Status of on-going DA studies

D.Banfi, T.Pieloni, J.Barranco

Acknowledment: R.DeMaria, X.Buffat

High Luminosity LHC

LHC@home SixTrack

SixTrack Simulations

Our default :

- 4 HL-LHC optics (2 round, 2 flat)
- 11 X-angles (from 400 to 900 mrad, step 50 mrad)
- 17 xy plane angles (from 5 to 85, step 5deg)
- 6 initial amplitudes (from 2 to 12 sigma, step 2 sigma)
- 7 beam intensity (from 1.6 to 3.0 10^{11})
- 60 seeds (for multipoles)
- tune scan (for beta=10cm)
- 4D and 6D BB lens
- All LR encounters and No LR after D1

Various physics cases to be simulated:

• Beam-Beam only	DONE
• BB + Multipoles Errors	DONE
• Crab Cavities	ONGOING..
• BB + Crab Cavities	ONGOING..
• BB + Crab + Multipoles	TO BE DONE
• BB + noise source	TO BE DONE

Reproduce the experimental observations from LHC 2011-2012 Long Range MDs.

Provide benchmark to LifeTrack.

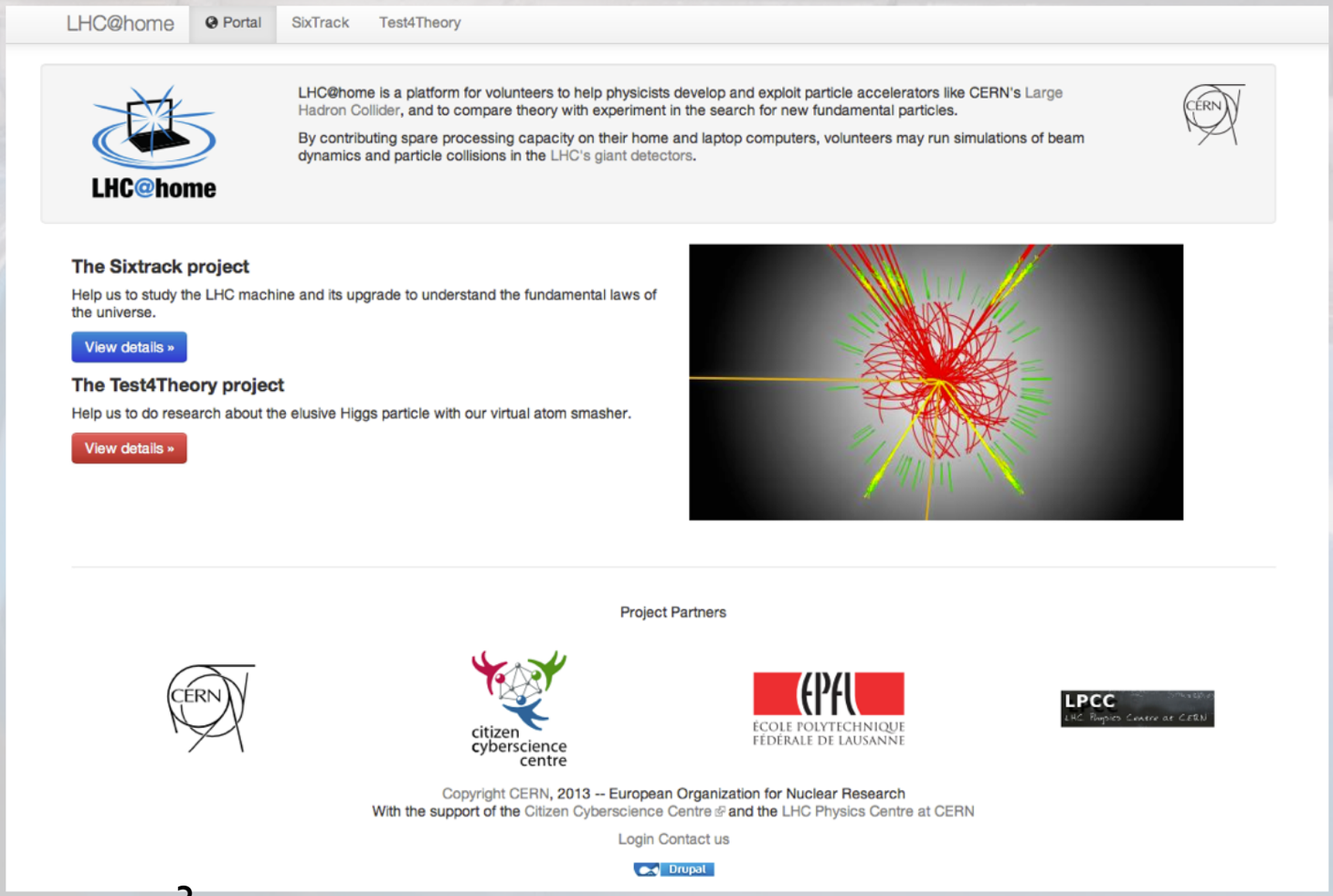
LHC@Home

Close to 10Mjobs to cover all possible cases!
It's impossible to run such number of jobs on CERN lsf: BOINC is the only way to go! EPFL is main sponsor of the LHC@Home project on BOINC platform!

We are at present :

- Testing existing features
- Extensive use (more than 3M jobs up to now)

- Forum administrator and moderator



http://lhcathomeclassic.cern.ch/sixtrack/
http://lhcathome.web.cern.ch

Thanks to LHC@Home Team for the support (E.McIntosh, R.Demaria, I.Zacharov, N. Hømyr et al.)

SixTrack Dev&Post-Proc

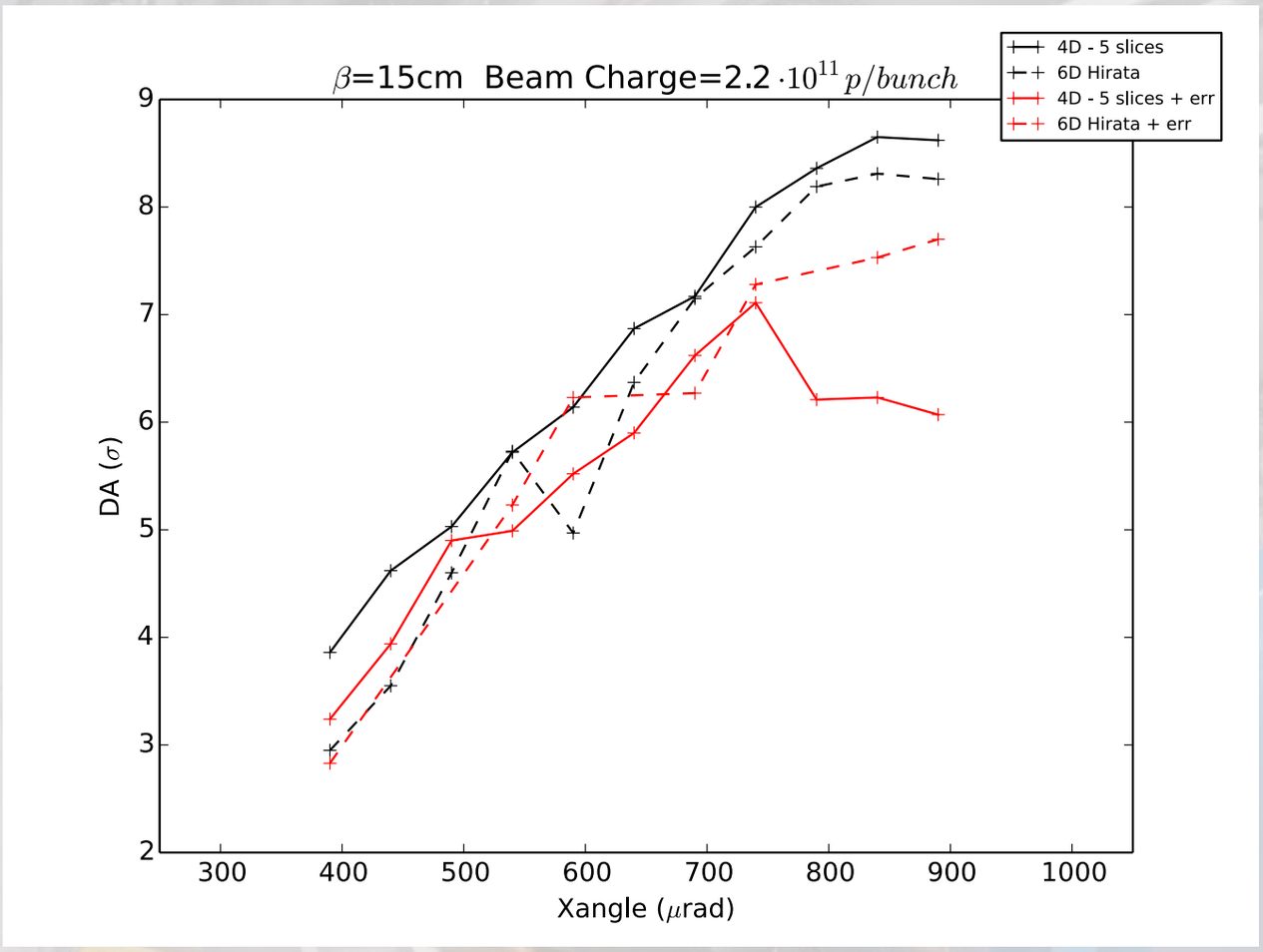
•Help to task 2.3 (R. De Maria) in SixTrack environment "restyling" : migration from OpenAFS structure for job/results handling to more efficient MySQL DB

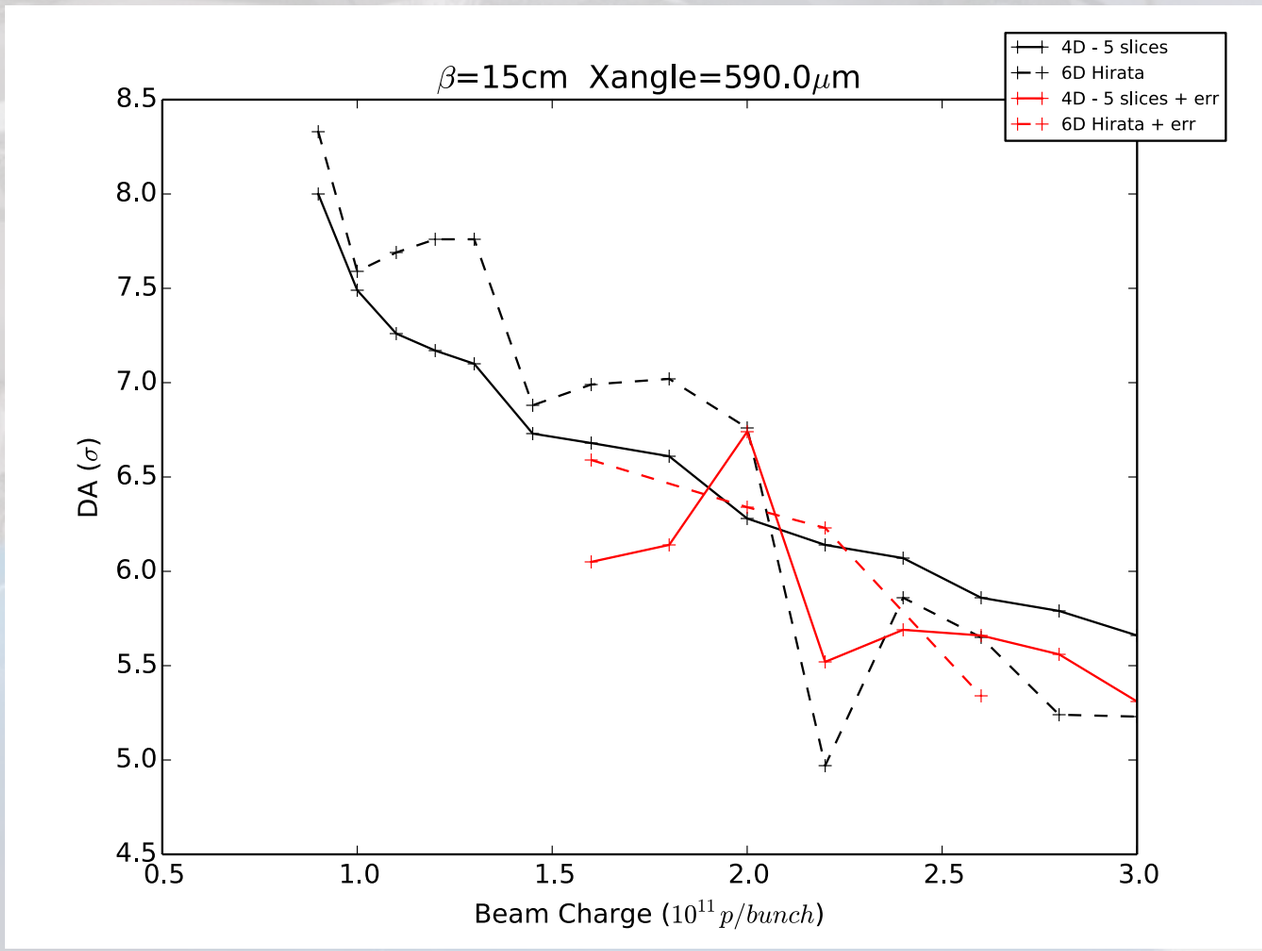
•The download of results strongly reduce the speed of the BOINC system, need to move to DB technology as soon as possible! Few other problems (ex:afs quota for result directory) that can slow down strongly the system need to be solved.

•For testing the improvement that DB technology could bring the post processing for DA computation was reimplemented in python. Same logic as the old fortran code, but implemented making use of new infrastructure (local sqlite db). Gives same result up to 8th digit.

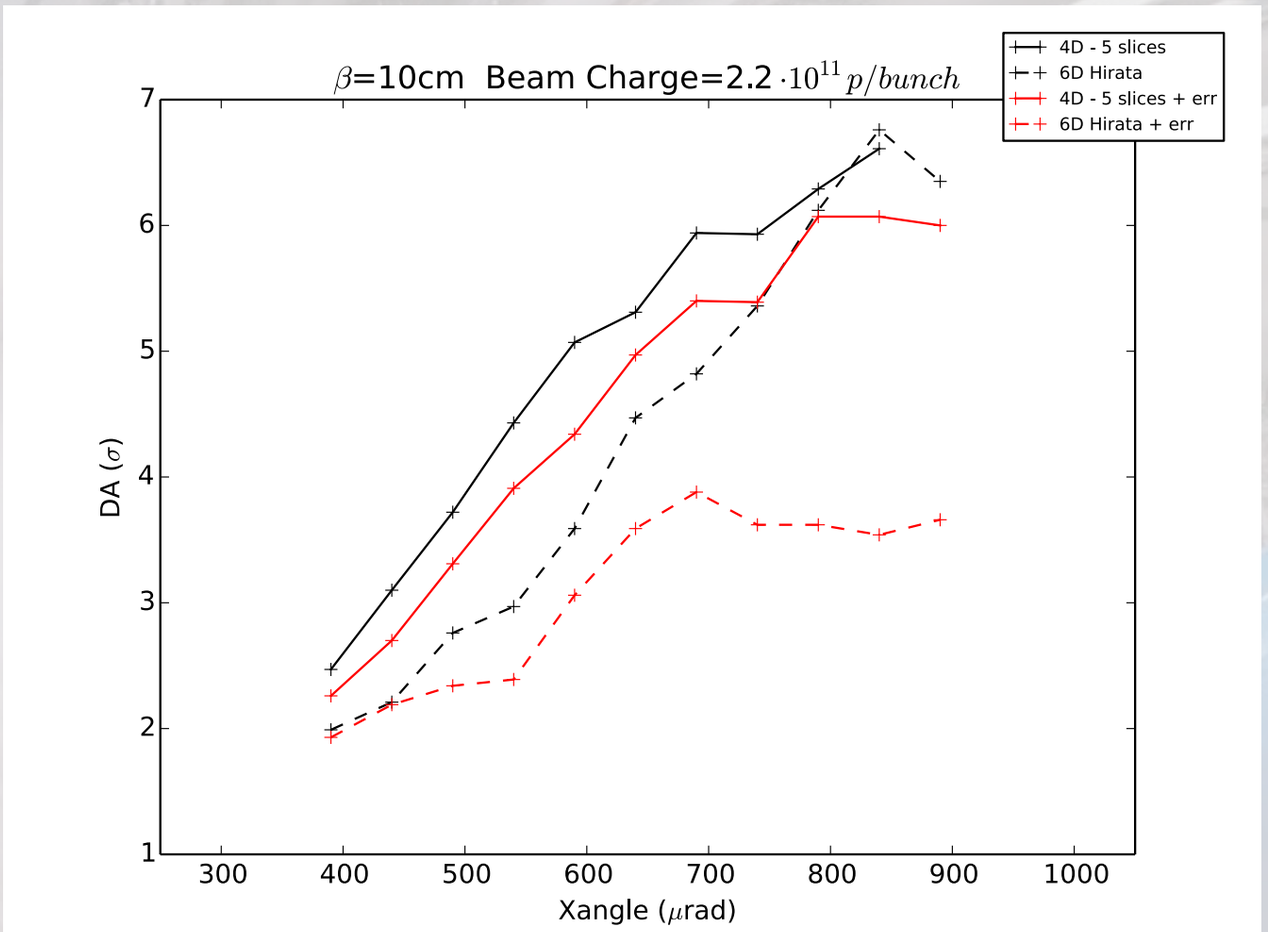
- •SPEED :
  - •OLD: post proc set up the environment for a study (export lots of variable), access all file in the /afs structure, read them, process them, ad write a DA file for each configuration (amplitude, beam intensity, etc etc...up to 2000 in my typical case). The process, in my typical case, takes ~2h on lxplus.
  - •NEW: python tools scans the /afs three, read all files for a given study and add them to a local sqlite3 database. This takes ~1-3min and need to be done only once. The DA computation with the new scripts takes (on my laptop) 30-35 SECONDS and write a single file with all the DA for a study.
- •All the new post processing will be tested deeply and added to SixTrack release.

