Monitoring the SD/FD Timing and HE/Co Relative Energy

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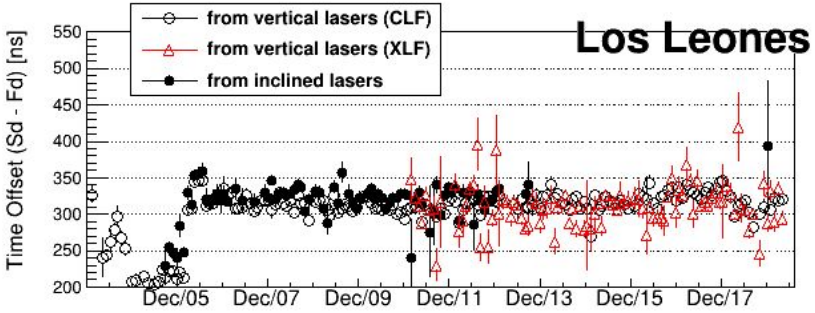
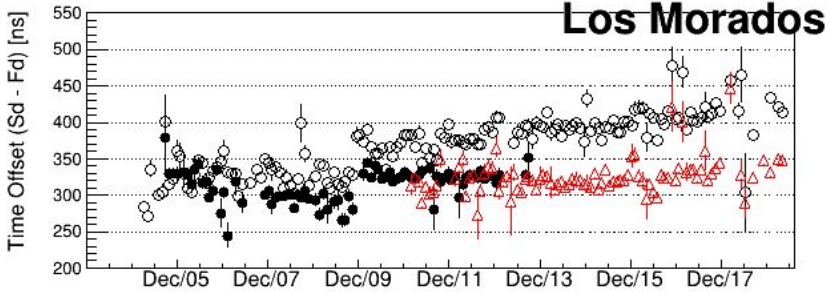
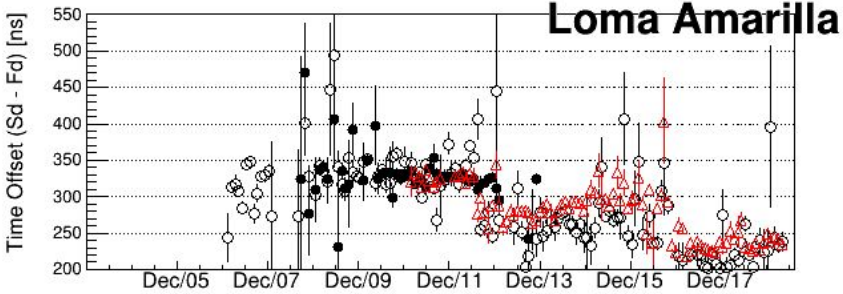
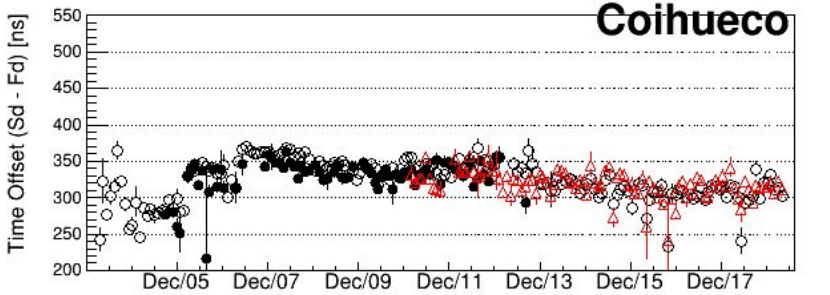
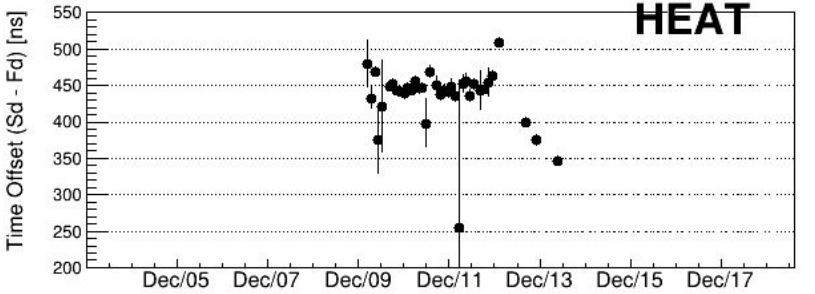
Draft for the Analysis meeting









