Correcciones a las seds

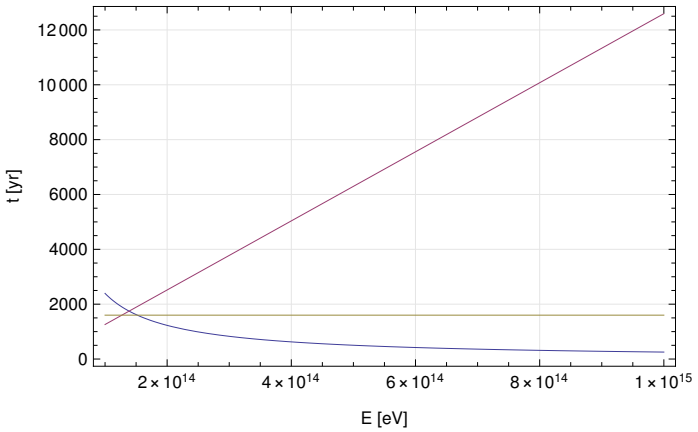
```
Eerep := 511 000 (*eV*)
Eprep := 9.38257 * 10^6 (*TeV*)
Eπrep := 139 600 × 10^3 (*eV*);
Esrn := 10^51 (*ergios*)
Kp := 7 * 10^-2
T2G := 10^-4
B := 7 * 10^-6          (*Gauss=cm^(-1/2) g^(1/2) s^-1*)
Bsi := B * T2G          (*Tesla*)
Tmcc := 4.553 * 10^-10
n := 0.011 (*cm^-3*)
relec := 2.8179 * 10^-13  (*cm*)
β := 1/137
c := 2.9979 * 10^10 (*cm s^-1*)
csi := 2.9979 * 10^8 (*m s^-1*)
echar := 1.602 * 10^-19  (*cb*)
η := 4 * 10^-5
sec2yr := 1 / 31 556 926 (*Conversor seg a años*)
erg2ev := 6.2415 × 10^11 (*Conversor erg a eV*)
γ[Ee_, Eerep_] := Ee / Eerep
tsrn := 1600 (*anios*)
Egilas := 1.6199925 * 10^16 (*eV*)
Eemin := 1 × 10^6 (*eV*)
Eeminerg := Eemin / erg2ev (*erg*)
pc2cm := 3.0857 × 10^18
Rout := 10 * pc2cm (*cm*)
Rin := 7.5 * pc2cm (*cm*)
fvol := 0.25
fvolh := 0.72
α := 1.7
```

CALCULO DE LA TASA DE ACELERACION;

```
dEacel := η * echar * csi^2 * Bsi / (1.602 * 10^-19)  (*eV s^-1*)
tacel[Ee_] := Ee * sec2yr / dEacel  (*yr*)
```

CALCULO DE ENERGIA MAXIMA PARA ELECTRONES :

```
Plot[{(Ee * sec2yr) / (6.6 * 10^-4 * B^2 * (γ[Ee, Eerep])^2 +
      Eerep * (5.5 * 10^17) * Tmcc^3 * γ[Ee, Eerep] * (Log[1 + 0.55 * γ[Ee, Eerep] * Tmcc] / (1 + 25 * Tmcc * γ[Ee, Eerep])) *
      ((1.4 * γ[Ee, Eerep] * Tmcc) / (1 + 12 * (γ[Ee, Eerep])^2 * Tmcc^2) + 1) + 4 * n * relec^2 * β * c * (Log[183] - 1/18) * Ee),
  (Ee * sec2yr) / (η * echar * csi^2 * Bsi / (1.602 * 10^-19)), tsrn},
 {Ee, 10^14, 10^15}, Frame → True,
 FrameLabel → {"E [eV]", "t [yr]"},
 GridLines → Automatic,
 GridLinesStyle → GrayLevel[.9], Axes → False]
```




```
Solve[tacel[Ee] == (Ee * sec2yr) / (6.6 * 10^-4 * B^2 * (γ[Ee, Eerep])^2 + Eerep * (5.5 * 10^17) * Tmcc^3 * γ[Ee, Eerep] *
      (Log[1 + 0.55 * γ[Ee, Eerep] * Tmcc] / (1 + 25 * Tmcc * γ[Ee, Eerep])) * ((1.4 * γ[Ee, Eerep] * Tmcc) / (1 + 12 * (γ[Ee, Eerep])^2 * Tmcc^2) + 1) +
      4 * n * relec^2 * β * c * (Log[183] - 1/18) * Ee) && Ee > 0, Ee]
```

