

# Add support for in-browser interactive averaging of physics results

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Organisation: The Heavy Flavor Averaging Group  
(HFLAV)

# Overview of HFLAV-B2CHARM

- The Heavy Flavour AVeraging (HFLAV) group is responsible for collating measurements made at different High Energy Physics (HEP) experiments, at CERN and other particle physics laboratories, and combining them using robust statistical procedures.
- The 'Beauty to Charm' subgroup is responsible for combinations of measurements that involve the decay of a particle containing a b-quark to any final state where one of the particles involves a c-quark.
- The HFLAV website provides a 'live' snapshot of the averages that is updated after every new result is incorporated by an HFLAV representative.

# Problem

- Lots of equations (branching fractions) present, close to 700~800.
- Older website grouped these equations based on type of initial particle only
- Thus to find details about a particular equation(branching fraction), it would take a lot time and effort.
- [Link to website](#)
- Website was static, built purely only from HTML and CSS, thus it could not support input from user and respond back.
- This prevented from adding features to website like finding custom averages based on user's interests or drawing an overview plot with only equations that the user wants.

# Solution

- Change framework of website to Django, with a PostgreSQL database.
- [Averaging tool of HFLAV group](#) ( which is used to actually calculate averages), was modified such that it can generate JSON files for each branching fraction , such that each file contains all information about that particular branching fraction.
- Writing python script to use these generated JSON files and add them to PostgreSQL.
- Developing filters so that it is easier to navigate and find particular branching fraction.

# Filter

Initial particles	Type of observable	Charm mesons	Charmonium and exotic states	Baryons	Strange particles	Light particles	Child Particle Numbers												
$B^0$ $B^+$ $B^0 + B^+$ $B_s^0$ $B_c^+$ $\Lambda_b$ $\Xi_b$ $\Omega_b$	Branching fraction CP asymmetry Polarization	$D^0$ $D^\pm$ $D_s^\pm$ $D^{*0}$ $D^{*\pm}$ $D_s^{*\pm}$ excited $D$ excited $D_s$	$J/\psi$ $\psi(2S)$ $\eta_c$ $\chi_c$ other charmonium $X(3872)$ $P_c$	$p$ $n$ $\Lambda$ $\Sigma$ $\Xi$ $\Omega$ other light baryons $\Lambda_c$ $\Sigma_c$ $\Xi_c$ other charm baryons	$K^\pm$ $K_{(S/L)}^0$ $K^{*\pm}$ $K^{*0}$ $\phi$ other kaons	$\pi^\pm$ $\pi^0$ $\rho^\pm$ $\rho^0$ $\eta^{(\prime)}$ $\omega$ other light mesons lepton $\gamma$	<table border="1"> <tr> <td>-</td> <td>1</td> <td>+</td> <td><math>D^{*\pm}</math></td> </tr> <tr> <td>-</td> <td>1</td> <td>+</td> <td><math>J/\psi</math></td> </tr> <tr> <td>-</td> <td>2</td> <td>+</td> <td><math>\Xi</math></td> </tr> </table>	-	1	+	$D^{*\pm}$	-	1	+	$J/\psi$	-	2	+	$\Xi$
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-	2	+	$\Xi$																

- New filters provide various other categories other than initial particle, so it is easier to filter according to requirement and find a fraction.

# Solution

- Filters make an AJAX call every time the filter configuration is changed.
- Django processes the filter configuration and provides relevant information back, the information is displayed on frontend using DataTables jQuery plugin.
- Custom overview plot generation - Users can now select which fractions do they want in their plot . Django backend generates the plot using matplotlib and other libraries.
- Deployment of Django app - Used CERN Openshift (or OKD 4) service.
- Use Dockerfile for automatic building of image and write various scripts to configure python environment and run python scripts on Openshift instance. Use webhooks for automatic redeployment of app, if any change is made in source code.

# Thank You!!

Huge thanks to my mentors: Daniel Johnson and Thomas Kuhr for helping and guiding me throughout the journey!

Code and detailed report available at -  
<https://gitlab.cern.ch/hflav/b2charm-webpage>