# pCMFD for RM

October 30, 2019

**Abstract**

Following Daniele Tomatis's notes.

## 1 Theoretical background

The partial currents are defined according to (Duderstadt 1979):

$$\boldsymbol{J}^{\pm}(x) \approx \frac{\phi(x)}{4} \pm \frac{\boldsymbol{J}^{\mathrm{D}}(x)}{2} \ , \tag{1}$$

Adding the partial currents (surface) correction factors

$$\boldsymbol{J}^{\pm}_{i+1/2} = \frac{1}{4}\phi_{i+1/2} \pm \frac{1}{2}\boldsymbol{J}^{\mathrm{D}}_{i+1/2} \pm \frac{1}{2}\delta\boldsymbol{J}^{\pm}_{i+1/2} \ , \tag{2}$$

where

$$\boldsymbol{J}^{\mathrm{D}}_{i+1/2} = -2D_{i+1/2}\frac{\phi_{i+1}-\phi_i}{\Delta_{i+1}+\Delta_i} \tag{3}$$

$$D_{i+1/2} \equiv \frac{\Delta_i D_i + \Delta_{i+1}D_{i+1}}{\Delta_i + \Delta_{i+1}} \tag{4}$$

$$\phi_{i+1/2} \equiv \frac{\Delta_i \phi_i + \Delta_{i+1}\phi_{i+1}}{\Delta_i + \Delta_{i+1}} \ . \tag{5}$$

Substituting

$$\frac{1}{2}\delta\boldsymbol{J}^{+}_{i+1/2} \equiv -\delta D^{+}_{i+1/2}\phi_i \tag{6}$$

$$\frac{1}{2}\delta\boldsymbol{J}^{-}_{i+1/2} \equiv -\delta D^{-}_{i+1/2}\phi_{i+1} \ , \tag{7}$$

yields for CCFs

$$\boldsymbol{J}^{+}_{i+1/2} = \frac{1}{4}\phi_{i+1/2} + \frac{1}{2}\boldsymbol{J}^{\mathrm{D}}_{i+1/2} - \delta D^{+}_{i+1/2}\phi_i \tag{8}$$

$$\boldsymbol{J}^{-}_{i+1/2} = \frac{1}{4}\phi_{i+1/2} - \frac{1}{2}\boldsymbol{J}^{\mathrm{D}}_{i+1/2} + \delta D^{-}_{i+1/2}\phi_{i+1} \ . \tag{9}$$

Recall that $\boldsymbol{J}^{\pm}$ are calculated using the integral expression. Solving for CCFs

$$\delta D^{+}_{i+1/2} = \frac{\frac{1}{4}\phi_{i+1/2} + \frac{1}{2}\boldsymbol{J}^{\mathrm{D}}_{i+1/2} - \boldsymbol{J}^{+}_{i+1/2}}{\phi_i} \tag{10}$$

$$\delta D^{-}_{i+1/2} = \frac{-\frac{1}{4}\phi_{i+1/2} + \frac{1}{2}\boldsymbol{J}^{\mathrm{D}}_{i+1/2} + \boldsymbol{J}^{-}_{i+1/2}}{\phi_{i+1}} \ . \tag{11}$$

In case the diffusion current is accurate, the CCFs should vanish and Eqs. (**??**)–(**??**) reduces back to Eq. (**??**), as expected, which imply for the total (accurate) current

$$\boldsymbol{J}_{i+1/2} = \boldsymbol{J}^{+}_{i+1/2} - \boldsymbol{J}^{-}_{i+1/2} = \boldsymbol{J}^{\mathrm{D}}_{i+1/2} \ . \tag{12}$$

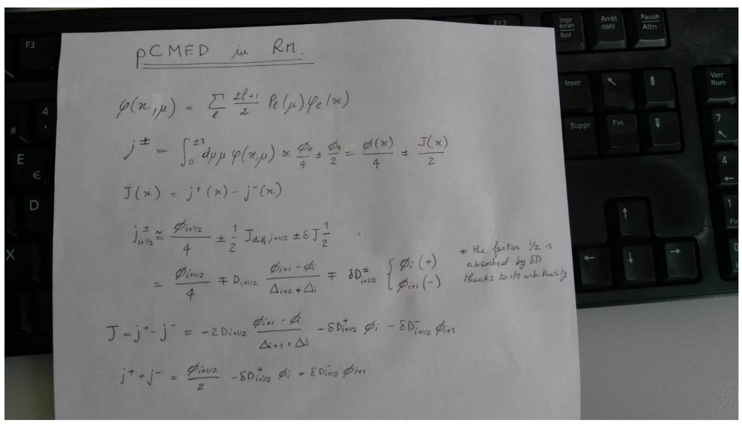

Figure 1: Tomatis's notes.

## 2 Numerical implementation