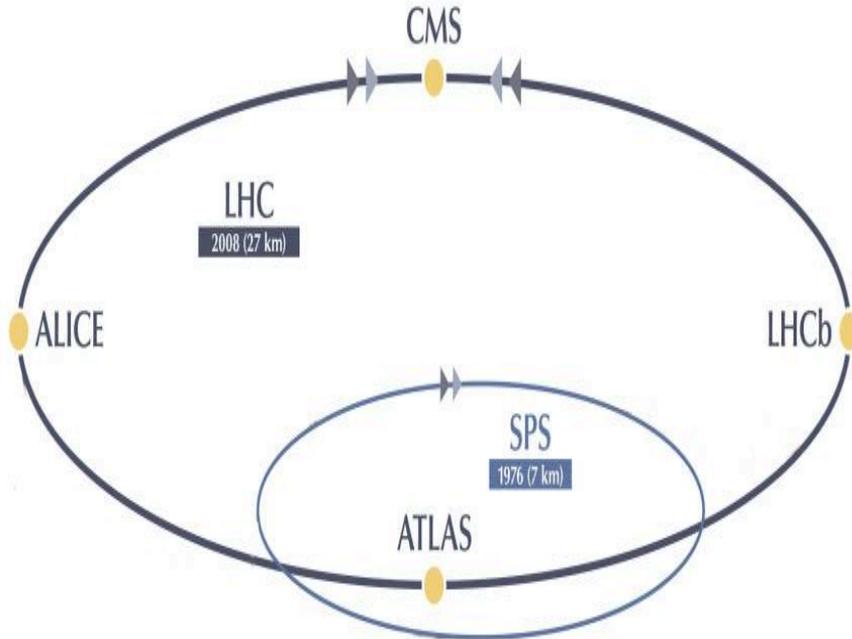


Outline

- ❖ The LHC & CMS
 - ❖ Simulations Software & Data Sequence
 - ❖ Web Calculator Tool
 - ❖ Improvements
 - ❖ Summary
-

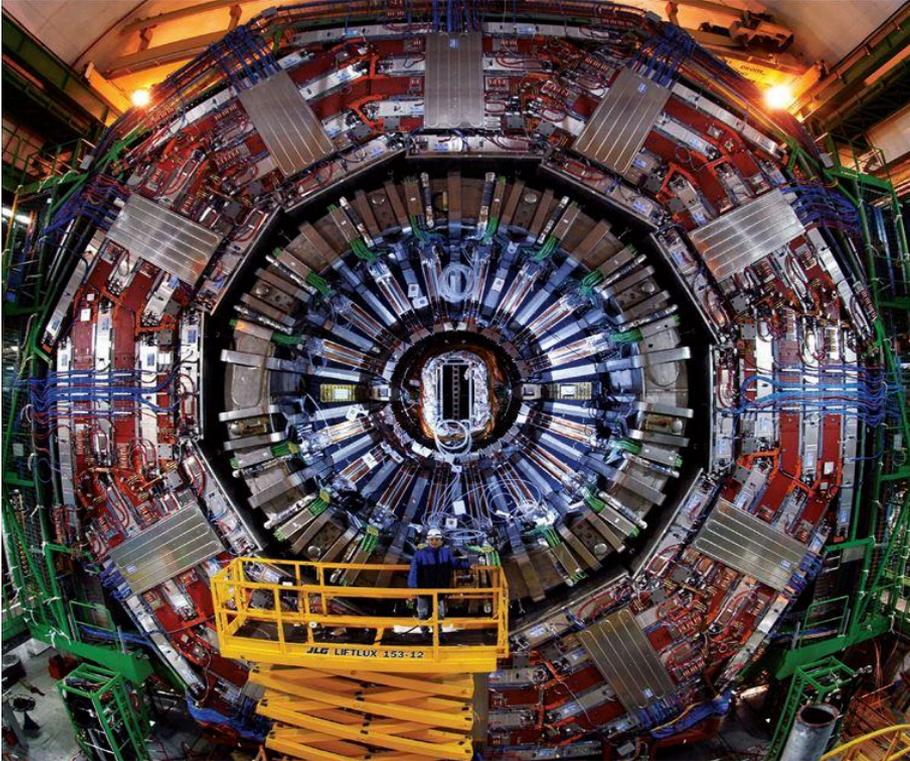
The LHC & CMS



CERN Accelerator Complex, copyright CERN

- Largest and most powerful collider
- Accelerates & collides two proton beams
- Designed to run 7 TeV beams. Previous runs were at 3.5 TeV and 4 TeV
- Design Luminosity 10^{34} $\text{cm}^{-2} \text{s}^{-1}$
- Higgs Boson discovery, July 2012