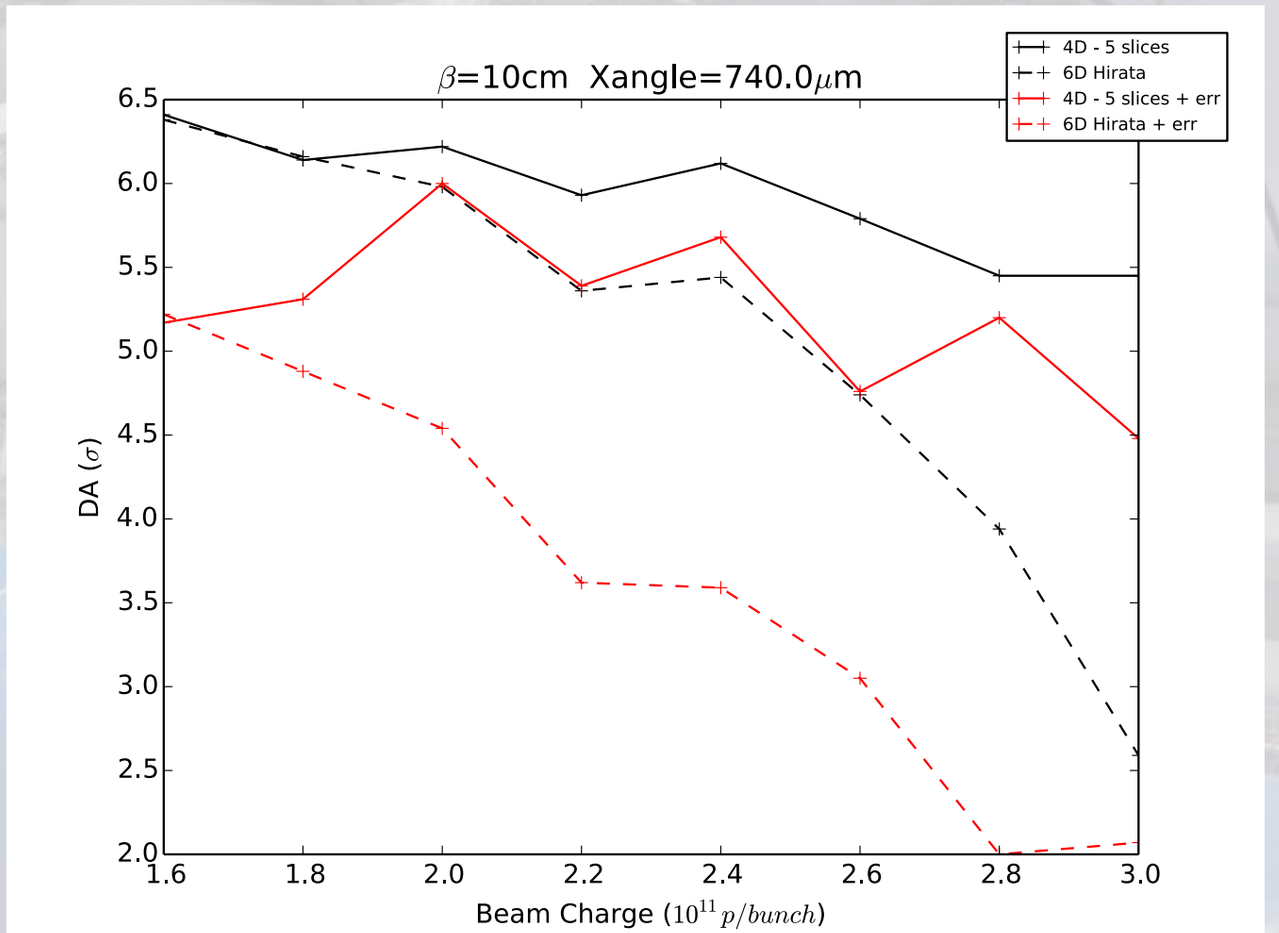
β=15cm


β=15cm Beam Charge=2.2 $\cdot 10^{11}$ $p/bunch$
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Xangle (μrad)

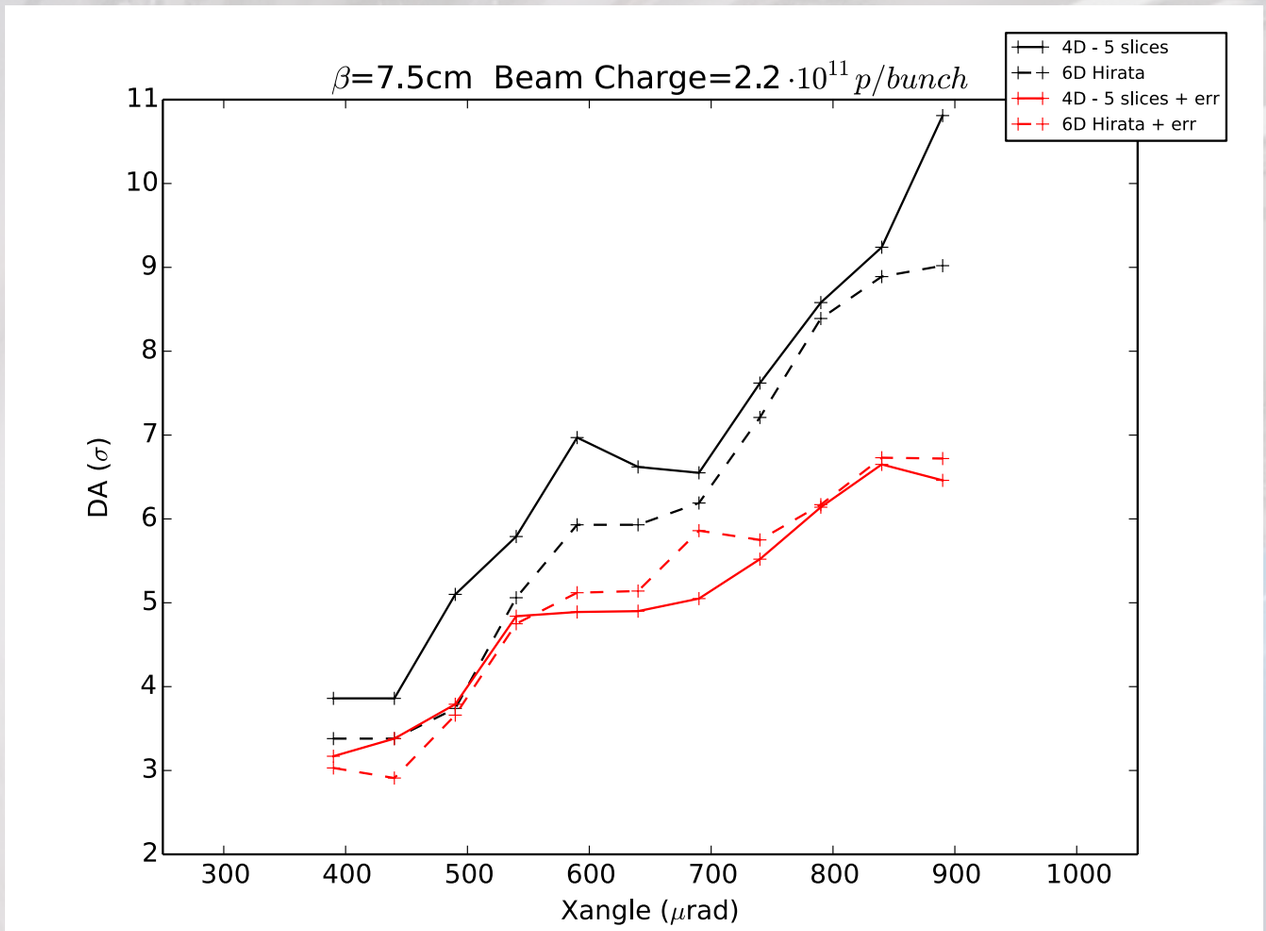

β=15cm Xangle=590.0μm
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Beam Charge (10^{11} $p/bunch$)

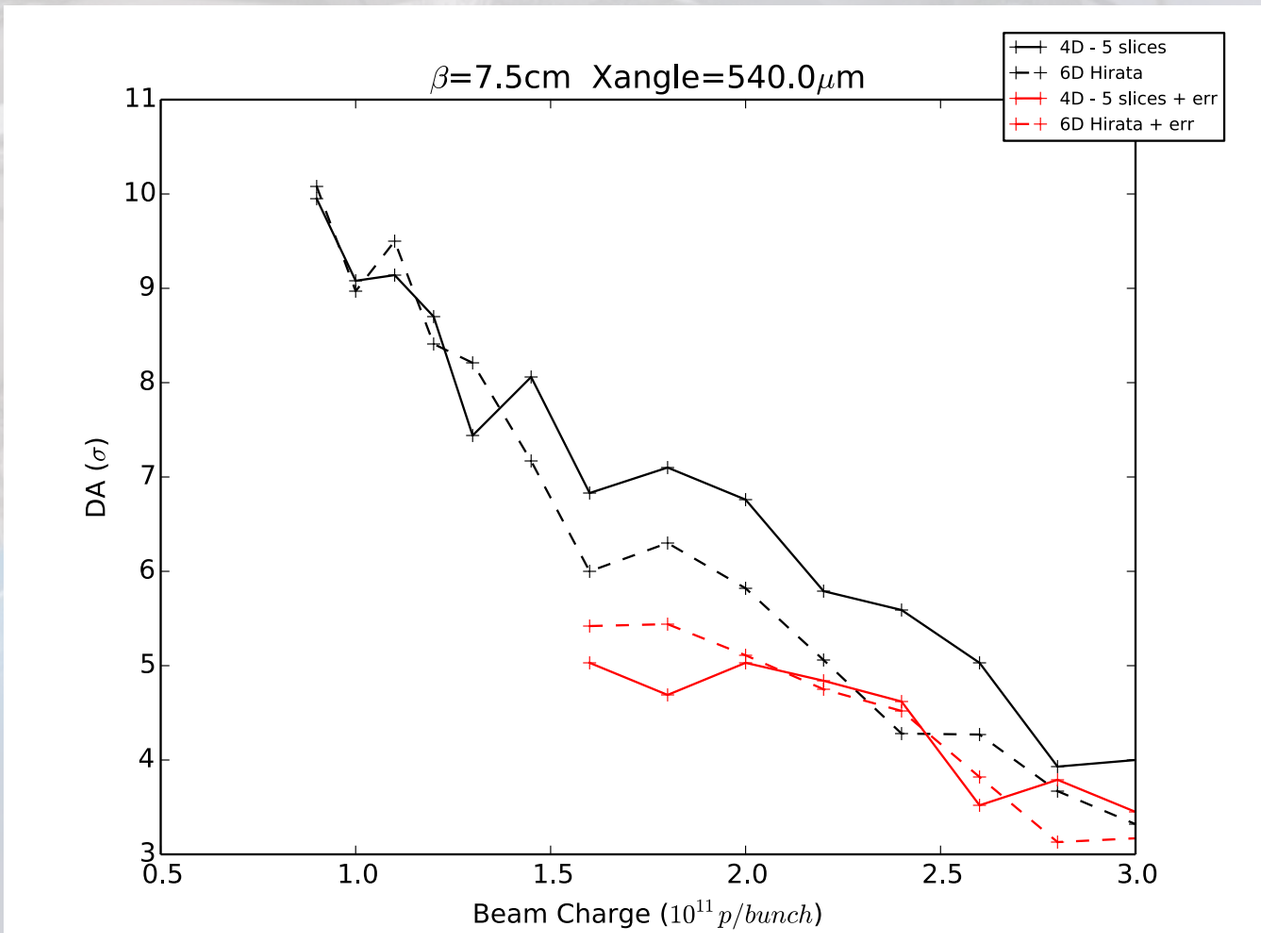
β=10cm


β=10cm Beam Charge=2.2 $\cdot 10^{11}\, p/bunch$
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Xangle (μrad)
1
2
3
4
5
6
7
300
400
500
600
700
800
900
1000

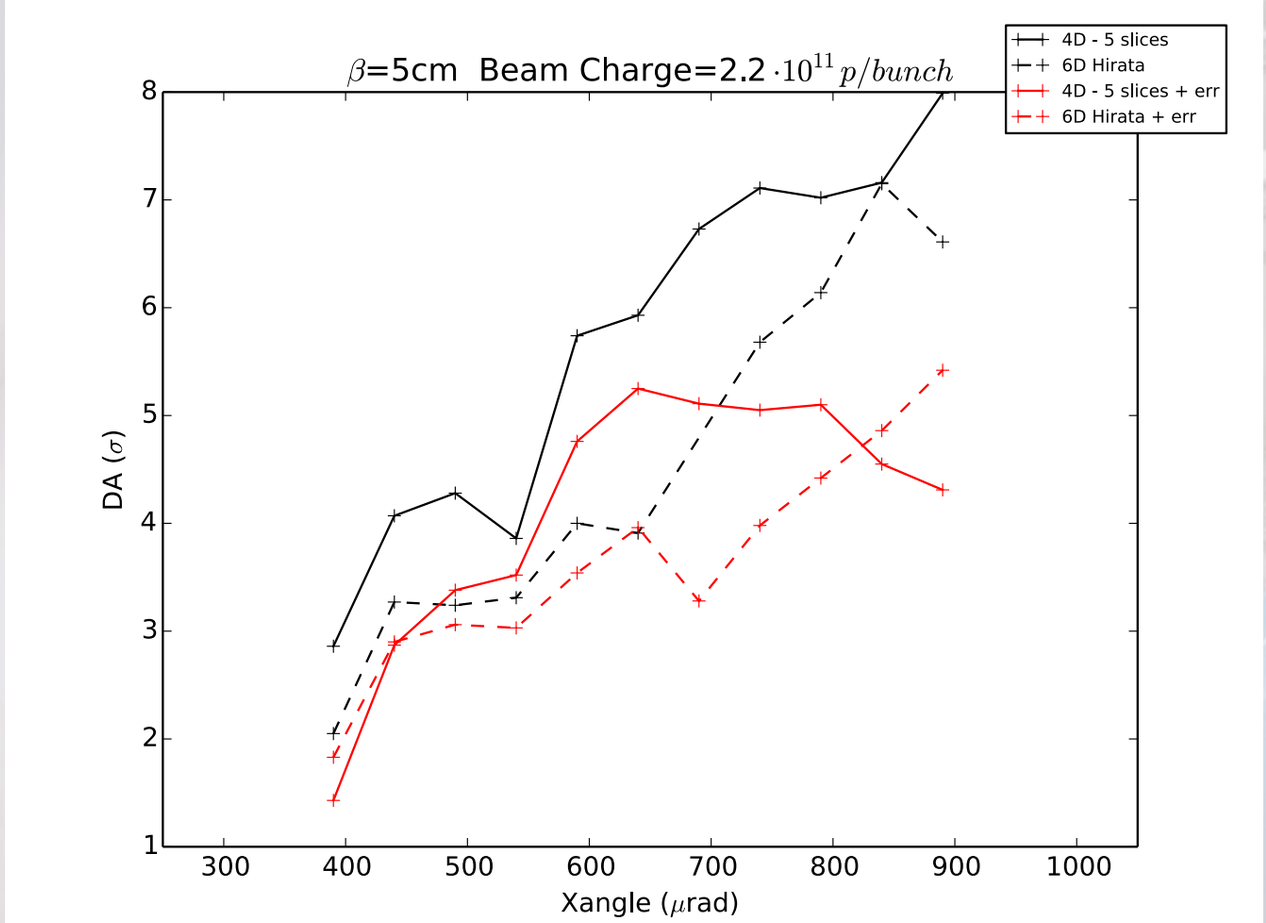

β=10cm Xangle=740.0μm
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Beam Charge ($10^{11}\, p/bunch$)
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0

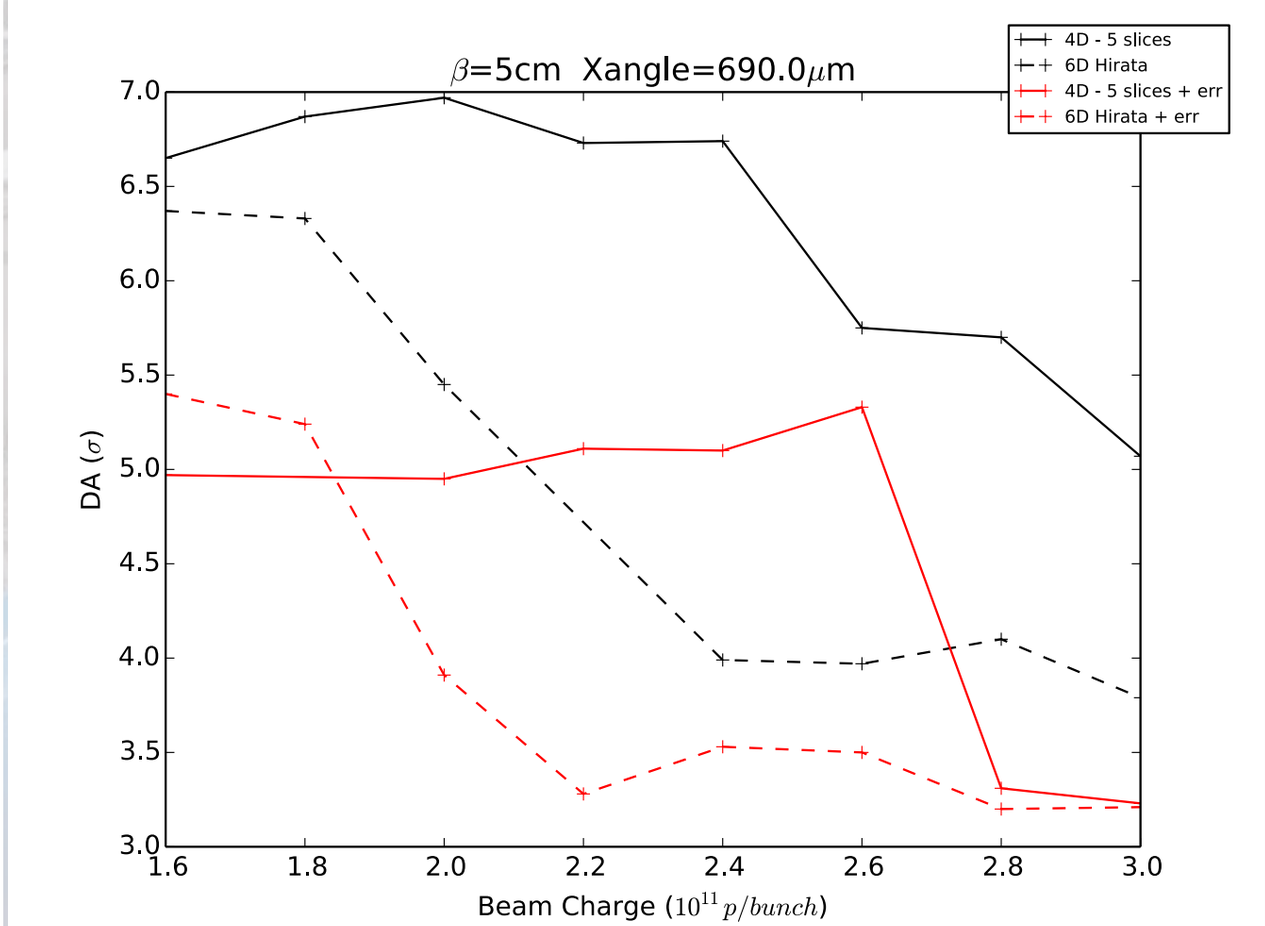
β=7.5cm


β=7.5cm Beam Charge=2.2 $\cdot 10^{11}\, p/bunch$
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Xangle (μrad)

