2018 VdM Analysis

Lumi-PAG Meeting, Apr. 29, Chong Kim

- **Outline**
  - Recap
    a. Able to extract XS (visible cross-section) values

       tested with Fill 6864 (2018) and various options such as intensity type

    b. Able to study systematic error

       b-1. Items tested: scan direction, intensity type, rate type, and fit model

       b-2. Item not tested: separation points determination (received ODC separation file from Martino)
  - In this report
    a. Conditions

    b. 2018 XS xcheck

       b-1. Pileup correction factors: wrong values were applied so far, negligible

       b-2. Fit model dependency: NOT negligible

    c. XS values for 2016, 2017, and 2018

       * Bad bunches issue in 2017

Conditions

- **Conditions**
  - Input files from Kralik's repository
  - Default options used in this report:

    Nominal (separation) + FBCT (intensity) + V0 (rate) + GP6 (fit model)
  - Pileup correction factors (RatioA/RatioC):

    a. 2016 (Fill 4937)

    a-1. V0: 0.0755 ± 0.0002 / 0.0611 ± 0.0002

    a-2. T0: 0.4459 ± 0.0008 / 0.3911 ± 0.0007

    b. 2017 (Fill 6012)

    b-1. V0: 0.0755 ± 0.0002 / 0.0611 ± 0.0002

    b-2. T0: 0.4459 ± 0.0008 / 0.3911 ± 0.0007

    c. 2018 (Fill 6864)

    c-1. V0: 0.07703 ± 0.00004 / 0.06216 ± 0.00004 (* Values used in last report: 0.07684 / 0.06193)

    c-2. T0: 0.4990 ± 0.0002 / 0.3933 ± 0.0002 (* Values used in last report: 0.49 / 0.49)
  - Bad bunches:

    only for 2016, 8 of 20 bunches (942, 1022, 1142, 1655, 1695, 1735, 1953, and 2033)

Cross sections summary

- 2018 results crosscheck, Nominal + FBCT + V0 are common

Pileup factor	Fit model (index)	Scan 0	Scan 1	Plot
Old (last report)	GP2 (0)	56.1710 ± 0.0370	56.5432 ± 0.0362	Link
	GP6 (1)	55.6076 ± 0.0403	56.0476 ± 0.0398	Link
New	GP2 (0)	56.1600 ± 0.0379	56.5425 ± 0.0362	Link
	GP6 (1)	55.6069 ± 0.0404	56.0476 ± 0.0399	Link
	G (2)	56.1695 ± 0.0361	56.5373 ± 0.0355	Link
	DG (4)	~~56.1712 ± 0.0710~~ (* multiple fit failure)	~~57.0244 ± 0.0719~~ (* multiple fit failure)	Link

- No dramatic effects by pileup factors
- Notable fluctuation by fit model
  a. Result by GP6 looks outlying compared to GP2 or G, but its χ^2/NDF is in general better
  b. The "slope" in XS vs. bunches looks originated by the GP2 (next page)
  c. Numerical integration (index 3) wasn't tested - should I?
  d. Many fit failed cases in DG

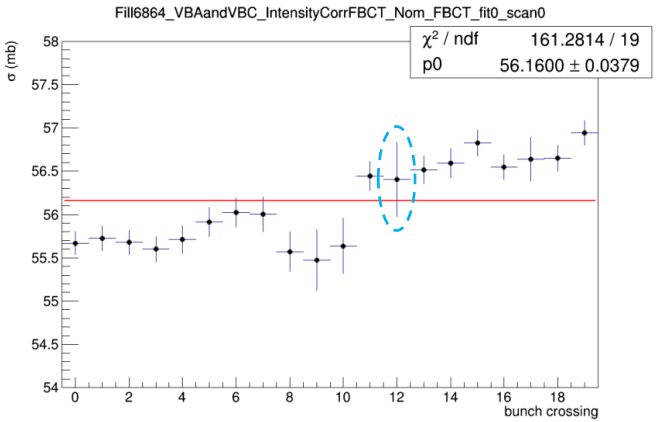
- XS for 2016 and 2017, Nominal + FBCT + V0 + GP6 are common

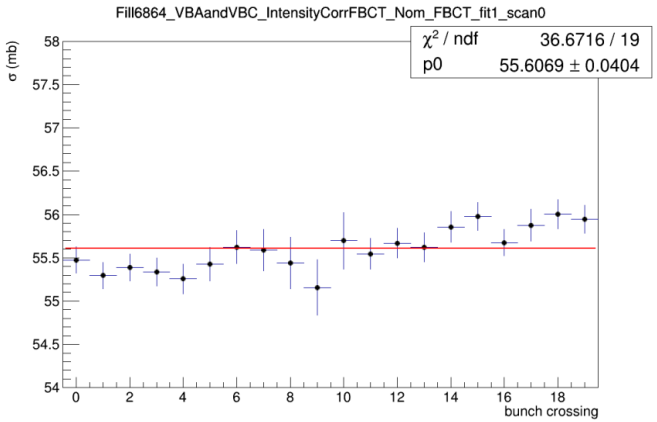
Year	Scan 0	Scan 1	Plot
2016	56.2541 ± 0.0443	55.9505 ± 0.0462	Link
2017 (w/ QA)	55.6381 ± 0.0612	55.6417 ± 0.0676	Link
2017 (w/o QA)	~~55.4410 ± 0.0510~~ (* bad bunches)	~~53.0966 ± 0.0557~~ (* bad bunches)	Link

- 2016: no special issue
- 2017: bad bunches (8 of 20)
  a. Prepared a routine for bad bunches QA
  b. I'm not sure "in which process" the QA should be applied (following page)

