PARTONS project
for Generalised Parton Distributions

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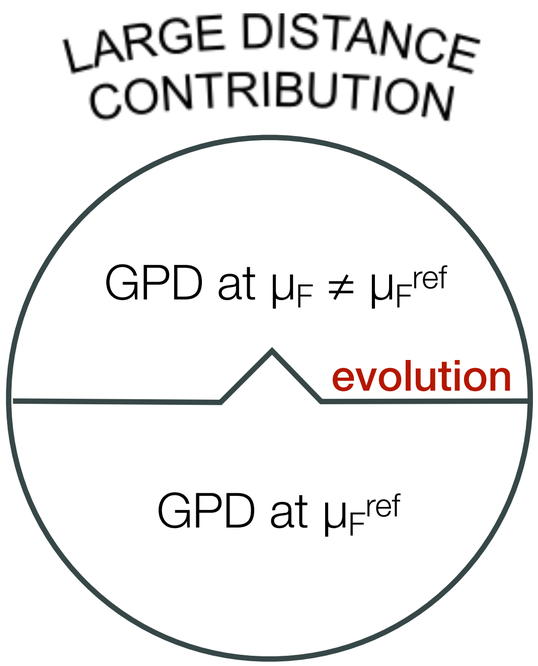
Outline

- what's PARTONS?
- architecture - basic information
- reference sources

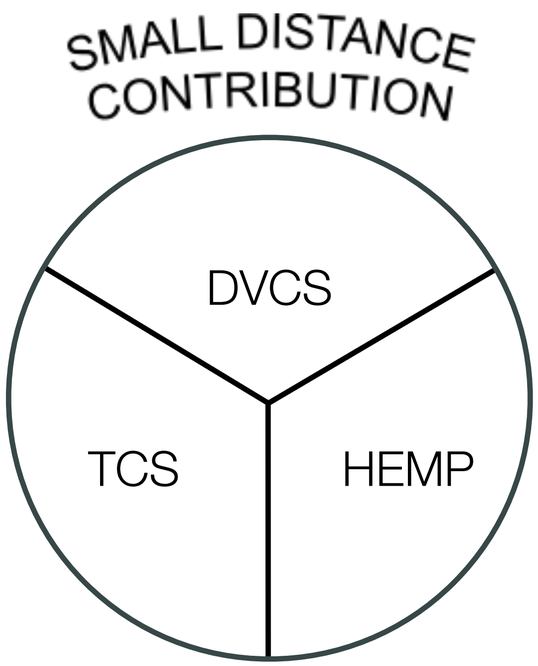
PARTONS - PARtonic Tomography Of Nucleon Software

- dedicated to the phenomenology of GPDs
- bridge between models of GPDs and experimental data
- can be used by both experimentalists and theoreticians
- aggregation point for GPD-related developments
- collaborative tool to support the effort of whole GPD community in a long run

