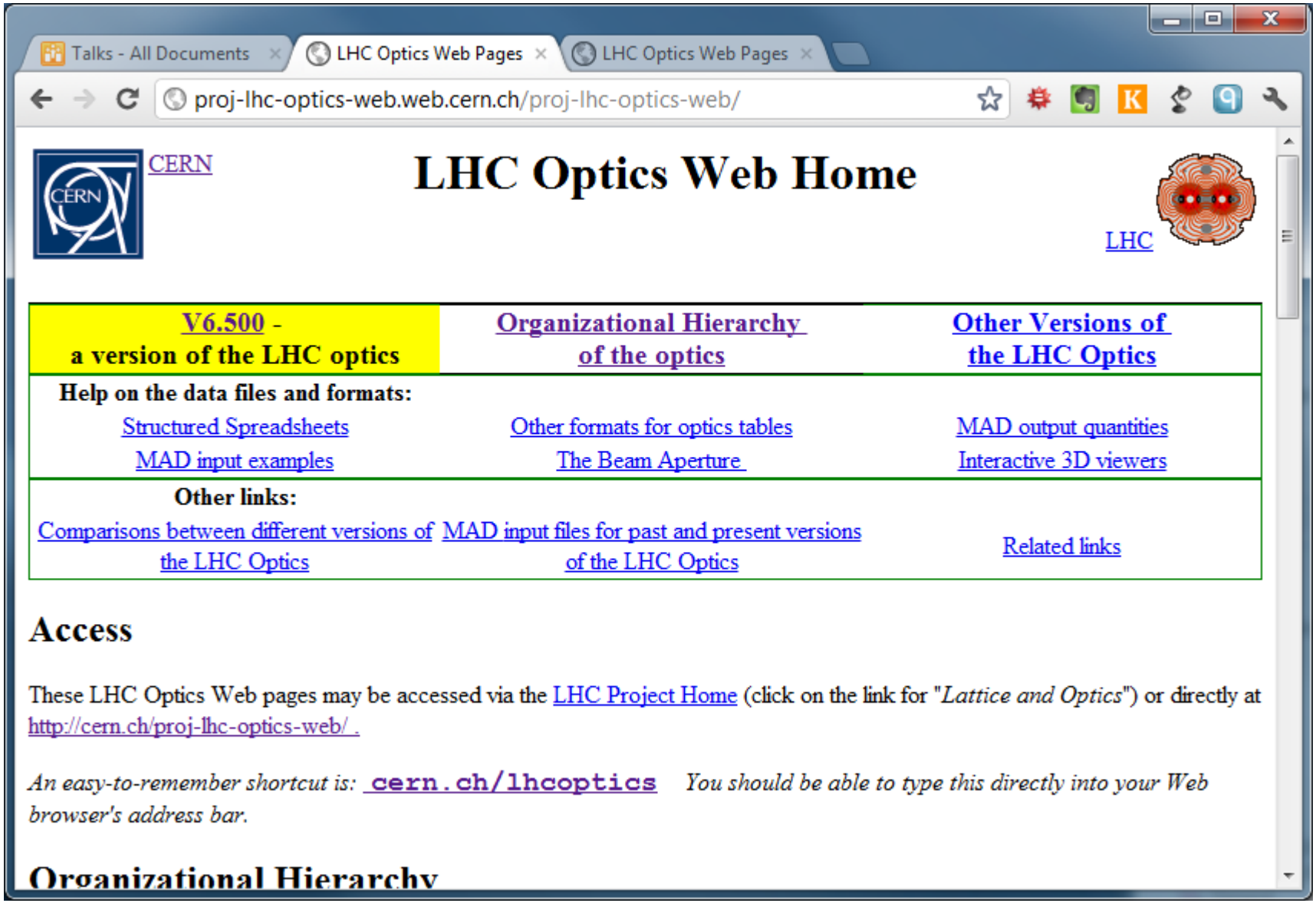
