

- DoSSiER
  - About DoSSiER.
  - What is in DoSSiER.
  - Manpower situation and to do list.
  - Components, Meta Data, Example views etc.
  - How to get your data into DoSSiER.
  - Summary and Conclusions.





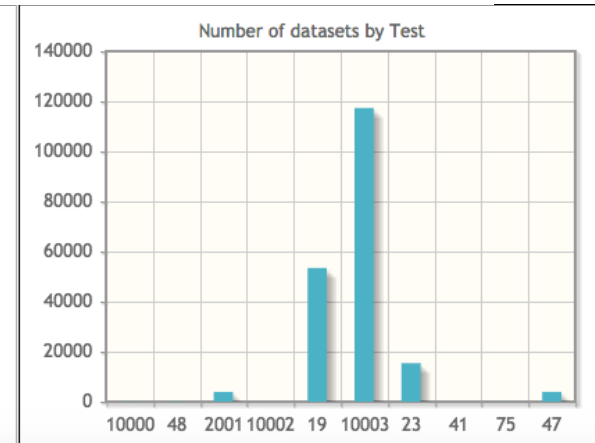
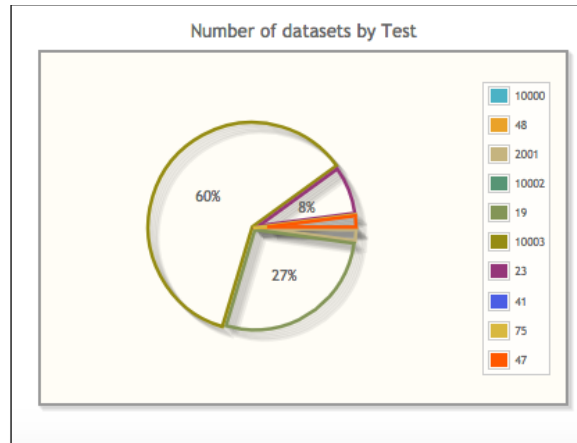
# About DoSSiER

- Provides repository:
  - to store all experimental data used for Geant4 as raw data. (Currently ~ 4000 experimental data curves in db.)
  - to store simulation results as raw data and as static plots. (Currently ~200K simulated results in db.)
- Provides secure display web-application which:
  - allows to select and overlay compatible tests,
  - allows to overlay experimental data,
  - allows secure automatic upload into repository,
  - allows to display static images,
  - provides search functions and easy navigation.
- Provide REST-ful Web service which:
  - allows programmatic access to the data.
- Supposed to be “the” validation repository of Geant4.

## Geant4 Test Browser

As of Wed Aug 29 22:55:44 CDT 2018  
 Number of distinct Geant4 tests with results in database: 10  
 Number of data sets in database: 194428

Geant4 tests with Results in DoSSiER. Click on the ID to select Test		
ID	Name	Description
<a href="#">10000</a>	Franz	Neutron-induced production of protons, deuterons and tritons by neutrons between 300-580 MeV
<a href="#">48</a>	test48	Stopping particle test Monte Carlo predictions are compared to experimental data.
<a href="#">2001</a>	simplifiedCalo	Test of Shower shapes using selected simplified calorimeter setups.
<a href="#">10002</a>	Pion Cross sections	Compare total,elastic,inelastic pion cross section with data
<a href="#">19</a>	test19	High energy Experiment, provides comparison with NA61 (31 GeV/c proton beam) and NA49 (158 GeV/c proton beam) data sets.
<a href="#">10003</a>	ProcessLevel	Process level (single interaction) validation test suite
<a href="#">23</a>	test23	Physicslist label test.
<a href="#">41</a>	test41	Validation of multiple and single Coulomb scattering of muons versus MuScat experimental data
<a href="#">75</a>	test75	Test of gamma-nuclear interactions.
<a href="#">47</a>	test47	Intermediate energy validation.



- Existing databases:
  - HEPData: <https://hepdata.net/>
  - ExFor: <http://www.nndc.bnl.gov/exfor/exfor.htm>
  - Inspire: <https://inspirehep.net/> -> cross link for references
  - Particle Data Group: <http://pdg.lbl.gov/> (cross section, energy loss)
- Directly from article/thesis: if only paper copy OCR, engage digitizer....
- Contact the authors.
- Both e.g. geant4 or Genie developers have data collections.
- Experimental web sites:
  - <https://spshadrons.web.cern.ch/spshadrons/>
- Compilations: <https://www.oecd-nea.org/dbdata/bara.html>
- → Labor intensive and error prone, biased.

- Biased (driven by needs of Fermilab community):
  - Cross sections ( elastic, inelastic , charge exchange, absorption ..)  $\pi$ , K, p, n .. on Ar, C, ...
  - Energy loss (lots of info in PDG).
  - $dE/dx$ .
  - Multiple scattering.
  - $\mu$  decay (Michel electrons) charge determination in absence of magnetic field.
  - em/shower shapes.
  - Optical properties (rayleigh, refraction index, etc. ..)
  
- If there is a dataset you want in the database please let me know.



