```
> restart;with(Riemann):with(Canon):with(TensorPack): CDF(0); CDS(index):
> read "EFE": read "SFE":read "fids":read "seneqs80":
```

Chapter XX
Using Ricci Identities
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time propogation of SSSeq72 with p'=-1/3
SSSeq82

In this file we aim to show, assuming p'=-1/3, that the time differentiation of SSSeq72 leads to:

```
> eq[82] := -4/9 * omega^2 * theta * (Psi^2 + 1) = 0 : T(%);
```

$$-\frac{4}{9}\,\omega^2\,\theta\left(\Psi^2+1\right)=0 \tag{1.1}$$

SSSeq72 is:

```
> eq[72] : T(%);
```

$$\frac{\left(\left(\frac{3p^2}{\Psi^2}+\frac{1}{3}\right)\theta^2-2\left(\Psi^2+1\right)\omega^2+\frac{1}{2}\,\mu+\frac{3}{2}\,p\right)p'}{\Psi^2}=\left(\frac{3p^2}{\Psi^2}+\frac{1}{3}-\frac{PUp''}{p'}\right)\omega^2 \tag{1.2}$$

```
> temp := expand(Psi^2 · subs(`p'''`=0, `p''`=0, `p'`=-1/3, eq[72])) : T(%);
```

$$-\frac{1}{9}\,\frac{\theta^2}{\Psi^2}-\frac{1}{9}\,\theta^2+\frac{2}{3}\,\Psi^2\,\omega^2+\frac{2}{3}\,\omega^2-\frac{1}{6}\,\mu-\frac{1}{2}\,p=\frac{1}{3}\,\omega^2+\frac{1}{3}\,\Psi^2\,\omega^2 \tag{1.3}$$

```
> temp1 := lhs(temp) - rhs(temp) = 0 : T(%);
```

$$-\frac{1}{9}\,\frac{\theta^2}{\Psi^2}-\frac{1}{9}\,\theta^2+\frac{1}{3}\,\Psi^2\,\omega^2+\frac{1}{3}\,\omega^2-\frac{1}{6}\,\mu-\frac{1}{2}\,p=0 \tag{1.4}$$

```
> temp2 := dotT(temp1) : T(%);
```

$$-\frac{2}{9}\,\frac{\theta\,dottheta}{\Psi^2}+\frac{2}{9}\,\frac{\theta^2\,dotPsi}{\Psi^3}-\frac{2}{9}\,\theta\,dottheta+\frac{2}{3}\,\Psi\,dotPsi\,\omega^2+\frac{2}{3}\,\Psi^2\,\omega\,dotomega \tag{1.5}$$
$$+\frac{2}{3}\,\omega\,dotomega-\frac{1}{6}\,dotmu-\frac{1}{2}\,dotp=0$$

Now we use the following identities:

```
> temp3 := dotomega = θ·ω·`p'` - 2/3 · θ ·ω : T(%);
```

$$dotomega=\theta\,\omega\,p'-\frac{2}{3}\,\theta\,\omega \tag{1.6}$$

```
> temp4 := eq[65] : T(%);
```

$$dotPsi=\left(-\frac{p''\mu}{p'}-\frac{p''p}{p'}+\frac{3p^2}{\Psi^2}+\frac{1}{3}\right)\Psi\,\theta \tag{1.7}$$

```
> temp5 := subs(thetadot = dottheta, eq[69]) : T(%);
```

$$dottheta = \frac{3\,p^2\,\theta^2}{\Psi^2} \tag{1.8}$$

```
> temp6 := TEDS(mu + p = PU, isolate(eq[30], dotmu)) : T(%);
```

$$dotmu = -\theta\,PU \tag{1.9}$$

```
> temp7 := `dotp` =- `p'` ·θ ·PU : T(%);
```

$$dotp = -p'\,\theta\,PU \tag{1.10}$$

```
>
```

```
> temp8 := expand(TEDS(temp7, expand(TEDS(temp6, expand(TEDS(temp5, TEDS(temp4,
      expand(TEDS(temp3, temp2))))))))) : T(%);
```

$$-\frac{2}{3}\,\frac{\Psi^2\,\mu\,\omega^2\,p''\,\theta}{p'} - \frac{2}{3}\,\frac{\Psi^2\,\omega^2\,p\,p''\,\theta}{p'} + \frac{2}{3}\,\Psi^2\,\omega^2\,\theta\,p' - \frac{2}{9}\,\Psi^2\,\omega^2\,\theta + 2\,p^2\,\omega^2\,\theta \tag{1.11}$$

$$+\frac{2}{3}\,\omega^2\,\theta\,p' - \frac{4}{9}\,\omega^2\,\theta - \frac{2}{3}\,\frac{p^2\,\theta^3}{\Psi^2} - \frac{2}{9}\,\frac{\mu\,p''\,\theta^3}{\Psi^2\,p'} - \frac{2}{9}\,\frac{p\,p''\,\theta^3}{\Psi^2\,p'} + \frac{1}{6}\,\theta\,PU$$

$$+\frac{1}{2}\,p'\,\theta\,PU + \frac{2}{27}\,\frac{\theta^3}{\Psi^2} = 0$$

```
> temp9 := factor(subs(`p'''` = 0, `p''` = 0, `p'` =- 1/3, temp8)) : T(%);
```

$$-\frac{4}{9}\,\omega^2\,\theta\,\left(\Psi^2 + 1\right) = 0 \tag{1.12}$$

```
> eq[82] := temp9 : T(%);
```

$$-\frac{4}{9}\,\omega^2\,\theta\,\left(\Psi^2 + 1\right) = 0 \tag{1.13}$$

```
proof completed
>
> convert(temp9, string);
```

"-4/9*omega^2*theta*(Psi^2+1) = 0" (1.14)

```
>
```