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Monte Carlo Method: Theory and Exercises (3)

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ANNEX:

Estimation of the graphite reflector contribution on the TRIGA source driven simulation

The method of "flagged" tallies was applied to estimate the graphite reflector worth in the sub-critical TRIGA core model. The method permits to separate (flag) the contribution of particles coming from certain, user-defined, zone of the model. When a flagged particle reach a phase space zone bounded by a tally a partial and total weight tally counters were incremented. At the end of the simulation the tally reports, in function of time, the total flux and the partial flux that can be ascribed to flagged neutrons. The flagging method works on histories basis: all the particles that belongs from the same history inherit the flag. The three sub-critical simulation presented in the paper were driven by a source delta time shoot and flux tallies were accumulated versus time for the fuel rods C1, E1 and D1. Figures 1a to 9a reports the total and flagged fluxes for the three configurations whereas figures 1b to 9b reports the flagged to total flux ratio. The three fuel rods show the same main features for all simulated configurations:

I) The flagged flux is the major component of the total flux (all figures "a" series).

II) The flux ratio approaches 1 only for a short period of time and then an oscillating pattern, that becomes more evident at low K_{eff}, take place (all figures "b" series).

This behavior is caused by delayed neutrons emission, at higher times, from not flagged (source) neutrons captured by fission before they reach the graphite reflector. In figure 10 the prompt neutron flux (fig. 10a) and prompt flux ratio (fig. 10b) were reported. As expected, in the absence of delayed neutron, the flux ratio approaches one and remains constant for the entire tally accumulation period. Figure 11 reports the flux time behavior for fuel rods C11 and G31; as expected the flux decay for the two fuel rods is quite similar (Fundamental mode shutdown).

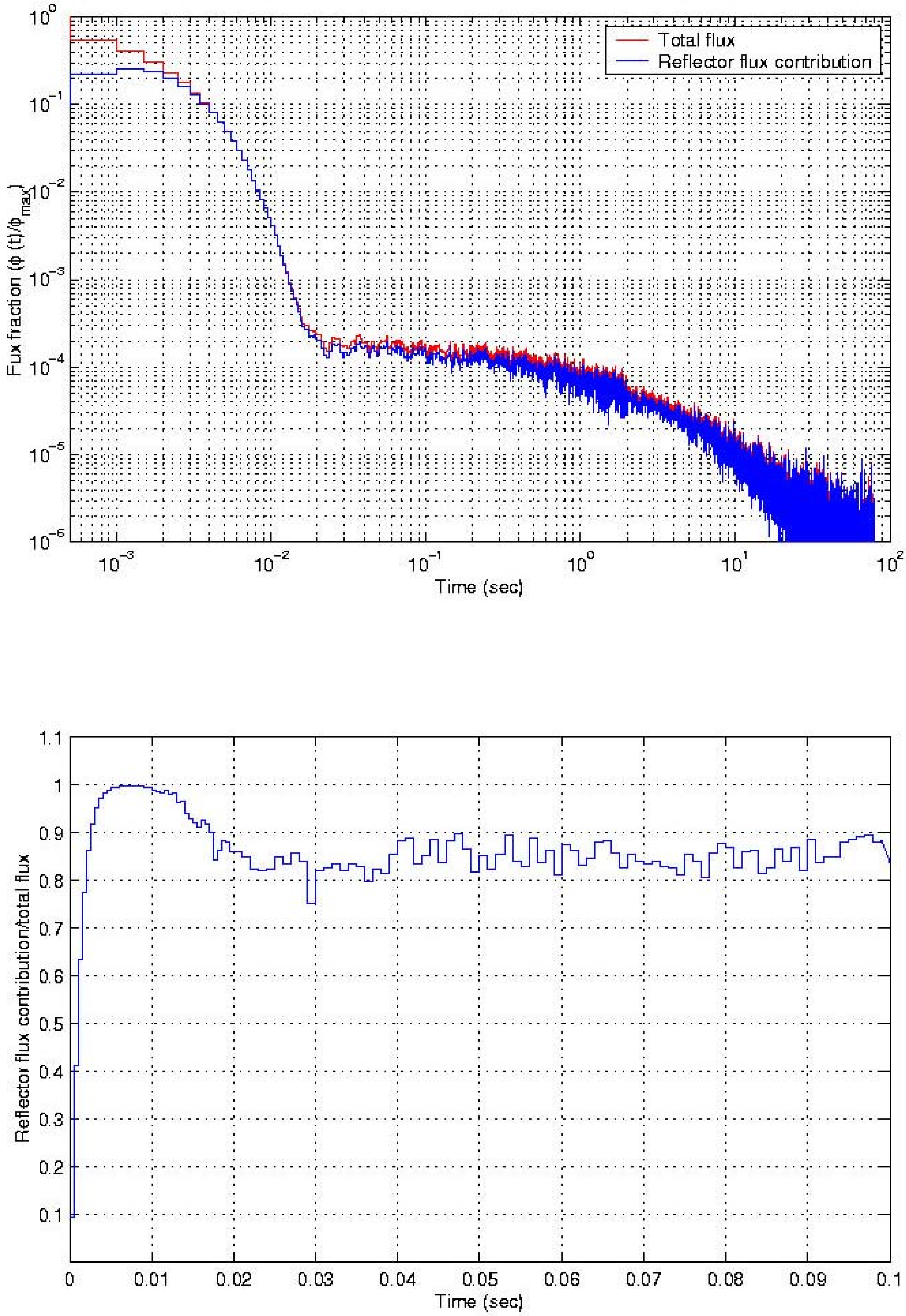
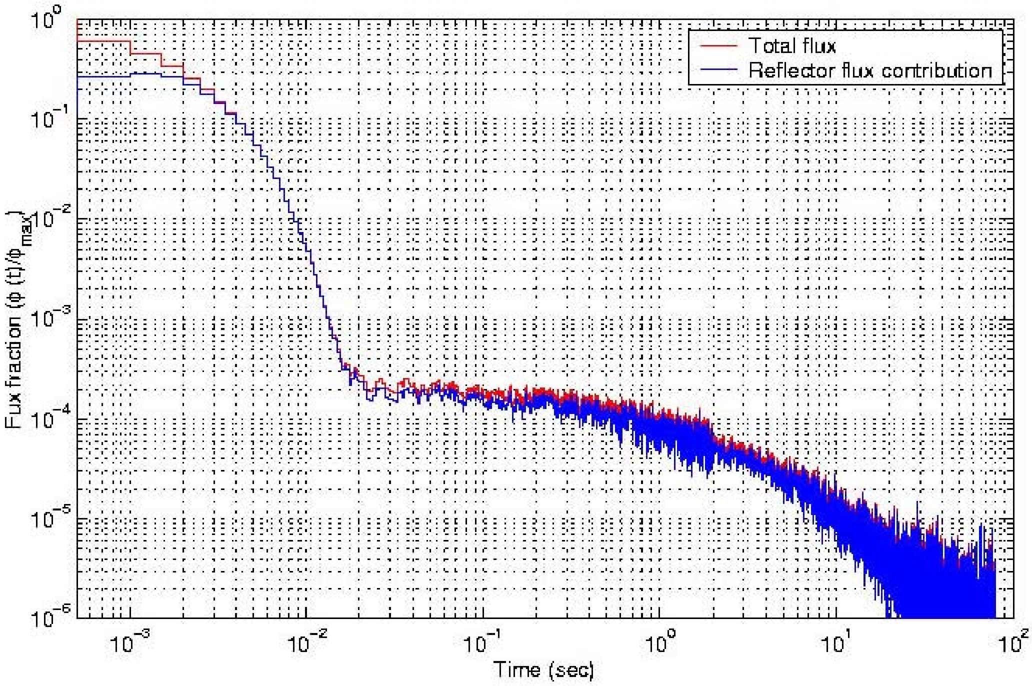


