

Event selection and background estimation for the reactor neutrinos at RENO

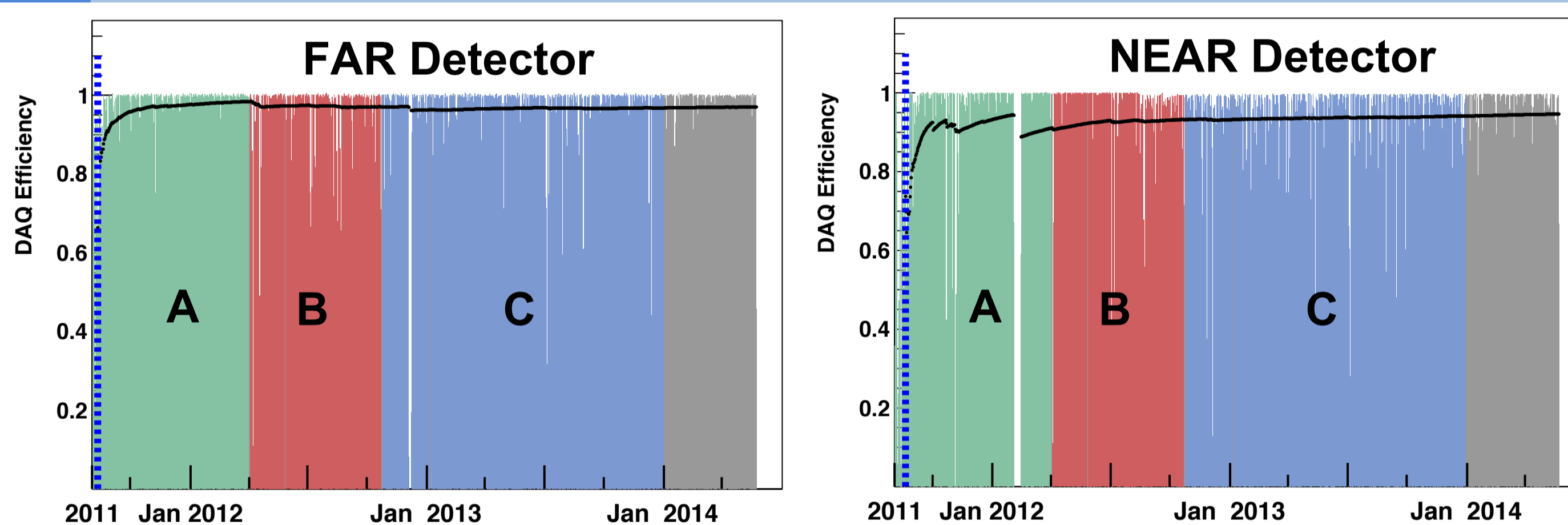
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For the RENO Collaboration



