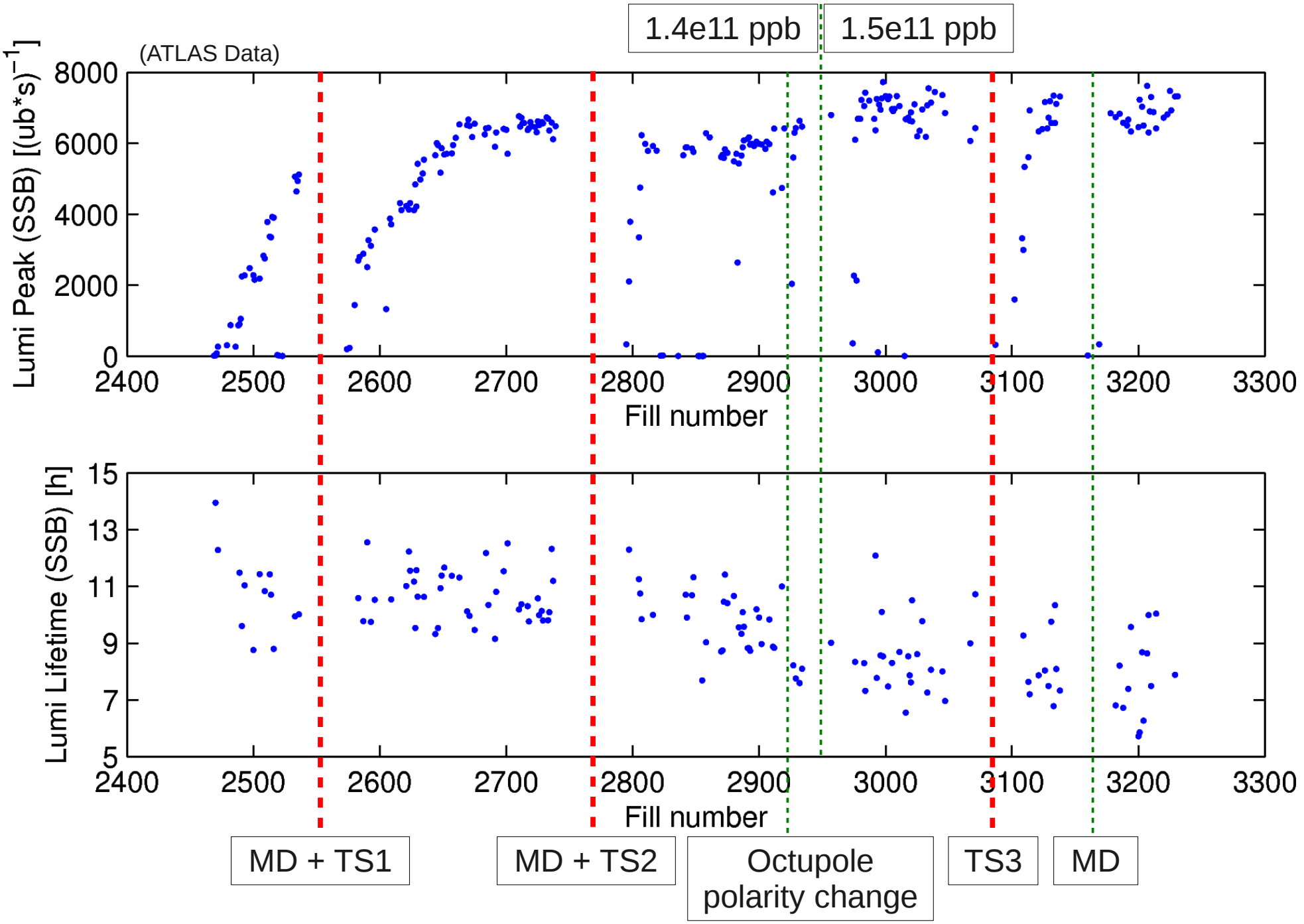
Follow-up: Fill-to-fill Luminosity Comparison in 2012