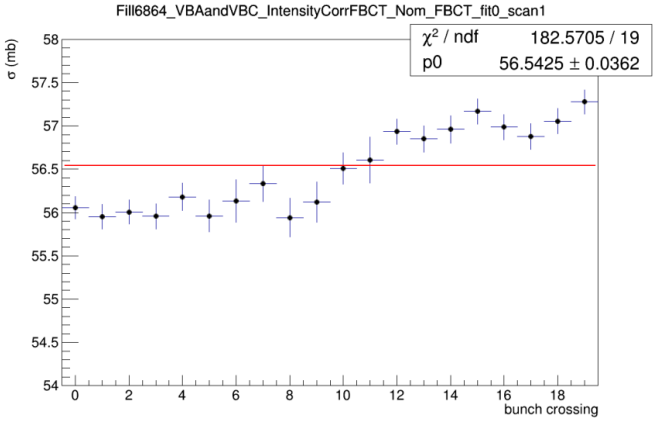
Fit model dependence

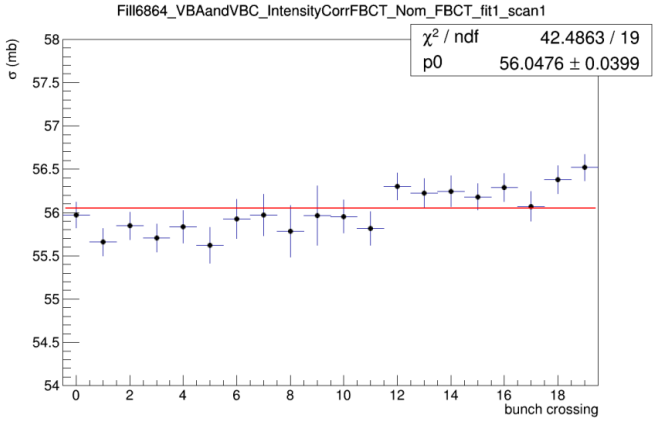
2018, XS vs. bunch, GP2 vs. GP6





Scan 0





Scan 1

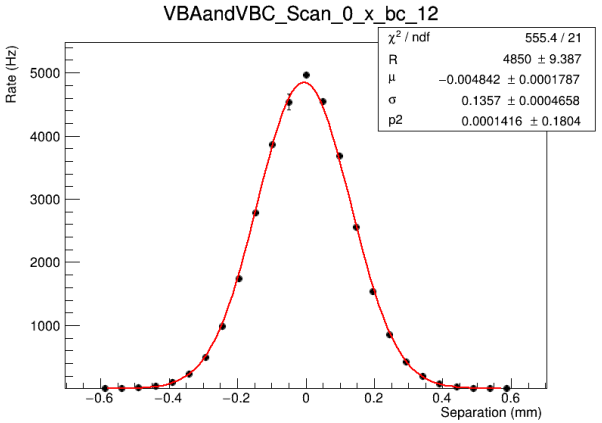
GP2

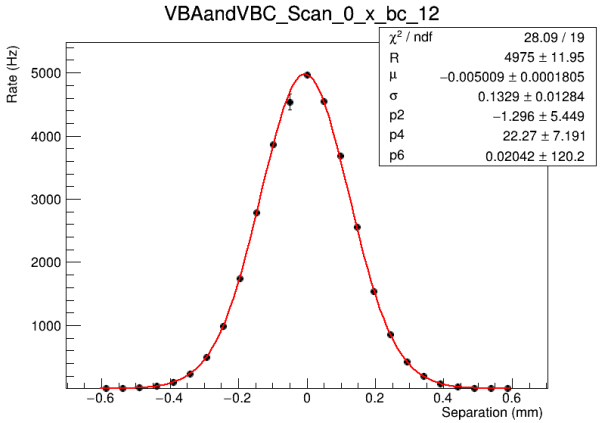
GP6

- The XS values by GP2 look more fluctuating, especially for bunches i > 10
- The slope like structure in GP2 is much degraded in GP6

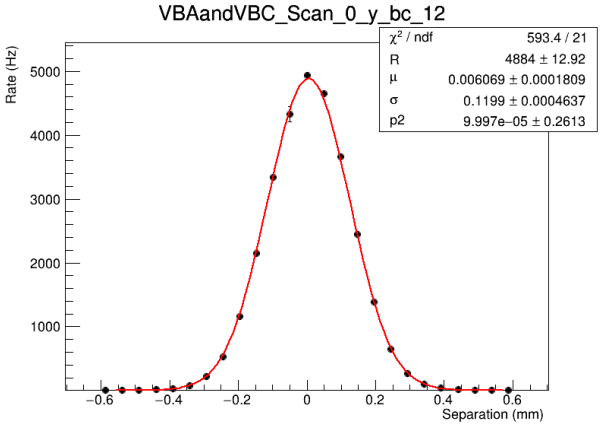
Fit model dependence

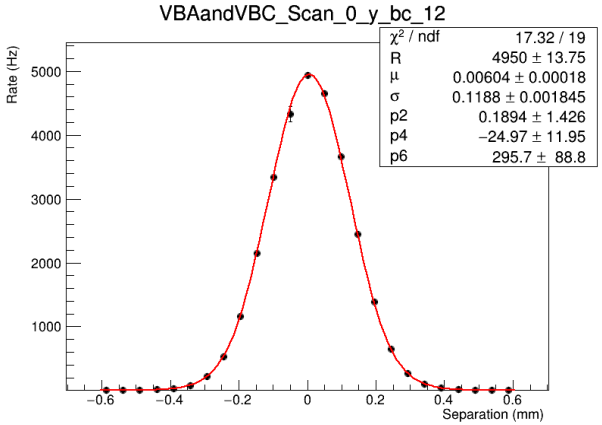
2018, Fit on bunch crossing 12, GP2 vs. GP6





Scan 0, x





Scan 0, y

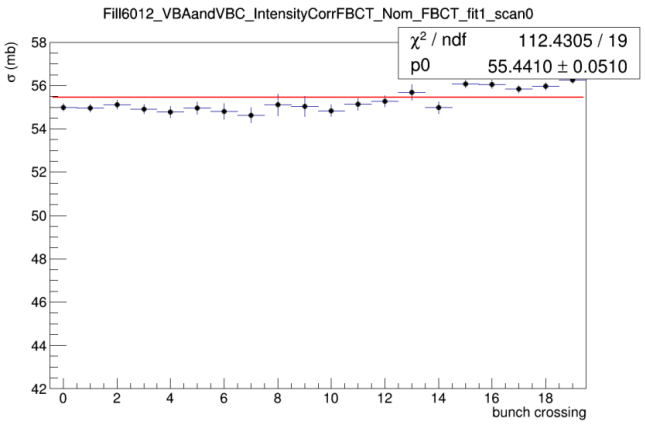
GP2

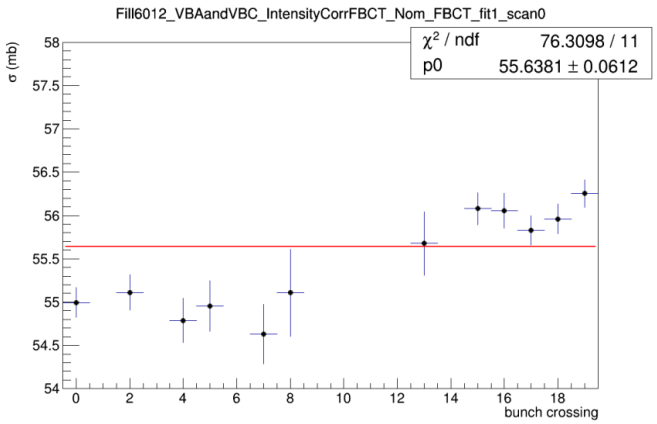
GP6

- XS vs. bunches in the previous report looks similar for GP2 and G – then the problematic one can be GP6
- But χ2/NDF by GP6 is, in general, better (~20 / ~20) than the one by GP2 (a few hundred / ~20)
- Perhaps it'd be better to have a routine that checks fit quality by using χ2/NDF

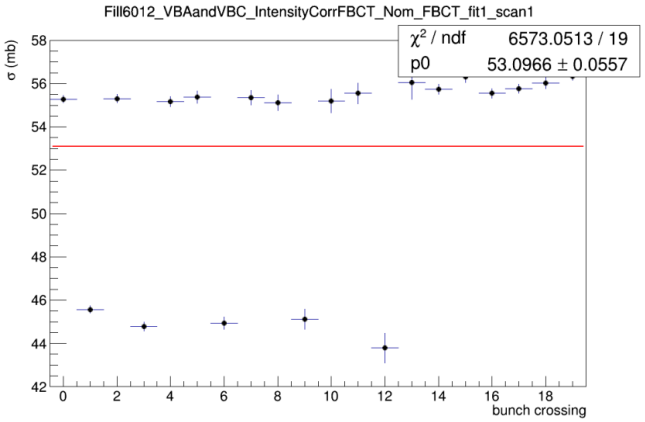
Bad bunches QA

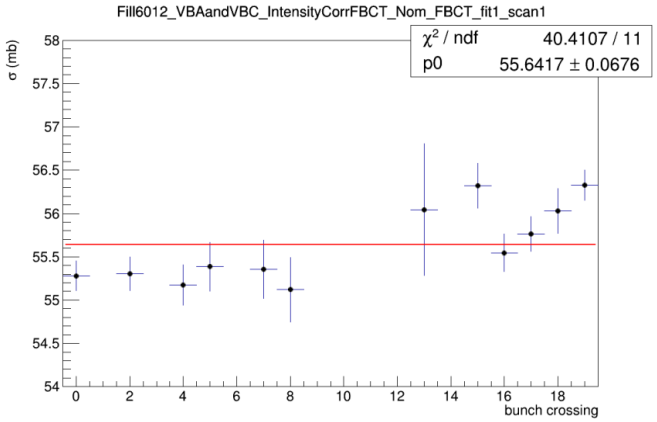
2017 results, w/o or w/ QA





Scan 0





Scan 1

w/o QA

w/ QA

- Prepared a container and a function check bad marked bunches (next page)
- For now, I simply dropped bad bunches at the final level (when drawing this very figure)

