Report on BCM calibration for Nov 13 2002 run

On Nov 13, 2002 a series of measurements were done to calibrate the beam current monitors. First there was a calibration of the 0L02 cavity versus the Faraday cup with no beam in the hall. EPICS data was written to the file */usr/opdata/bcm_hallA/BcmLog_72*. In table 1, the average value for each step is listed along with the ratio. The Faraday cup reading is about 1% higher than the OL02 cavity.

Faraday Cup current	OL02 cavity current	Faraday/OL02
98.18980	97.37840	1.00833
49.93210	49.54000	1.00791
19.93440	19.79420	1.00708
9.97302	9.91749	1.00560
5.04652	5.02274	1.00473
4.69569	4.68421	1.00245
1.52754	1.67706	0.91084
0.71129	0.61671	1.15337

Table 1: Average values for the Faraday cup and OL02 injector cavity

Then there was a scan with beam into the hall. EPICS data was written to the file */usr/opdata/bcm_hallA/BcmLog_73* and the scalar data is in the file *e01020_3147.dat.0*. The basic technique is to normalize the cavities to the OLO2 cavity at the injector. During the measurements beam only went to Hall A. The beam was interrupted by inserting a Faraday cup after the OLO2 cavity so that the zeroes for the cavities and the Unser could be determined. The procedure was to set the beam current at one setting for one minute and then insert the Faraday cup for one minute and then step down to the next current. This is demonstrated in Fig. 1 in which the current measured by the Unser is plotted as a function of time.

First, an explanation of how the EPICS BCM calibration constants were determined. While the beam was being stepped through various currents the EPICS values for the upstream BCM voltage, downstream BCM voltage,Unser current, injector Faraday cup current, OLO2 current are written to once a second to a file. One can determine the zeros for the cavities and Unser from the beam off periods when the Faraday cup was inserted. The EPICS calibration constants were then

$$\text{Constant} = (\text{Ave current in OLO2})/(\text{Ave volt in cavity} - \text{zero\_offset}) \qquad (1)$$

The ratio of the Unser current to the OLO2 is plotted in Fig. 2 and the average value was . Also in Fig. 2 the ratios of the OLO2 current to the downstream and upstream as a function of OLO2 current. The average values are given in Table tab:econ with comparision to values obtained in Oct 2000. The calibration constants have been stable.

Constant	Nov 13 2002	Oct 2000	% Change
EPICS Downstream cavity constant	79.66 ± 0.2	78.84 ± 0.26	+1.0 %
EPICS Upstream cavity constant	77.37 ± 0.2	76.85 ± 0.25	+0.7 %

Table 2: EPICS BCM calibration constants which are the ratio of output voltage for the cavity to the OLO2 current.

OL02 current	Unser/OL02
98.25750	0.99195± 0.00455
98.70130	0.99889± 0.00433
80.04980	1.00543± 0.00402
49.84880	0.99059± 0.00672
19.89740	1.01202± 0.02157
9.94715	0.95643± 0.03490
5.00659	1.01466± 0.51786
4.41659	1.01775± 0.09185
2.13257	1.02195± 0.18268

Table 3: Comparison of Unser and OL02

The calibration constants for converting the V-to-F scalers to charge were determined. During the data taking, the scalers were written to a regular data file.. The scalers were extracted from the data file using the program *read_scalar*. Then a paw kumac, *bcm_calib.kumac*, was used to determine to constants. The scaler data was broken into a time intervals and the average value of the V-to-F rate was determined for the interval. The zero offsets for the V-to-F rate was determined for the following time interval. The calibration constants are plotted versus OLO2 current in Fig. 3. The weighted average of the V-to-F calibration constants are given in Table 4 compared to those in use for the end-of-run script which are from Jan 2001. The formula for using the constants is

$$\text{Ave current} = \frac{\frac{\text{Scalar}}{\text{time}} - \text{offset}}{\text{constant}} \tag{2}$$

The useful range for the 10x is to about 35μA with the downstream cavity saturating earlier. For the 1x , there is a hint that it shouldn't be used below 10μA but more low current points would be needed.