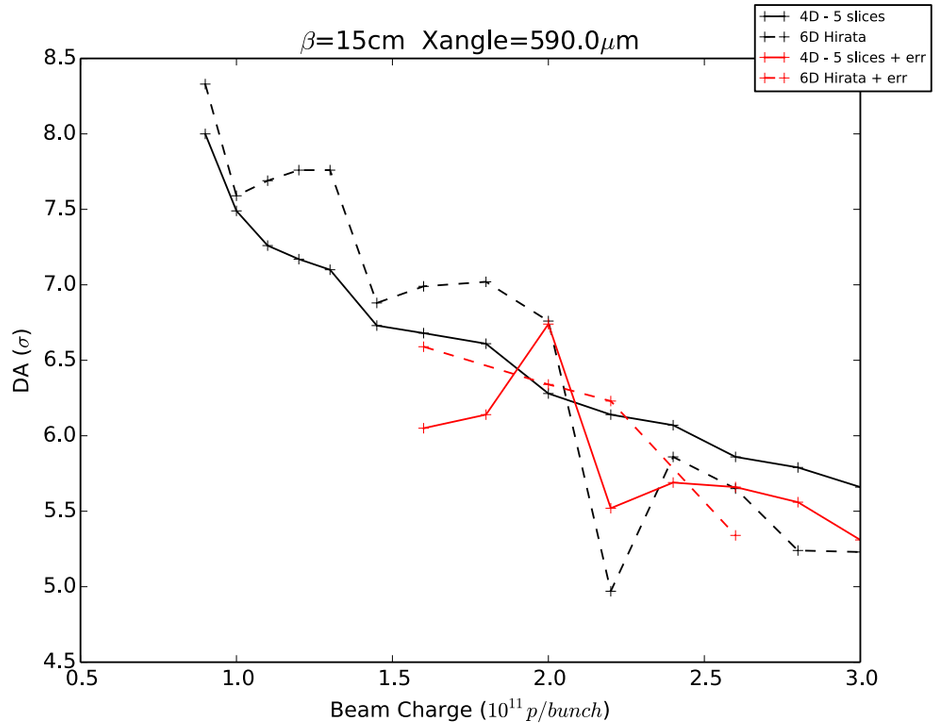

β=7.5cm Xangle=540.0μm
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Beam Charge ($10^{11}\, p/bunch$)

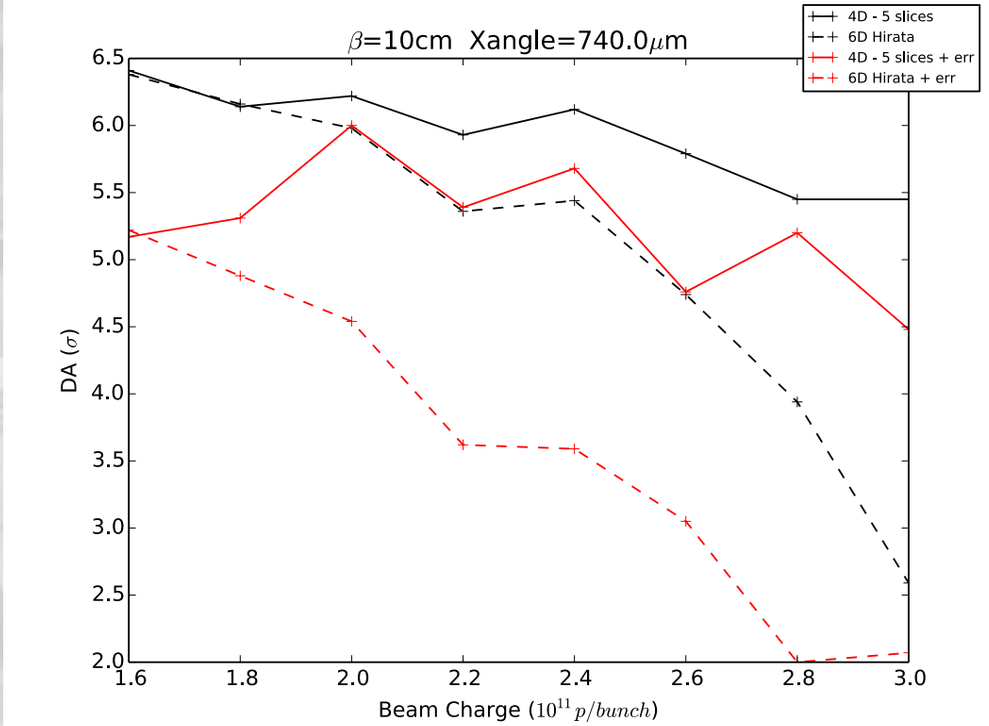
β=5cm

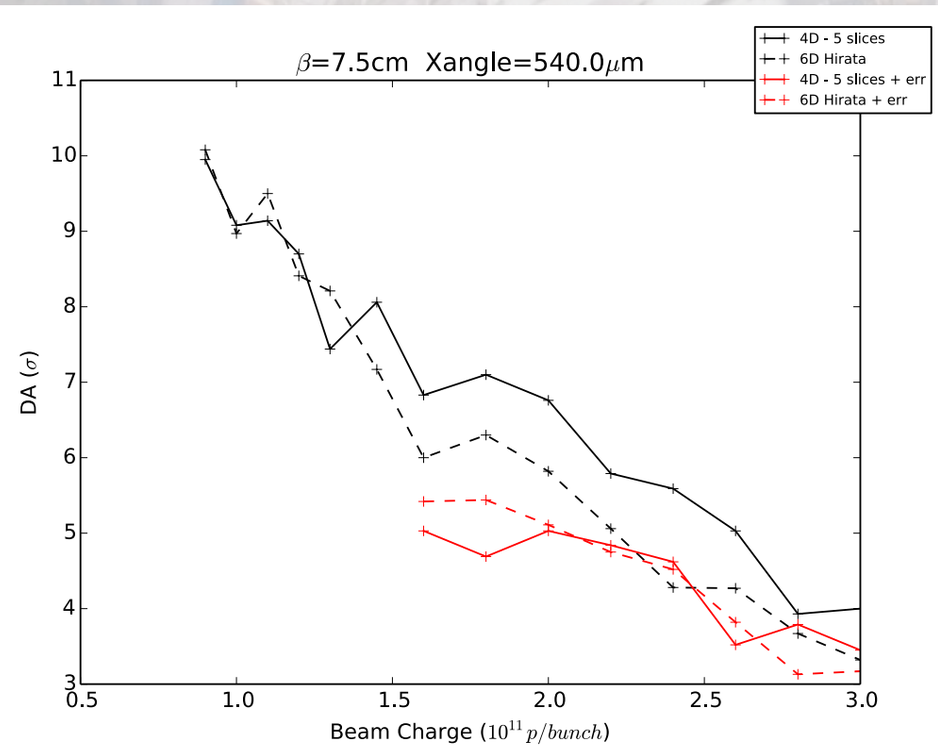

β=5cm Beam Charge=2.2 $\cdot 10^{11}$ $p/bunch$
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Xangle (μrad)

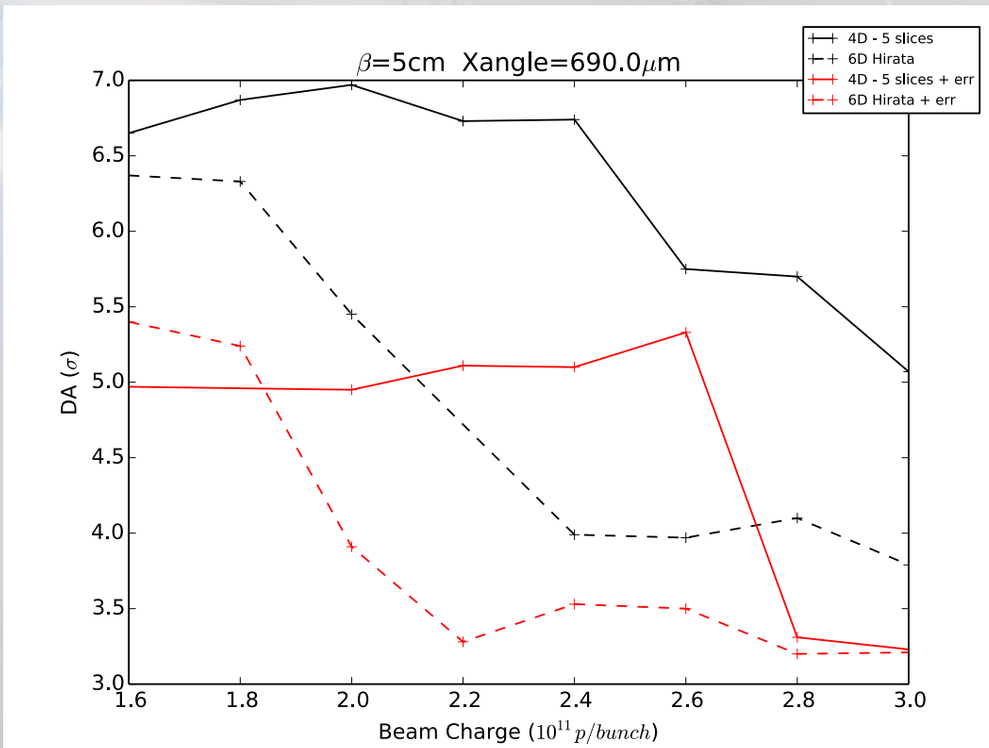

β=5cm Xangle=690.0μm
4D - 5 slices
6D Hirata
4D - 5 slices + err
6D Hirata + err
DA (σ)
Beam Charge (10^{11} $p/bunch$)

