RooFit @ BaBar

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RooFit workshop
December 6th, 2007 @ SLAC
A long story

- At the beginning: RooFitTools (documented in BAD 18):
  - 16-FEB-2000 Initial version
  - 22-AUG-2001 Version 14 (last version)
  (take a look, it is interesting in any case)

- RooFitCore/RooFitModels splitting
  - Make the code more stable and readable

- Migration of the package outside Babar @ sourceforge.net
  - General tool used in other Collaborations
  - More users for validations, several applications (not only CP fits)

- Integration of RooFit inside ROOT
  - Big change, since ROOT v5
  - Now it is part of the ROOT project, fully supported
  - General framework in the incoming experiments (LHC), used in HEP community
A long story: BaBar experience

- Almost all BaBar analyses are based on RooFit (most of the Time Dependent CP analysis)
- People wrote their personal fitting packages based on RooFit
  - High flexibility for many different kinds of analysis
    - Branching fractions
    - Time Dependent CP
    - Dalitz analysis
    - ...
- Furthermore we have developed some general packages based on RooFit, where you don’t need to modify the code for your specific analysis (just using simple text configuration files):
  - RooRarFit
  - MiFit
A long story: the bottom line

- We are strongly involved in RooFit use
- BaBar users have the highest experience for using RooFit in many complex applications
- This is very useful for RooFit authors for testing the code, requiring further developments, …

Many thanks to RooFit authors to take care of our requests!
BaBar-RooFit use (1)

- **RooFit integrated in the BaBar release:**
  - Two packages: RooFitCore, RooFitModels
  - Another package only for BaBar developments: RooFitBabar

- **These packages are in CVS and maintained by the RooFit-BaBar coordinator and the Physics Software Coordinator**

- **Starting with ROOT 5, RooFit is already integrated in ROOT**
  - BaBar users can use directly RooFit in BaBar for their code ==> need some modification in how we include the header files in the BaBar code (see later)
  - Of course there is still the possibility to use the BaBar packages
BaBar-RooFit use (2)

- Remember the BaBar code (events, calibrations constants,…) depends on ROOT: not trivial update of ROOT in case we need just a RooFit update (for example to fix bugs)

- It is VERY preferable to maintain a “standalone” RooFit version in BaBar release (independently from ROOT)

- In this way we can update RooFit without changing ROOT
  - This require some work to change the syntax from ROOT/RooFit to BaBar/RooFit (see later)
ROOT/RooFit @ BaBar

- Currently the latest BaBar release is based on ROOT 5.14/00e
  - Stable release for event reconstruction
  - RooFit in this ROOT version (v2.10) has a lot of problems
- RooFit in BaBar release based on version 2.09
  - Also the RooFit version in BaBar release has some bugs

  **Need an update!**

- The possibility to move BaBar release to newer ROOT versions is not trivial
  - ROOT 5.16 has a problem with our CDB (bug, noted by Igor G.): the fix will be in ROOT 5.18, available in December, too late for BaBar schedule
  - ROOT >=5.16 has already a library called RooFitCore: conflict with our library

- Adopted Solution
  - Keep ROOT 5.14/00e for BaBar release
  - Update of the RooFit in BaBar release
Updating RooFit @ BaBar

- Download of RooFit/RooFitCore source code from ROOT SVN repository:

  ```
  svn co http://root.cern.ch/svn/root/branches/dev/roofit/roofit roofit
  svn co http://root.cern.ch/svn/root/branches/dev/roofit/roofitcore roofitcore
  ```

  (special repository for RooFit dev version)

- NOTE: Update to RooFit v2.22/2.23, big jump from our previous version v2.09 ==> need a carefully validation
  - Many bugs fixed
  - Many new features added (and many improvements to the existing code)

- Change from ROOT “syntax” to BaBar release:
  - Change file extensions: .h in .hh, .cxx in .cc
  - Change header includes, adding the name of the package:
    ```
    #include "RooAbsReal.h"
    in
    #include "RooFitCore/RooAbsReal.hh"
    ```
Updating RooFit @ BaBar

- Simple script for the conversion: copy_roofit (in RooFitBabar package)
  - roofit ==> RooFitModels V02-00-22
  - roofitcore ==> RooFitCore V02-00-22

- Some simple changes needed to use new RooFit with (old) ROOT 5.14/00e, not important for RooFit itself:
  - TDirectoryFile.h new class in ROOT
  - Some methods in different classes: TMath::Hash instead of TString::Hash
  - Streamer declaration for RooPlot

- They are due to ROOT changes
RooFit V2.22

- The dev version that it is imported in BaBar is V2.22
- Many changes in this new version (consider that in BaBar we have RooFit V2.09):
  - In particular there are new classes for p.d.f.s that cache values
- Many problems found (of course for a new version):
  - Problems using resolution models in TD fits (me)
  - Problems using Range option in the fit (Jake A.)
  - Different definition of virtual function
    RooAbsAnaConvPdf::getCoefAnalyticalIntegral ==> broken back-compatibility with user-code (Josh T.)
  - Problem found by Lei for projections plot and Simultaneous PDF builder
- Problems reported to Wouter (in ROOT savannah) and fixed: Thanks to all people involved in the validation and of course Wouter for fixing the bugs!
Newest RooFit (2.23) (1)

- By December 1 is available a new RooFit version V2.23, included with ROOT 5.17/06 (see ROOT web page for details)
  