Figure 1 Total and flagged fluxes versus time on C1 control rod (a) at keff=0.98. Flagged to Total fluxes ratio (b).



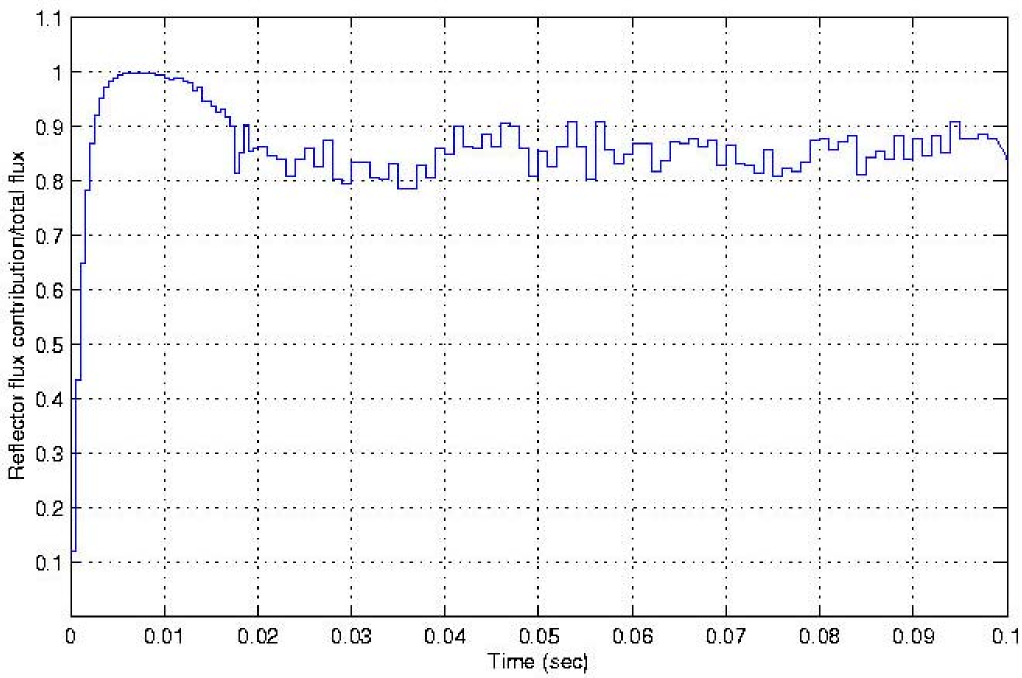


Figure 2 Total and flagged fluxes versus time on D1 control rod (a) at keff=0.98. Flagged to Total fluxes ratio (b).

