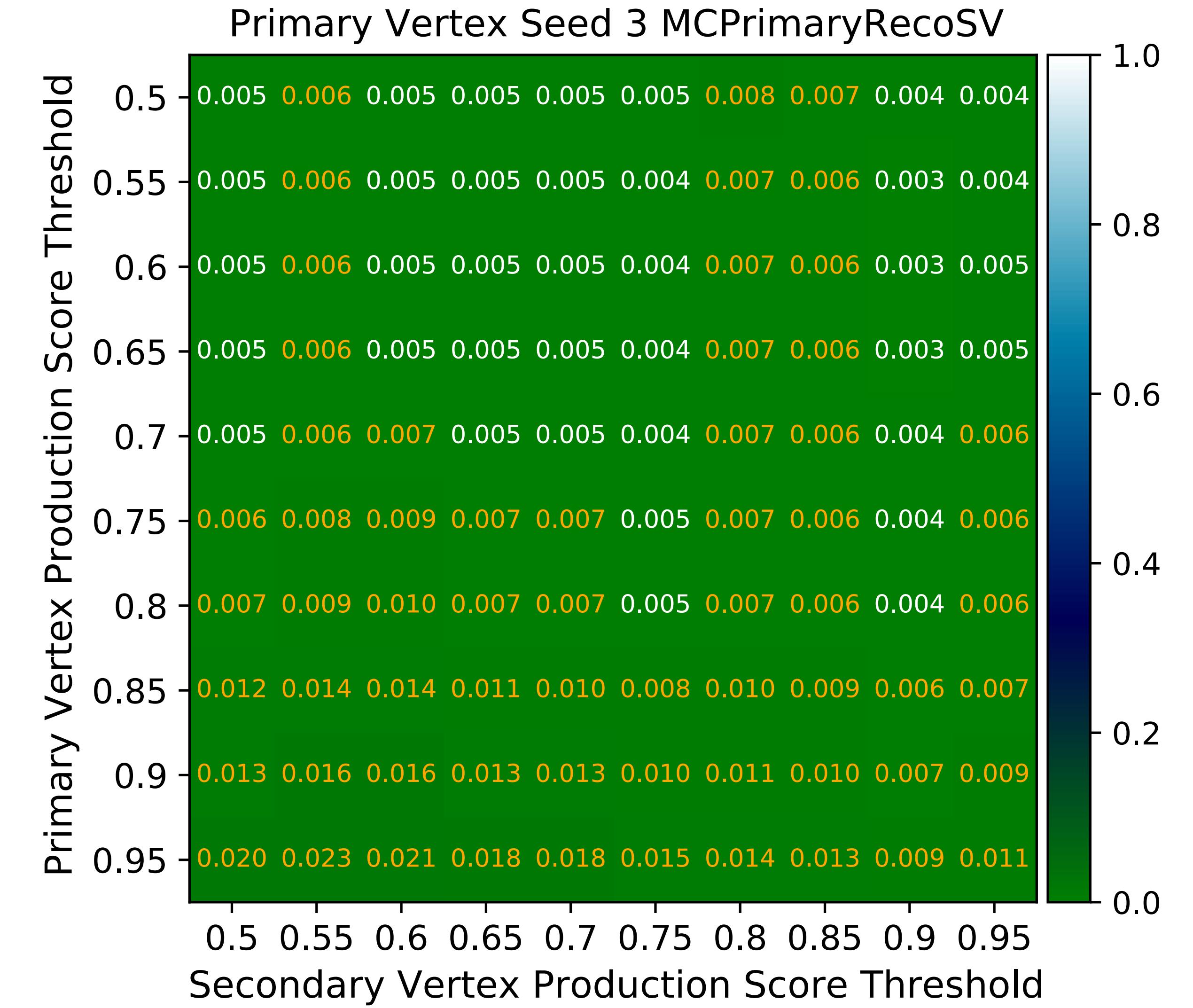