- Left
- Main
  - Display exp. data
  - Display Geant4 data
  - Display GeantV data
  - Display GENIE data
  - Display Statistics
  - Display Dictionaries
  - RESTful web service

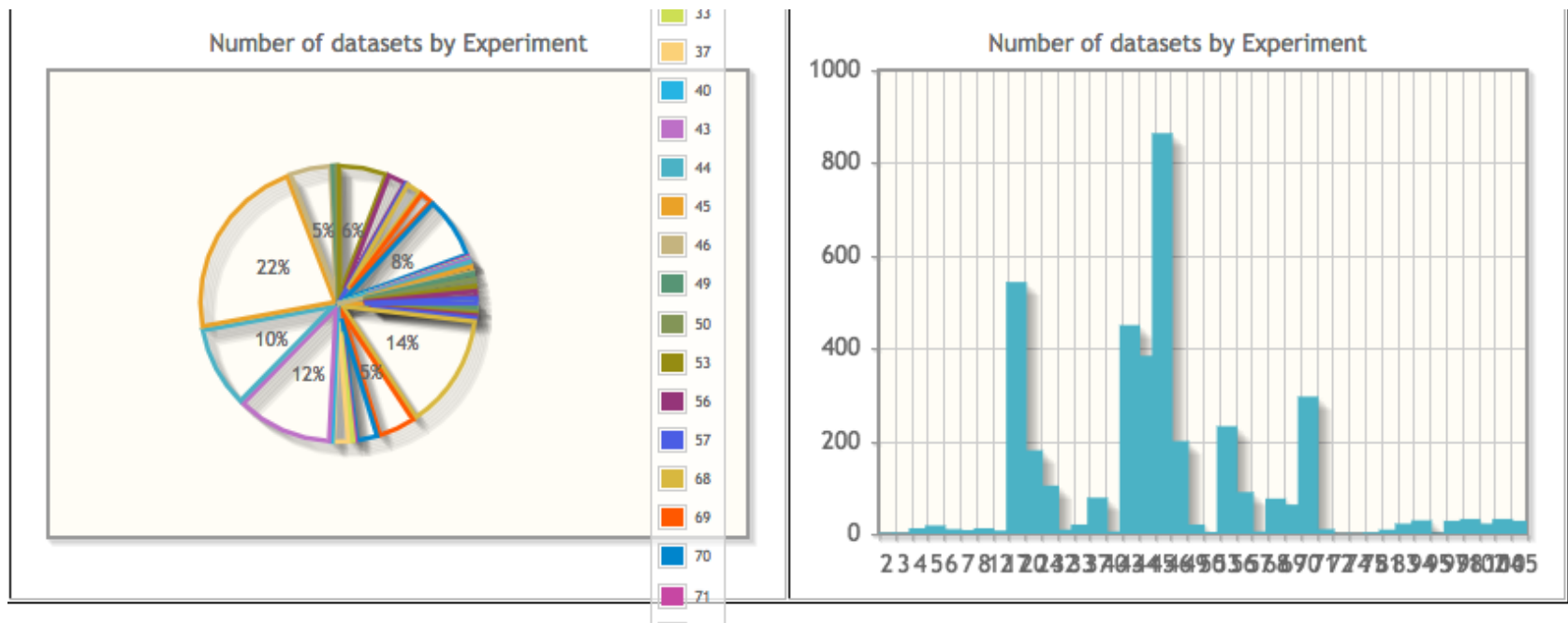
Inspire

References to experimental data used in validation

REFID	Title	Journal/URL	Authors	Link
1	Pion-Nucleon Total Cross Sections from 0.5 to 2.65 GeV/c	Phys.Rev. <b>168</b> (1968) , p: 1457-1	Carter, A.A. et al	<a href="#">link</a>
2	Kaon-Nucleon Total Cross Sections from 0.6 to 2.65 GeV/c	Phys.Rev. <b>168</b> (1968) , p: 1466-1	Bugg, D.V. et al	<a href="#">link</a>
3	Proton Total Reaction Cross Sections in the 10-20-MeV Range: Calcium-40 and Carbon	Phys.Rev. <b>C2</b> (1970) , p: 488-49	Dicello, J.F. et al	<a href="#">link</a>
4	A comparison of pi+ and pi- total cross-sections of light nuclei near the 3-3 resonance	Nucl.Phys. <b>B62</b> (1973) , p: 61-85	Wilkin, Colin et al	<a href="#">link</a>
5	Pion reaction cross-sections and nuclear sizes	Nucl.Phys. <b>A209</b> (1973) , p: 1-51	Allardyce, B.W.	<a href="#">link</a>
6	Pion-Nucleus Total Cross-Sections from 88-MeV to 860-MeV	Nucl.Phys. <b>B76</b> (1974) , p: 15-28	Clough, A.S. et al	<a href="#">link</a>
7	Emission of particles following muon capture in intermediate and heavy nuclei	Springer Tracts Mod.Phys. <b>71</b> (1973)	Singer, P. et al.	<a href="#">link</a>
8	Pion-Nucleus Total Cross-Sections in the (3,3) Resonance Region	Phys.Rev. <b>C14</b> (1976) , p: 635-6	Carroll, A.S. et al	<a href="#">link</a>
9	Quasifree Pion Photoproduction From Carbon Above 300-{MeV}	Nucl.Phys. <b>A306</b> (1978) , p: 292-	Baba, K. et al.	<a href="#">link</a>
10	CU (GAMMA, P) X REACTION AT E (GAMMA) = 150-MEV AND 300-MEV	Phys.Rev. <b>C25</b> (1982) , p: 2269-	Schumacher, F	<a href="#">link</a>
11	KAON SCATTERING FROM C AND CA AT 800-MEV/C	Phys.Rev. <b>C25</b> (1982) , p: 2619-	Marlow, Daniel	<a href="#">link</a>
12	NEUTRONS FROM NUCLEAR CAPTURE OF NEGATIVE PIONS	Phys.Rev. <b>C25</b> (1982) , p: 3050-	Madey, R. et al	<a href="#">link</a>
13	PRODUCTION CROSS-SECTIONS OF PROTONS WITH ENERGIES OF 70-MeV TO	(1983) , p:	Bayukov, Yu.D.	<a href="#">link</a>
14	PARTICLE PRODUCTION IN THE TARGET RAPIDITY REGION FROM HADRON NUC	Nucl.Phys. <b>A408</b> (1983) , p: 525-	Shibata, T.A. et al	<a href="#">link</a>
15	PROTON + NUCLEUS INCLUSIVE (P, P') SCATTERING AT 800-MeV	Phys.Rev. <b>C29</b> (1984) , p: 204-2	Mcgill, J.A. et al	<a href="#">link</a>
16	Analyses of Particle Production in Hadron - Nucleus Reactions at Several {GeV} With a	Phys.Lett. <b>B159</b> (1985) , p: 1	Enyo, H. et al.	<a href="#">link</a>
17	ANGULAR DEPENDENCES OF INCLUSIVE NUCLEON PRODUCTION IN NUCLEAR	Sov.J.Nucl.Phys. <b>42</b> (1985) , p: 1	Bayukov, Yu.D.	<a href="#">link</a>
18	High \$p_T\$ Deuteron and Anti-deuteron Production in \$p\$-\$p\$ and \$p\$-\$p\$-\$p\$ Collisions at 70	Sov.J.Nucl.Phys. <b>45</b> (1987) , p: 8	Abramov, V.V. et al	<a href="#">link</a>