Intensity Scan: all optics

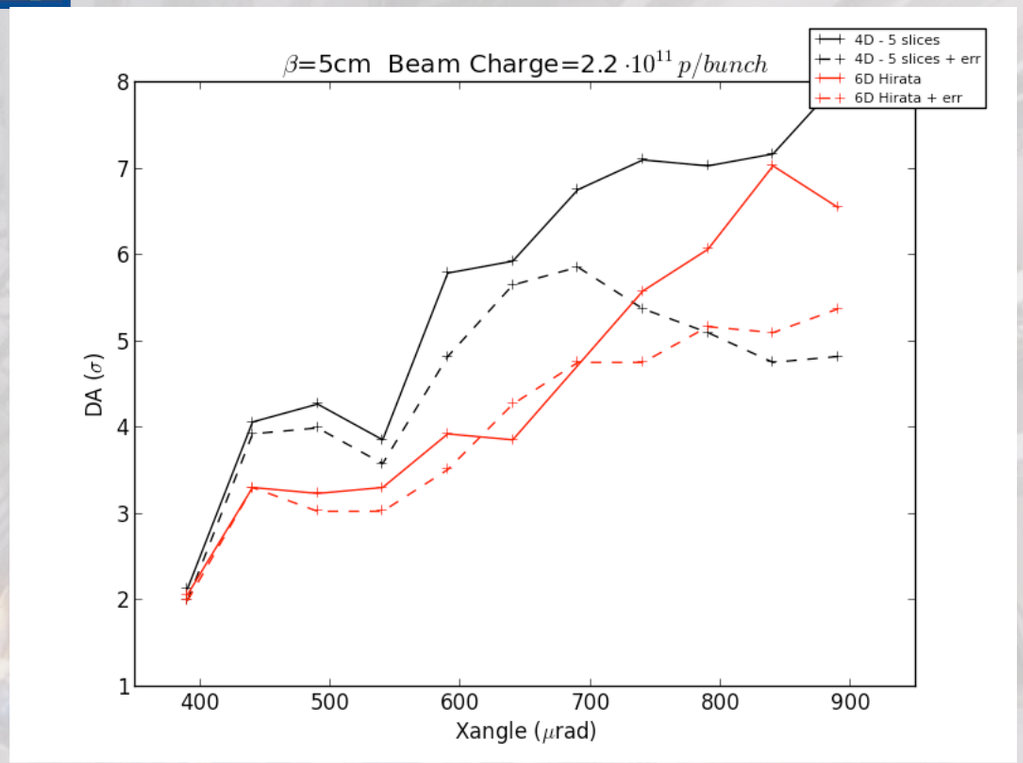


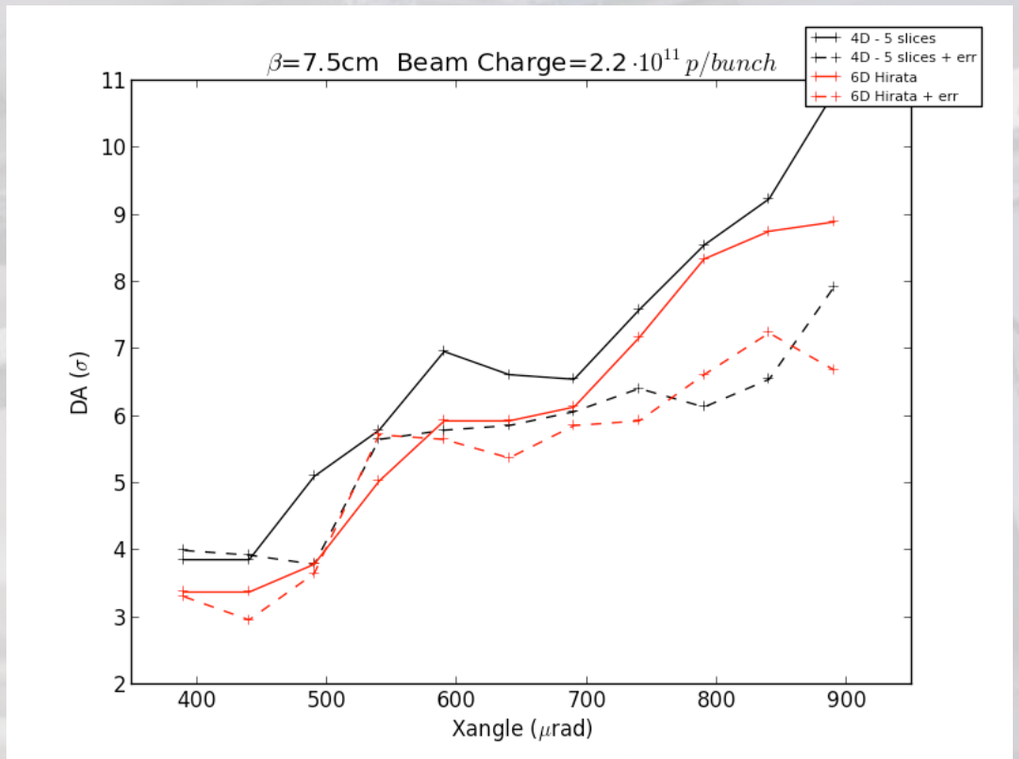


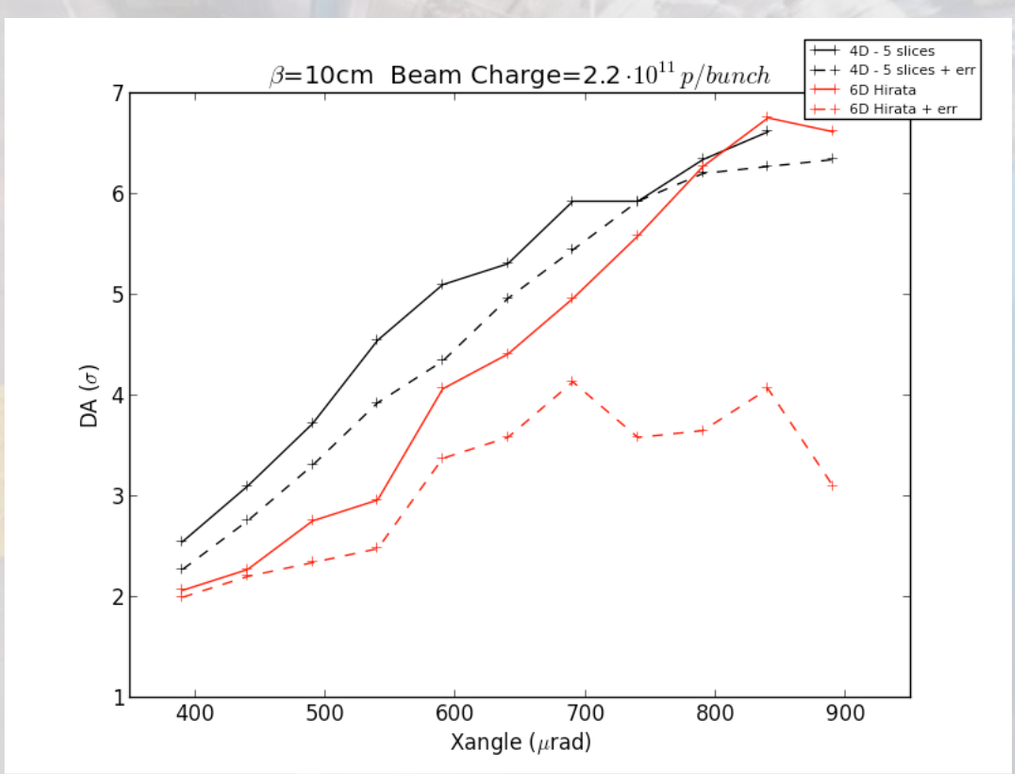


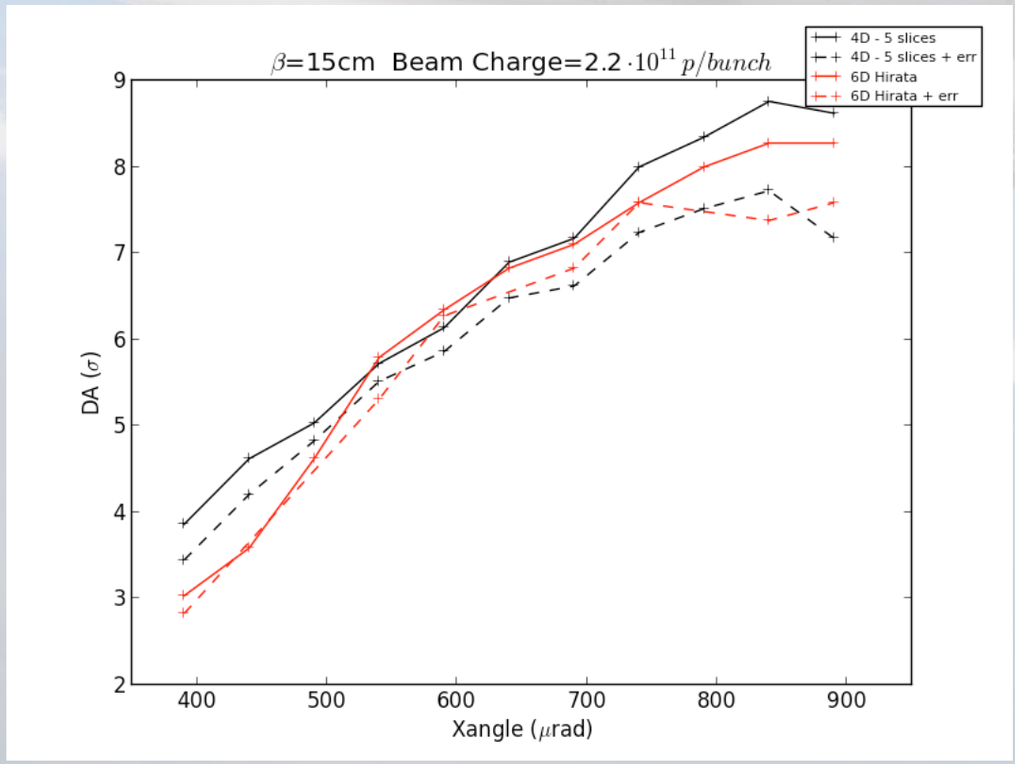


X-ing angle Scan: all optics

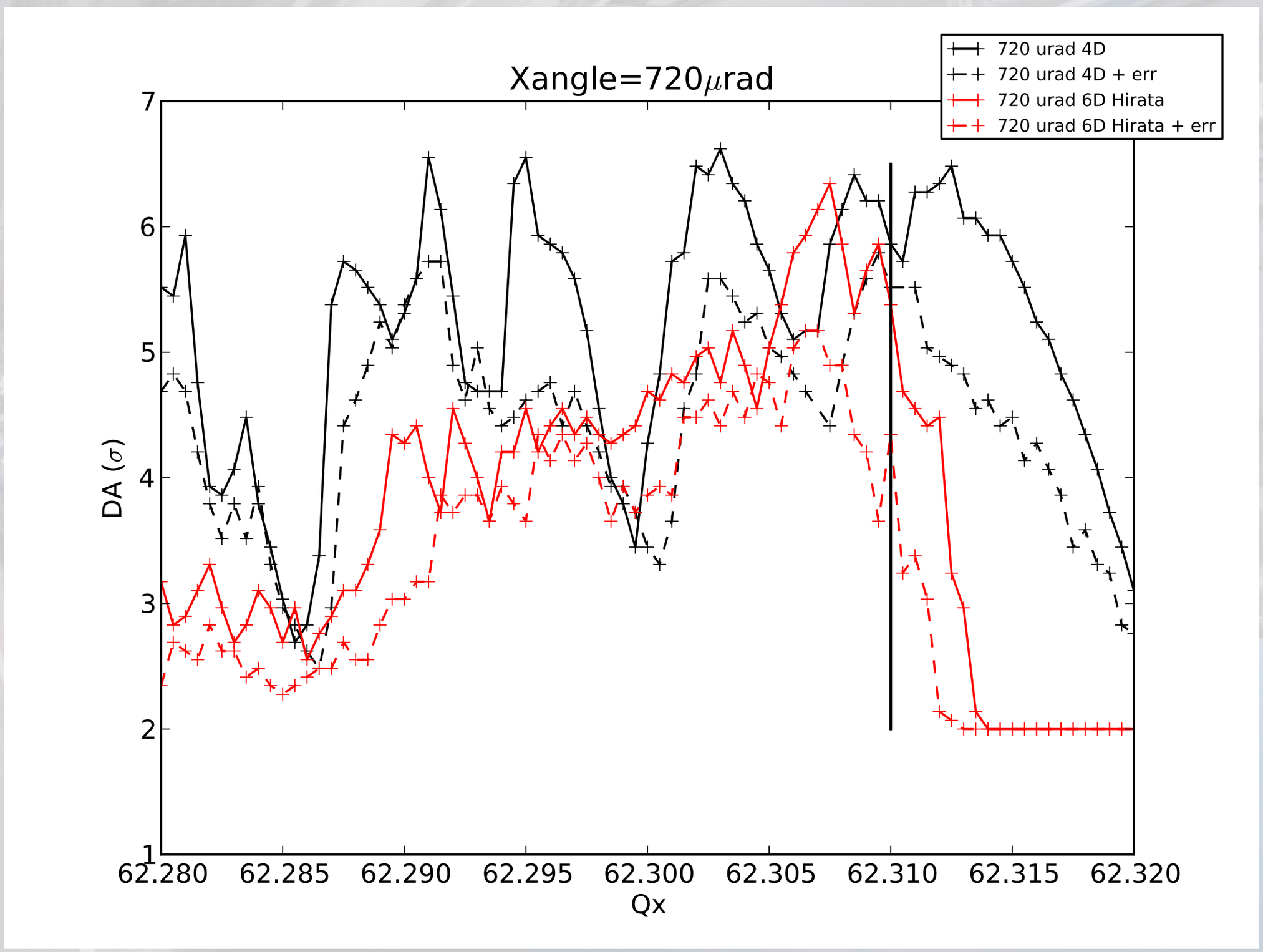




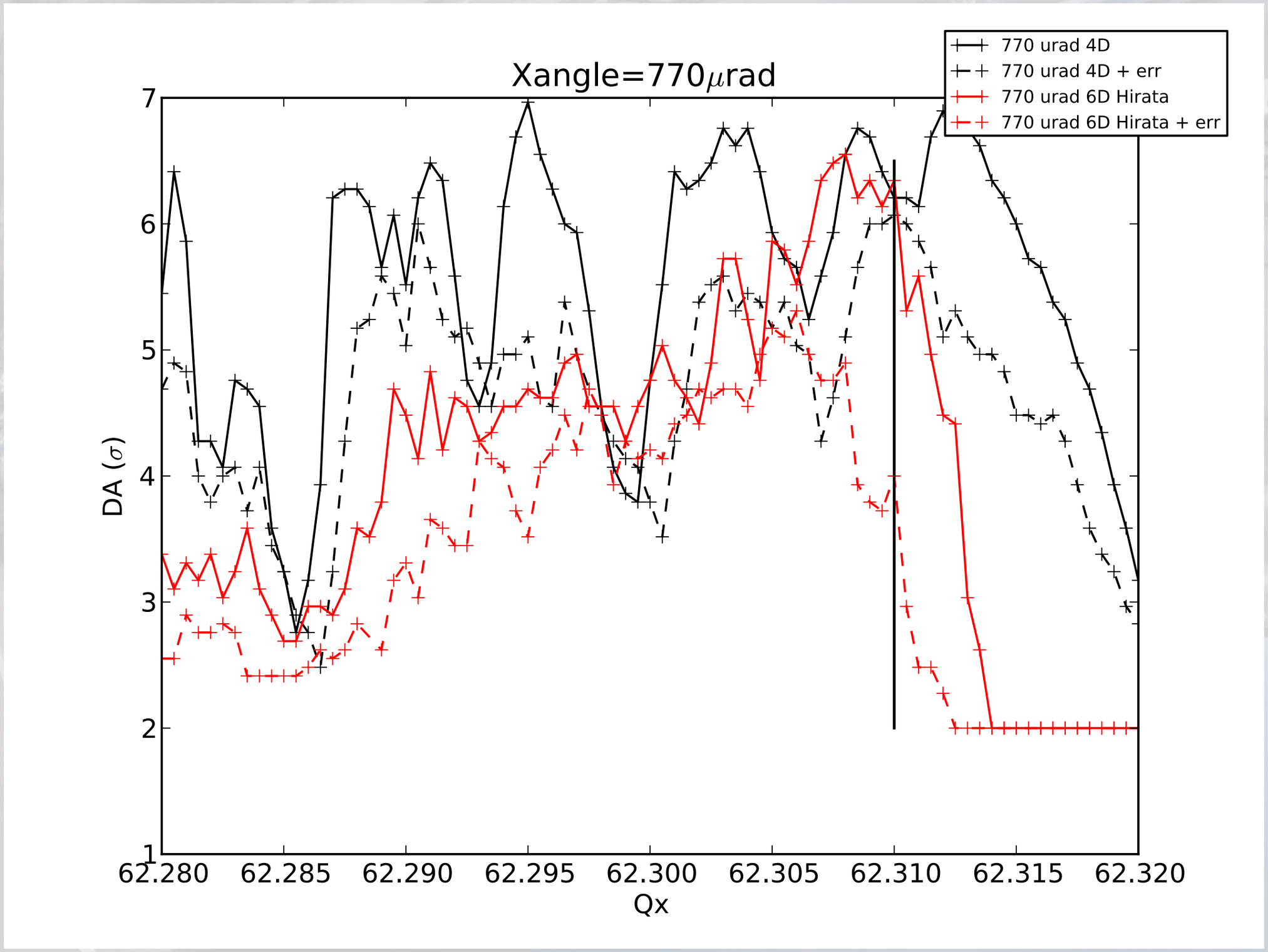




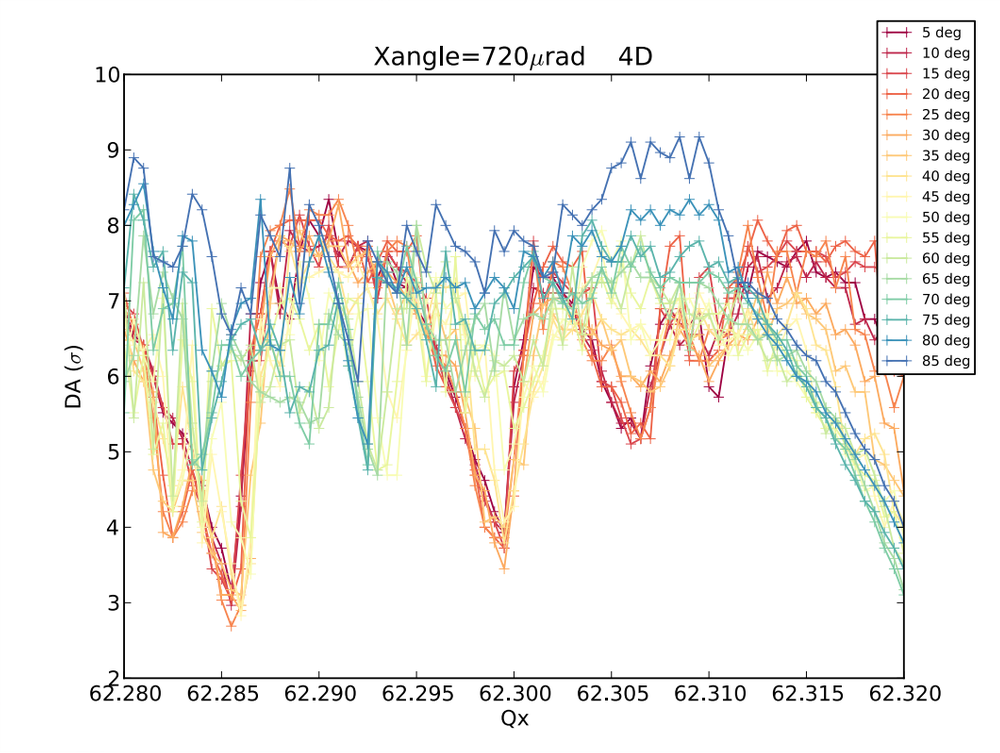
Tunescan β=10cm, 720urad

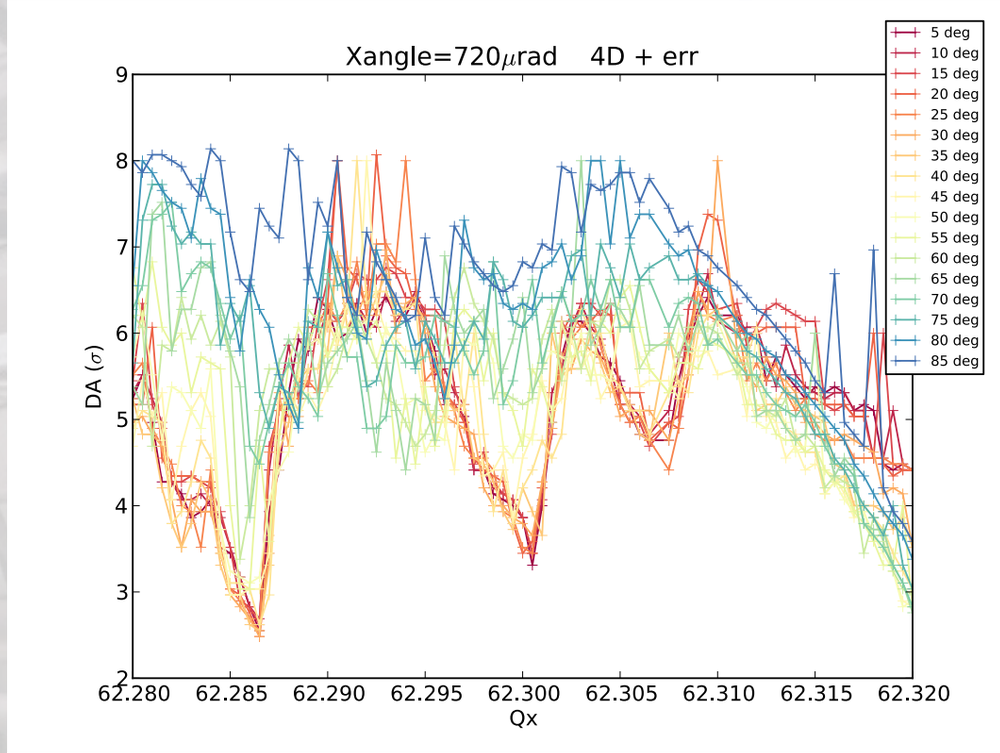


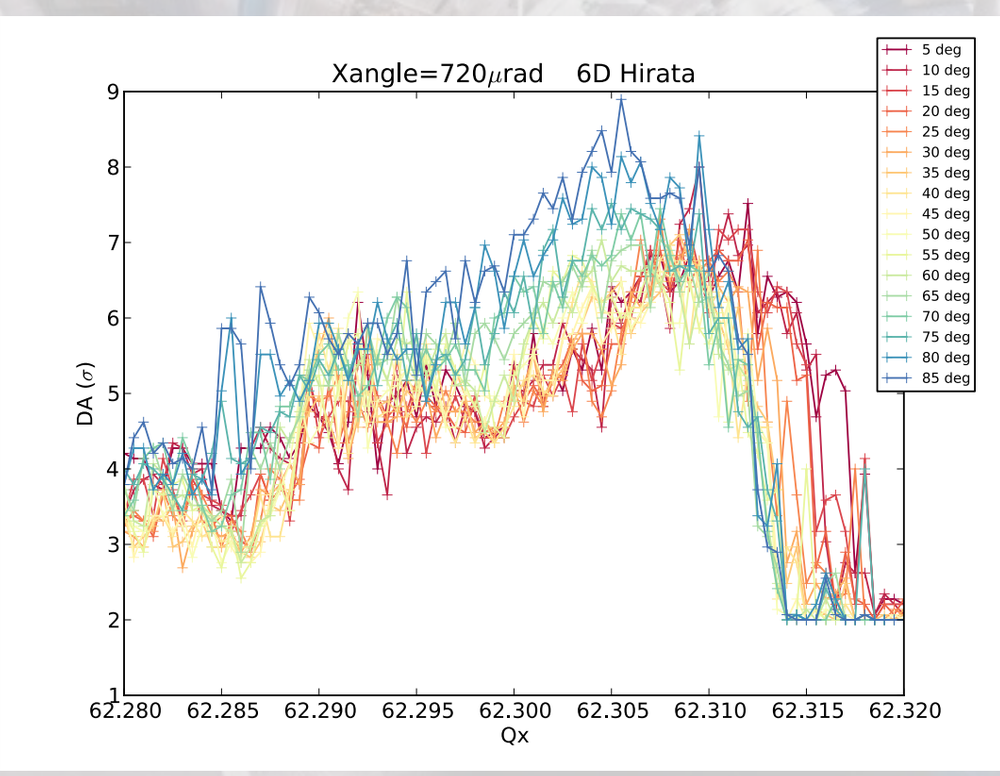
Tunescan ß=10cm, 770urad

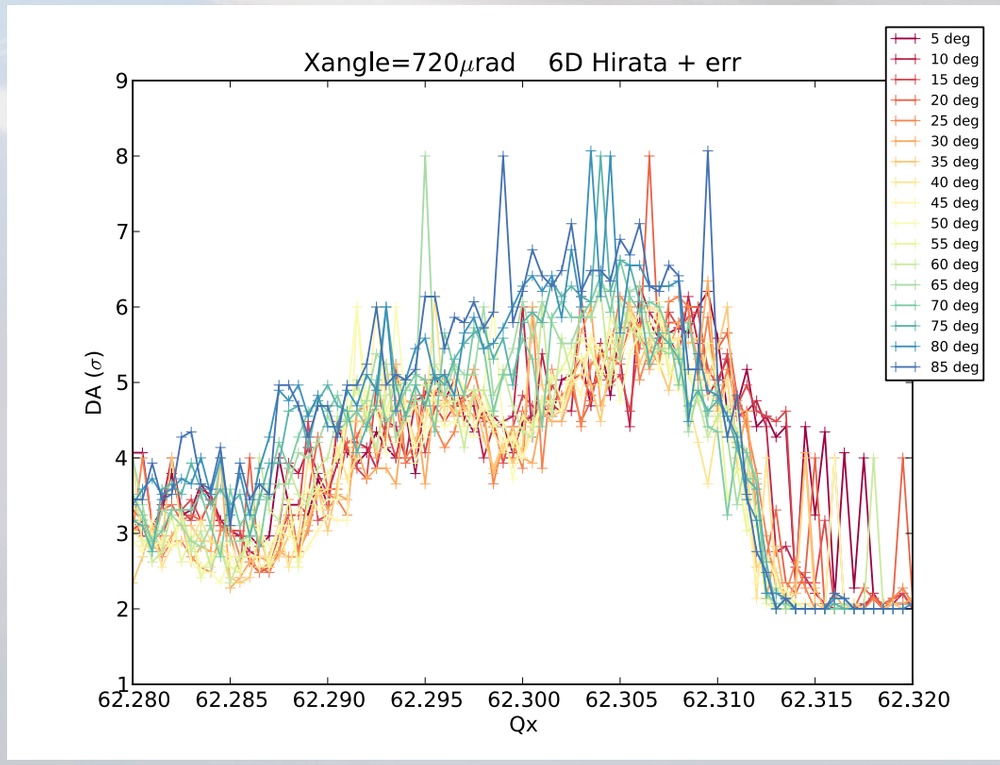


Tunescan β=10cm, 720urad

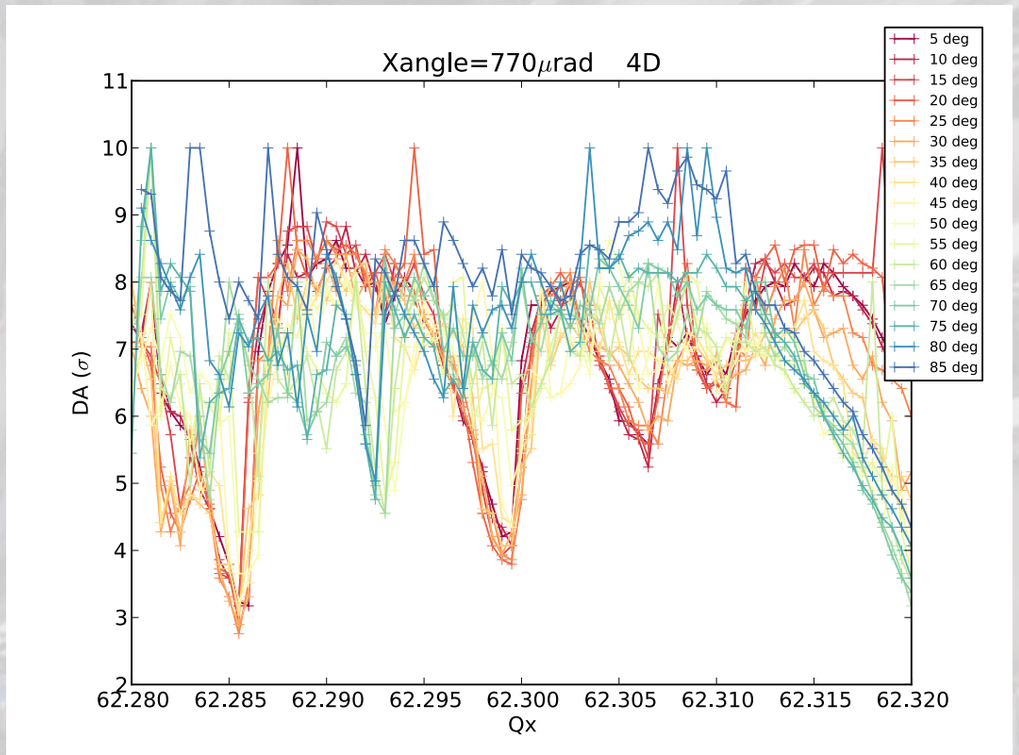


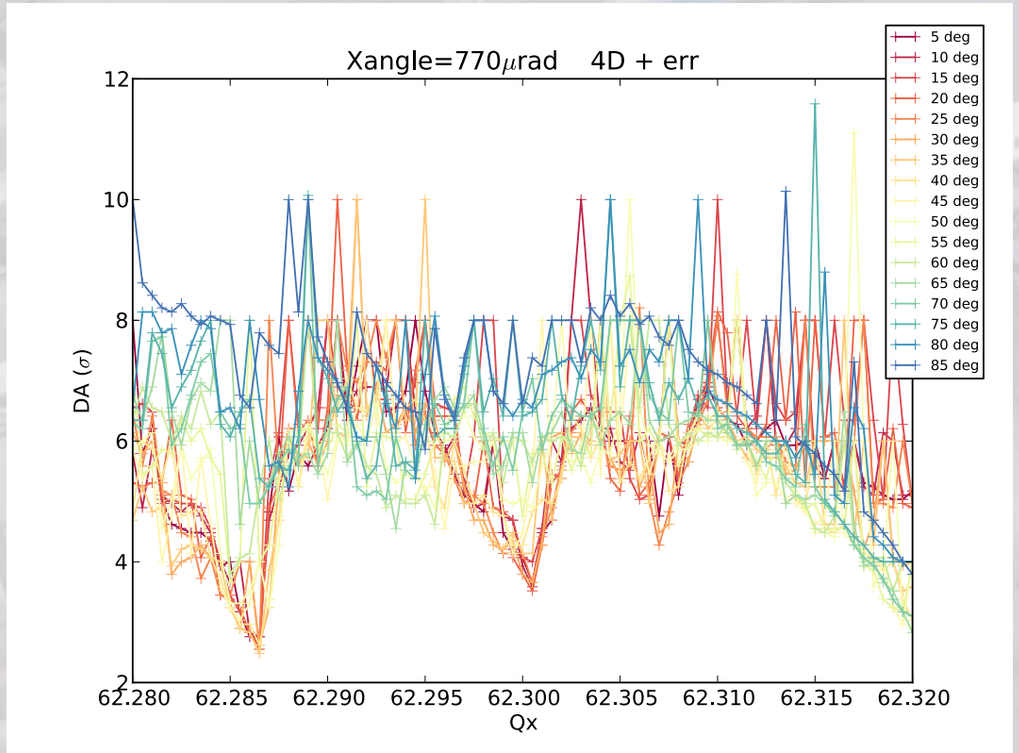


