

Charm quark status with tmQCD ($N_f = 2$)

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- m_c
- f_D
- m_{D_s}/m_D
- f_{D_s}/f_D

$$\beta = 3.9$$

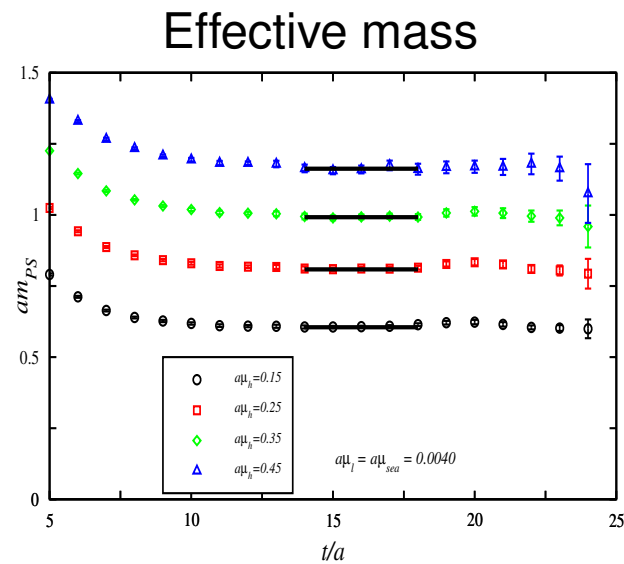
$$V = 24^3 \times 48$$

240 configurations

1 measurement every 20 trajectories

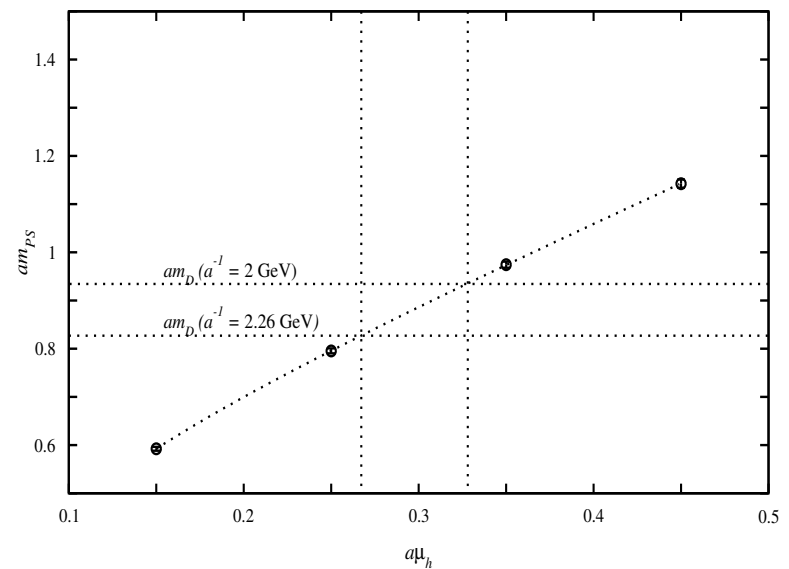
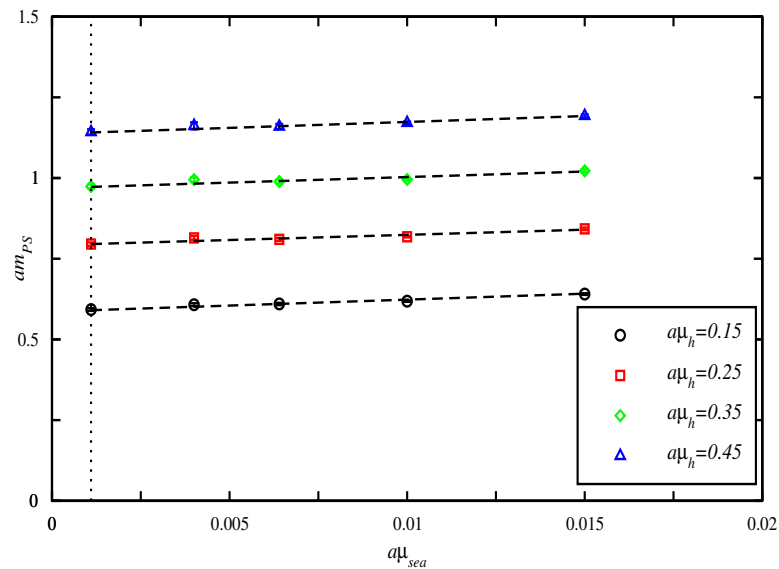
$a\mu_l$	$a\mu_h$
0.0040	0.15
0.0064	0.25
0.0100	0.35
0.0150	0.45