Bad bunches QA QA routine

- **Preparing and Applying bad bunches QA**
  - Prepared a QA routine
    a. Following objects added under *GlobalVariables.h*
      a-1. *FillToI* / *IToFill* : converts fill number to index and vice versa
      a-2. *bcBlacklists*: container for bad bunches, separated by Fill number
    b. Following functions added under *vdmUtilities.h*
      b-1. *SetBCBlacklists*: set the blacklist of bunches, fill by fill separated
      b-2. *OnBCBlacklists(Fill, bcID)* : checks if the given bcID exists in the blacklist and returns true/false
  - Applying QA functions
    a. The functions can be invoked in any part of the analysis: separation, intensity, rate…
    b. Question is, “from when” or “in which process” I should apply these bad bunches QA?
      b-1. Each analysis process (ex. Intensity) is tangled with the other
      b-2. If I exclude bad bunches in an early process, they must be excluded in the following processes, too – otherwise, the entire analysis chain screws up
      b-3. For some process applying QA itself isn’t that simple
      (ex. Create_beam__normalisation_tree.C : gets DCCT currents from already prepared TH1)

Backup Input files used

- **Input files used** (* https://home.saske.sk/~kralik/VdM/VdM-allin1file)
  - 2016 (Fill 4937)

    a-1. vdm_time_4937_6m11_12p17_1_v3.root

    a-2. vdm_DDL2_4937-6m11_12p17_1_v3.root

    a-3. vdm_time_4937_6m11_12p17_1_v3-BPTX.root
  - 2017 (Fill 6012)

    b-1. vdm_time_6012_6m11_12p17_1_v3.root

    b-2. vdm_DDL2_6012-6m11_12p17_1_v3.root

    b-3. vdm_time_6012_6m11_12p17_1_v3-BPTX.root
  - 2018 (Fill 6864, same to the last report)

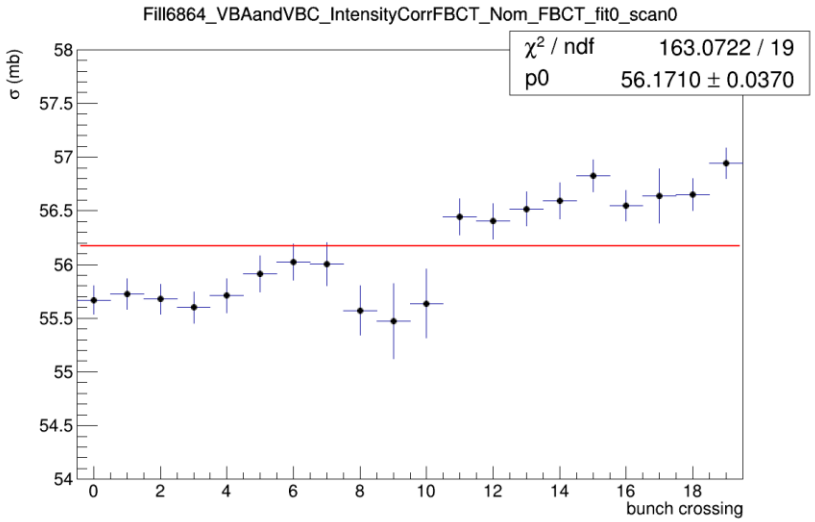
    c-1. vdm_time_6864_5m11.5_11p17.5_1_v3.root

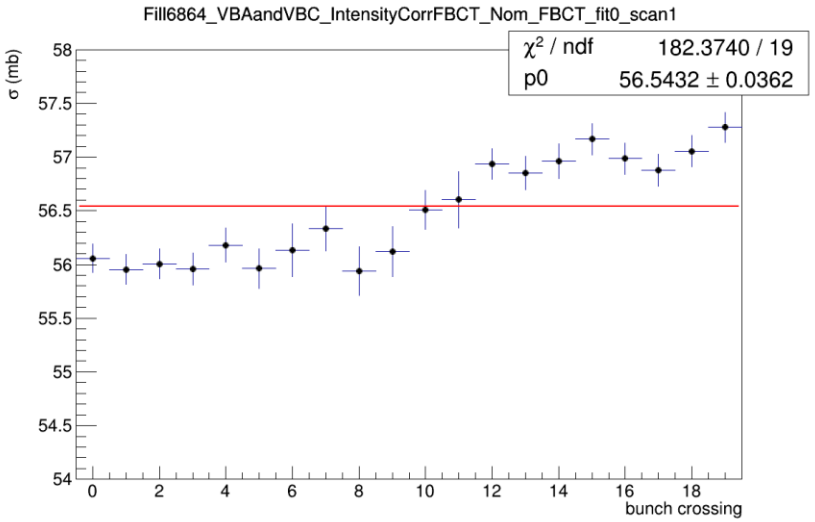
    c-2. vdm_DDL2_6864-5m11.5.root

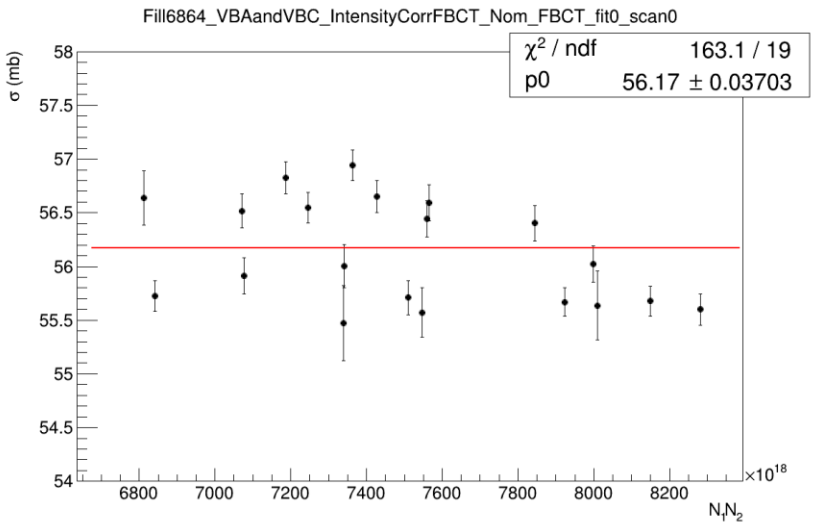
    c-3. vdm_time_6864_5m11.5_11p17.5_1_v3-BPTX.root