The LHC & CMS



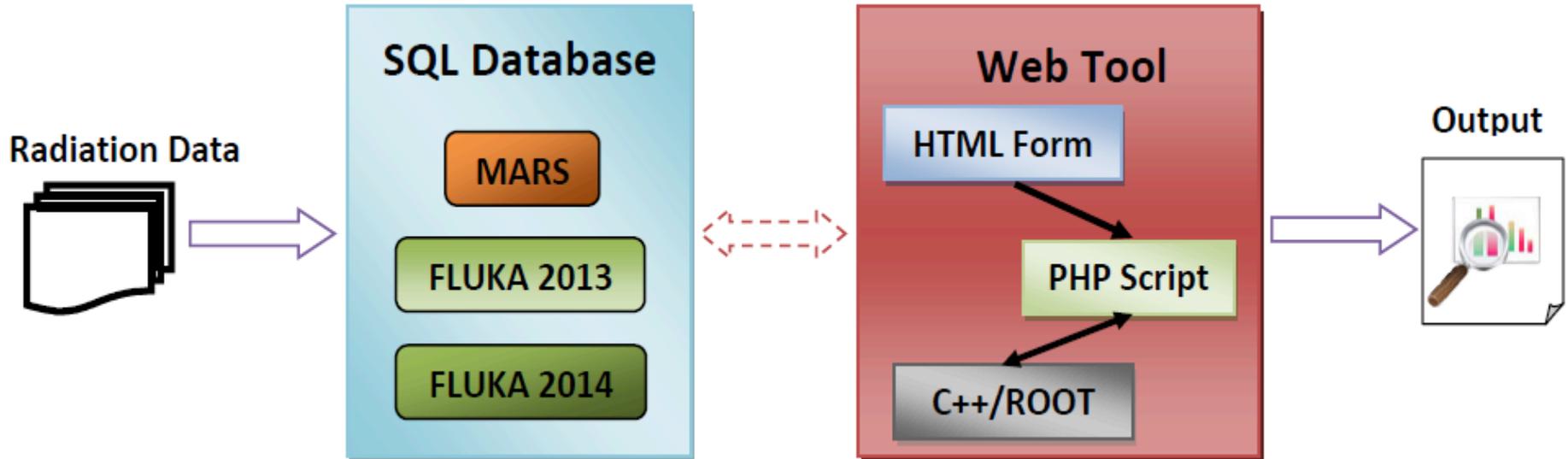
CMS Detector, copyright CERN

- CMS is one of your detectors on the LHC
- General purpose detector designed to identify a variety of particles
- Very intense radiation environment
- To optimally protect the detector & electronics we study simulated events

Simulations Software

- To study the radiation environment we use FLUKA & MARS Monte Carlo Simulation packages.
 - Variety of particles tracked through Detector
 - Quantities Scored
 - Dose
 - Fluence
 - Electron/Positron
 - Photon
 - Muon
 - Neutral Hadron
 - Charged Hadron
-

Data Sequence



Calculator Web Tool

Three data viewing options:

- Point Calculator
- 1D Plots
- 2D Plots

CMS Dose/Fluence Calculator

Luminosity: fb⁻¹

Simulation: FLUKA MARS BOTH

Volume: Full CMS Detector Tracker

Action: Calculator 1D Plots
 2D Plots

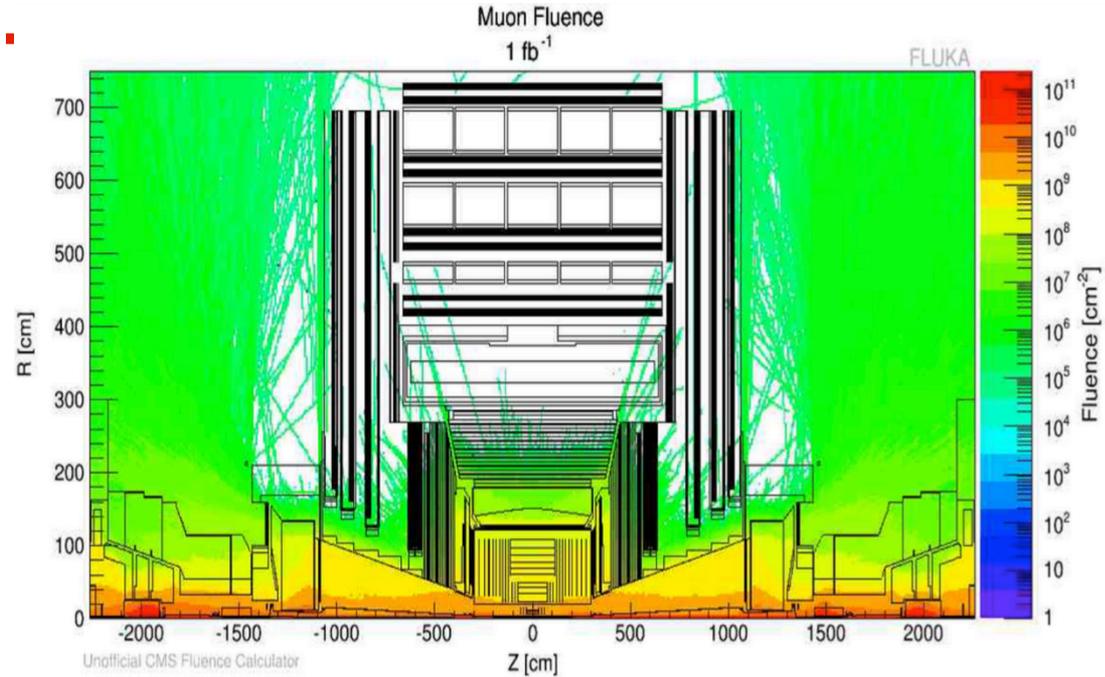
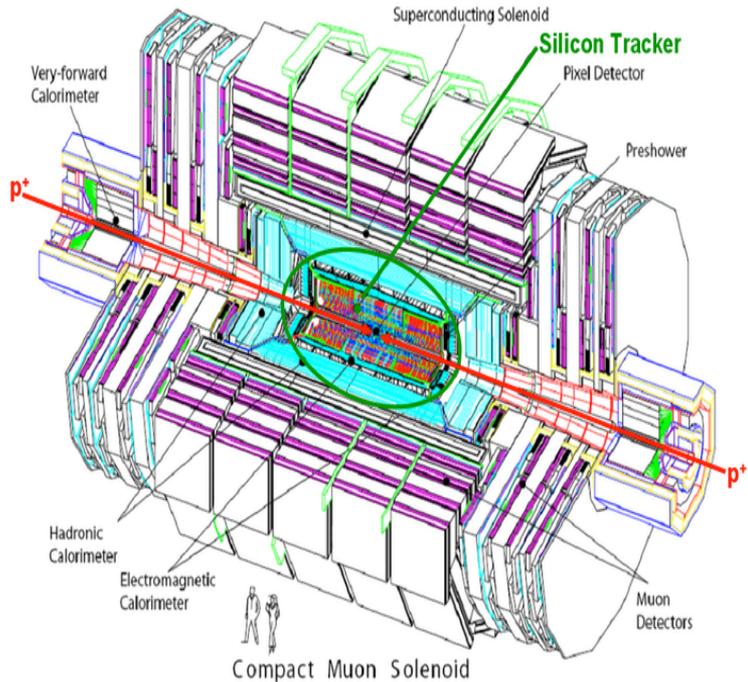
http://uscms.org/uscms_at_work/dmo/siTracker/lhcCalcForm.html

Web Tool Improvements

Key upgrades to the Web Tool:

- User Interface Enhancements
 - Interpolated Data Return
 - Multi-File System
-

2D Plots



CMS Detector, copyright HEPHY

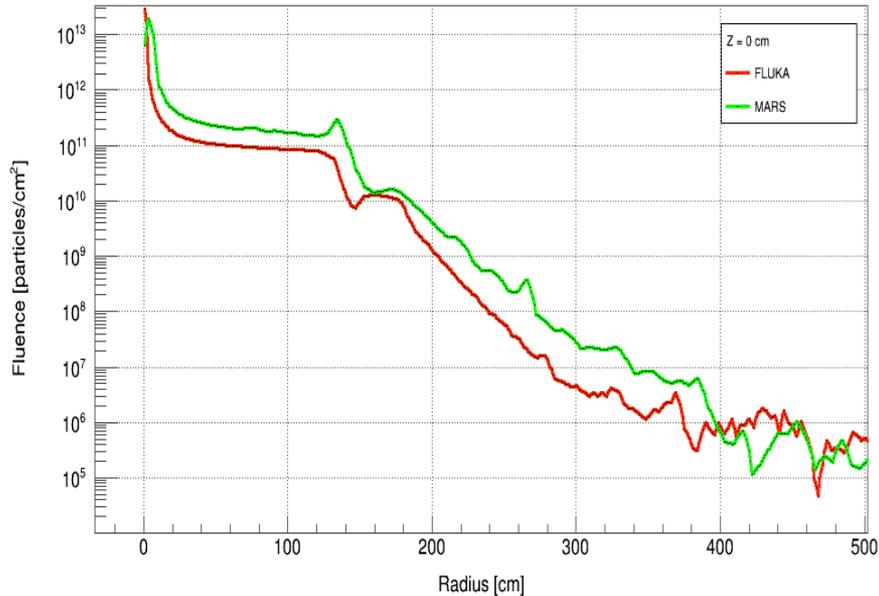
Data Fetch feature displays all particle quantities. →

Beam Axis, Z [cm]	Radius, R [cm]	Dose [Gy]	Total Energy Dep. GeV/gm/cm ²	Electron/Positron Fluence [cm ⁻²]	Charged Hadron Fluence [cm ⁻²]	Muon Fluence [cm ⁻²]	Photon Fluence [cm ⁻²]	Neutral Hadron Fluence [cm ⁻²]	NIEL - DEP [GeV]	1 MeV Neutron Equiv. Fluence [cm ⁻²]
52	390	1.92381e-5	4.42180e-14	3.97200e+4	0.00000e-1	0.00000e-1	8.88080e+5	5.54488e+8	1.53888e+1	1.22792e+8