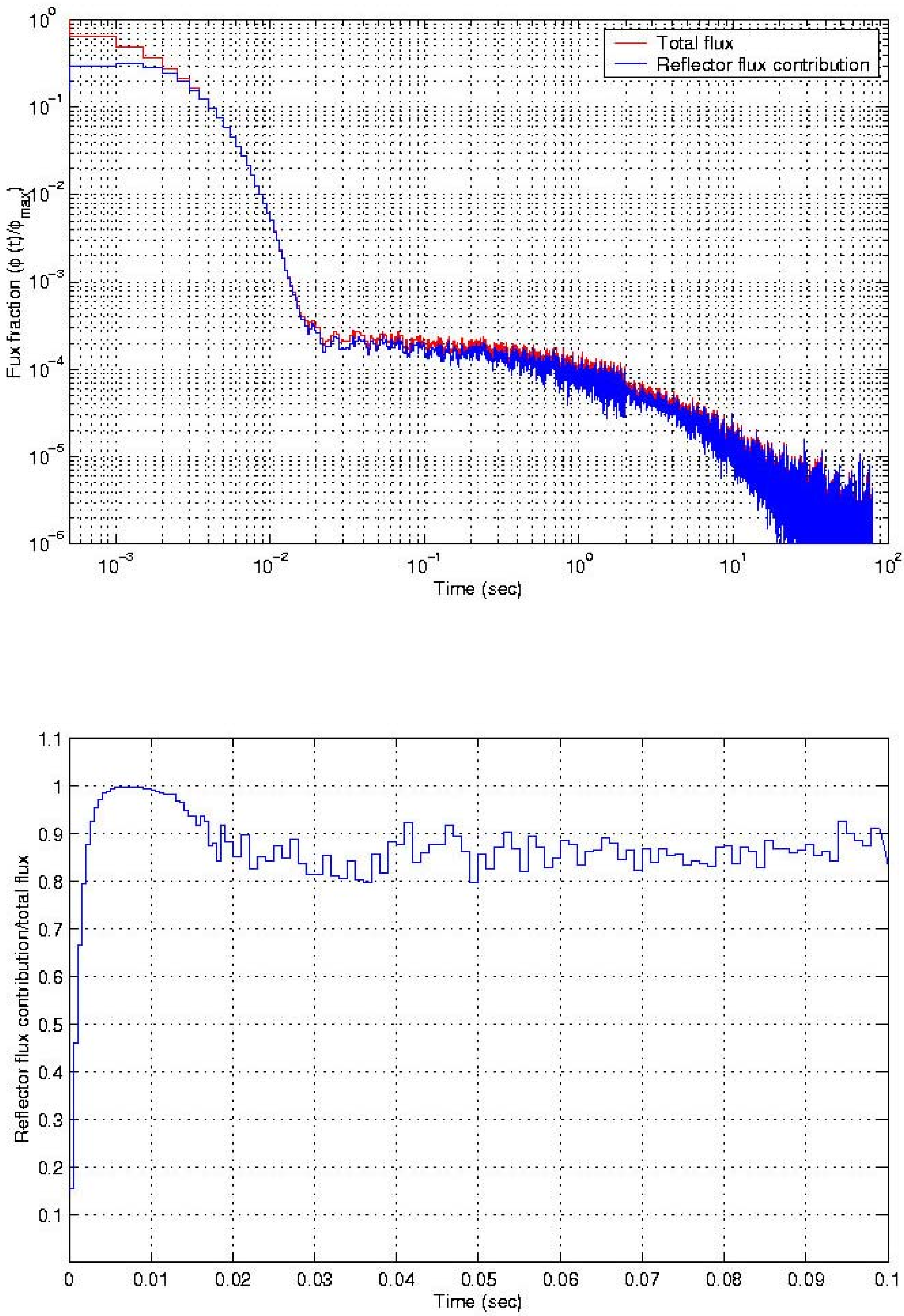


Figure 3 Total and flagged fluxes versus time on E1 control rod (a) at keff=0.98. Flagged to Total fluxes ratio (b).

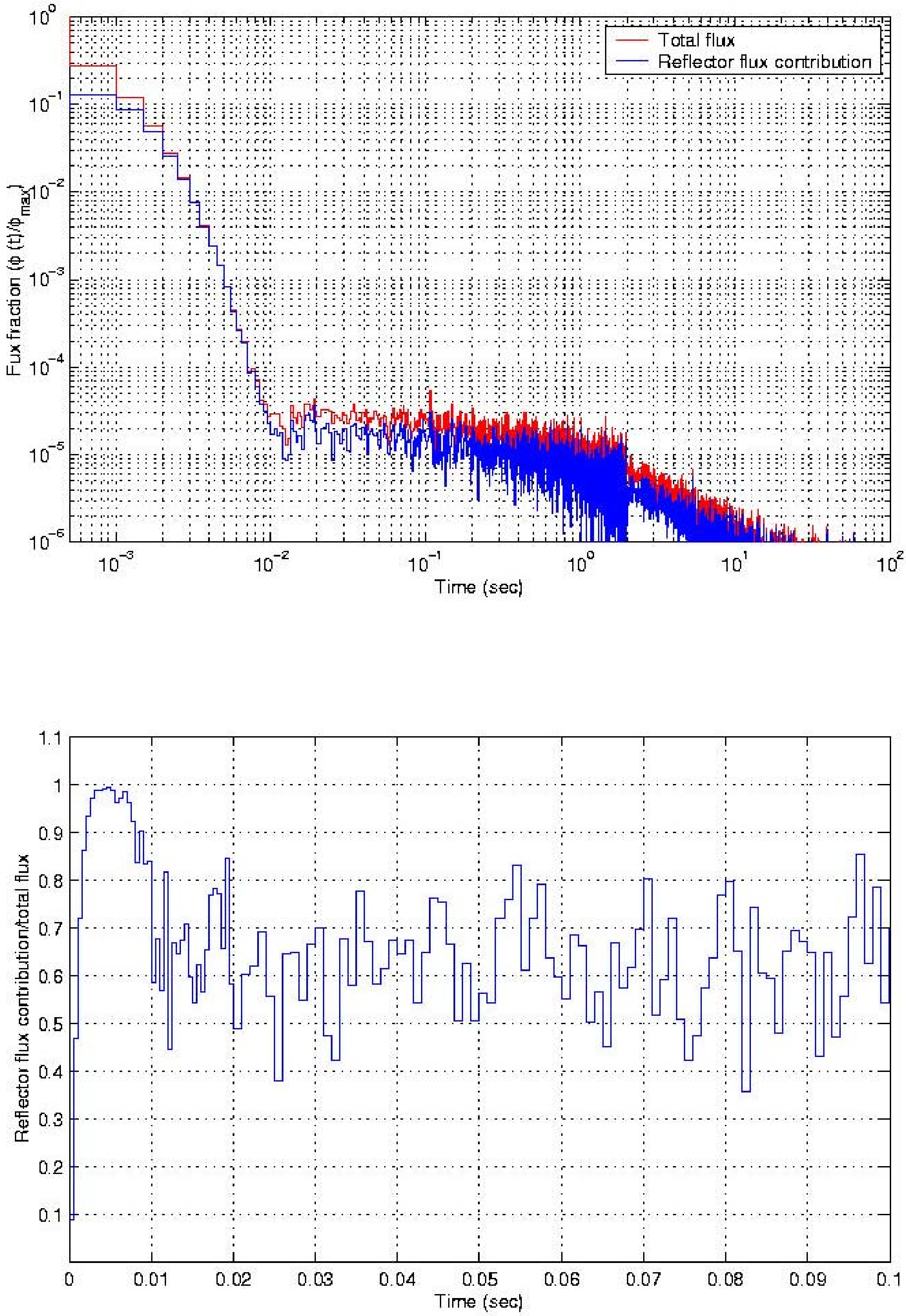


Figure 4 Total and flagged fluxes versus time on C1 control rod (a) at keff=0.96. Flagged to Total fluxes ratio (b).