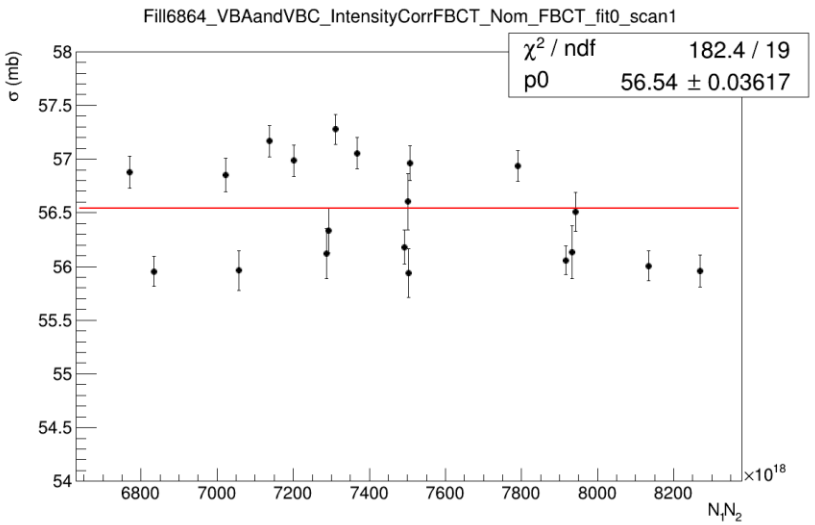
Backup

2018 results, Old pileup factor, GP2



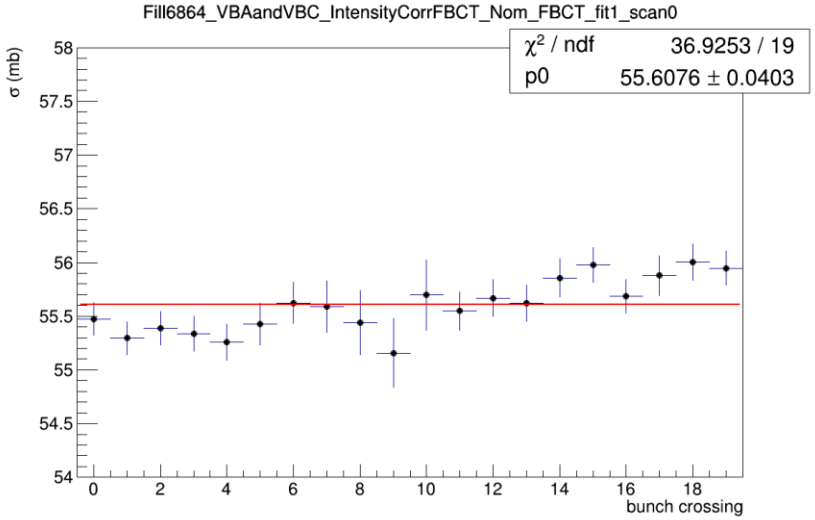


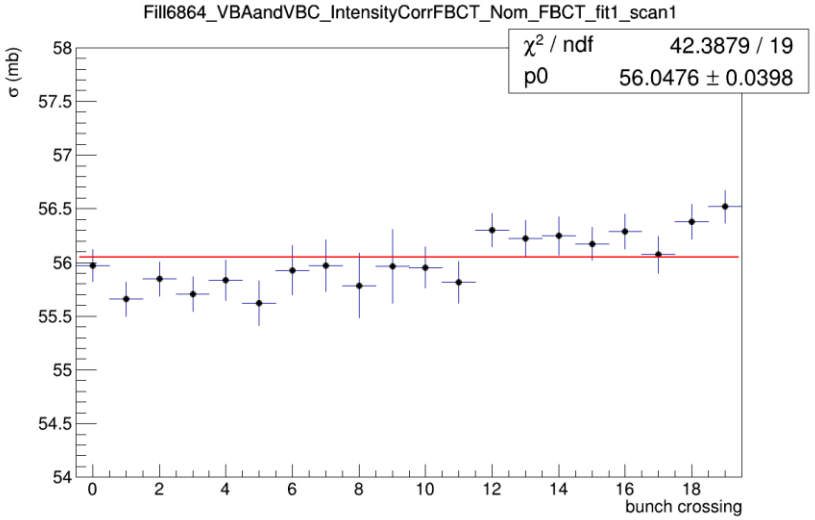


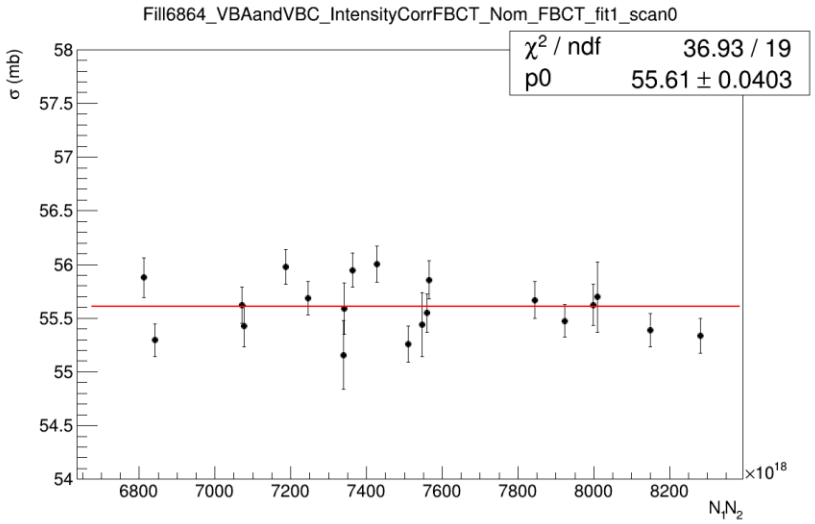


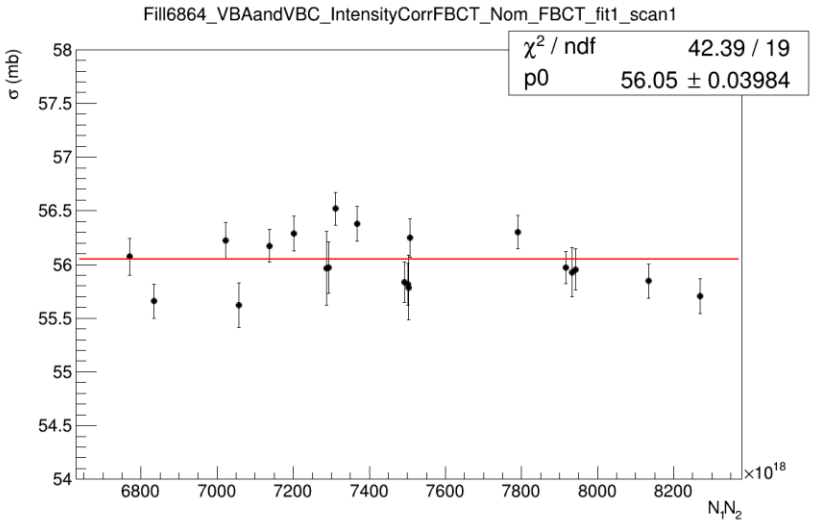
Backup

2018 results, Old pileup factor, GP6



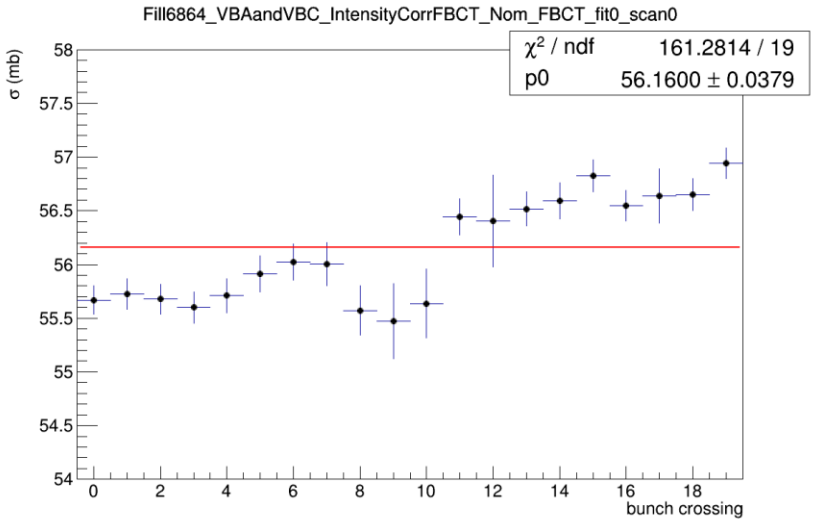


