The low mass scalar impostor and the composite Higgs

Chik Him (Ricky) Wong

Lattice Higgs Collaboration (LHC):
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Julius Kuti [†], *Santanu Mondal* [−],
Dániel Nógrádi [−], *Chik Him Wong* [†]

†: University of California, San Diego *: University of the Pacific $: University of Wuppertal -: Eötvös University

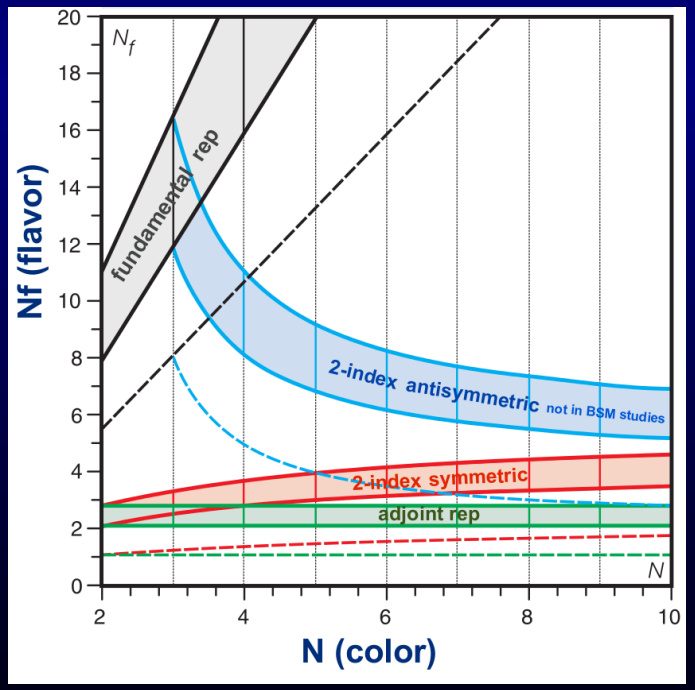
LATTICE 2014

Outline

- Review: Sextet model as Composite Higgs candidate
- Hadron Spectroscopy on Extended Dataset
  - Simulation Details
  - Scale-setting: M_π and F_π
  - Taste-breaking check: $M_{\pi_{sc}}$, $M_{\pi_{ij}}$ and $M_{\pi_{i5}}$
  - Light 0^{++} ground state M_{f_0} as Higgs Impostor
  - Other phenomenologically interesting channels:
    - LHC reachable: M_{a_0}, M_ρ, M_{a_1}
    - Dark Matter candidate: M_N
- Study on topological effects
- Conclusion

Review: Sextet model as Composite Higgs candidate

- Goal: Look for a Composite Higgs model:
  An infrared fixed point almost exists + Confining below Electroweak scale $\Rightarrow$ models at the edge of conformal window
- After Higgs boson discovery : Light 0^{++} Higgs + reproduce detected phenomenology
- Parameter Space: N_C, N_f, Representations of $SU(N_C)$



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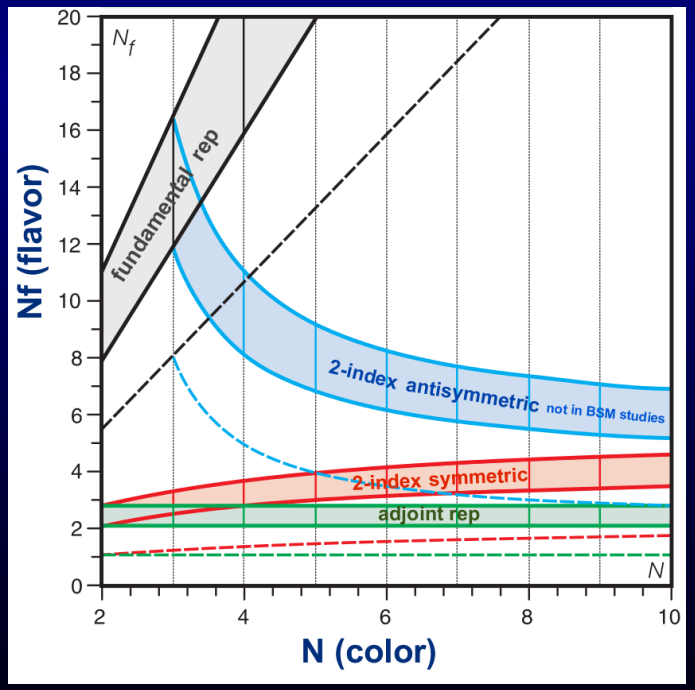

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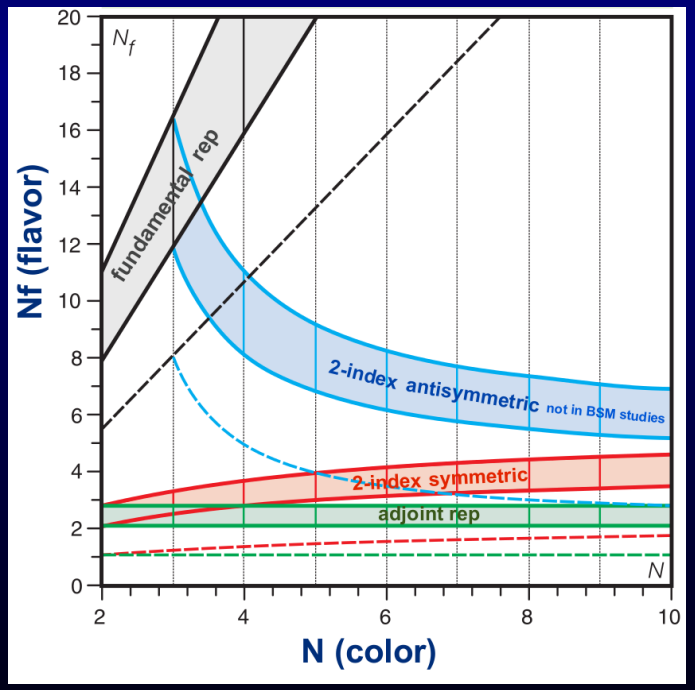

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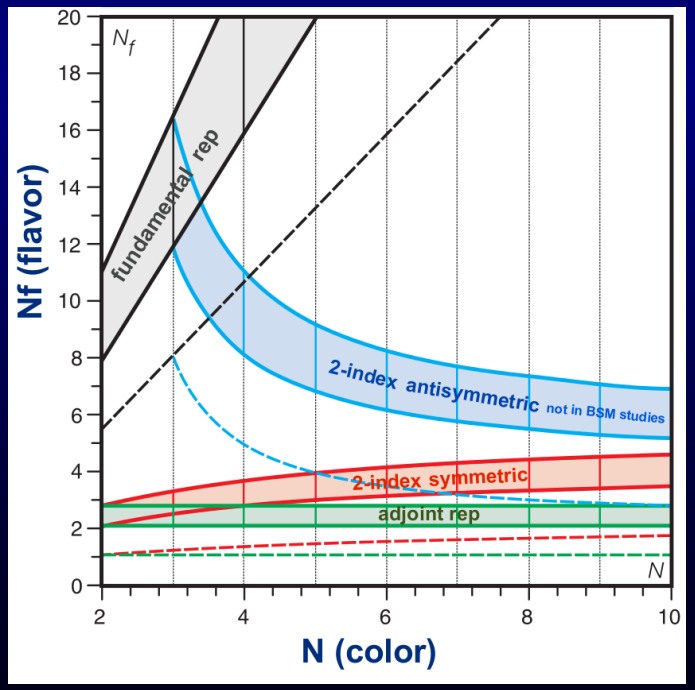

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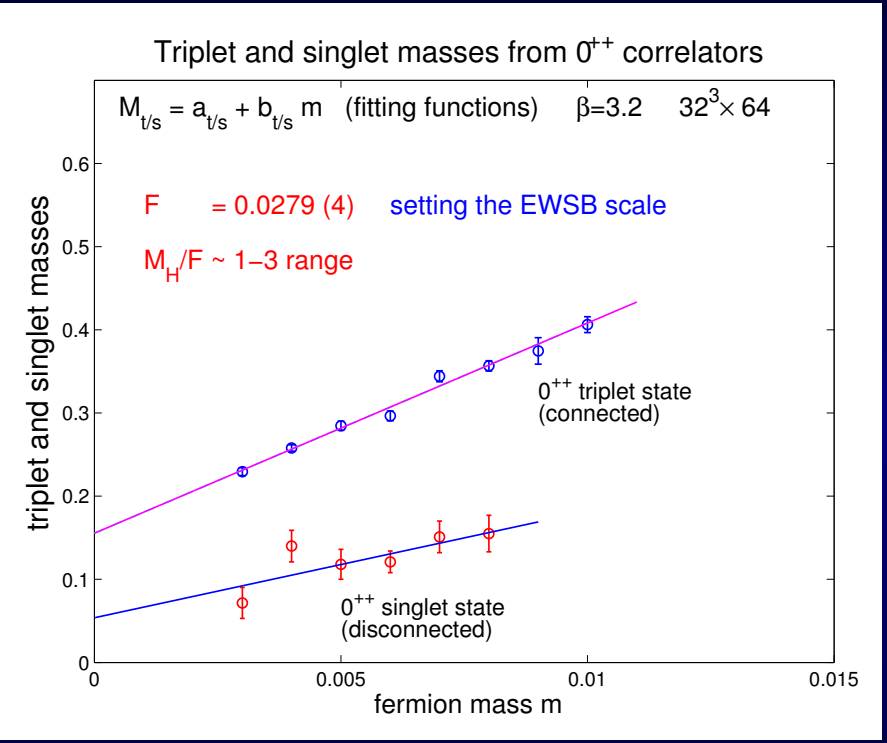

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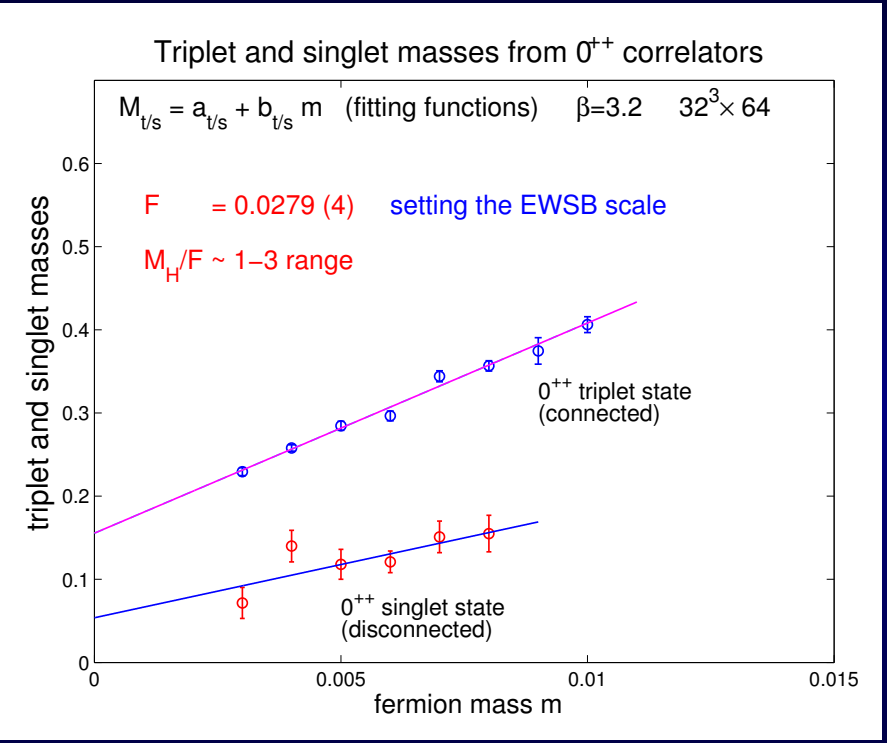

