V^0 Decay Parameters.

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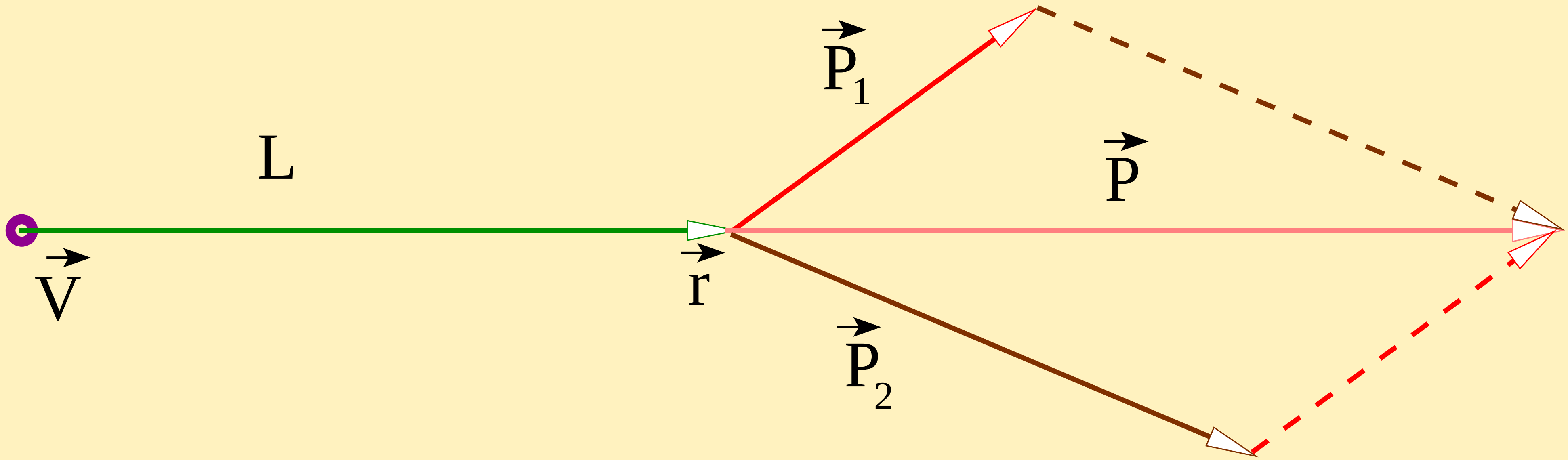
Decay Topology.



List of Parameters.

In 3D :

- position of primary vertex $\overrightarrow{V}$: 3 parameters
- points on tracks $\overrightarrow{r_1}$ and $\overrightarrow{r_2}$: 4 parameters
- momentum $\overrightarrow{p_1}$ and $\overrightarrow{p_2}$ at $\overrightarrow{r_1}$ and $\overrightarrow{r_2}$: 6 parameters
- covariance matrix C($\overrightarrow{V}$) : 6 parameters
- covariance matrices of track parameters C($\overrightarrow{p_1}, \overrightarrow{r_1}$) and C($\overrightarrow{p_2}$ and $\overrightarrow{r_2}$) : 30 parameters

Variable transformation.

More comfortable to create a vector $\overrightarrow{q}$ orthogonal to $\overrightarrow{p}$:

$$\overrightarrow{q} = \overrightarrow{r} - \frac{\overrightarrow{r} \cdot \overrightarrow{p}}{p^2} \overrightarrow{p} \quad \rightarrow \quad \overrightarrow{q} \cdot \overrightarrow{p} = 0$$

Rotation invariants in 3D - scalars and pseudo-scalars:

$$s = \overrightarrow{u} \cdot \overrightarrow{v} = \sum_{ij} \delta_{ij} u_i v_j \quad \text{and} \quad a = \overrightarrow{u} \cdot (\overrightarrow{v} \times \overrightarrow{w}) = \sum_{ijk} \varepsilon_{ijk} u_i v_j w_k$$

Scalars and pseudo-scalars.

$$= \overrightarrow{p_1} \cdot \overrightarrow{p_1} \quad p_{12} = \overrightarrow{p_1} \cdot \overrightarrow{p_2} \quad p_2^2 = \overrightarrow{p_2} \cdot \overrightarrow{p_2}$$

$$q_1^2 = \overrightarrow{q_1} \cdot \overrightarrow{q_1} \quad q_{12} = \overrightarrow{q_1} \cdot \overrightarrow{q_2} \quad q_2^2 = \overrightarrow{q_2} \cdot \overrightarrow{q_2} \quad Q_{12} = \overrightarrow{q_1} \cdot \overrightarrow{p_2} \quad Q_{21} = \overrightarrow{q_2} \cdot \overrightarrow{p_1}$$

$$A_1 = \overrightarrow{q_1} \cdot (\overrightarrow{p_1} \times \overrightarrow{p_2}) \;\; A_2 = \overrightarrow{q_2} \cdot (\overrightarrow{p_1} \times \overrightarrow{p_2}) \;\; B_1 = \overrightarrow{p_1} \cdot (\overrightarrow{q_1} \times \overrightarrow{q_2}) \;\; B_2 = \overrightarrow{p_2} \cdot (\overrightarrow{q_1} \times \overrightarrow{q_2})$$

12 quantities, 5 of which are redundant.

Result.

Without proof - description for V^0 decay:

$$p_1^2 \quad p_{12} \quad p_2^2 \quad Q_{12} \quad Q_{21} \quad A_1 \quad A_2$$

For the selection a physical quantities can be used:

- invariant mass M
- impact parameters of tracks at the primary vertex $IP_1 = |\overrightarrow{q_1}|, \ IP_2 = |\overrightarrow{q_2}|$
- distance of closest approach between the tracks $D = |A_1 - A_2|/N$, with $N = p_1^2 p_2^2 - p^2 12$
- distance of the PV from the event plane $V = |A_1 + A_2|/N$
- decay length L
- impact parameter at the primary vertex Iv

Ω cut.

The simplest combination accounting correlations:

$$\Omega = \frac{IP_1 \cdot IP_2}{Iv^2 + 4 \cdot D}$$