Improving $\pi\pi$ dispersive amplitude analyses and resonance determination with Forward Dispersion Relations

Pablo Rabán

in collaboration with J.R. Peláez and J. Ruiz de Elvira

Universidad Complutense de Madrid

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Outline

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- 2 Improving $\pi\pi$ dispersive amplitudes
  - Global fit to data
  - Results (preliminary)

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- 3 Resonance determination

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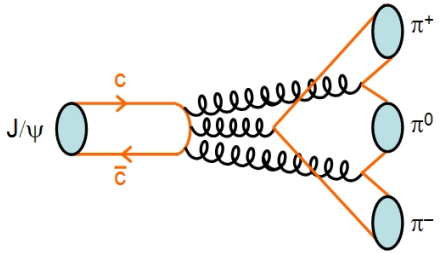

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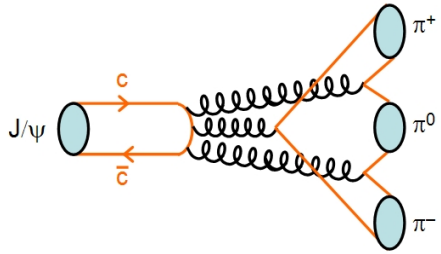
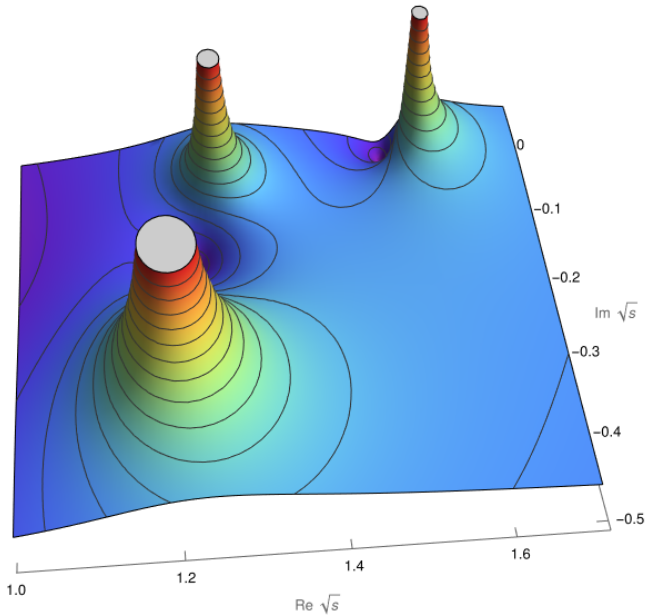


2. Extract resonances produced in the interaction in a model-independent way



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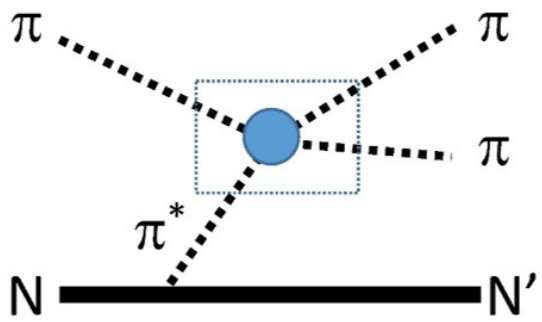

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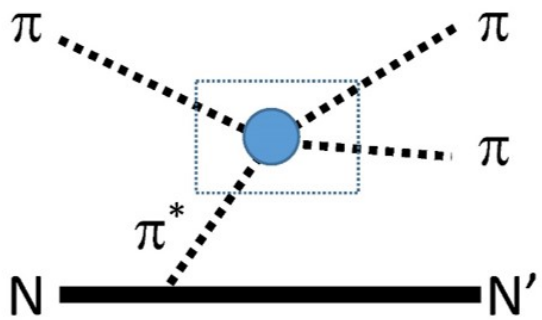

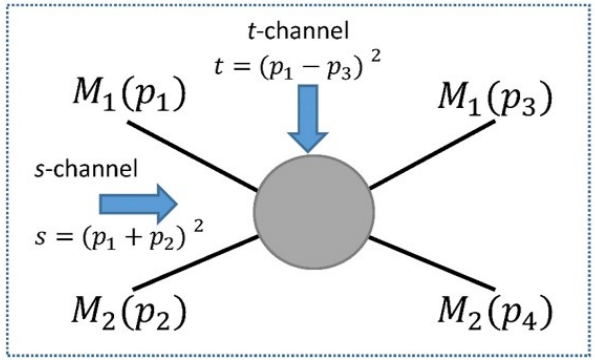

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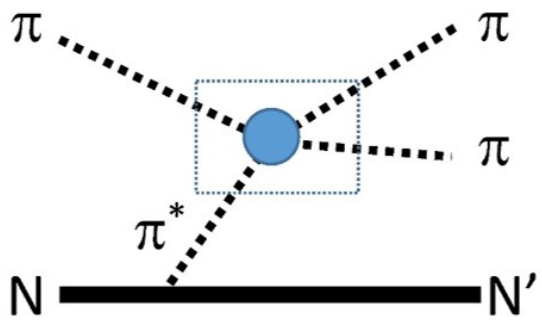

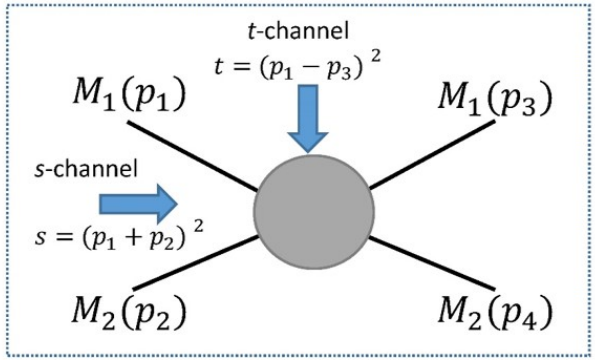

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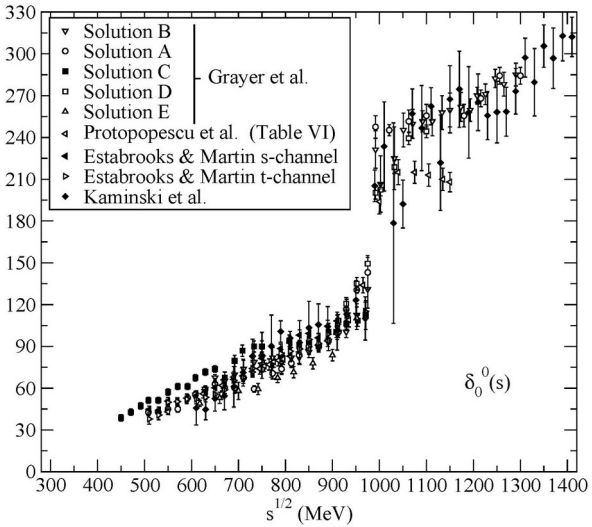

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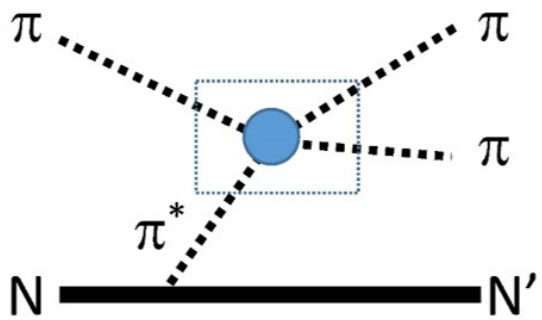

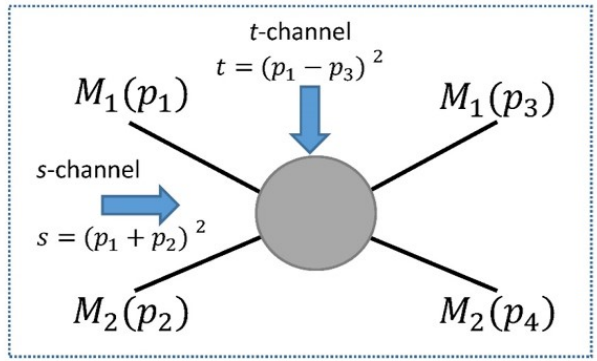

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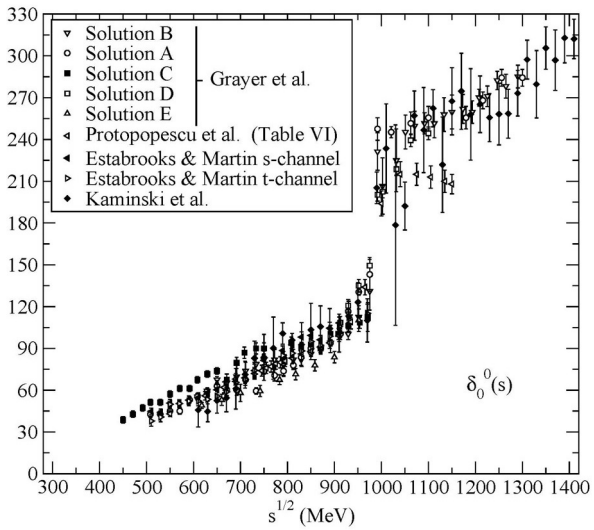

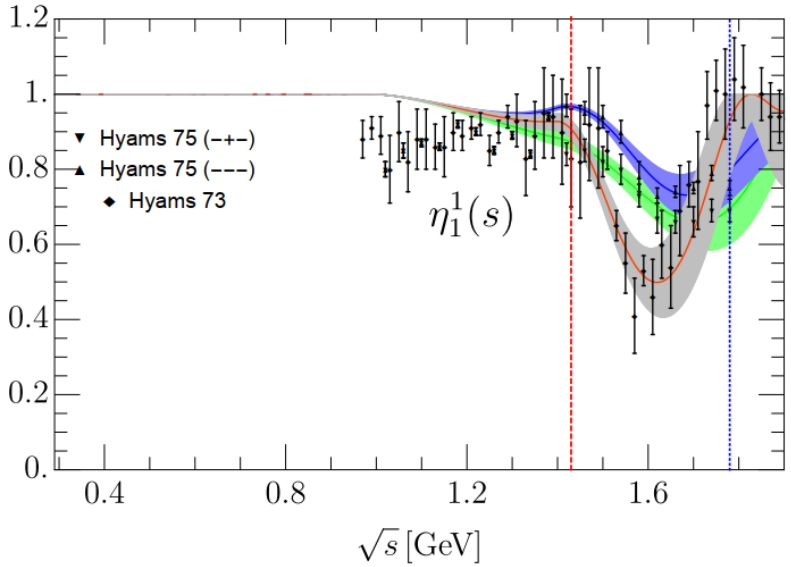

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✓ **Model-independent** resonance determination: **pole positions and couplings** for $f_0(500)$, $f_0(980)$, $f_0(1370)$, $f_0(1500)$, $f_2(1270)$ and $\rho(770)$
R. García-Martín et al., Phys. Rev. Lett. 107, 072001 (2011)
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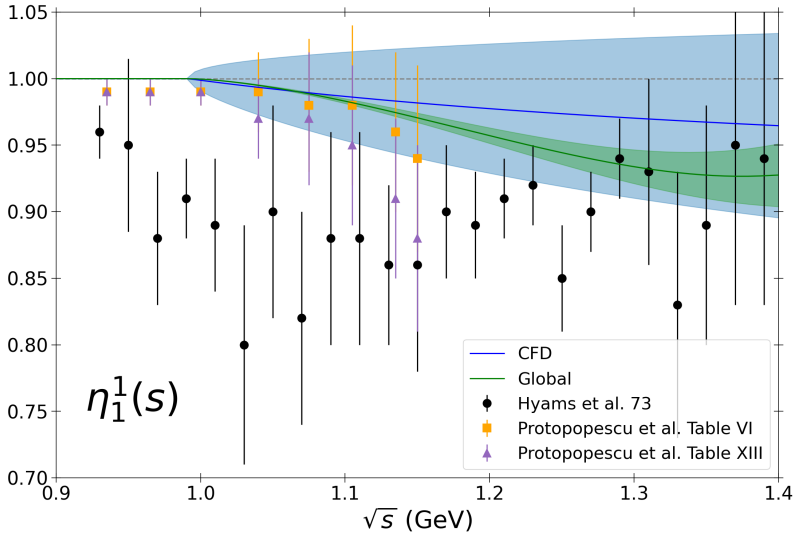