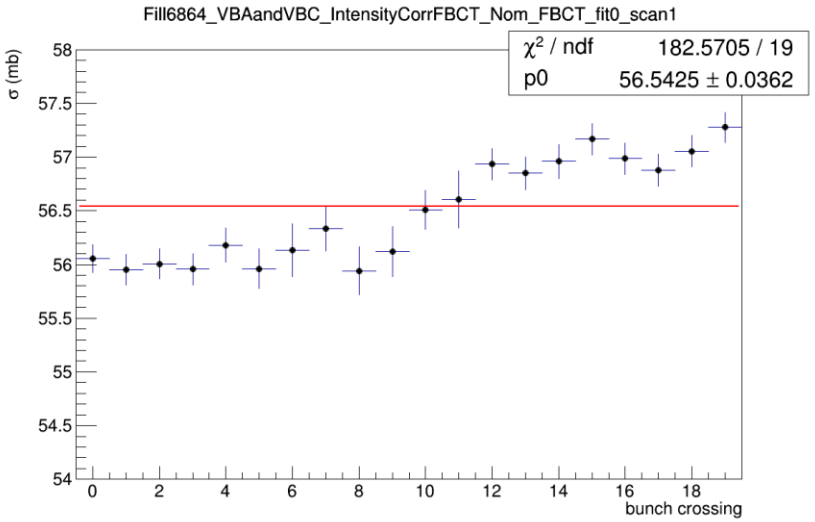


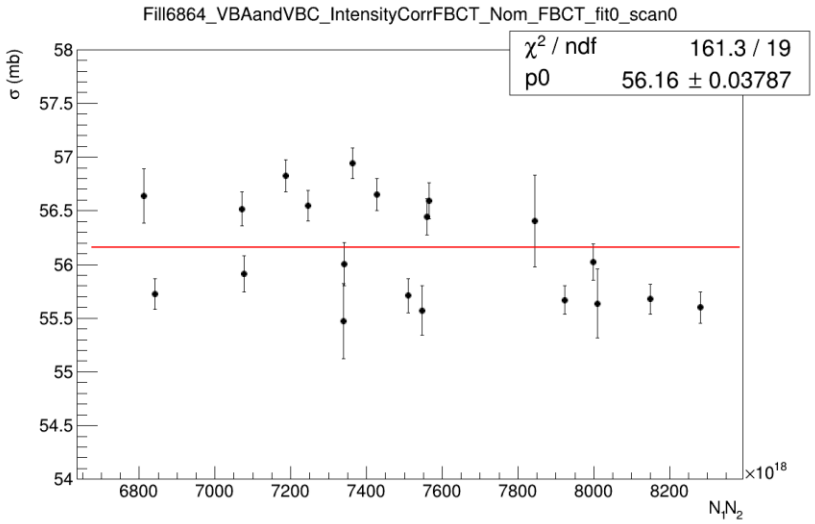


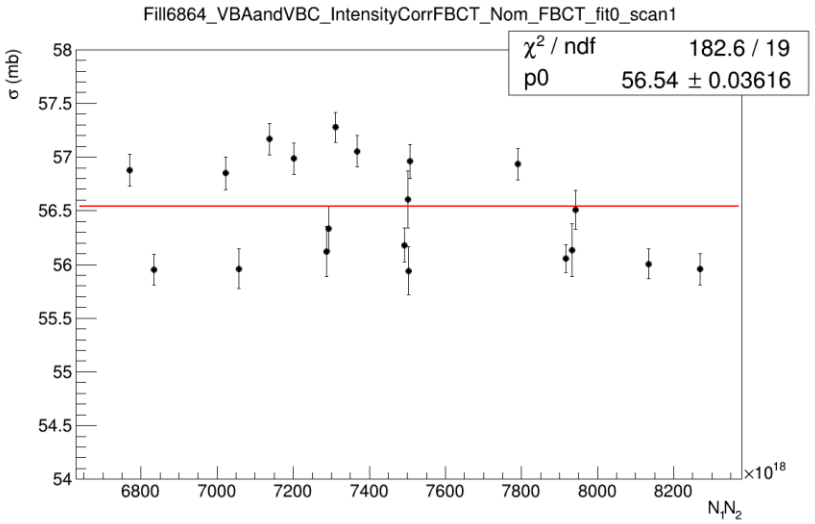
Backup

2018 results, Updated pileup factor, GP2



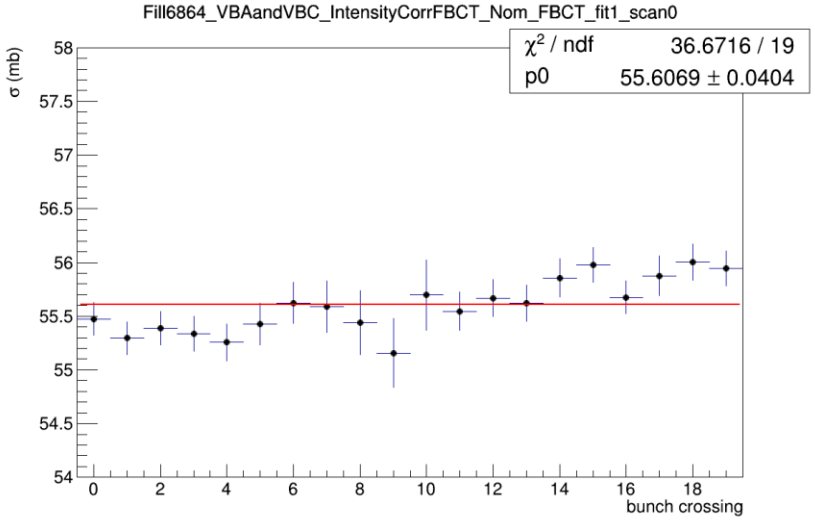


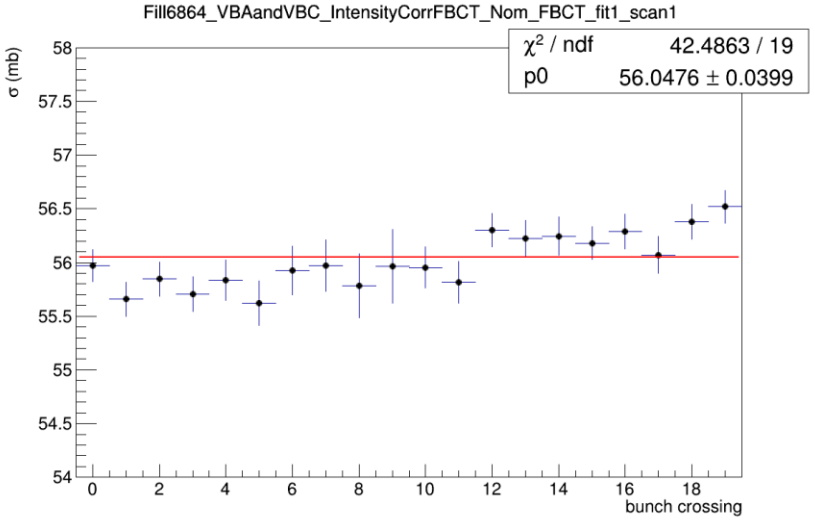


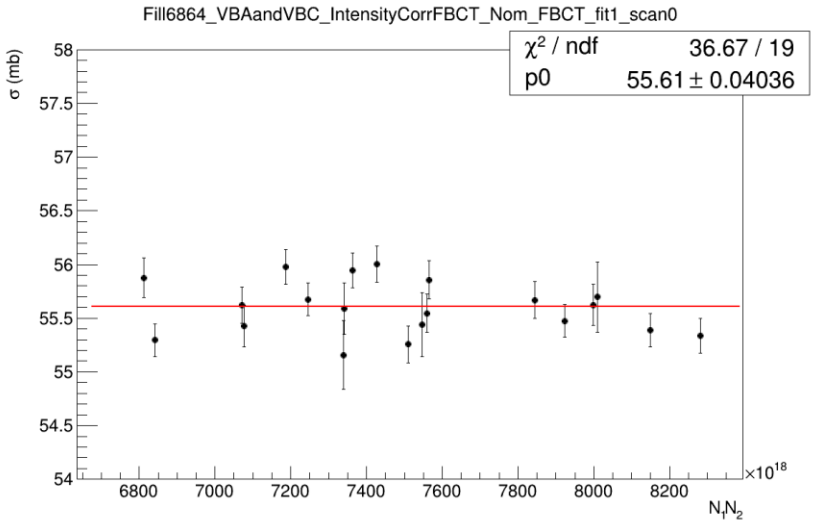


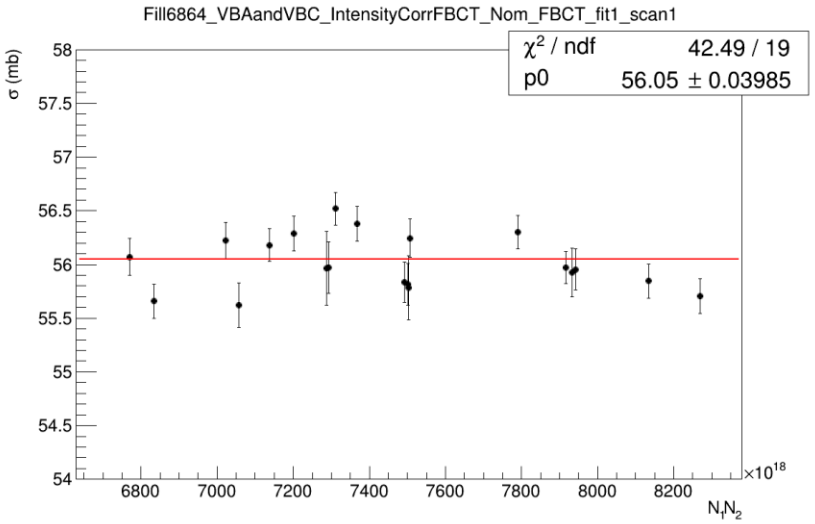