Solve::ratnz : Solve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result. ≫

$$\{\{Ee \to 4.50521 \times 10^{13}\}\}$$

```
Eemax := 1.2705945544250278`*^14
```

CALCULO ENERGIA MAXIMA PARA PROTONES

```
σ[Ep_] := (34.3 + 1.88 * Log[Ep * 10^9] + 0.25 * (Log[Ep * 10^9])^2) * 10^-27  (*cm^2*)
dEpp[Ep_] := 0.65 * c * n * σ[Ep] * HeavisideTheta[Ep - 1.22 * 10^9] * (Ep - Eprep)
(*eV s^-1*)
tpp[Ep_] := Ep * sec2yr / dEpp[Ep] (*yr*)

Plot[{(*tpp[Ep],*)tacel[Ep], tsrn}, {Ep, 10^15, 10^16},
 Frame → True, FrameLabel → {"E [eV]", "t [yr]"},
 GridLines → Automatic, GridLinesStyle → GrayLevel[.9], Axes → False]

NSolve[tacel[Ep] == tsrn , Ep]
{{Ep → 1.27059 × 10^14}}

Epmax := 1.2705945544250278`*^14
```

CONSTANTES AE AP

```
Ap;

χ := 0.1
Epmaxerg := Epmax / erg2ev (*erg*)
Epminerg := 1 * 10^9 / erg2ev(*erg*)
(*La energia minima viene de que para que se produzcan colisiones p-
 p es necesario una energia mayor a 1GeV*)
Np[Ep_, α_, Epmaxerg_] := Ep^-α e^-(Ep/Epmaxerg)
Aperg = χ Esrn / (1 + Kp) * 3 / (4 π (Rout^3 - Rin^3) fvol)
   (1 / Integrate[Ep Np [Ep, α, Epmaxerg], {Ep, Epminerg, Epmaxerg}])

4.03727 × 10^-10

Ae;

Eemaxerg := Eemax / erg2ev(*erg*)
Ne[Ee_, α_, Eemaxerg_] := Ee^-α e^-(Ee/Eemaxerg)
Aeerg = χ Esrn Kp / (1 + Kp) * 3 / (4 π (Rout^3 - Rin^3) fvol) 1 / NIntegrate[Ee Ne [Ee, α, Eemaxerg],
     {Ee, Eeminerg, Eemaxerg}, PrecisionGoal → 9, MaxRecursion → 40]

2.73722 × 10^-11
```

```
e := 4.8 * 10^-10        (*StatCoulomb*)
Bcgs := B          (*Gauss=cm^(-1/2) g^(1/2) s^-1*)
Bsi := B * T2G              (*Tesla*)
mc2 := 511 000             (*eV*)
m := 9.1 * 10^-28           (*g*)
c := 3 * 10^10              (*cm/s*)
h := 6.63 × 10^-27         (*ergios s*)
Dsrn := 15 000 * pc2cm
f2L := 4 * π * Dsrn^2 (*factor para pasar de flujo a luminosidad en tabla *)
V := 4/3 * π * (Rout^3 - Rin^3)  (*cm^3*)
CC := 1.85    (*viene de la aproximacion bessel*)
erg2ev := 1 / ev2erg
ev2erg := 1.602 * 10^-12
β := 1/137
re := 2.8179 * 10^-13  (*cm*)
κ := 0.17
k := 8.61 * 10^-5;   (*eV/kelvin*)
T := 2.7 (*Kelvin*)
