Results about the Nucleon and Delta

Orsay/Grenoble

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- **Data**
- **Effective masses**

Data

- $\beta = 3.9$, $\kappa = 0.160856$, $24^3 \times 48$.
- $\mu = 0.0085$, **82 configurations: 1000,1020,$\cdots$,2620.**
- $\mu = 0.0064$, **100 configurations: 1000,1020,$\cdots$,2980.**
- $\mu = 0.004$, **41 configurations: 2520,2540,$\cdots$,3320.**
- **Random point source.**
- **The interpolating fields are**

$$J^P(x) = \epsilon^{abc}[u^{Ta}(x)C\gamma_5 d^b(x)]u^c(x),$$

$$J^N(x) = \epsilon^{abc}[u^{Ta}(x)C\gamma_5 d^b(x)]d^c(x),$$

$$J^{\Delta^{++}} = \epsilon^{abc}[u^{Ta}(x)C\gamma_2 u^b(x)]u^c(x),$$

$$J^{\Delta^-} = \epsilon^{abc}[d^{Ta}(x)C\gamma_2 d^b(x)]d^c(x).$$

The two point correlator is

$$K_{ij}(t) = \sum_{\vec{x}} \langle \Omega | J_i(x) \bar{J}_j(y) | \Omega \rangle,$$

where $t = x_0 - y_0$**.**

From twisted base to physical base:

- **The fields are related by**

$$\psi_{phys} = e^{i\frac{\pi}{4}\gamma_5\tau^3}\psi_{tw},$$

$$\bar{\psi}_{phys} = \bar{\psi}_{tw} e^{i\frac{\pi}{4}\gamma_5\tau^3}.$$

- **The quark propagators are related by**

$$\langle u\bar{u}\rangle_{phys} = e^{i\frac{\pi}{4}\gamma_5}\langle u\bar{u}\rangle_{tw} e^{i\frac{\pi}{4}\gamma_5},$$

$$\langle d\bar{d}\rangle_{phys} = e^{-i\frac{\pi}{4}\gamma_5}\langle d\bar{d}\rangle_{tw} e^{-i\frac{\pi}{4}\gamma_5}.$$

- **The two point correlators are related by**

$$K^P(t)_{phys} = e^{i\frac{\pi}{4}\gamma_5} K^P(t)_{tw} e^{i\frac{\pi}{4}\gamma_5},$$

$$K^N(t)_{phys} = e^{-i\frac{\pi}{4}\gamma_5} K^N(t)_{tw} e^{-i\frac{\pi}{4}\gamma_5},$$

$$K^{\Delta^{++}}(t)_{phys} = e^{i\frac{\pi}{4}\gamma_5} K^{\Delta^{++}}(t)_{tw} e^{i\frac{\pi}{4}\gamma_5},$$