Impact of peak luminosity and luminosity lifetime on integrated luminosity

M. Hostettler, G. Papotti
LBOC, 2012-11-06

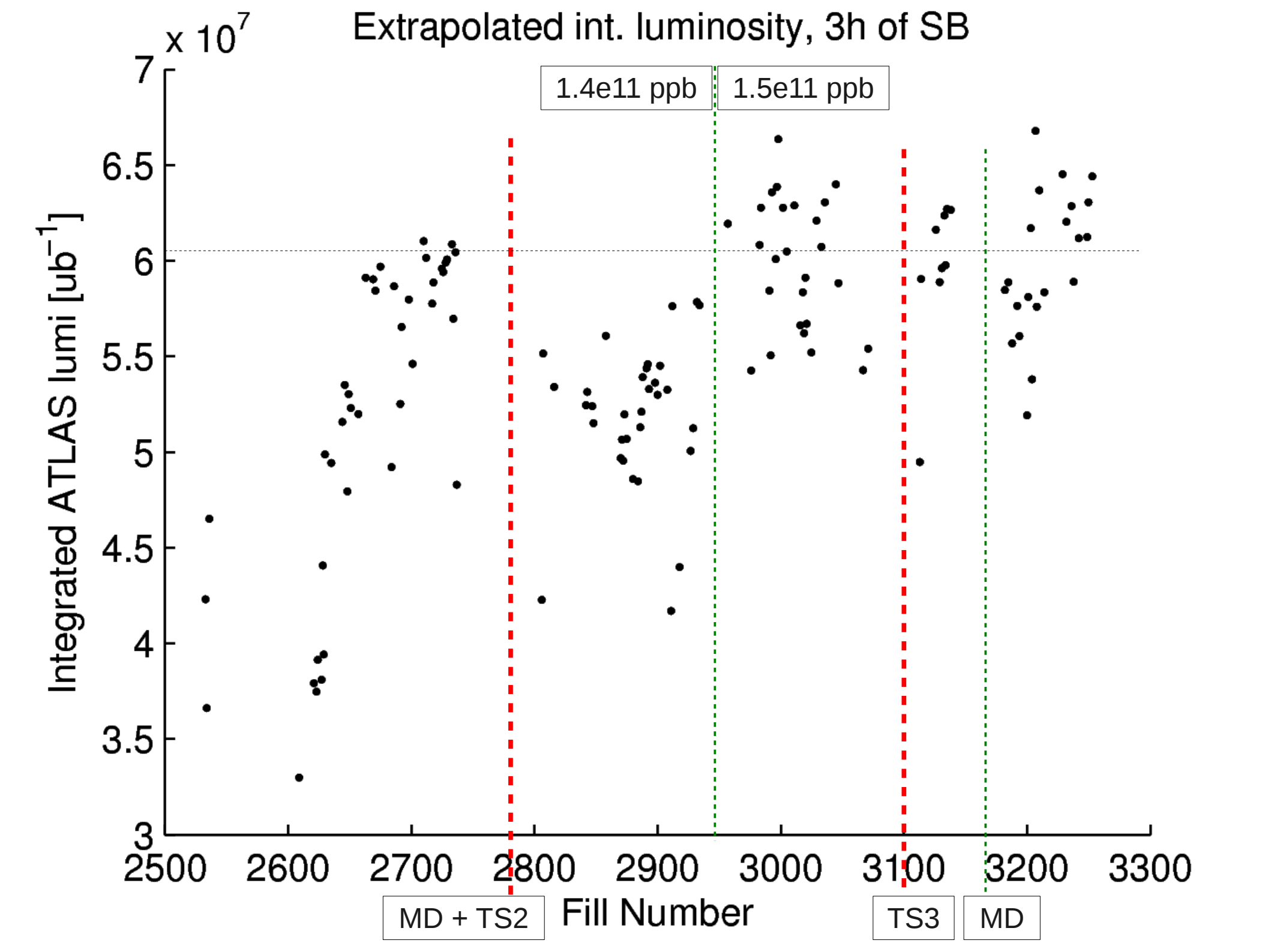

1.4e11 ppb
1.5e11 ppb
(ATLAS Data)
Lumi Peak (SSB) [(ub*s)$^{-1}$]
8000
6000
4000
2000
0
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill number
Lumi Lifetime (SSB) [h]
15
13
11
9
7
5
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill number
MD + TS1
MD + TS2
Octupole polarity change
TS3
MD