hev := 4.13 * 10^-15 (*eV s*)
σT := 0.66 × 10^-24 (*cm^2*)
A := Aeerg(*en cgs*)
Ae := A * (erg2ev)^(0.9) (*ev^0.9 cm^-3*)
Ap := Aperg * (erg2ev)^(0.9) (*eV^0.9 cm^-3*);

(*Sincro*)
PP[Eph_, Ee_] := (Sqrt[3] * π * e^3 * Bcgs)/(h * m * c^2) * CC * (Eph/((3/(4 π)) * (e*h*Bcgs)/(m*c) * (Ee/(m*c^2))^2))^(1/3) * ℯ^-(Eph/((3/(4 π)) * (e*h*Bcgs)/(m*c) * (Ee/(m*c^2))^2))
NSinc[Ee_] := A * Ee^-α * ℯ^(-Ee/Eemaxerg)

P[Eph_] :=
 NIntegrate[PP[Eph, Ee] * NSinc[Ee], {Ee, Eeminerg, Eemaxerg}, AccuracyGoal → 12]

L[Eph_] := Eph * P[Eph] * V * fvol

(*Brems*)
σ[Eγ_, Ee_] := (4 * β * re^2)/Eγ * ϕ[Eγ, Ee] * ev2erg (*cm^2 eV^-1*)
ϕ[Eγ_, Ee_] := (1 + (1 - Eγ/Ee)^2 - 2/3 * (1 - Eγ/Ee)) * Log[191] + 1/9 * (1 - Eγ/Ee)
I1[Ee_] := c/(4 π) * Ae * Ee^-α * ℯ^(-Ee/Eemax)
```

```
(*IC*)
ϵph[Eph_] := Eph / Eerep
ϵγ[Eγ_] := Eγ / Eerep
γ[Ee_] := Ee / Eerep
x[Ee_, Eph_, Eγ_] := ϵγ[Eγ] / (4 ϵph[Eph] γ[Ee]^2 (1 - ϵγ[Eγ] / γ[Ee]))
PH[Ee_, Eph_, Eγ_] :=
 HeavisideTheta[1 - x[Ee, Eph, Eγ]] HeavisideTheta[x[Ee, Eph, Eγ] - 1 / (4 γ[Ee]^2)]
f[Ee_, Eγ_, Eph_] := (2 x[Ee, Eph, Eγ] Log[x[Ee, Eph, Eγ]] + x[Ee, Eph, Eγ] + 1 -
     2 x[Ee, Eph, Eγ]^2 + ((4 ϵph[Eph] γ[Ee] x[Ee, Eph, Eγ])^2 (1 - x[Ee, Eph, Eγ])) /
      (2 (1 + 4 ϵph[Eph] γ[Ee] x[Ee, Eph, Eγ]))) PH[Ee, Eph, Eγ]
σIC[Ee_, Eγ_, Eph_] := 3 σT / (4 ϵph[Eph] γ[Ee]^2) f[Ee, Eγ, Eph]
Iic[Ee_] := Ae * Ee^-α * e^-(Ee / Eemax)
nBB[Eph_] := 8 * π / (h * c)^3 * Eph^2 (e^(Eph / (k * T)) - 1)^-1 * erg2ev

radio := 5.4 * 10^-6 | 8.4 * 10^-14 * f2L
         8.6 * 10^-6 | 1.1 * 10^-13 * f2L

ex :=
5.4 * 10^2 | 4.42 * 10^-10 * f2L
1.6 * 10^3 | 4.05 * 10^-10 * f2L
3.4 * 10^3 | 3.12 * 10^-10 * f2L
6.3 * 10^3 | 2.29 * 10^-10 * f2L
8.6 * 10^3 | 1.69 * 10^-10 * f2L
1.4 * 10^4 | 1.30 * 10^-10 * f2L
2.2 * 10^4 | 8.04 * 10^-11 * f2L
2.9 * 10^4 | 4.55 * 10^-11 * f2L

gamlat :=
7.4 * 10^8  | 5.4 * 10^-12 * f2L
1.8 * 10^9  | 4.5 * 10^-12 * f2L
4.6 * 10^9  | 6.6 * 10^-12 * f2L
1.4 * 10^10 | 1.0 * 10^-11 * f2L
3.4 * 10^10 | 2.1 * 10^-11 * f2L
1.0 * 10^11 | 1.9 * 10^-11 * f2L
2.5 * 10^11 | 1.8 * 10^-11 * f2L
```