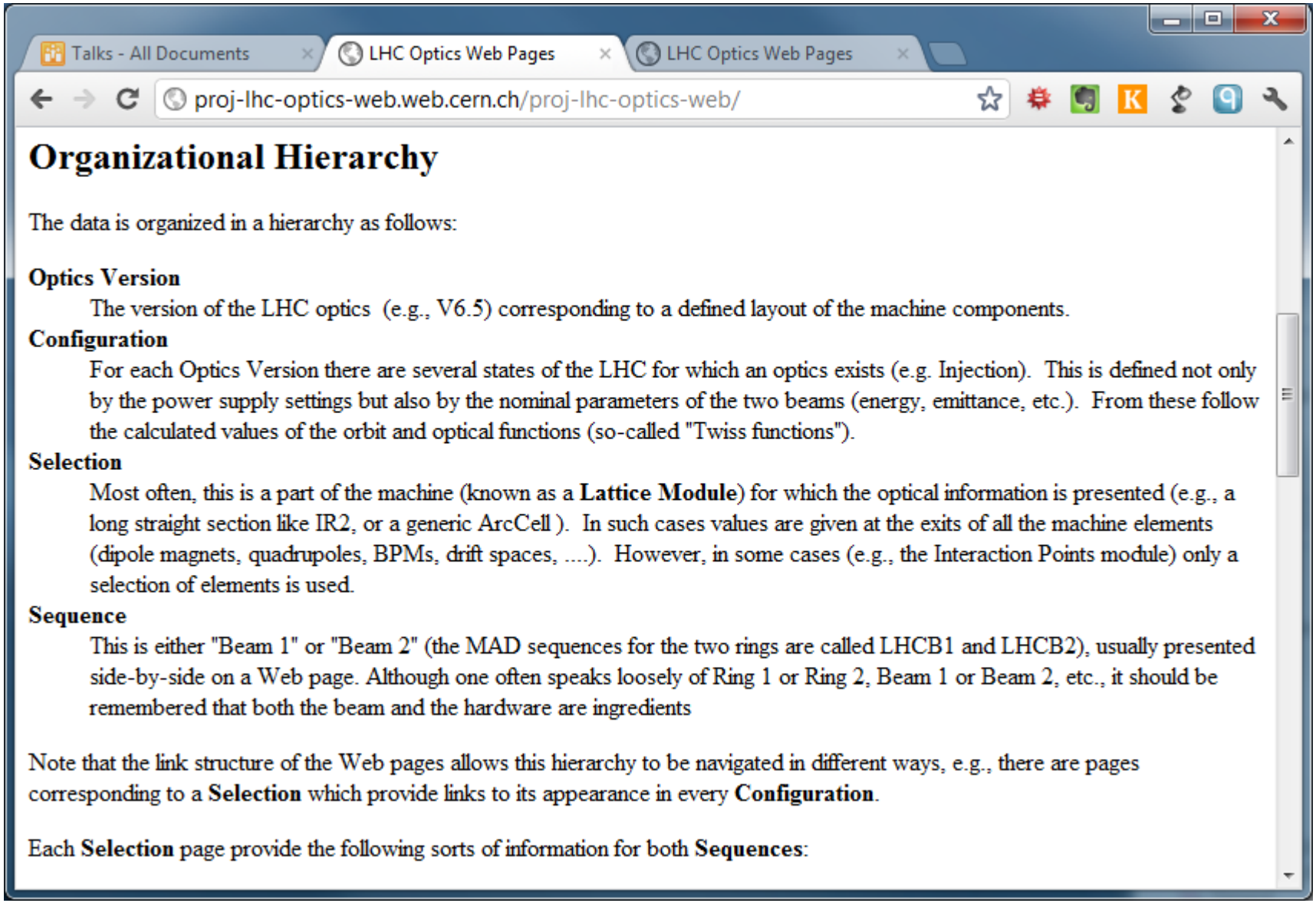
LHC Optics Web – proposal for update