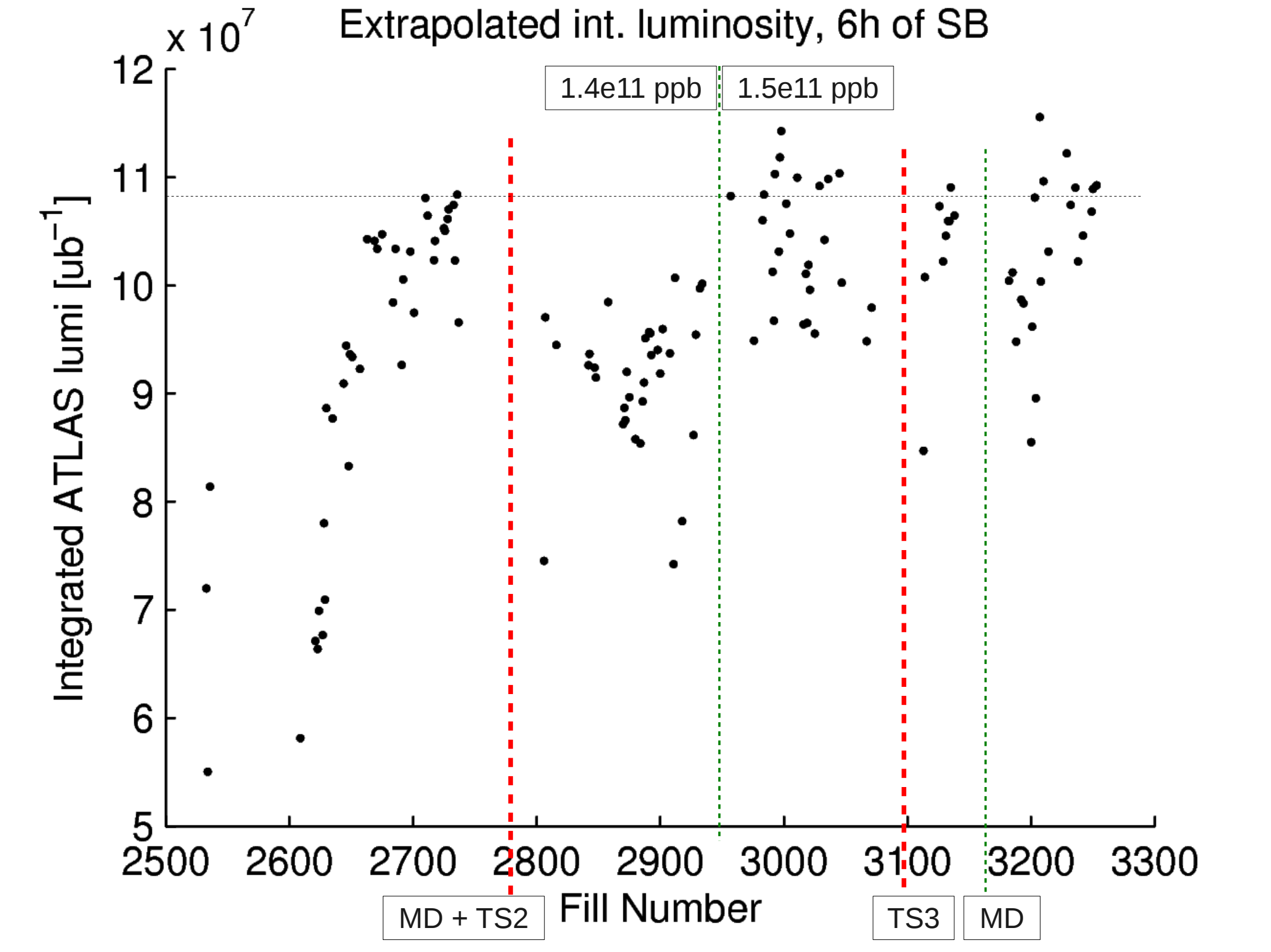
Integrated Luminosity

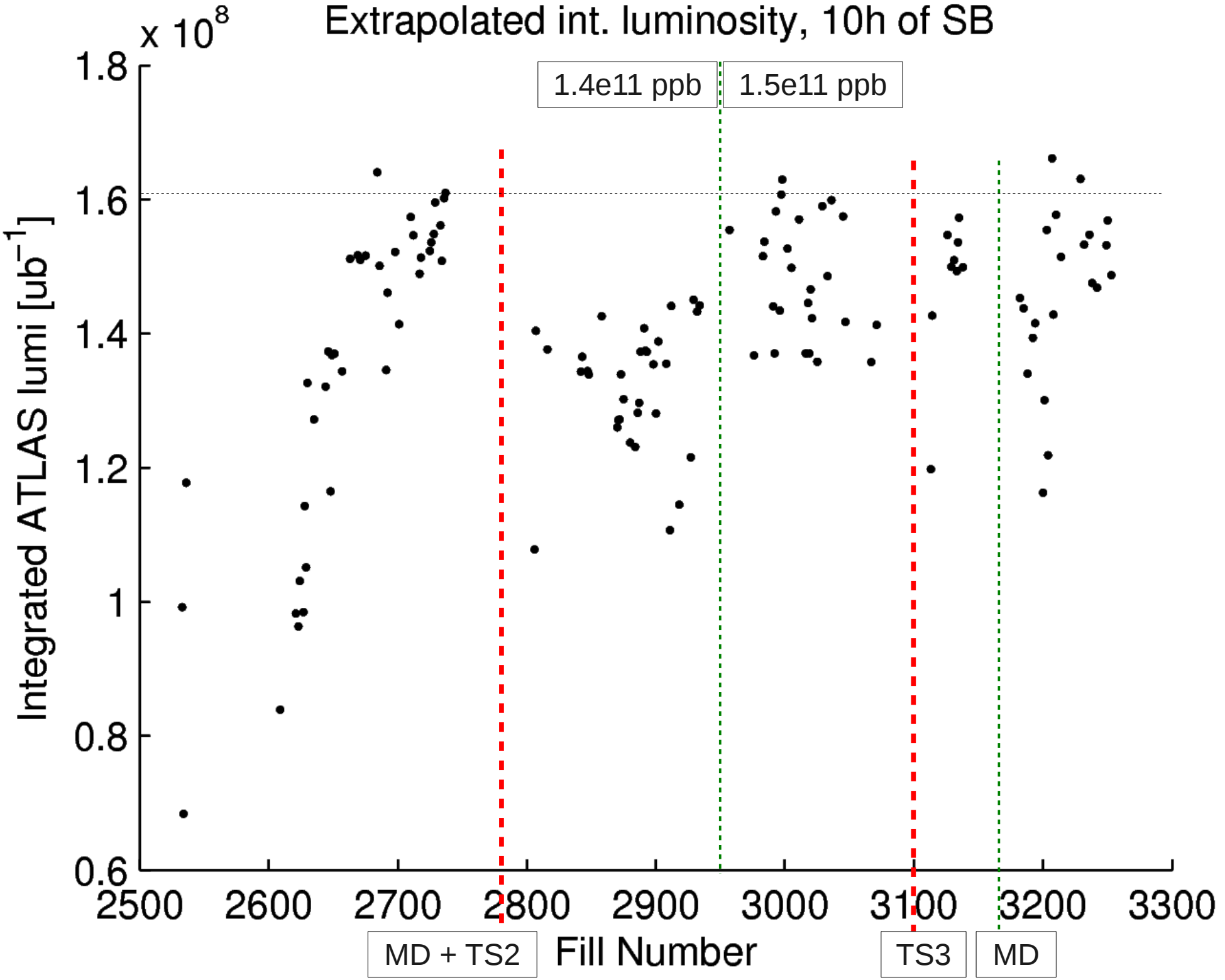
- Performance of the LHC!
- Does the higher peak luminosity pay off even though the lifetime decreased?
- Integration through TEVATRON approximation fit

