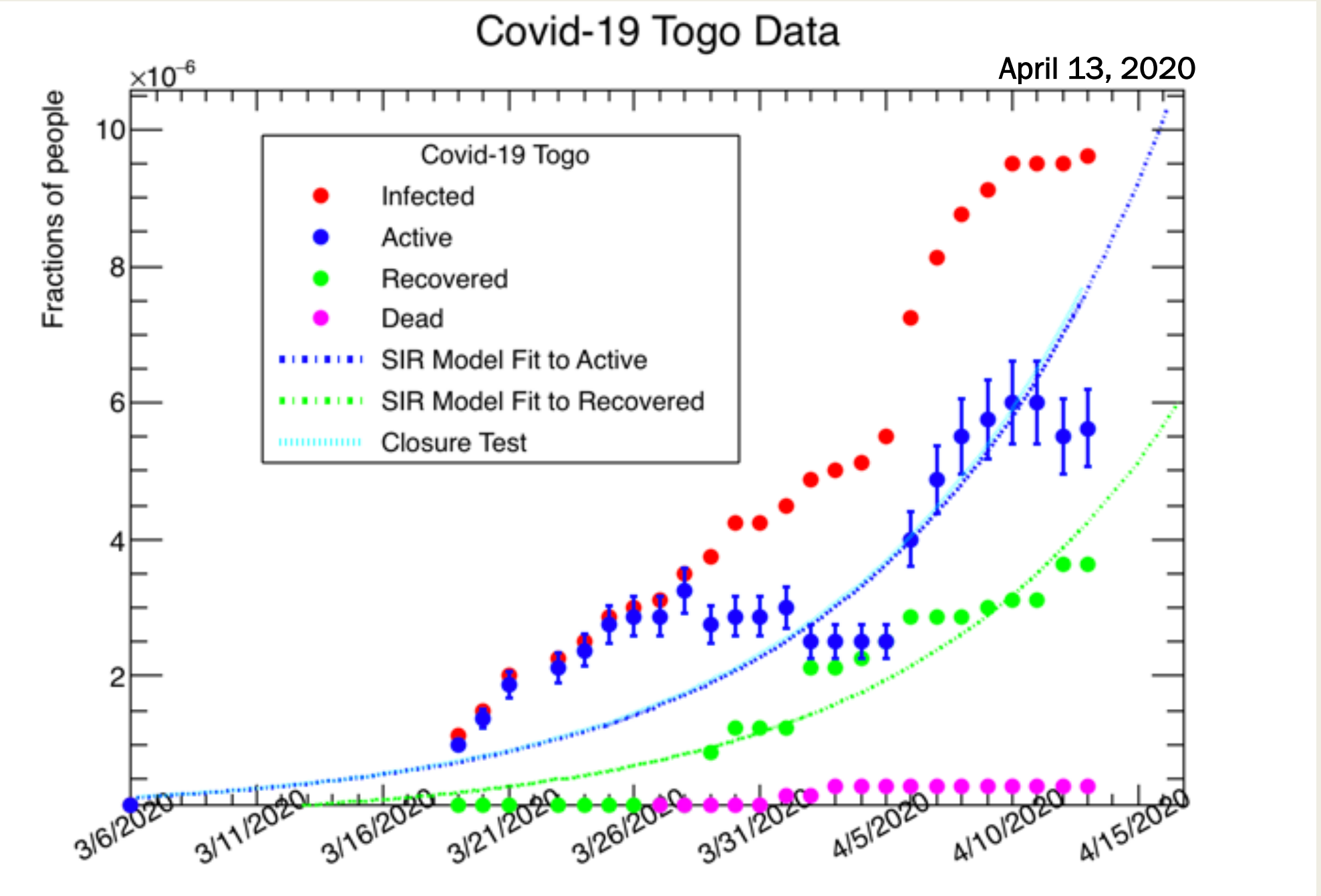
SIR Model equations

$$\frac{ds}{dt} = -b\, s(t)\, i(t), \qquad s(0) = 1,$$

$$\frac{di}{dt} = b\, s(t)\, i(t) - k\, i(t), \qquad i(0) = 1.25 \times 10^{-6},$$

$$\frac{dr}{dt} = k\, i(t), \qquad r(0) = 0.$$

Estimate the parameters b and k for Togo and solve these equations
Plot the Covid-19 data of Togo and fit the SIR model to the data
Population 8.0 e+6 → i(0) = 1.25 e-6: one infected individual arrived in Togo on March 6.

