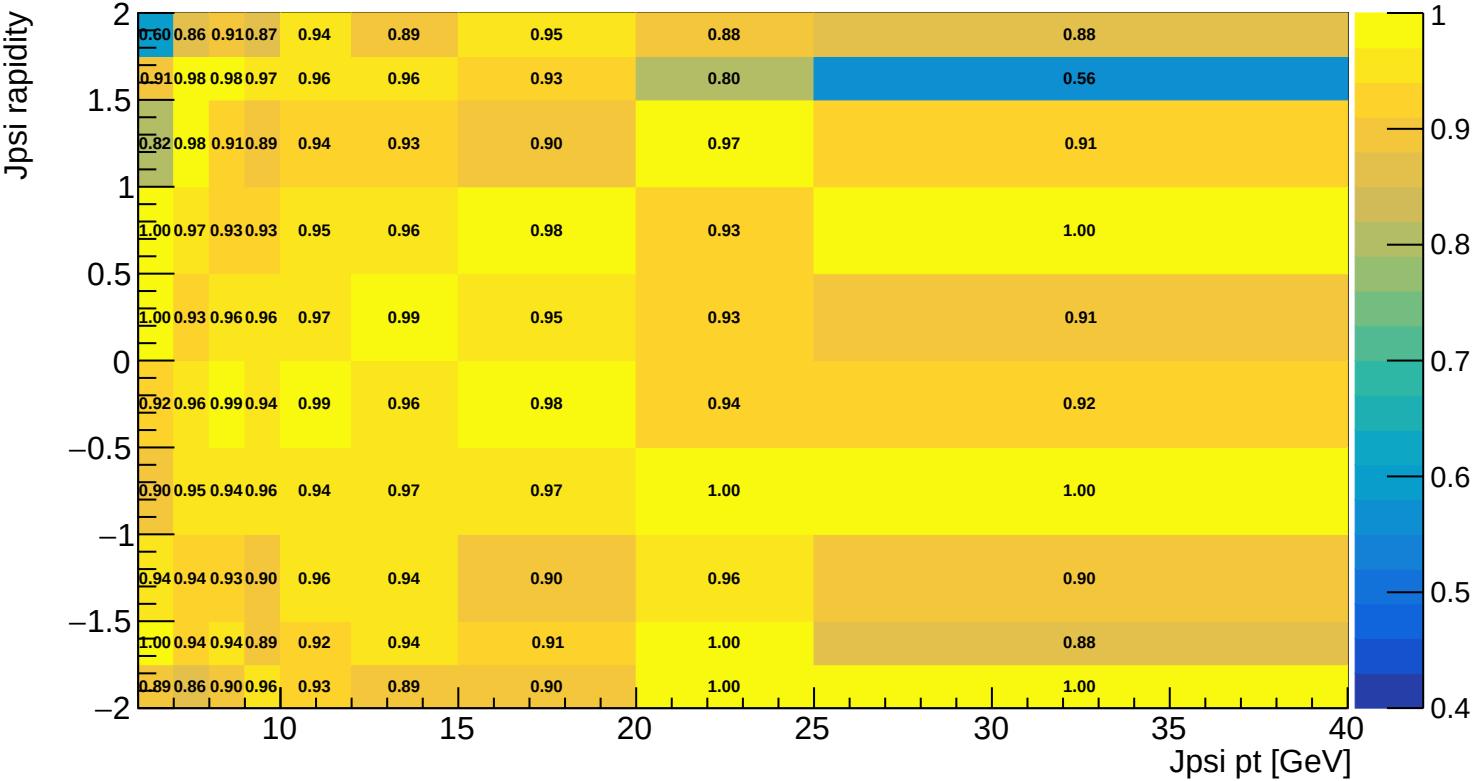vertex probability