CAIN non-linear QED effects and Dec 16 AF03 Report Meeting

Tim Barklow

XFEL $\gamma\gamma$ Collider Meeting

Dec 09, 2020

U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

Definitions

$\sigma_{ex}, \sigma_{ey}, \sigma_{ez}$ = rms of electron bunch population density in x,y,z directions

We call $l_e = 2\sigma_{ez}$ the electron bunch length.

σ_{ex}, σ_{ey} vary with z according to

$$\sigma_{ex}(z) = \sigma_{ex0}\sqrt{1 + z^2 / \beta_{ex}^2} \quad , \quad \sigma_{ey}(z) = \sigma_{ey0}\sqrt{1 + z^2 / \beta_{ey}^2}$$

$\sigma_{\gamma r}, \sigma_{\gamma z}$ = rms of laser photon density distribution in radial and longitudinal directions

We call $l_\gamma = 2\sigma_{\gamma z}$ the laser pulse length.

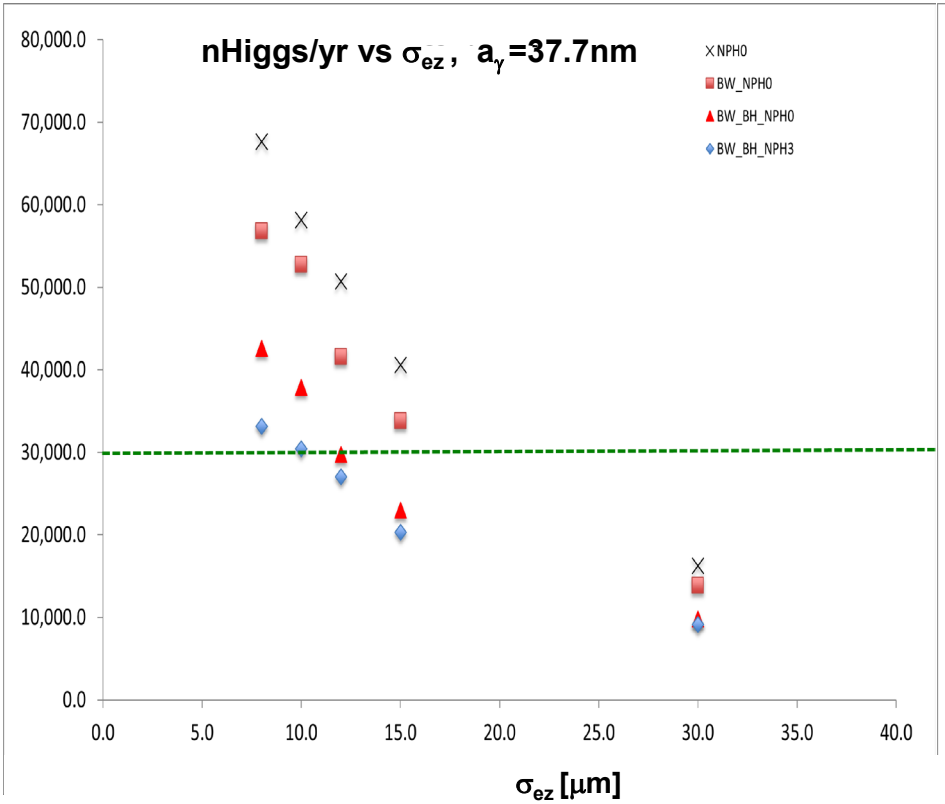
$\sigma_{\gamma r}$ varies with z according to