$$C_{PP}(t) = \frac{Z_{PS}}{2 \sinh(am_{PS})} e^{-m_{PS} \frac{T}{2}} \cosh \left(t - \frac{T}{2} \right)$$



m_c

- Linear chiral extrapolation of $am_{PS}(a\mu_h, a\mu_l)$ through $a\mu_{ud}$
- Fits of $am_{PS}(a\mu_h)$: quadratic in $a\mu_h$ (not good), quadratic in $1/a\mu_h$ or linear in $a\mu_h$ and $1/a\mu_h$ (preferred)



Depending on a^{-1} , $a\mu_c \in [0.26 - 0.33]$

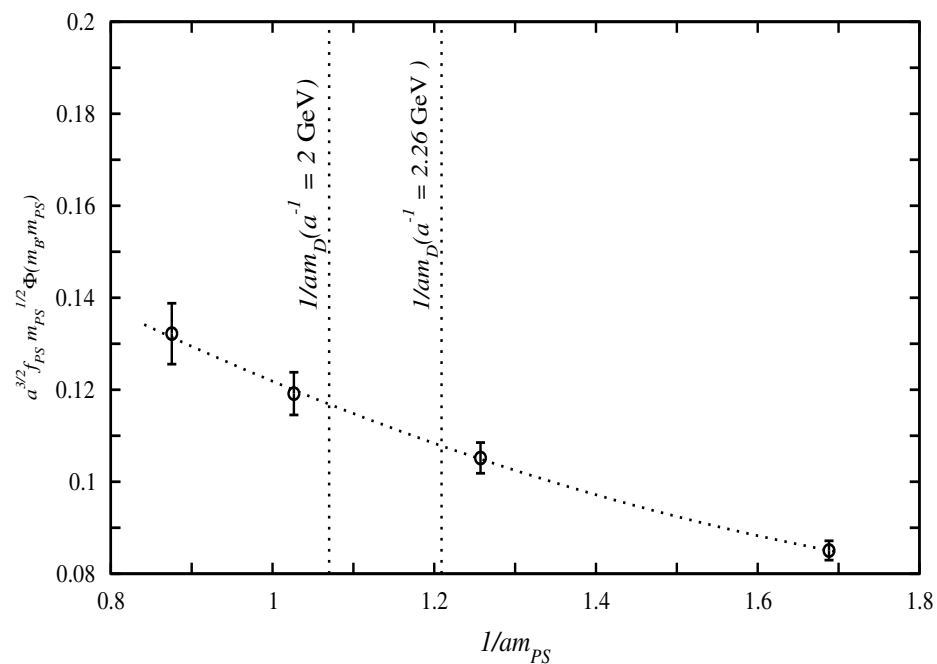
With $Z_P^{\text{RI-MOM}}(\mu = a^{-1}) = 0.39(1)$:

$$m_c^{\overline{\text{MS}}}(2 \text{ GeV}) = 1.37(1)_{-9}^{+3} \text{ GeV}$$

$$f_D$$

$$\text{Ward identity: } af_{PS} = \frac{a\mu_l + a\mu_h}{(am_{PS})^2} \sqrt{Z_{PS}}$$