Adding new data sets all the time



- Just a fraction of my time
  - mainly maintenance
    - migrating to new database servers and postgres versions, safe configuration.
    - bug fixes
  - very few mayor features implemented (e.g. human readable json files)
    - adding new data (experimental and simulation)
- Julia, providing lots of data and feed back.
- Lost Andrea Dotti:
  - he provided lot of feed back, data and was a great supporter
  - he provided python tools for fileupload → took over that task.
- No summer student this year.

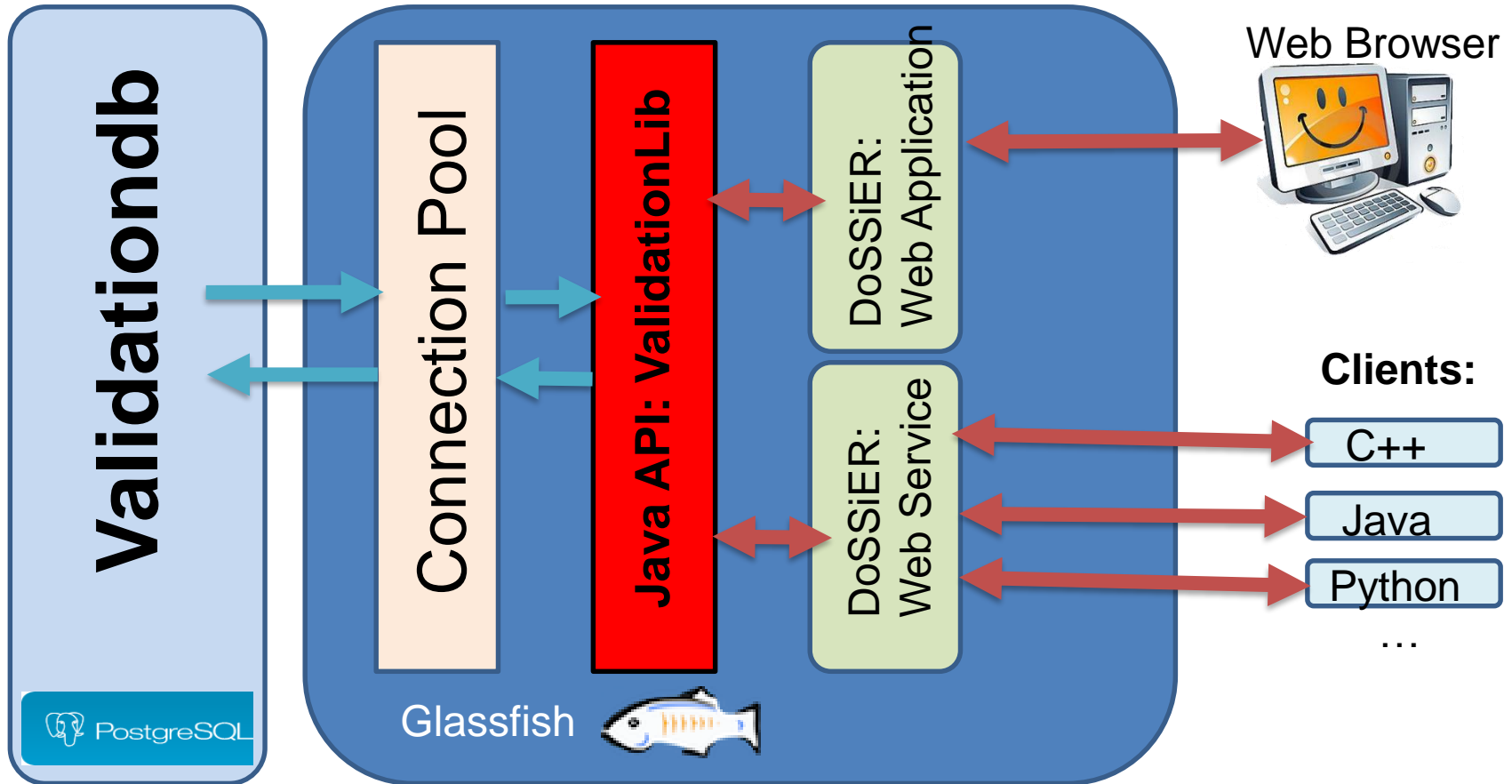
→real problem!!



