Dedicated TMD MC generators

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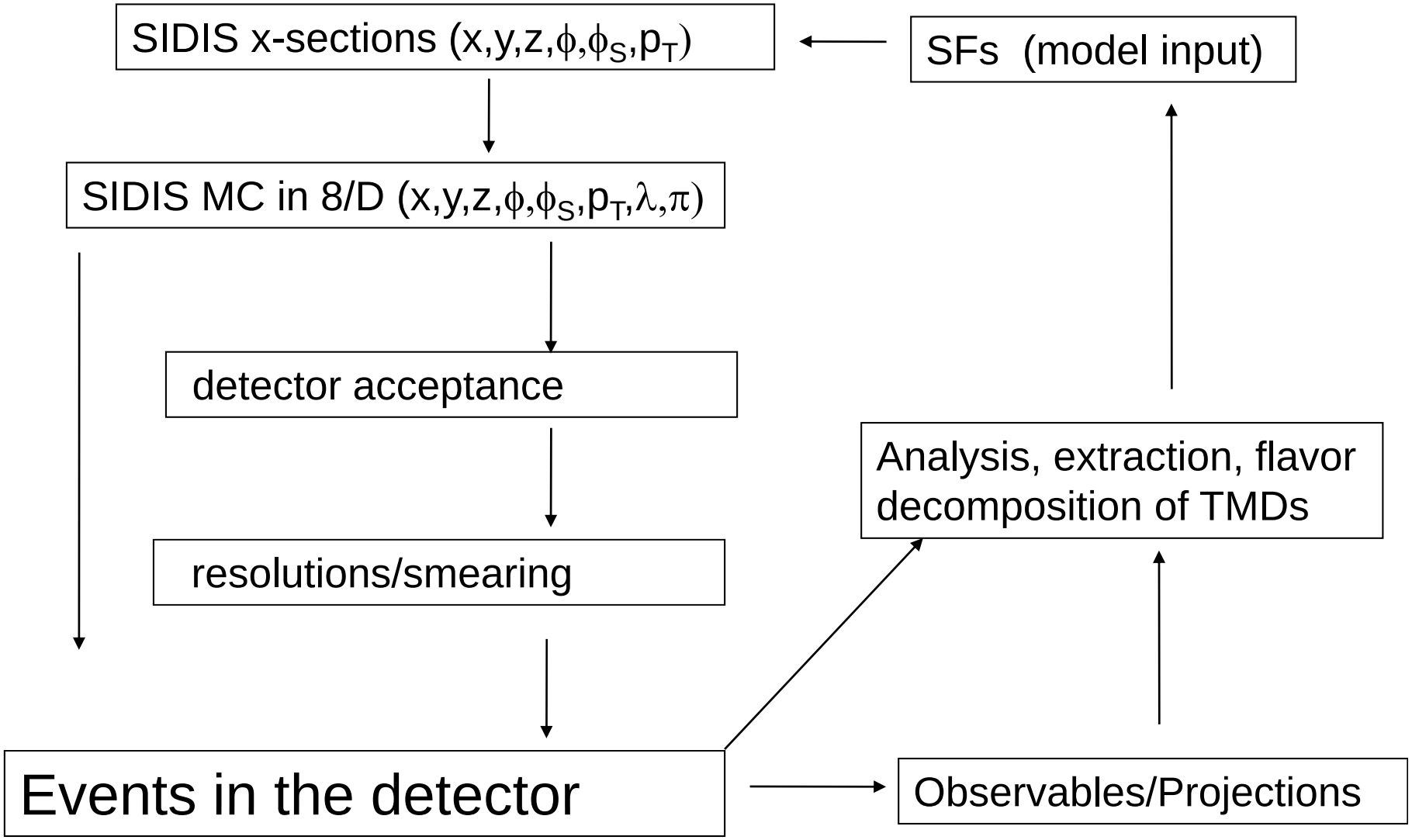
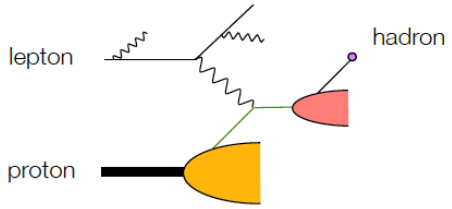
- Main goals
- Generator input: Models of Structure Functions
- Detector simulations: acceptances and projections
- From moments/asymmetries to TMDs
- From simulation to extraction
- Global analysis