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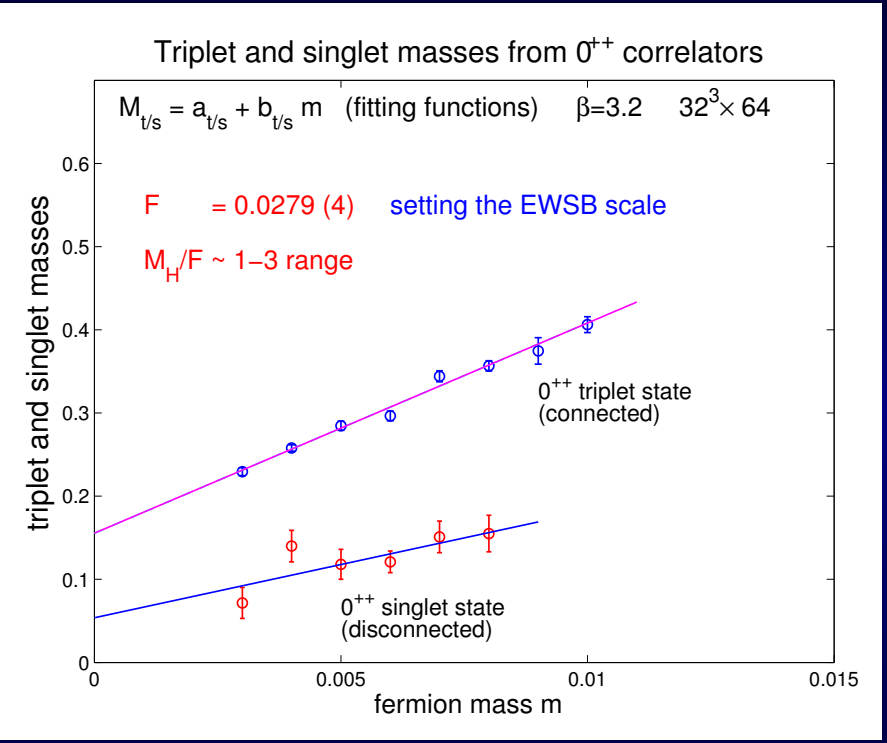

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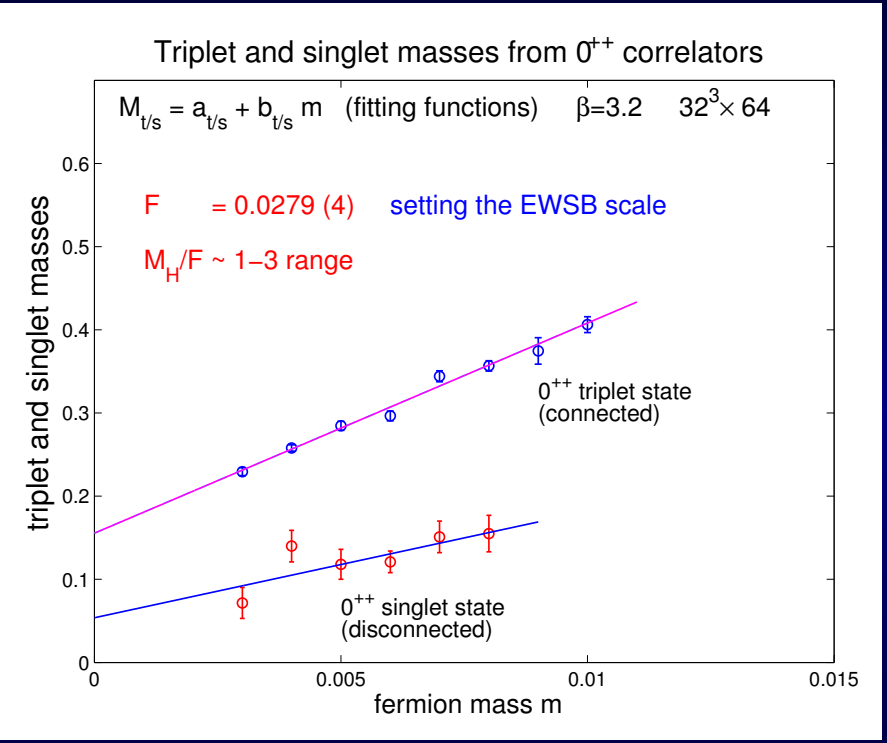

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Hadron Spectroscopy on Extended Dataset - Simulation Details

- Action: Tree-level Symanzik-Improved gauge action with Staggered $N_f = 2$ Sextet SU(3) fermions
- RHMC algorithm with multiple time scales and Omelyan integrator
- $\beta \equiv 6/g^2 = 3.20$ and 3.25, which is in the weak coupling regime
- Lattices available:($\sim 2000 - 4000$ Trajectories each)

β	L	T	m_q
3.20	48	96	0.002, 0.003, 0.004
	40	80	0.002, 0.003, 0.004
	32	64	0.003, 0.004, 0.005, 0.006, 0.007, 0.008
	28	56	0.003, 0.004, 0.005, 0.006, 0.007, 0.008
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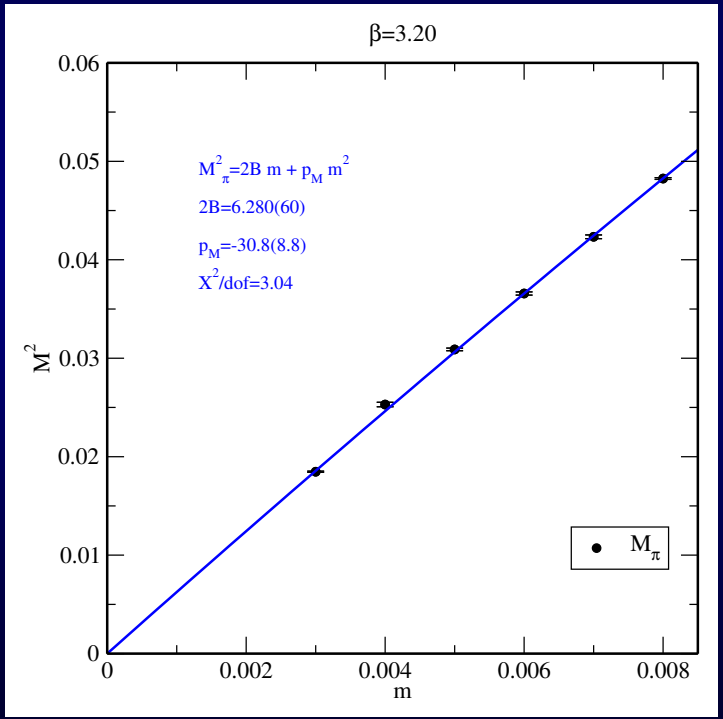
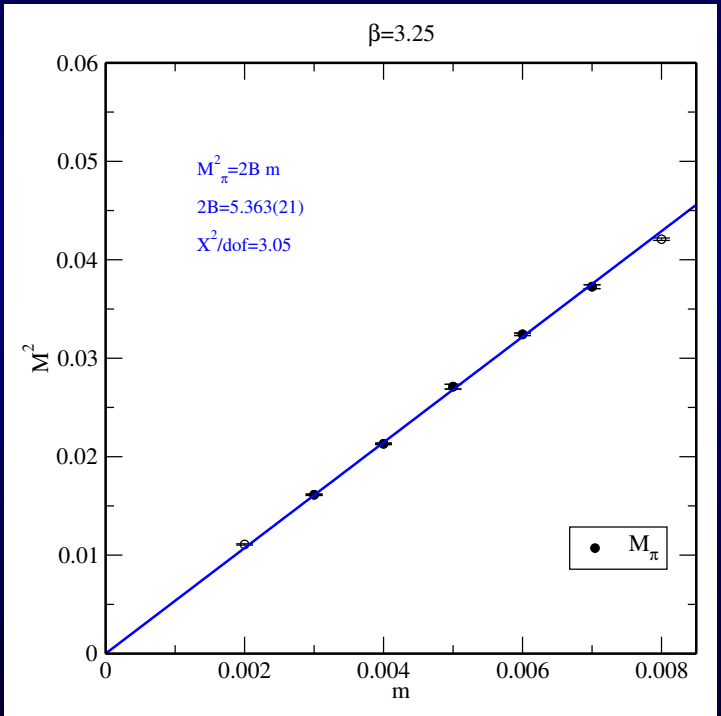
- M_π determination





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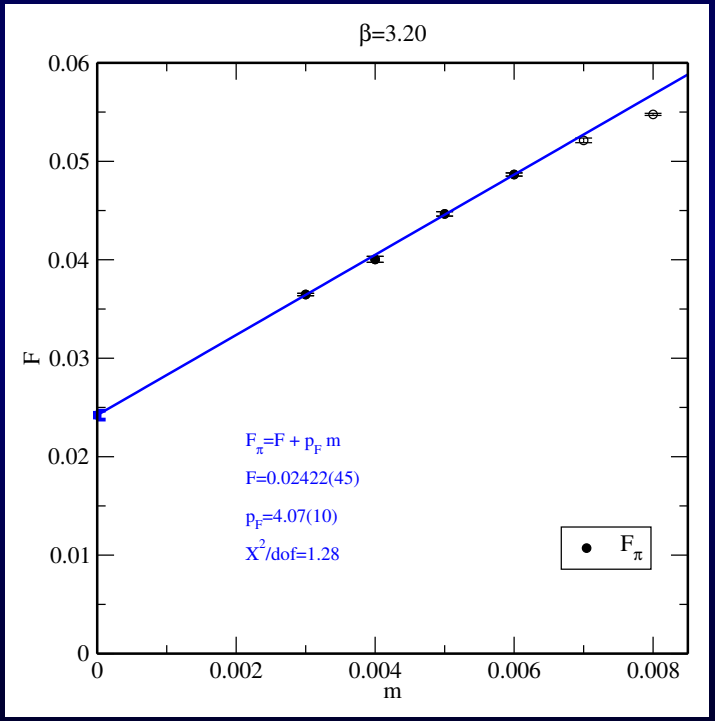