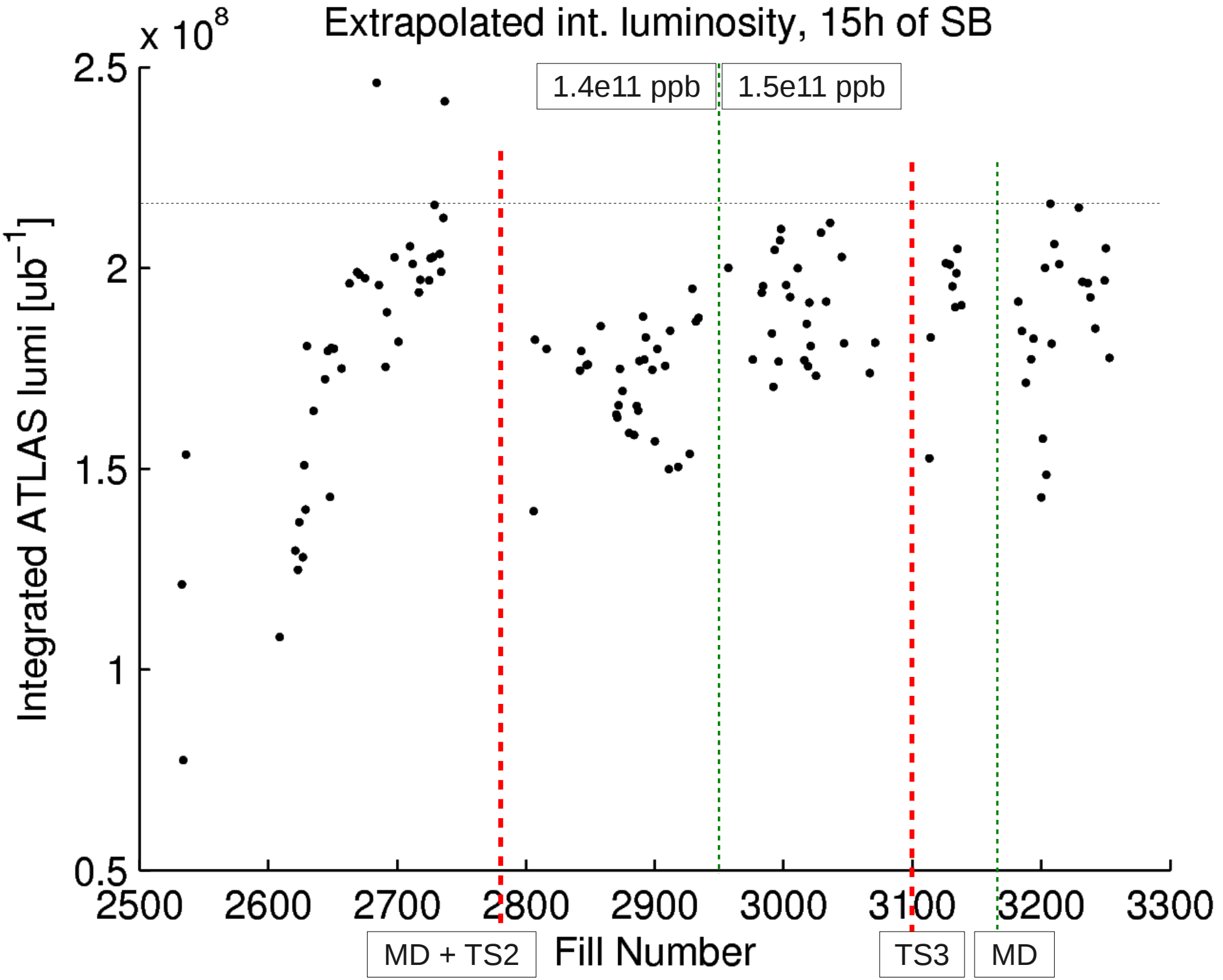
$$L_T(t) = \frac{L_{0,T}}{\left(1 + \frac{t\,b}{\tau_T}\right)^b}$$