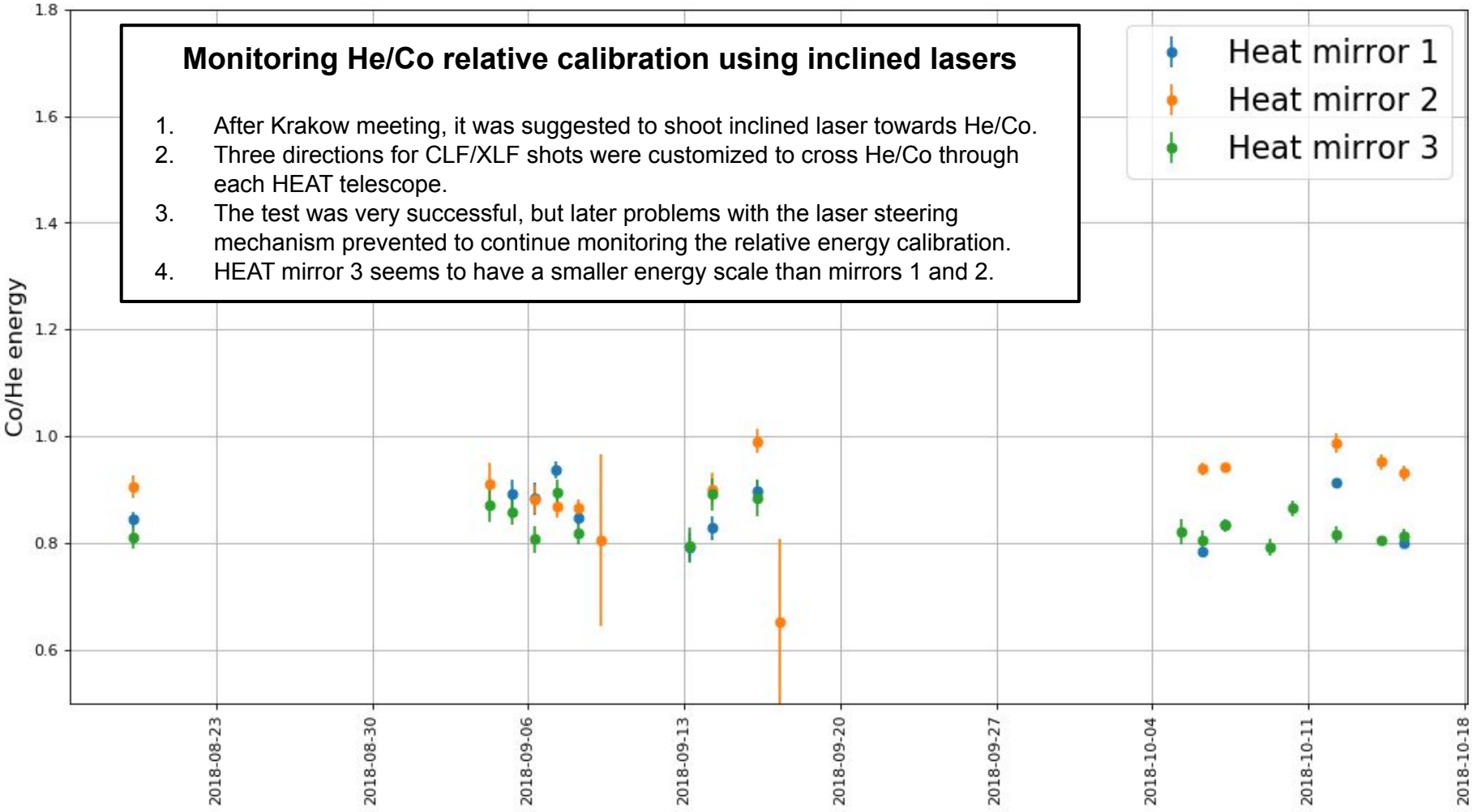


Monitoring the SD/FD synchronization

1. Only inclined lasers measurements are insensitive to possible small laser/telescope misalignments or laser energy changes.
2. In the past, lasers were firing towards AGNs and timing lasers were stopped. Currently, there are problems with the laser steering mechanism.