Backup

2018 results, Updated pileup factor, GP6



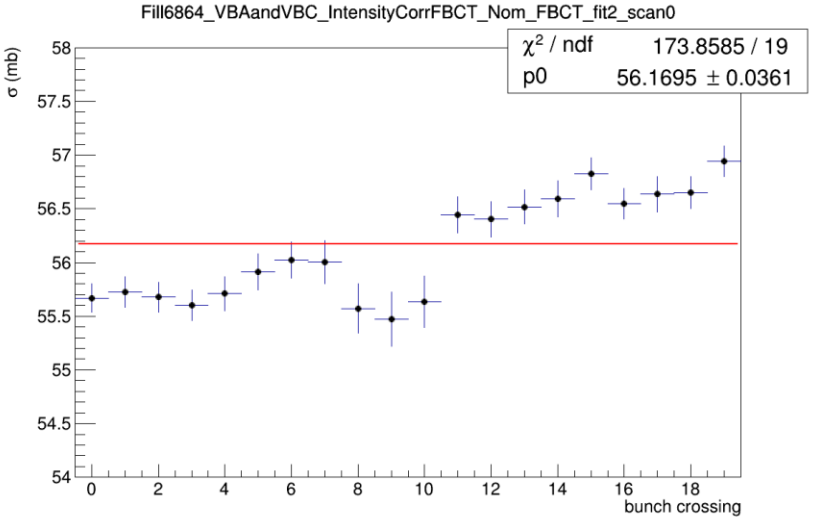


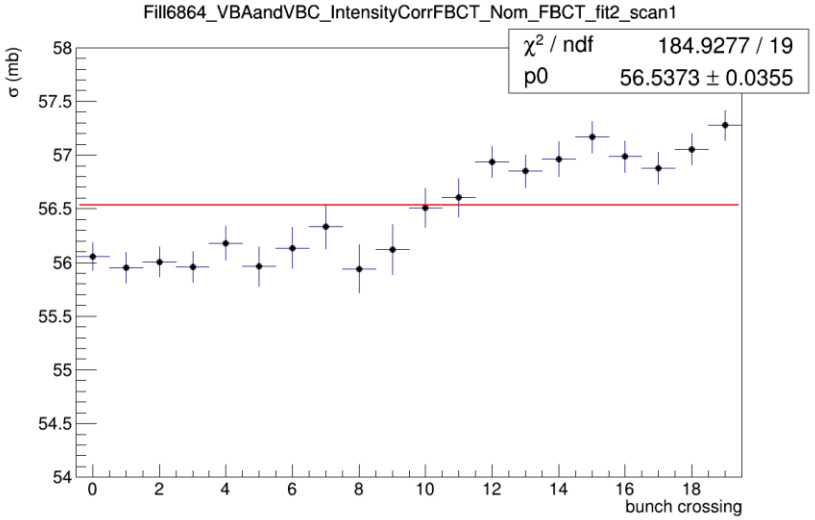


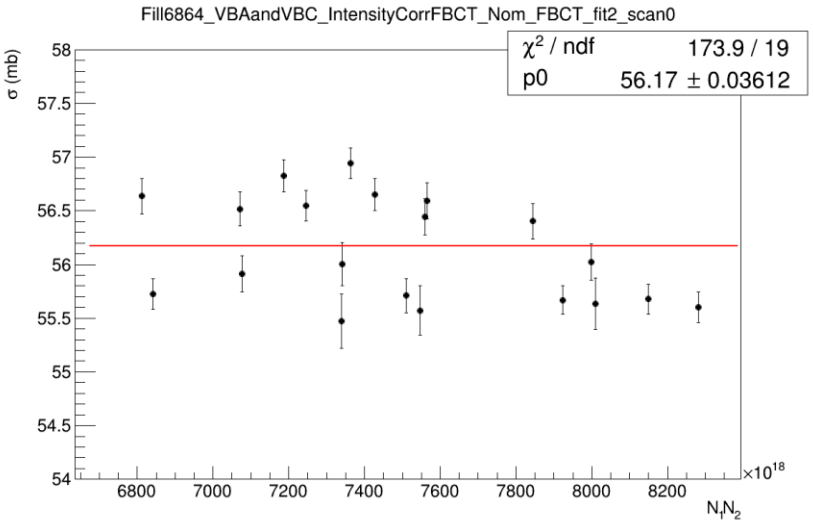


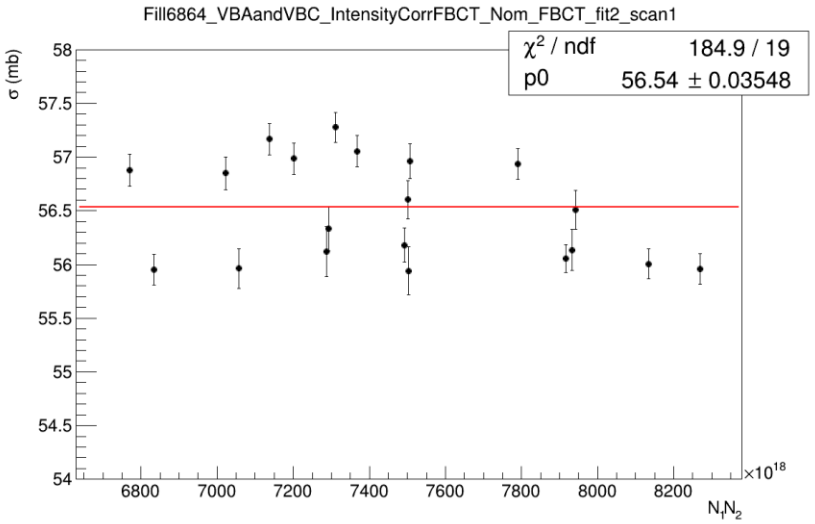
Backup

2018 results, Updated pileup factor, G



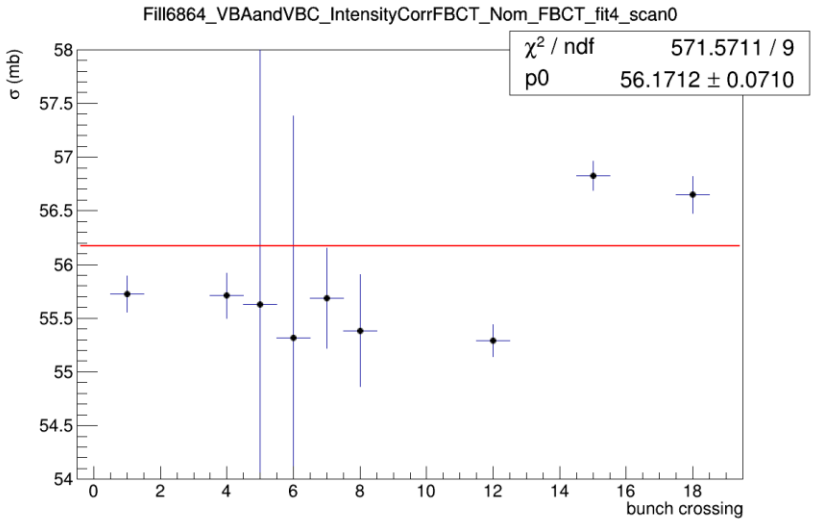