Constant	Nov 2002	May 2002	% Diff
V-to-F U1x	1333.3 ± 0.3	1330.4 ± 0.7	+0.22 %
V-to-F U3x	4101.6 ± 0.9	4092.4 ± 2.0	+0.22 %
V-to-F U10x	12474.3 ± 2.9	12446.6 ± 7.8	+0.22 %
V-to-F D1x	1345.1 ± 0.3	1352.7 ± 0.7	-0.56 %
V-to-F D3x	4165.65 ± 0.9	4188.5 ± 2.1	-0.55 %
V-to-F D10x	13122.2 ± 3.7	13190.3 ±10.2	-0.52 %

Table 4: The V-to-F calibration constants .% Diff is (value in Nov - May)/(value in Nov). The 10x are average over 0 to 40 μA .

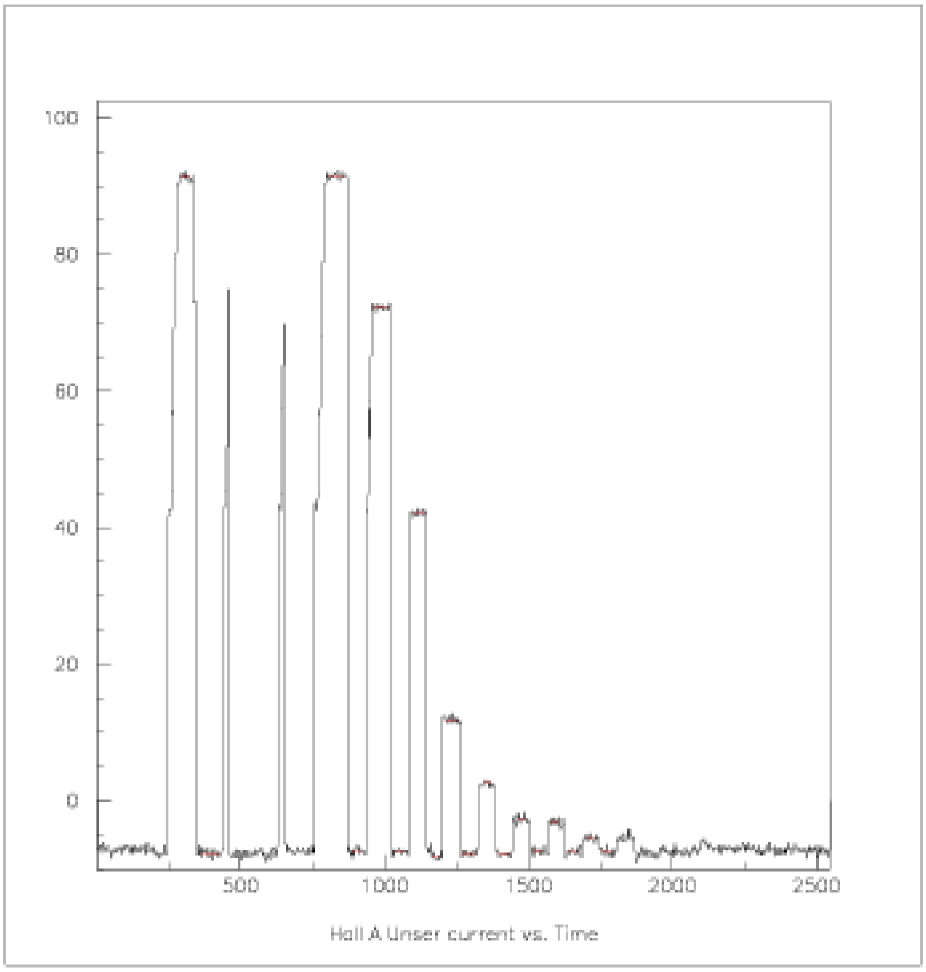
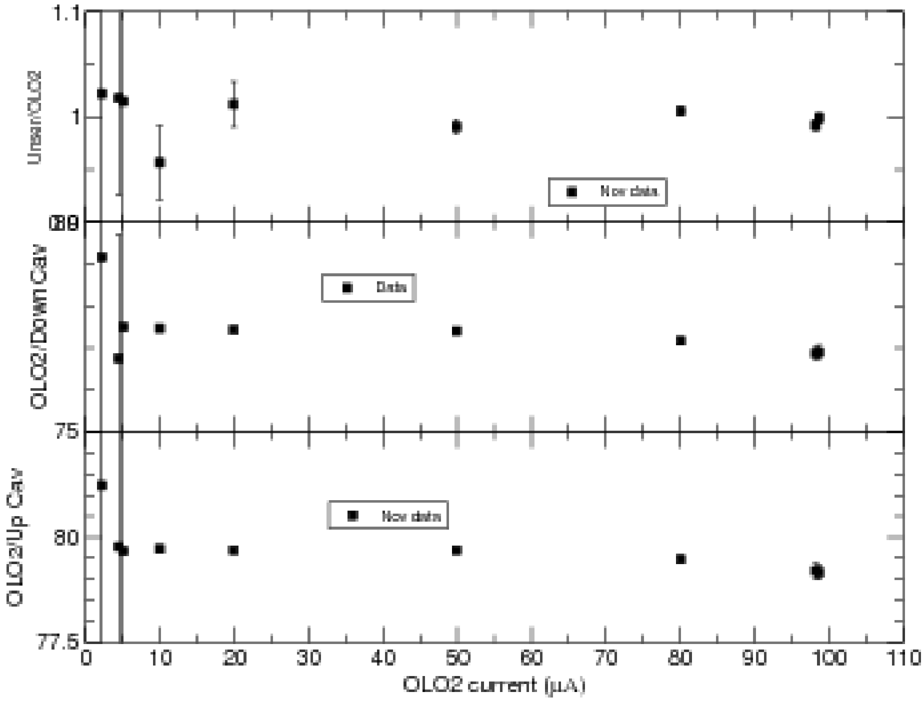