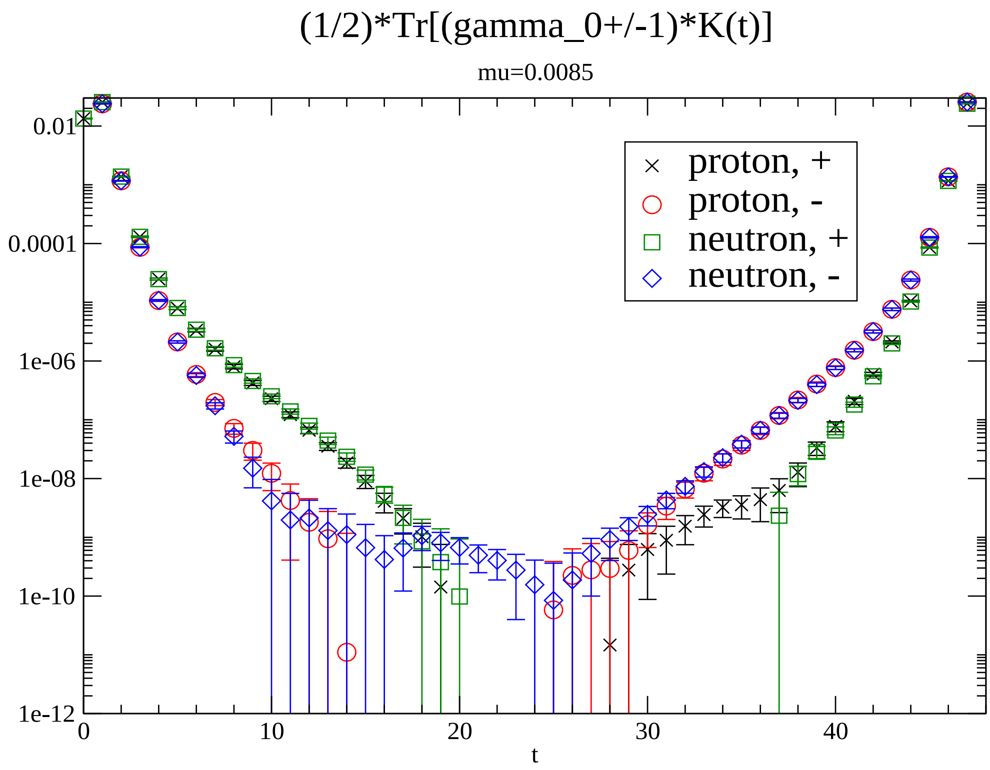
$$K^{\Delta^{-}}(t)_{phys} = e^{-i\frac{\pi}{4}\gamma_5} K^{\Delta^{-}}(t)_{tw} e^{-i\frac{\pi}{4}\gamma_5}.$$

Parity projection

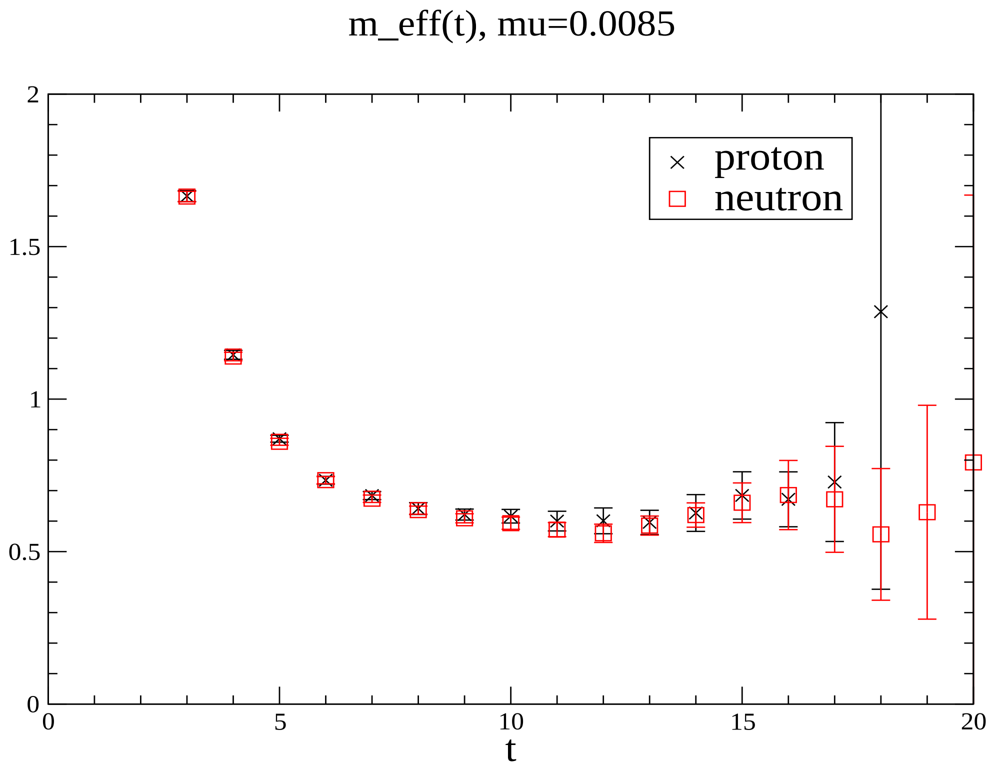
We do a parity projection on $K(t)_{phys}$ to separate the positive parity states from the negative parity states:

$$C^{\pm}(t) = \mathrm{Tr}[\frac{\gamma_0 \pm 1}{2} K(t)_{phys}].$$

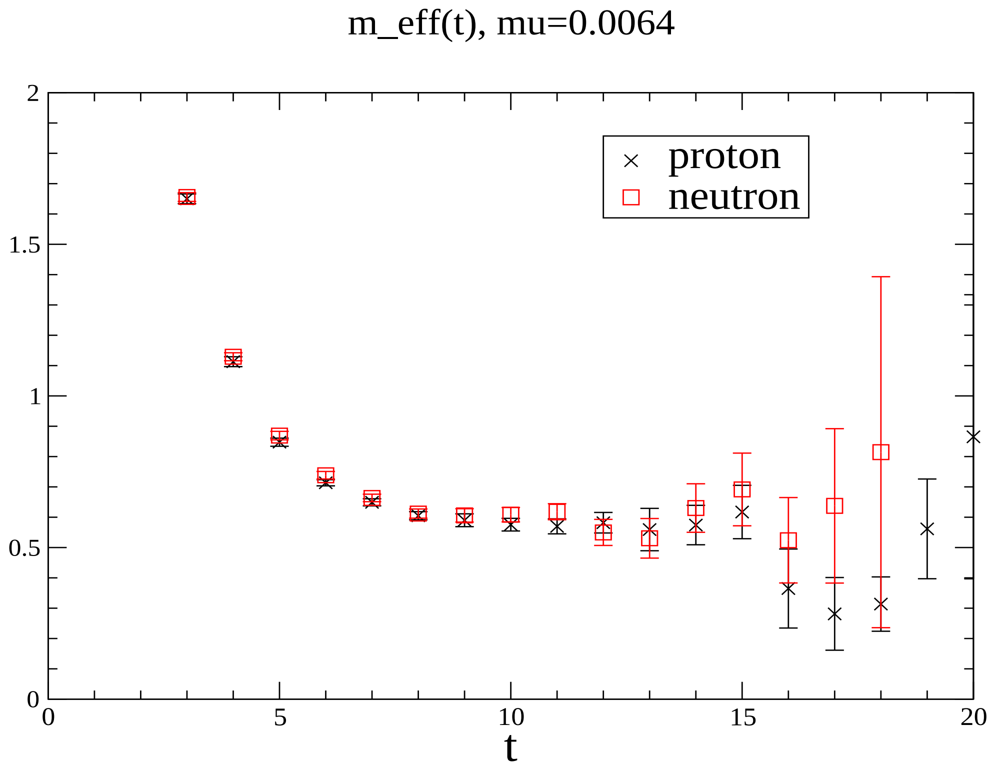
$C^{\pm}(t)$ of proton and neutron