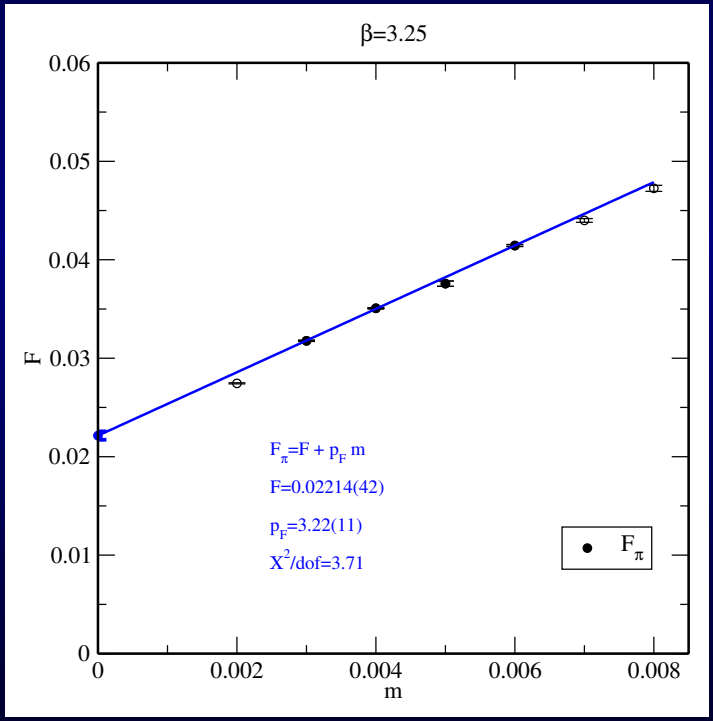

Hadron Spectroscopy on Extended Dataset - Finite Size Scaling

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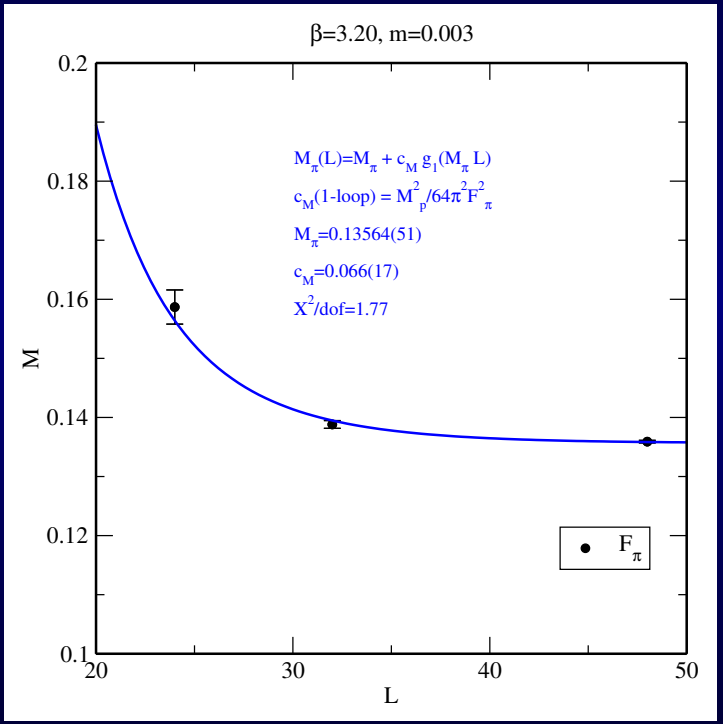

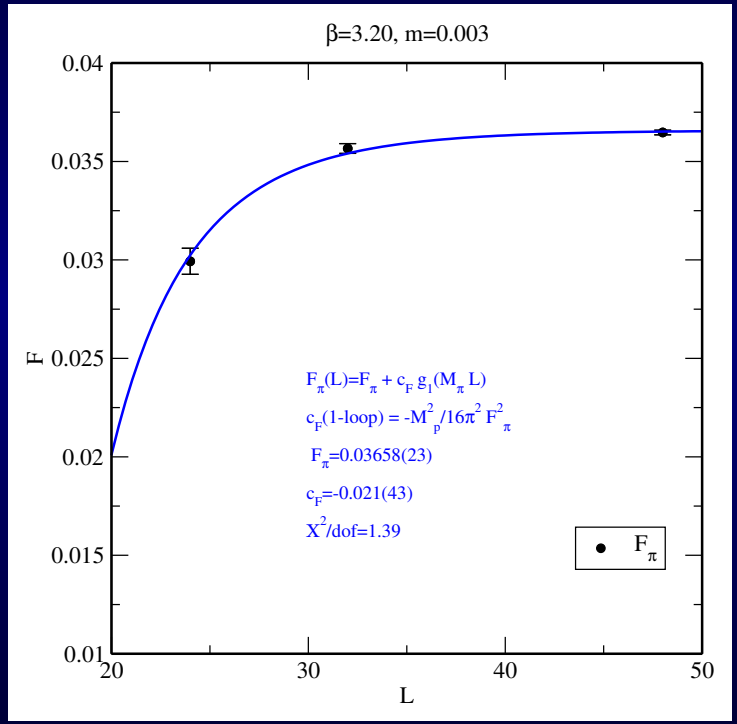

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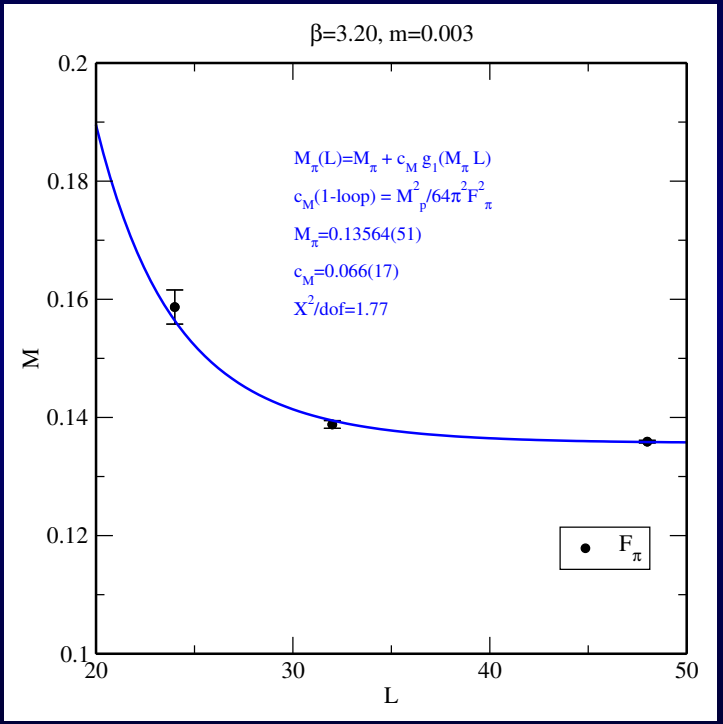

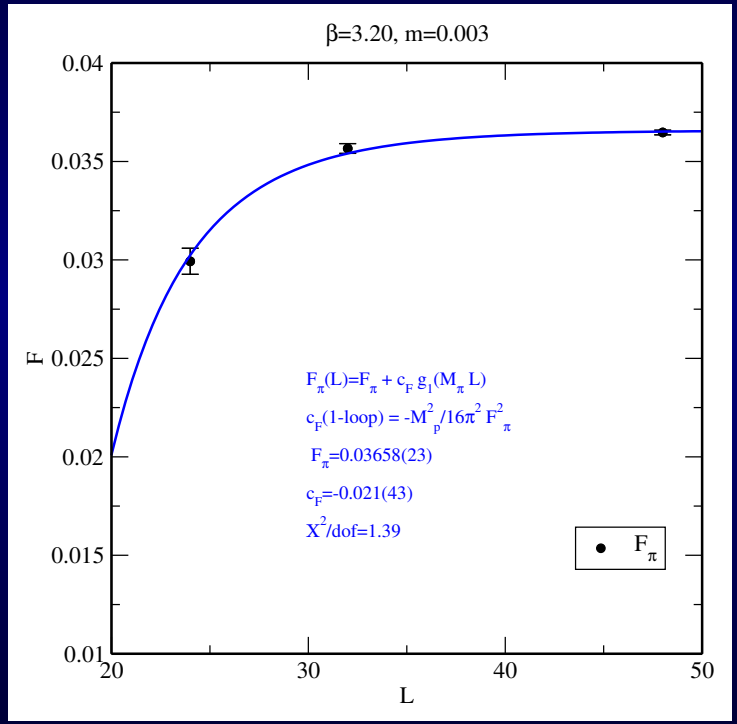

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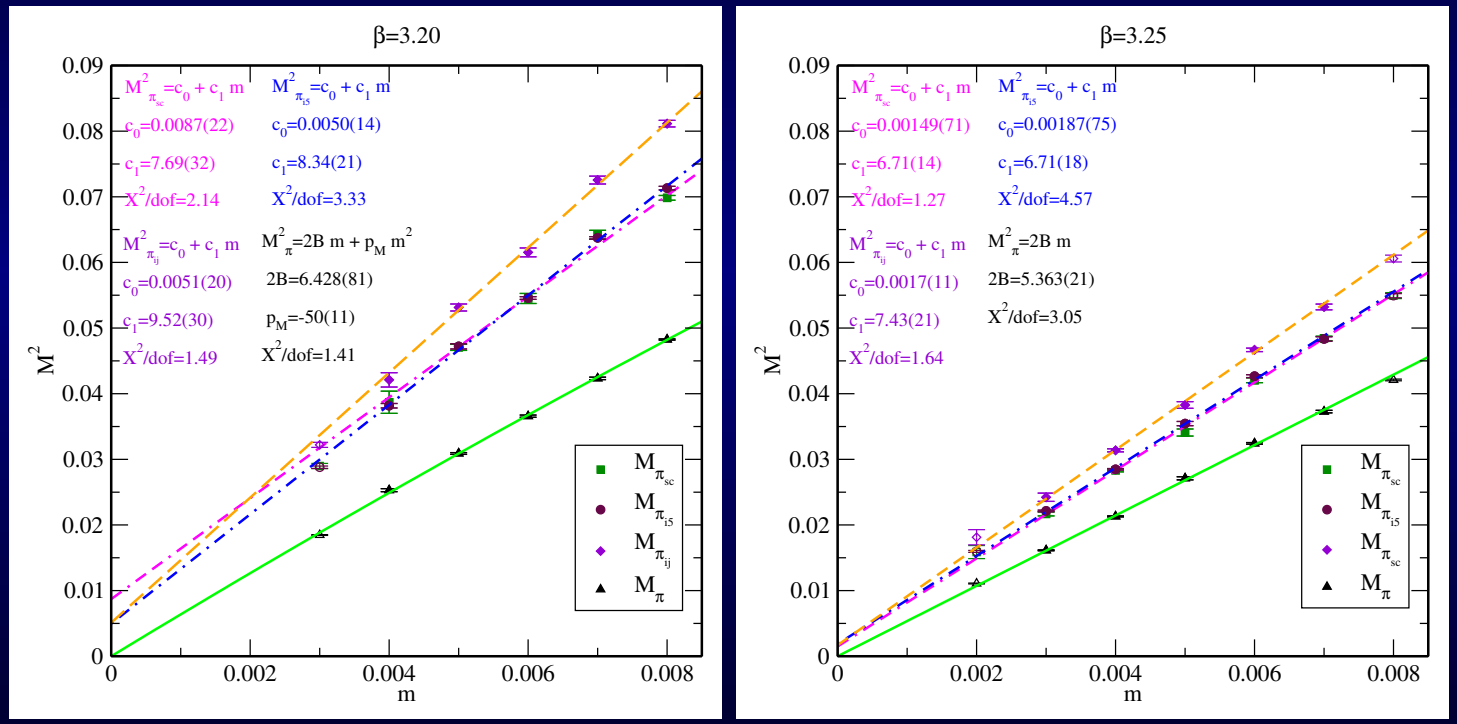