# To do list







---

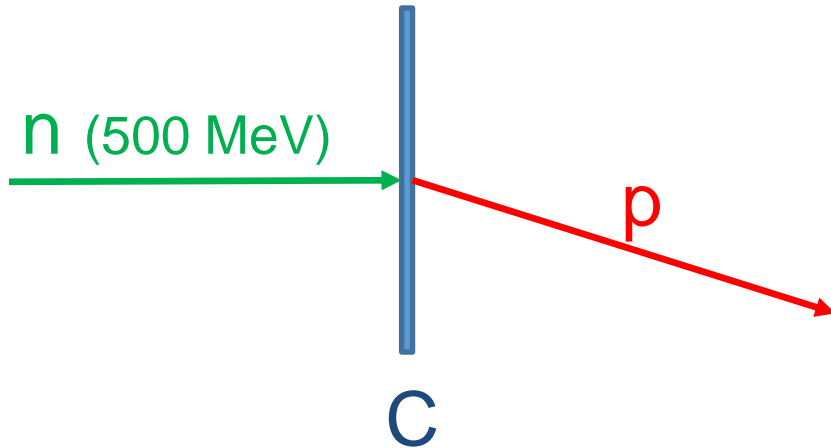
- Provide on-line tutorial for testers.
- Move to fermilab web hosting, single sign on (SSO) → problem is Tomcat by default doesn't provide complete support for JavaEE.
- Sustain/manage load caused by grid jobs.
- Converting plotting to RootJS
- fix web service API.
- Make file upload fool proof, provide more feed back.
- Migrate 'old' validation pages using static images to DoSSiER.



+ python ancillary tools: e.g. converter between various data formats: root, ascii, json to DoSSiER json format for upload. Uses Web Service to populate dictionaries.

## Technologies

	<p><b>Java Programming Language:</b> Java EE framework, JAX-RS RESTful web service, Maven software management tool.</p>	<p><b>GlassFish</b></p> 	<p><b>GlassFish:</b> Combined web application and web service server hosted on FermiCloud.</p>
	<p><b>Netbeans IDE:</b> Integrated Development Environment that works well with GitLab and GlassFish.</p>		<p><b>PostgreSQL:</b> Open source relational database hosted by the Fermilab database group.</p>
	<p><b>GitLab:</b> Web-based Git repository hosting service for managing collaborative revision.</p>		<p><b>PrimeFaces:</b> Java Server Faces based framework for creating clean and easy to navigate web pages.</p>



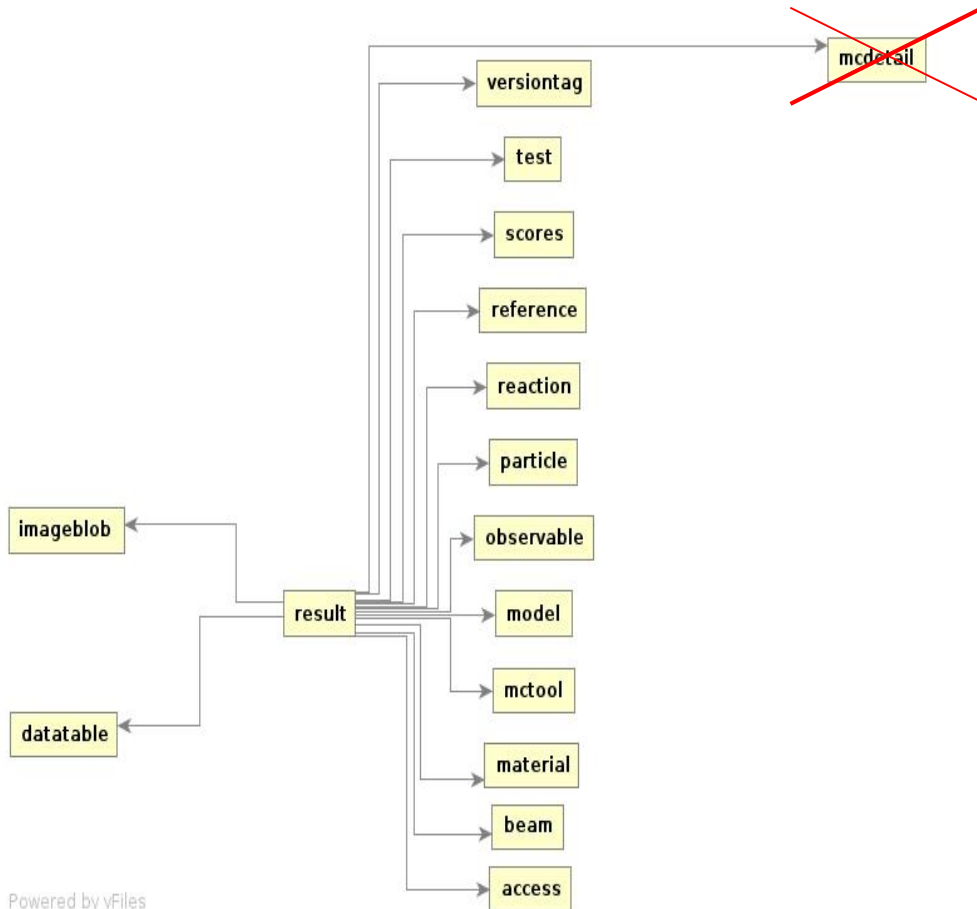
Example: n induced p production

**Beam:** mono energetic neutrons  
**Target:** Carbon.  
**Secondary:** protons.  
**Observable:** differential cross section  
**Reaction:** particle production  
**Model:** e.g. BIC  
**Version:** geant4.10.1.p02  
 In addition parnames/parvalue pairs can be added

## Note:

- Values for metadata stored in dictionaries:  
 (Beams, Materials, Particles, Observable, Reaction, Model, Version...).
- Meta data used to match experimental and simulated results.
- Complicated Beams (e.g. neutrino flux files, test beams consisting of many particles can be described by the schema).
- Ditto for Materials .
- Dictionaries can evolve as needed.