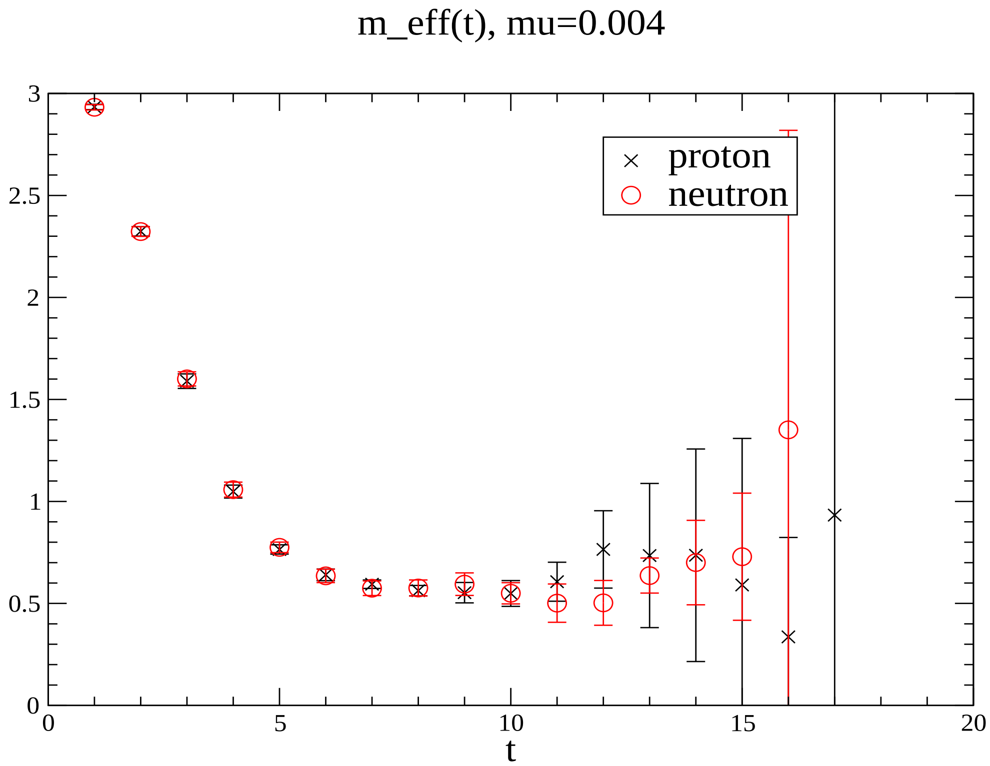
Effective masses of nucleon



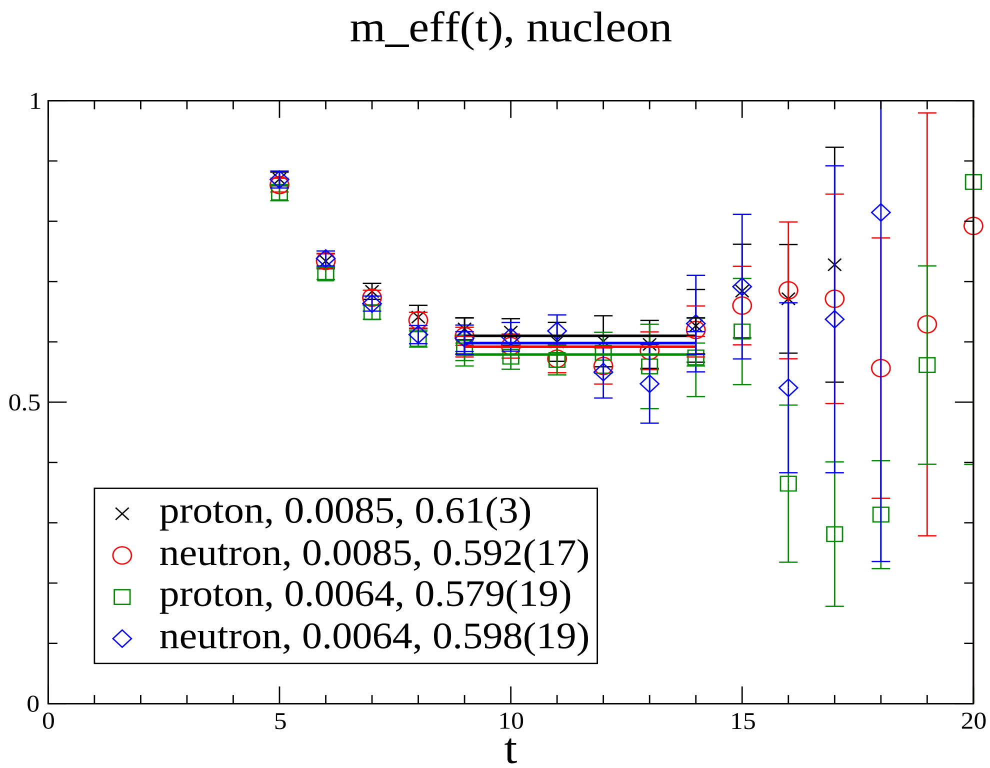
Effective masses of nucleon



Effective masses of nucleon