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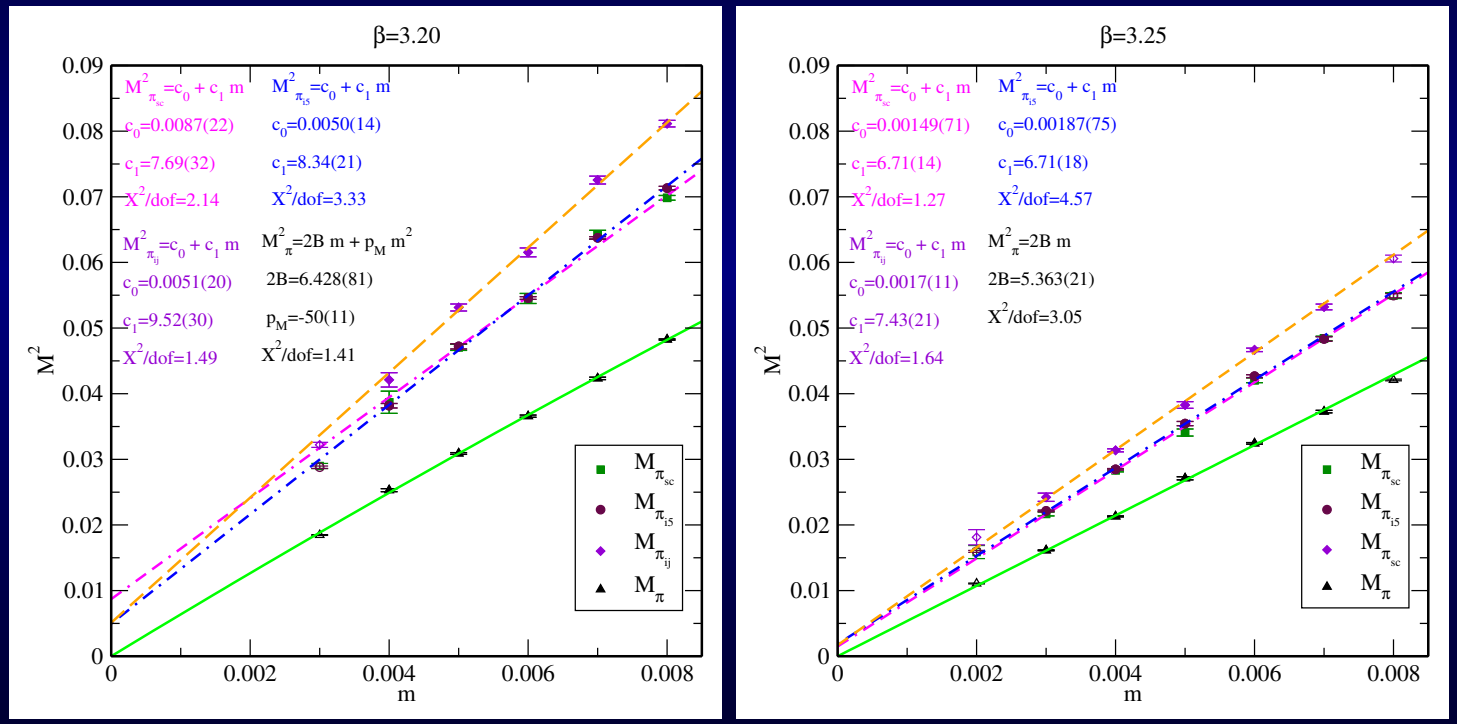

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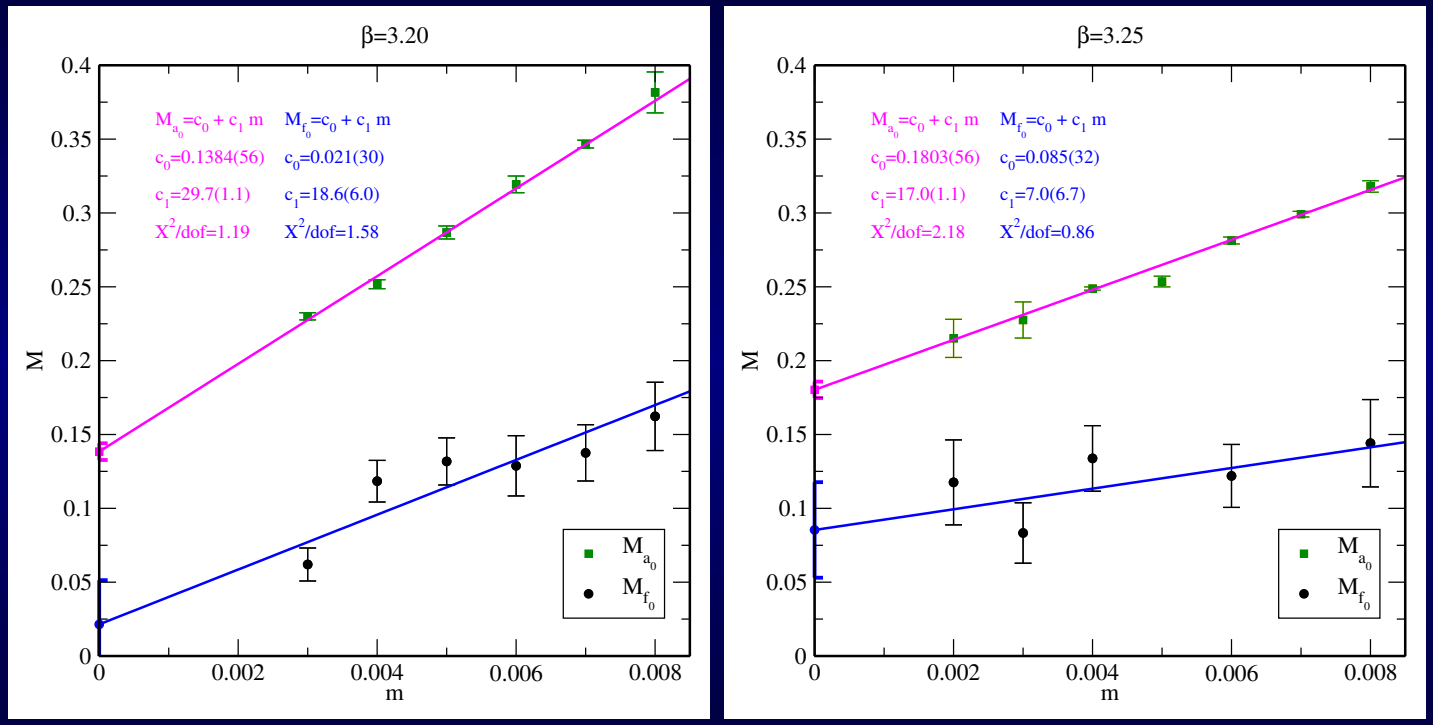

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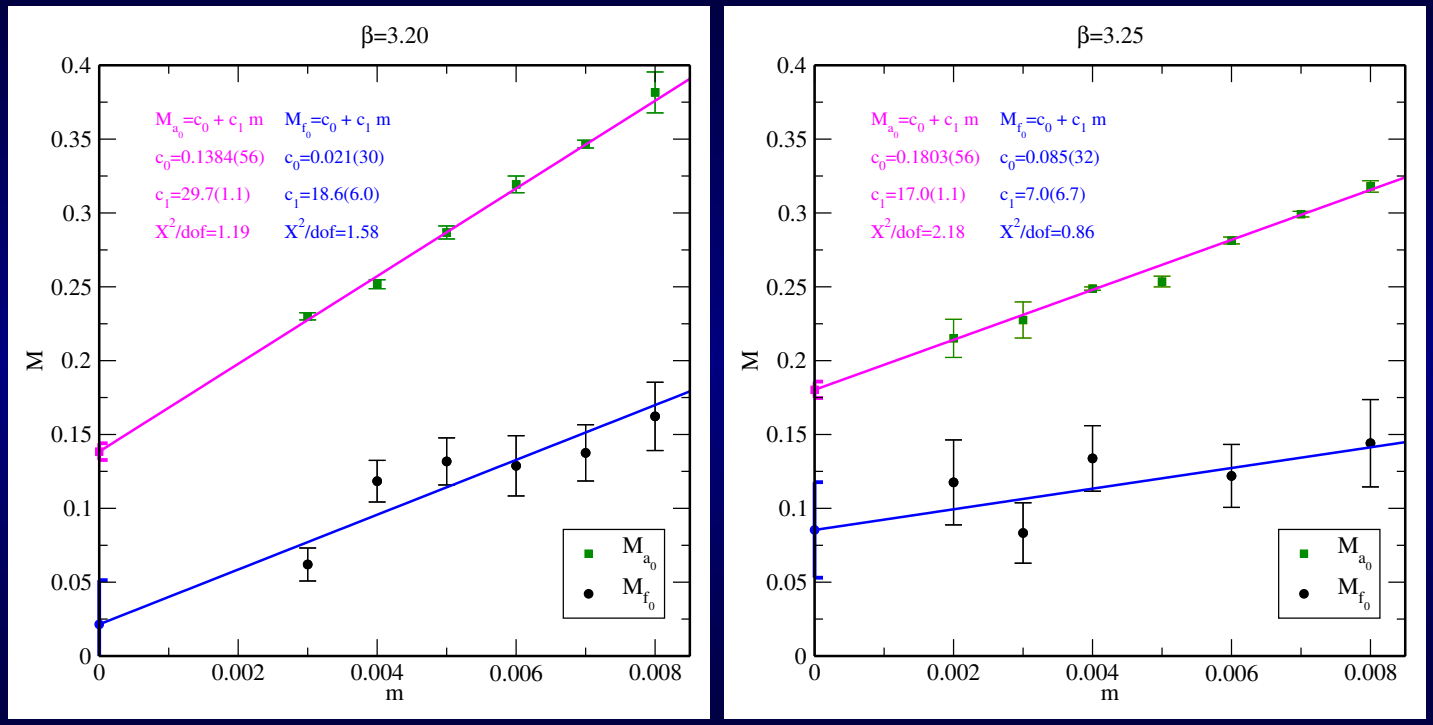