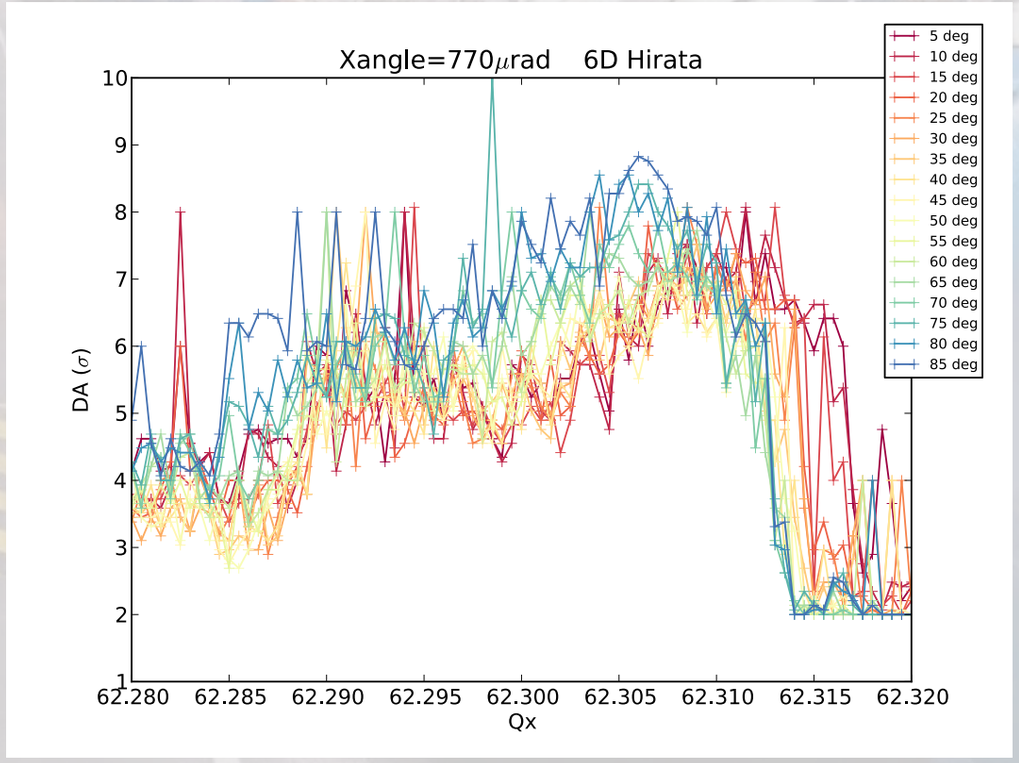


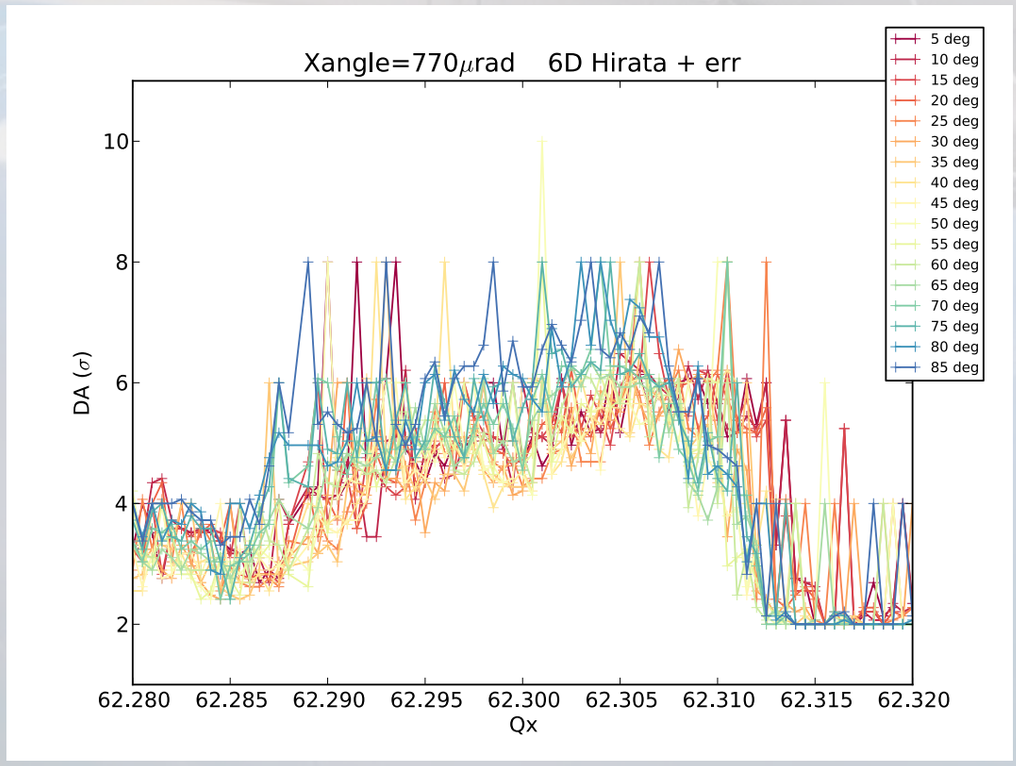


Tunescan ß=10cm, 770urad

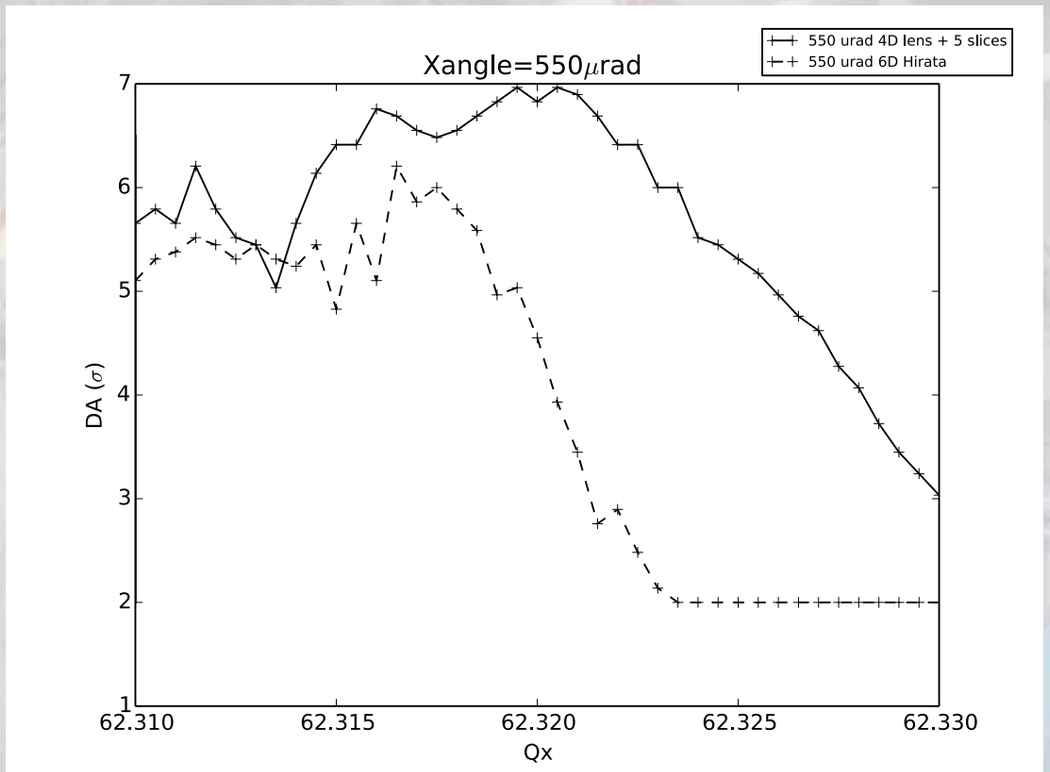


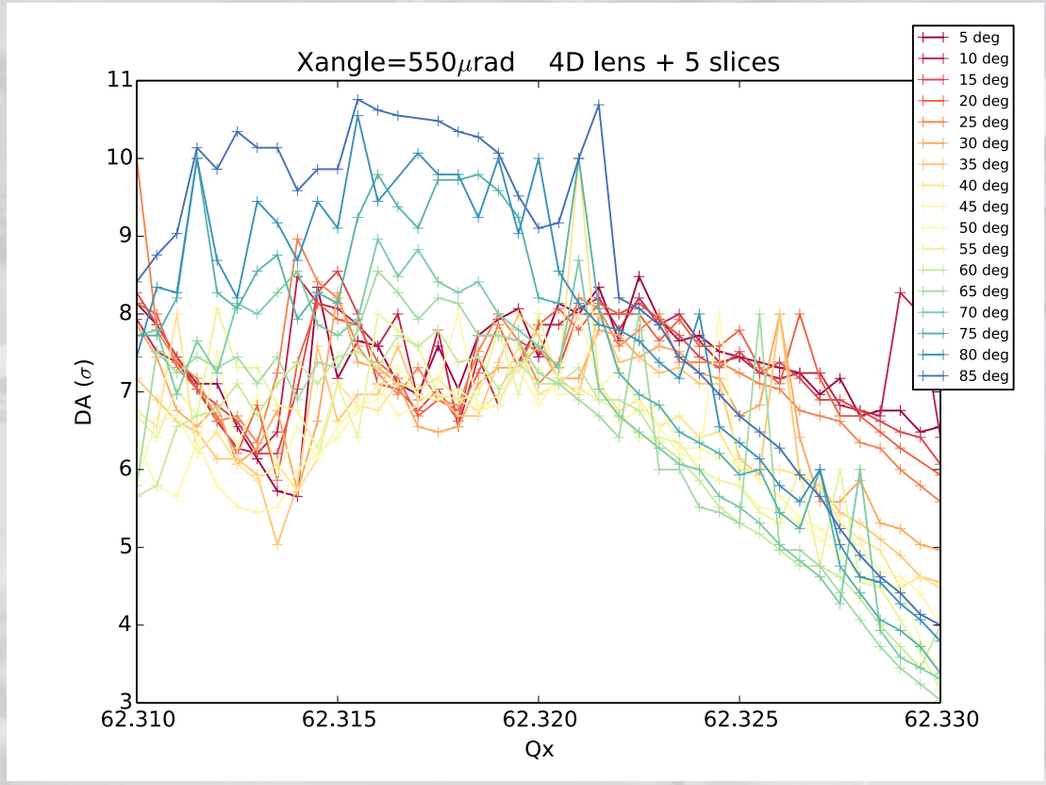


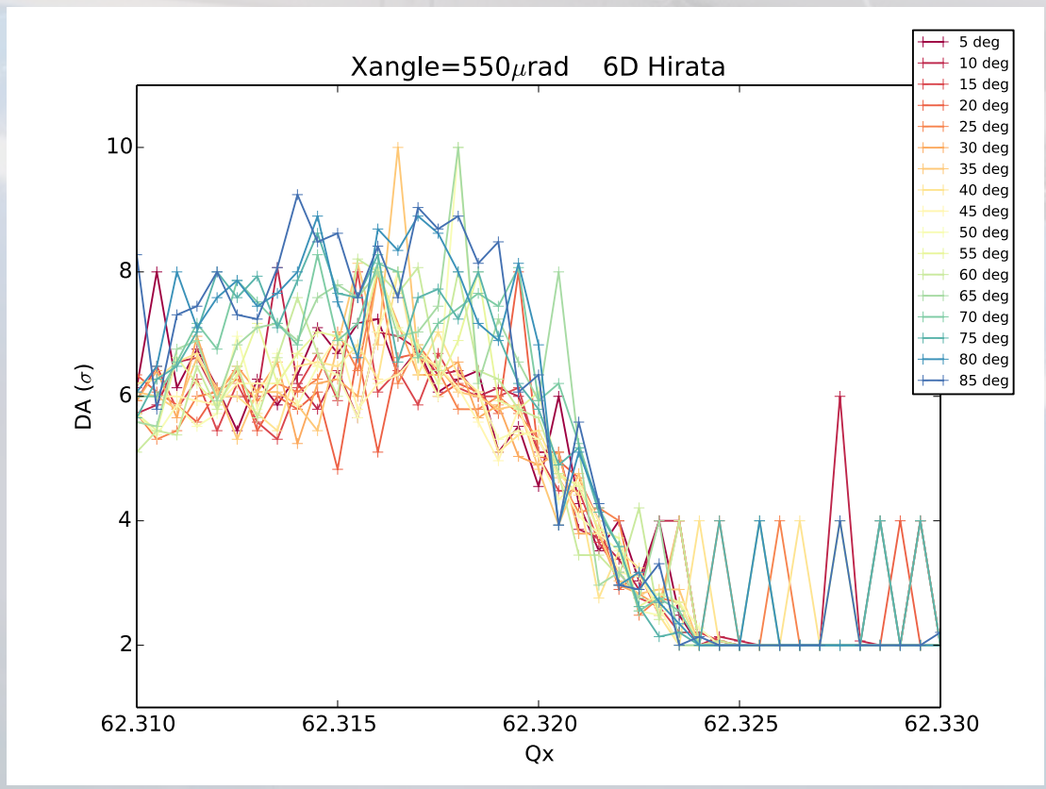




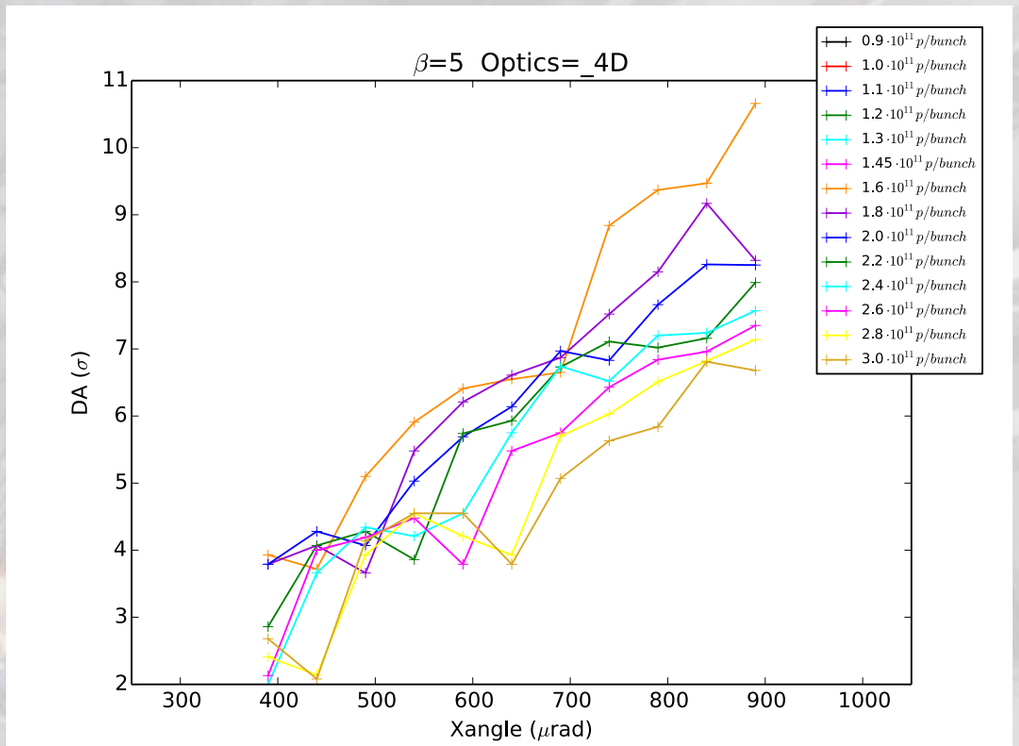
Tunescan ß=7.5cm, 550urad

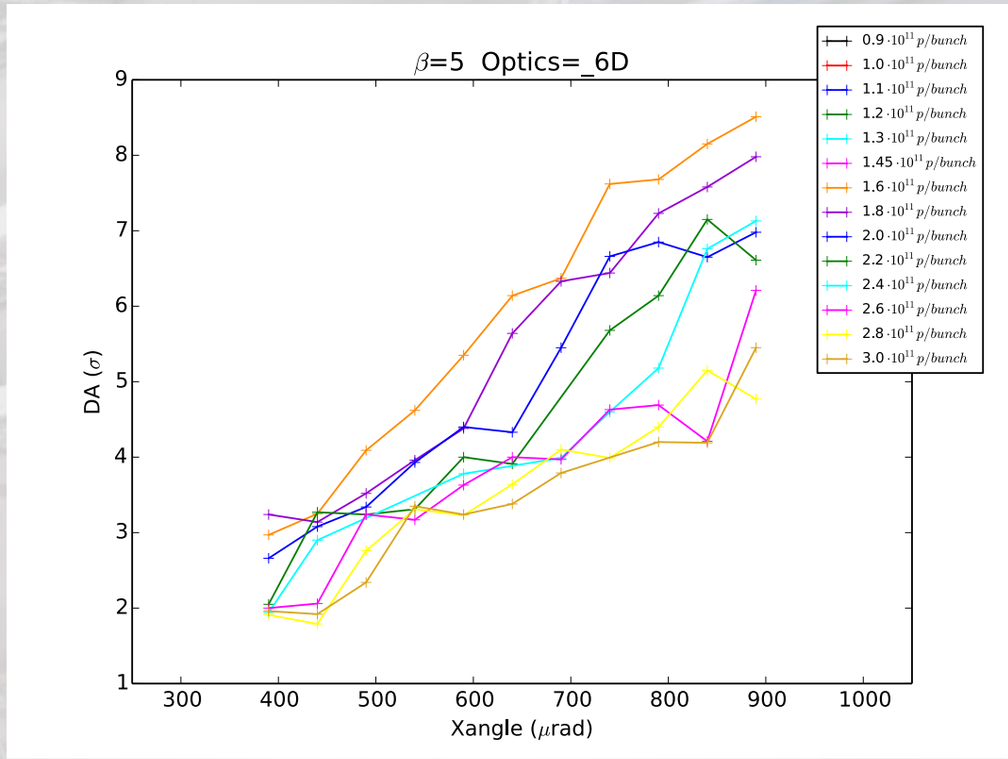


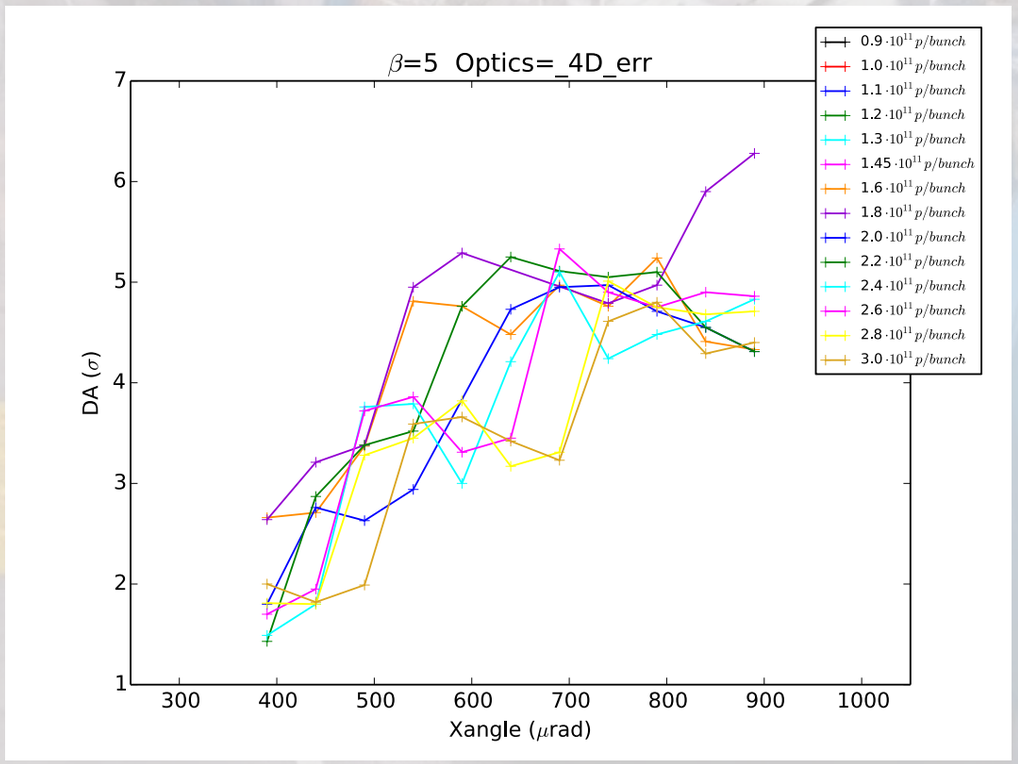


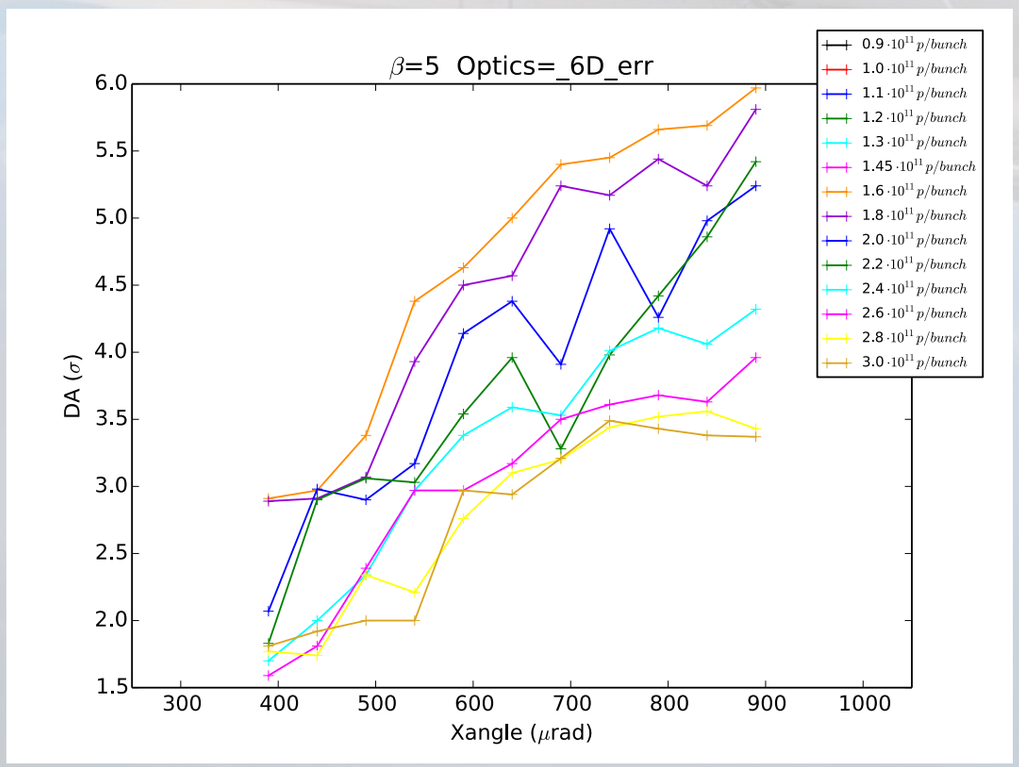


Analysis Summary

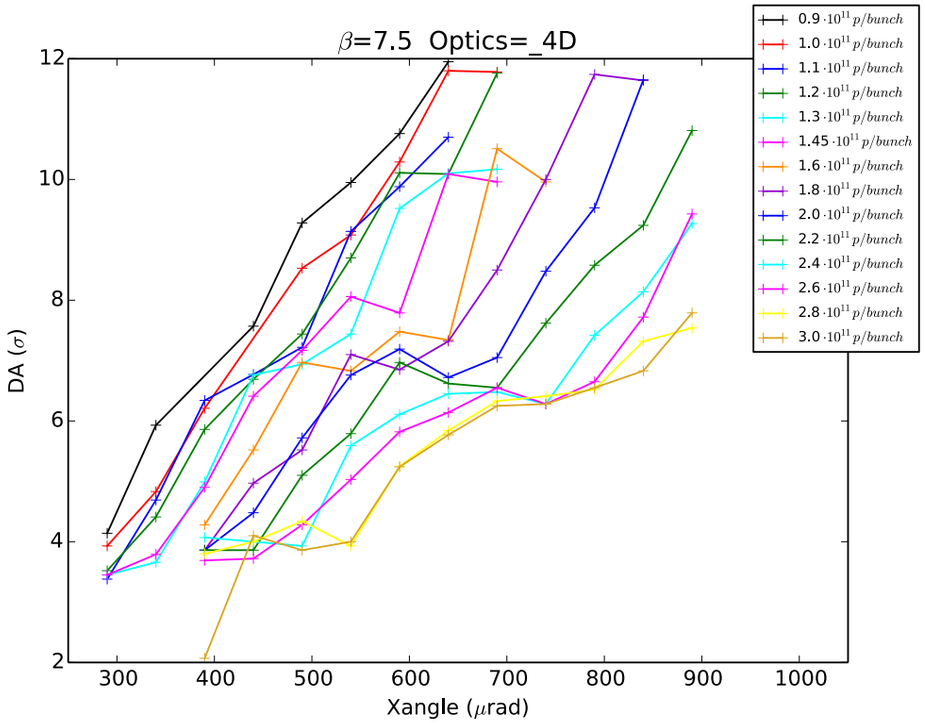


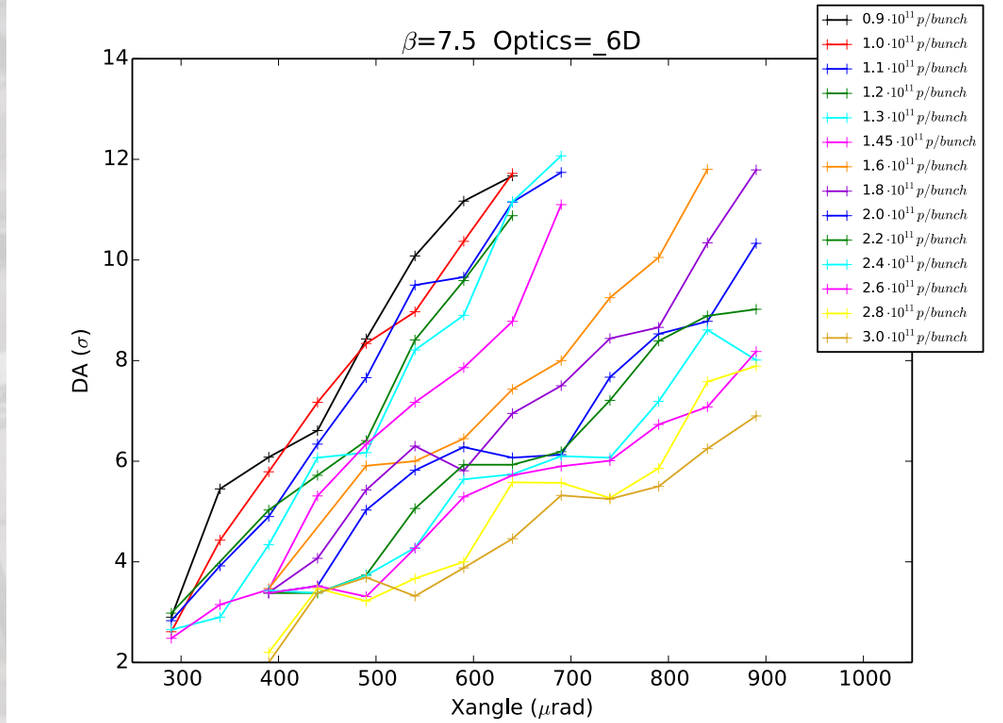


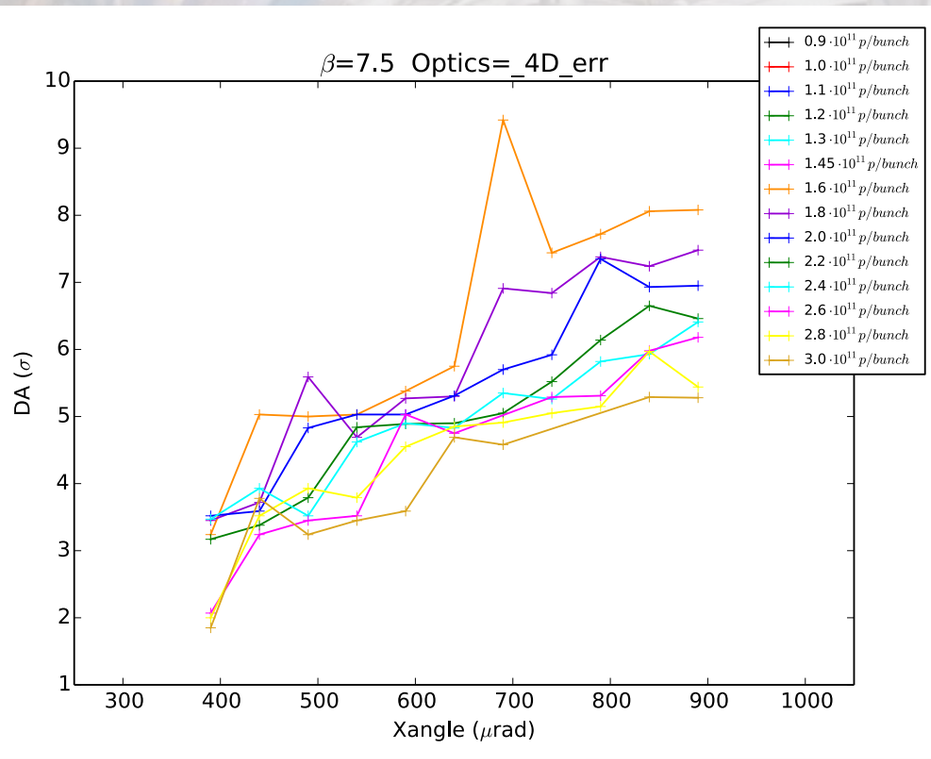


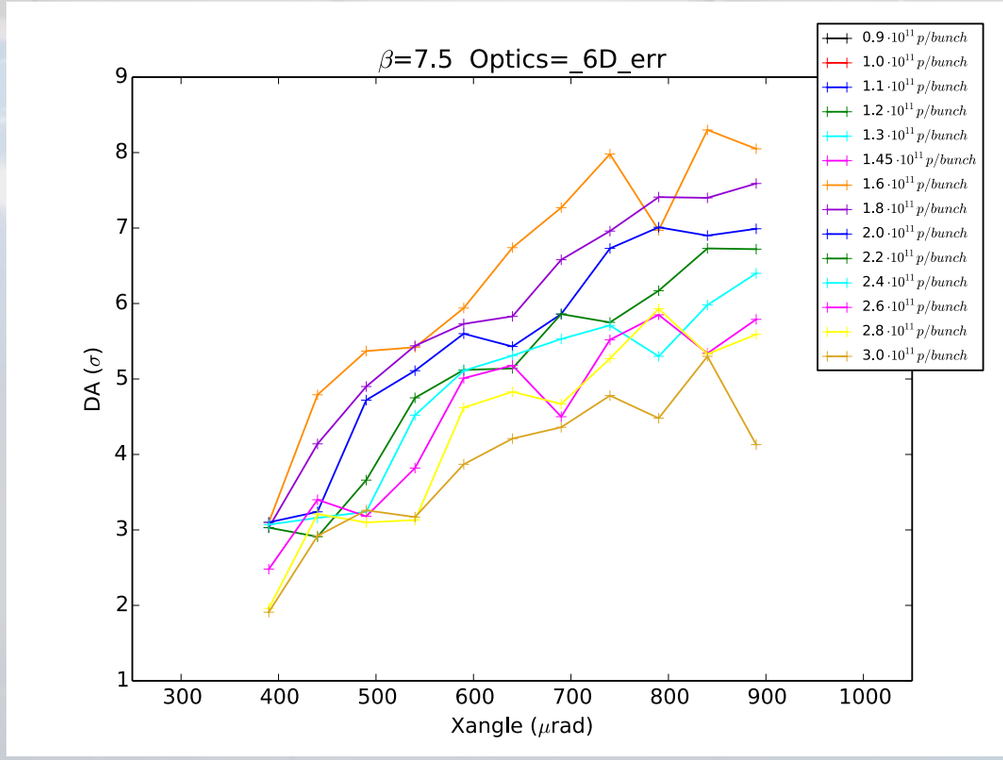


Analysis Summary

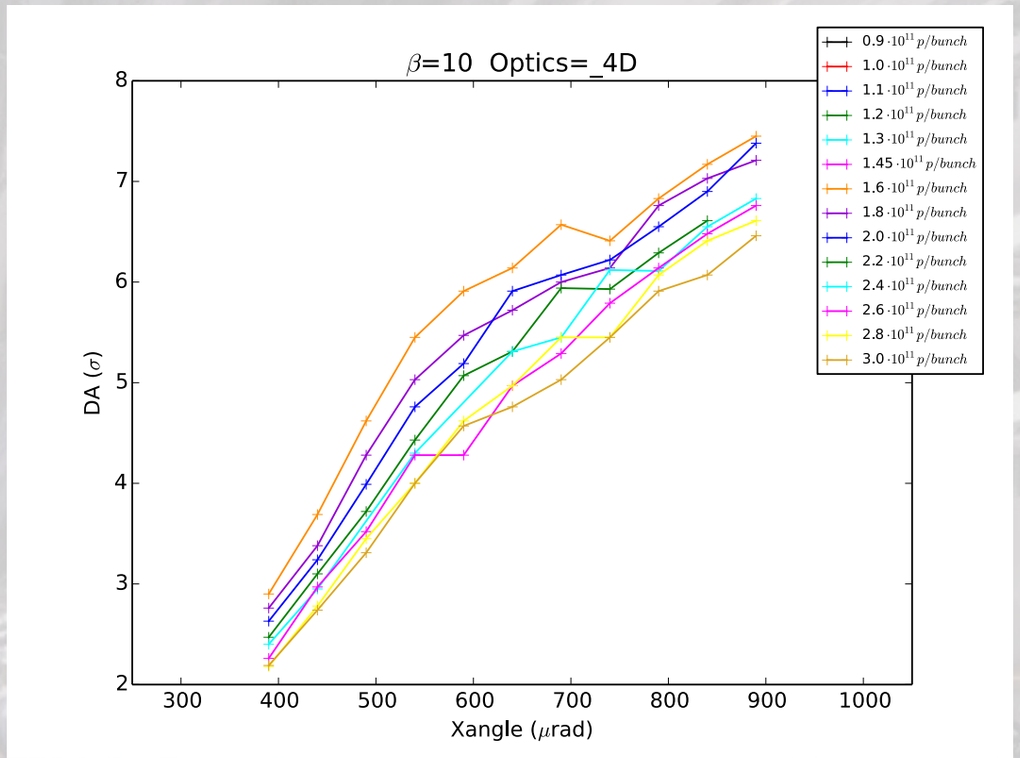