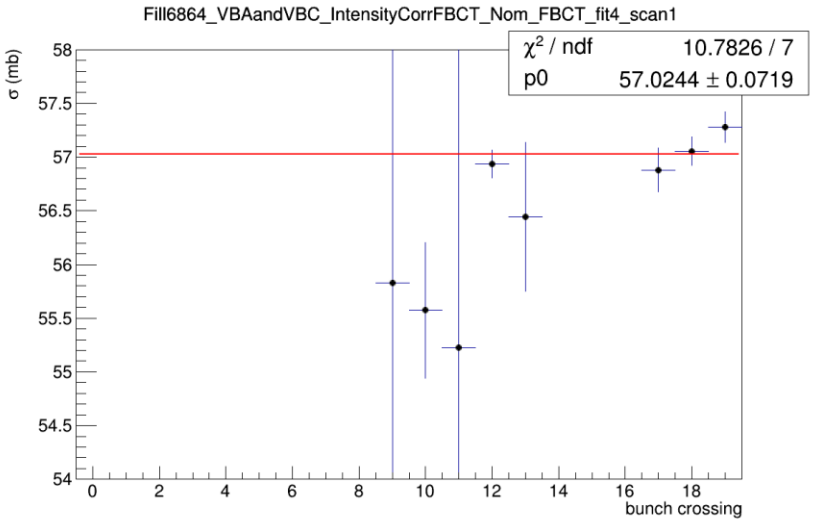


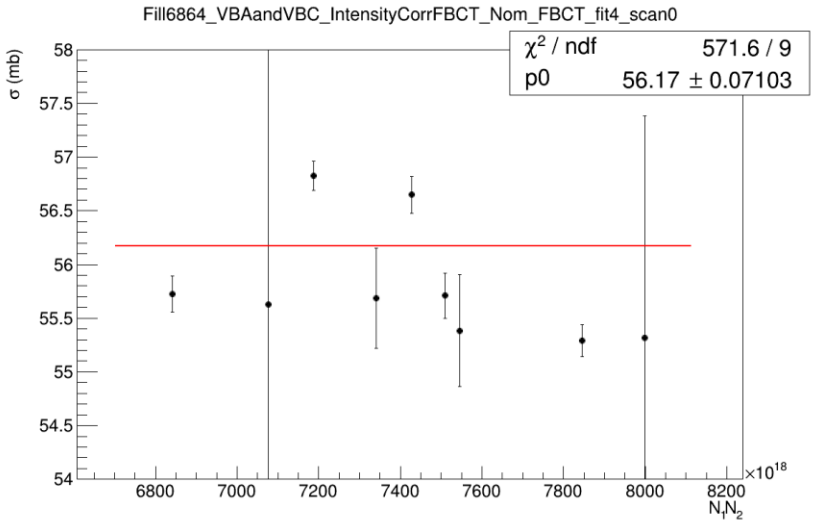


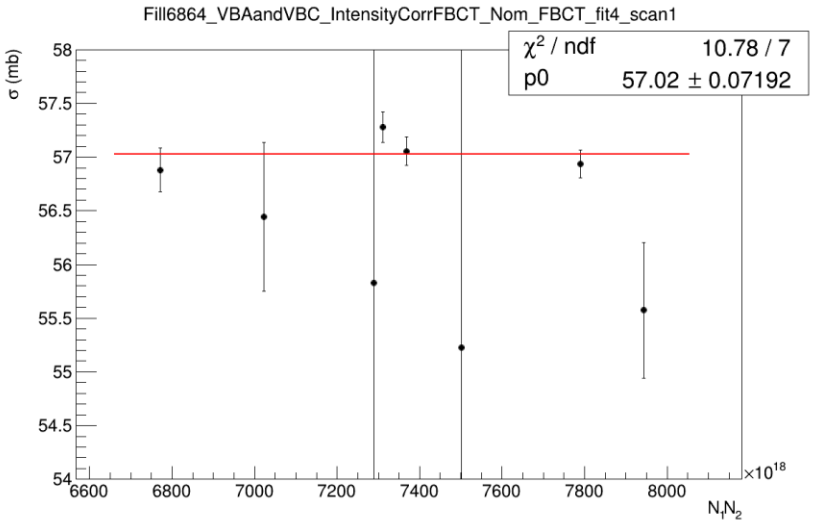
Backup

2018 results, Updated pileup factor, DG



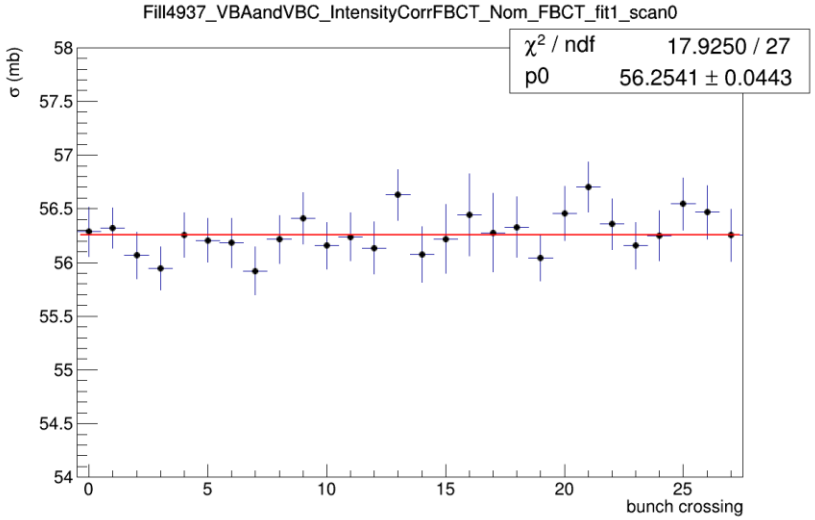


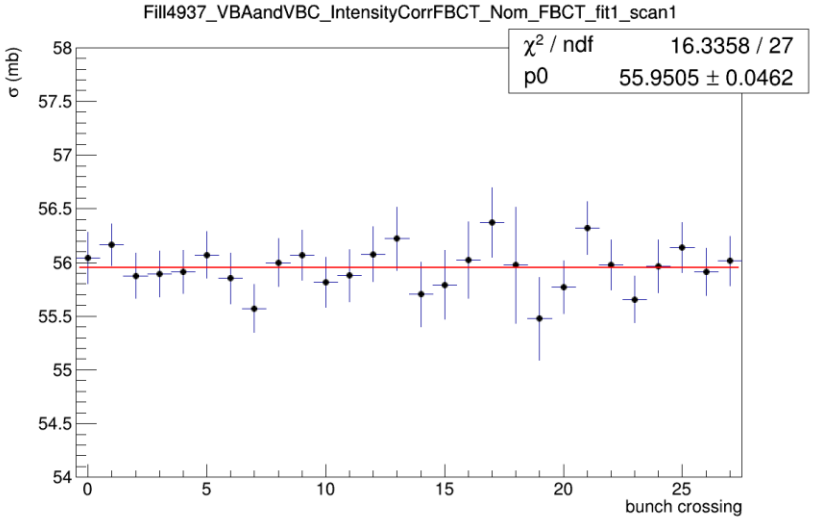


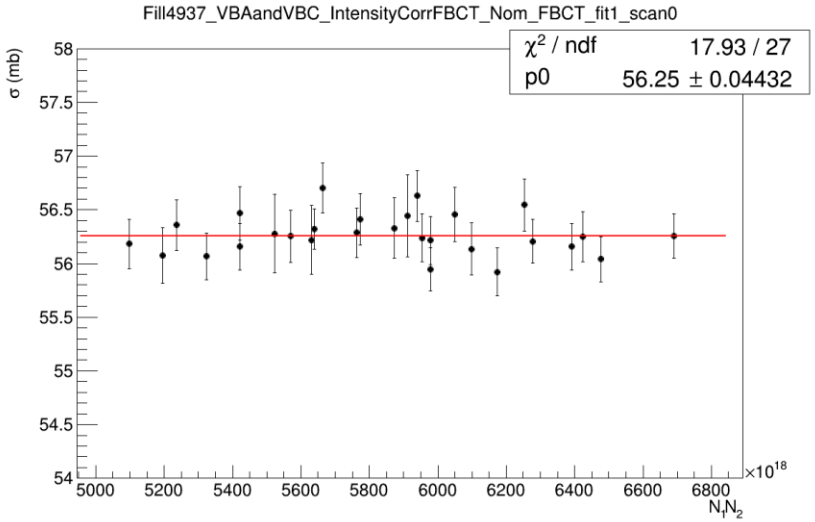


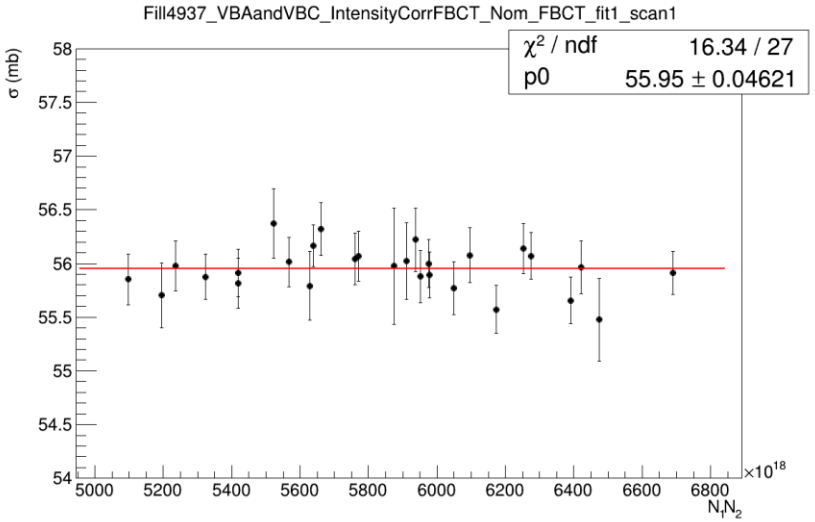
Backup