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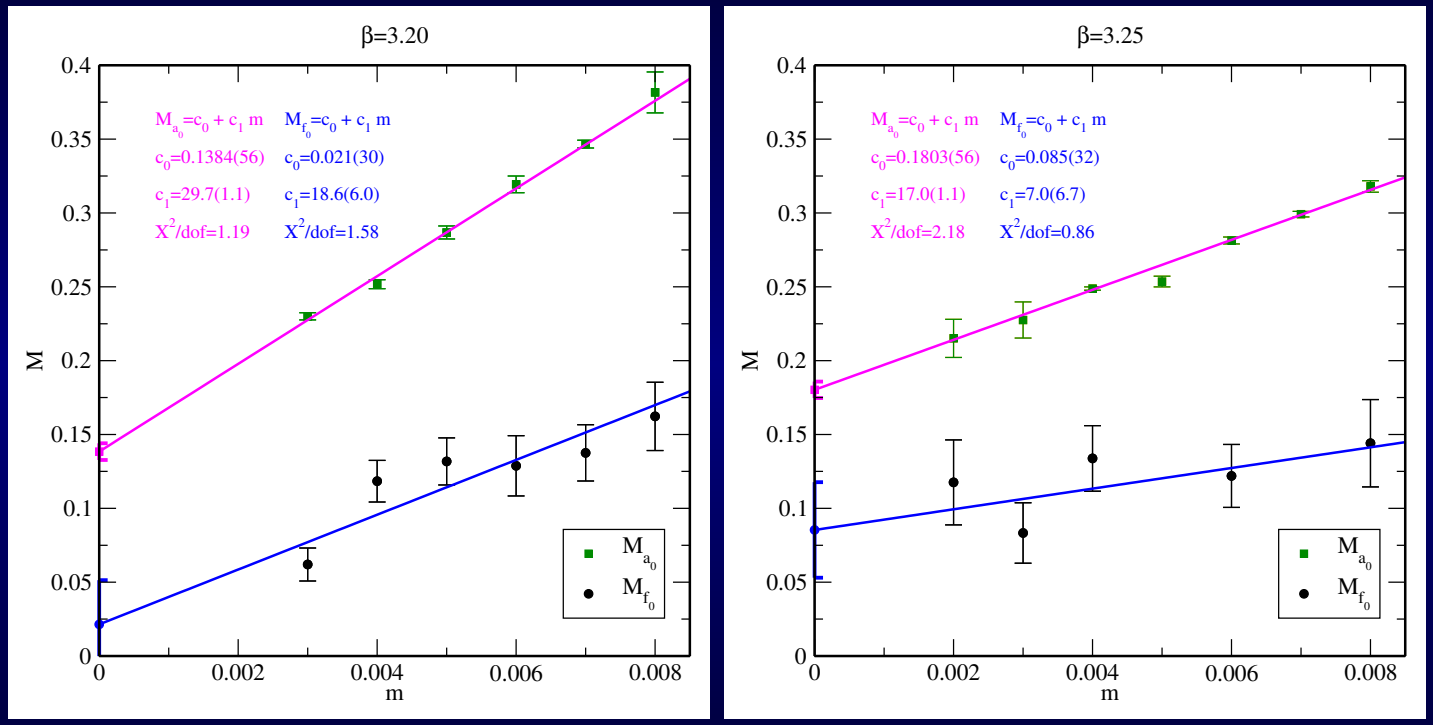

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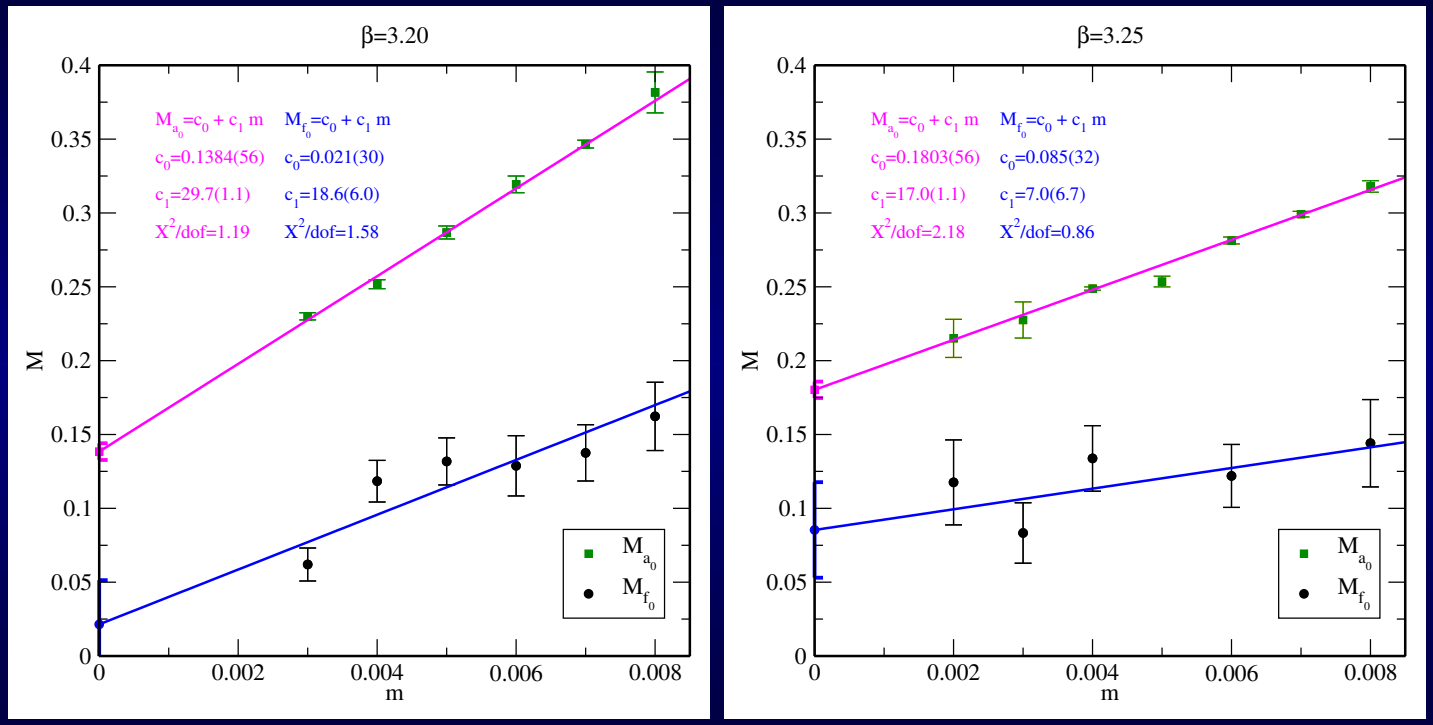

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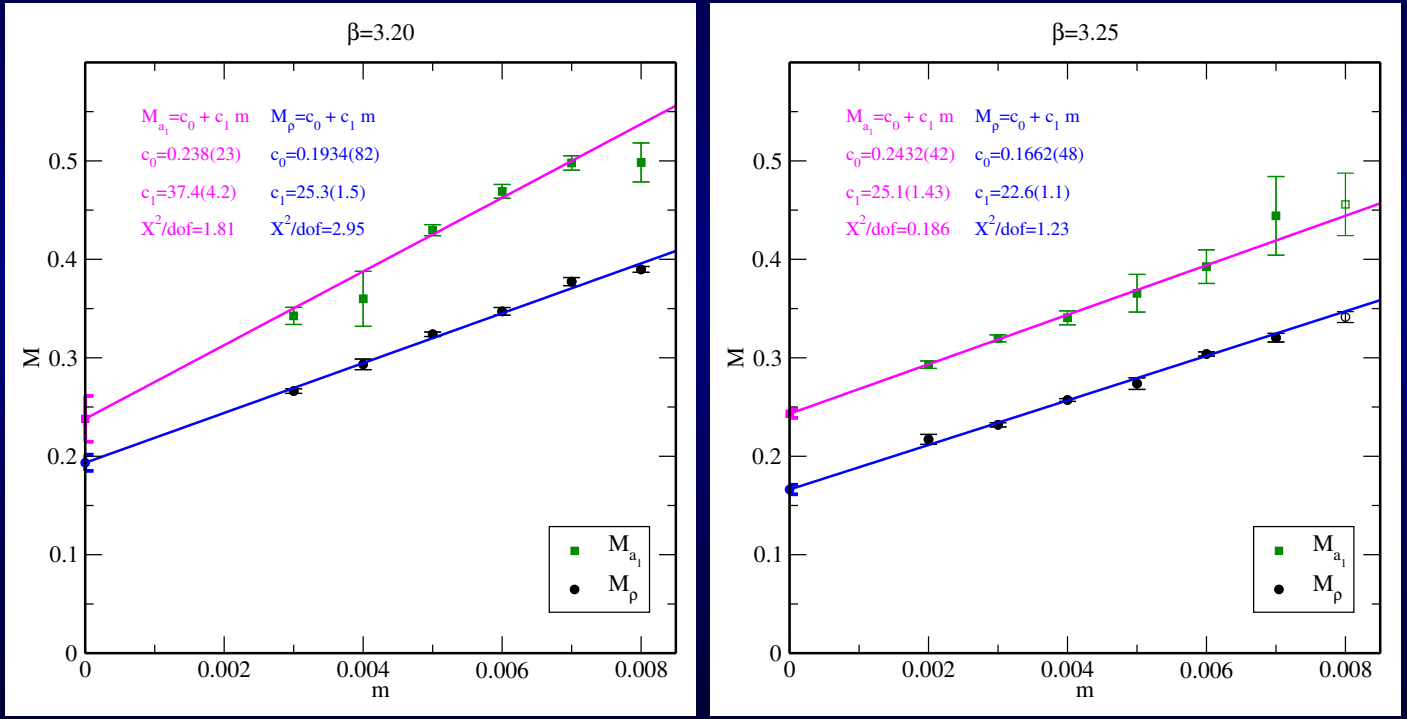
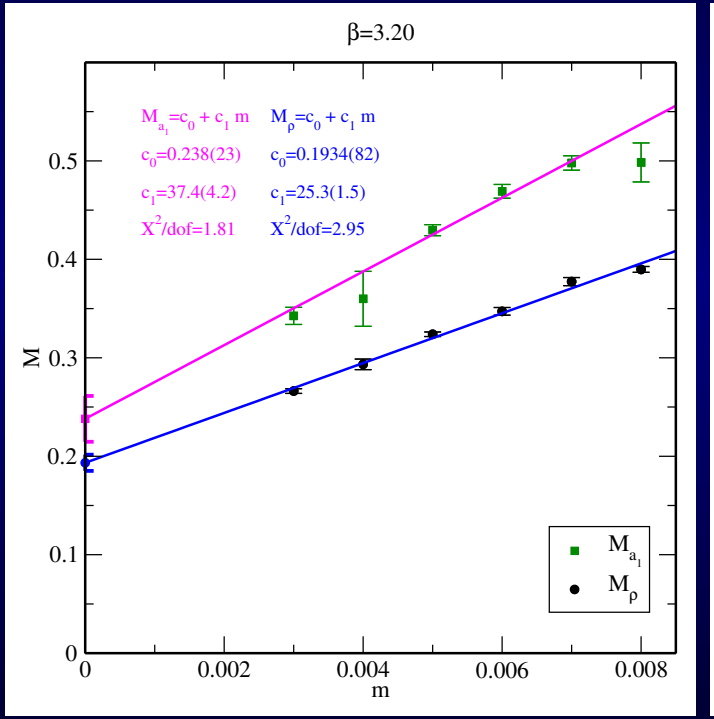
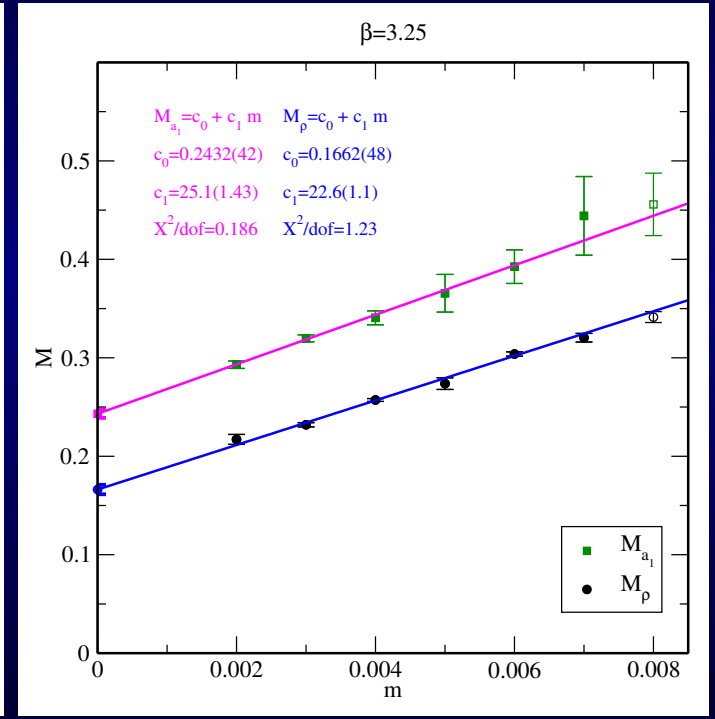