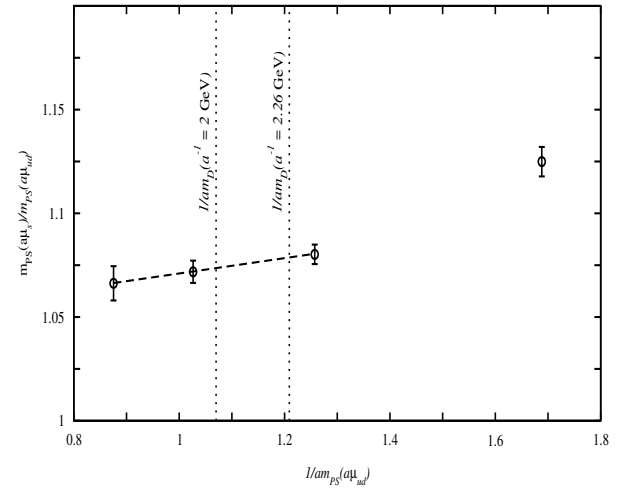
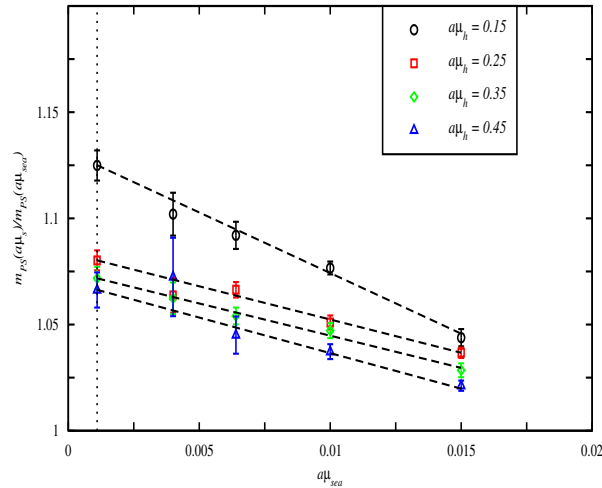
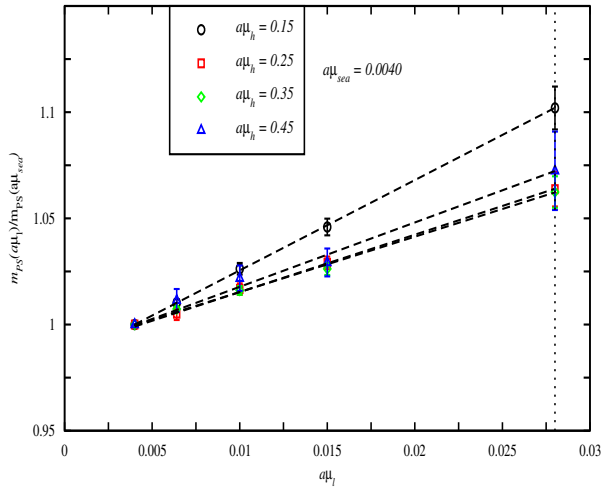
$$a^{3/2} f_{PS} \sqrt{m_{PS}} \left(\frac{\alpha_s(m_B)}{\alpha_s(m_{PS})} \right)^{\frac{\gamma_0}{2\beta_0}} = c_0 + \frac{c_1}{am_{PS}} + \frac{c_2}{(am_{PS})^2} \quad \gamma_0 = -4 \quad \beta_0 = 11 - \frac{2}{3}N_f$$



