NCSX Edge Modeling with PIES

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LCMS is Determined Visually from Poincare Surface-of-Section

3 surfaces-of-section with starting points at:

\[(R_0, Z_0, \Phi_0) = \begin{cases} 
(1.720, 0, 0) & \text{not smooth} \\
(1.725, 0, 0) & \text{LCMS (red)} \\
(1.730, 0, 0) & \text{internal islands}
\end{cases}\]
Global Integration Error Scales as $L (\Delta s)^4$

4th-order Runge-Kutta Integrator

Integration error determined by forward/backward integration (e.g., 100m on LCMS)

$\varepsilon \propto N (\Delta s)^5 = (N \Delta s) (\Delta s)^4 = L(\Delta s)^4$
Plasma/Wall Gap is a Smooth Function of $\Phi$

Minimum distance from LCMS to wall varies smoothly from 3 to 6 cm as $\Phi$ varies from 0 to 60°
Rate of Field-Line Separation Depends on Starting Position

NCSX at $\Phi = \pi / 3$

Core

$\propto \exp(s / 29)$

$\propto \exp(s / 282)$

LCMS

$\propto \exp(s / 334)$

$\propto \exp(s / 105)$

External Region

$\propto \exp(s / 105)$

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Divertor Modeling

Benchmarking wall heat-load determination:

- Field-line tracing with trajectory diffusion
- 3D finite-difference solution of electron energy transport equation (McTaggart, Zagorski, et al, PSI 16)