- Lowest states within reach of LHC

Hadron Spectroscopy on Extended Dataset - Other channels

- M_ρ and M_{a_1}

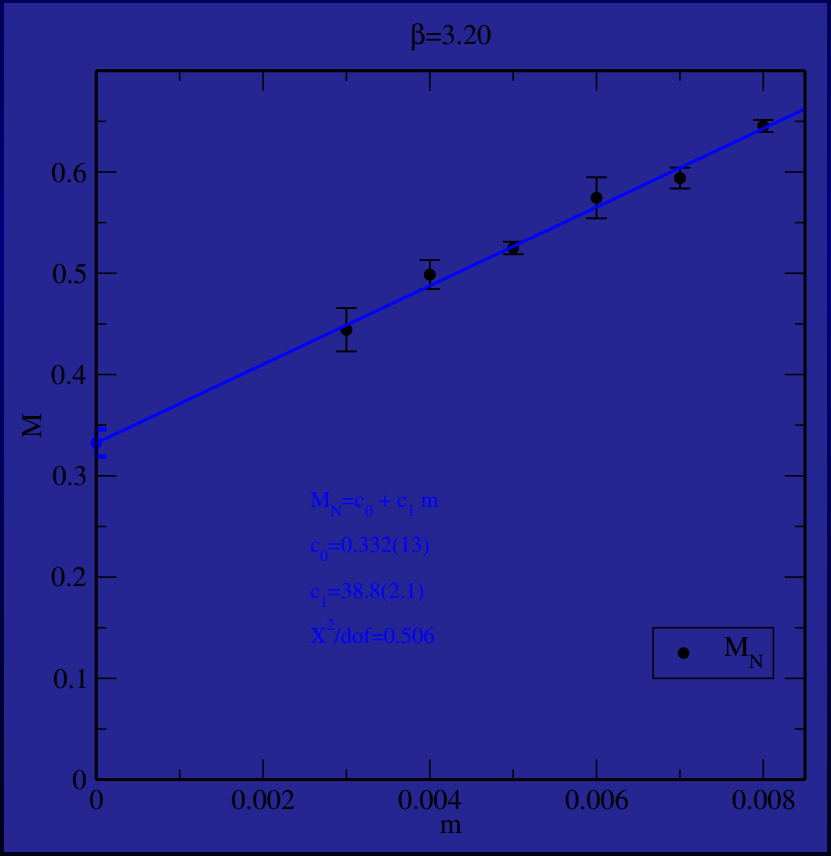




- Lowest states within reach of LHC

Hadron Spectroscopy on Extended Dataset - Other channels

- Dark Matter candidate: M_N
- Tricky to construct due to symmetric color structure (details in Santanu Mondal's talk)



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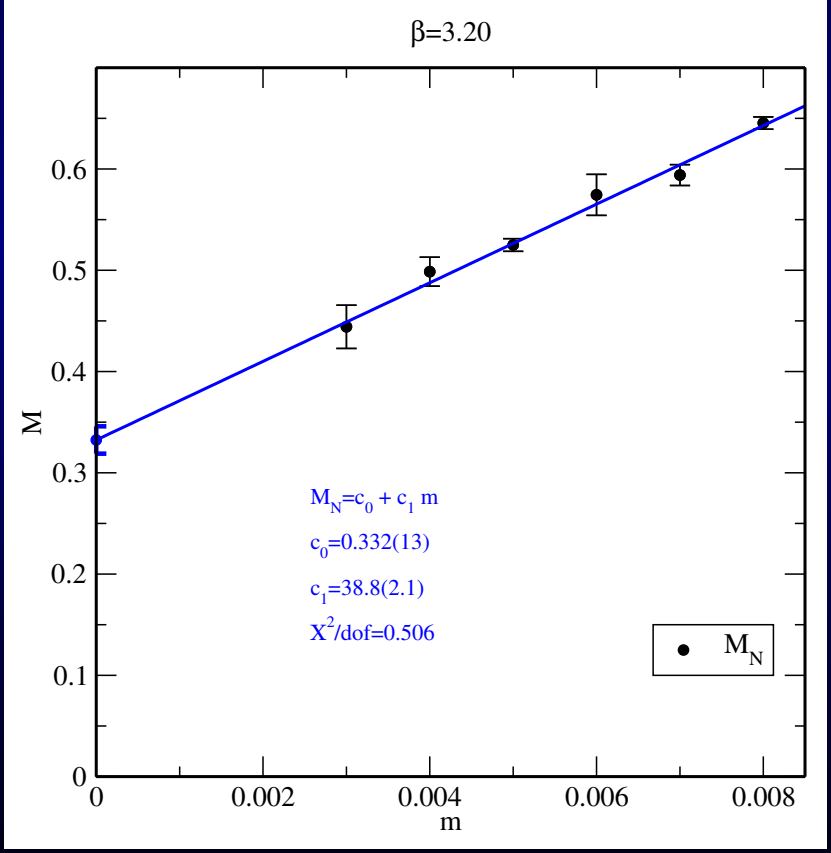

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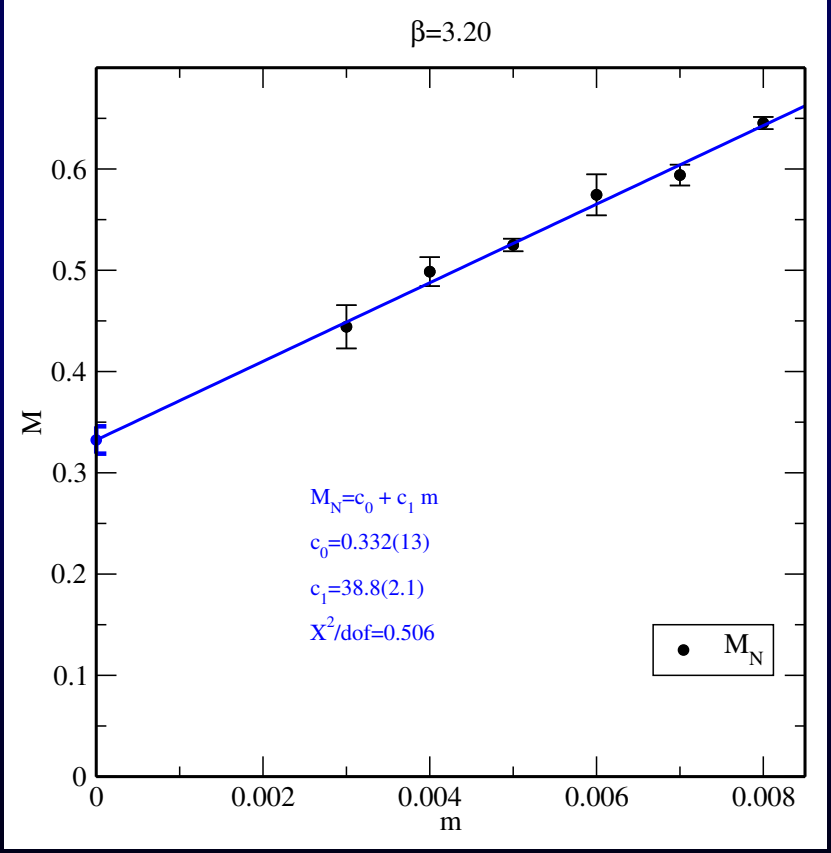

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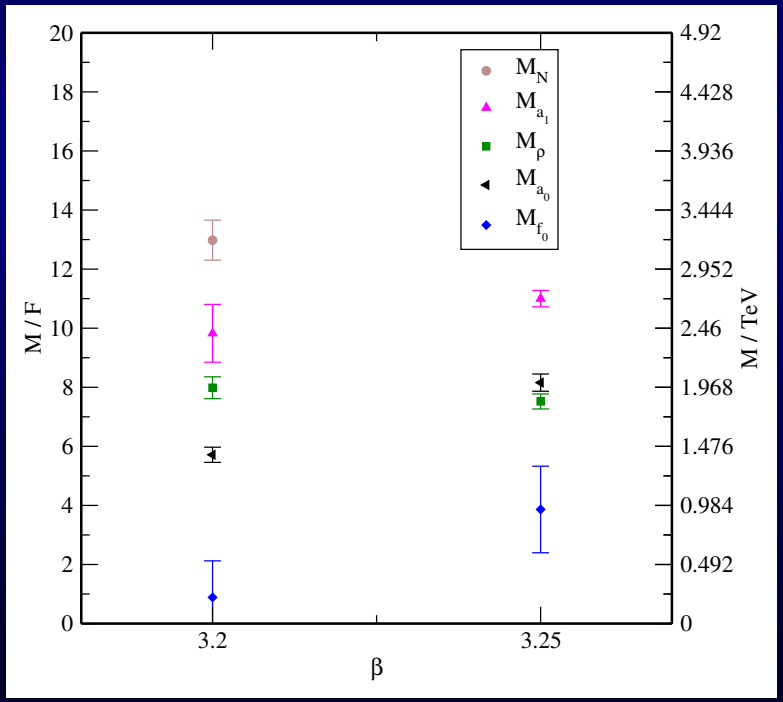

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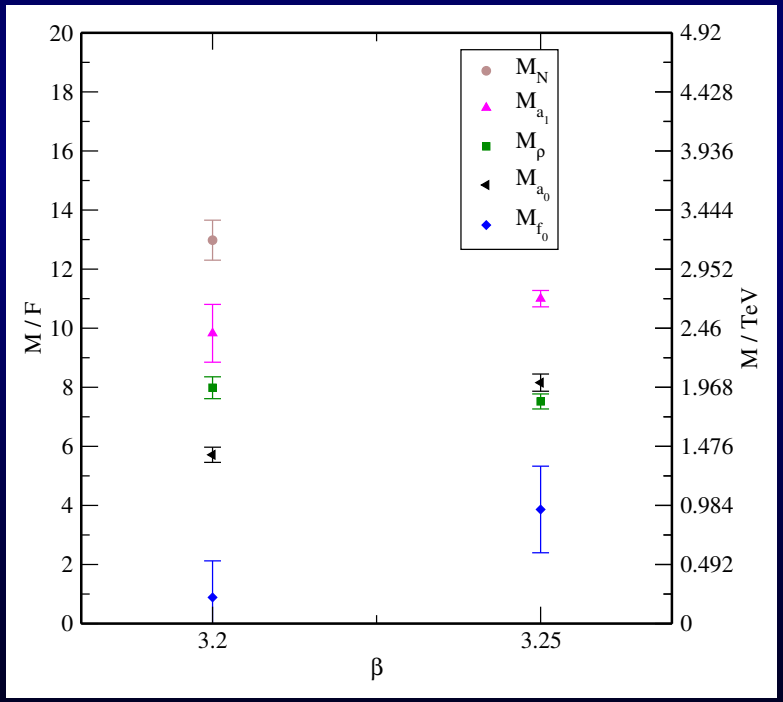