- DoSSiER uses “dictionaries” of different objects so that the metadata of results can be referenced by their ID keys or unique name.



material		
 <b>mid</b>	SERIAL	
z	INTEGER	
<b>mname</b>	CHARACTER VARYING(50)	
density	REAL	
ion	REAL	
ncomp	INTEGER	
comp	INTEGER[]	
frac	REAL[]	

Powered by yFiles

Database of Scientific Simulation and Experimental Results

Geant4 Test Browser

ID	Name	Description
2002	Franz	Nuclide induced production of protons, deuterons and tritons by neutrons between 300-580 MeV
2003	simplifiedCalo	Test of Shower shapes using selected simplified calorimeter setups.
2005	Pion Cross sections	Compare total elastic,inelastic pion cross section with data.
21	test41	Validation of multiple and single Coulomb scattering of muons versus MuScat experimental data

Select Pion Cross Sections in Geant 4 test browser

- Display exp. data
- Display Geant4 data
- Display GeantV data
- Display GENIE data
- Display Statistics
- Display Dictionaries
- RESTful web service

6	Pion-Nucleus Total Cross-Sections from 88-MeV to 860-MeV	Nucl.Phys. <b>B76</b> (1974) , p: 15-28	Allardyce, B.W. et al.	<a href="#">link</a>
4	A comparison of pi+ and pi- total cross-sections of light nuclei near the 3-3 resonance	Nucl.Phys. <b>B62</b> (1973) , p: 61-85	Cox, C.R. et al.	<a href="#">link</a>
5	Pion reaction cross-sections and nuclear sizes	Nucl.Phys. <b>A209</b> (1973) , p: 1-51	Allardyce, B.W. et al.	<a href="#">link</a>
8	Pion-Nucleus Total Cross-Sections in the (3,3) Resonance Region	Phys.Rev. <b>C14</b> (1976) , p: 635-638	Carroll, A.S. et al.	<a href="#">link</a>

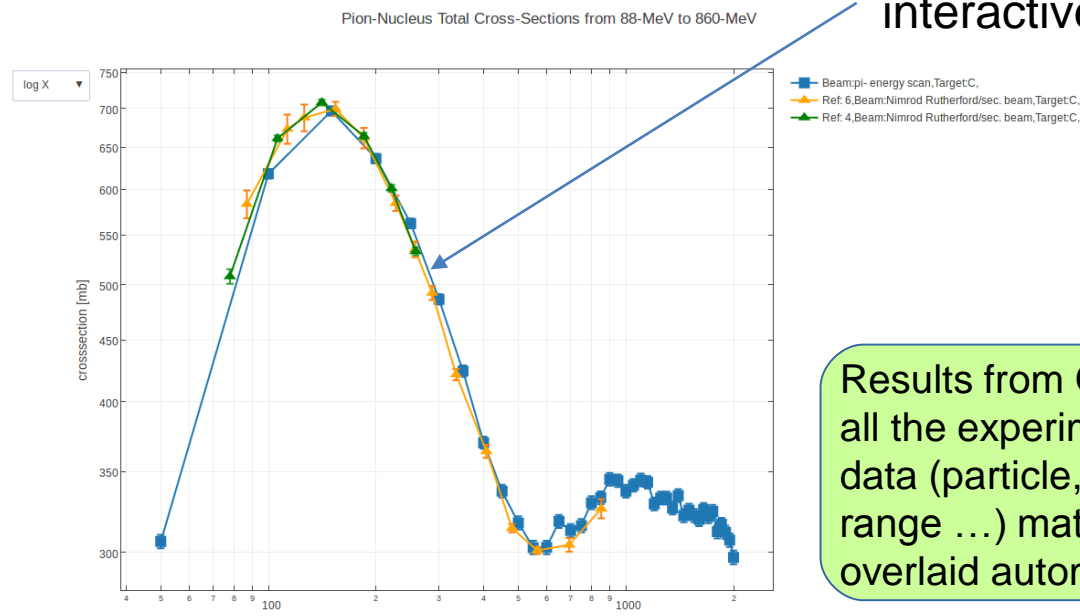
Beam Target Submit

Table Default

Print

Menus created on the fly

Java script allows for interactive graphs



Results from Geant4 simulations and all the experiments where the meta data (particle, target material energy range ...) matches the selection are overlaid automatically.



# Display as tables



## Database of Scientific Simulation and Experimental Results

Thu May 25 16:14:15 CDT 2017

- Home
- Geant4
- Geant4 Collaborators
- GeantV
- GENIE
- Fermilab
- CERN

- Left
- Main
- Display exp. data
  - Display Geant4 data
  - Display GeantV data
  - Display GENIE data
  - Display Statistics
  - Display Dictionaries
  - RESTful web service

Select Geant 4 Test > Display selected Geant 4 Test > Display selected Geant 4 Test as table



Beam [particles],Energies [Unit]:	pi- energy scan: [-211], [50.0, 100.0, 150.0, 200.0, 250.0, 300.0, 350.0, 400.0, 450.0, 500.0, 550.0, 600.0, 650.0, 700.0, 750.0, 800.0, 850.0, 900.0, 950.0, 1000.0, 1050.0, 1100.0, 1150.0, 1200.0, 1250.0, 1300.0, 1350.0, 1400.0, 1450.0, 1500.0, 1550.0, 1600.0, 1650.0, 1700.0, 1750.0, 1800.0, 1850.0, 1900.0, 1950.0, 2000.0] [MeV]
Reaction:	nuclear interaction
Target:	C
Secondary:	
Observable:	total cross section
dtype:	1000
Parameters:	{}: {}

X Pion KE (MeV)	Error in X	Y XS (mb)	Error in Y
50.0	0.0	306.39334	3.908574
100.0	0.0	617.9223	5.550673
150.0	0.0	696.65216	5.893682
200.0	0.0	636.1214	5.6318192
250.0	0.0	562.0784	5.2939177
300.0	0.0	486.29034	4.924096

- **Based on: Java API for REST - ful (Representational State Transfer) Services (JAX-RS)**
- Deployed on the development server: <https://g4devel.fnal.gov:8181/>
- Allows to programmatically retrieve results in json or xml format (with dictionaries expanded or not) -> these are the same formats used for uploads!
- C++ clients already used by selected Geant4 validation jobs!
- Dictionaries are retrieved by python upload tool to create look up tables so that dictionary can be accessed by keyword (not number)
- Last the summer Niccole added:
  - Search functions like in INSPIRE/SPIRES.
  - Programmatic upload to database works but not enabled until we can secure the application.
  - Provide examples in python and java, curl to deal with https.
  - Improved multiple file upload web application.