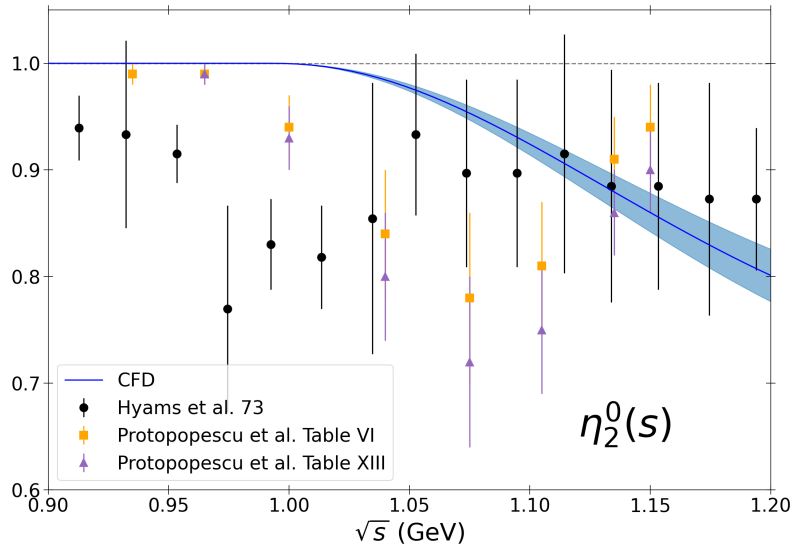

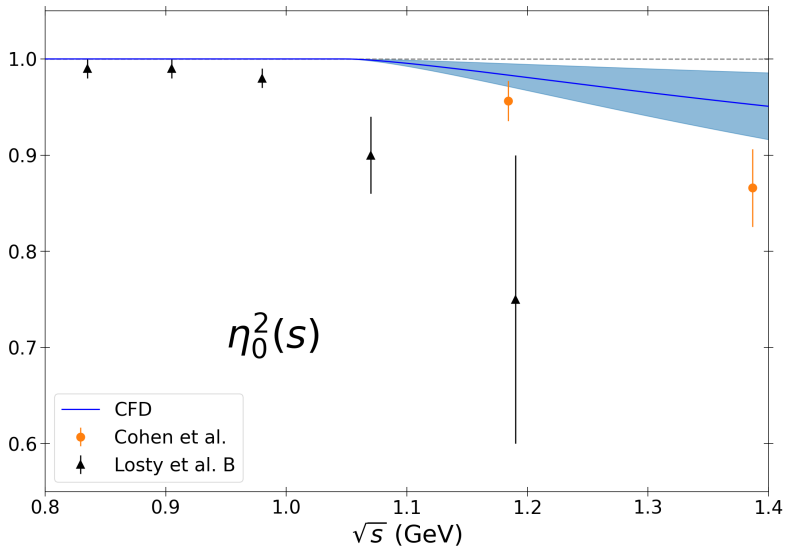

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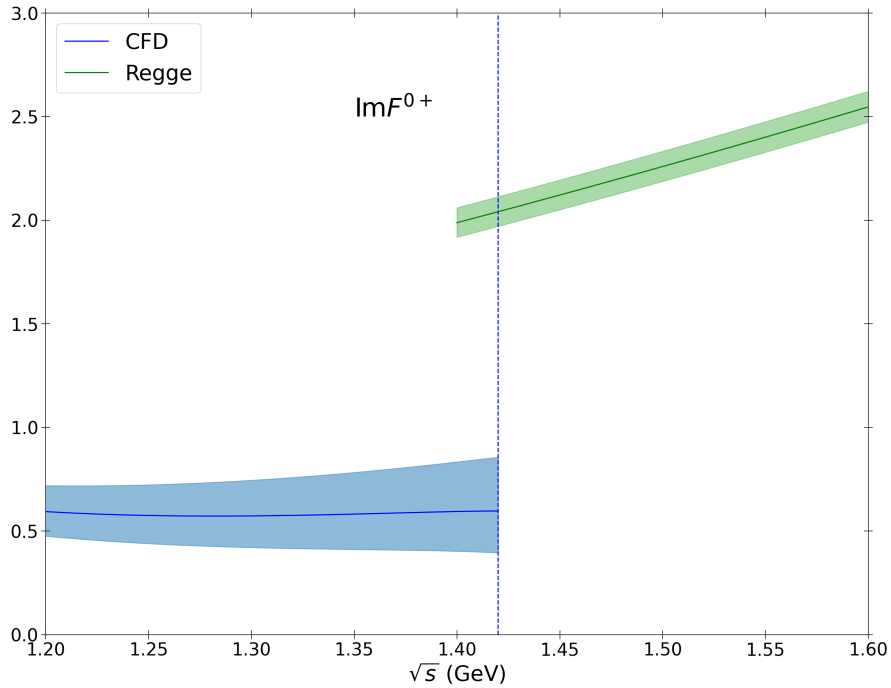

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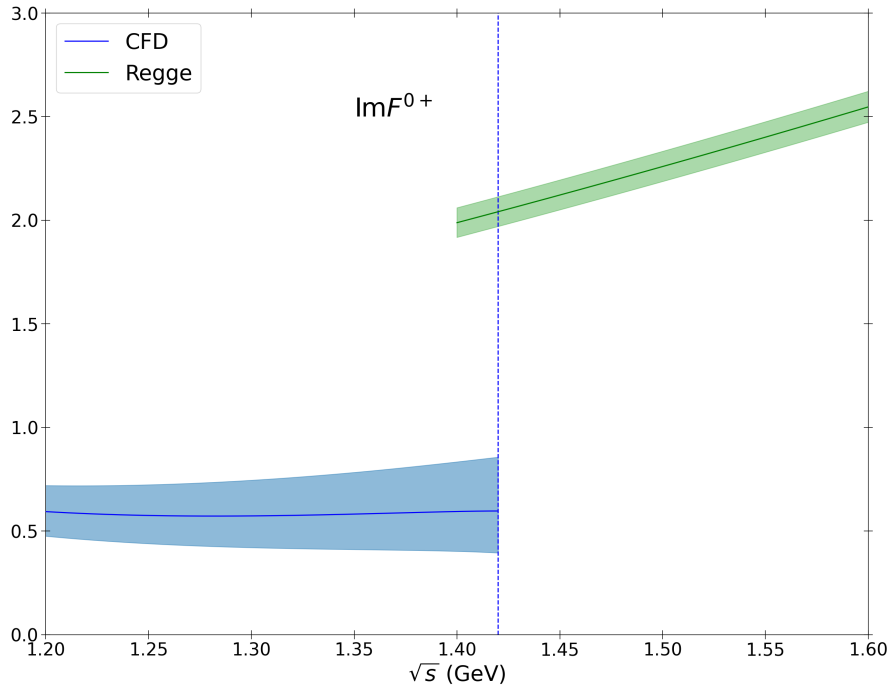

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✗ Improving the precision and imposing dispersive constraints up to higher energies allows us to study the well-known $\rho(1450)$

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* Parameterization and model-independent analyses in order to extract resonances, without imposing them in our analysis

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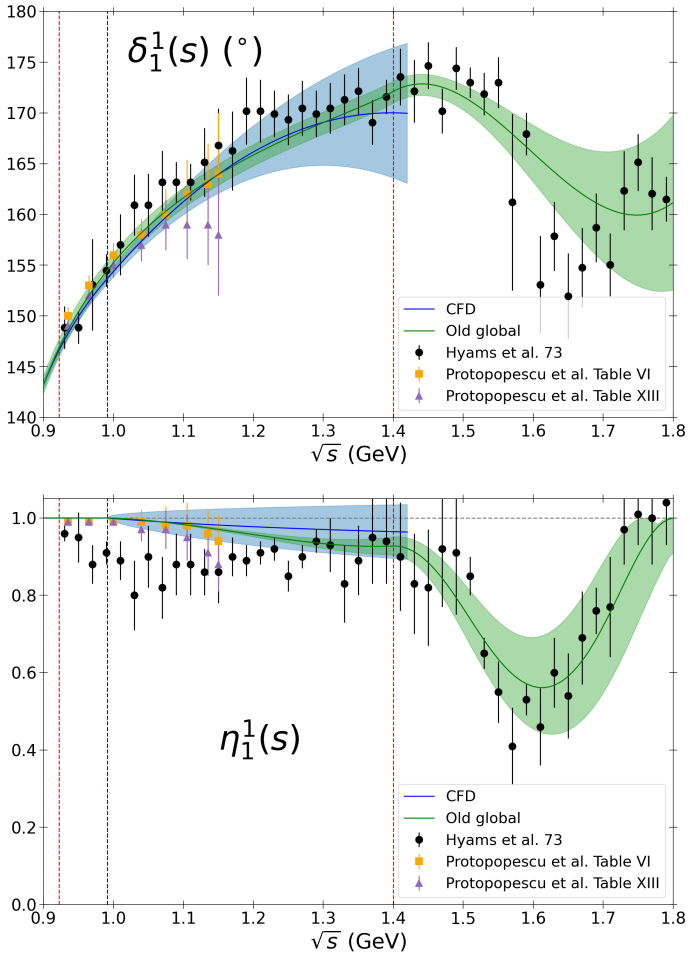