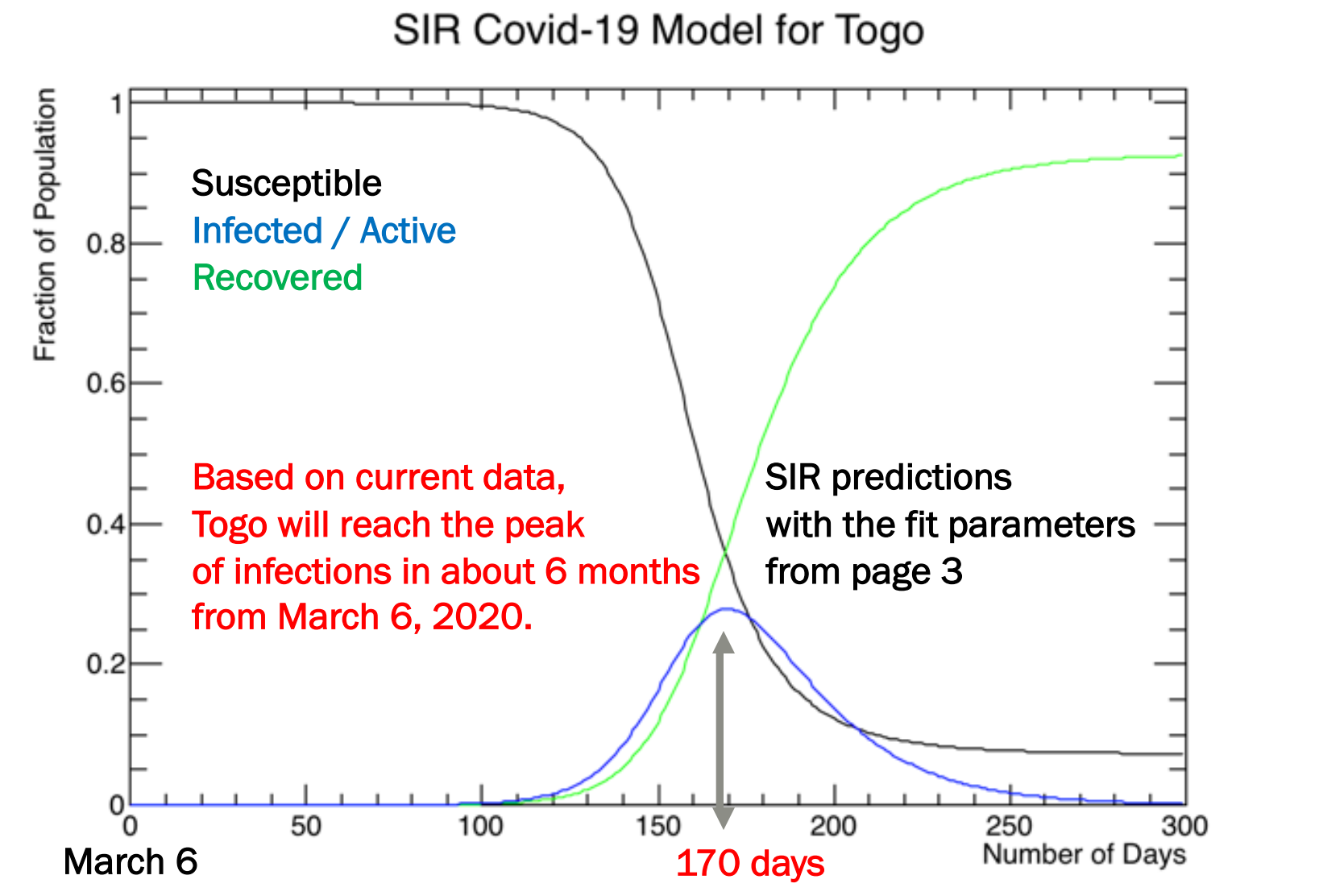

Covid-19 Togo Data
April 13, 2020
Fractions of people
×10⁻⁶
10
8
6
4
2
Covid-19 Togo
Infected
Active
Recovered
Dead
SIR Model Fit to Active
SIR Model Fit to Recovered
Closure Test
3/6/2020
3/11/2020
3/16/2020
3/21/2020
3/26/2020
3/31/2020
4/5/2020
4/10/2020
4/15/2020