$$\text{gamhess} := \begin{array}{|l|l|} \hline 2.9*10^{11} & 4.4*10^{-11}*\text{f2L} \\ \hline 3.4*10^{11} & 3.3*10^{-11}*\text{f2L} \\ \hline 7.4*10^{11} & 2.6*10^{-11}*\text{f2L} \\ \hline 1.4*10^{12} & 3.4*10^{-11}*\text{f2L} \\ \hline 4.6*10^{12} & 2.8*10^{-11}*\text{f2L} \\ \hline 5.4*10^{12} & 2.4*10^{-11}*\text{f2L} \\ \hline 6.3*10^{12} & 2.0*10^{-11}*\text{f2L} \\ \hline 8.6*10^{12} & 1.5*10^{-11}*\text{f2L} \\ \hline 1.8*10^{13} & 9.9*10^{-12}*\text{f2L} \\ \hline 3.4*10^{13} & 1.2*10^{-11}*\text{f2L} \\ \hline 4.0*10^{13} & 3.6*10^{-12}*\text{f2L} \\ \hline 8.6*10^{13} & 2.3*10^{-12}*\text{f2L} \\ \hline \end{array}$$

```
Show[Plot[{Log[10, L[10^(Eγ) / erg2ev]], Log10[(10^Eγ)^2 * V * fvol *
      NIntegrate[n * σ[Eγ, Ee] * I1[Ee], {Ee, 10^Eγ, ∞}, MaxRecursion → 15] * ev2erg],
   Log[10, (10^Eγ)^2 * fvolh * V * 2 * c * n / κ * Ap * 10^-27
      NIntegrate[1 / Sqrt[Eπ^2 - Eπrep^2] (Eprep + Eπ/κ)^-α * e^-((Eprep + Eπ/κ)/Epmax) *
         (34.3 + 1.88 * Log[(Eprep + Eπ/κ) * 10^12] + 0.25 * Log[(Eprep + Eπ/κ) * 10^12]^2),
         {Eπ, (10^Eγ) + Eπrep^2 / (4 * (10^Eγ)), 10^16}, MaxRecursion → 20] / erg2ev],
   Log[10, (10^Eγ)^2 * fvol * V * c / (4 π) * NIntegrate[nBB[Eph] * σIC[Ee, 10^Eγ, Eph] * Iic[Ee],
      {Ee, Eemin, 10 * Eemax}, {Eph, 0, 100 * k * T}, AccuracyGoal → 15] / erg2ev]},
  {Eγ, Log[10, 10^-6], Log[10, 10^15]}, Axes → False,
  Frame → True,
  FrameLabel → {"Log10[Eγ/eV]", "Log10[L/(erg/s)]"}],
 ListPlot[{Log10[radio], Log10[ex], Log10[gamlat], Log10[gamhess]}],
 PlotRange → {{-6, 16}, {20, 39}},
 PlotRangeClipping → True,
 Frame → True,
 GridLines → Automatic,
 GridLinesStyle → GrayLevel[.9],
 Axes → False]
```

NIntegrate::izero : Integral and error estimates are 0 on all integration subregions. Try increasing the value of the MinRecursion option. If value of integral may be 0, specify a finite value for the AccuracyGoal option. ≫

NIntegrate::izero : Integral and error estimates are 0 on all integration subregions. Try increasing the value of the MinRecursion option. If value of integral may be 0, specify a finite value for the AccuracyGoal option. ≫

NIntegrate::izero : Integral and error estimates are 0 on all integration subregions. Try increasing the value of the MinRecursion option. If value of integral may be 0, specify a finite value for the AccuracyGoal option. ≫

General::stop : Further output of NIntegrate::izero will be suppressed during this calculation. ≫

NIntegrate::slwcon : Numerical integration converging too slowly; suspect one of the following: singularity, value of the integration is 0, highly oscillatory integrand, or WorkingPrecision too small. ≫

NIntegrate::ncvb : NIntegrate failed to converge to prescribed accuracy after 18 recursive bisections in Eph near $\{Ee, Eph\} = \{0.844124, 3.22008 \times 10^{-6}\}$. NIntegrate obtained 1.511081188830741`*^28 and 4.5291173557460307`*^27 for the integral and error estimates. ≫

```
$Aborted
```