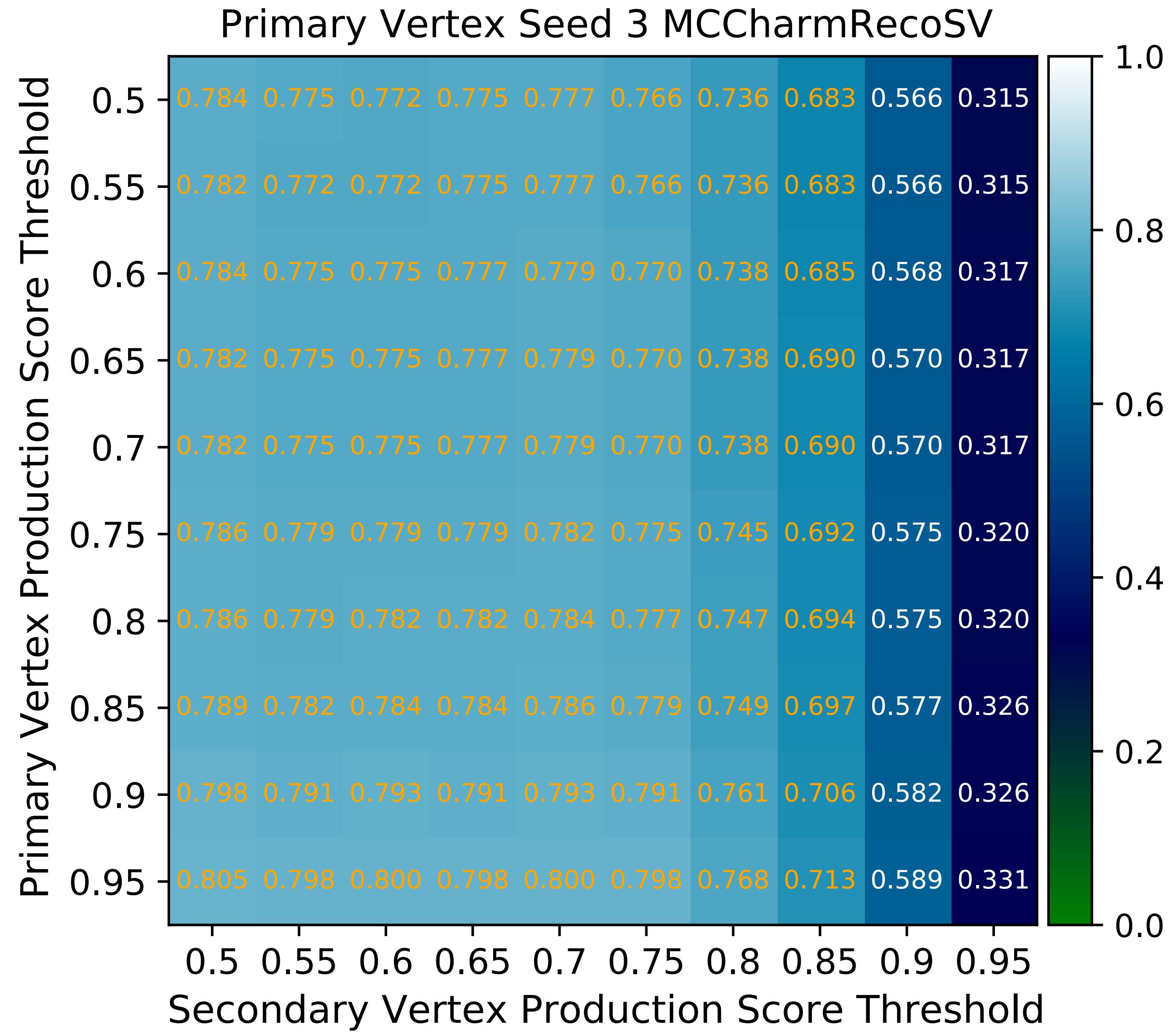