Generators & FAST-MC



Generators: main input



$$\frac{d\sigma}{dx\,dy\,d\phi_S\,dz\,d\phi_h\,dP_{h\perp}^2} = \frac{\alpha^2}{x\,y\,Q^2}\,\frac{y^2}{2\,(1-\varepsilon)}\Big\{ F_{UU,T}(x,z,P_{h\perp}^2,Q^2) + \varepsilon\,F_{UU,L} + \sqrt{2\varepsilon(1+\varepsilon)}\,\cos\phi_h\,F_{UU}^{\cos\phi_h} + \varepsilon\cos(2\phi_h)\,F_{UU}^{\cos 2\phi_h}$$
$$+ \lambda_e\sqrt{2\varepsilon(1-\varepsilon)}\,\sin\phi_h\,F_{LU}^{\sin\phi_h} + S_L\Big[\sqrt{2\varepsilon(1+\varepsilon)}\,\sin\phi_h\,F_{UL}^{\sin\phi_h} + \varepsilon\sin(2\phi_h)\,F_{UL}^{\sin 2\phi_h}\Big]$$
$$+ S_L\,\lambda_e\Big[\sqrt{1-\varepsilon^2}\,F_{LL} + \sqrt{2\varepsilon(1-\varepsilon)}\,\cos\phi_h\,F_{LL}^{\cos\phi_h}\Big]$$
$$+ S_T\Big[\sin(\phi_h-\phi_S)\Big(F_{UT,T}^{\sin(\phi_h-\phi_S)} + \varepsilon\,F_{UT,L}^{\sin(\phi_h-\phi_S)}\Big) + \varepsilon\,\sin(\phi_h+\phi_S)\,F_{UT}^{\sin(\phi_h+\phi_S)}$$
$$+ \varepsilon\,\sin(3\phi_h-\phi_S)\,F_{UT}^{\sin(3\phi_h-\phi_S)} + \sqrt{2\varepsilon(1+\varepsilon)}\,\sin\phi_S\,F_{UT}^{\sin\phi_S}$$
$$+ \sqrt{2\varepsilon(1+\varepsilon)}\,\sin(2\phi_h-\phi_S)\,F_{UT}^{\sin(2\phi_h-\phi_S)}\Big] + S_T\lambda_e\Big[\sqrt{1-\varepsilon^2}\,\cos(\phi_h-\phi_S)\,F_{LT}^{\cos(\phi_h-\phi_S)}$$
$$+ \sqrt{2\varepsilon(1-\varepsilon)}\,\cos\phi_S\,F_{LT}^{\cos\phi_S} + \sqrt{2\varepsilon(1-\varepsilon)}\,\cos(2\phi_h-\phi_S)\,F_{LT}^{\cos(2\phi_h-\phi_S)}\Big]\Big\}$$

	observable	twist
"SIDIS F_T"	$F_{UU,T}$	2
"SIDIS F_L"	$F_{UU,L}$	4
"Cahn"	$F_{UU}^{\cos\phi_h}$	3
"Boer-Mulders"	$F_{UU}^{\cos 2\phi_h}$	2
	$F_{LU}^{\sin\phi_h}$	3
	$F_{UL}^{\sin\phi_h}$	3
"otzinian-Mulders"	$F_{UL}^{\sin 2\phi_h}$	2
"SIDIS g_1"	F_{LL}	2
"Polarized Cahn"	$F_{LL}^{\cos\phi_h}$	3
"Sivers"	$F_{UT,T}^{\sin(\phi_h-\phi_S)}$	2
	$F_{UT,L}^{\sin(\phi_h-\phi_S)}$	4
"Collins"	$F_{UT}^{\sin(\phi_h+\phi_S)}$	2
"Pretzelosity"	$F_{UT}^{\sin(3\phi_h-\phi_S)}$	2
	$F_{UT}^{\sin\phi_S}$	3
	$F_{UT}^{\sin(2\phi_h-\phi_S)}$	3
"Worm gear"	$F_{LT}^{\cos(\phi_h-\phi_S)}$	2
"SIDIS g_2"	$F_{LT}^{\cos\phi_S}$	3
	$F_{LT}^{\cos(2\phi_h-\phi_S)}$	3

Need a library of Structure Functions

Projections and acceptances

https://userweb.jlab.org/~avakian/tmp/pro.sidis.pip.dat (also pim,pi0,kap,kam)