- LHC Optics Web at
  - http://cern.ch/lhcoptics
  - Short alias for http://proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/)
  - Provides pre-calculated data in variety of formats for both kinds of people (MAD users and non-MAD users)
  - However it has not been updated for some years and things have changed:
    - The LHC optics (now operational) and our views of it
    - Mathematica (Implemented in Version 5 …, now 8)
    - Madtomma packages – more functionality
    - To be maintained by someone else …


Talks - All Documents
LHC Optics Web Pages
LHC Optics Web Pages
proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/
CERN
LHC Optics Web Home
LHC
V6.500 - a version of the LHC optics
Organizational Hierarchy of the optics
Other Versions of the LHC Optics
Help on the data files and formats:
Structured Spreadsheets
Other formats for optics tables
MAD output quantities
MAD input examples
The Beam Aperture
Interactive 3D viewers
Other links:
Comparisons between different versions of the LHC Optics
MAD input files for past and present versions of the LHC Optics
Related links
Access
These LHC Optics Web pages may be accessed via the LHC Project Home (click on the link for "Lattice and Optics") or directly at http://cern.ch/proj-lhc-optics-web/ .
An easy-to-remember shortcut is: cern.ch/lhcoptics You should be able to type this directly into your Web browser's address bar.
Organizational Hierarchy



Organizational Hierarchy

The data is organized in a hierarchy as follows:

Optics Version
The version of the LHC optics (e.g., V6.5) corresponding to a defined layout of the machine components.

Configuration
For each Optics Version there are several states of the LHC for which an optics exists (e.g. Injection). This is defined not only by the power supply settings but also by the nominal parameters of the two beams (energy, emittance, etc.). From these follow the calculated values of the orbit and optical functions (so-called "Twiss functions").

Selection
Most often, this is a part of the machine (known as a **Lattice Module**) for which the optical information is presented (e.g., a long straight section like IR2, or a generic ArcCell). In such cases values are given at the exits of all the machine elements (dipole magnets, quadrupoles, BPMs, drift spaces, ...). However, in some cases (e.g., the Interaction Points module) only a selection of elements is used.

Sequence
This is either "Beam 1" or "Beam 2" (the MAD sequences for the two rings are called LHCB1 and LHCB2), usually presented side-by-side on a Web page. Although one often speaks loosely of Ring 1 or Ring 2, Beam 1 or Beam 2, etc., it should be remembered that both the beam and the hardware are ingredients

Note that the link structure of the Web pages allows this hierarchy to be navigated in different ways, e.g., there are pages corresponding to a **Selection** which provide links to its appearance in every **Configuration**.

Each **Selection** page provide the following sorts of information for both **Sequences**:

Configurations: list becomes open-ended

- Previously list of configurations was fixed and hard-wired in Web templates:

Selection: IR1 (an Interaction Region or Long Straight Section)

The links below give access to detailed information about this selection in various configurations .