Result

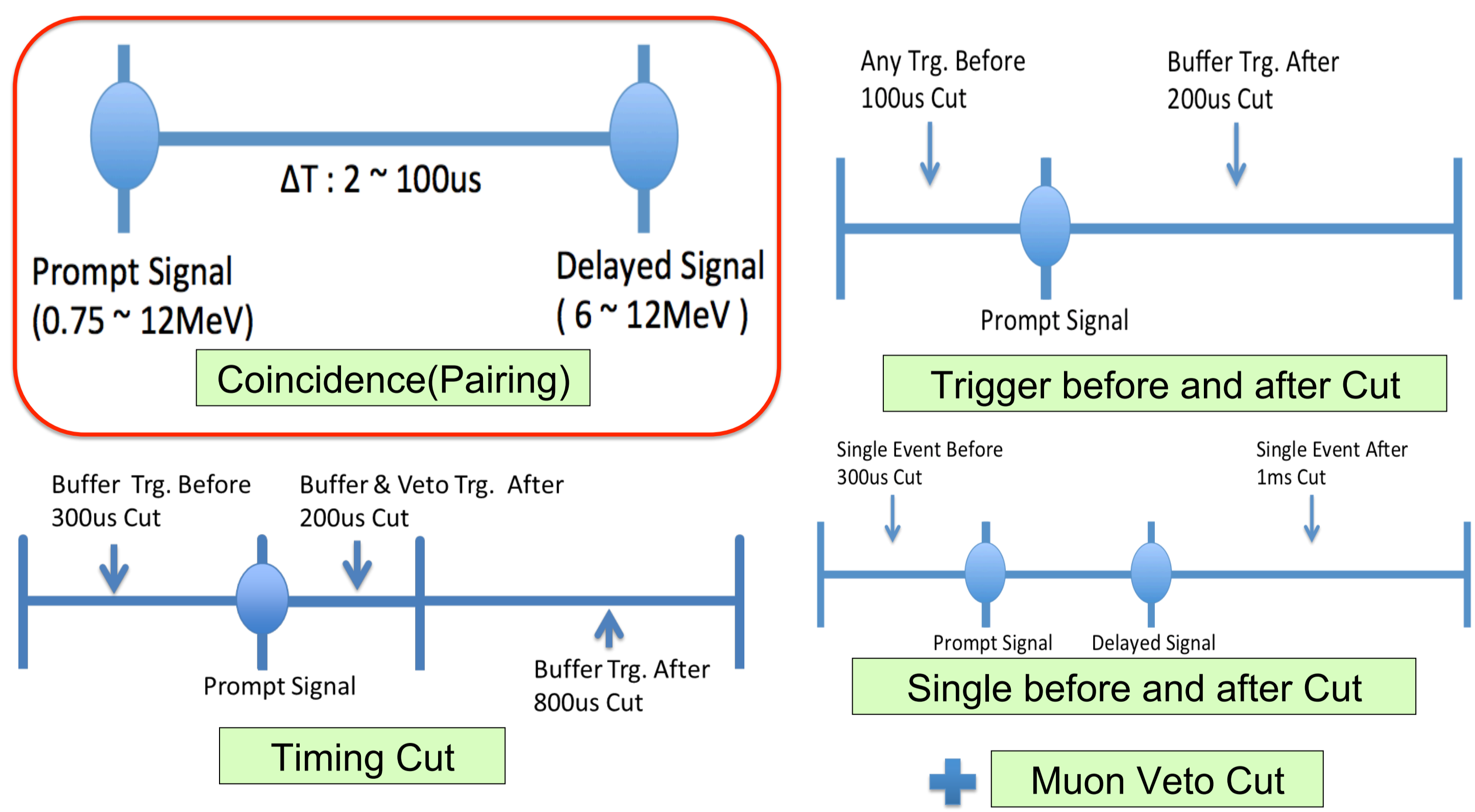
	FAR	NEAR
# of IBD events	52318	433196
Total Background rate (/day)	4890.30 ± 276.01 6.168 ± 0.348	10789.06 ± 521.94 14.175 ± 0.686
Accidental background (/day)	0.359 ± 0.006	1.823 ± 0.108
Fast neutron background (/day)	0.556 ± 0.024	2.668 ± 0.082
Li/He Background (/day)	2.072 ± 0.208	9.181 ± 0.665
Californium Background (/day)	3.166 ± 0.277	0.452 ± 0.067
DAQ Live-time (days)	794.722	761.111