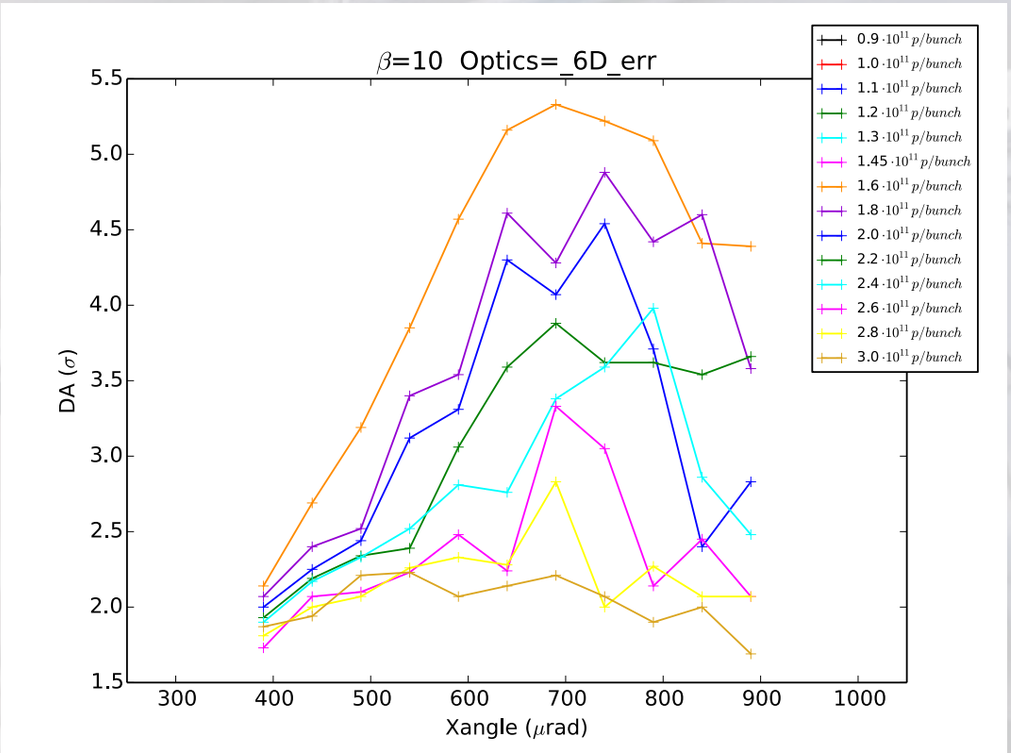


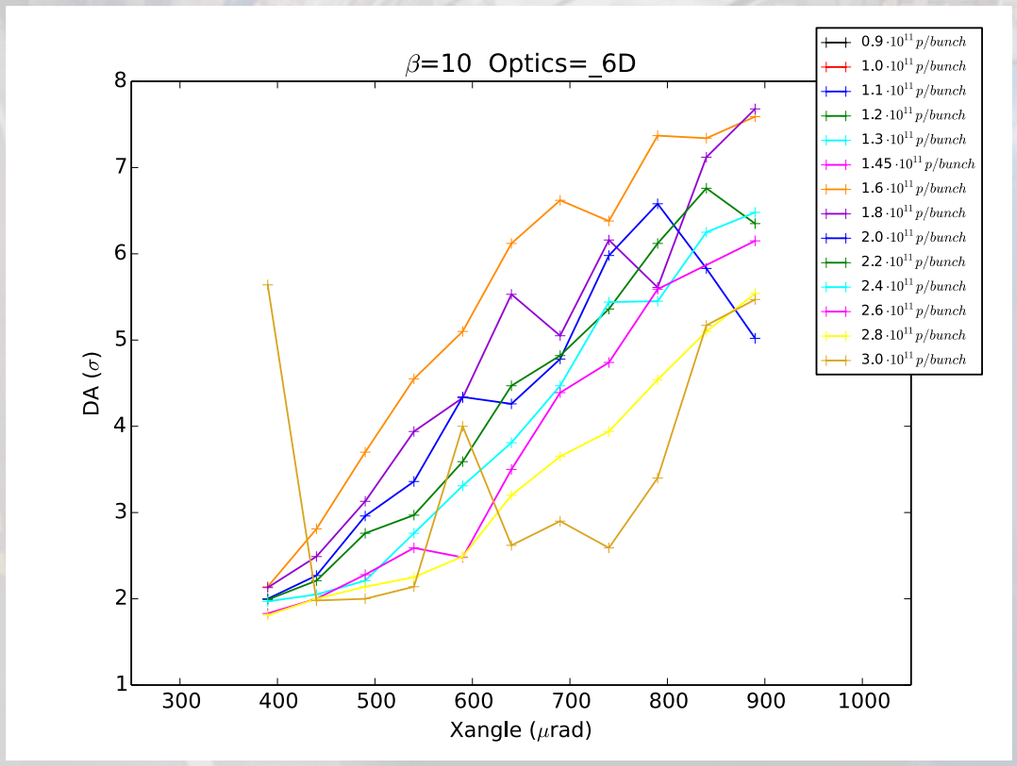


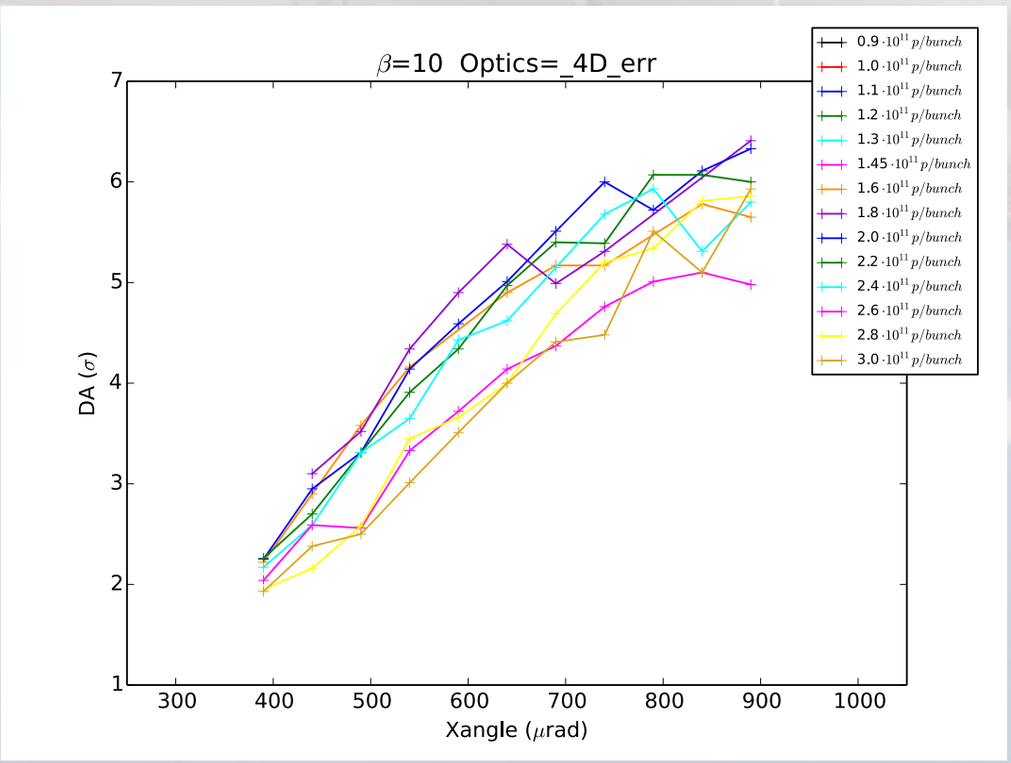


Analysis Summary

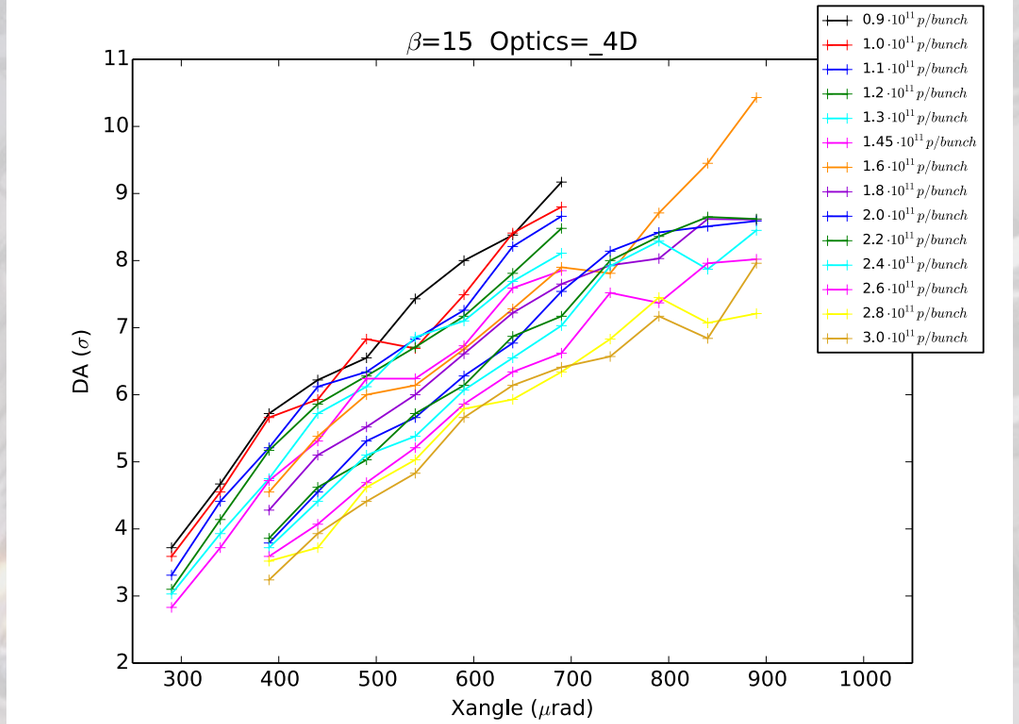


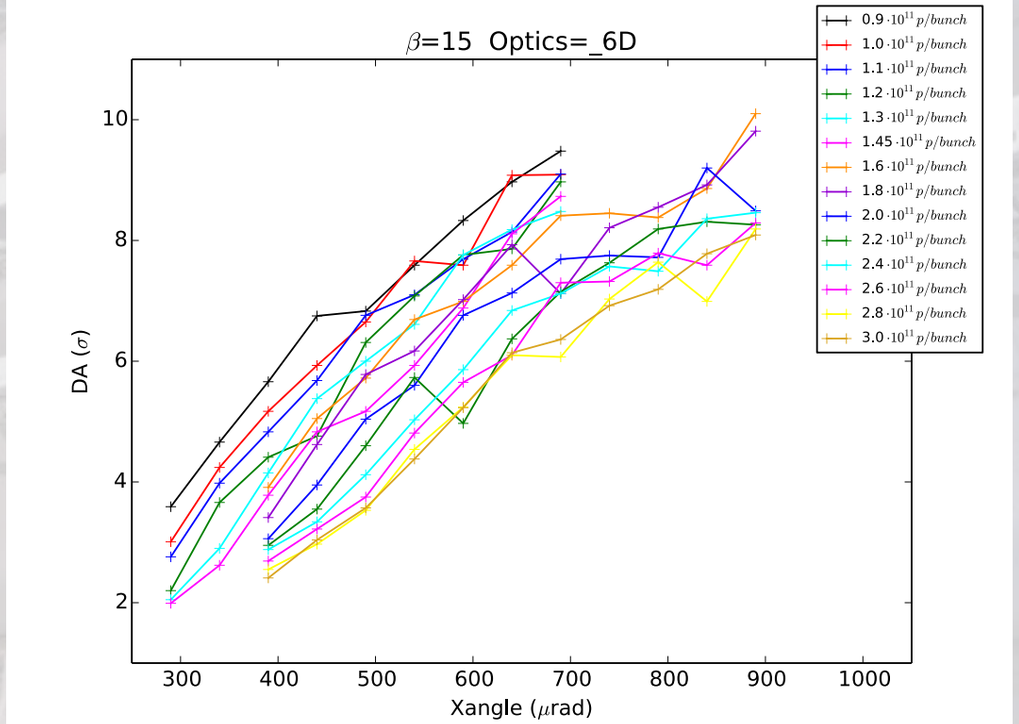


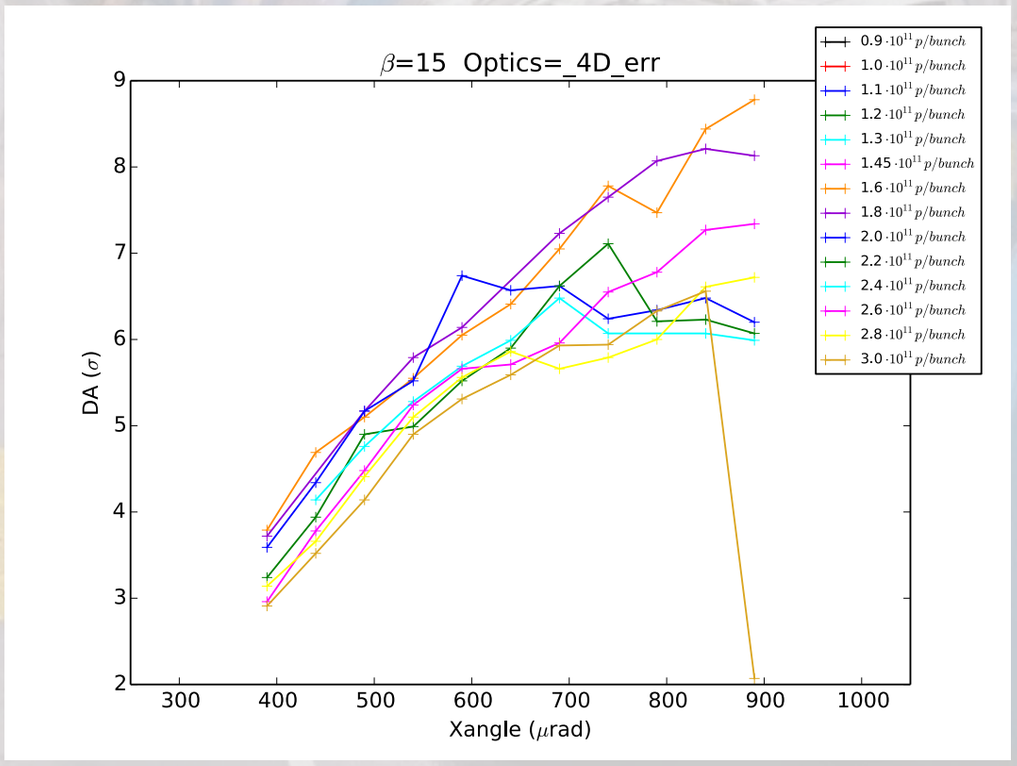


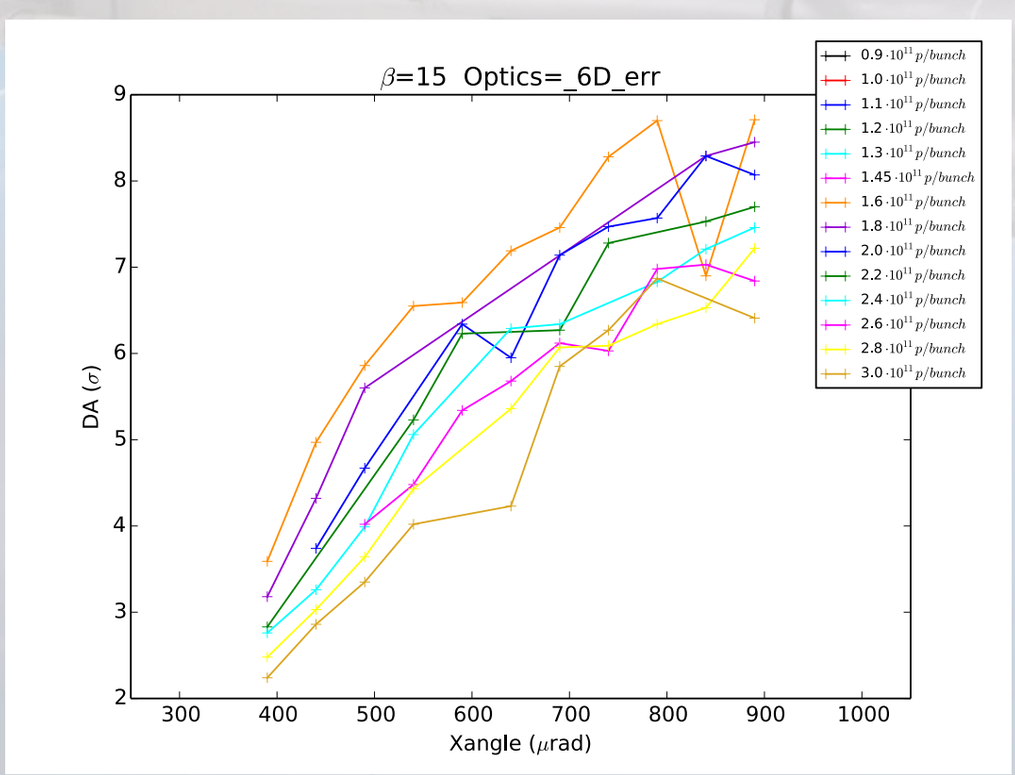


Analysis Summary

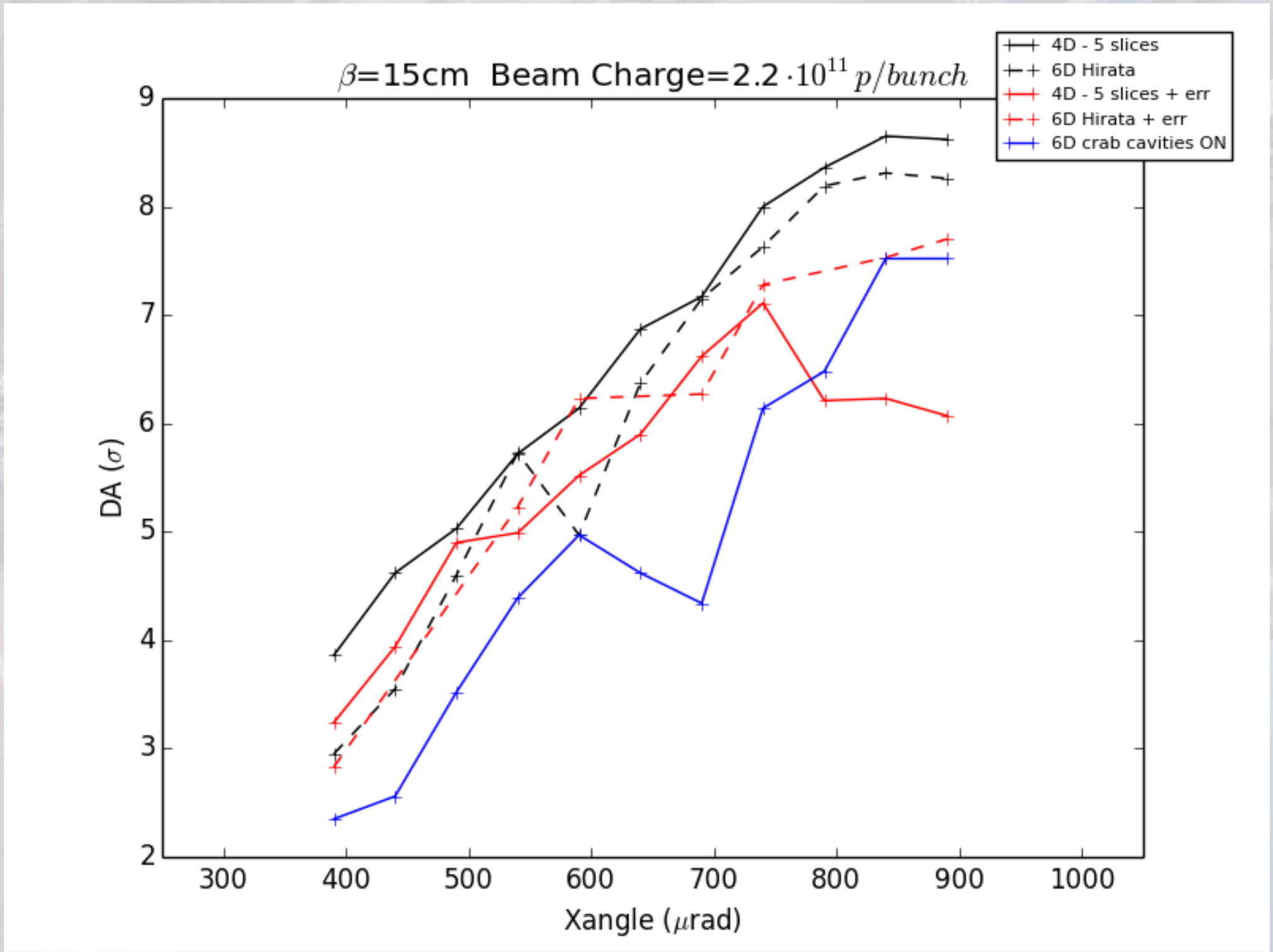




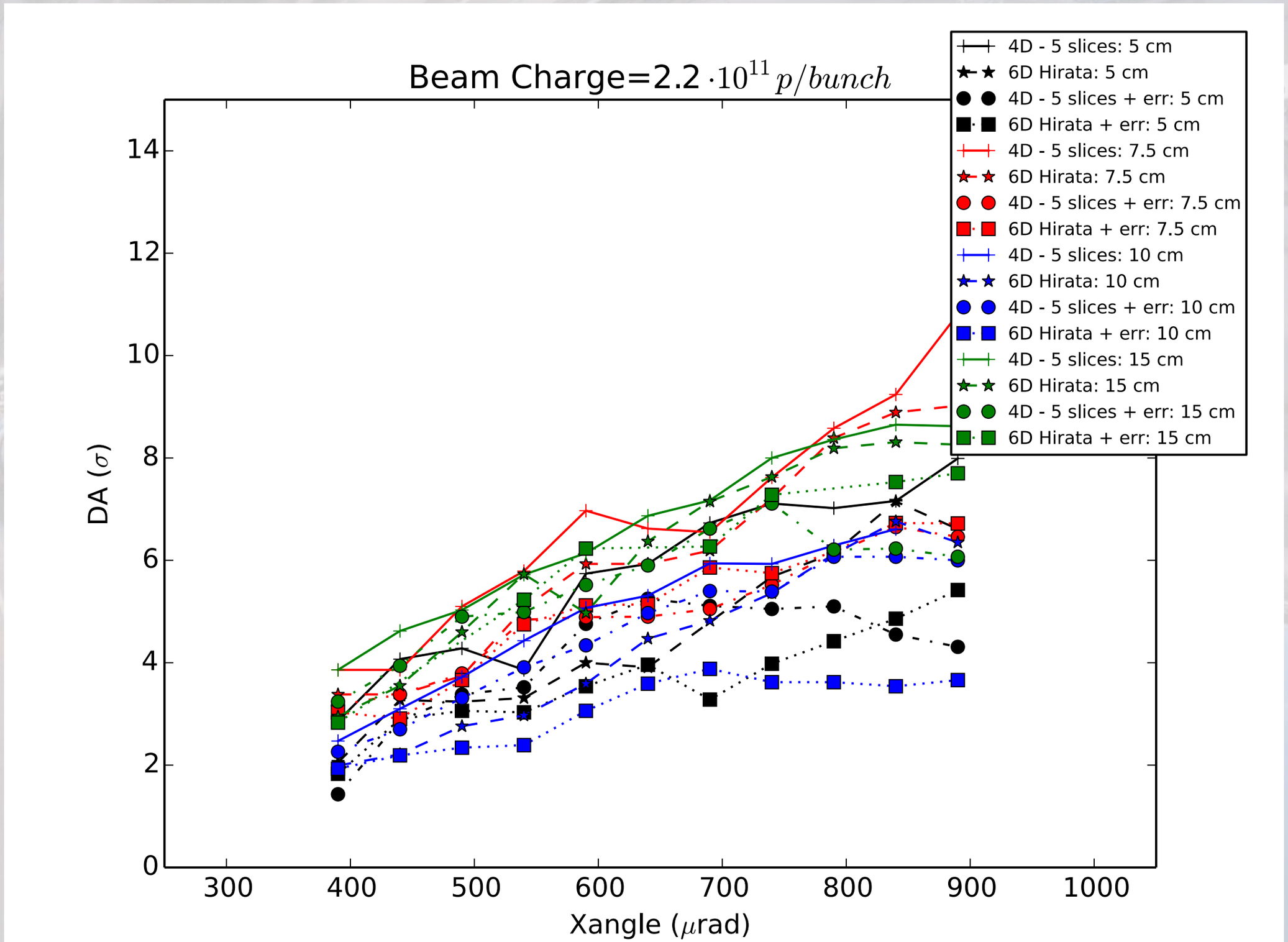




Crab Cavities



Analysis Summary



Conclusions

-HiLumi optics tested with BB 4D and 6D

-First studies with errors show important impact, to be understood

- BOINC system (almost) fully efficient: standard DA study possible in week time

