

Monte Carlo generator

Paweł Sznajder
National Centre for Nuclear Research, Poland

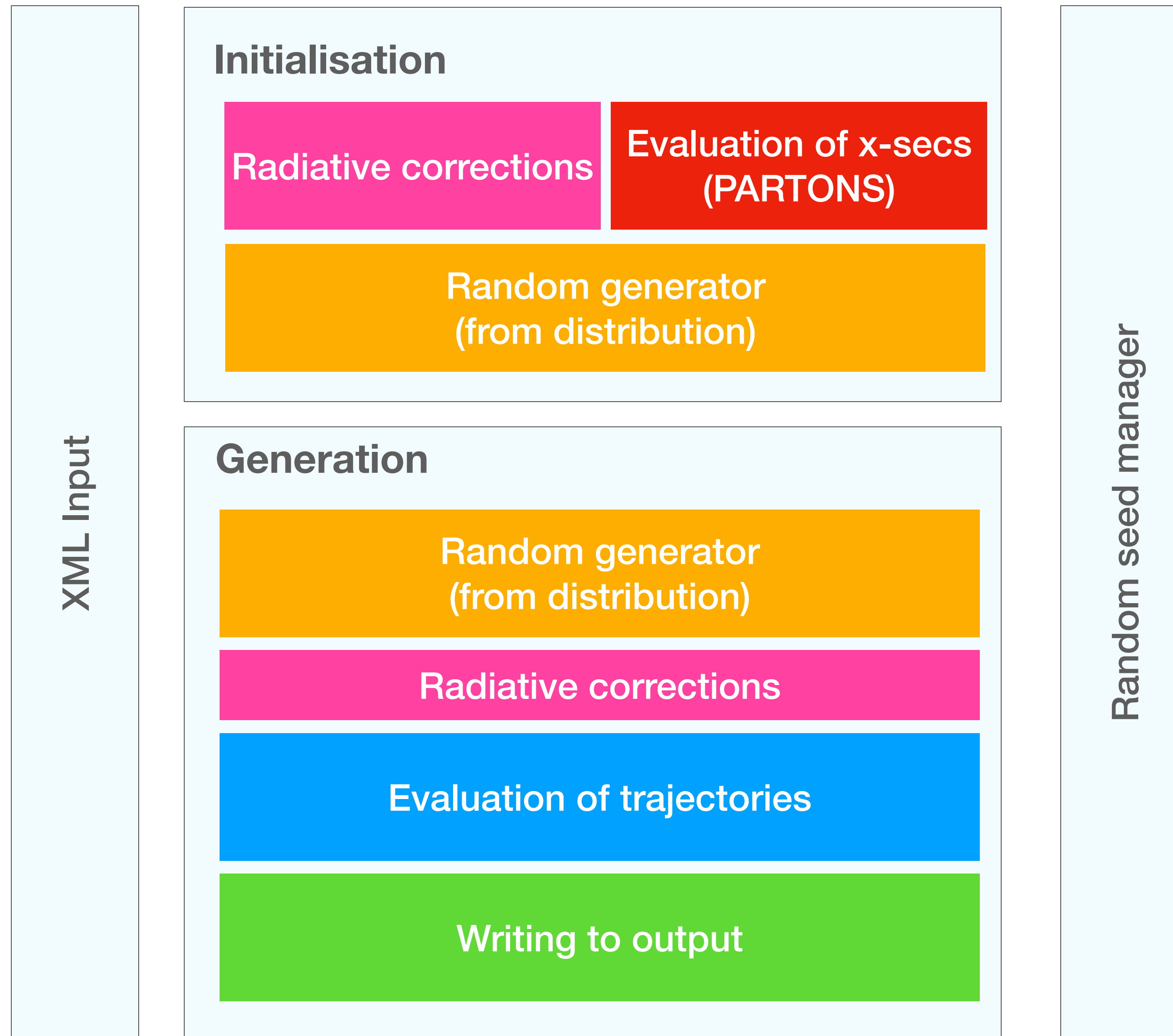


February 22nd, 2021

Introduction

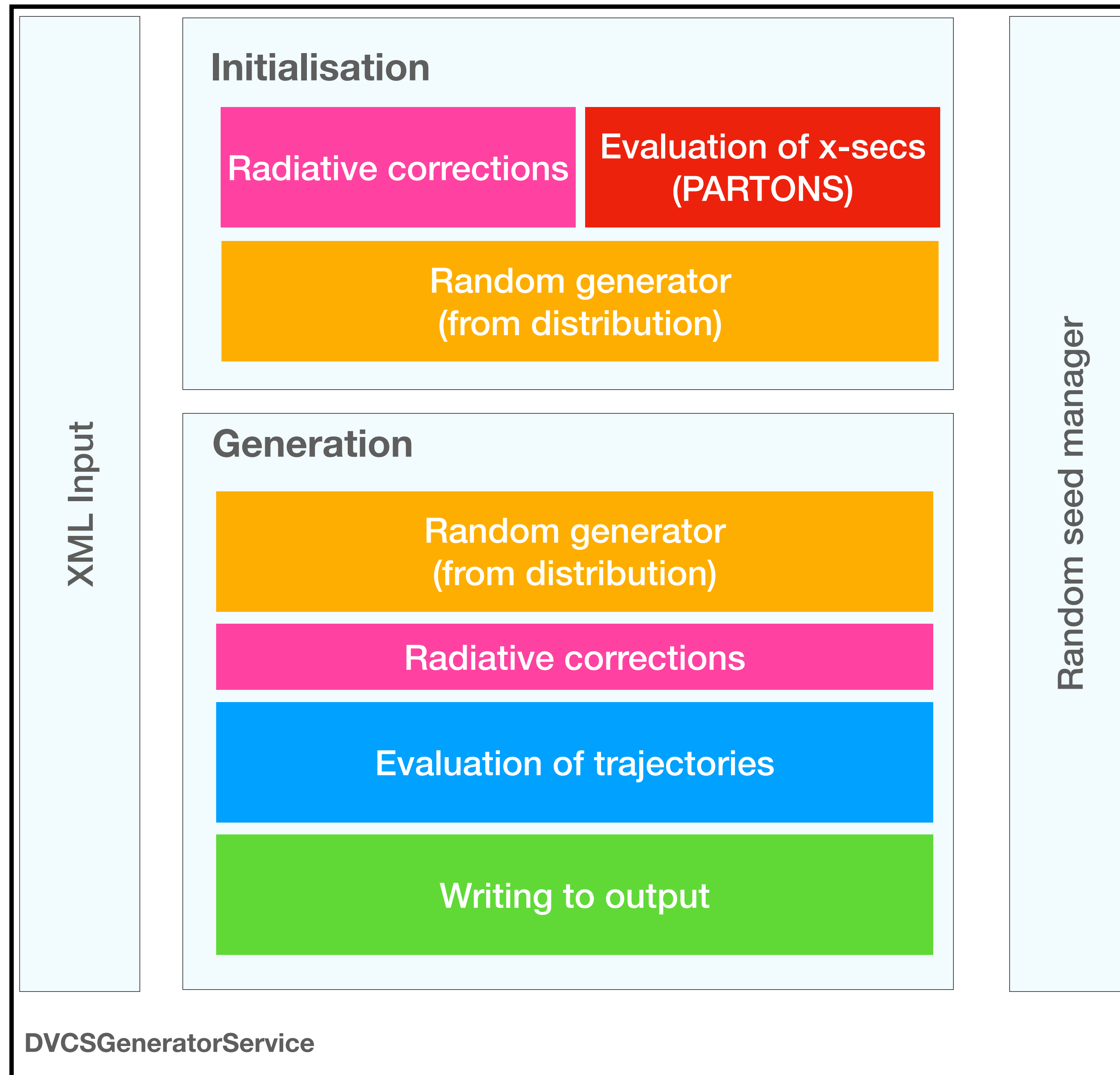
- **Generic**
 - to be used at CERN, JLab, EIC, ... (no more “home-made” generators)
- **Multichannel (DVCS, TCS, DVMP, ...) capability**
 - what is available in PARTONS will be available in new MC generator
- **Modularity**
 - for flexibility and simplicity
- **Well developed**
 - good coding practices, use modern programming language (c++) and paradigms
- **Easy to maintain**
 - we expect at least 20 years of lifetime, project must be well designed and properly established, must have useful documentation
- **Robust**
- **Multithreaded**

