

Grad-Shafranov solvers

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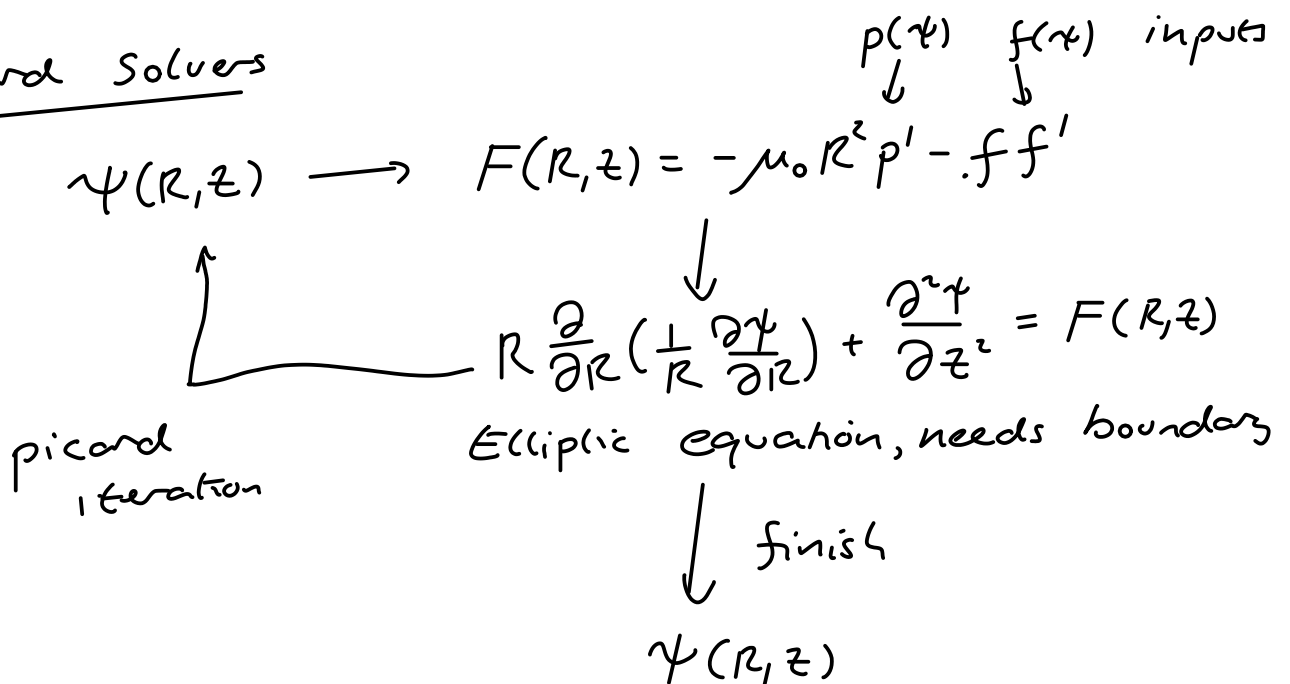
- Applications of Grad-Shafranov solvers
- Forward and inverse
- Free and fixed boundary

Applications

① Interpret experiment (inverse problem)
Experimental data $\rightarrow p(\psi), f(\psi), \psi(R, z)$
EFIT $\begin{matrix} \uparrow \\ R, \beta, p \end{matrix}$

② Theoretical studies (forward problem)
Specify $p(\psi), f(\psi) \rightarrow$ Calculate $\psi(R, z)$
TEQ, CORSICA, TES, SCENE, HELENA, ...

Forward Solvers

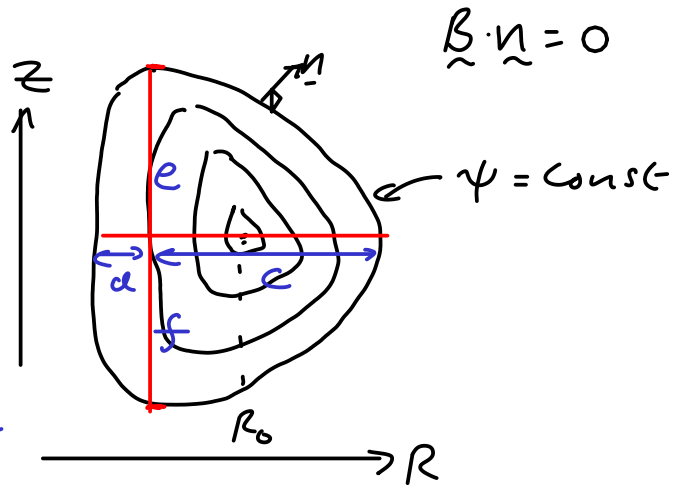


Boundary Conditions

1) Fixed boundary

$$R = R_0 + a \cos(\theta + \delta \sin \theta)$$

Minor radius \swarrow
 a
 \nearrow Triangularity c/d



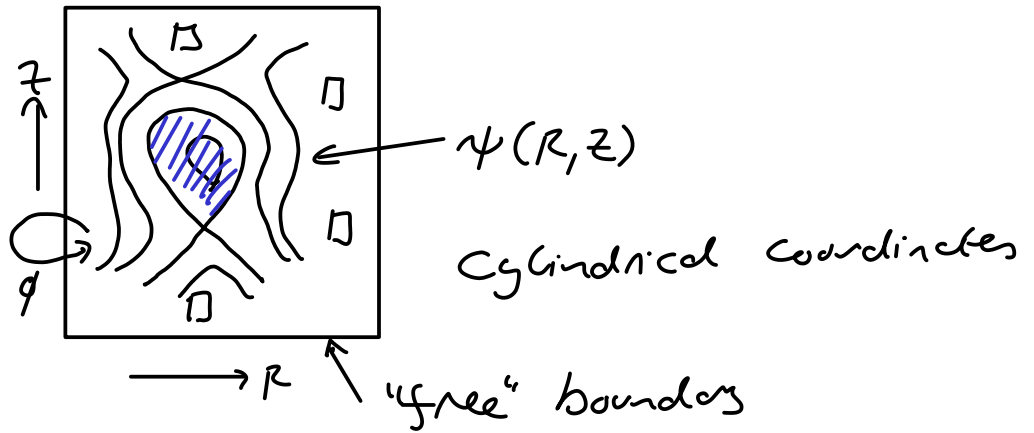
$$z = \kappa a \sin \theta$$

\uparrow Ellipticity $\frac{e+f}{d+c}$

Elongation = $\kappa - 1$

2) Free boundary

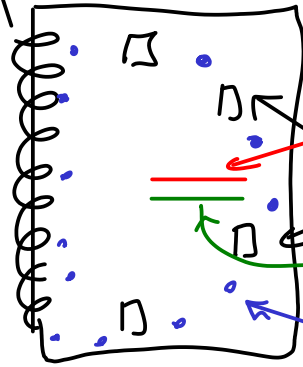
$p(\psi), f(\psi)$ specified
Coil currents



e.g. FreeGS

Inverse Solvers

Solenoid



known:

- Coil currents

Thomson Scattering $\rightarrow n, T$

PF coils

MSE pitch of field

Mirnov coils (Magnetic)

find $\psi(R, z)$, $p(\psi)$, $f(\psi)$

use polynomials for $p(\psi)$, $f(\psi)$

nonlinear least squares

Basic EFIT: Magnetic constraints

Kinetic EFIT: Use additional constraints
e.g. MSE