Fit parameters

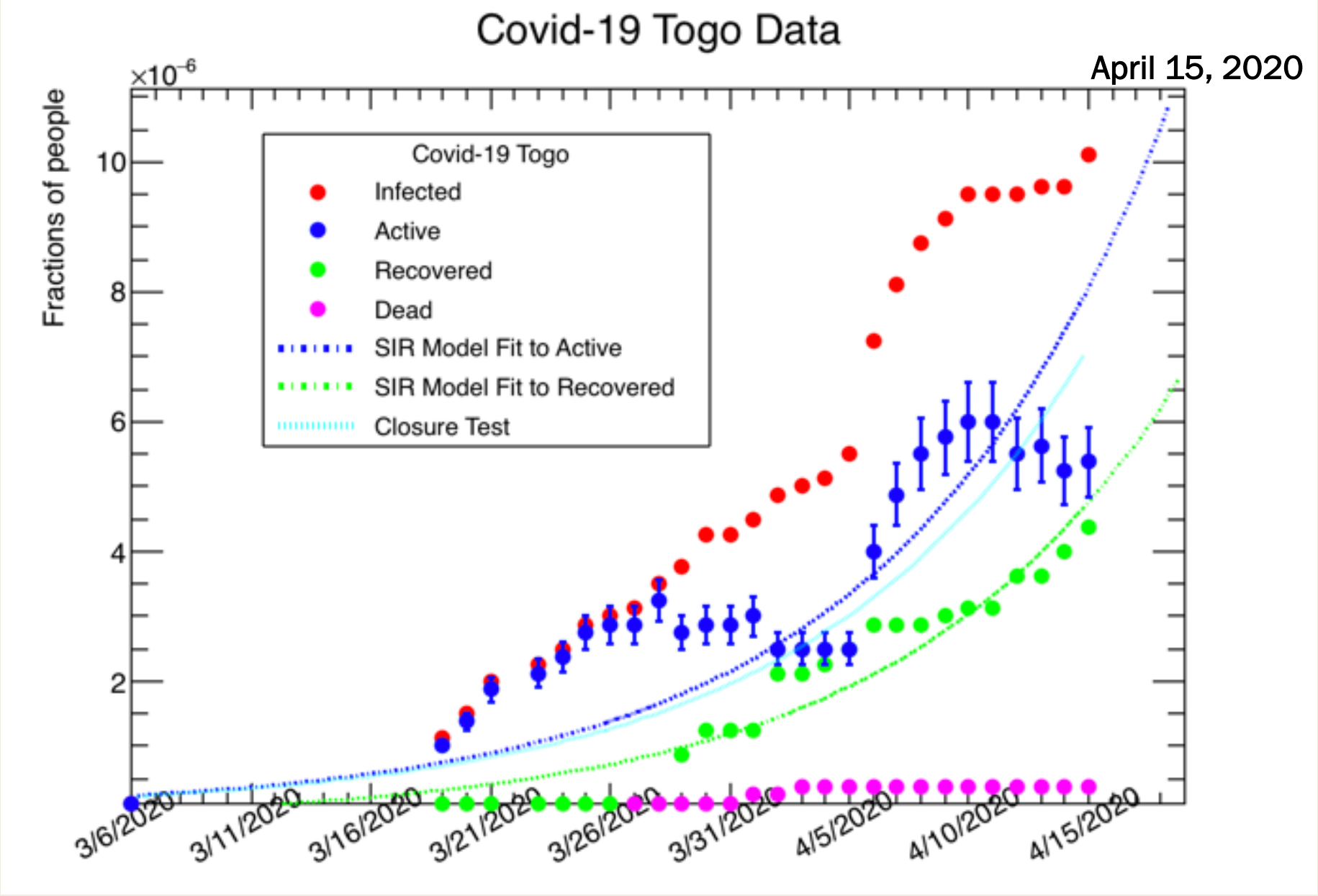
```
root [0] .x Covid19_Togo.C
 FCN=321.172 FROM MINOS     STATUS=SUCCESSFUL     78 CALLS         618 TOTAL
                     EDM=8.93423e-07    STRATEGY= 1      ERROR MATRIX ACCURATE
  EXT PARAMETER                                          STEP          FIRST
  NO.   NAME      VALUE            ERROR                 SIZE      DERIVATIVE
   1  p0(b)           1.52023e-01   5.34730e-01   8.43584e-04   2.14490e-02
   2  p1(b/k)         2.79412e+00   7.14963e-01  -1.73022e-03   8.54810e-03
   3  p2 (I[0])       2.22306e-07   1.14364e-08   1.14364e-08   2.11816e-02


****************************************
Minimizer is Minuit / MigradImproved
Chi2                      =  4.75853e-12
NDf                       =          23
Edm                       =  2.41729e-13
NCalls                    =          95
P0 (b)                    =    0.152514   +/-   2.33289e-07   (limited)
p1 (b/k)                  =     2.78718   +/-   4.0181e-07    (limited)
p2 (I[0])                 =  2.25596e-07   +/-   2.3531e-13    (limited)
```

Chi2 / NDf not good — data has many irregularities.

Projection for Togo based on the SIR Model



Projection for Togo based on the SIR Model



Conclusions (for Togo)

- Data shows many discontinuities
- Data has large statistical uncertainties
  - *Only 2739 tests have been done in Togo as of April 13, 2020; population 8 millions*
  - *Predictions likely to change with more test*
- Not sure if more stringent measures can be taken to reach plateau sooner
- It seems that the infections will increase slowly / slower over a much longer times (6 months) before it will start to slow down
  - *Containing Covid-19 may be a long haul — I hope not*