Scheme



Scheme

MonteCarloParser
MonteCarloScenario
MonteCarloTask



DVCSRCModule

DVCSProcessModule
DVCSConvolCoeffFunctionModule
GPDModule
GPDEvolutionModule

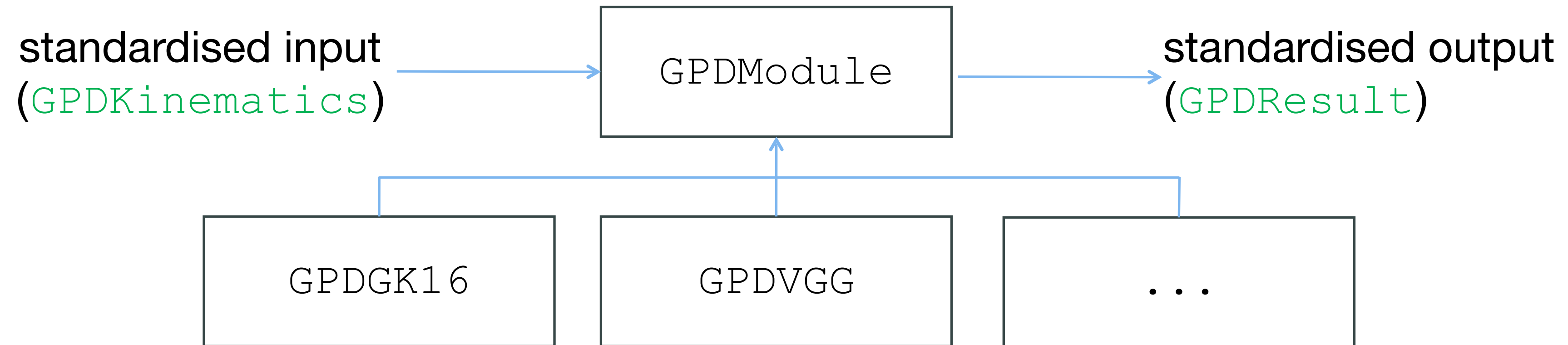
EventGeneratorModule

DVCSKinematicModule

WriterModule

RandomSeedManager

Module



- benefiting from C++ inheritance and polymorphism mechanisms
- reduction of mistake probability
- part of registry-factory mechanism
- adding new modules as easy as possible

XML

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

<!-- Scenario starts here -->
<scenario date="2017-07-18" description="Select specific GPD types">

  <!-- First task -->
  <task service="DVCSGeneratorService" method="generate">

    <!-- General configuration -->
    <general_configuration>
      <param name="number_of_events" value="10" />
      <param name="random_seed" value="1" />
    </general_configuration>

    <!-- Kinematic limits -->
    <kinematic_range>
      <param name="range_xB" value="0.|1.|lin" />
      <param name="range_t" value="-1.|0.|lin" />
      <param name="range_Q2" value="1.|2.|lin" />
      <param name="range_phi" value="0.|2.|lin" />
    </kinematic_range>

    <!-- Experimental conditions -->
    <experimental_conditions>
      <param name="lepton_energy" value="10" />
      <param name="lepton_type" value="e-" />
      <param name="lepton_helicity" value="1" />
      <param name="hadron_energy" value="100" />
      <param name="hadron_type" value="p" />
      <param name="hadron_polarisation" value="0.|0.|0." />
    </experimental_conditions>

    <!-- Computation scenario -->
    <computation_configuration>

      <module type="DVCSProcessModule" name="DVCSProcessGV08">

        <module type="DVCSScalesModule" name="DVCSScalesQ2Multiplier">
          <param name="lambda" value="1." />
        </module>

        <module type="DVCSXiConverterModule" name="DVCSXiConverterXBToXi">
          </module>

      </computation_configuration>

    </task>
  </scenario>
```

```
      <module type="DVCSConvolCoeffFunctionModule" name="DVCSCoeffStandard">
        <param name="qcd_order_type" value="LO" />

        <module type="GPDModule" name="GPDGK16">
          </module>
        </module>
      </computation_configuration>

    <!-- Radiative corrections -->
    <radiative_correction_configuration>
      <module type="DVCSRCModule" name="DVCSRCCollinear">
        </module>
      </radiative_correction_configuration>

    <!-- Generator module configuration -->
    <generator_configuration>
      <module type="EventGeneratorModule" name="EventGeneratorFOAM">
        <param name="nCells" value="500" />
        <param name="nSamples" value="200" />
        <param name="nBins" value="8" />
      </module>
    </generator_configuration>

    <!-- Kinematic module configuration -->
    <kinematic_configuration>
      <module type="DVCSKinematicModule" name="DVCSKinematicDefault">
        </module>
      </kinematic_configuration>

