

> restart;with(Riemann):with(TensorPack): with(Canon):CDF(0): CDS(index):

Chapter XX Tensor analysis using indices - Senovilla et al. - Shearfree for acceleration parallel to vorticity if $\sigma_{ab}=0 \Rightarrow \omega \Theta = 0$

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file 2d:eq62

> read "EFE" : read "SFE" :read "fids" :read "Seneqs80" :

proof of eq62:

Combining eq55 and eq61 (with the orthogonality assumption):

> eq55SSSS := P[a,-b].dotdu[b] = $\left(p' - \frac{1}{3} - (\mu + p) \cdot \left(\frac{p''}{p'} \right) \right) \cdot \text{theta} \cdot \text{du}[a]$
 $+ \omega[a,-b] \cdot \text{du}[b] + p' \cdot P[a,b] \cdot \text{theta}[-B] : T(\%);$

$$P^a_b \text{dotdu}^b = \left(p' - \frac{1}{3} - \frac{(\mu + p) p''}{p'} \right) \theta \text{du}^a + \text{du}^b \omega^a_b + p' P^a_b \theta_{,b} \quad (1.1)$$

> temp := collect(TEDS(du[b].omega[a,-b]=0, eq55SSSS), [theta, du[a]]) : T(%);

$$P^a_b \text{dotdu}^b = -\frac{1}{3} \frac{(3 \mu p'' + 3 p p'' - 3 p^2 + p') \text{du}^a \theta}{p'} + p' P^a_b \theta_{,b} \quad (1.2)$$

> temp1 := subs(a=-a, eq[61]) : T(%);

$$P^a_b \theta_{,b} = \frac{3 p' \theta \omega^a}{\Psi} + \frac{3}{2} \frac{\Psi^{,d} \omega^a_d}{\Psi} \quad (1.3)$$

> temp2 := TEDS(omega[a] = $\frac{\text{du}[a]}{\text{Psi}}$, temp1) : T(%);

$$P^a_b \theta_{,b} = \frac{3}{2} \frac{\Psi^{,d} \omega^a_d \Psi + 2 p' \theta \text{du}^a}{\Psi^2} \quad (1.4)$$

> temp3 := collect(TEDS(temp2, temp), [theta, du[a]]) : T(%);

$$P^a_b \text{dotdu}^b = -\frac{1}{6} \frac{(6 \Psi^2 \mu p'' + 6 \Psi^2 p p'' - 6 \Psi^2 p^2 + 2 \Psi^2 p' - 18 p^3) \text{du}^a \theta}{\Psi^2 p'} \quad (1.5)$$

$$+ \frac{3}{2} \frac{p' \Psi^{,d} \omega^a_d}{\Psi}$$

which is eq62

> convert(temp3, string);

$$\text{"P[a,-b]*dotdu[b] = -1/6*(6*Psi^2*mu*p'' + 6*Psi^2*p*p'' - 6*Psi^2*p'^2 + 2*Psi^2*p' - 18*p^3)/Psi^2/p' * du[a]*theta + 3/2*p'*Psi[D]/Psi*omega[a,-d]" \quad (1.6)$$

> eq[62] := temp3 : T(%);

$$P^a_b \text{dot} du^b = -\frac{1}{6} \frac{(6 \Psi^2 \mu p'' + 6 \Psi^2 p p'' - 6 \Psi^2 p^2 + 2 \Psi^2 p' - 18 p^3) du^a \theta}{\Psi^2 p'} \quad (1.7)$$

$$+ \frac{3}{2} \frac{p' \Psi ;^d \omega^a_d}{\Psi}$$

> eq[62] := parse("P[a,-b]*dotdu[b]=1/6*(6*psi^2*p''^2-6*psi^2*p''*mu-6*psi^2*p''*p+18*p'^2*p*'-2*p'*psi^2)/p'/psi^2*du[a]*theta+3/2*p'*Psi[D]*Psi*omega[a,-d]/psi^2"):T(%);

$$P^a_b \text{dot} du^b = \frac{1}{6} \frac{(18 p p^2 - 6 \mu p'' \Psi^2 - 6 p p'' \Psi^2 + 6 p^2 \Psi^2 - 2 p' \Psi^2) du^a \theta}{p' \Psi^2} \quad (1.8)$$

$$+ \frac{3}{2} \frac{p' \Psi ;^d \Psi \omega^a_d}{\Psi^2}$$

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