2016 (Fill 4937), Nominal + FBCT + V0 + GP6



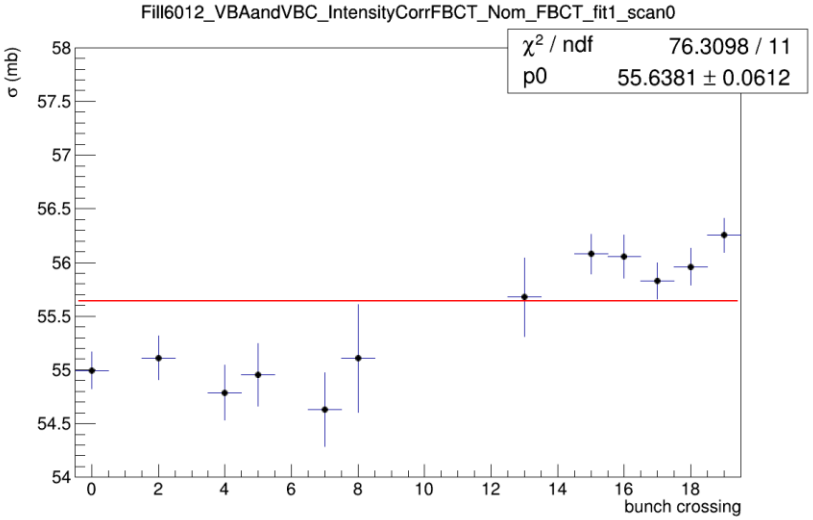


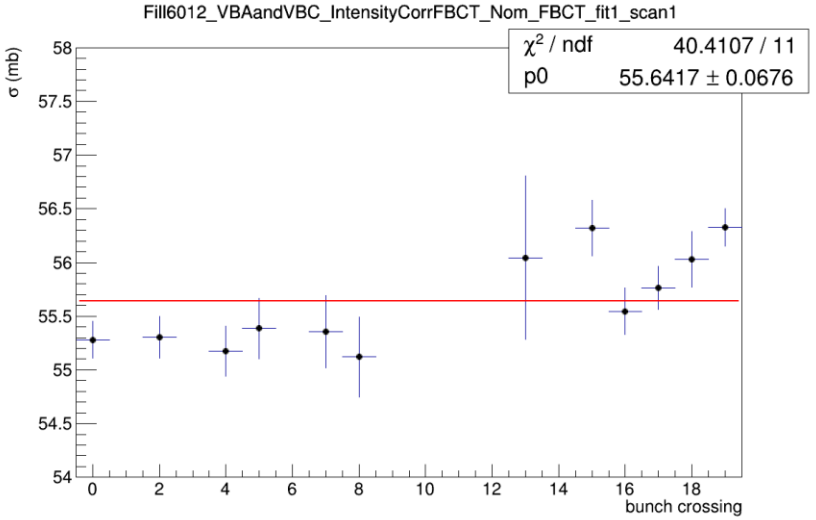


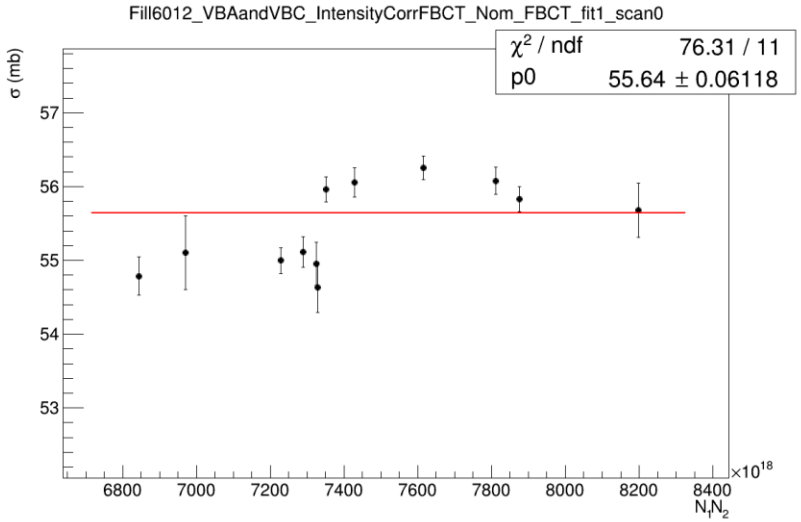


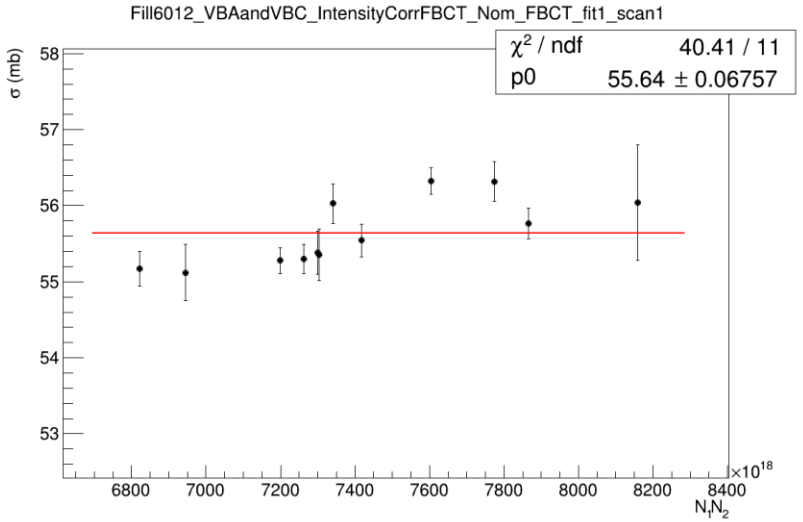
Backup

2017 (Fill 6012), Nominal + FBCT + V0 + GP6, w/ QA









Backup

2017 (Fill 6012), Nominal + FBCT + V0 + GP6, w/o QA