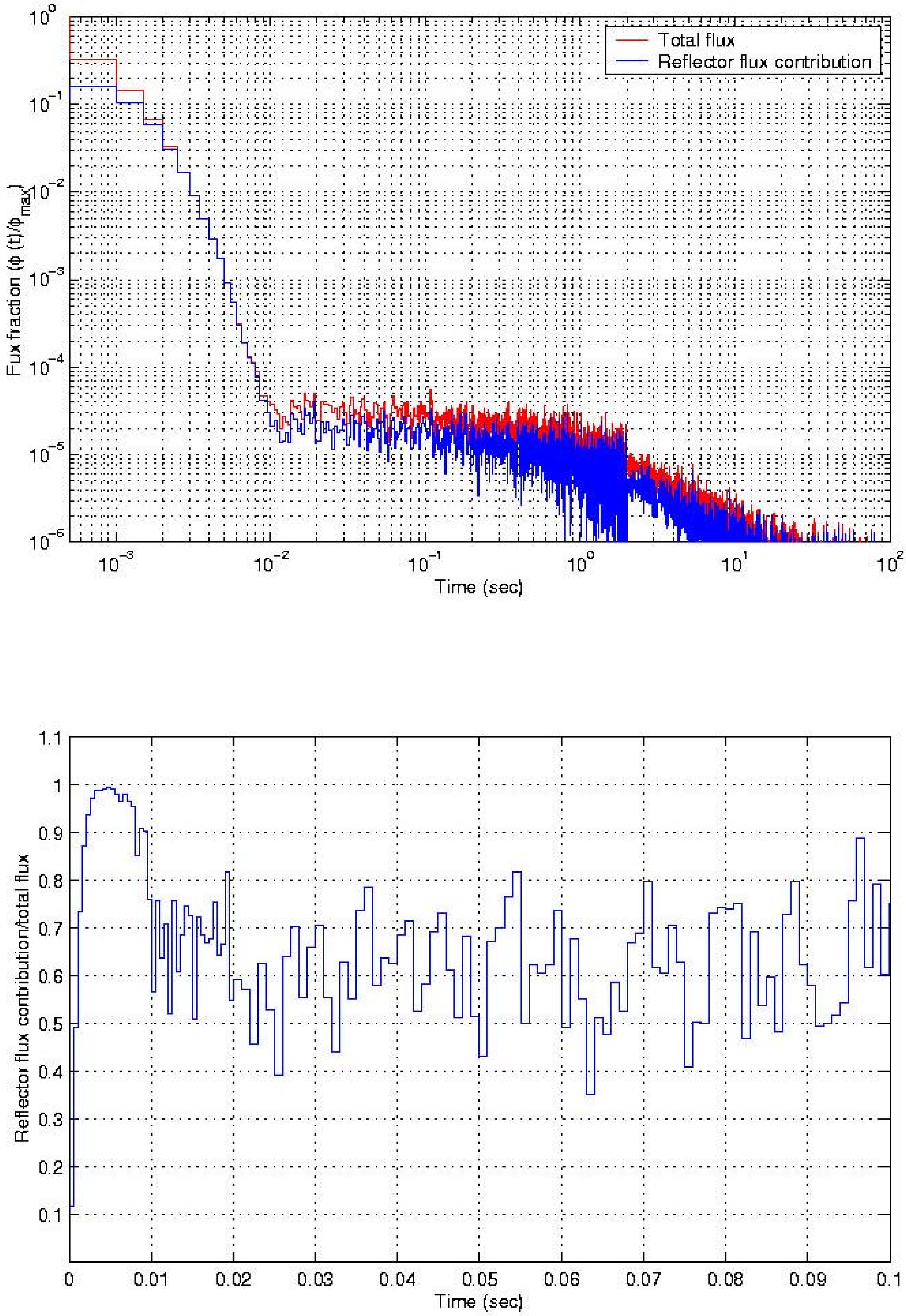


Figure 5 Total and flagged fluxes versus time on D1 control rod (a) at keff=0.96. Flagged to Total fluxes ratio (b).