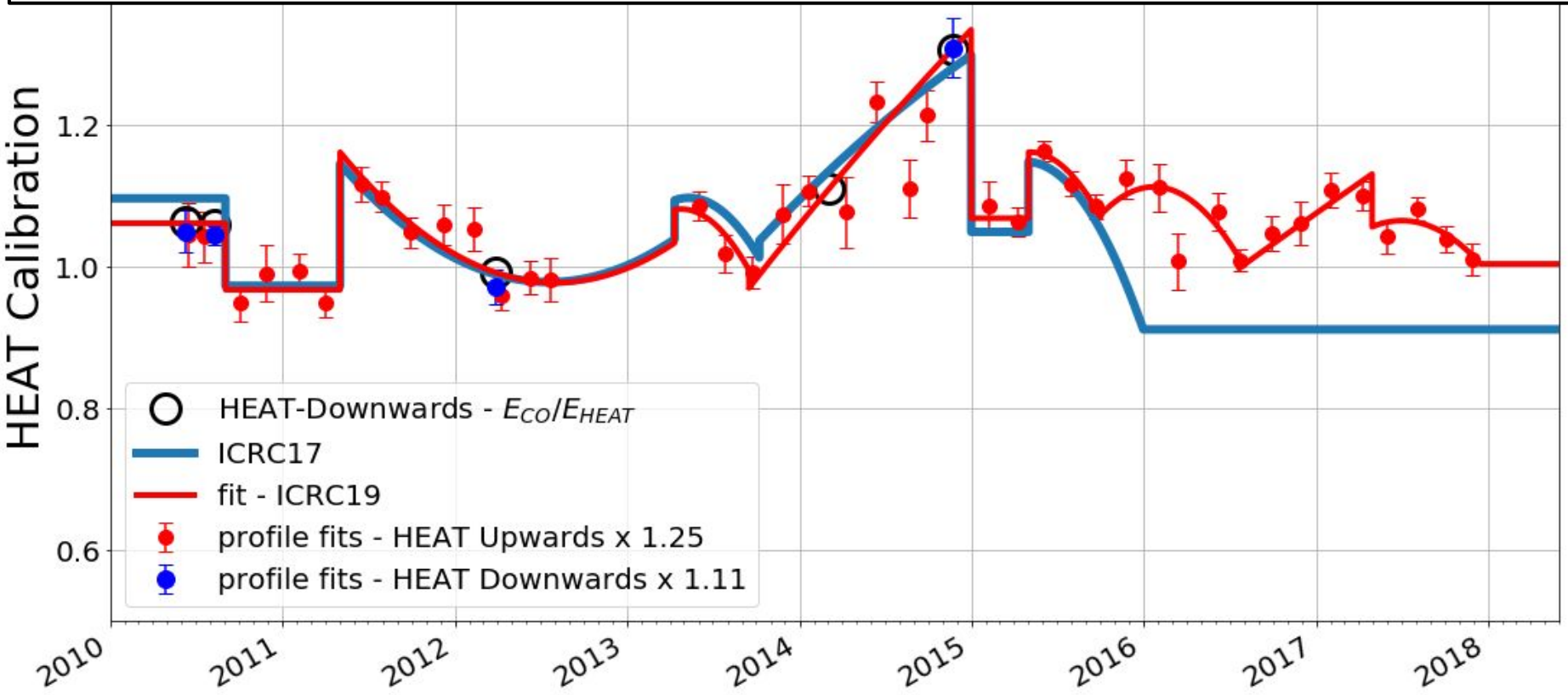
Monitoring He/Co relative calibration using inclined lasers

1. After Krakow meeting, it was suggested to shoot inclined laser towards He/Co.
2. Three directions for CLF/XLF shots were customized to cross He/Co through each HEAT telescope.
3. The test was very successful, but later problems with the laser steering mechanism prevented to continue monitoring the relative energy calibration.
4. HEAT mirror 3 seems to have a smaller energy scale than mirrors 1 and 2.