Data Set



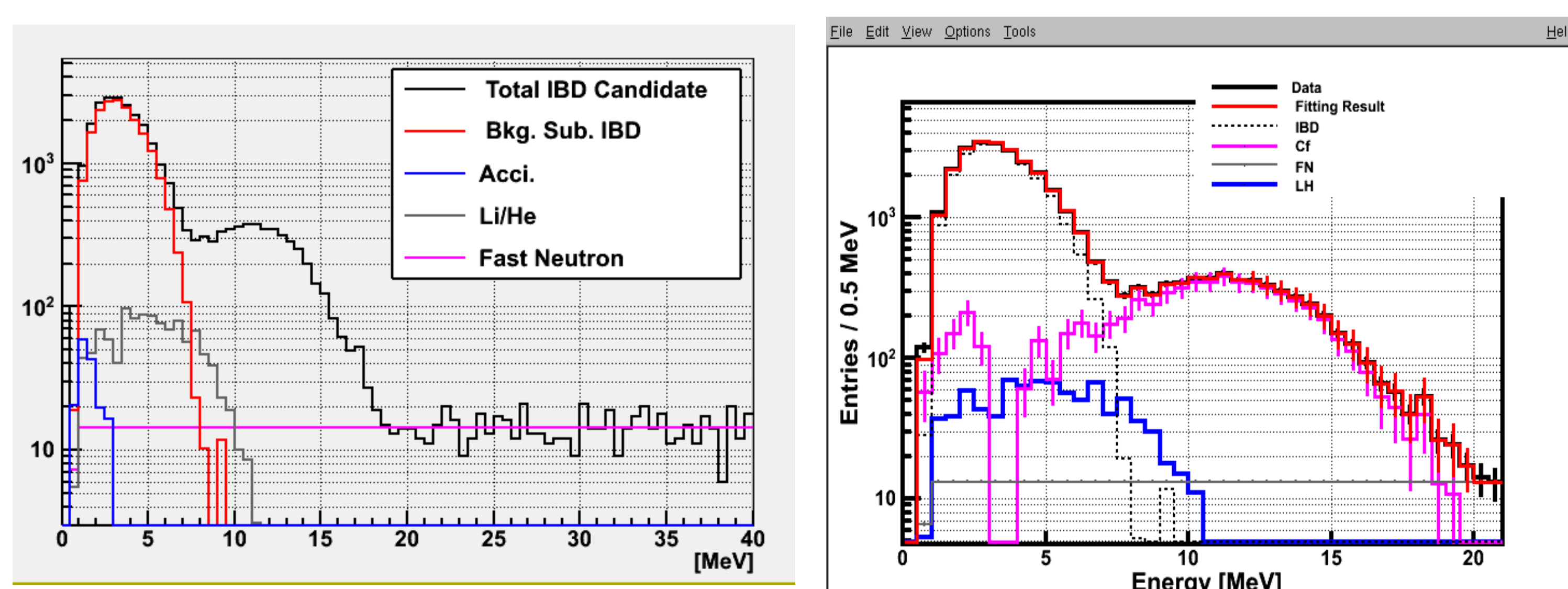
- Data taking began on Aug. 11, 2011 with both far and near detectors. (DAQ efficiency: ~95%)
- A+B+C (~800 days) : **Shape+rate analysis** [11 Aug, 2011 ~ 31 Dec, 2013], Neutrino2014
- DAQ Live-Time : [FAR : 794.722 (days)], [NEAR : 761.111 (days)]

Selection Cut



Californium Background

- Californium Background is assumed as subtraction of all background (Accidental, Li/He, Fast Neutron) from IBD candidates.