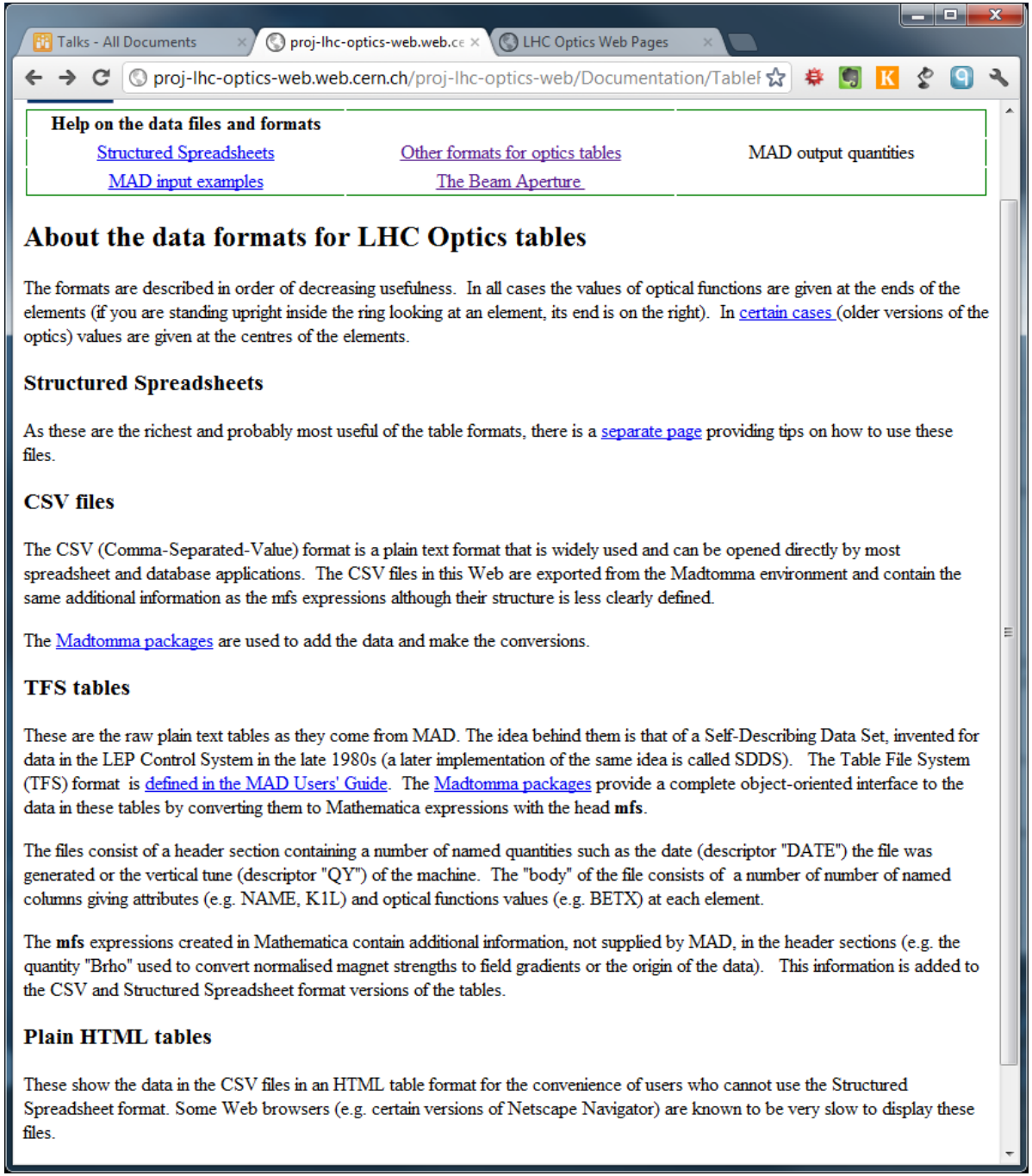
Injection	EarlyCollision5TeV (pp 5+5 TeV)	
Collision450GeV (pp)	Collision (pp 7+7 TeV)	EarlyCollision (pp 7+7 TeV)
CollisionIons	EarlyCollisionIons	LowBeta

These pages provide plots of optical functions, tables of optical functions and element strengths strengths (in a variety of formats) and complete MAD input files.

- Impractical to keep this scheme going: instead make an open-ended list (with grouping) on the top Web page for V6.503
  - Standard process for generating a new configuration's data

Naming scheme for configurations

- Each configuration identified by a string containing energy and β^*/m (to ≥ 2 decimal places), should work as part of URL/folder name, eg,
  - "ppInjection-0.45TeV-11.00-10.00-11.00-10.00"
  - "ppCollision2012A-4.00TeV-0.60-3.00-0.60-3.00"
  - "pPbCollision2012-3.50TeV-0.655-0.60-0.655-3.00"
  - "ppTOTEM-4.00TeV-11.00-10.00-11.00-10.00"
- NB initial part of name (before FIRST "-") is catch-all and might encode any further information as necessary (low-emittance, solenoids off, …)
  - Compromise: not too long, can be constructed more-or-less deterministically
  - Including everything in this label is impractical …
  - There will be a place to explain more