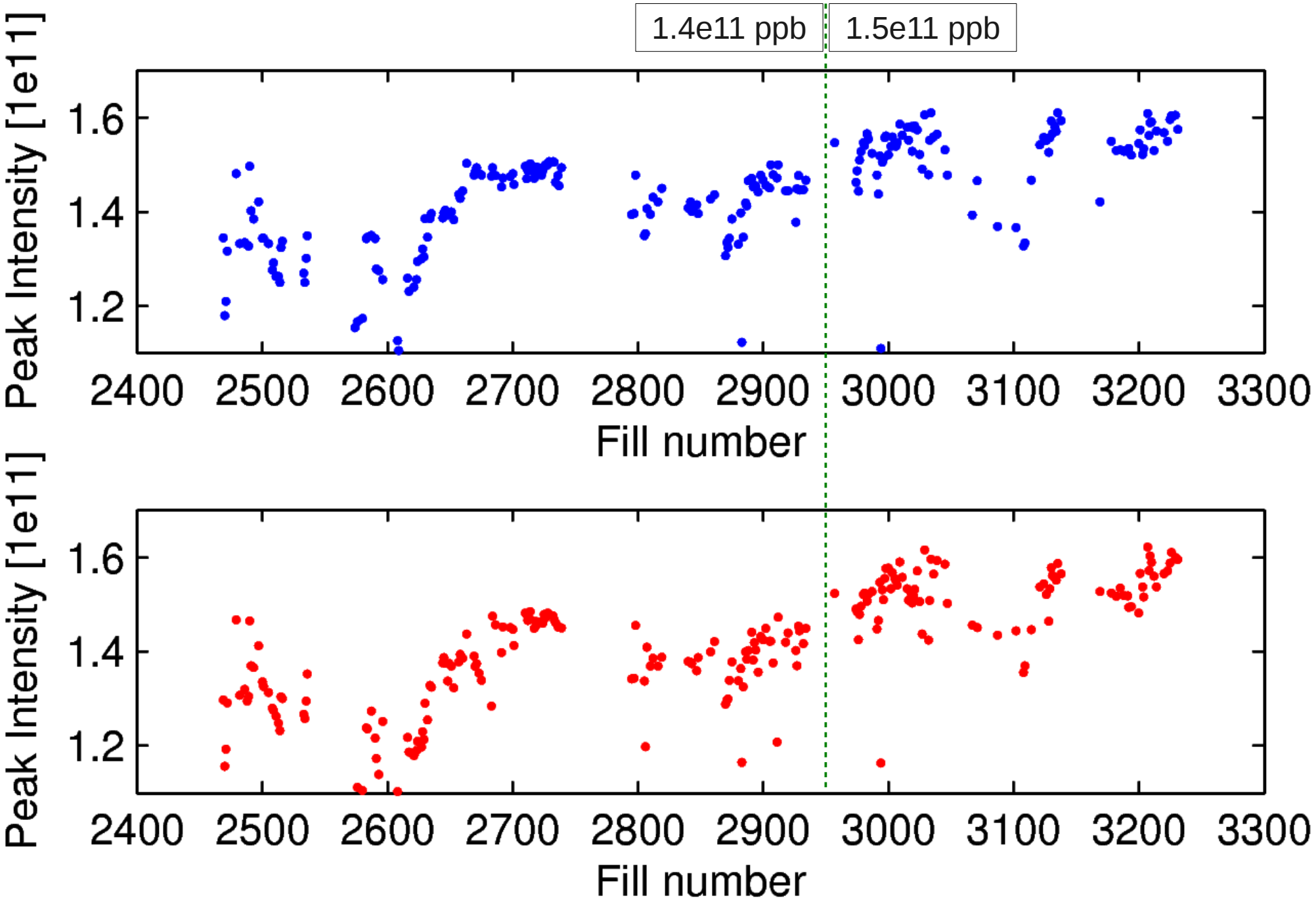
  - Fit over the whole fill to get parameters
  - Integrate the fit function to get an extrapolation of the integrated luminosity after given times in SB


Extrapolated int. luminosity, 3h of SB
x 10^7
7
6.5
6
5.5
5
4.5
4
3.5
3
Integrated ATLAS lumi [ub^-1]
1.4e11 ppb
1.5e11 ppb
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill Number
MD + TS2
TS3
MD


Extrapolated int. luminosity, 6h of SB
x 10^7
Integrated ATLAS lumi [ub^-1]
12
11
10
9
8
7
6
5
1.4e11 ppb
1.5e11 ppb
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill Number
MD + TS2
TS3
MD


Extrapolated int. luminosity, 10h of SB
x 10^8
1.8
1.6
1.4
1.2
1
0.8
0.6
Integrated ATLAS lumi [ub^-1]
1.4e11 ppb
1.5e11 ppb
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill Number
MD + TS2
TS3
MD


Extrapolated int. luminosity, 15h of SB
x 10^8
2.5
2
1.5
1
0.5
Integrated ATLAS lumi [ub^-1]
1.4e11 ppb
1.5e11 ppb
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill Number
MD + TS2
TS3
MD


1.4e11 ppb
1.5e11 ppb
Peak Intensity [1e11]
1.6
1.4
1.2
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill number
Peak Intensity [1e11]
1.6
1.4
1.2
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
Fill number

Expected integrated luminosity

- Starting from a (double-)exponential:

$$L(t) = L_{0,1}\exp\left(-\frac{1}{\tau_1}t\right) + L_{0,2}\exp\left(-\frac{1}{\tau_2}t\right)$$

- Integrate:

$$L_{tot} = \int_0^{t_r} L(t)\,dt = L_{0,1}\tau_1\left(1-\exp\left(\frac{-t_r}{\tau_1}\right)\right) + L_{0,2}\tau_2\left(1-\exp\left(\frac{-t_r}{\tau_2}\right)\right)$$

- Split into two single-exponential integrals
  - Proportional to $L_0 * \tau$ (time-independant)
  - Time evolution factor: (1-exp(-t/τ))