$$f_D = 228(5)_0^{+25} \text{ MeV}$$

$$m_{D_s}/m_D$$

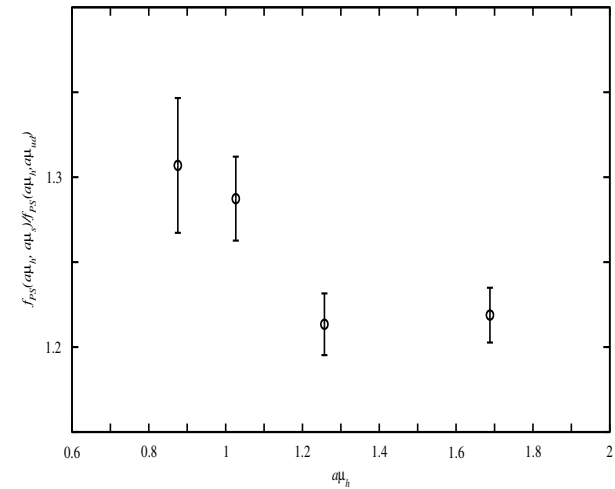
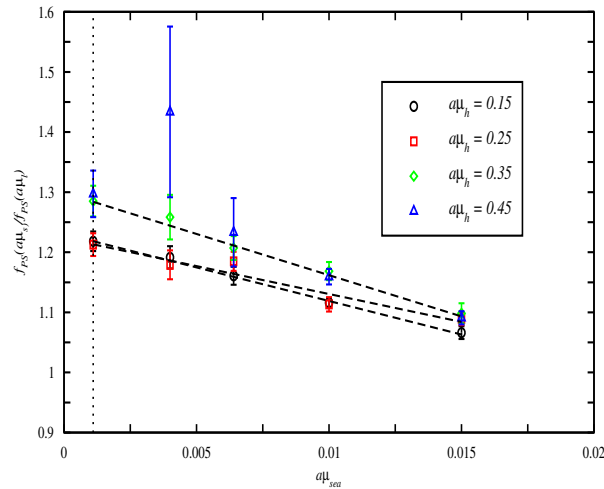
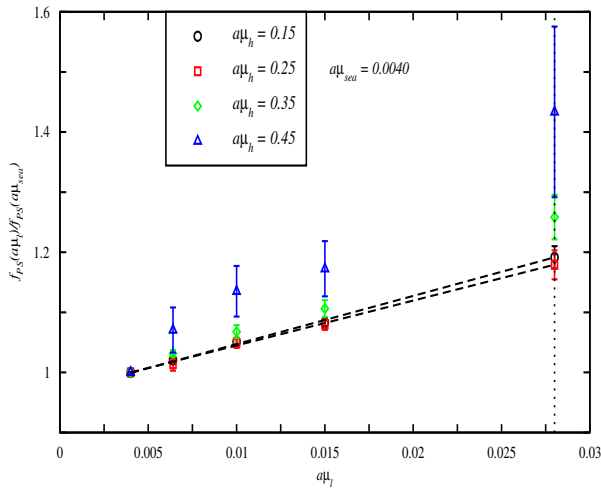
- Extrapolation of $m_{PS}(a\mu_l)/m_{PS}(a\mu_{sea})$ through $a\mu_l = a\mu_s = 0.028$ at a given μ_{sea}
- Linear chiral extrapolation of $m_{PS}(a\mu_h, a\mu_s)/m_{PS}(a\mu_h, a\mu_{sea})$ through $a\mu_{ud}$
- Linear fit of $m_{PS}(a\mu_h, a\mu_s)/m_{PS}(a\mu_h, a\mu_{sea})$ in $1/am_{PS}$ acceptable if we exclude the point $a\mu_h = 0.15$



$$(m_{D_s}/m_D) \sim 1.07 \quad (m_{D_s}/m_D)^{\text{exp}} = 1.054$$

$$f_{D_s}/f_D$$

- Extrapolation of $f_{PS}(a\mu_l)/f_{PS}(a\mu_{sea})$ through $a\mu_l = a\mu_s = 0.028$ at a given μ_{sea}
- Linear chiral extrapolation of $f_{PS}(a\mu_h, a\mu_s)/f_{PS}(a\mu_h, a\mu_{sea})$ through $a\mu_{ud}$
- Fit of $f_{PS}(a\mu_h, a\mu_s)/f_{PS}(a\mu_h, a\mu_{sea})$: strong dependence on am_{PS}



Only a lower bound: $f_{D_s}/f_D > 1.2$

Group	Heavy	Light	N _f	f_{D_s}/f_D
CP-PACS	Fermilab	Clover	2	$1.18(4)(3)^{+4}_{-0}$
MILC	Fermilab	Wilson	2	$1.14(1)(^{+2}_{-3})(2)(^{+5}_{-0})$
FNAL/MILC	Fermilab	Impr. Stag	3	$1.21(1)(4)$