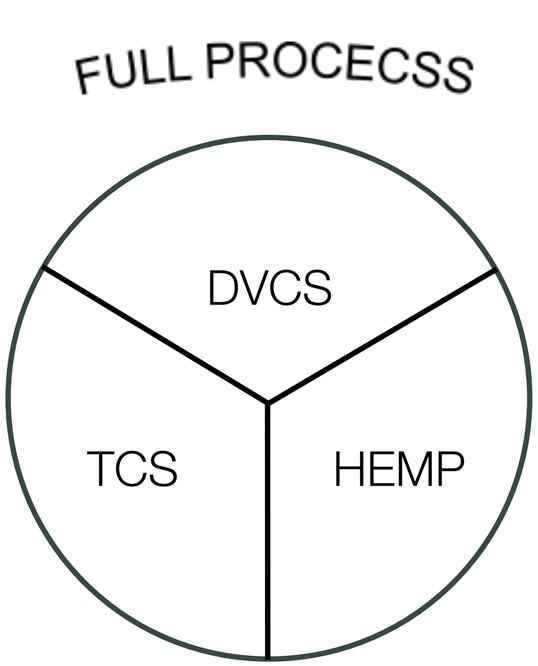
GPD computation scheme



First principles and fundamental properties



Computation of amplitudes



Experimental data and phenomenology

- physical models
- perturbative approximations

- many observables
- numerical methods

- accuracy and speed
- fits

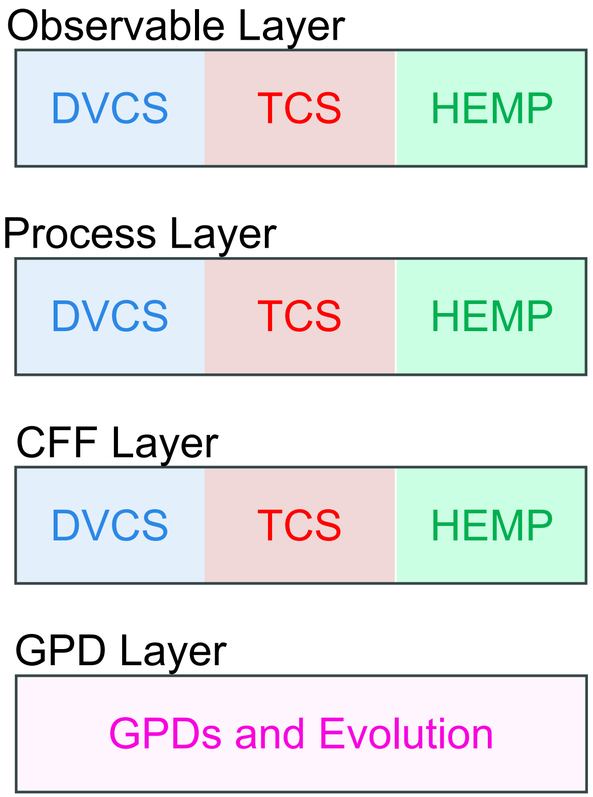
Layered structure

- one layer = collection of objects designed for common purpose
- one module = one physical development
- operations on modules provided by Services, e.g. for GPD Layer

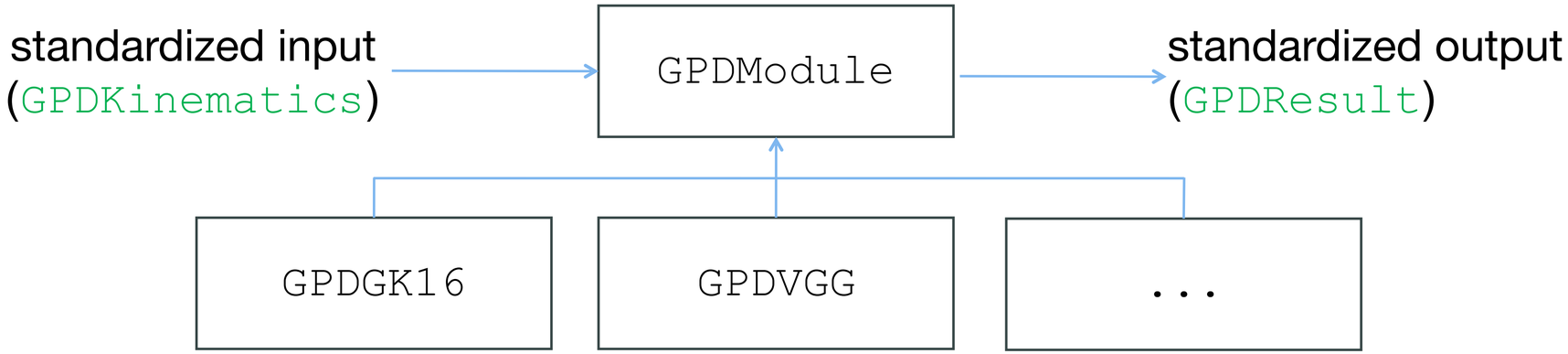
```
GPDResult computeGPDModel (const GPDKinematic& gpdKinematic,
        GPDModule* pGPDModule, const List<GPDType>& gpdType);

List<GPDResult> computeManyKinematicOneModel (
        const List<GPDKinematic>& gpdKinematicList,
        GPDModule *pGPDModule, const List<GPDType>& gpdType);
...
```

- what can be automated is automated
- features improving calculation speed

  e.g. threads



Modularity



- benefiting from C++ inheritance and polymorphism mechanisms
- reduction of mistake probability
- adding new modules as easy as possible (tutorials and templates available online)