- Several SixTrack checks (ex: 6D BB lens, Frequency Map Analysis implemented, crab crossing...) done by Javier Barranco and not presented here

Perspective

- Check and document b1 and b2 implementation for flat beams (Laface implementation)

-Test intermediate round optic when available to understand the DA degradation

-Further studies with different error configurations

-Keep benchmarking with LifeTrack

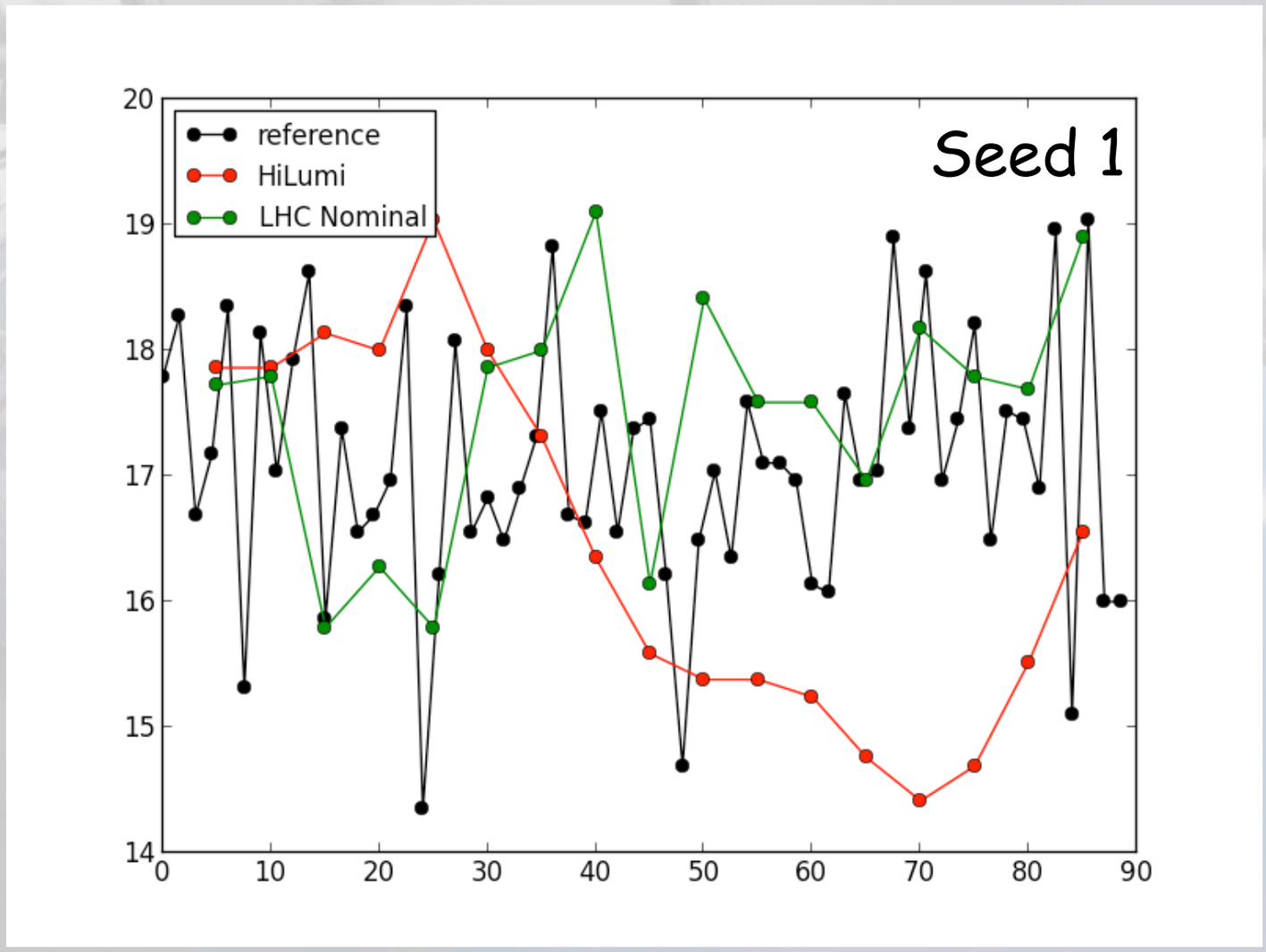
-Reproduce LHC long range MDs and start studies with crab crossing (for Daresbury Meeting)

BackUp Slides

Error

Used error as in slhcv3.1b_check2.mask , nominal error for all LHC magnets + HL magnets
(https://espace.cern.ch/HiLumi/WP2/task3/SitePages/Simulations.aspx.)

```
! New IT/D1/D2/Q4/Q5
myseed=%SEEDRAN;
eoption,seed=myseed+101;call, file="slhc/errors/Efcomp_MQXCD.madx";      ! new IT in IR1/5
eoption,seed=myseed+102;call, file="slhc/errors/Efcomp_MBXAB.madx" ;     ! new D1 in IR1/5
eoption,seed=myseed+103;call, file="slhc/errors/Efcomp_MBRD.madx" ;      ! new D2 in IR1/5
eoption,seed=myseed+104;call, file="slhc/errors/Efcomp_MQYY.madx" ;      ! new Q4 in IR1/5
eoption,seed=myseed+105;call, file="slhc/errors/Efcomp_MQYL.madx" ;      ! new Q5 in IR1/5/6
exec show_error_newHLmagnet;
```



Slices

Effect of number of SixTrack Slices on DA