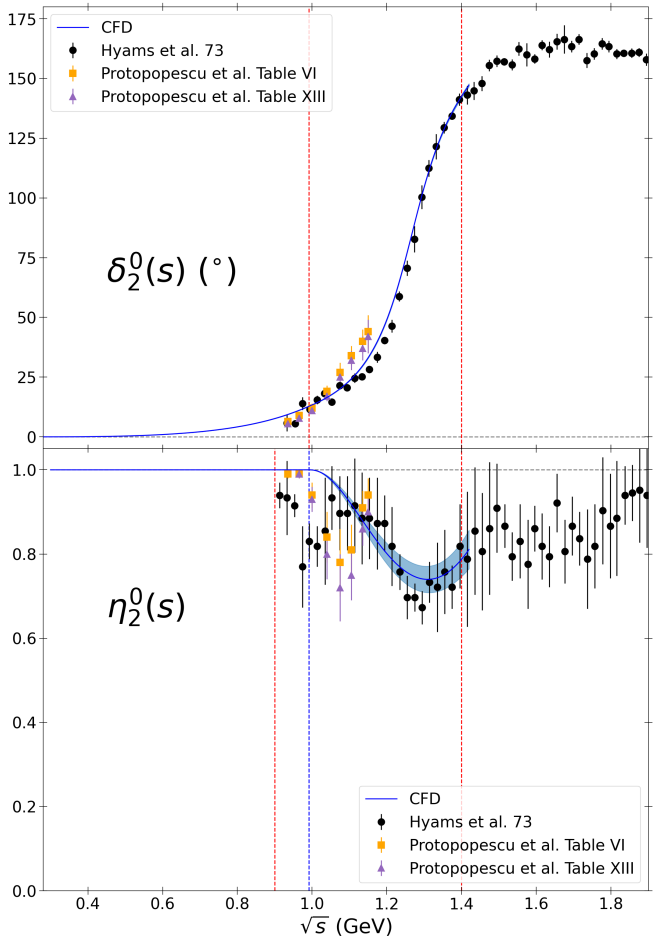

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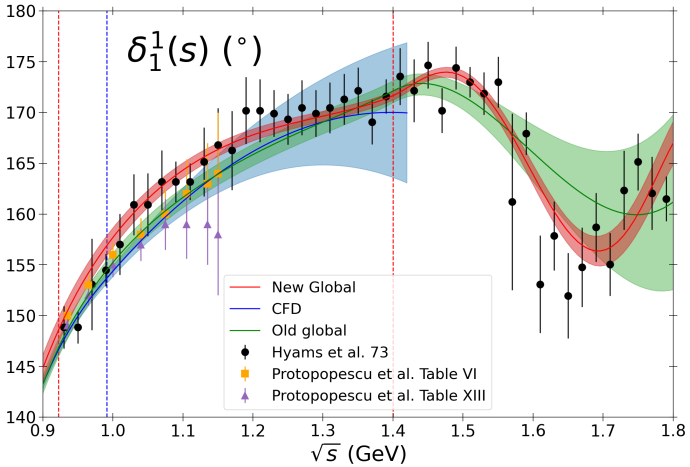

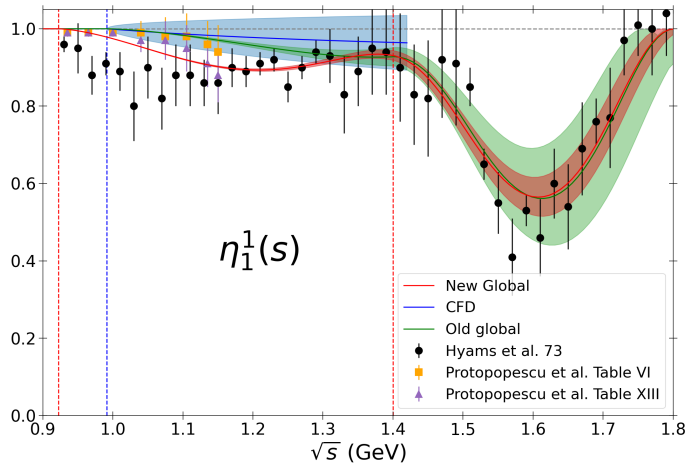

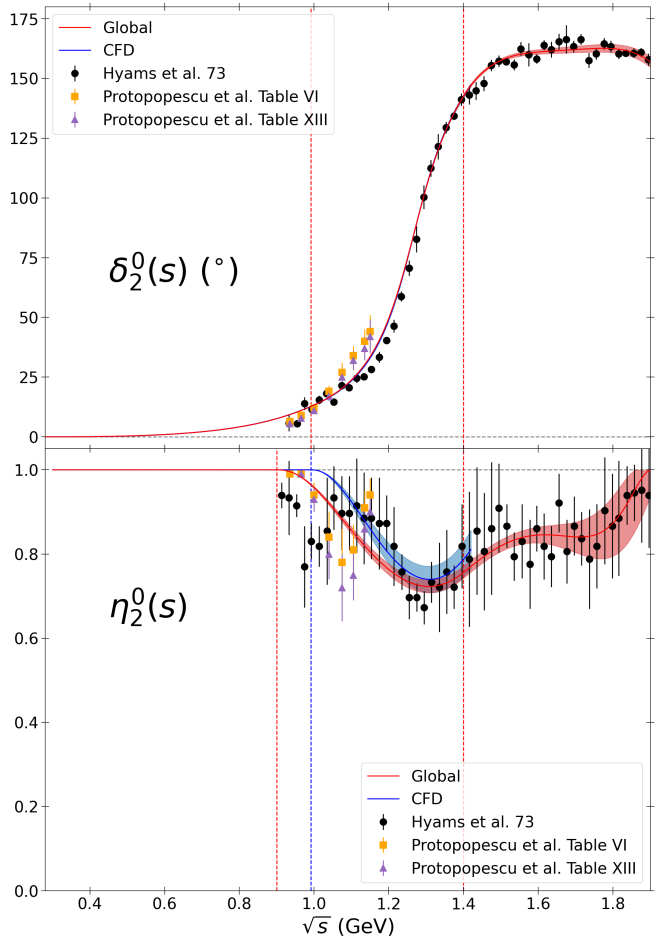

CFD(2011)

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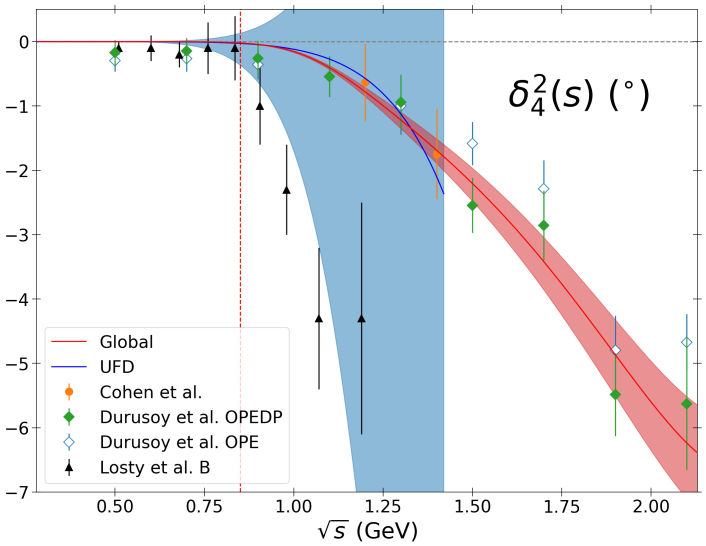
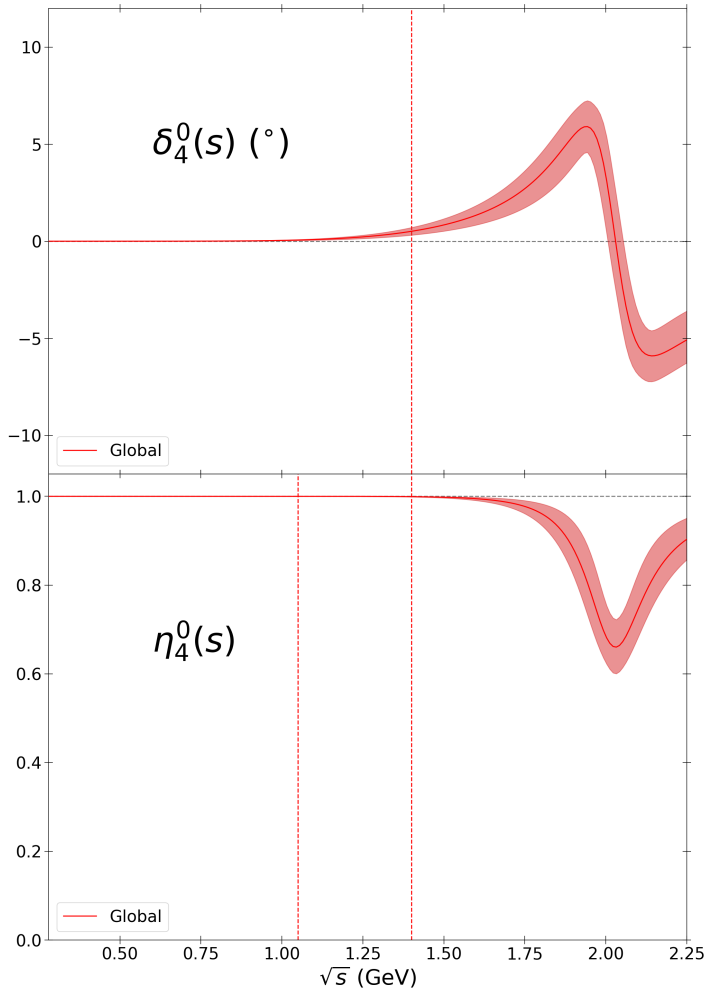
New Global

* New global G-waves (relevant for precision above 1 GeV)





2. Reconstruct the amplitudes $T^I(s,0)$ from the global partial-wave parameterizations

$$T^I(s,\theta) = 32\pi \sum_\ell (2\ell+1) P_\ell(\cos\theta) t_\ell^I(s)$$

Convenient isospin basis for the Forward Dispersion Relations

$$T^{00} = \frac{1}{3}(T^0 + 2T^2)\,,\quad T^{0+} = \frac{1}{2}(T^1 + T^2)\,,\quad T^{I_t=1} = \frac{1}{6}(2T^0 + 3T^1 - 5T^2)$$