Interface - xml

```
<?xml version="1.0" encoding="UTF-8" standalone="yes" ?>

<!-- Scenario starts here -->
<scenario date="2018-01-23" description="Example: evaluation of GPD model">

    <!-- Indicate service and its methods to be used -->
    <task service="GPDService" method="computeGPDModel" storeInDB="0">

        <!-- Define GPD kinematics -->
        <kinematics type="GPDKinematic">
            <param name="x" value="1.E-1" />
            <param name="xi" value="1.E-2" />
            <param name="t" value="-0.1" />
            <param name="MuF2" value="2." />
            <param name="MuR2" value="2." />
        </kinematics>

        <!-- Define physics assumptions -->
        <computation_configuration>
             <module type="GPDModule" name="GPDGK16">
            </module>
        </computation_configuration>
    </task>
</scenario>
```

Interface - c++

```
// Retrieve GPD service
GPDService* pGPDService =
        Partons::getInstance()->getServiceObjectRegistry()->getGPDService();

// Load GPD module with BaseModuleFactory
GPDModule* pGPDModel =
        Partons::getInstance()->getModuleObjectFactory()->newGPDModule(
                GPDGK16::classId);

// Create GPDKinematic(x, xi, t, MuF2, MuR2) to compute
GPDKinematic gpdKinematic(1.E-1, 1.E-2, -0.4, 2., 2.);

// Perform the calculation
GPDResult gpdResult = pGPDService->computeGPDModel(
        gpdKinematic, pGPDModel);

// Print result
std::cout << gpdResult.toString() << std::endl;
```

Features

Database

- result computed by each layer can be stored/retrieved from database

```
...
<task service="GPDService" method="computeGPDModel" storeInDB="1">
...
```

- MySQL support
- rollback mechanism and optimisation for large transactions
- database also to store experimental data → Fits