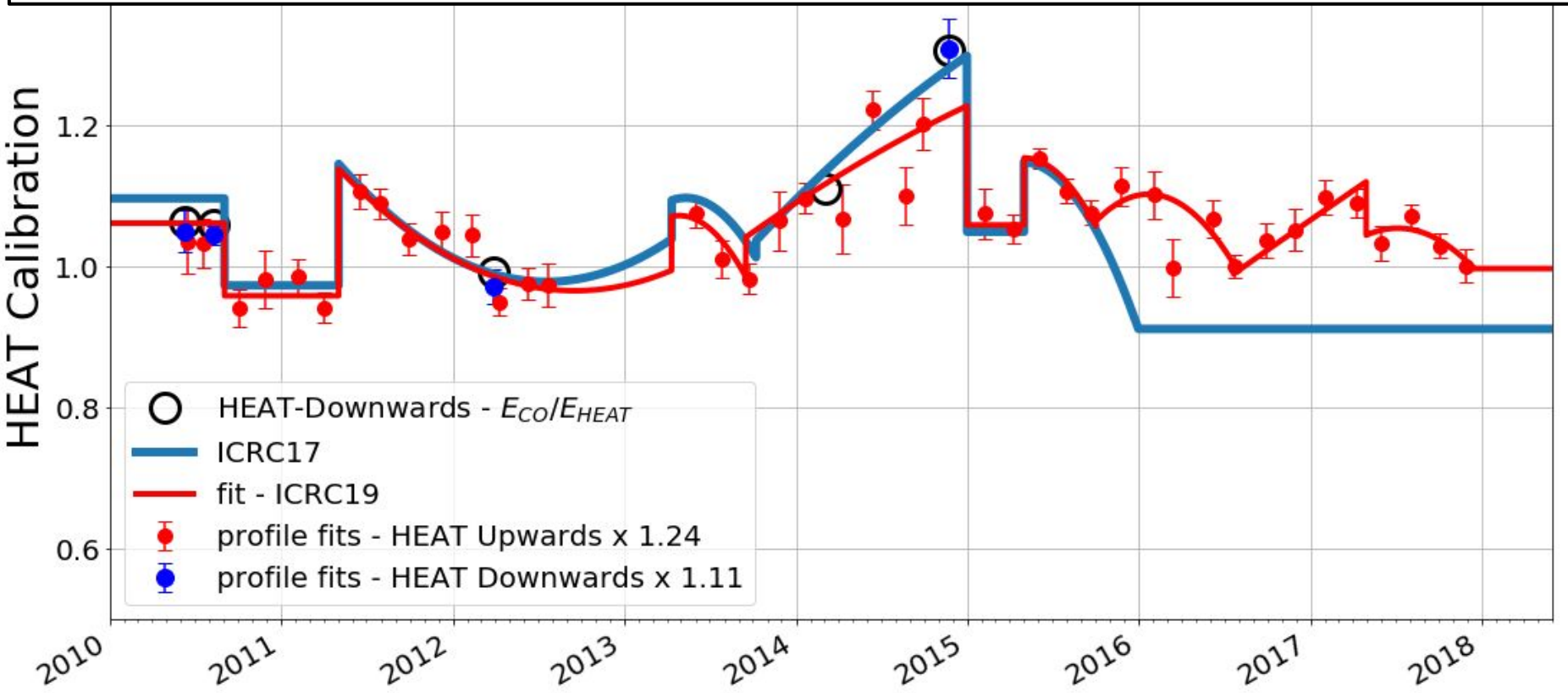
Monitoring He/Co relative calibration using real events

