What is a VERTEX all about ?

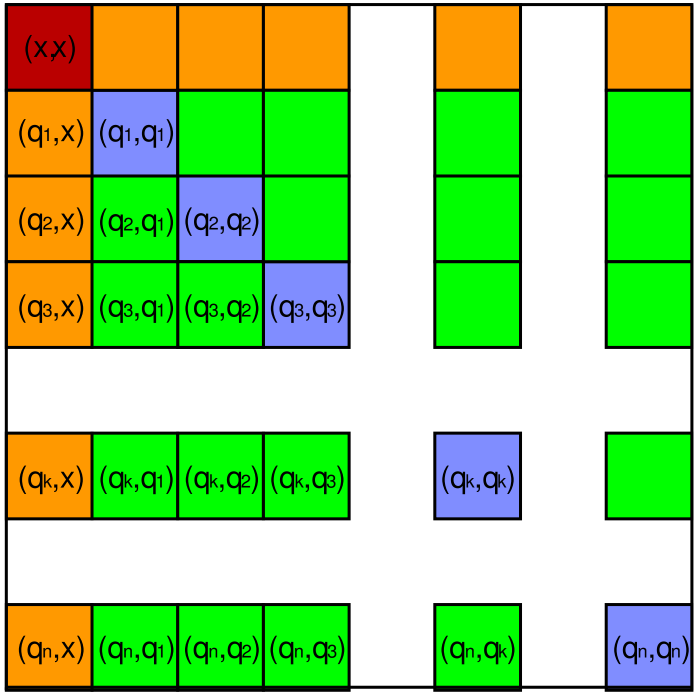
Input to a geometric vertex fit:

- Fitted tracks: $\mathbf{p}_i$, $\mathrm{cov}(\mathbf{p}_i, \mathbf{p}_i)$, $i = 1 \ldots n$
  - $\mathbf{p}_i$ = 5-vectors of track parameters,
  - $\mathrm{cov}(\mathbf{p}_i, \mathbf{p}_i)$ = symmetric 5×5 matrices.
- Beam int. profile (optional): $\mathbf{v}$, $\mathrm{cov}(\mathbf{v}, \mathbf{v})$
  - $\mathbf{v}$ = 3-vector of centre of the beam i.p.,
  - $\mathrm{cov}(\mathbf{v}, \mathbf{v})$ = symm. or diag. 3×3 matrix.

Results of a geometric vertex fit:

- Vertex position: $\mathbf{x}$, $\mathrm{cov}(\mathbf{x}, \mathbf{x})$
  - $\mathbf{x}$ = 3-vector of space coordinates,
  - $\mathrm{cov}(\mathbf{x}, \mathbf{x})$ = symmetric 3×3 matrix.
- Tracks at vertex: $\mathbf{q}_i$, $\mathrm{cov}(\mathbf{q}_i, \mathbf{q}_i)$, $i = 1 \ldots n$
  - $\mathbf{q}_i$ = 3-vectors of re-fitted track parameters,
  - $\mathrm{cov}(\mathbf{q}_i, \mathbf{q}_i)$ = symmetric 3×3 matrices

  (obtained by the Kalman "smoother").



- But this is not the full information from a vertex fitter; there are more covariances to deal with:
  - $\mathrm{cov}(\mathbf{q}_i, \mathbf{x})$, $i = 1 \ldots n$ — n asymmetric 3×3 matrices,
  - $\mathrm{cov}(\mathbf{q}_i, \mathbf{q}_j)$, $i, j = 1 \ldots n$ with $i \neq j$ — $n \cdot (n-1)$ asymmetric 3×3 matrices.

In practice, the $\mathrm{cov}(\mathbf{q}_i, \mathbf{q}_j)$, $i \neq j$ are only needed in case of a subsequent vertex re-fit with kinematic constraints. The n asymmetric $\mathrm{cov}(\mathbf{q}_i, \mathbf{x})$, however, should not be forgotten for persistency (`LCIO`).