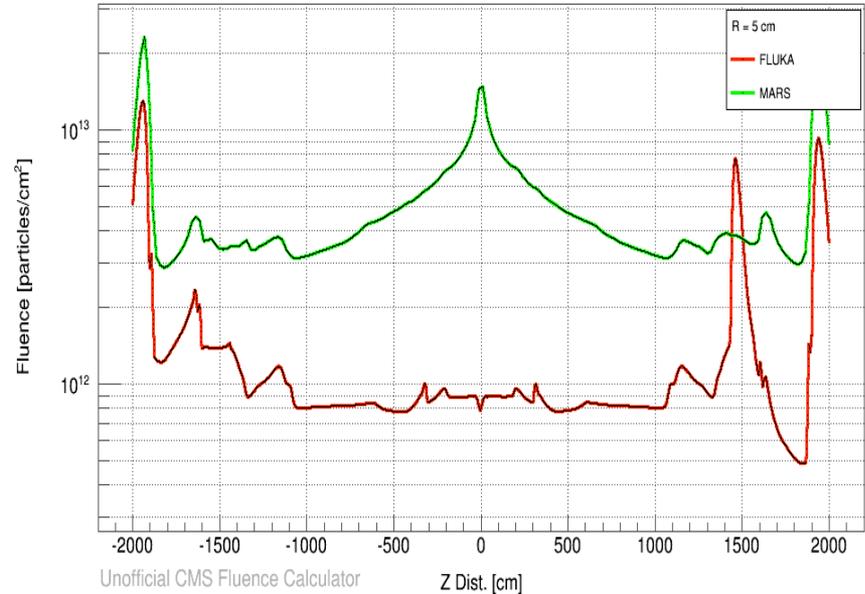
FLUKA vs. MARS 1D Plots

Added Simulation option allows for MARS and FLUKA comparisons

Photon Fluence , 1 fb⁻¹



Charged Hadron Fluence , 1 fb⁻¹

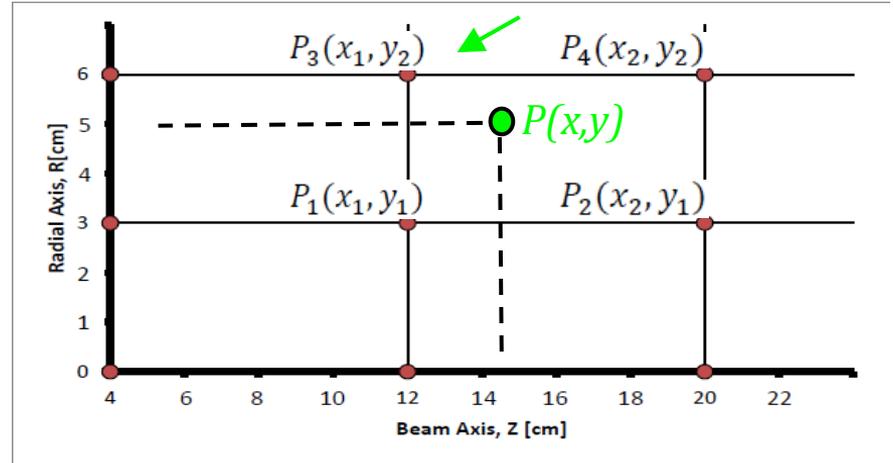


Data Interpolation Extension

Extracted data from FLUKA database

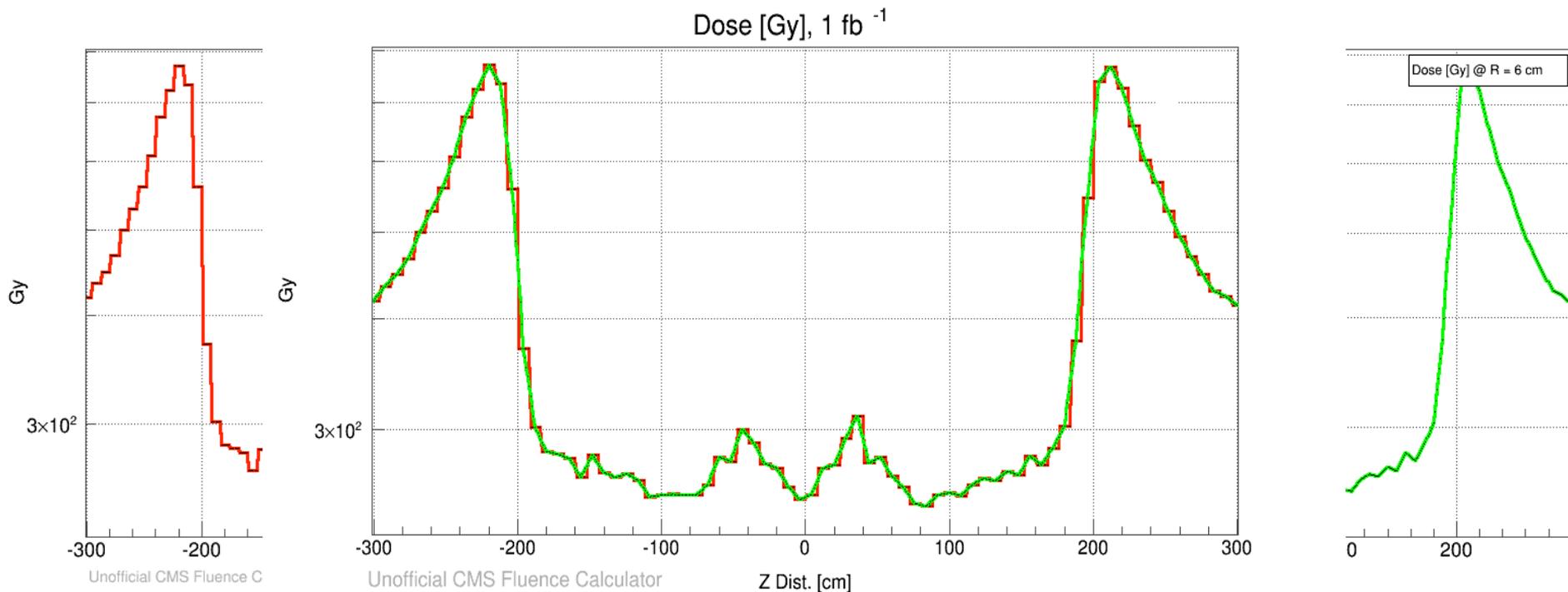
Z [cm]	R [cm]	Photon Fluence [$\frac{\text{particles}}{\text{cm}^2}$]
4	0	4.10104×10^{13}
12	0	3.56704×10^{13}
20	0	3.28976×10^{13}
4	3	1.70176×10^{12}
12	3	1.71168×10^{12}
20	3	1.752×10^{12}
4	6	6.94792×10^{11}
12	6	7.03936×10^{11}
20	6	7.47256×10^{11}