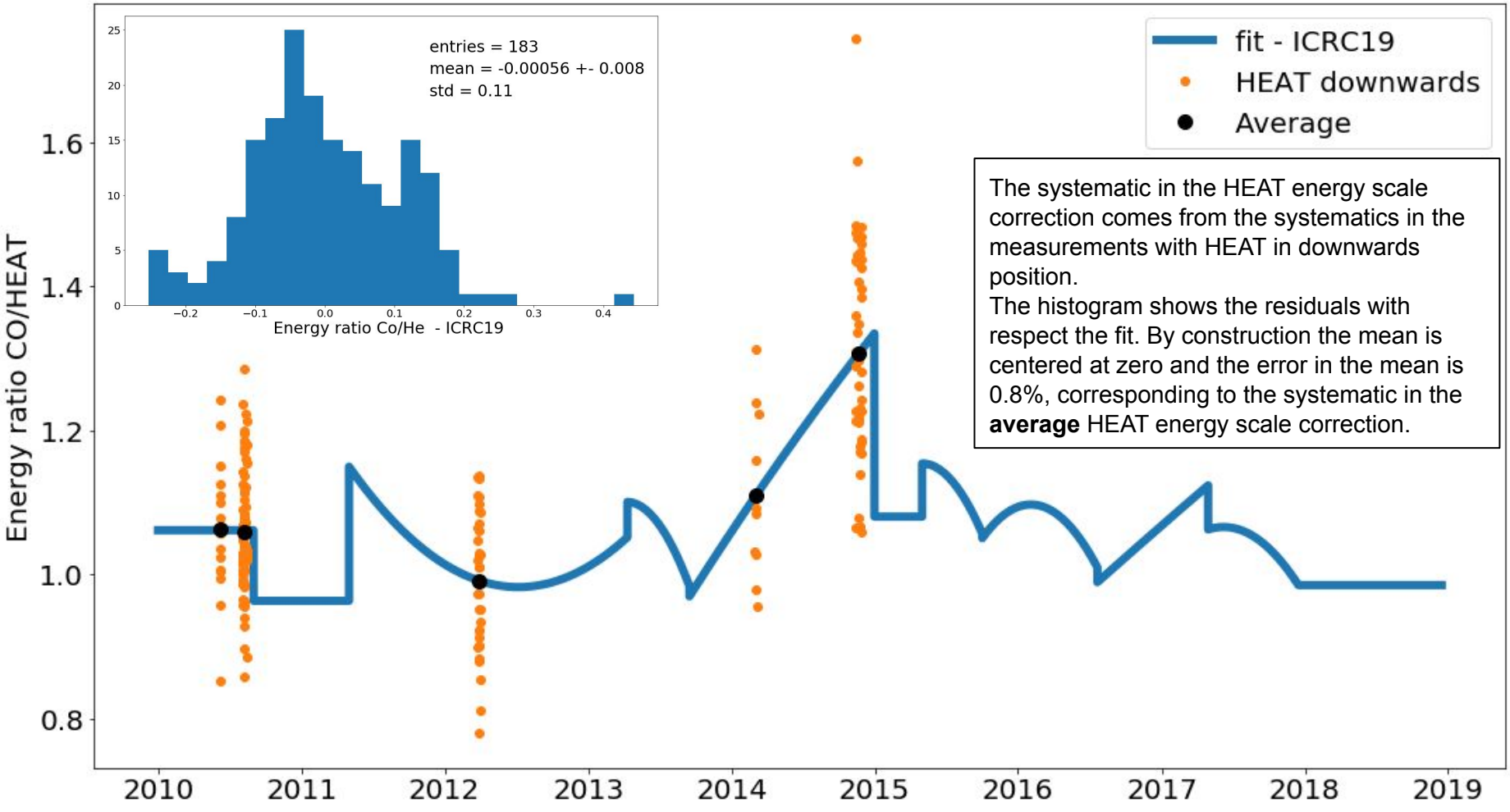
1. Events crossing HEAT and Coihueco field of view were selected.
2. When performing the G-H profile fit, a scaling factor multiplying HEAT data points is included in the fit.
3. The results were compared with direct measurements using HEAT in downwards position. They seem to be off by a constant factor.
4. The profile fit and the **HEAT in downwards** position results were used to fit the calibration function and the (1.25) scaling factor.



Monitoring He/Co relative calibration using real events

1. If using only the first two **HEAT in downwards** position results to fit the calibration function and the (1.24) scaling factor.




fit - ICRC19
HEAT downwards
Average
entries = 183
mean = -0.00056 +- 0.008
std = 0.11
Energy ratio Co/He - ICRC19
Energy ratio CO/HEAT
0.8
1.0
1.2
1.4
1.6
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
The systematic in the HEAT energy scale correction comes from the systematics in the measurements with HEAT in downwards position.
The histogram shows the residuals with respect the fit. By construction the mean is centered at zero and the error in the mean is 0.8%, corresponding to the systematic in the **average** HEAT energy scale correction.