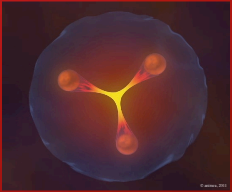
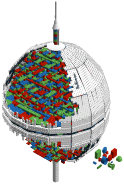
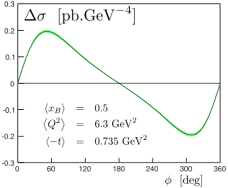
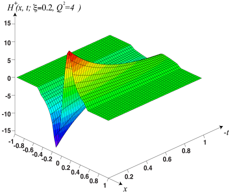
DE LA RECHERCHE À L'INDUSTRIE

3DPartons









Introduction | Hervé MOUTARDE

31 May 2021

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Work Package objectives

- Aggregate, improve and homogenize existing codes written by independent groups from the GPD and TMD communities: **ensure interoperability**.
- Maintain and release robust, flexible, validated and up-to-date open source codes to the 3D hadron structure community: **foster progress**.
- Provide documentation, technical assistance and perform nonregression tests: **facilitate dissemination**.
- Promote Open Data and Open Science: **build on previous research and get new results faster**.

Work Package tasks

- Flexible software architecture for GPD and TMD codes, elaborating on existing libraries and benefiting from experience from the PDF community.
- Generic MC event generators for GPDs and TMDs.
- Associated tools to compare theoretical calculations to experimental data.
- 3DPartons workshops and training schools.
- Webpage, software forge and mailing lists.
- Interact with relevant Work Packages of STRONG-2020.

Program.

Monday, May 31st, 2021

14:00	**Introduction to the session** *IJCLab*	*Hervé MOUTARDE* 14:00 - 14:10
	Status of the GeParD code *IJCLab*	*Kresimir Kumericki* 14:10 - 14:35
	Evolving GPD in x space: a new path through APFEL *IJCLab*	*Cédric Mezrag* 14:35 - 15:00
15:00	**DVCS off a pion target** *IJCLab*	*M. Jose Manuel Morgado Chavez* 15:00 - 15:30
16:00	**Round table discussion: Benchmarking GPD evolution codes** *IJCLab*	15:30 - 16:30

Tuesday, June 1st, 2021

14:00	**Introduction to the session**	*Hervé MOUTARDE*	*IJCLab*	14:00 - 14:10
	A determination of the collinear PDFs of the pion with xFitter	*Alexander Glazov*	*IJCLab*	14:10 - 14:35
	The NangaParbat code for TMD phenomenology	*Valerio Bertone*	*IJCLab*	14:35 - 15:00
15:00	**Pion fragmentation functions using single-inclusive annihilation and semi-inclusive data**	*Rabah Abdul Khalek*	*IJCLab*	15:00 - 15:25
	The EpIC event generator for exclusive processes	*Dr Kemal Tezgin*	*IJCLab*	15:25 - 15:45
	Impact of a positron beam at JLab on an unbiased determination of DVCS Compton Form Factors	*Dr Pawel Sznajder*	*IJCLab*	15:45 - 16:05
16:00	**Determination of parton distribution functions from lattice QCD**	*Savvas ZAFEIROPOULOS*	*IJCLab*	16:05 - 16:30
	Round table: Improving parton distribution fits with lattice QCD calculations		*IJCLab*	16:30 - 17:00
17:00				

Round table.

Some questions to initiate the discussion.

- Which GPD models should we use?
- Which “model” of the strong coupling should we use?
- How do we treat flavor thresholds?
- What should be the desired target accuracy?
- How do we compare evolution in x-space and in conformal space?
- What is the kinematic range for benchmarking?
- What should the data format for comparison (grids? Other types of files?)?

- Which GPD models should we use?

Theoretically consistent (polynomiality and correct smoothness properties mandatory, positivity optional).
Preferentially usable for both x space and moment methods.
Analytic form (rather than purely numerical) for practical reasons.

- Which “model” of the strong coupling should we use?

For LO evolution, I think the closed form of the LO running coupling is the obvious choice (i.e. one has to agree on a reference value of α_s *at some scale).*
If you come to NLO evolution, unless there are strong practical reasons against it, I would take the exact numerical solution of the two-loop RGE in that case (so one needs again just one reference value to fix things). This is cheap to compute using a standard Runge-Kutta method.

- How do we treat flavor thresholds?

For LO evolution, Choose a "matching scale" $\mu \simeq m_h$, and impose $GPD_a(\mu, n_F + 1) = GPD_a(\mu, n_F)$ for a = light flavors and $GPD_h(\mu, n_F + 1) = 0$ for h = the new heavy flavor. Varying μ and comparing the result for GPDs at scales $\gg m_h$ can be taken as a measure of the perturbative uncertainty. For NLO evolution, one would need the corresponding matching conditions at order α_s. This requires a one-loop calculation with heavy quarks for GPD matrix elements, with hasn't been done but should be easy enough to do. For computing observables, $n_F = 4$ GPDs should only be used at scales $\gg m_c$ (not just $> m_c$). For scales $\simeq m_c$, one should get reliable results with $n_F = 3$ GPDs but with hard-scattering coefficients including the charm mass. For DVCS this was computed at $O(\alpha_s)$ by Noritzsch long ago.

Round table.

Inputs from Markus Diehl.

- What should be the desired target accuracy?

The accuracy on numerical evolution should be $\gg$ better than the expected experimental accuracy for corresponding observables. (This will ensure that discrepancies between theory and future data are not possibly due to numerical problems, but more likely to insufficient theory, which can then be improved.) As "$\gg$ better", one may require 1 or 2 orders of magnitude.

- How do we compare evolution in x-space and in conformal space?

Identify quantities that can be computed well in both approaches. Conformal moments for integer j should be straightforward to get from x-space GPDs.
Also available in both approaches should be the convolutions $\int_{-1}^{1} \mathrm{d}x [1/(\rho - x - i\epsilon) \pm 1/(\rho + x - i\epsilon)] GPD(x, \xi, t)$ *which correspond to the amplitudes for double DVCS (with the + between the two terms; the combination with the - should appear with electroweak currents and thus is not unphysical).*
One can vary ξ *and* ρ *independently and should thus be sensitive to the evolved GPDs in a meaningful way.*

Round table.

Inputs from Markus Diehl.

- What is the kinematic range for benchmarking?

Take experimentally reachable kinematics as a guide and perhaps go a little bit beyond.

- What should the data format for comparison (grids? Other types of files?)?

Up to the practitioners. You may want to avoid formats that are tied to licensed software (like mathematica). ASCII format would have the advantage to be readable by humans and offer some basic santity checks by eye.

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