Talks - All Documents
proj-lhc-optics-web.web.ce
LHC Optics Web Pages
proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/Documentation/Tablef
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About the data formats for LHC Optics tables
The formats are described in order of decreasing usefulness. In all cases the values of optical functions are given at the ends of the elements (if you are standing upright inside the ring looking at an element, its end is on the right). In certain cases (older versions of the optics) values are given at the centres of the elements.
Structured Spreadsheets
As these are the richest and probably most useful of the table formats, there is a separate page providing tips on how to use these files.
CSV files
The CSV (Comma-Separated-Value) format is a plain text format that is widely used and can be opened directly by most spreadsheet and database applications. The CSV files in this Web are exported from the Madtomma environment and contain the same additional information as the mfs expressions although their structure is less clearly defined.
The Madtomma packages are used to add the data and make the conversions.
TFS tables
These are the raw plain text tables as they come from MAD. The idea behind them is that of a Self-Describing Data Set, invented for data in the LEP Control System in the late 1980s (a later implementation of the same idea is called SDDS). The Table File System (TFS) format is defined in the MAD Users' Guide. The Madtomma packages provide a complete object-oriented interface to the data in these tables by converting them to Mathematica expressions with the head mfs.
The files consist of a header section containing a number of named quantities such as the date (descriptor "DATE") the file was generated or the vertical tune (descriptor "QY") of the machine. The "body" of the file consists of a number of number of named columns giving attributes (e.g. NAME, K1L) and optical functions values (e.g. BETX) at each element.
The mfs expressions created in Mathematica contain additional information, not supplied by MAD, in the header sections (e.g. the quantity "Brho" used to convert normalised magnet strengths to field gradients or the origin of the data). This information is added to the CSV and Structured Spreadsheet format versions of the tables.
Plain HTML tables
These show the data in the CSV files in an HTML table format for the convenience of users who cannot use the Structured Spreadsheet format. Some Web browsers (e.g. certain versions of Netscape Navigator) are known to be very slow to display these files.

Data formats: which ones to keep?

- Proposed
  - TFS, only full ring optics for LHCB1, LHCB2
  - CSV tables for each module/selection: simple, flexible, may contain more than MAD TFS tables …
    - Derived quantities like Brho,
    - For elements sets, eg,Quadrupoles: currents (linear approx.), dB/dx, K1, max & min values, …
  - Excel (from CSV, additional structure), probably most popular (demo…)
  - MADX input example
- Must go:
  - MAD built-in graphics (PS converted to PDF), will be replaced by interactive Web images, PDF, PNG, …
  - TFS tables for insertions – just one for complete ring
- Not very useful ?
  - HTML from Excel (did anyone ever use it?)

New simplified hierarchy

V6.503 main page

<edited by hand>

Flat list of configurations, each identified by "label":

ppInjection-0.45TeV-11.00-10.00-11.00-10.00

ppCollision2012A-4.00TeV-0.60-3.00-0.60-3.00

...

(add more as required, group according to any reasonable logic.)

ppCollision2012A **configuration page**

http://proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/V6.503/ppInjection-0.45TeV-11.00-10.00-11.00-10.00.html

<Explanatory text, written by hand>

<Everything else automatic/same in all cases>

Global optical parameters and plots

Links to TFS table, plots

IR1

Plots, links to data files (CSV, XLSX, PDF, PNG)

Supporting data files in "ppInjection-0.45TeV-11.00-10.00-11.00-10.00" folder

Just one TFS TWISS file from MAD for whole ring, all other files below derived from it.

For each insertion (IR1, ...) or sub-view (eg MARKERS)

- CSV files with subset of data from TWISS file **LHCB1-IR1.csv, LHCB2-IR1.csv**
- XLSX file with additional data and structure IR1.**LHCB1-IR1.xlsx, ...**
- Various plots as PDF, PNG, ... **LHCB1_IR1optics.pdf**, IR1optics.png, IR1 ...