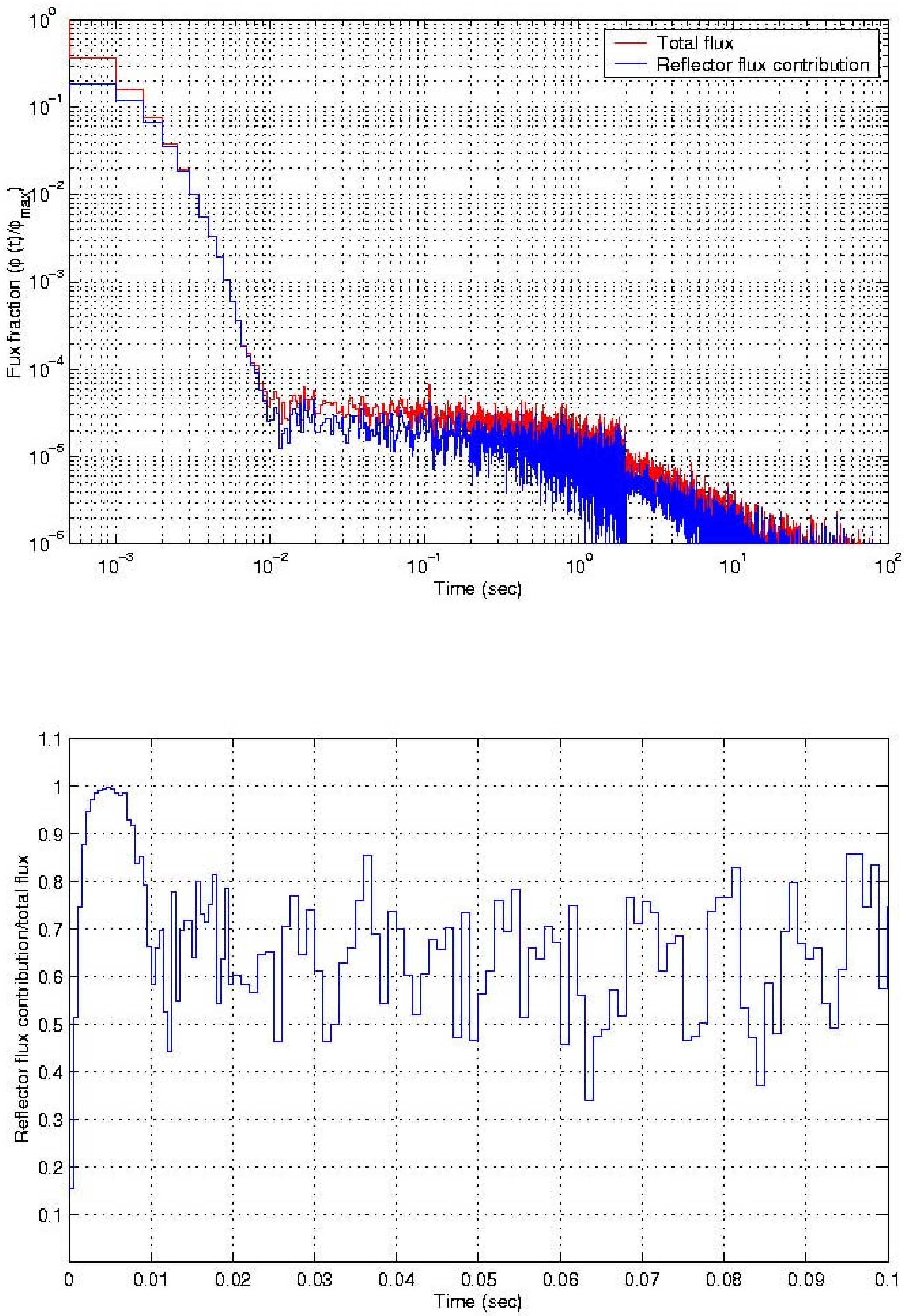
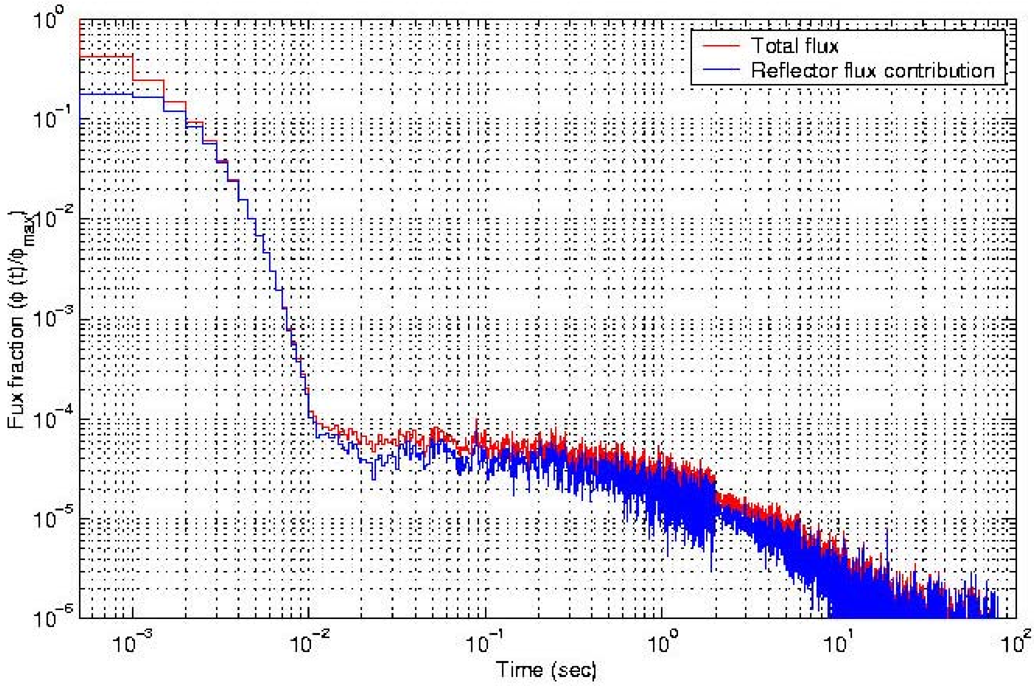


Figure 6 Total and flagged fluxes versus time on E1 control rod (a) at keff=0.96. Flagged to Total fluxes ratio (b).



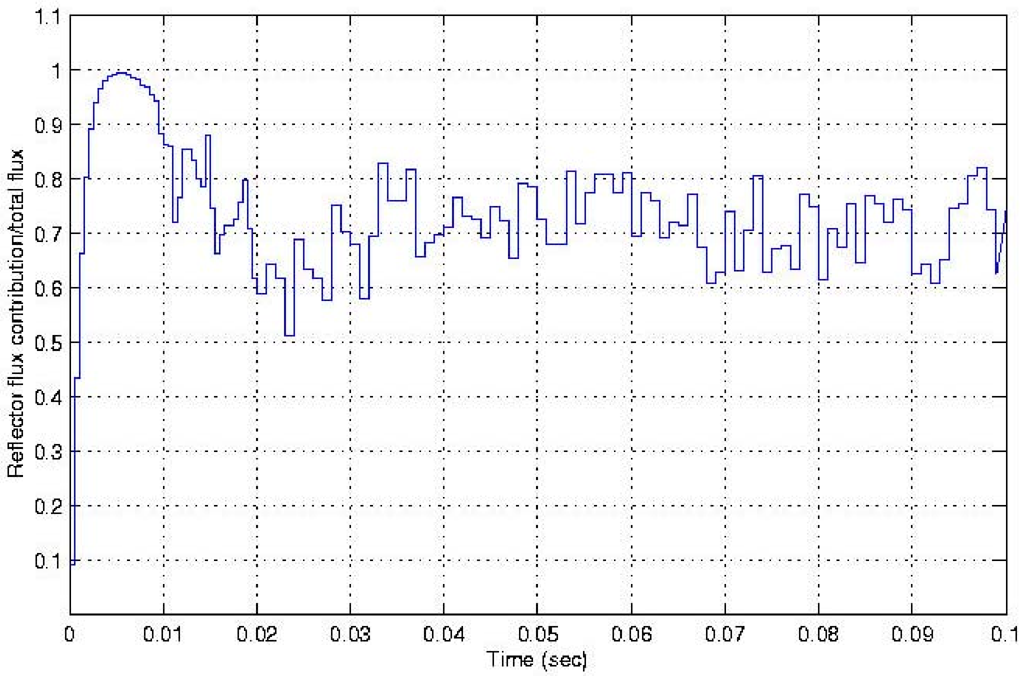


Figure 7 Total and flagged fluxes versus time on C1 control rod (a) at keff=0.93. Flagged to Total fluxes ratio (b).