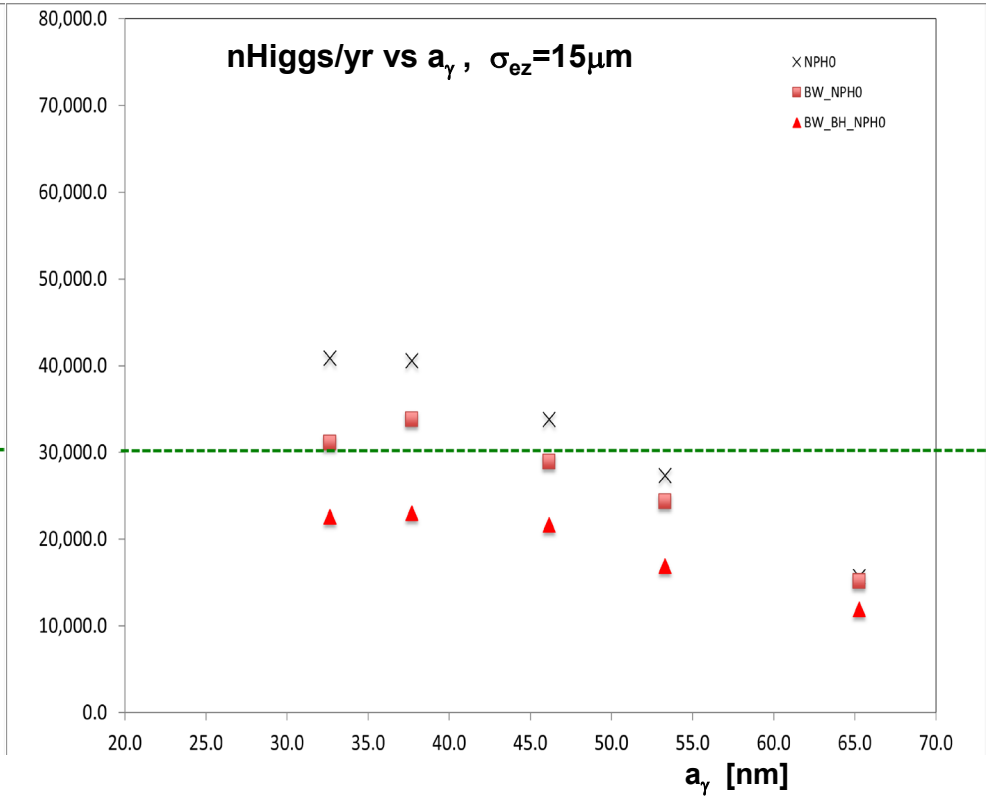
$\sigma_{\gamma r}(z) = a_\gamma\sqrt{1 + z^2 / \beta_\gamma^2}$, where $\beta_\gamma = \dfrac{2\pi a_\gamma^2}{\lambda}$, λ = laser photon wavelength, and

a_γ = rms of laser photon density distribution in radial direction at Compton IP

nHiggs vs σ_{ez} and nHiggs vs a_γ with corrected pulse energy and beam size input to CAIN & proper binning for non-linear QED