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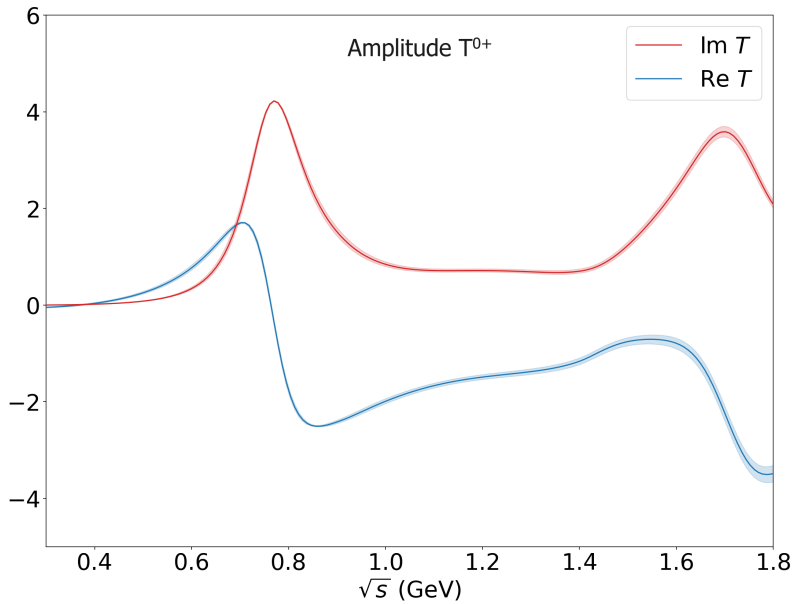

3. Imposing the Forward and Roy-like dispersion relations through a constrained fit to data

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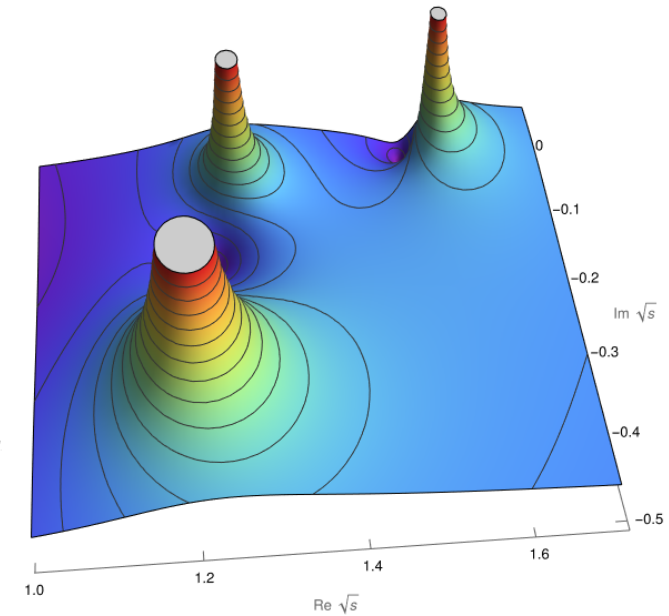
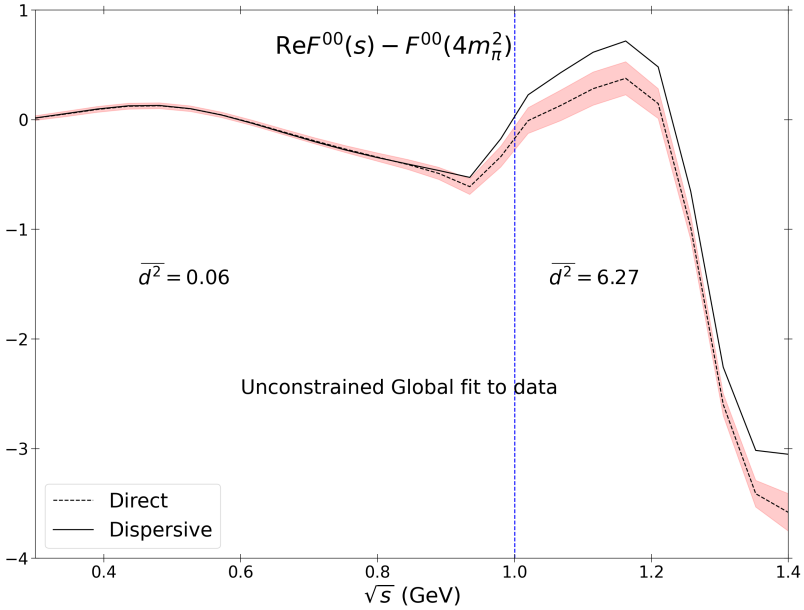
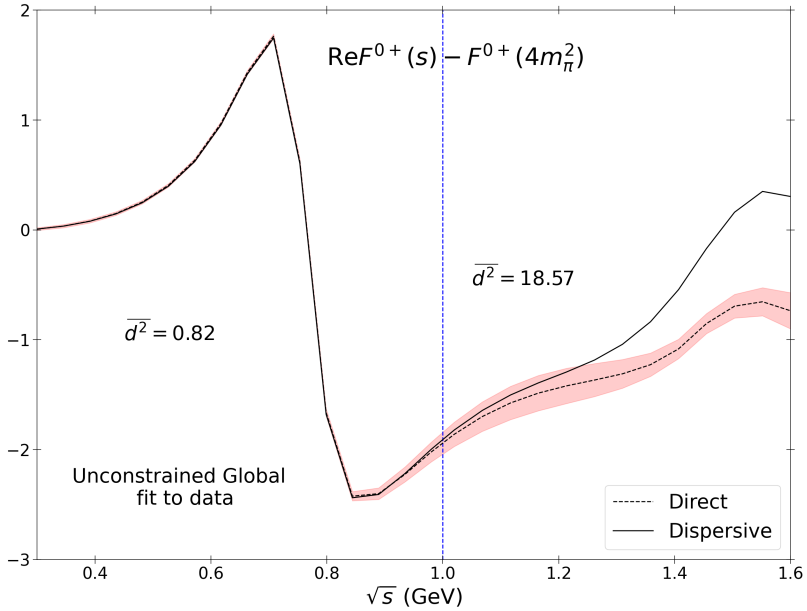
4. Extract resonances from the FDRs

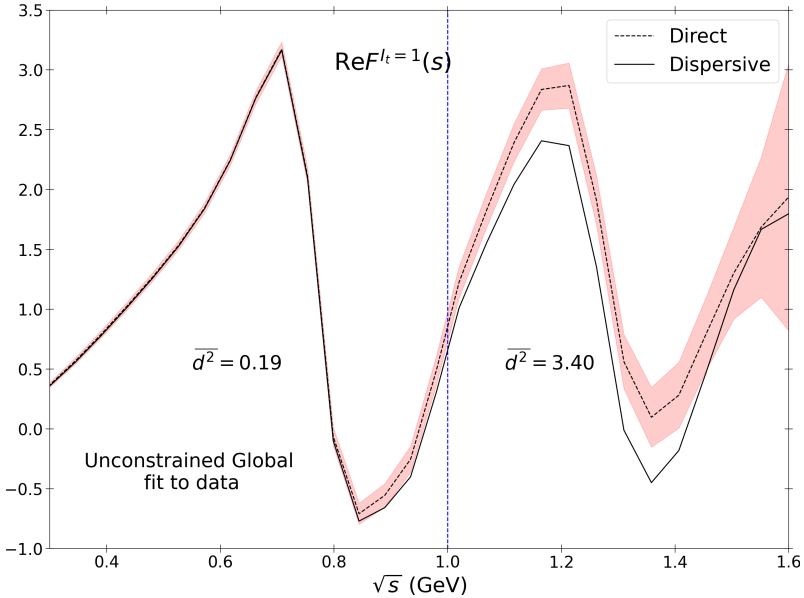


2. Global fit to data results (preliminary)

✓ Are the **Forward Dispersion Relations** fulfilled?







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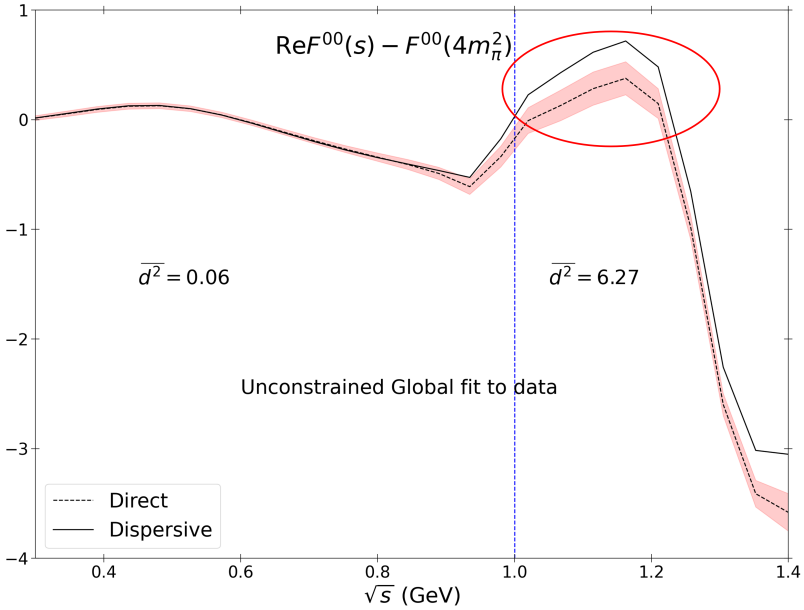