Inspire ID

```

referencekw: "285052"
modelkw: "NA"
mctoolkw: "Experiment"
versiontagkw: "NA"
beamkw: "SIN Neutron beam [477MeV]"
targetkw: "Cu"
observablekw: "differential cross section dsig/d0 dT"
secondarykw: "proton"
reactionkw: "particle production"
scoreskw: "NA"
accesskw: "public"
▼ datatable:
  ▼ title: "NEUTRON-INDUCED PRODUCTION OF PROTONS, DEUTERONS AND TRITONS ON COPPER AND BISMUTH"
    npoints: 0
    ▼ nbins:
      0: 31
    ▼ axisTitle:
      0: "E(MeV / c) of sec."
      1: "dsig / dp[] / dSr"
    ▶ val: [...]
    ▶ errStatPlus: [...]
    ▶ errStatMinus: [...]
      errSysPlus: []
      errSysMinus: []
    ▶ binMin: [...]
    ▶ binMax: [...]
      datatypeskw: "1D Histogram with variable binning and errors in y"
    imageblobslnk: 0
  ▼ parnames:
    0: "theta outgoing particle"
  ▼ parvalues:
    0: "54"
  
```

**DoSSiER** Database of Scientific Simulation and Experimental Results

Home Geant4 Geant4 Collaborators GeantV GENIE Fermilab CERN Thu May 18 11:14:57 CDT 2017

Left

- Main
  - Display exp. data
  - Display Geant4 data
  - Display GeantV data
  - Display GENIE data
  - Display Statistics
  - Display Dictionaries
  - RESTful web service

Web service

**Welcome to the DoSSiER RESTful web service portal**

DoSSiER provides a RESTful web service to access the data records and the dictionaries describing the metadata. This is work in progress! The final API has not been decided and we plan to support various interchange formats (json/xml) At the moment the following methods are supported (subject to change):

To retrieve the dictionaries in json format use the following syntax:

- To retrieve the Access dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Access>
- To retrieve the Beam dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Beam>
- To retrieve the Datatypes dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Datatypes>
- To retrieve the Material dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Material>
- To retrieve the Mcdetail dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Mcdetail>
- To retrieve the Mctool dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Mctool>
- To retrieve the Observable dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Observable>
- To retrieve the Particle dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Particle>
- To retrieve the Reaction dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Reaction>
- To retrieve the Reference dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Reference>
- To retrieve the Test dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Test>
- To retrieve the Working Groups dictionary: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/dictionary?name=Wgroups>

To retrieve a result record (here 2) in json format:

To retrieve the result record 2: <http://g4devel.fnal.gov:8080/DoSSiER/WebAPI/get?format=json&record=2>

JSON	Raw Data	Headers
Save	Copy	
0:	rid: 1 rname: "particle production"	
1:	rid: 2 rname: "capture"	
2:	rid: 3 rname: "scattering"	
3:	rid: 4 rname: "nuclear interaction"	

