

The primary position variables are (x, y, s) , where x and y are the displacements along the normal and binormal vectors, \mathbf{n} and \mathbf{b} , respectively. Let \mathbf{t} denote the tangential vector along s , then \mathbf{n} , \mathbf{b} , \mathbf{t} consist a right-handed system. The action in t is expressed by

$$S = \int L_t c dt, \quad (2)$$

$$L_t = -\frac{mc}{p_0} \sqrt{1 - \dot{x}^2 + \dot{y}^2 + (1 + x/\rho)^2 \dot{s}^2} + a_x \dot{x} + a_y \dot{y} + (1 + x/\rho) a_s \dot{s}, \quad (3)$$

where p_0 and $(a_x, a_y, a_z) = e(A_x, A_y, A_z)/p_0$ are the design momentum and the normalized vector potentials, respectively, and $\dot{}$ denotes the derivative by ct . SAD's coordinate only has the radius of curvature ρ in the local x - s plane. Note that ρ is the curvature of the coordinate system, not that of the orbit. The transverse vector potentials (a_x, a_y) are non-zero only in the solenoid region, where $1/\rho$ is zero.

Currently SAD does not handle the electrostatic potential.

As SAD uses s for the independent variable instead of t , the Lagrangean L for s is written as

$$L = L_t \frac{dct}{ds}, \quad (4)$$

$$= -\frac{mc}{p_0} \sqrt{c^2 t'^2 - x'^2 + y'^2 + (1 + x/\rho)^2} + a_x x' + a_y y' + (1 + x/\rho) a_s, \quad (5)$$

where $'$ is the derivative by s .