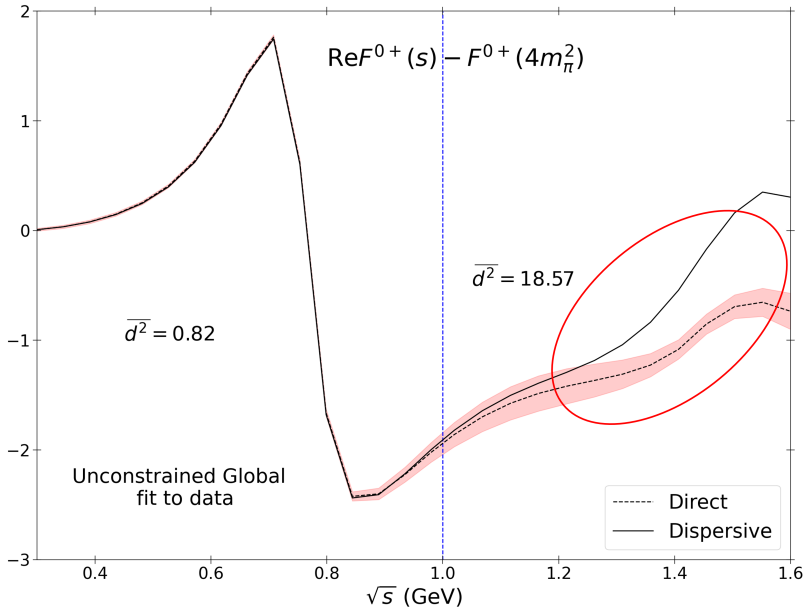

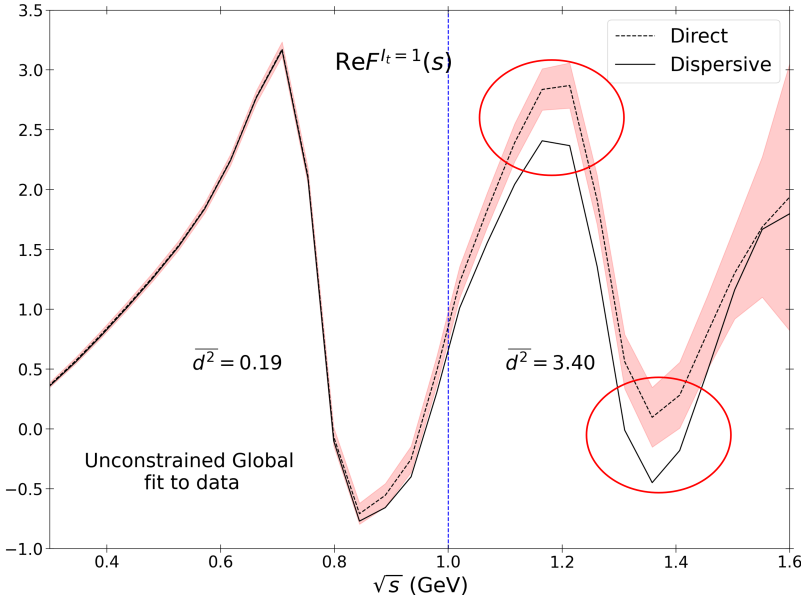

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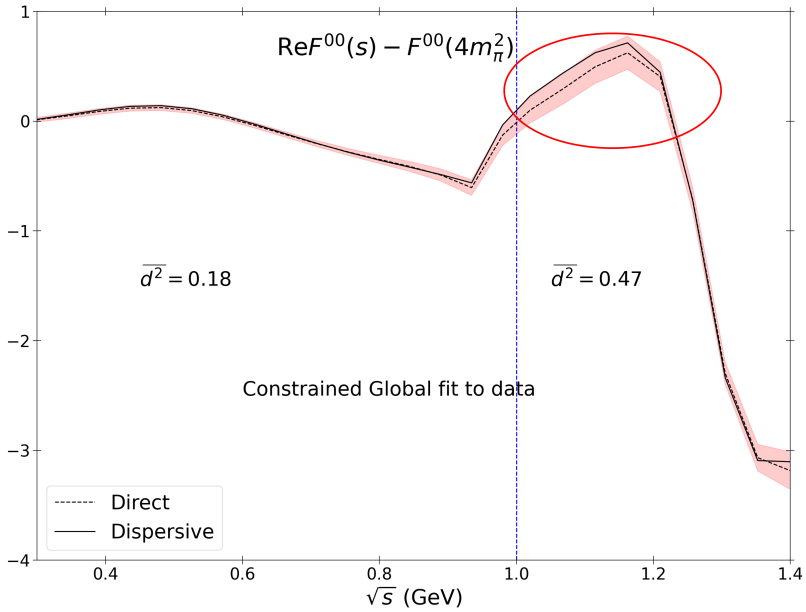

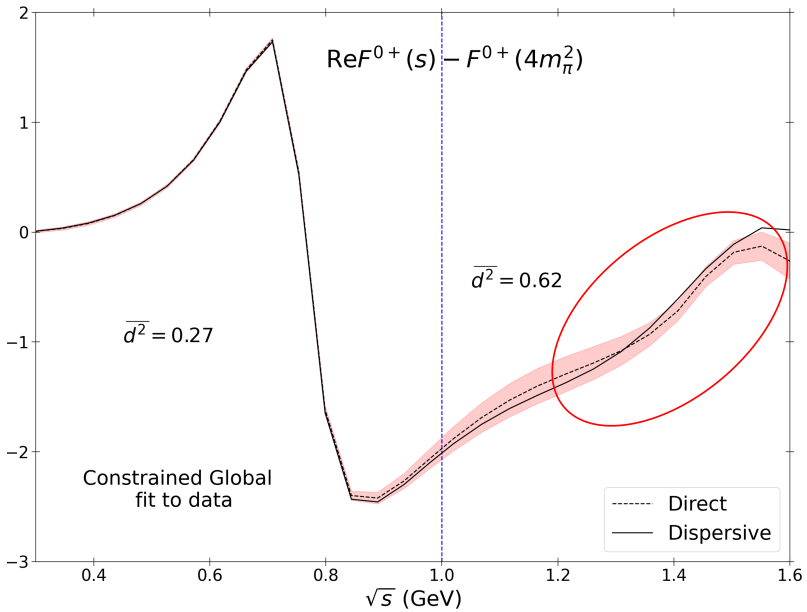

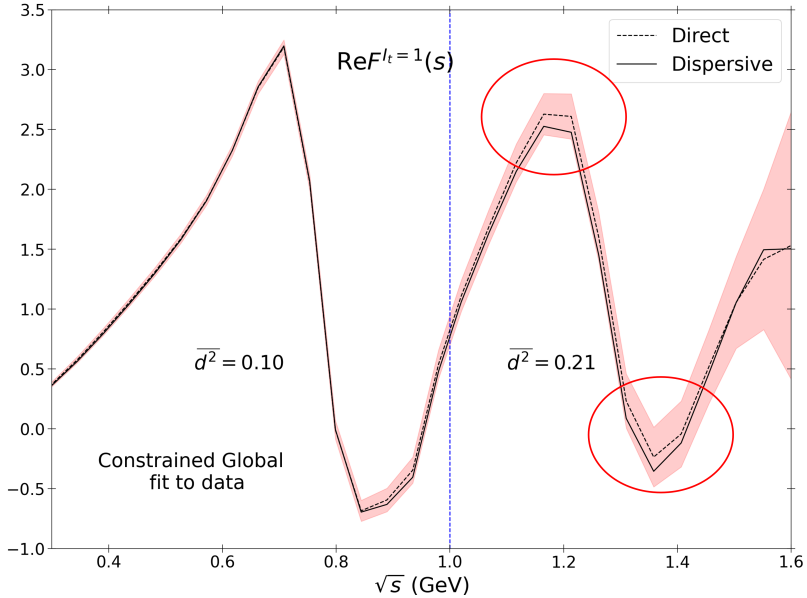

Constrained fit to data

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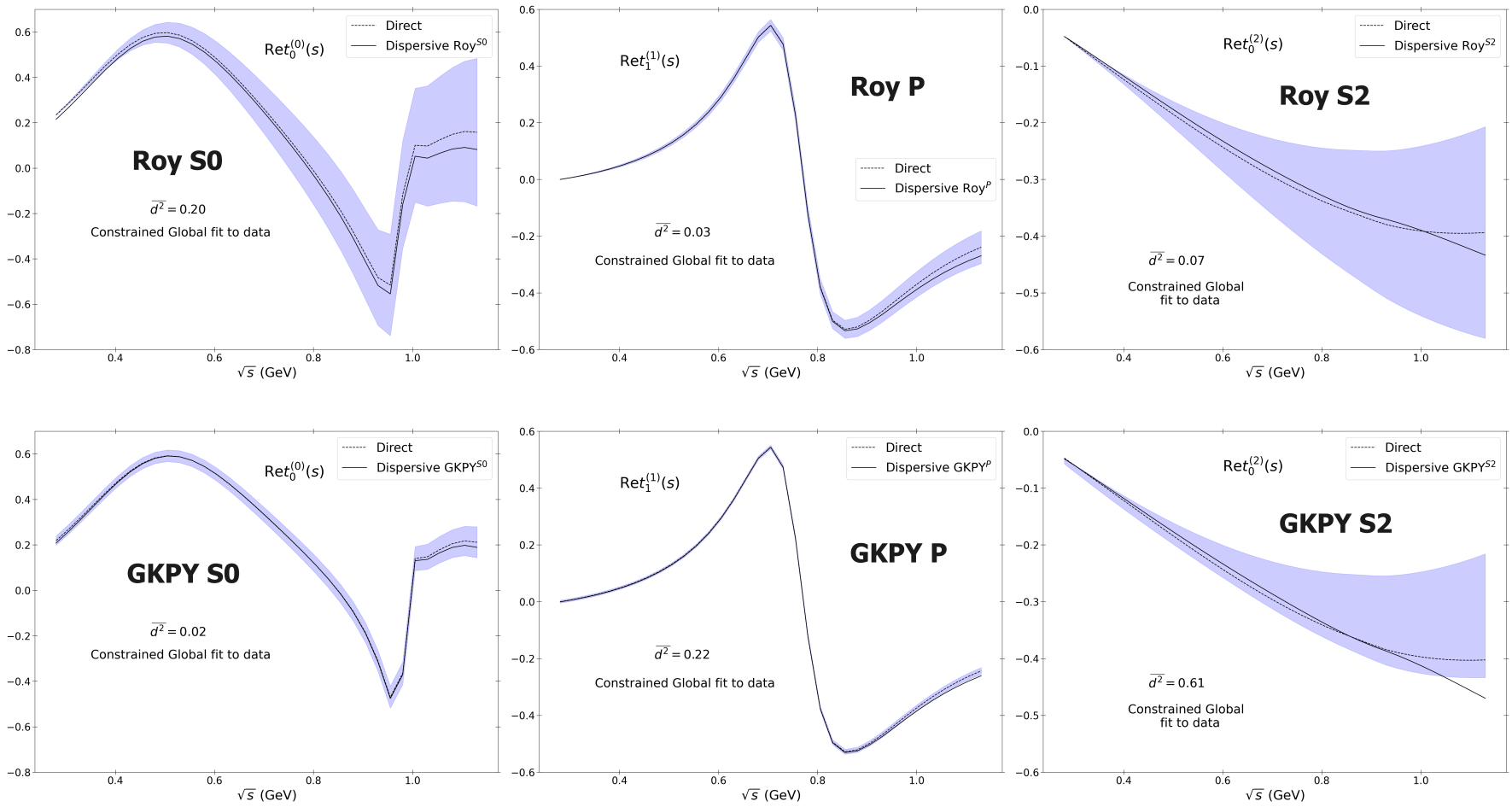
✓ **Roy** and **GKPY** (once-subtracted Roy eqs) for **S0, P** and **S2** partial-waves are also satisfied by our new global parameterizations