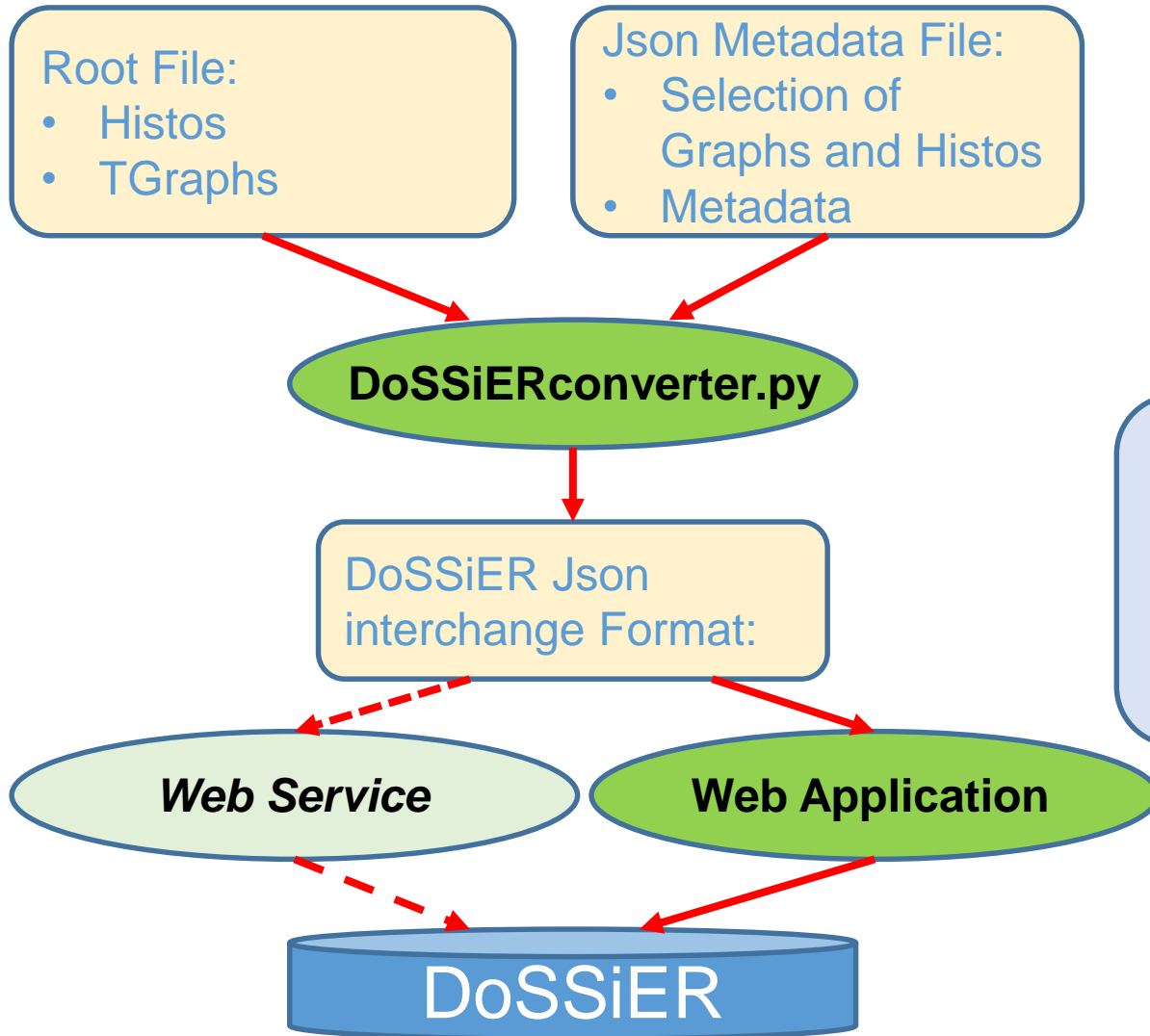
- Contact me -> create a new test in the db:

```

0:
  testid:      19
  mctool:
    mcid:      2
    mcname:    "Geant4"
  wgroups:
    wgid:      2
    wgroupName: "Geant4 hadronic working group"
    testname:  "test19"
  description: "High energy Experiment, ...proton beam) data sets."
  responsible:
    0:         "Julia Yarba (Fermilab)"
  keywords:
    0:         "inclusive production"
    1:         "high energy"
    2:         "thin Target"
  referenceid:
    0:
      refid:    43
      inspireid: 786183
      authors:  [-]
      title:    "Large-angle production o...tons on nuclear targets"
      journal:  "Phys.Rev."
      ern:      "10.1103/PhysRevC.77.055207"
      pages:    "055207"
      volume:   "C77"
      year:     2008
      Abstract: "Measurements of the doub_ear interaction length."
      keywords: []
      linkurl:  "https://inspirehep.net/record/786183"
  
```

Might also need new entries to:

- References (inspire ID)
- Experimental data sets
- Observables
- Reactions
- Materials
- Default selection
- ...



**Note!**  
Json Metadata file only needs to be defined once then probably only the Geant4 version changes.



# DoSSiER Summary and Conclusions

- Manpower is a real problem!
- Still DoSSiER: **D**atabase **o**f **S**cientific **S**imulation and **E**xperimental **R**esults is actively being developed although at a pedestrian pace!
- <https://g4devel.fnal.gov:8181/> (https protocol; for end to end encryption)
- We already identified features in Geant4 that needed fixing.
- Experimental data and results from simulation are stored in a relational database.
- Data can be imported and exported using json/xml formats. (python scripts are provided to extract data from root files or ASCII tables and convert to json/xml.)
- Web application:
  - allows to select and search.
  - allows to overlay experimental and simulated data.
  - authentication is necessary to have access to internal data and functions (e.g. upload, edit, delete).
- Web service: allows to programmatically access the repository(read only at the moment) → needs some fixes after we moved to different json format.



# DoSSiER Summary and Conclusions

- Finding good experimental data and adding to DoSSiER is a continuing manual effort.
- So is developing new tests to validate the Simulation vs. data → would be nice to set it up to run on every new geant 4 version. Currently many tests I run are randomly triggered by user requests/questions.
- Finding students to contribute is quite difficult.
- We need more Geant4 collaborators to upload their data, pretty easy with the ancillary python tools developed by Andrea, new uploads require only minor changes to the meta data→will provide tutorial! Would like to have all geant4 tests in DoSSiER.
- Would be nice to automate running, analyzing, uploading (install Geant4 and tests in CVMFS) →getting things running on the grid takes a lot of effort (no support for Geant 4 VO)
- Change to 'human readable json format done.