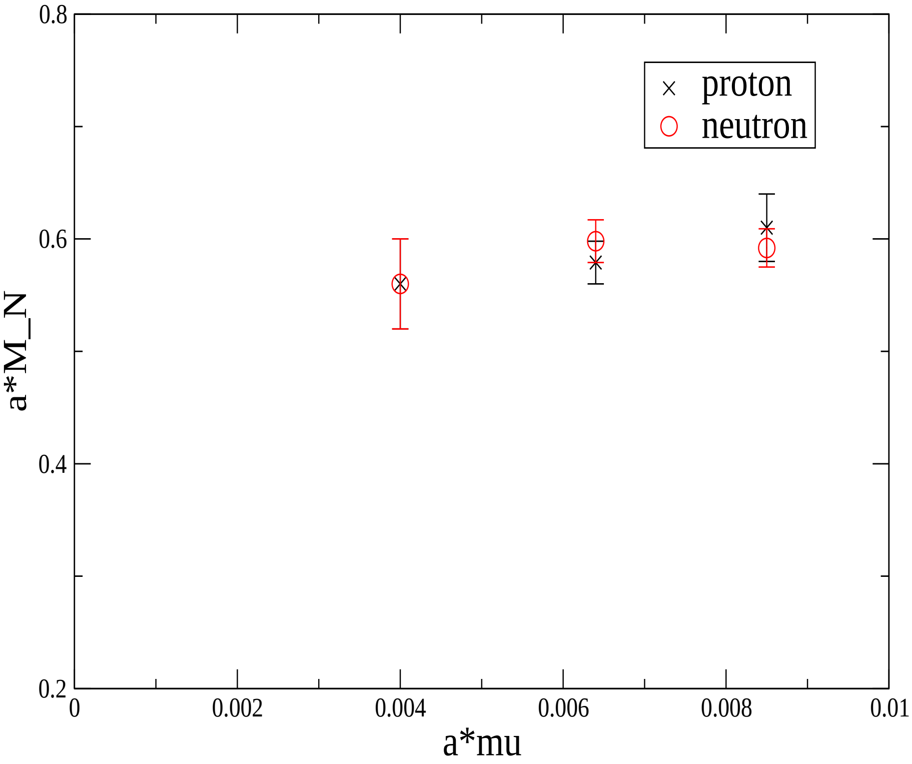
Constant fits



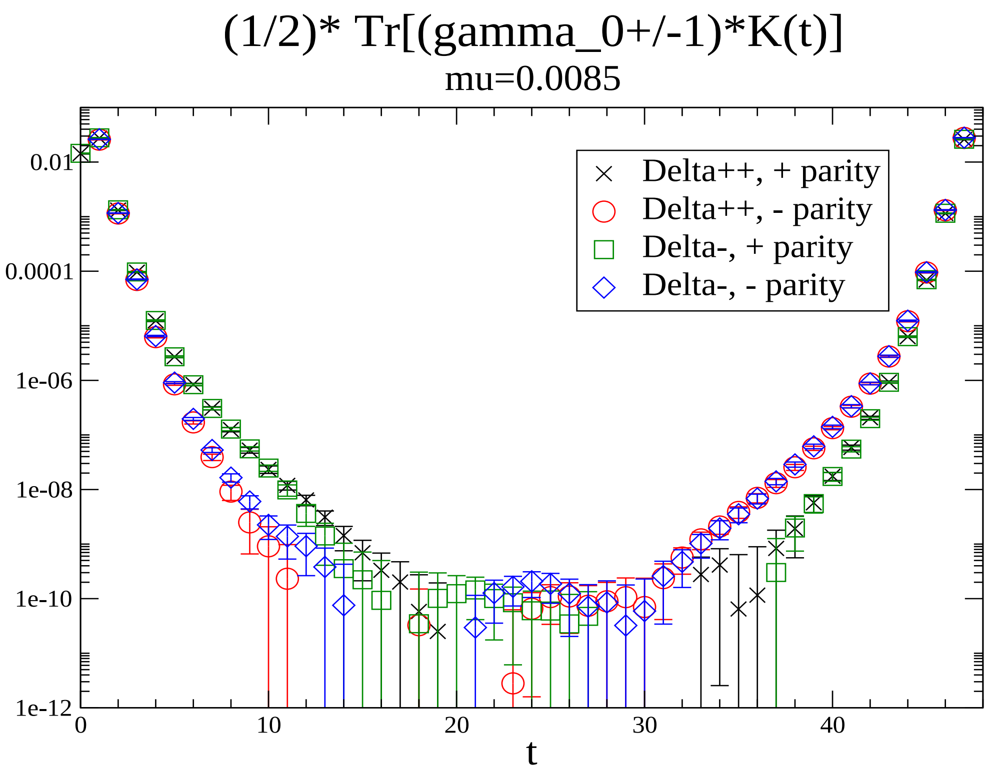
$\mu = 0.004$**:**

proton and neutron: 0.56(4) (t:8-11)