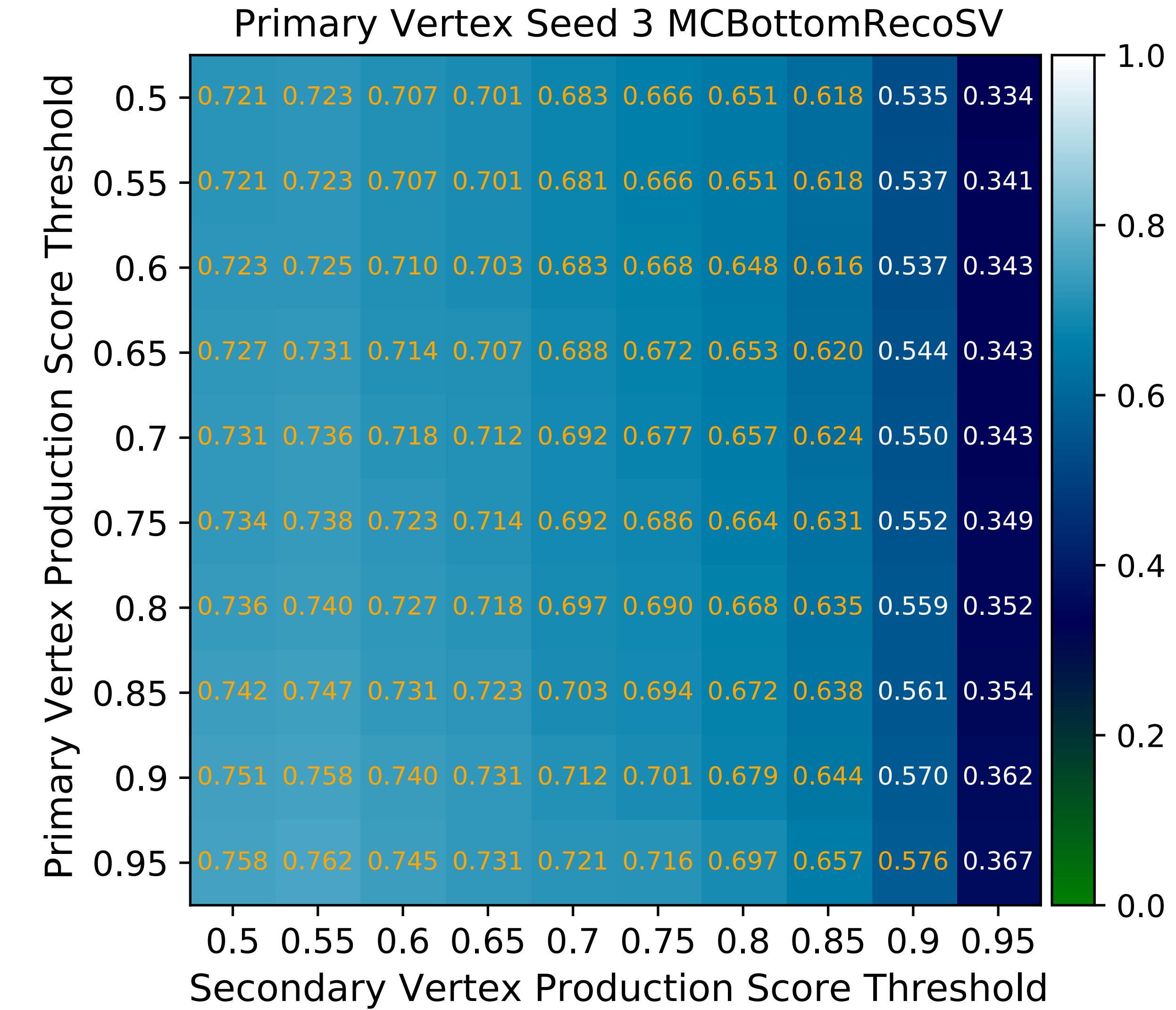