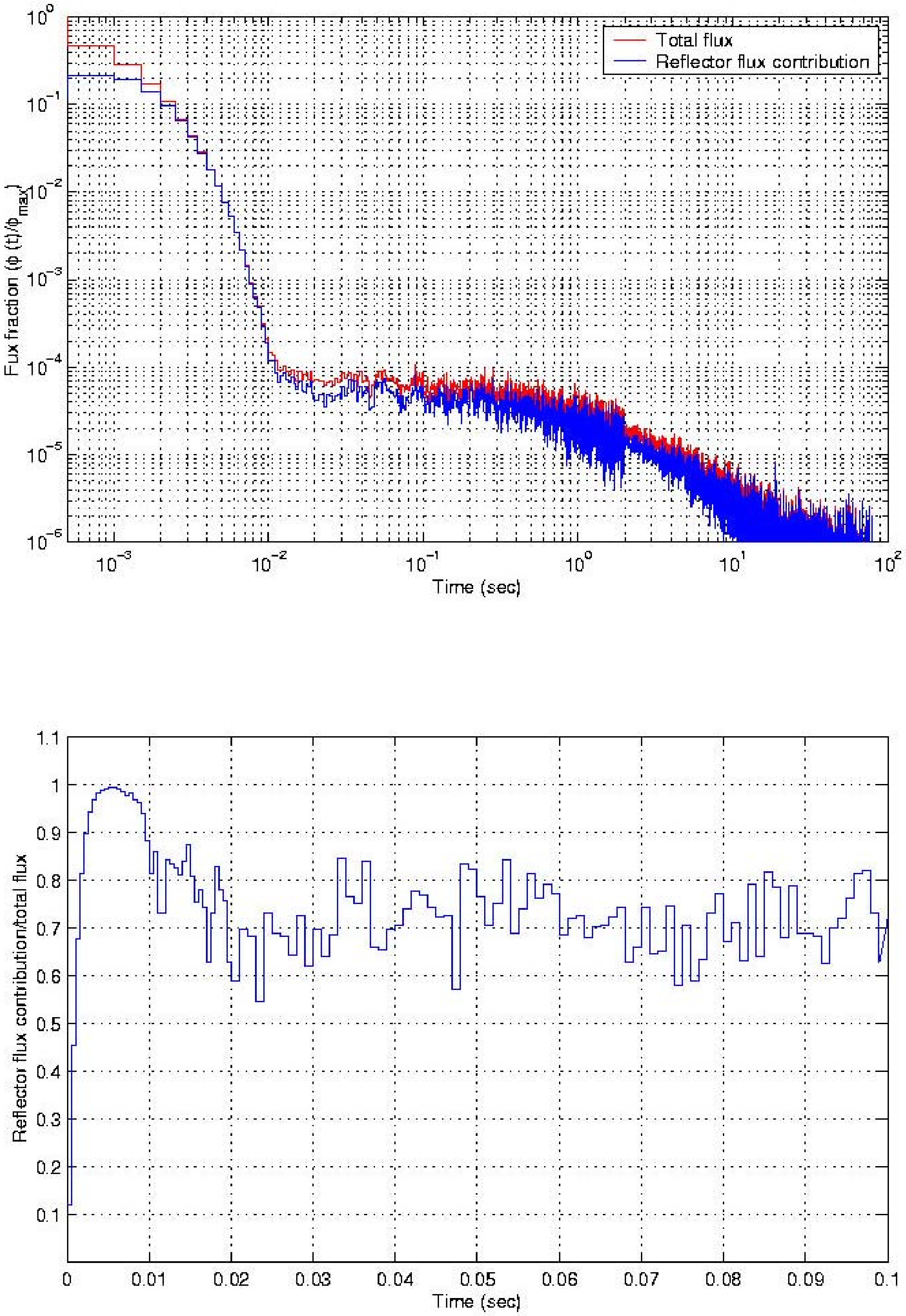
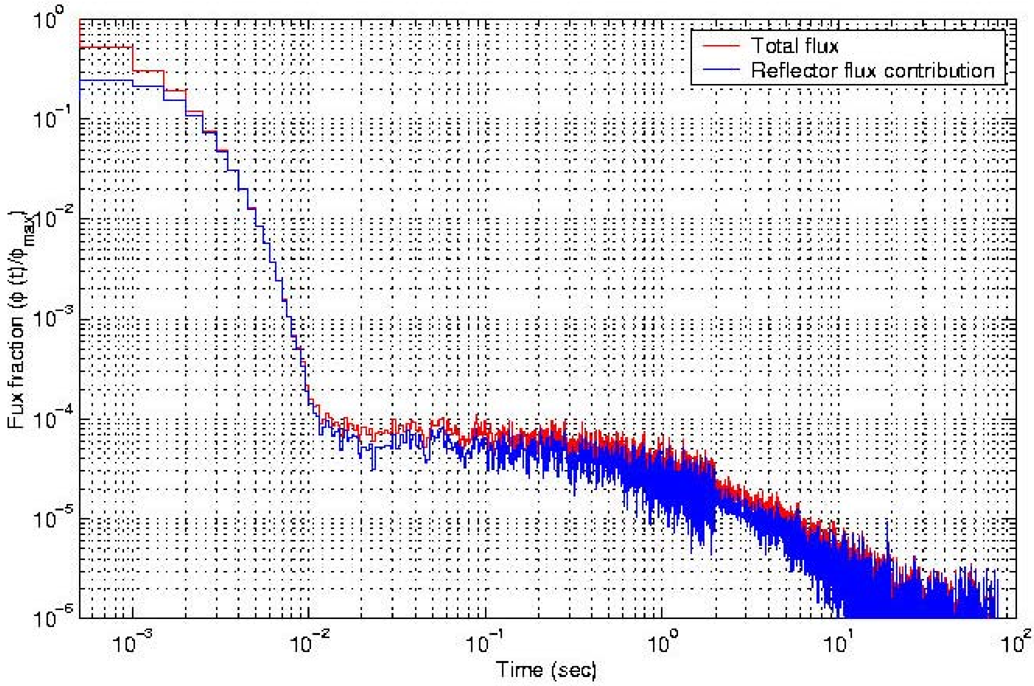