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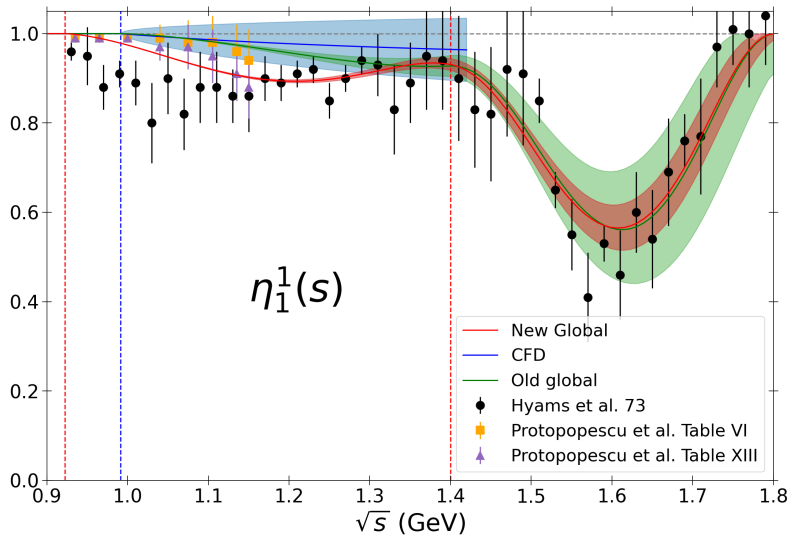
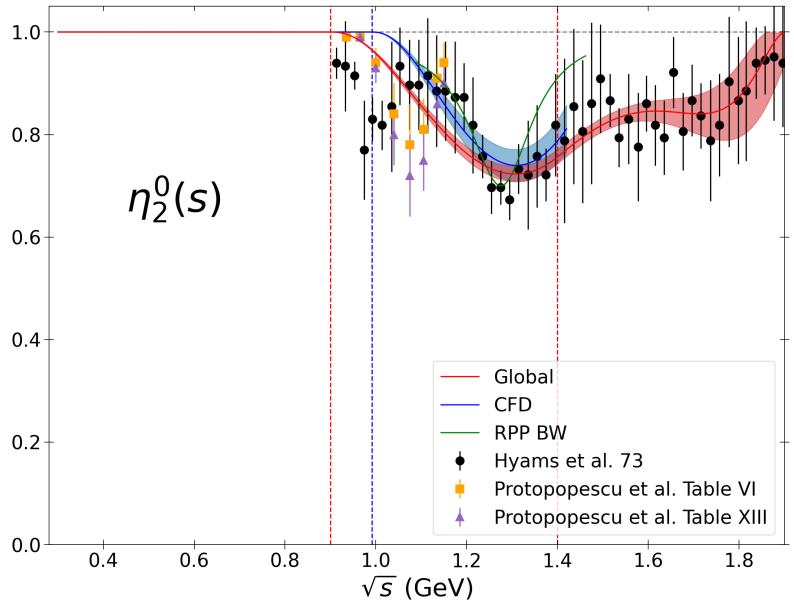
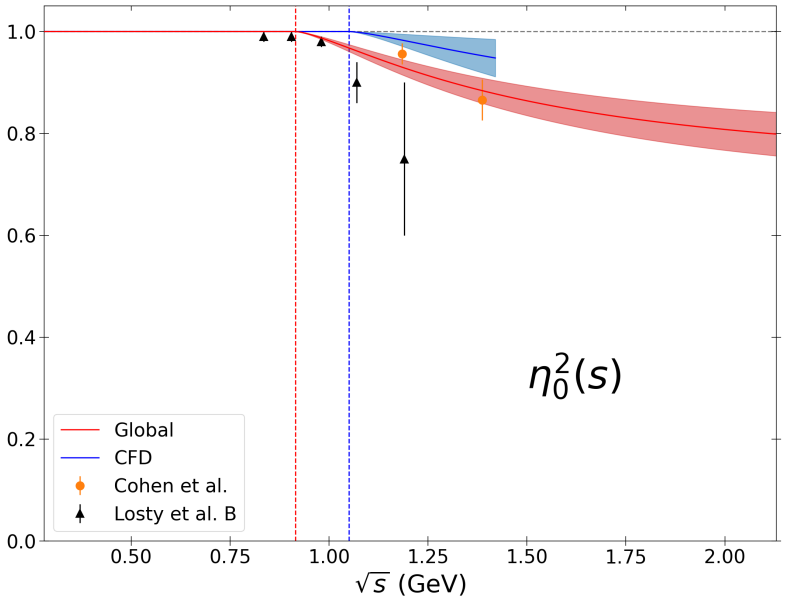
✓ Inelasticity data description improved







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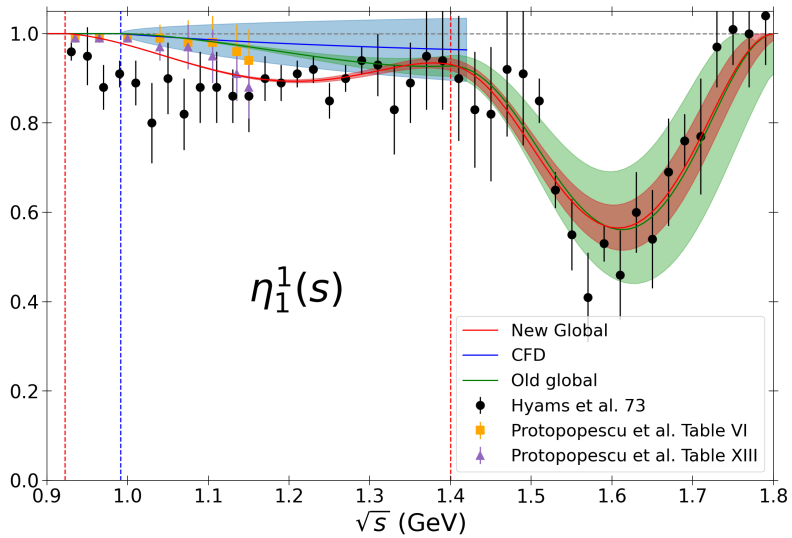

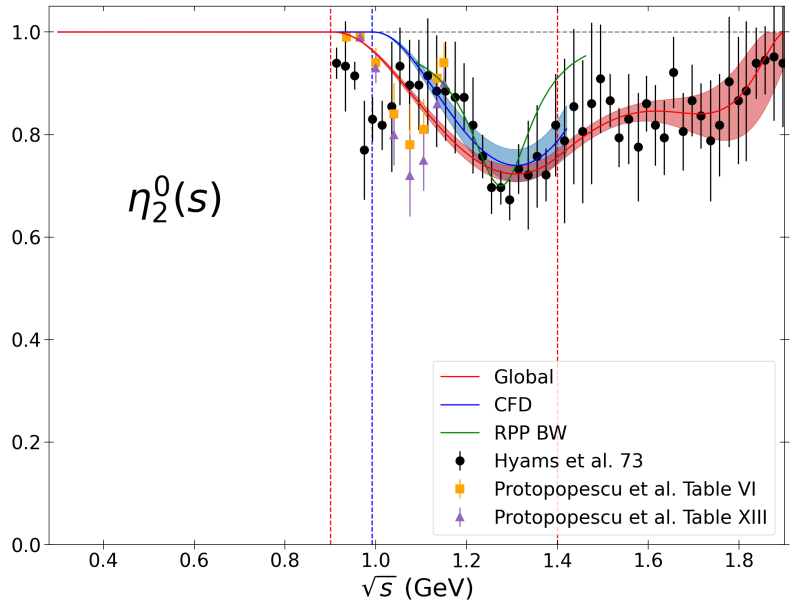

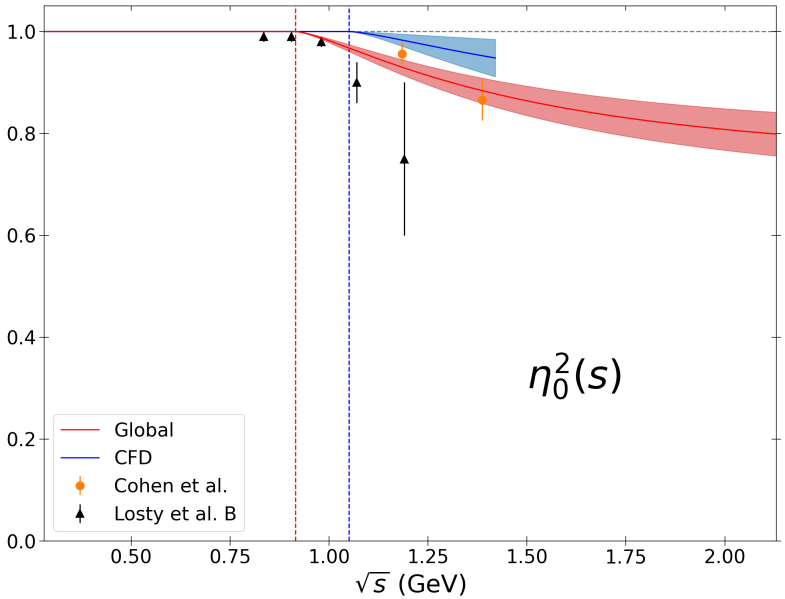

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✓ Data description up to $\sim$ 1.8-2 GeV
(previously up to 1.4 GeV)

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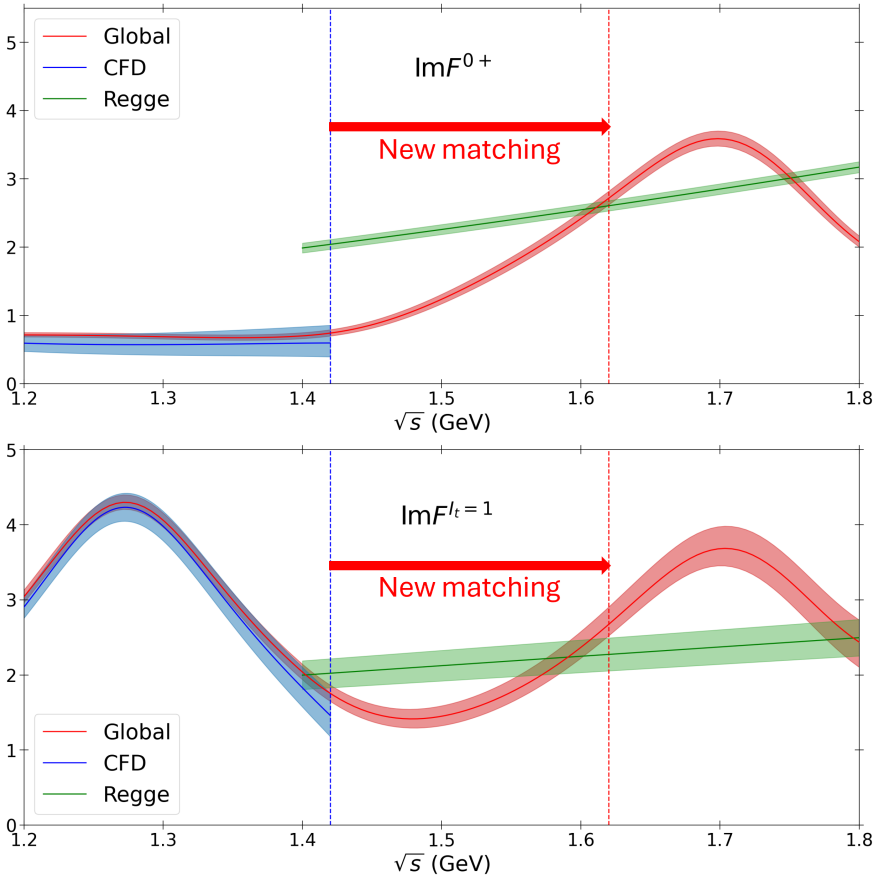
✓ Better matching between PWAs and Regge parameterizations