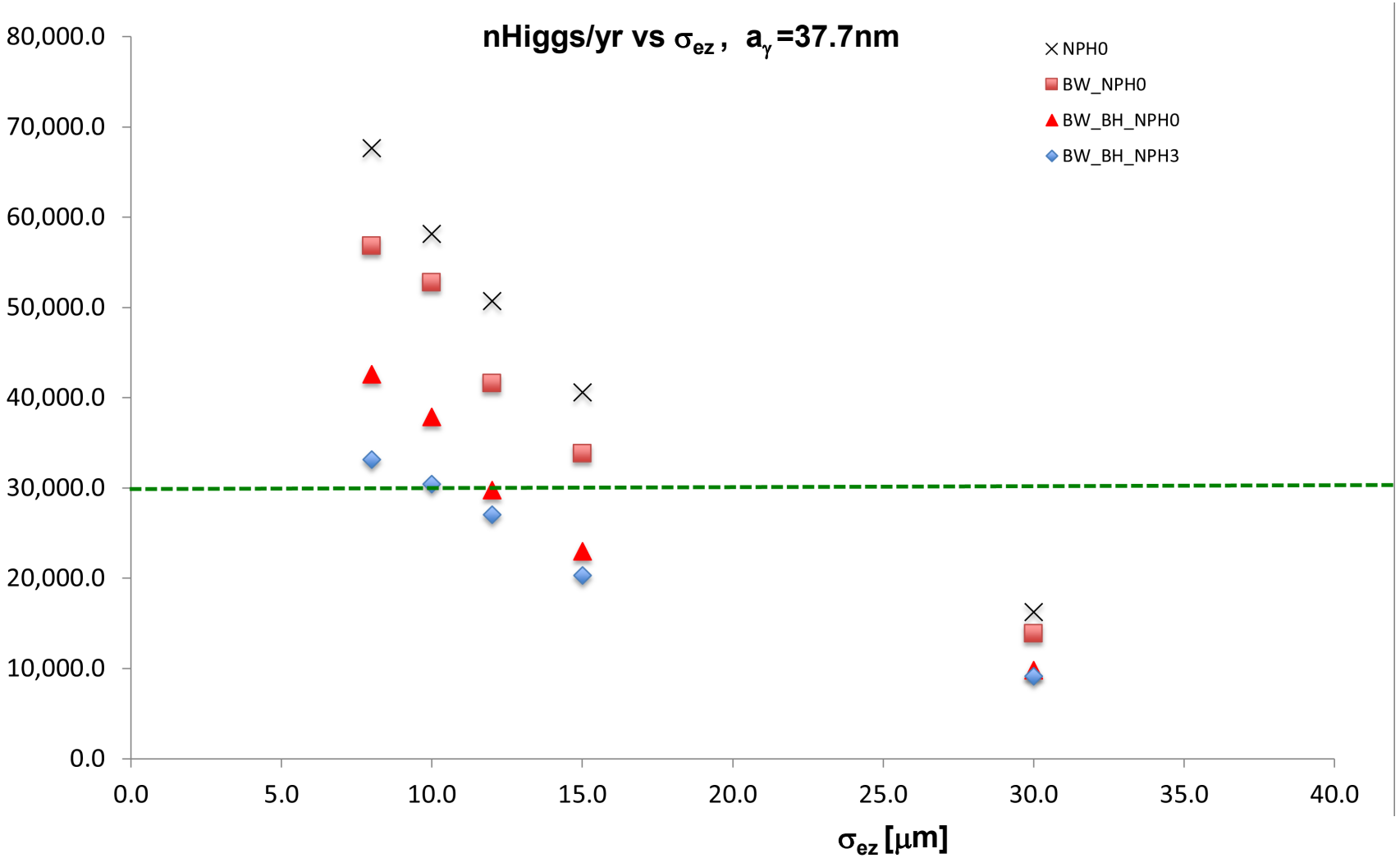
- linear $e^-\gamma_{laser} \rightarrow e^-\gamma$
- linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$
- linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$, $e^-\gamma_{laser} \rightarrow e^-e^+e^-$
- non-linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$, linear $e^-\gamma_{laser} \rightarrow e^-e^+e^-$





nHiggs vs σ_{ez} with corrected pulse energy and beam size input to CAIN & proper binning for non-linear QED

- linear $e^-\gamma_{laser} \rightarrow e^-\gamma$
- linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$
- linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$, $e^-\gamma_{laser} \rightarrow e^-e^+e^-$
- non-linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$, linear $e^-\gamma_{laser} \rightarrow e^-e^+e^-$