Figure 1:



Unser/OLO2
OLO2/Down Cav
OLO2/Up Cav
OLO2 current (μA)
Nov data
Data
Nov data

Figure 2:

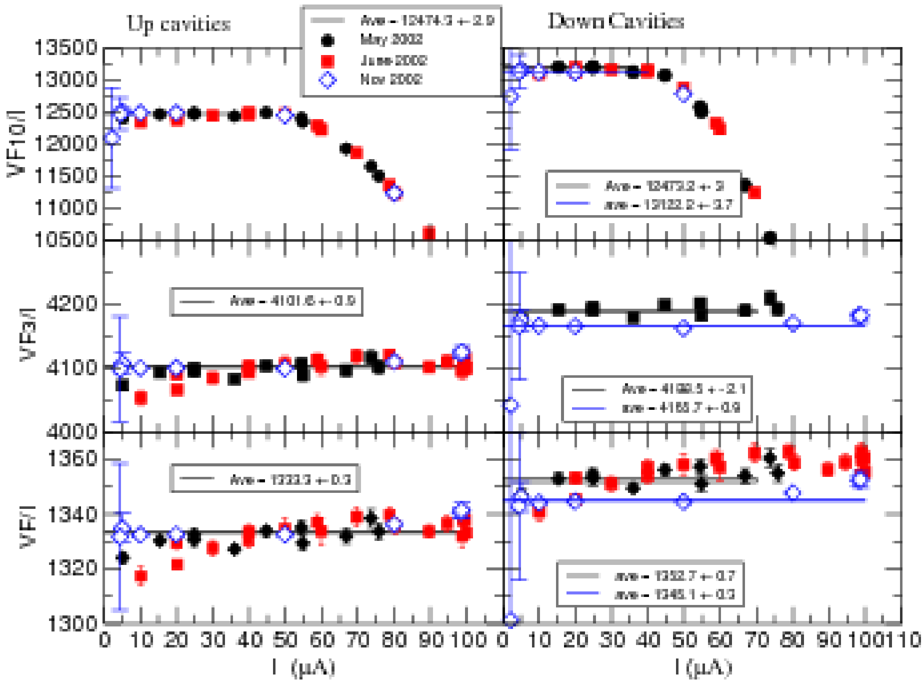


Figure 3: Upstream cavity data in left plots and downstream cavity data in right plots.