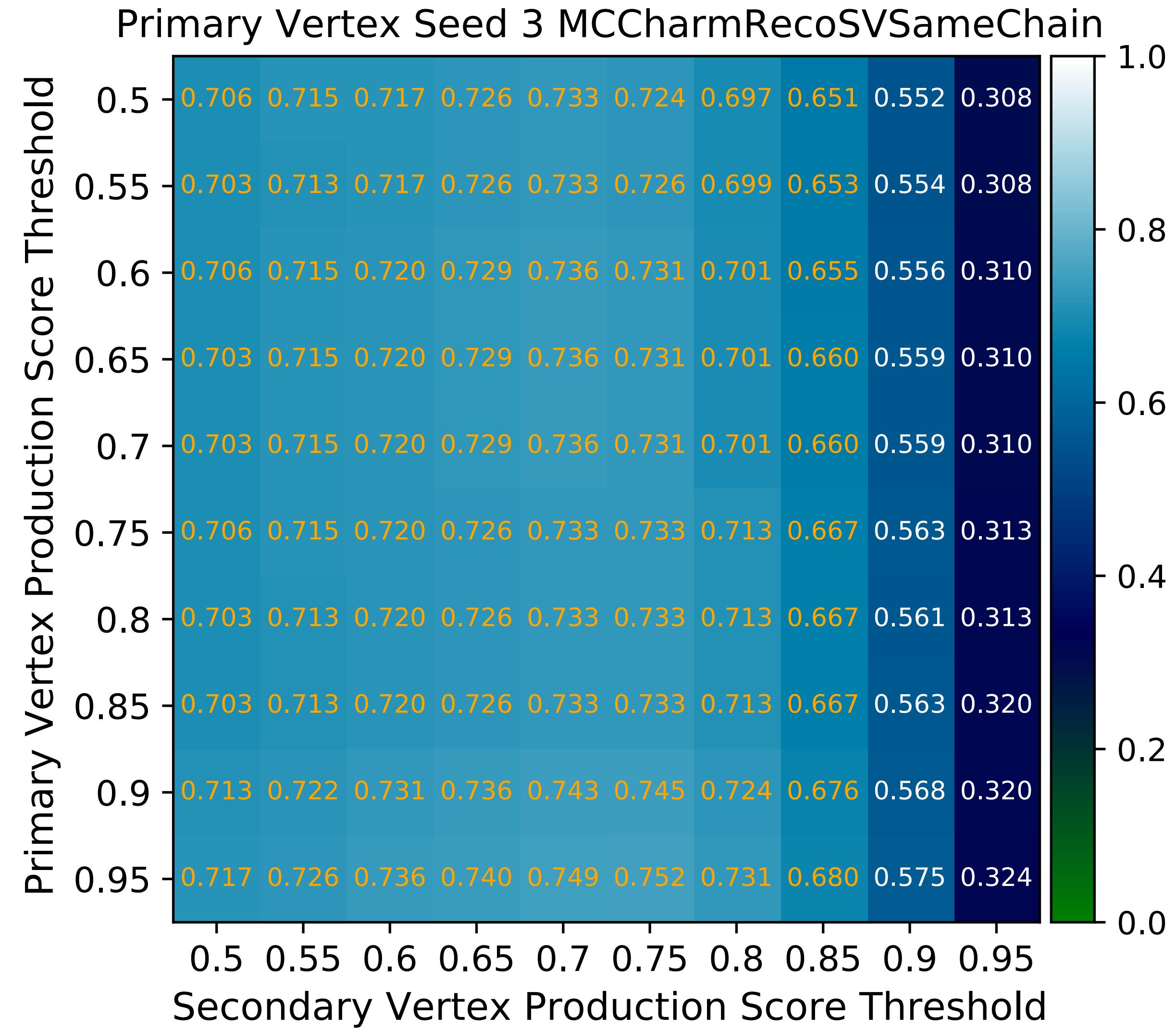
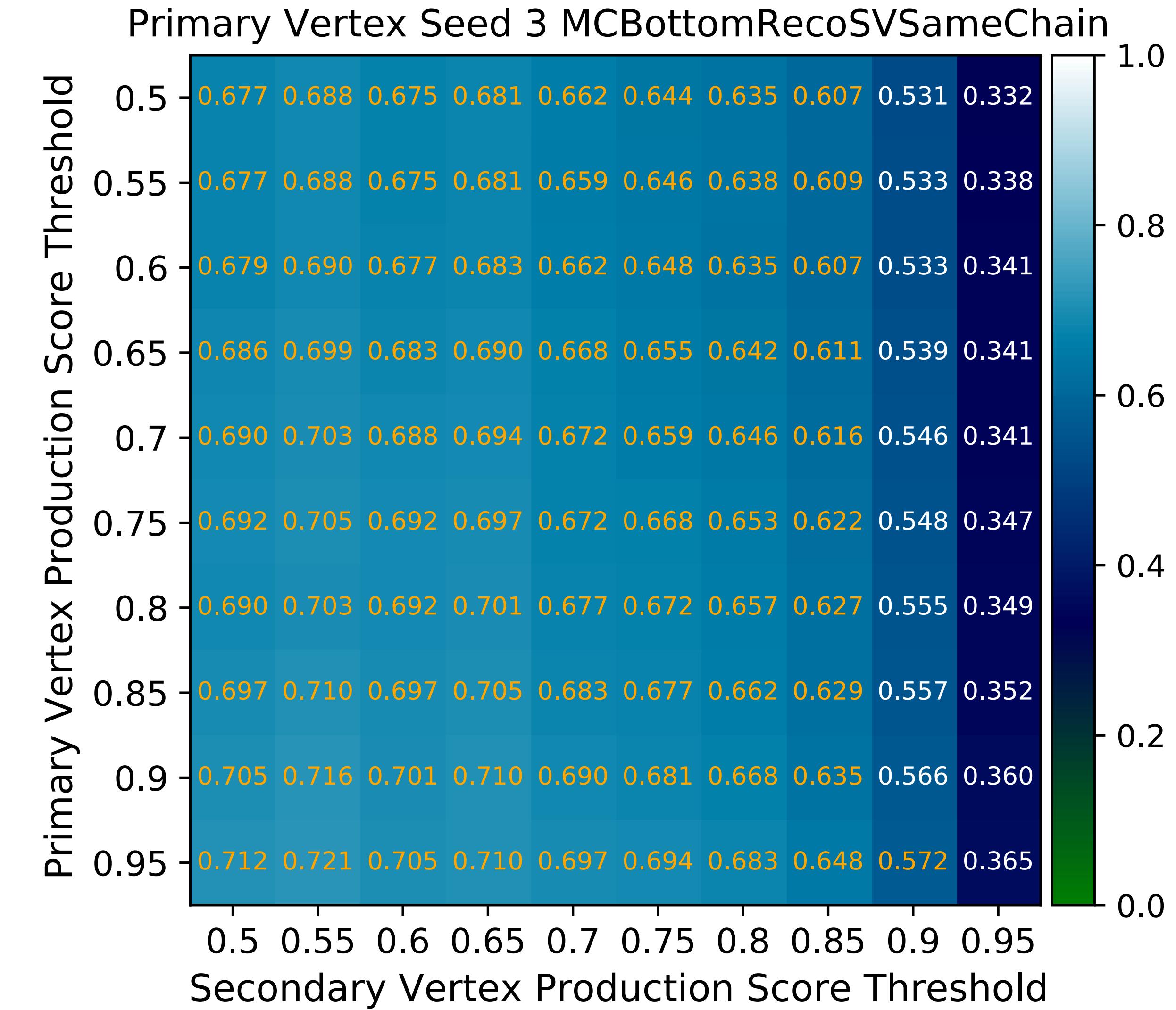