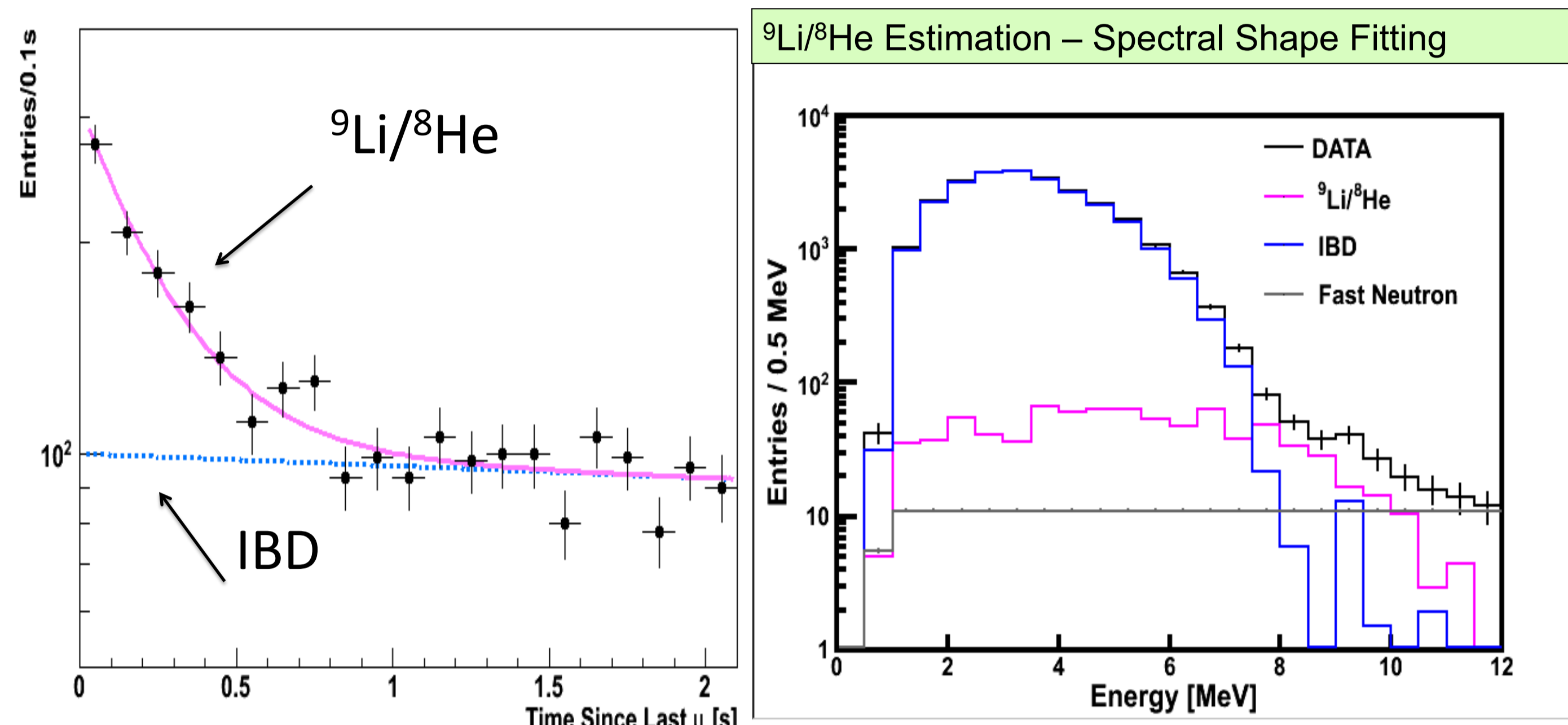


	FAR	NEAR
Background rate [/day]	3.166 ± 0.277	0.452 ± 0.067

Background estimation

${}^9\text{Li}/{}^8\text{He}$ (β -n) Background

${}^9\text{Li}/{}^8\text{He}$ are unstable isotopes emitting (β ,n) followers and produced when muon interact with carbon in the LS.



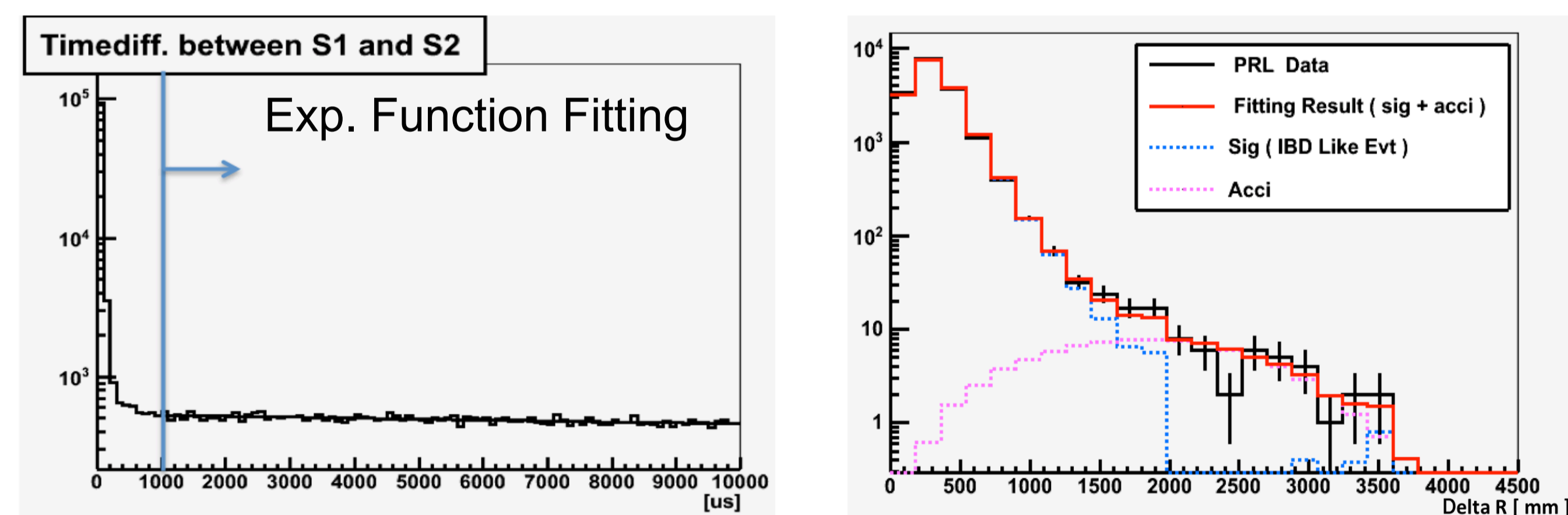
	FAR	NEAR
Background rate [/day]	2.072 ± 0.208	9.181 ± 0.665