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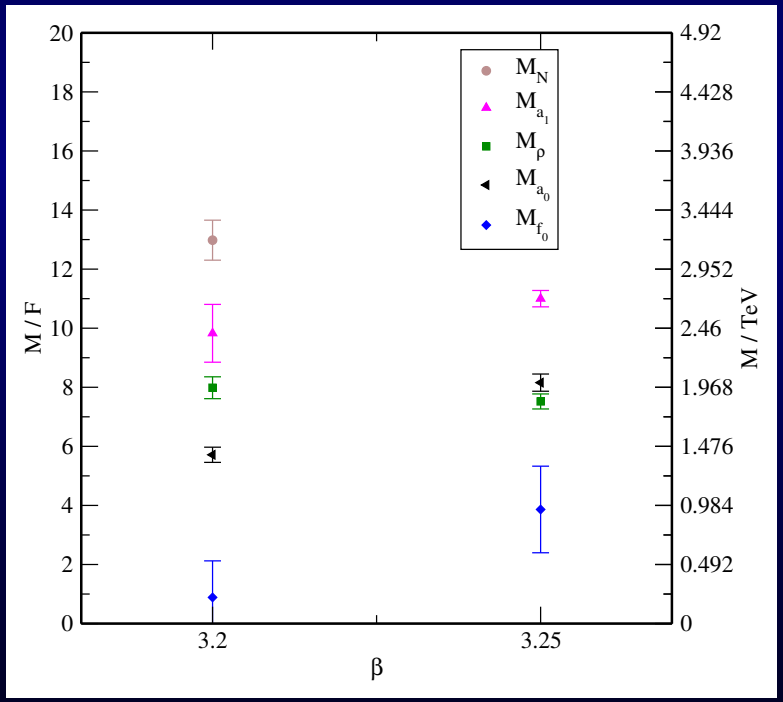

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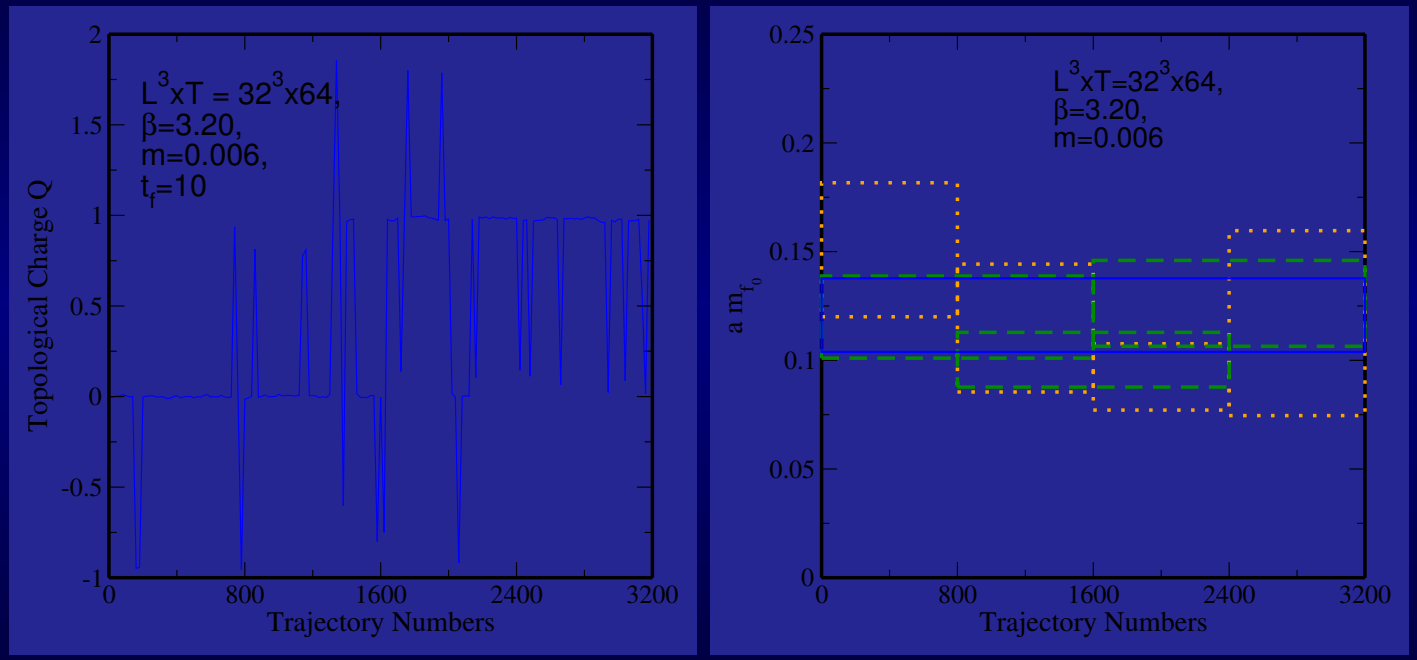

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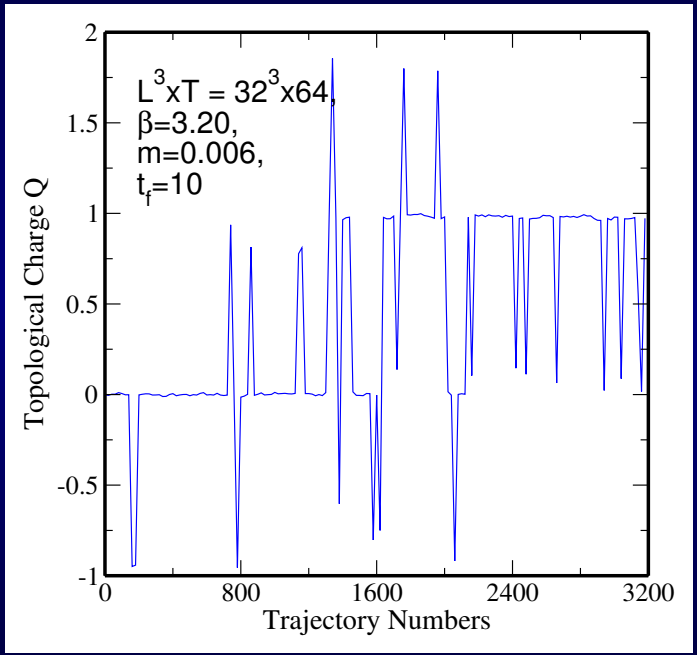

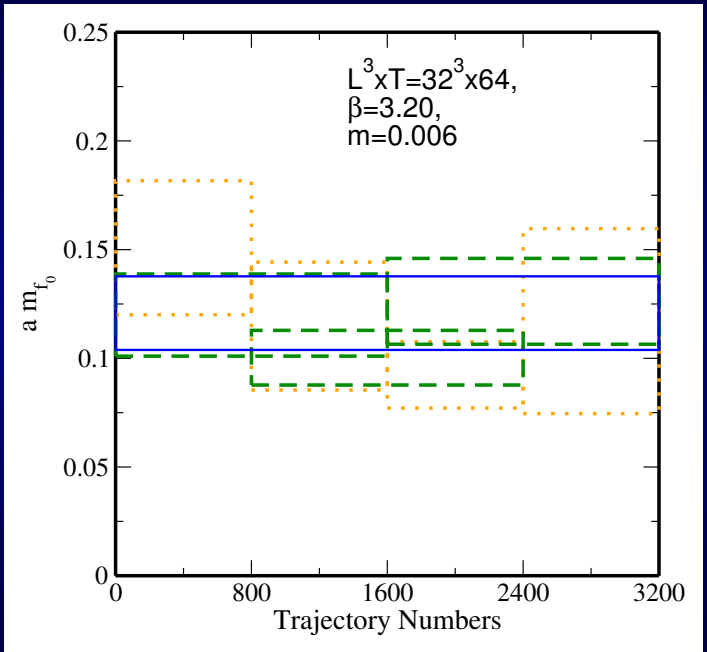

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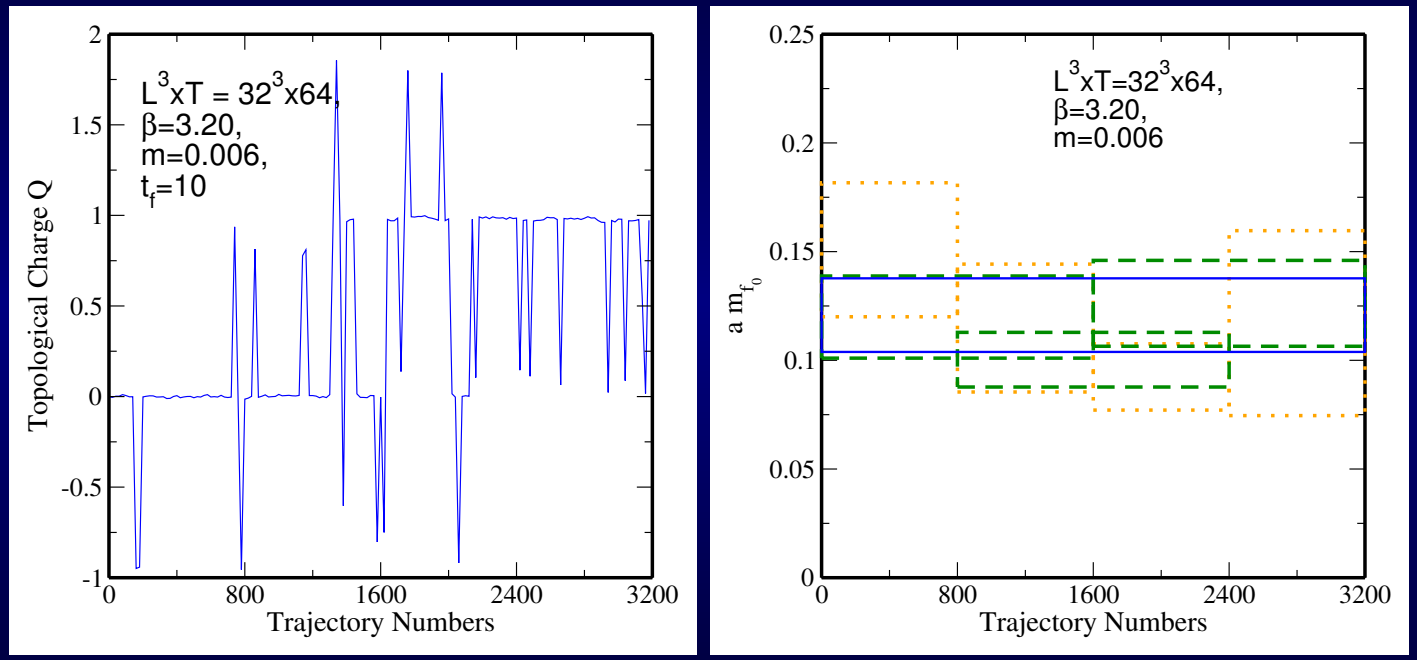