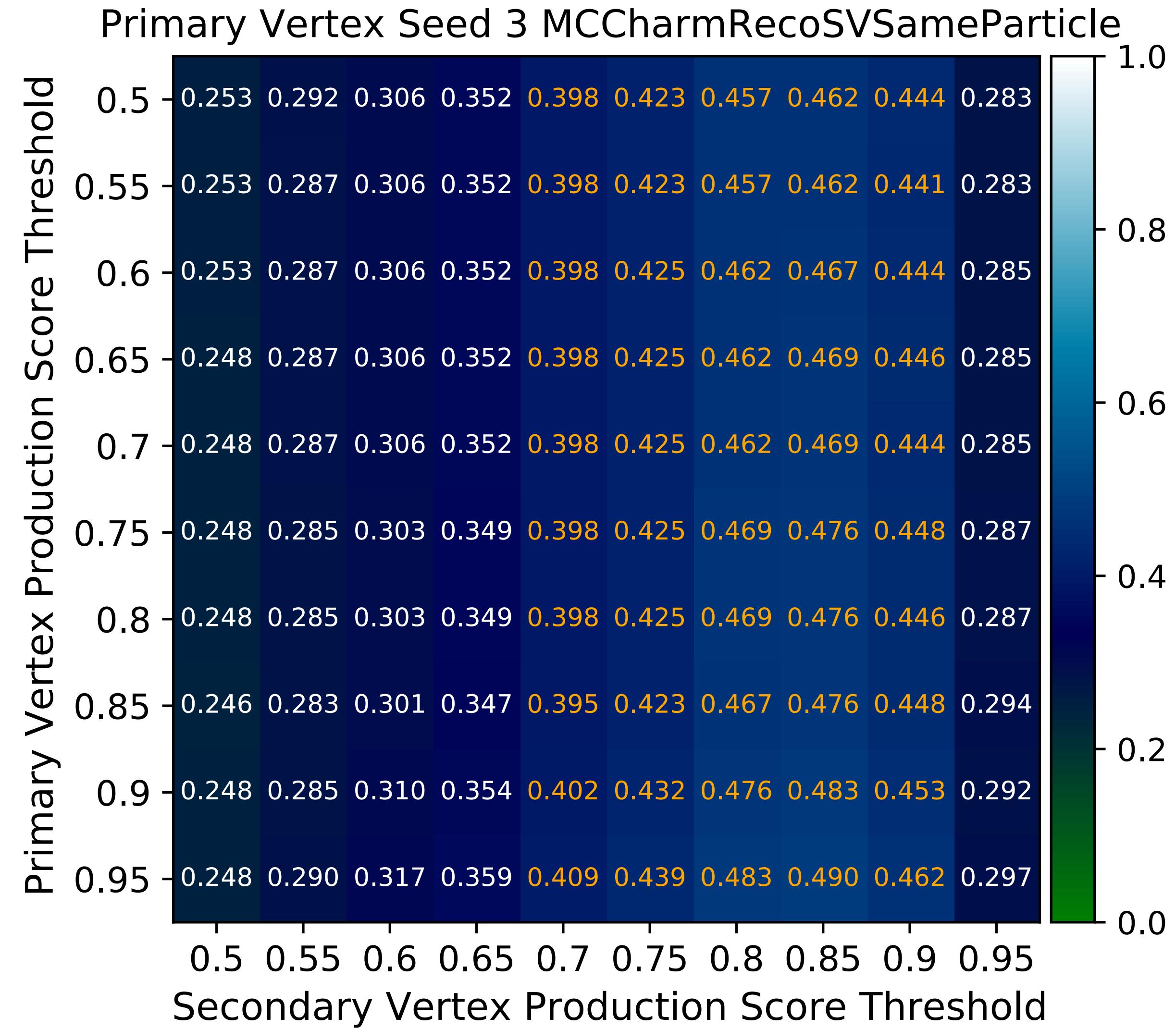