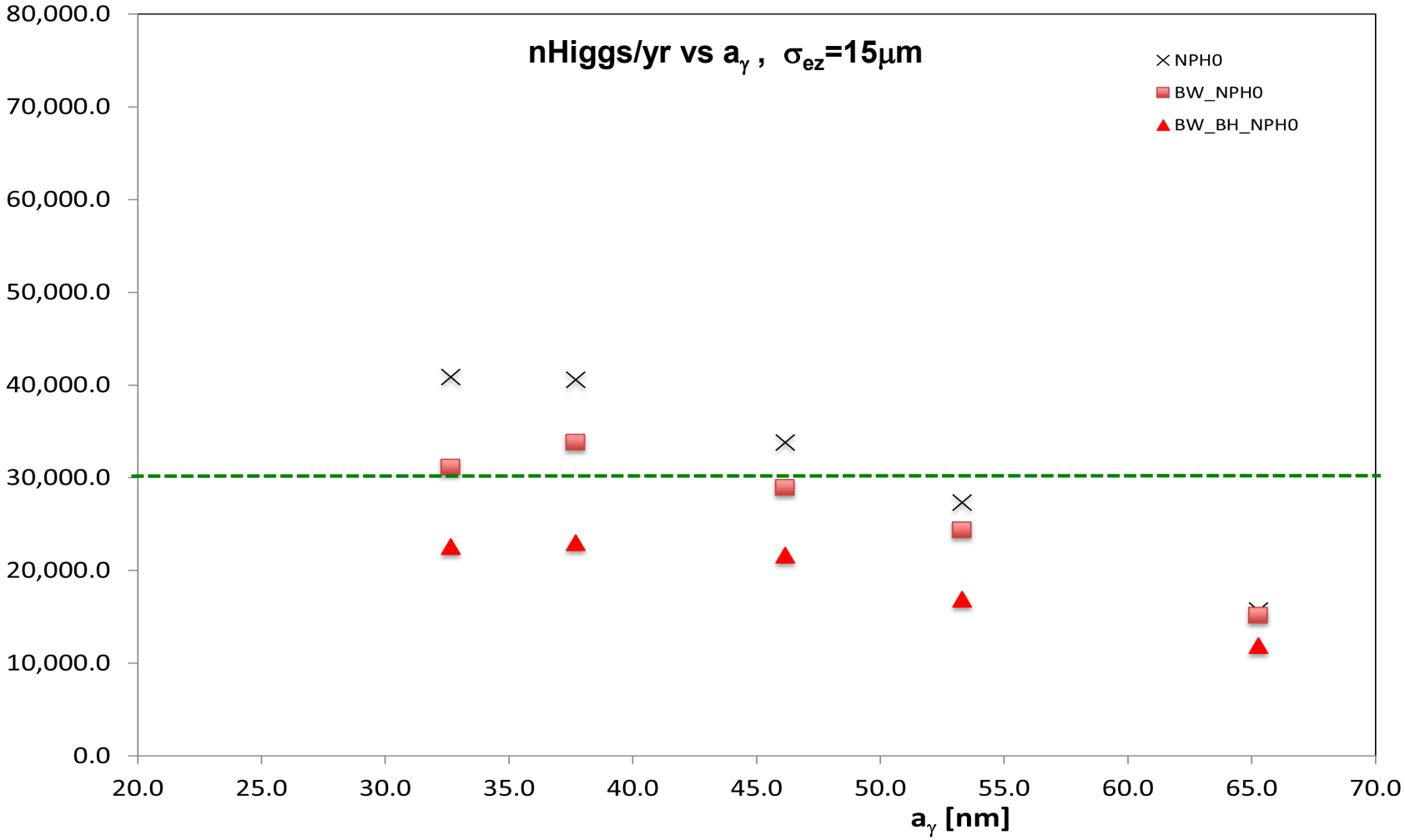
nHiggs vs a_γ with corrected pulse energy and beam size input to CAIN & proper binning for non-linear QED

X linear $e^-\gamma_{laser} \rightarrow e^-\gamma$

linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$

linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$, $e^-\gamma_{laser} \rightarrow e^-e^+e^-$

non-linear $e^-\gamma_{laser} \rightarrow e^-\gamma$, $\gamma_{laser}\gamma \rightarrow e^+e^-$, linear $e^-\gamma_{laser} \rightarrow e^-e^+e^-$



AF03 Meeting on Dec 16, 2020

We propose to convene a teleconference meeting to prepare for the Snowmass 2021 AF03 Report. The purpose of the meeting is to plan the Report and make writing assignments. The AF03 Report will build on the LOI and should include contributions from each team. Please see the attached (draft) Report outline.

Note especially sections 2 and 3, and the (very high-level) executive summary

The meeting agenda will have three parts (1/3:1/3:1/3), roughly corresponding to the 3 Report sections.

1) A presentation on each of the proposed sub-sections (1:10), focused on plans to complete the report (need not be more than a bulleted version of what has already been presented and discussed, LOI, 24 June 2020, and CPM). For each of the sub-sections, it is important for you to submit material a minimum of two weeks ahead of the teleconference to facilitate the development of 'comparative' sections 2 and 3.
2) A structured discussion of plans for section 2. For the discussion, we would like to nominate Frank to coordinate the synthesis of common technology needs/challenges.
3) Similar for the above, for section 3. We would like to nominate Steinar, Mark, and Akira, to coordinate the synthesis of timelines, cost-comparisons, and staging toward the future.

Please RSVP. We should plan to re-convene in two months.

Teleconference: Wednesday 16 December 2020, 3 hours. 5 AM PST, 8 AM EST, 2PM CET, 10 PM JST, 9PM China. Zoom connection details to follow.