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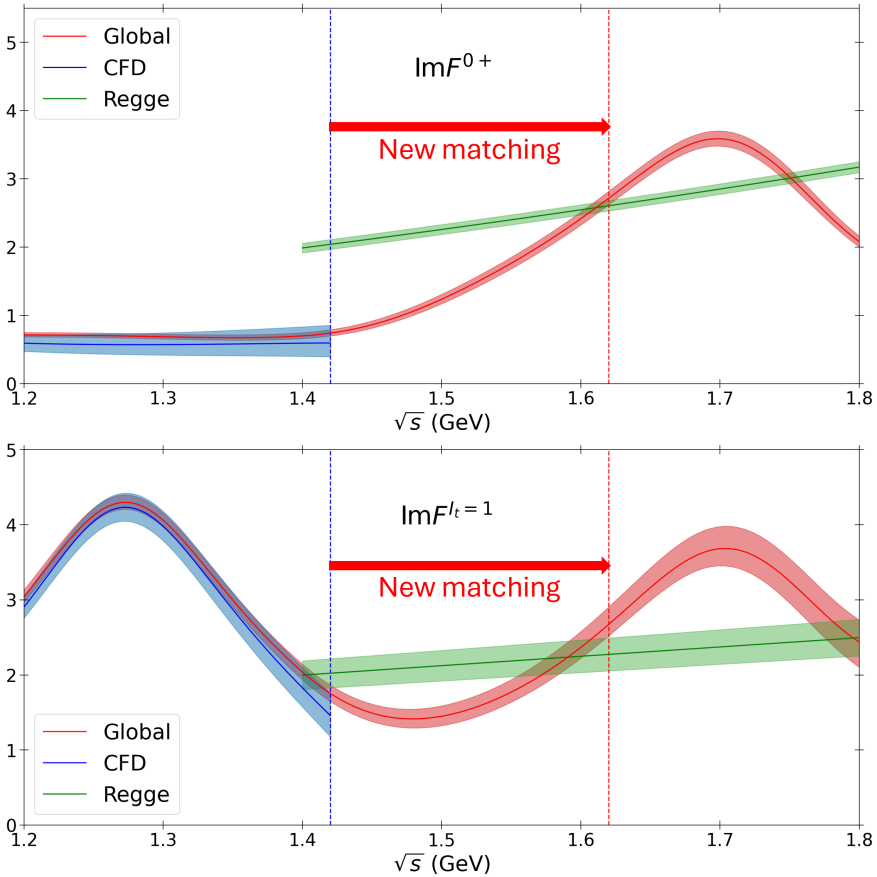

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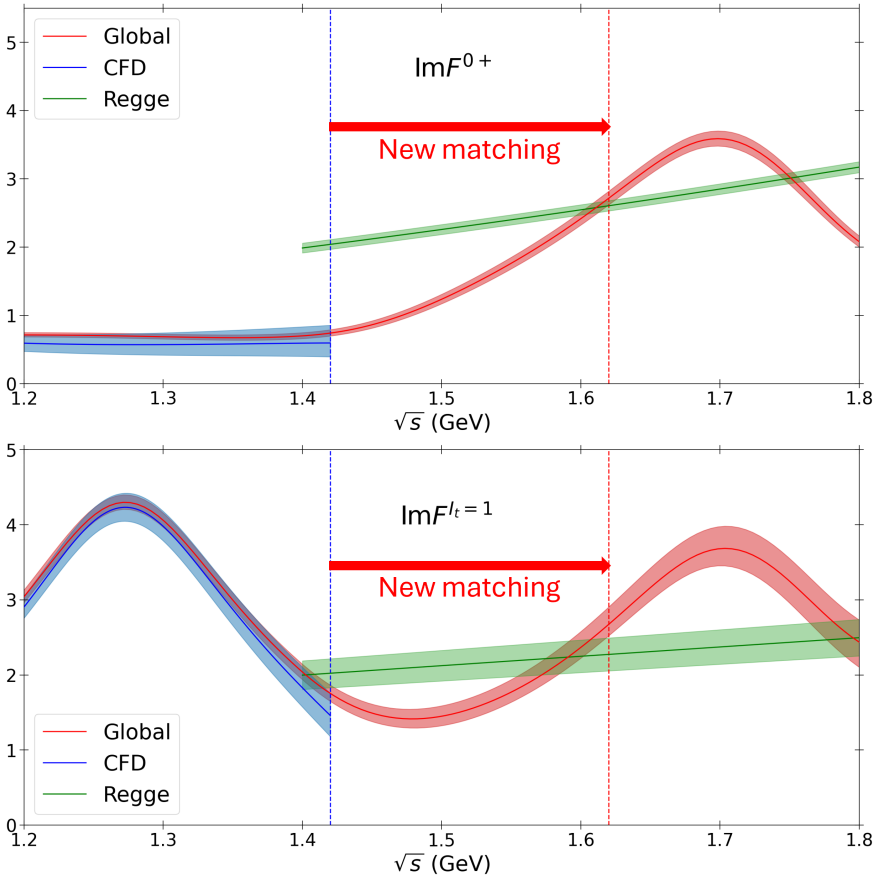

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But... What about the $\rho(1450)$?

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* In order to determine a **pole resonance**, we look for poles for different N, and we only obtain the physical poles in a stable way!

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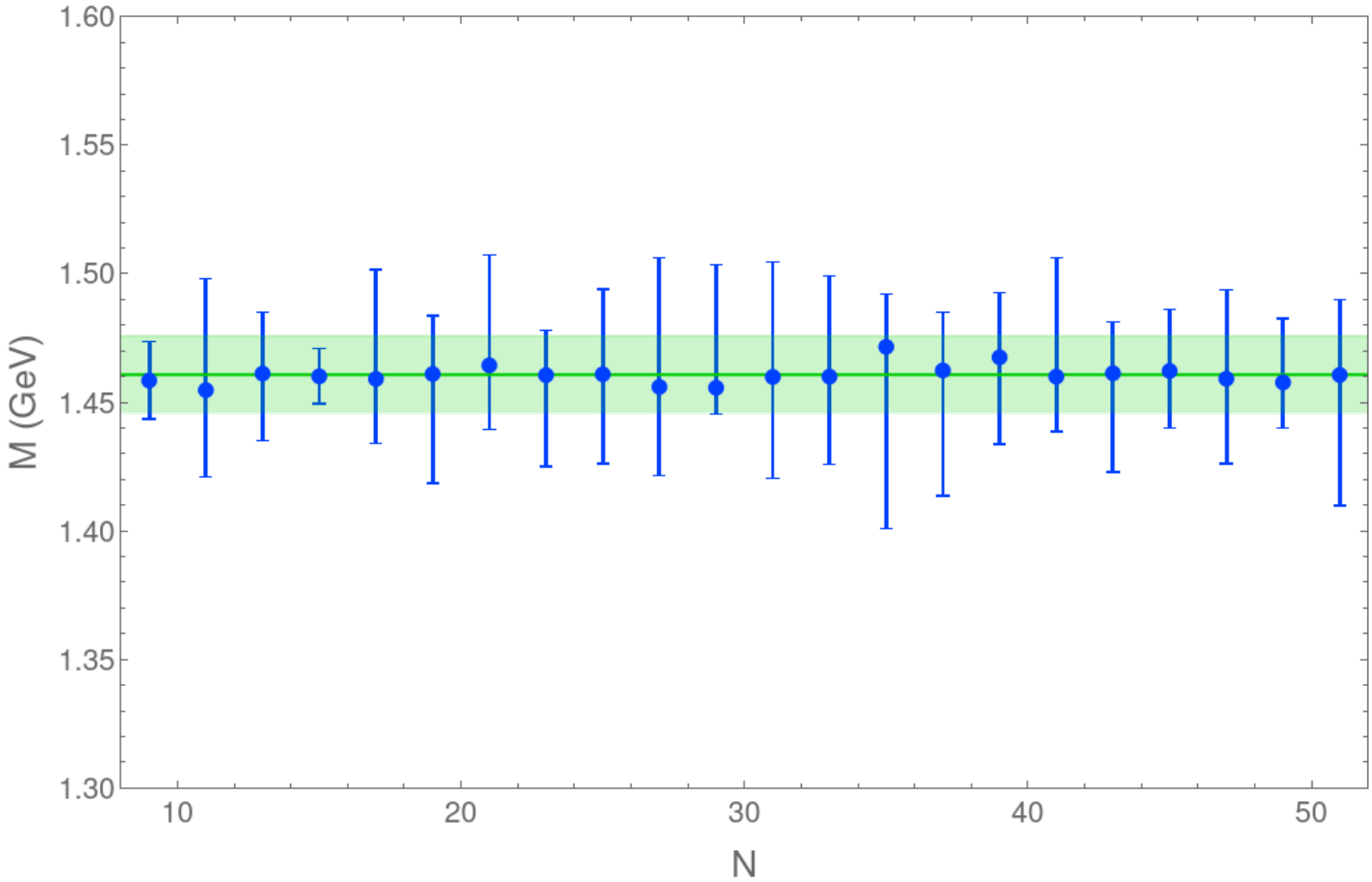
* **Stable** results for different N (e.g. for the $\rho(1450)$)