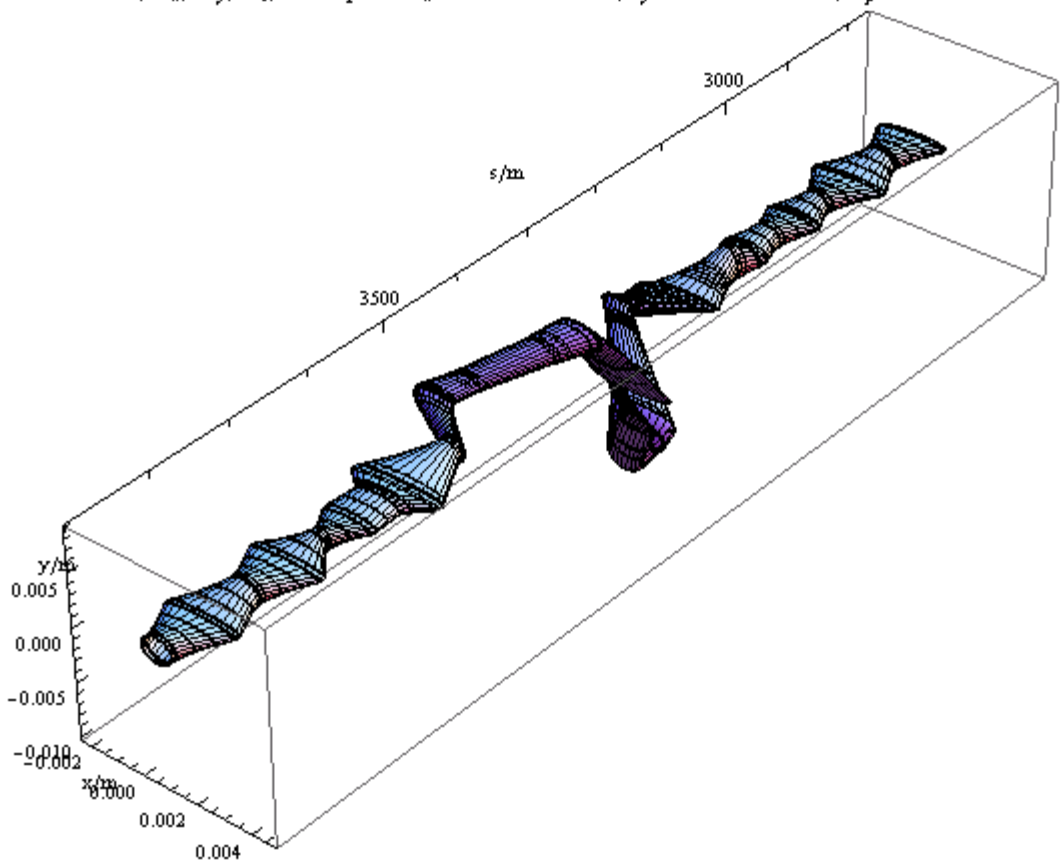
Uses of URLS

- URL of any file is predictable, eg,
  - http://cern.ch/lhcoptics/V6.503/index.html
  - http://cern.ch/lhcoptics/V6.503/ppInjection-0.45TeV-11.00-10.00-11.00-10.00/
  - http://cern.ch/lhcoptics/V6.503/ppInjection-0.45TeV-11.00-10.00-11.00-10.00/LHCB1-IR1.csv
  - http://cern.ch/lhcoptics/V6.503/ppInjection-0.45TeV-11.00-10.00-11.00-10.00/LHCB1-IR1-optics.pdf
  - http://cern.ch/lhcoptics/V6.503/ppInjection-0.45TeV-11.00-10.00-11.00-10.00/LHCB1-IR1-optics.png
- Data can be used programmatically in applications, eg, in Mathematica
  - Import["http://cern.ch/lhcoptics/V6.503/ppInjection-0.45TeV-11.00-10.00-11.00-10.00/LHCB1-IR1.csv"]
- Or in Madtomma environment for more structure
  - mfsOpticsClassicEnvelopePlot3D[mfsFromCSV[…]

Untitled-19 *

In[56]:=
```
mfsOpticsClassicEnvelopePlot3D[
 mfsFromCSV[
  "http://proj-lhc-optics-web.web.cern.ch/proj-lhc-optics-web/V6.500/Injection/
    LHCB1IR2.csv"]]
```

Out[56]=



100%

Future additions

- Interactive pages in CDF format ?
  - Eg, manipulate squeezes, …
  - Requires free browser plug-in (or Mathematica), compressed optics data in page
- Aperture data and graphics ?
- Parasitic beam-beam analysis, …
- …
- Add all these things to basic configuration template, single automatic process
  - Mainly Mathematica, Excel process for XLSX files
- But restore basic functionality first!