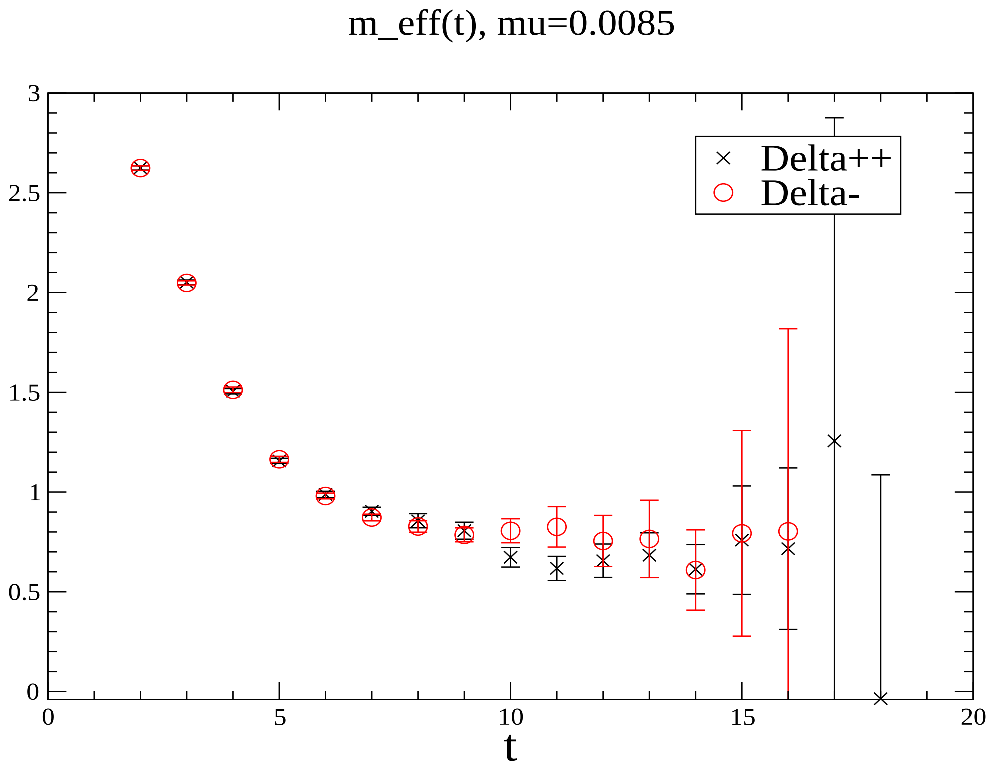
aM_N versus $a\mu$



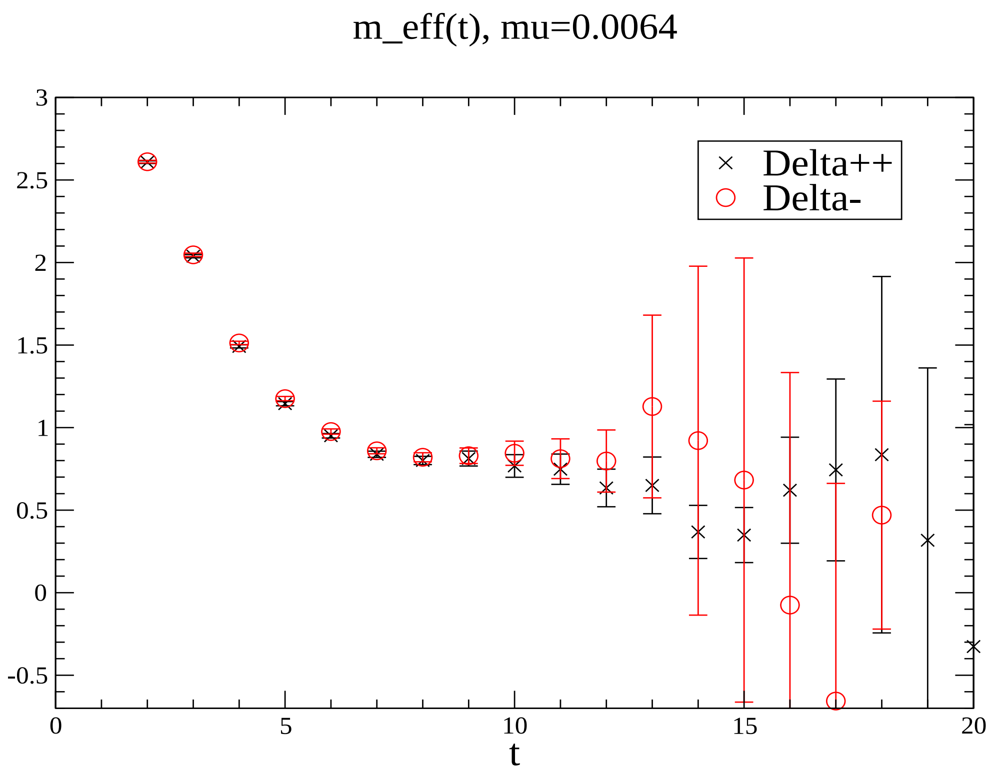
Δ^{++} and Δ^{-}



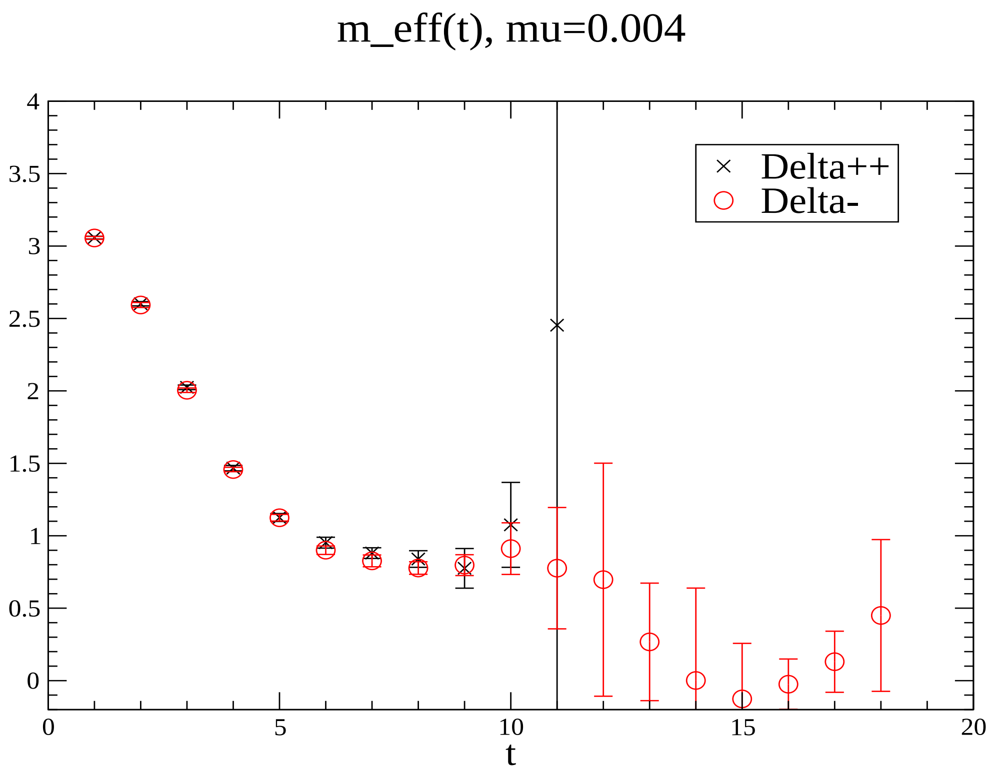
Effective masses of Δ^{++} and Δ^{-}



Effective masses of Δ^{++} and Δ^{-}



Effective masses of Δ^{++} and Δ^{-}



Constant fits