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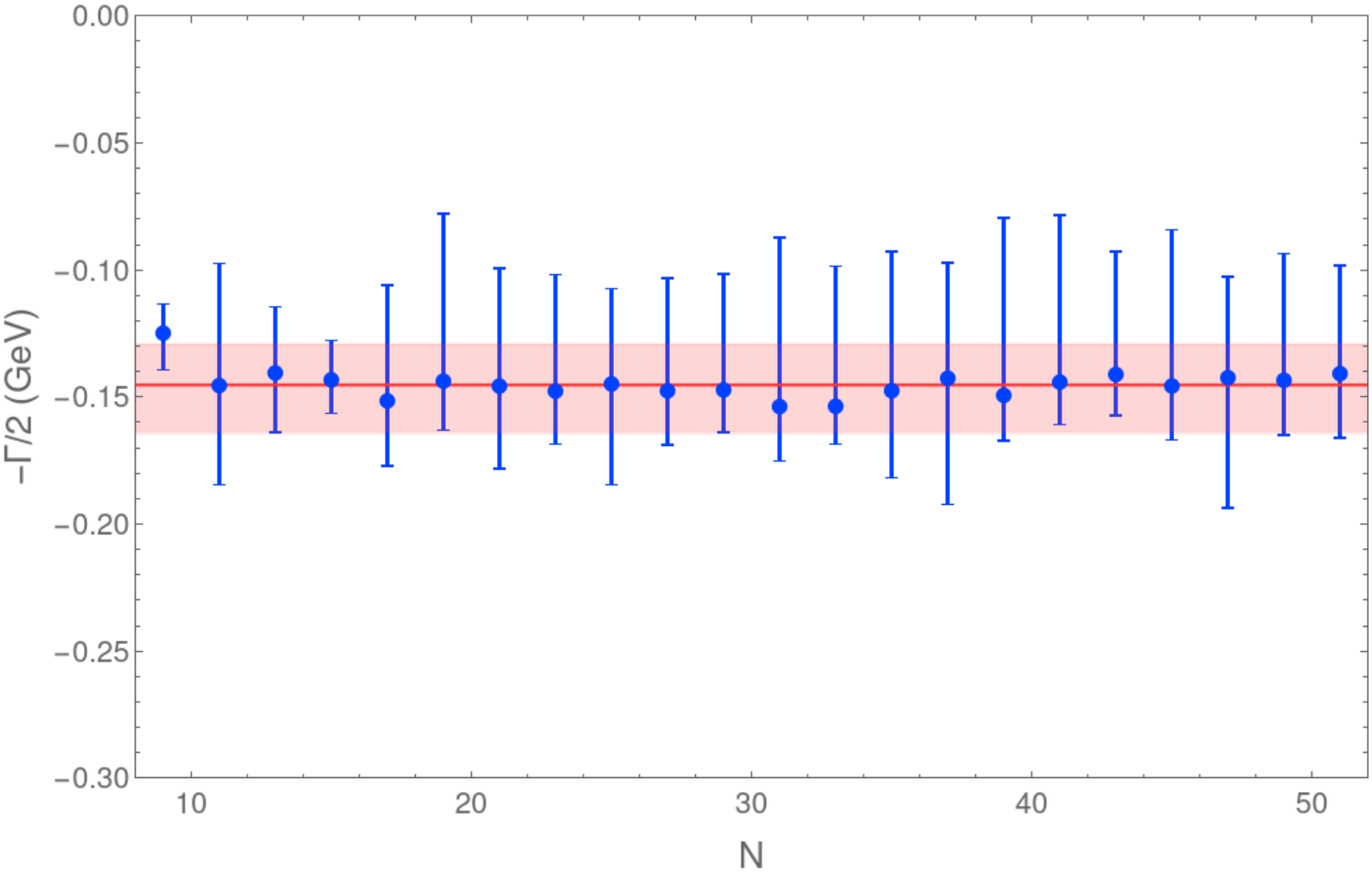

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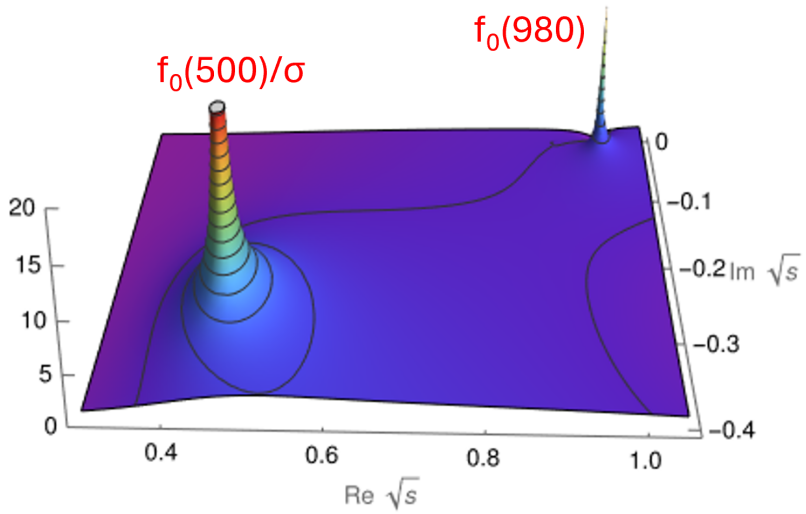

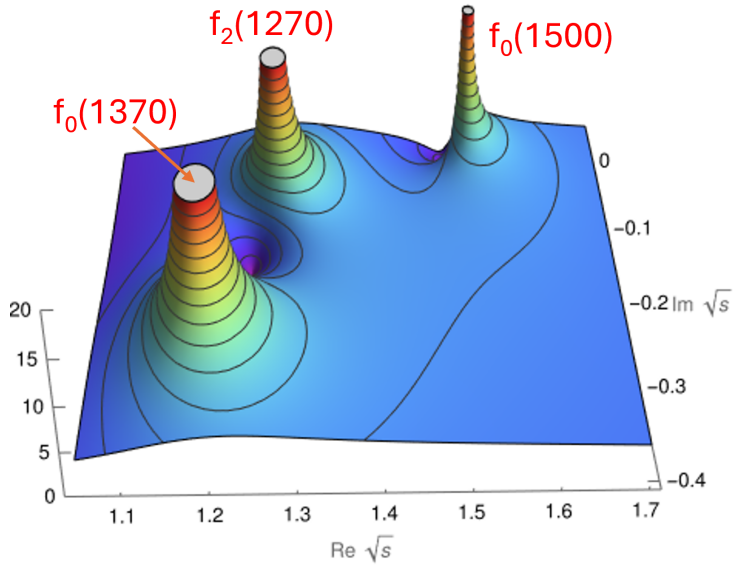

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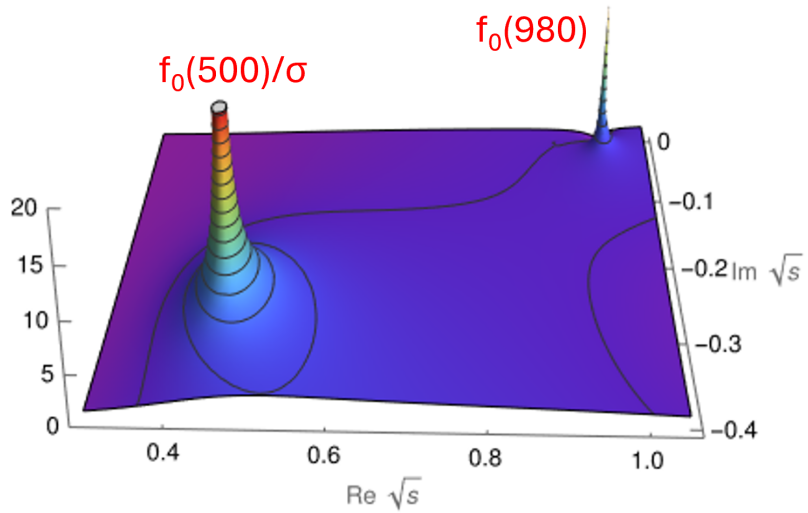

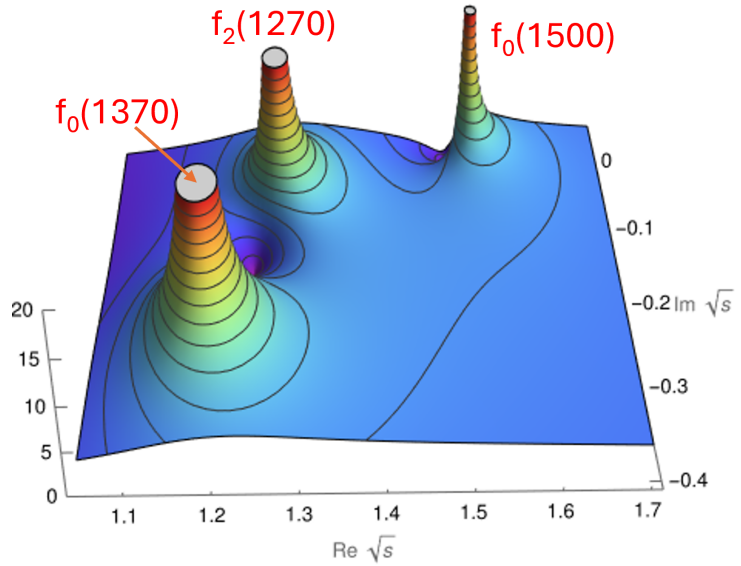

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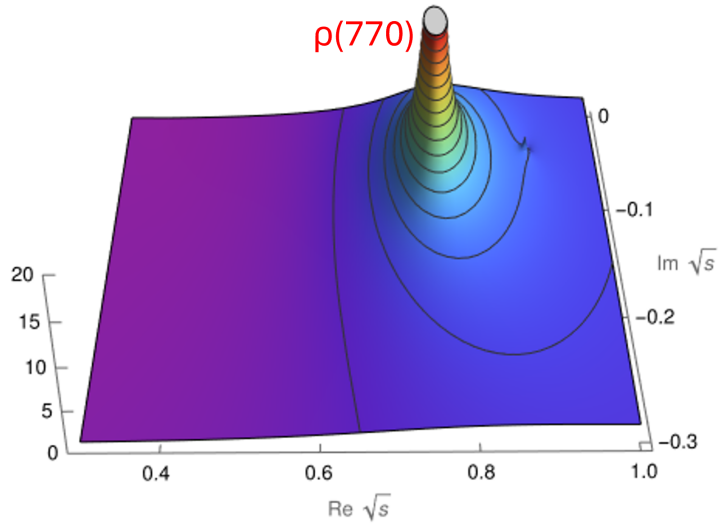

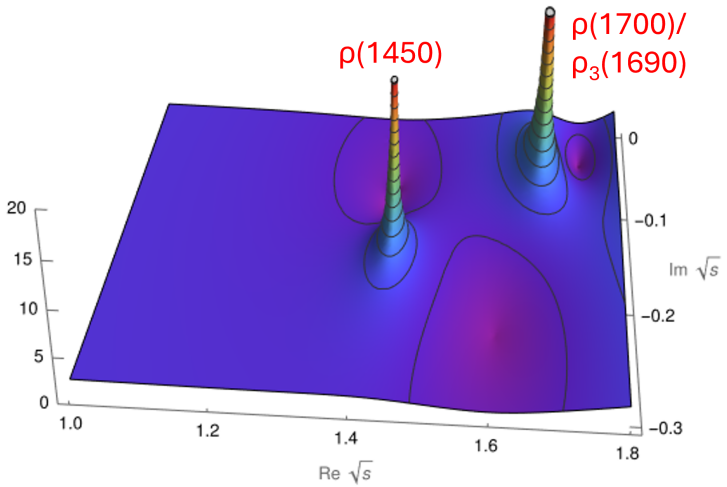

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	M (MeV)	**Γ** (MeV)	$\|g\|$
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$f_0(1370)$	1238^{+38}_{-31}	550^{+58}_{-116}	$9.2^{+1.9}_{-1.1}$ GeV
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* No hints of **$\rho(1250)$** (present in old PDG editions and recently claimed for the same data N. Hammoud et al., Phys.Rev. D102, 054029 (2020))

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★ To Do
- Improve the constraints fulfillment and double check the results
- Final results for Solutions II and III (better results for Solution I so far)

Thank you for your attention