Geometric Visual

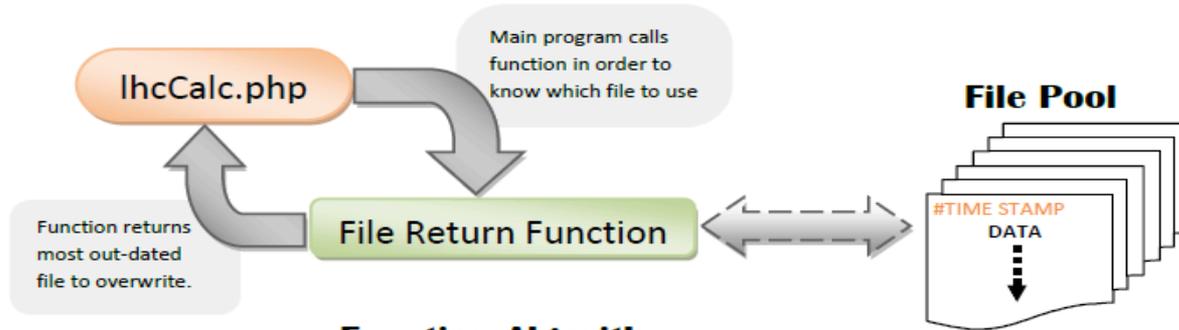


$$P(x,y) = \frac{(x_2 - x)(y_2 - y)}{(x_2 - x_1)(y_2 - y_1)} P_1(x_1, y_1) + \frac{(x - x_1)(y_2 - y)}{(x_2 - x_1)(y_2 - y_1)} P_2(x_2, y_1) + \frac{(x_2 - x)(y - y_1)}{(x_2 - x_1)(y_2 - y_1)} P_3(x_1, y_2) + \frac{(x - x_1)(y - y_1)}{(x_2 - x_1)(y_2 - y_1)} P_4(x_2, y_2)$$

1D Plot: Standard vs. Interpolated



Multi File System



Function Algorithm

Set **#ageLimit**
Set **#timeOffSet**

- 1) Move to first file in pool.
- 2) Read file time-stamp on first line
- 3) If file is older than **#ageLimit**, exit and return file.
- 4) Else move to next file in pool and go to **Step 2** until last file has been reached
- 5) **#ageLimit = #ageLimit - #timeOffSet**
- 6) Go to **Step 1**

Summary

- Simulated radiation data along with the web tool is important for studying the radiation environment of the CMS Detector.
 - The Calculator Web Tool has been improved in a number of ways.
 - Interface Enhancements
 - Interpolated Data Return
 - Multi-File System
 - We were able to compare MARS & FLUKA Simulations with the help of the tool, and are currently investigating the differences.
-

Special Thanks

Linda Diepholz & the rest of the SIST Committee

Supervisors: Pushpa Bhat & Leonard Spiegel

Co-workers: Graham Stoddard & Sudeshna Banerjee

Mentors: Mayling Wong & David Peterson