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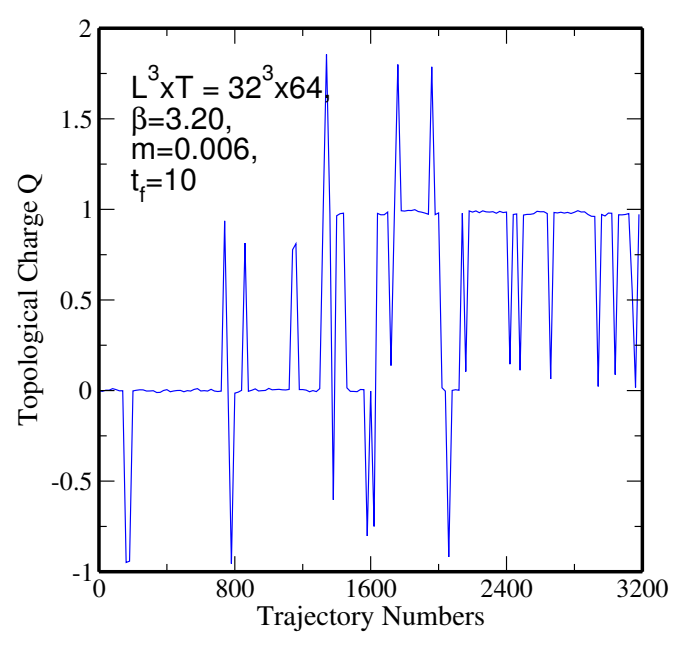

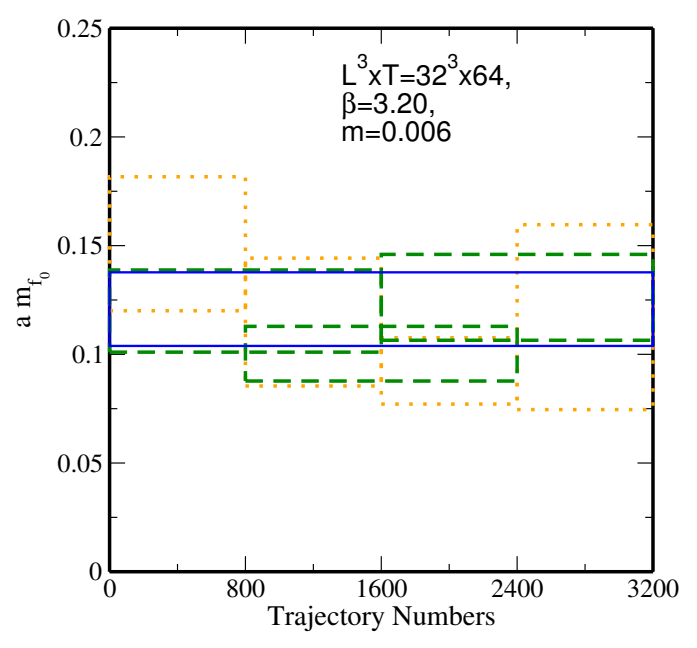

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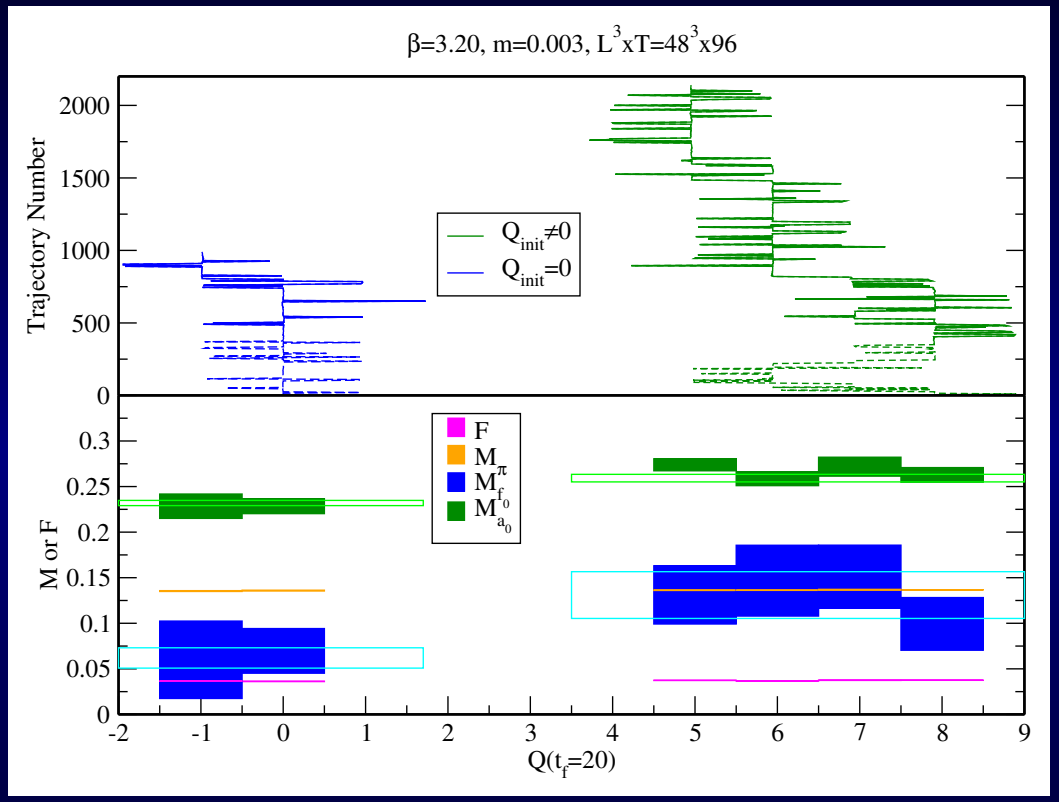

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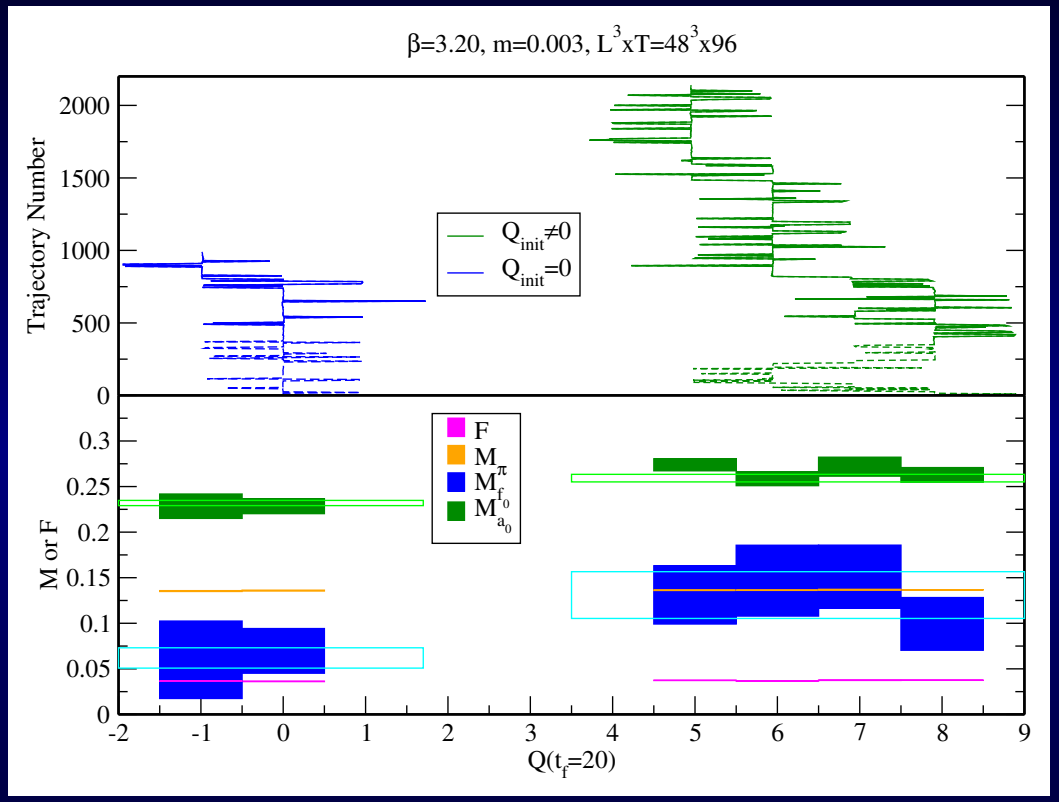

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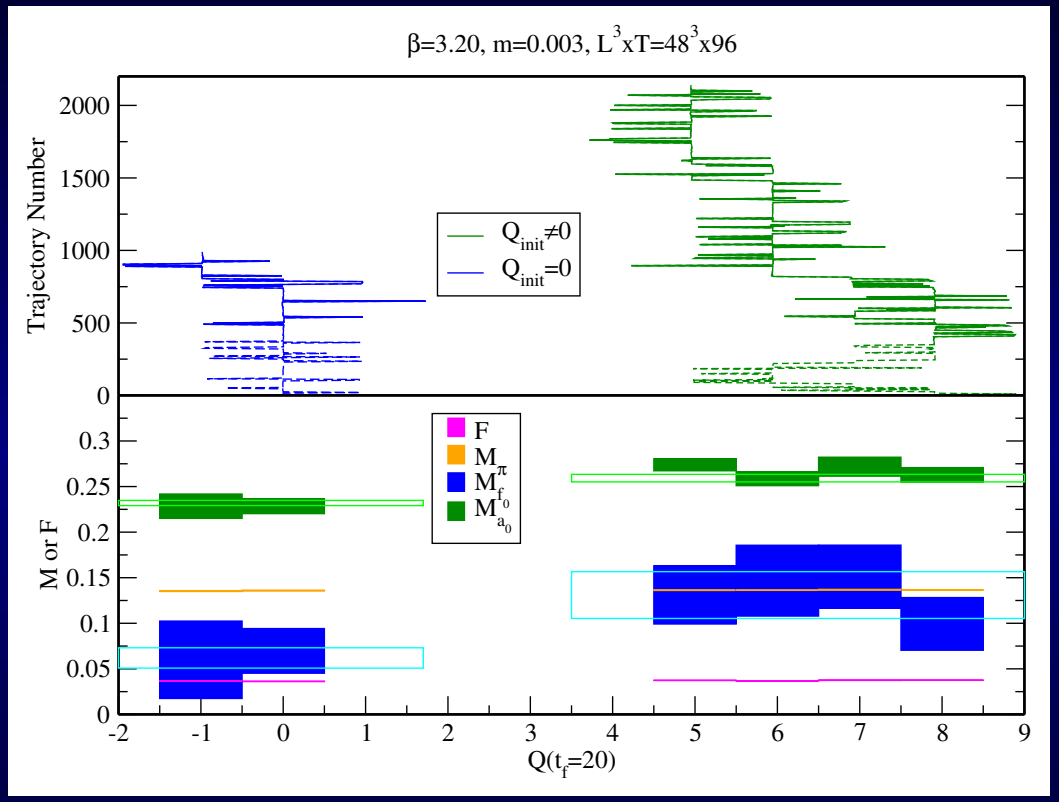

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- f_0 remains light but more efforts are still needed to determine the mass.
- A few important quantities have been studied:
  - Phenomenologically interesting channels M_ρ, M_{a_0}, M_{a_1} are studied and their masses are within reach of LHC.
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