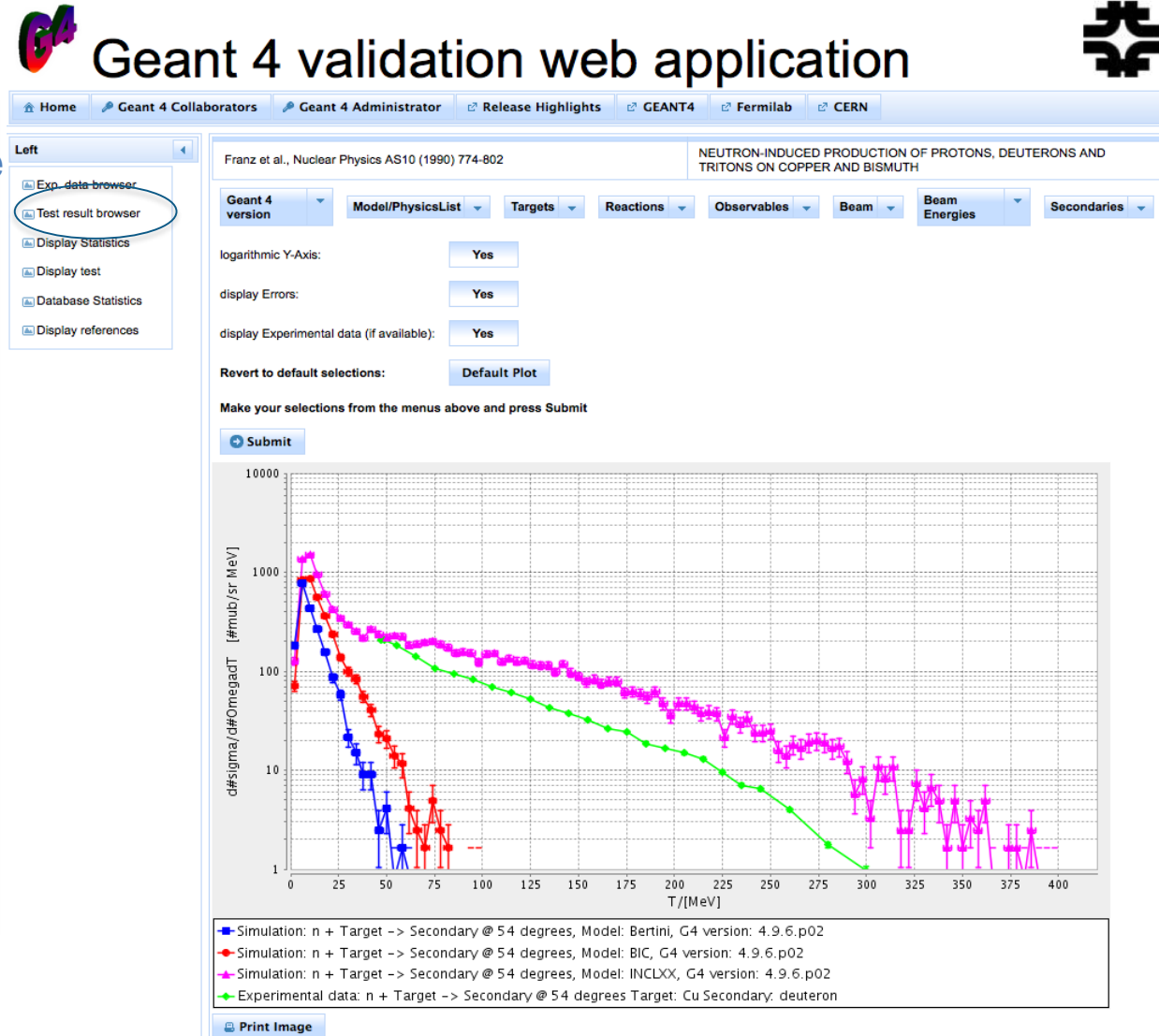
---

Backup

This allows to select Geant4 simulation results of interest, and to compare them to the experimental data as applicable. Shown on the right is neutron induced deuteron (default selection).

## Different Models:

- BIC(blue),
- Bertini (red)
- INCL++(magenta)
- Experimental Data (green)



- Options are selected from searchable drop down menus
- Beam energy is inputted or just left blank
- Test or experimental data is chosen
- The results include the ID of the matching experiment or test, which links to the display of the corresponding data

**Database of Scientific Simulation and Experimental Results**

Geant4 Collaborators | GeantV | GENIE | Fermilab | CERN | Search | Wed Jun 28 19:56:52 CDT 2018

Search Service

Select Observable(s):  Select Particle(s):  Select Target(s):

Select Mctool(s):  Select Reaction(s):  Select Scores:

Beam Energy Range Between  and

Select Test Data or Experimental Data:

ID	Name/Title	Number of Matches
<a href="#">17</a>	ANGULAR DEPENDENCES OF INCLUSIVE NUCLEON PRODUCTION IN NUCLEAR REACTIONS AT HIGH-ENERGIES AND SEPARATION OF CONTRIBUTIONS FROM QUASIFREE AND DEEP INELASTIC NUCLEAR PROCESSES	30
<a href="#">44</a>	Forward production of charged pions with incident pi <sup>+</sup> on nuclear targets measured at the CERN PS	32
<a href="#">45</a>	Large-angle production of charged pions with incident pion beams on nuclear targets	72
<a href="#">46</a>	Forward production of charged pions with incident protons on nuclear targets at the CERN PS	16
<a href="#">43</a>	Large-angle production of charged pions with 3-12.9-GeV/c incident protons on nuclear targets	36



# Web Page File Upload (Nicole Serpico)

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- Accessed through the G4Expert secure web page
- Multiple file upload that can handle hundreds of small files (~100 results) as well as large files (~50,000 results or ~0.5 GB).
- Goes through each uploaded file twice: first checks to make sure it doesn't have any formatting errors, then after doing that, uploads the file to the database.
- Still need to elevate errors that happen when adding to the database.
- Links to a summary page that details which files were successfully uploaded and which had errors. If a file contains errors the summary page shows where those errors are so they can be easily corrected.



# Images of the Web Page File Upload

## Web Application File Upload

Use the following form to upload one or more files.

In order to upload files, click the button "choose" and select your files. When your files are selected, press the "upload" button. Once you have received a message stating your files have been uploaded, and are sure you would like to add the files you uploaded to the database, press the "Commit to Database" button. Once your files have been processed, you will receive a message stating the processing is finished.

shouldNotWorkTest.json	98.7 KB	<input type="text"/>	<input type="button" value="x"/>
shouldWorkTest.json	98.7 KB	<input type="text"/>	<input type="button" value="x"/>

Once you have committed your files click the "File Upload Summary" button below for a summary of your uploads.

If a file did not have any errors it was automatically entered into the database and the upload summary will contain a message stating the upload was a success.

If a file did have any errors then nothing was entered into the database and the upload summary will contain a message stating the result numbers which contained errors.

## Summary of File Upload

This page is a summary of your file upload with information about which files were successfully uploaded and which were not.

If a file was not successfully uploaded because it contained errors this summary also includes information about which parts of the file contained the errors.

File Name	Outcome
shouldNotWorkTest.json	Upload Failed. The following result numbers caused the failure: [1, 2, 6, 11, 40]
shouldWorkTest.json	Successfully Uploaded!