- Many interesting developments

- Other bugs fixed in this new version:
  - Some of them are old bugs found in BaBar (in some case of 2002)
  - Multithread CP fits (very important for have faster fits)
    - Very interesting in multi-cores CPU era
  - Lei problem fixed
Newest RooFit (2.23) (2)

- I will update by the end of this week RooFit in BaBar for a new round of validation
- Deadline for a “stable” RooFit version is the next ROOT production release
  - next production release (will be version 5.18/00) is planned for December 12 (from ROOT site)
- Send all bugs found in time for this deadline
  - There are still a couple of minor issue, namely related to projection plots
  - Posted them in ROOT savannah
- We would like to have a stable RooFit version for the last round of BaBar analyses
RooFit How-to

- We have an HyperNews with a lot of posts concerning RooFit
  - Not easy to find informations
- Browsing posts in our ROOT HN (of last 2 years), I found a lot of important posts concerning some general topics
- I collected these posts in this web-page
  (I will copy this page in a RooFit web-page)
- I think that we (the RooFit coordinator) should keep update this page (useful as How-to)
  - Please send me an email if you think that I missed something in the list
RooFit How-to web-page

- No Parametric PDFs (KEYS, Binned, StepFunction):
  - RooKeysPdf from weighted dataset (Wed, 19 Sep 2007)
  - Boundaries on Roo2DKeysPdf (Thu, 19 Jul 2007)
  - Histogrammed PDFs (Wed, 30 May 2007)
- Blinding in RooFit:
  - Blinding in RooFit (Fri, 24 Aug 2007)
  - Blinding in RooFit (Tue, 19 Jun 2007)
  - Blinding in RooFit (Fri, 07 Apr 2006)
  - Blinding in RooFit (Fri, 27 Jan 2006)
- Binned and Unbinned fits:
  - Binned (RooChi2Var) and Unbinned fits (RooNLLVar) (Mon, 30 Jul 2007)
  - Setting specific errors in RooDataHist (Tue, 01 Aug 2006)
  - Simultaneous fit on several binned dataset (Tue, 19 Sep 2006)
- Per-event values (like per-event errors in TD fits or m_{ES} end point):
  - Fit with ConditionalObservable (Thu, 31 May 2007)
  - Projections with conditional observable (Wed, 05 Jul 2006)
  - Per-event endpoint frustration (Tue, 20 Mar 2007)
- Fitting a subrange:
  - Fitting a subrange in RooFit (Wed, 23 May 2007)
- Weighted dataset:
  - Data with weights (Thu, 28 Sep 2006)
  - Fit using event weights (Thu, 01 Jun 2006)
  - Combining weighted datasets (Mon, 24 Oct 2005)
BaBar RooFit web-page

- Last change: more than two years ago!
- A lot of works done in the meantime: NEED an update
  - I will update it after this meeting
RooFit workshop

- I don’t remember any previous workshop concerning RooFit
  - I think it is important to have the possibility to discuss out RooFit experiences, together with RooFit authors
  - NOTE that Wouter is not in BaBar anymore (Atlas Collaboration), so it is not suppose to read all our internal posts in HN
- So the idea of the workshop came out in September
  - Not a discussion for beginners users, but a more useful meeting to discuss our experience

Also Linked from the main BaBar home-page
RooFit workshop agenda

Many interesting topics in agenda:

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<tr>
<th>TIME</th>
<th>TITLE</th>
<th>SPEAKERS</th>
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<tbody>
<tr>
<td>14:00-14:10</td>
<td>Introduction to the Workshop</td>
<td>Alfio Lazzaro</td>
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<tr>
<td>14:10-14:30</td>
<td>RooFit Development and future plan (pdf)</td>
<td>Wouter Verkerke</td>
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<tr>
<td>14:30-14:50</td>
<td>RooFit Status in BaBar (pdf)</td>
<td>Alfio Lazzaro</td>
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<td>14:50-15:05</td>
<td>Conditional Observables in fits and projections (pdf)</td>
<td>Joe Tuggle</td>
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<td>15:05-15:20</td>
<td>Integration and Convolution in RooFit (pdf)</td>
<td>Jake Anderson</td>
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<td>15:20-15:35</td>
<td>Advanced Fitting tools: RooRarFit (pdf)</td>
<td>Lei Zhang</td>
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<td>15:35-15:50</td>
<td>Dalitz Plot Fitting with RooFit (pdf)</td>
<td>Joshua Thompson</td>
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<td>15:50-16:05</td>
<td>Towards a Simpler Interaction with RooFit (pdf)</td>
<td>David Kirkby</td>
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<td>16:05-16:20</td>
<td>Parallel Fit implementation (pdf)</td>
<td>Brian Meadows</td>
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<tr>
<td>16:20-</td>
<td>Discussion (pdf)</td>
<td>All</td>
</tr>
</tbody>
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Thanks to all speakers!
Other topics not in agenda

- Unfortunatelly I was able to find people to present some other topics:
  - Parametric/Non parametric PDFs
  - Blind/Unblind procedures
  - Integral calculations
  - Advanced RooFit graphics features
  - Minuit experiences: binned/unbinned fits
  - Status of the fits
- We can discuss these topics during the last discussion
Conclusion

- RooFit is the basis of many (almost all) BaBar analysis
- It is a very powerful package, which allows many techniques for data analysis
- We are working to update the RooFit version in BaBar
- Many thanks to all people involved in this validation
- And of course: Many thanks to Wouter and David to provide us this package!

Remind for BaBar users: there will be a school in February where you can find more details on RooFit for beginners