Figure 8 Total and flagged fluxes versus time on E1 control rod (a) at keff=0.93. Flagged to Total fluxes ratio (b).



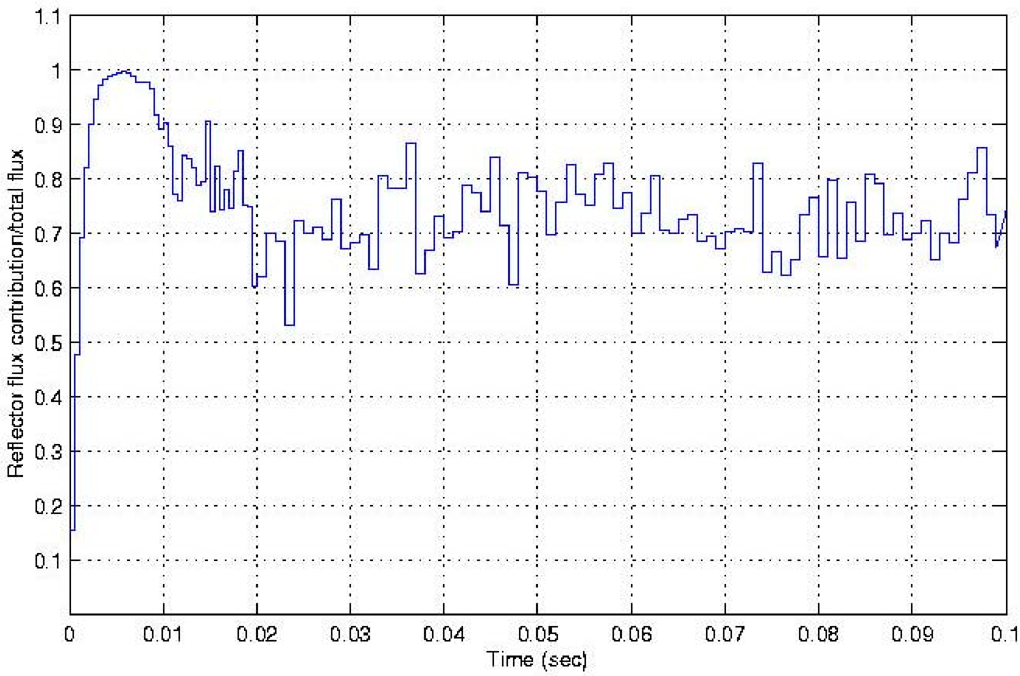
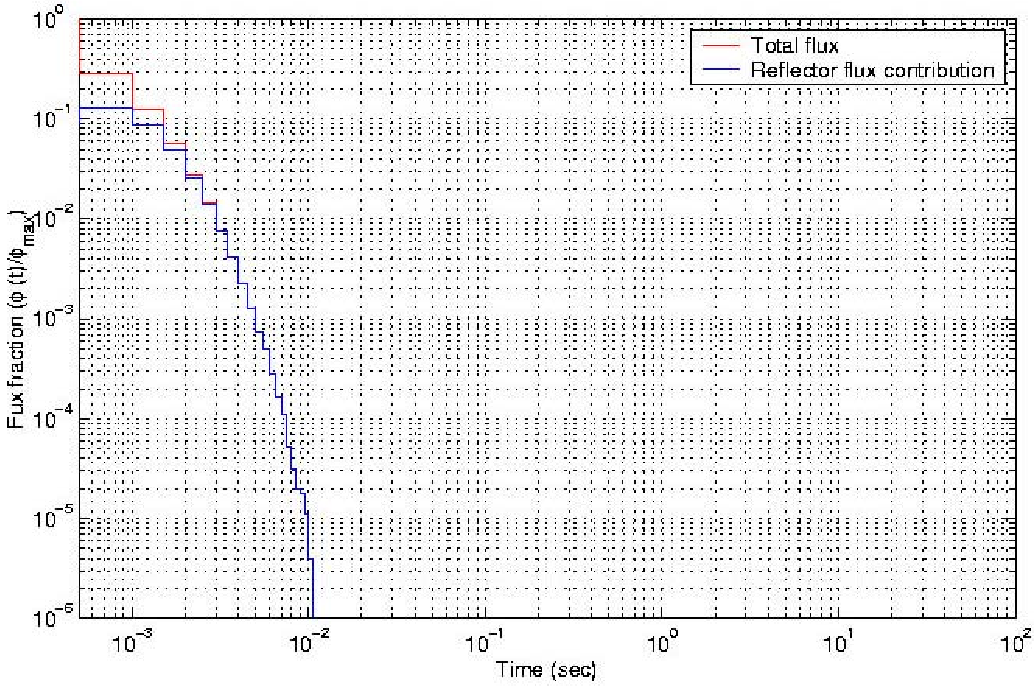


Figure 9 Total and flagged fluxes versus time on E1 control rod (a) at keff=0.93. Flagged to Total fluxes ratio (b).