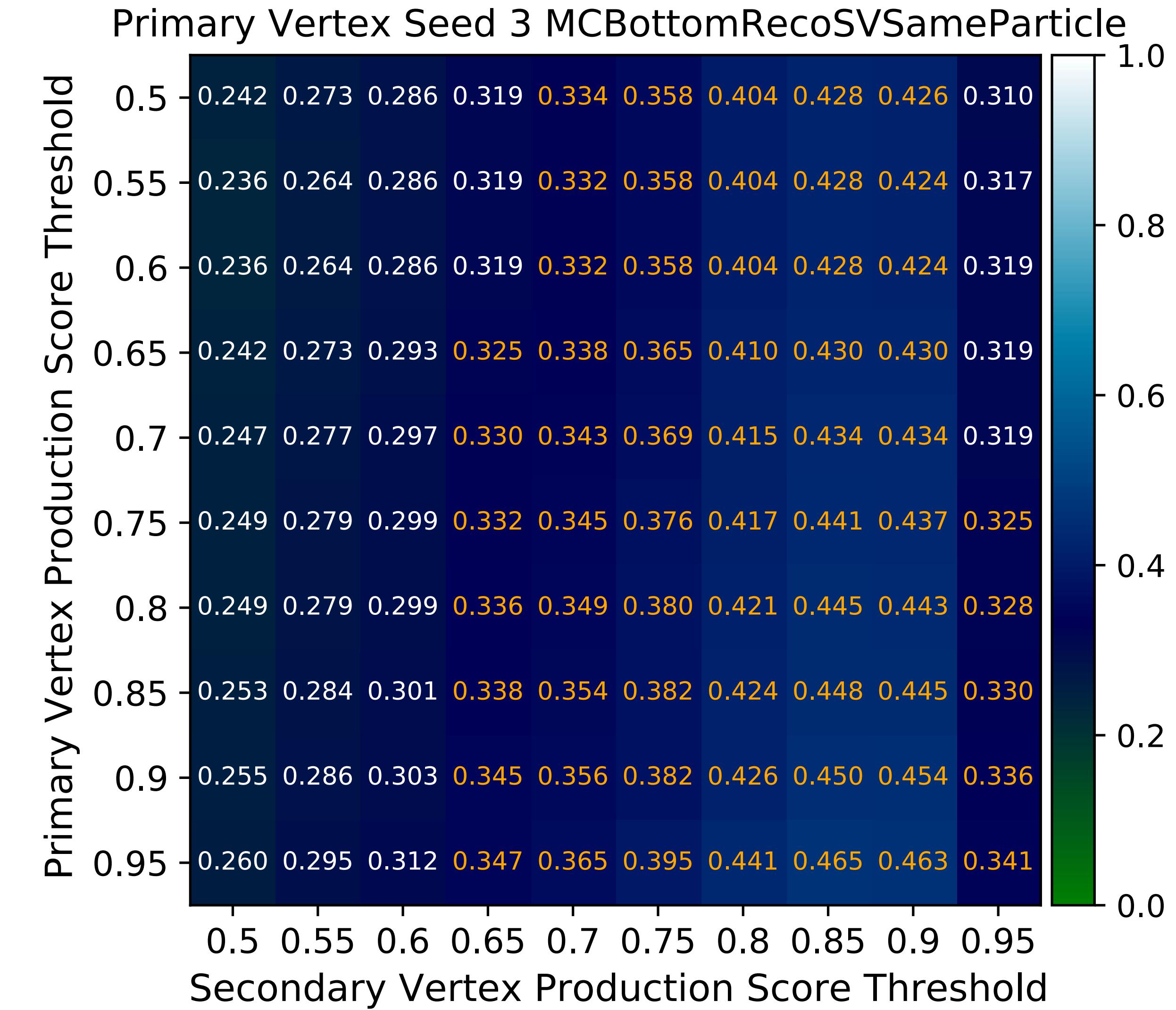