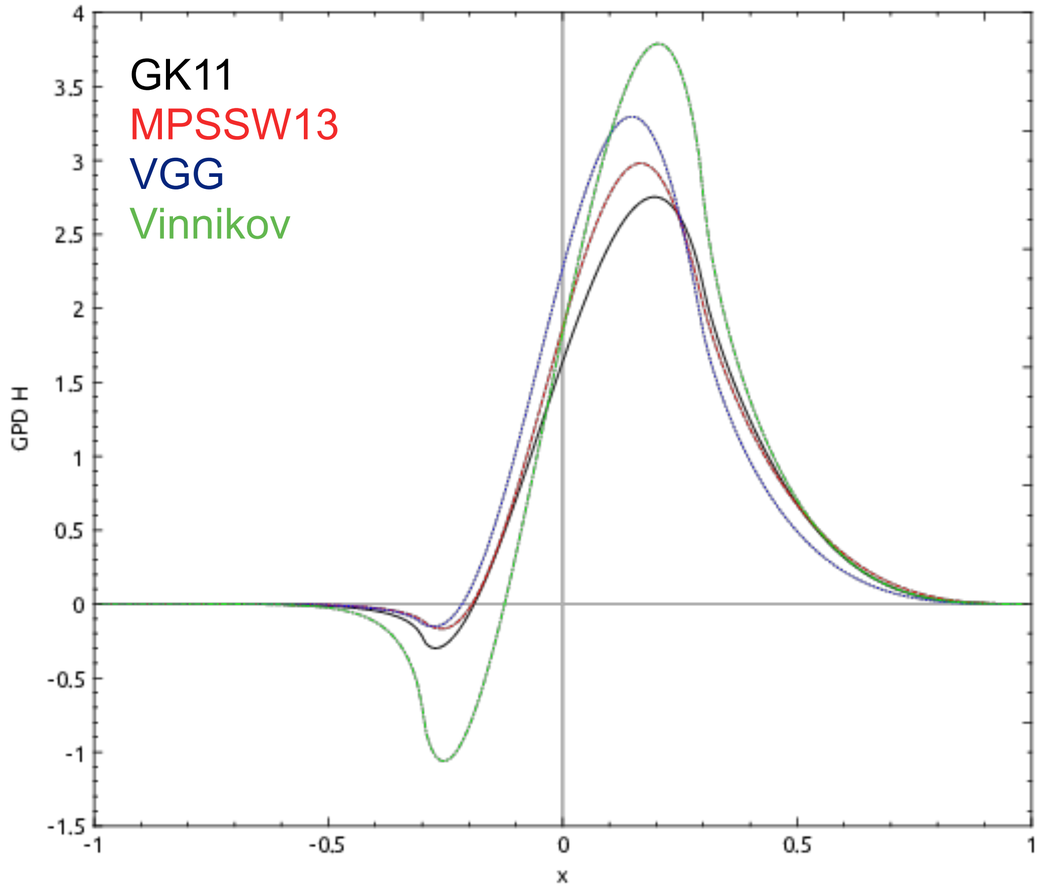
Threads

- to speed up calculation
- also used by Logger

Existing modules

- GPD: GK, VGG, Vinnikov, MPSSW, MMS, HM
- Evolution: Vinnikov's code
- CFF (DVCS only): LO, NLO (gluons and light (+heavy) quarks)
- Cross Section (DVCS only): VGG, BMJ, GV

H^u @ $\xi = 0.2$, $t = -0.1$ GeV^2, $\mu_F^2 = \mu_R^2 = 2$ GeV^2



Soon the next release with TCS → demonstration of multi-channel capability

More information

PARTONS is open source project distributed under following licenses (per subproject):

- elementary-utils: Apache
- numa, partons and partons-example: GPL

To download and for tutorials, useful information, reference documentation see:

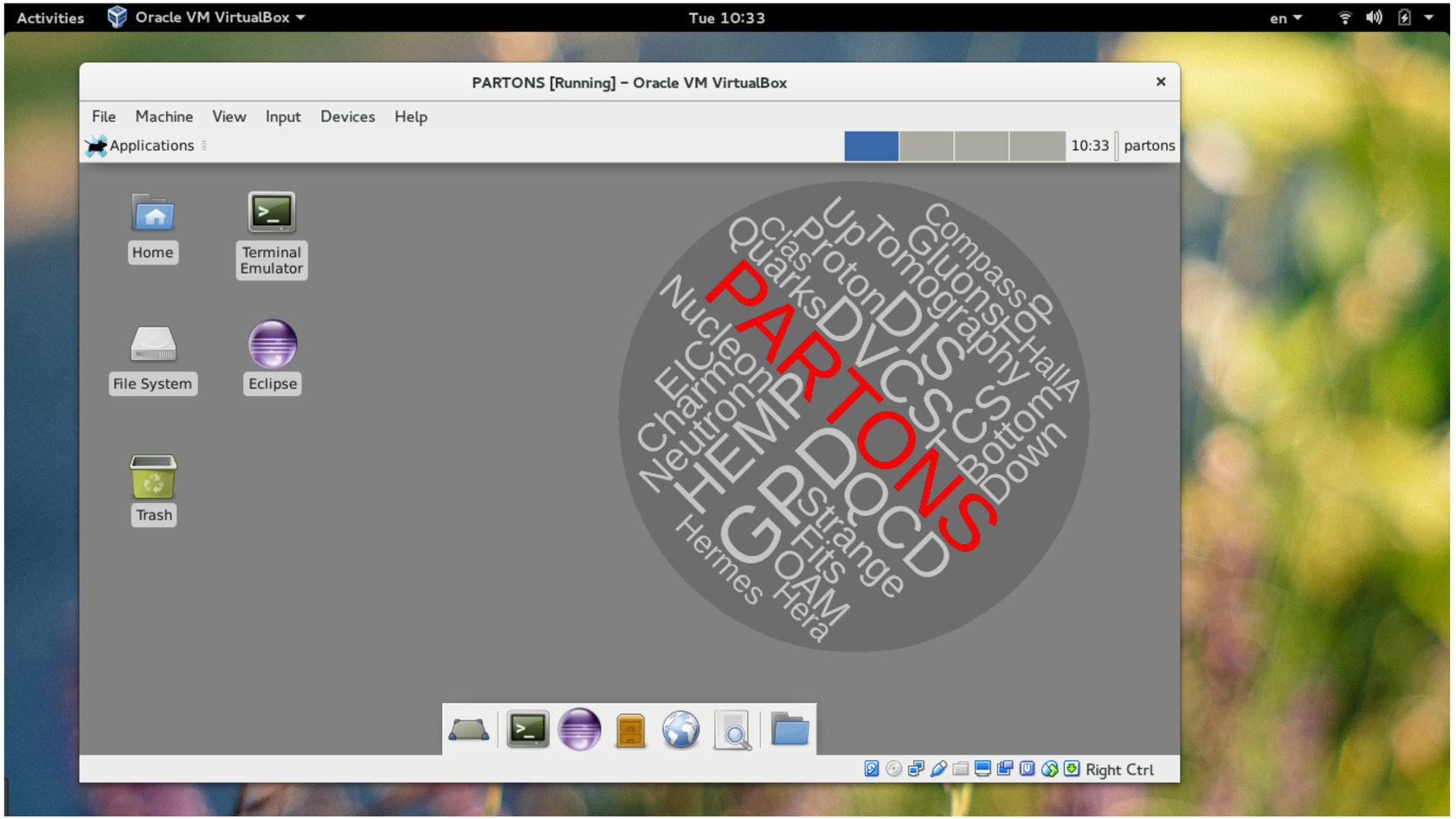
http://partons.cea.fr

For detail description of architecture see:

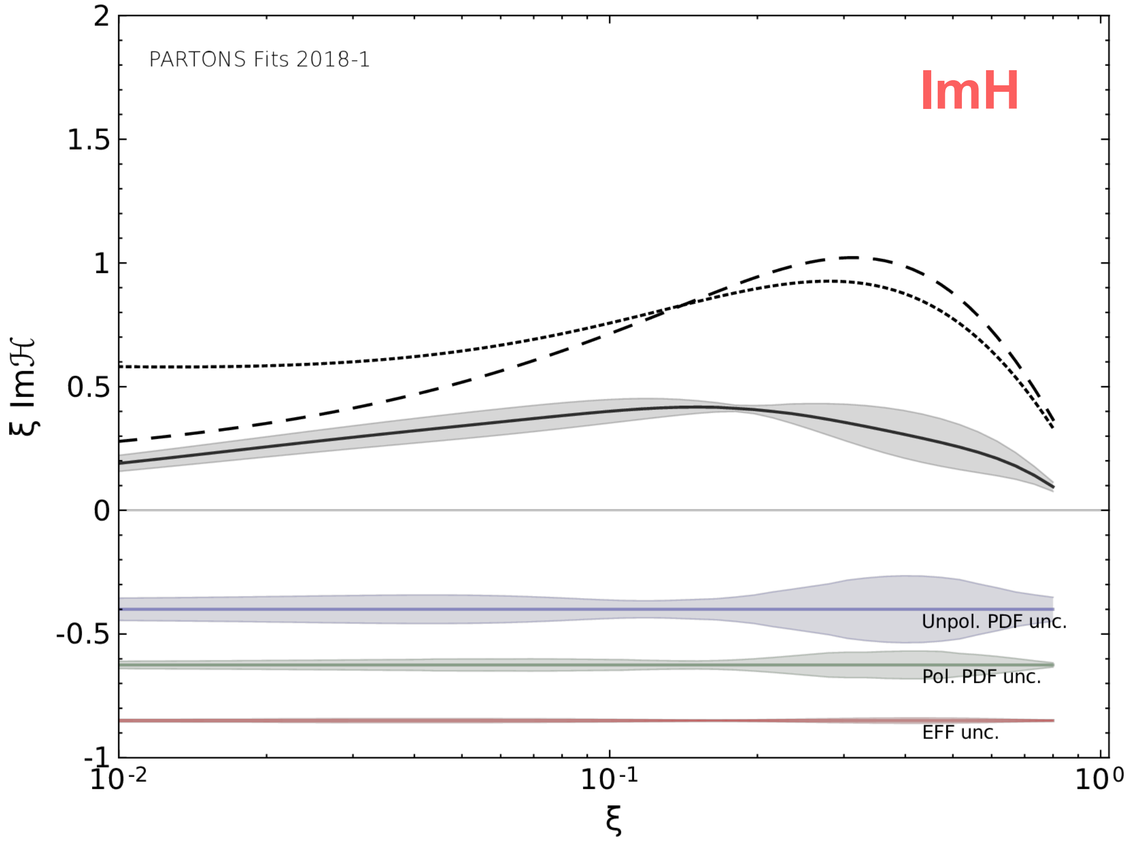
Eur. Phys. J. C78 (2018) 6, 478

Distribution

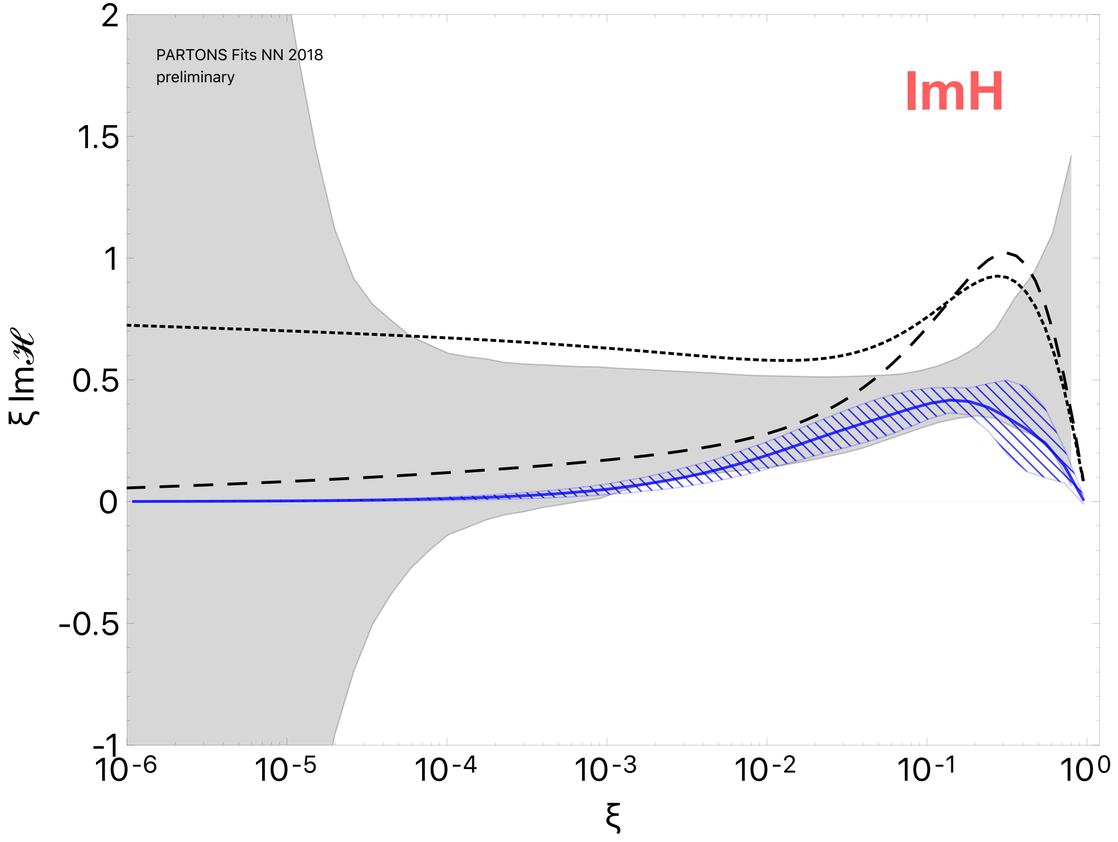
Compile PARTONS from scratch
or use provided Virtual Machine / Docker image (recommended)



Eur. Phys. J. C78 (2018) 11, 890
GPD-based Ansatz



preliminary results
ANN Ansatz



— — — VGG ····· GK

@ t = -0.3 GeV², Q² = 2 GeV²

SUMMARY

PARTONS (PARtonic Tomography Of Nucleon Software)

- Modern open source platform devoted to study GPDs
- Design to support the effort of whole GPD community
- Can be used by both theoreticians and experimentalists
- Flexible for addition of new developments
- Proofed to be useful in physics analyses

- Directions for development:
  - Implementation of TCS and HEMP
  - PARTONS-based MC generator