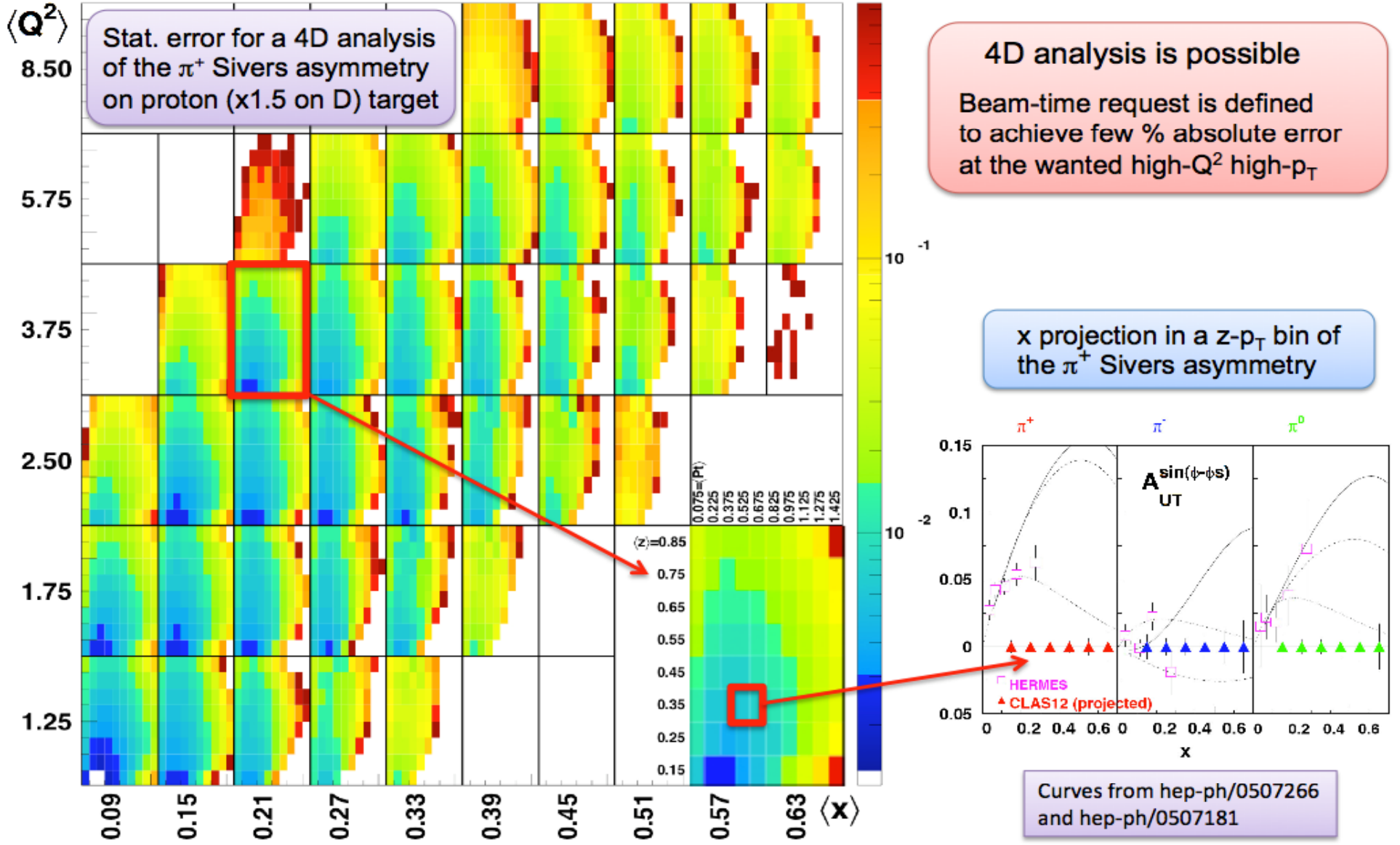
The bins are for x from 0.06 with 0.06 step, z from 0.1 with 0.1 step, P_T from 0 with 0.15 step, Q^2 going from 1 to 10 8 bins.

1	2	-	5	6				10	N_tot	N+	N_1……N_24				bins in \phi
bin#				<x>	<p_T>	<z>	<Q^2>	<y>							
644	3	0	2	7	0.19	1.10	0.19	2.86	0.75	8	3	0	1	1	1 …….
645	3	0	3	0	0.27	0.10	0.14	2.49	0.45	9616	5643	506	820	821	862 ……
646	3	0	3	1	0.27	0.24	0.12	2.48	0.45	33048	19381	2025	2386	2850	2965 ….
647	3	0	3	2	0.27	0.36	0.13	2.47	0.45	29634	17445	2374	2480	2469	2414 ….
648	3	0	3	3	0.27	0.51	0.15	2.48	0.45	9993	5778	776	778	783	823 ….
649	3	0	3	4	0.26	0.65	0.17	2.56	0.47	1753	1030	141	141	137	153 ….
650	3	0	3	5	0.26	0.79	0.18	2.70	0.51	126	78	8	14	10	14 10 ….
651	3	0	4	0	0.33	0.10	0.15	2.50	0.37	5205	2990	372	409	457	478 ….

……..