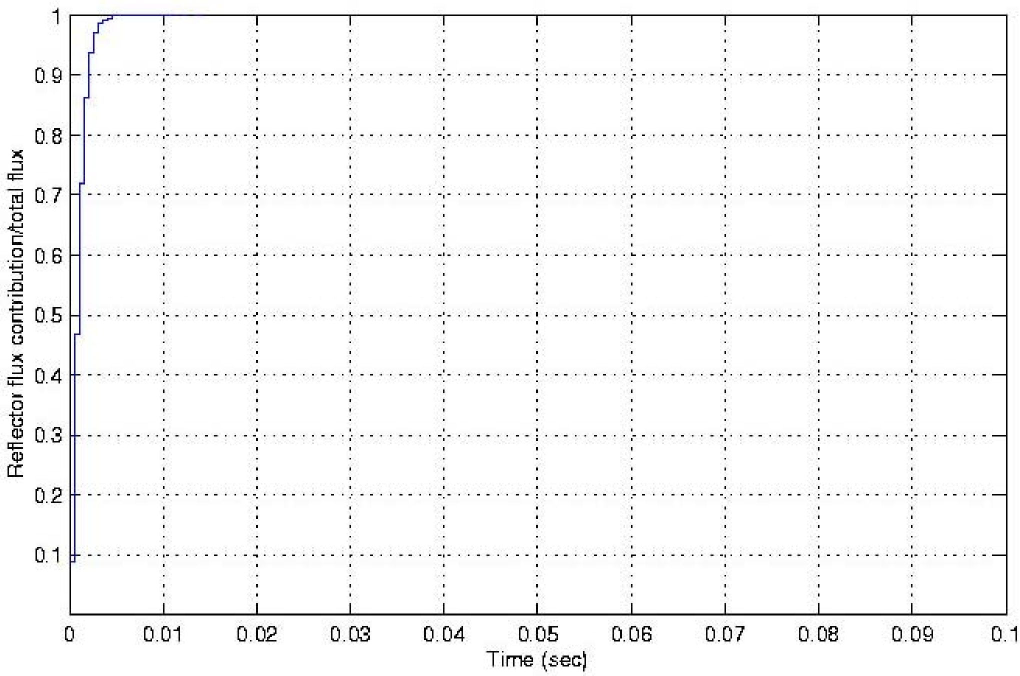


Figure 10 Prompt total and flagged fluxes versus time on C1 control rod (a) at keff=0.93. Prompt Flagged to Total fluxes ratio (b).

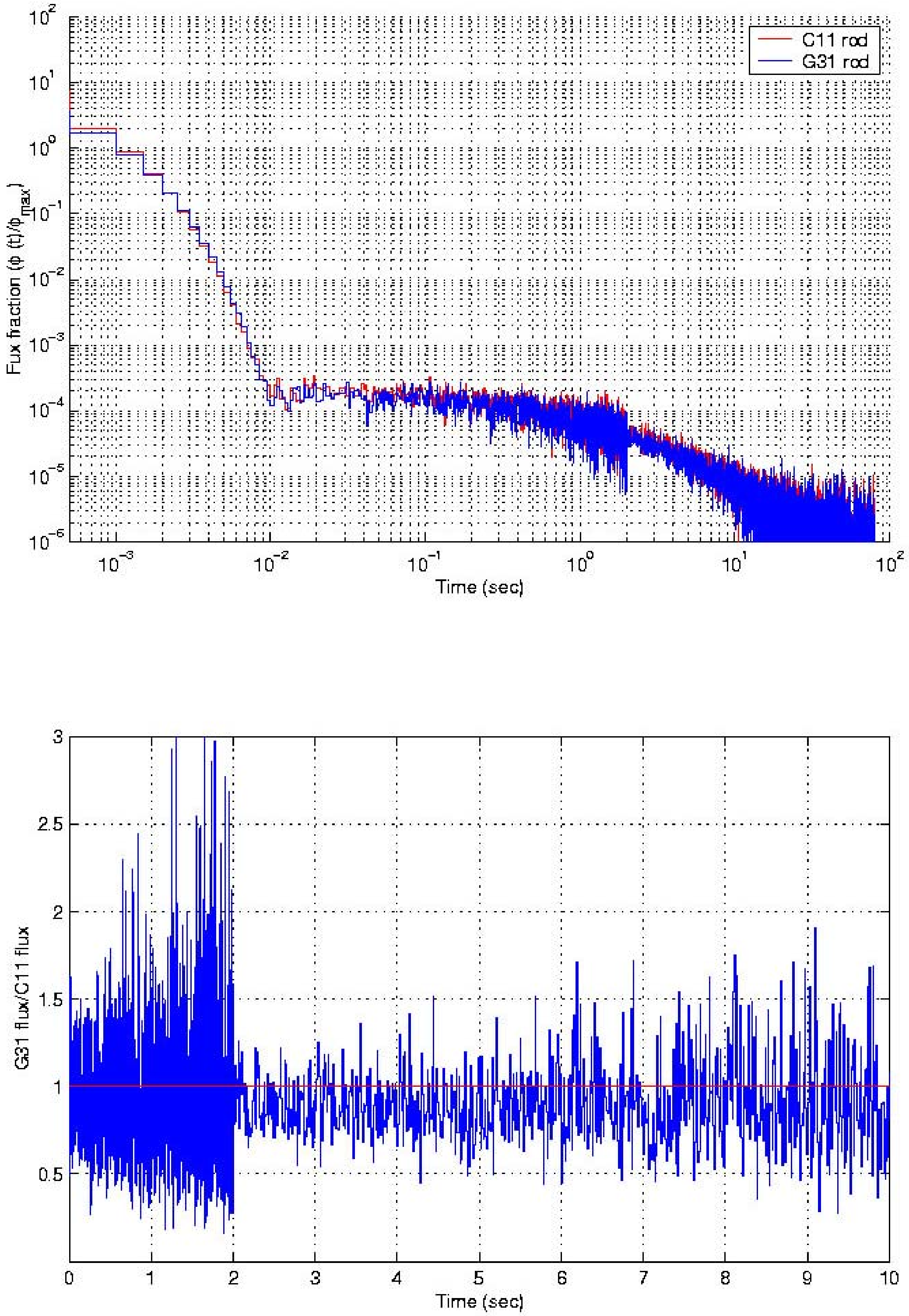


Figure 11 Total and flagged fluxes versus time of C11 and G31 control rod (a) at keff=0.93. Total fluxes ratio G31/C11 (b).