    <!-- Writer module configuration-->
    <writer_configuration>
      <module type="WriterModule" name="WriterHepMC3">
        <param name="output_file_path" value="test.txt" />
        <param name="HepMC3_writer_type" value="ascii" />
      </module>
    </writer_configuration>

  </task>
</scenario>
```

Output via Logger

22-02-2021 01:42:26 [INFO] (Partons::printVersion) PARTONS 2.0 (<http://partons.cea.fr>) distributed under GNU Public License
22-02-2021 01:42:26 [INFO] (Partons::printVersion) Built using Elementary-Utils 2.0 and NumA++ 2.0
22-02-2021 01:42:26 [INFO] (DatabaseManager::init) Database connection OK
22-02-2021 01:42:26 [INFO] (AutomationService::parseXMLFile) File test.xml is valid
22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getGeneralConfigurationFromTask) General configuration:

Number of events: 10

22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getExperimentalConditionsFromTask) Experimental conditions:

Experimental condition lepton energy: 10 [GeV]
Experimental condition lepton type: e-
Experimental condition lepton helicity: 1
Experimental condition hadron energy: 100 [GeV]
Experimental condition hadron type: p
Experimental condition hadron polarisation: Vector3D<0, 0, 0>

22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getKinematicRangesFromTask) Kinematic ranges:

DVCS kinematic range xB: min: 0 max: 1 type: lin
DVCS kinematic range t: min: -1 max: 0 type: lin
DVCS kinematic range Q2: min: 1 max: 2 type: lin
DVCS kinematic range phi: min: 0 max: 2 type: lin

22-02-2021 01:42:26 [INFO] (DVCSProcessGV08::prepareSubModules) Configured with ScaleModule = DVCSScalesQ2Multiplier
22-02-2021 01:42:26 [INFO] (DVCSScalesQ2Multiplier::configure) lambda configured with value = 1
22-02-2021 01:42:26 [INFO] (DVCSProcessGV08::prepareSubModules) Configured with XiConverterModule = DVCSXiConverterXBToXi
22-02-2021 01:42:26 [INFO] (DVCSProcessGV08::prepareSubModules) Configured with ConvolveCoeffFunctionModule = DVCSConvolveCoeffStandard
22-02-2021 01:42:26 [INFO] (DVCSConvolveCoeffStandard::configure) qcd_order_type configured with value = LO
22-02-2021 01:42:26 [INFO] (DVCSConvolveCoeffStandard::prepareSubModules) Configured with GPDModule = GPDGK16
22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getProcessModuleFromTask) Process module: DVCSProcessGV08
22-02-2021 01:42:26 [INFO] (EventGeneratorFOAM::configure) Parameter nCells changed to 10
22-02-2021 01:42:26 [INFO] (EventGeneratorFOAM::configure) Parameter nSamples changed to 10
22-02-2021 01:42:26 [INFO] (EventGeneratorFOAM::configure) Parameter nBins changed to 10
22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getEventGeneratorModuleFromTask) Event generator module: EventGeneratorFOAM
22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getKinematicModuleFromTask) Kinematic module: DVCSKinematicDefault
22-02-2021 01:42:26 [INFO] (WriterHepMC3::configure) Output file name set to: test.txt
22-02-2021 01:42:26 [INFO] (WriterHepMC3::configure) HepMC3 writer type set to: ascii
22-02-2021 01:42:26 [INFO] (DVCSGeneratorService::getWriterModuleFromTask) Writer module: WriterHepMC3
22-02-2021 01:42:26 [INFO] (EventGeneratorFOAM::initialise) Random seed is: 2
22-02-2021 01:42:26 [INFO] (EventGeneratorFOAM::initialise) ROOT object name: e13b165ce7a1809becf5a1d5cde3b48d06328d93
22-02-2021 01:43:23 [INFO] (LoggerManager::close) ... Closed properly ...

Summary

- Generator name: EpIC (or ePic), needs logo
- Set up at CEA GitLab → we can move it or mirror if necessary
- Written in modern C++
- CI

- First version ready

Outlook

- Testing
- Implementation of RCs
- Modules CFFs from tables

- Problems to solve:
 - multithreading
 - propagation of random seed

- Documentation:
 - technical documentation (Doxygen)
 - examples
 - reference paper

- Dissemination:
 - licence
 - source code via GitLab
 - installation at computing farms
 - containers