Develop a common format for projections

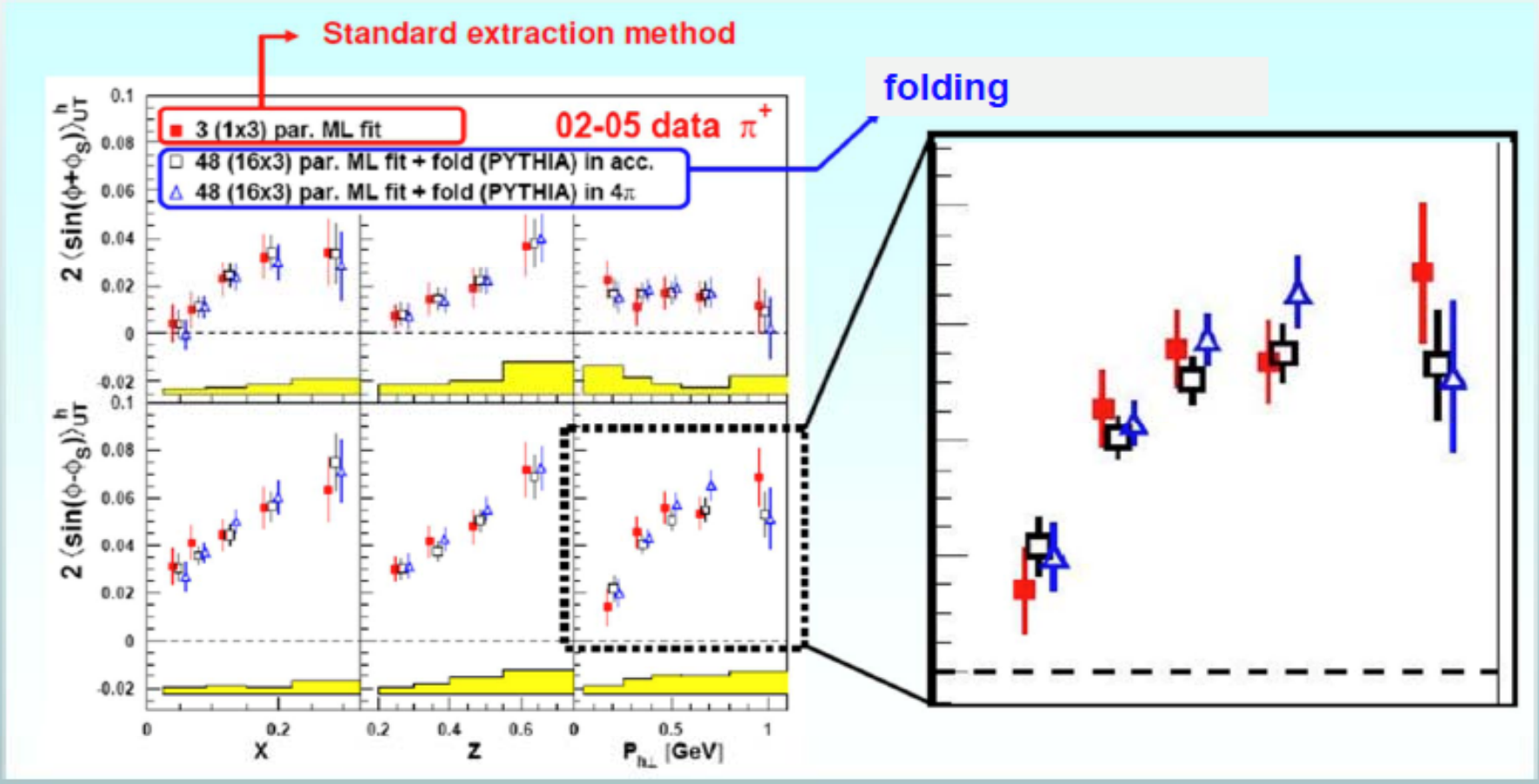
Projections: visualization



Evaluation of acceptance effects ("old" approach)

Luciano Pappalardo

applying the method on real data



- acceptance effects smaller in data than in MC

With defined procedure for flavor decomposition we can compare directly extracted final TMDs instead of azimuthal moments

Summary

- Develop a realistic TMD based generator (NJL/LUND/….)
- Develop a single/double hadron MC for common use (gmc_trans/Jlab SIDIS)
- Library of models for all structure functions
  - k_T/p_T-dependent PDFs and FFs

- Develop the procedure for k_T-dependent TMD flavor decomposition for
  - Systematic errors from experiment & theory
  - Check stability of extracted TMDs with different input k_T/p_T-dependences in TMDs and FFs /rad.corr/multiparticle backgrounds/…..
- Global analysis
  - Define what we measure, with what precision,..
  - Standards of projections
- ……..