Accidental Background

- Rate Coincidence Calculation Method
- Calculate a probability of coincidence of events rates

$$N_{\text{accidental}} = N_{\text{delayed}} \times \left(1 - \exp^{-R_{\text{prompt}}(\text{Hz}) \times \Delta T(\text{s})}\right) \pm \frac{N_{\text{accidental}}}{\sqrt{N_{\text{delayed}}}}$$

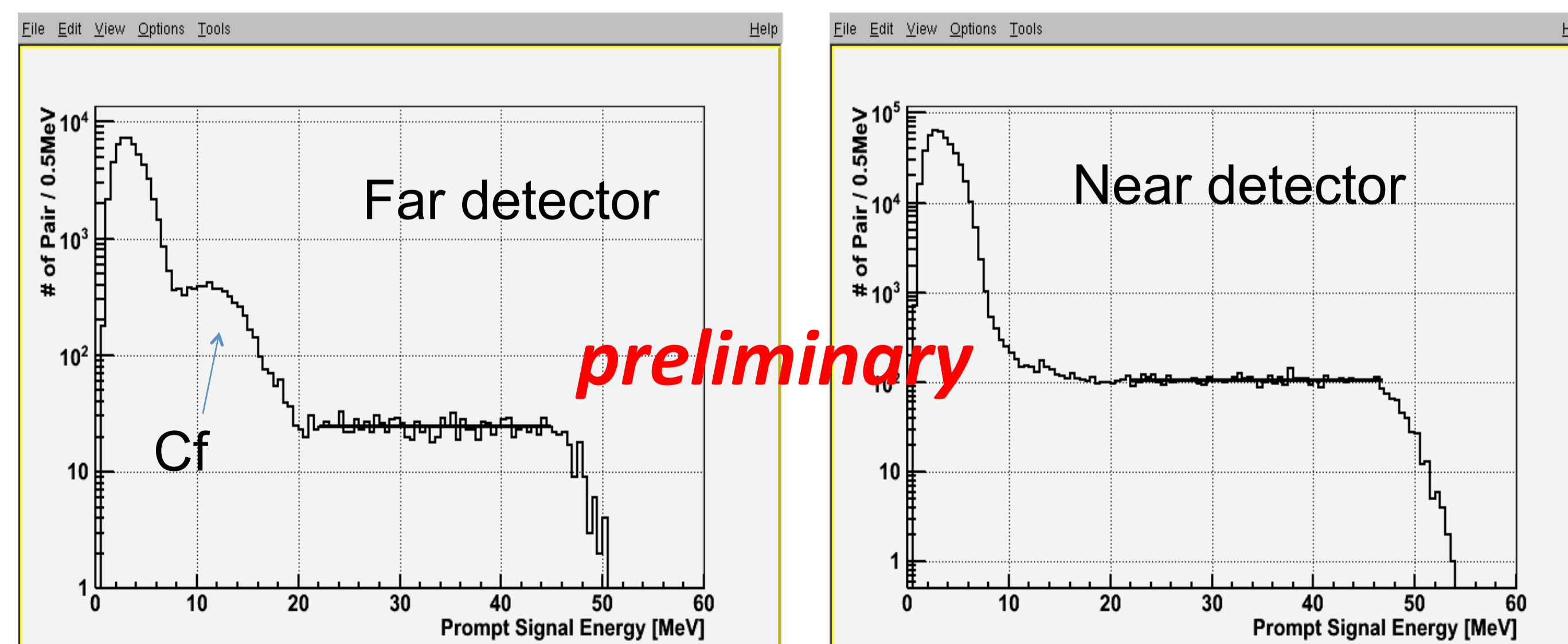
- ΔT Distribution Fitting Method
- Estimate accidental component in selection time window (by exponential fitting over 1ms)
- ΔR Distribution Fitting Method
- Estimate physical events based on spatial correlation (opposite : accidental component)



	Rate Coincidence	ΔT Distribution	ΔR Distribution
FAR Detector background rate [/day]	0.359 ± 0.006	0.384 ± 0.004	0.403 ± 0.031
NEAR Detector background rate [/day]	1.823 ± 0.108	2.041 ± 0.013	2.094 ± 0.111

Fast Neutron Background

- Fast Neutron is assumed as flat spectrum because of scattering with protons
- Estimate fast neutron magnitude by 0th order polynomial fitting



	FAR	NEAR
Background rate [/day]	0.556 ± 0.024	2.668 ± 0.082