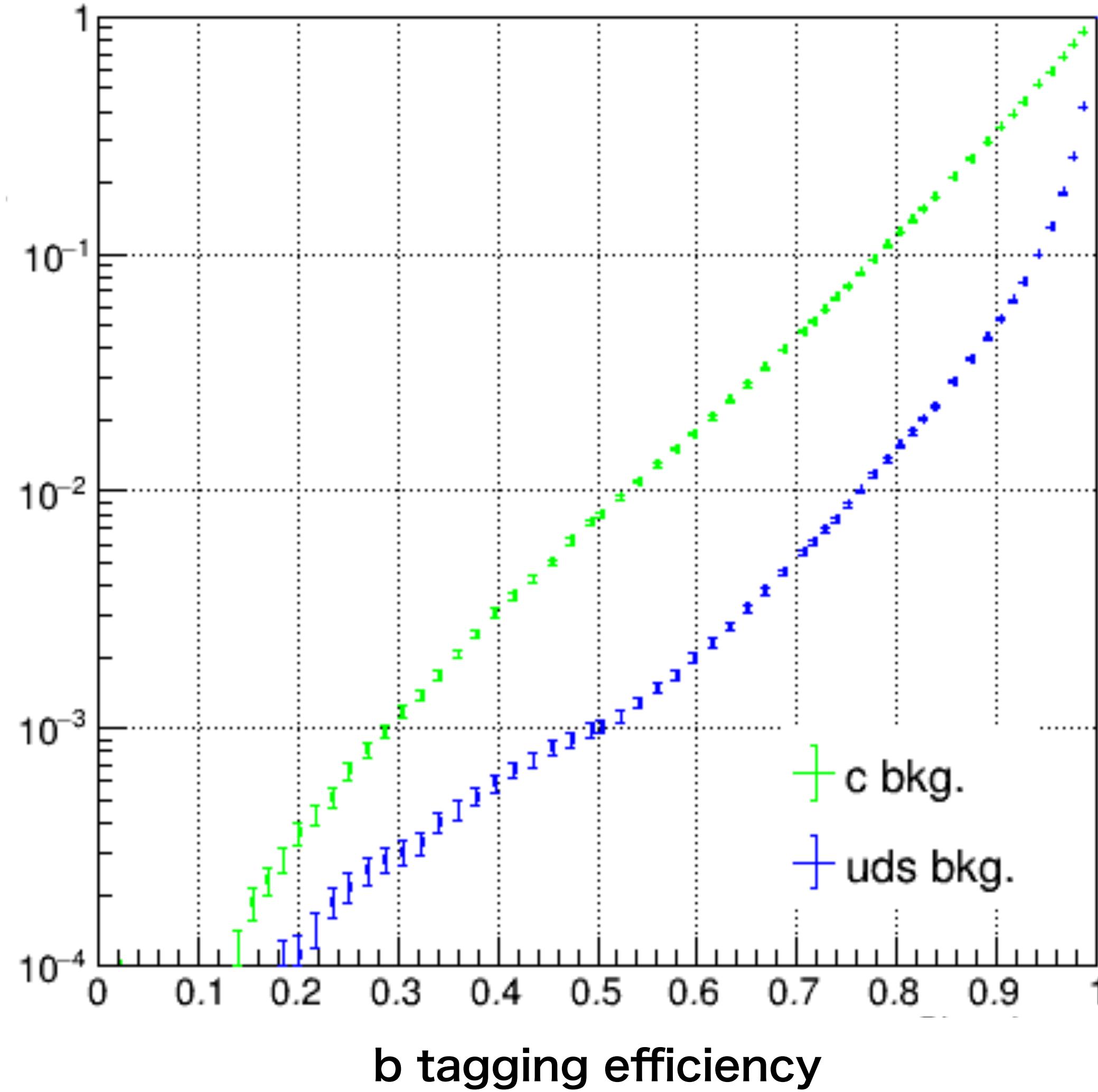








BG efficiency



BG efficiency

