

**Subject: MDI panel response to CCR**  
**From: Hitoshi Yamamoto**  
**To: Nobu Toge**  
**Date: Sat, 19 Aug 2006 18:56:13 +0900**

Dear CCB,

I think it is still Friday in Hawaii.  
Here is the response from MDI panel to the BDS CCR.

Best

- Hitoshi

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#### 1. 14mrad crossing angle

For physics, the mode that is most affected by the crossing angle is the slepton pair production where the slepton-LSP mass difference is small (so-called co-annihilation region). Here, the main background is 2-photon processes and an efficient low-angle electron tag by BEAMCAL is needed to veto them. There are several studies and the difference in the amount of expected background is now understood as the different levels of simulation for the veto efficiency. The study using full simulation shows that the signal to noise will be about 4 to 1 for the nominal machine parameter case with 2mrad crossing angle (for a given SUSY parameters).

For a large crossing angle (14 or 20mrad), anti-DID is needed to collimate the pair background along the outgoing beam. For 14mrad crossing with be comparable to the 2mrad case while the signal efficiency reduces by about 30% to 40%. This is mainly due to the 2nd hole of BEAMCAL that is needed for the large crossing angle which will force additional cuts to remove the 2-photon and other backgrounds. This is not based on a complete analysis but on a study of the pair background distribution on the BEAMCAL: that for 20mrad crossing with anti-DID was found to be essentially the same as the 2mrad case. A complete analysis is needed for 14mrad with anti-DID, also covering different values of the mass difference (namely, for different SUSY parameter space). Backgrounds considered here is mainly the pair background and a lesser extent Bhabha events. More studies are sorely needed in this area.

With this limited information, the MDI panel thinks that the 14mrad is acceptable as the baseline at this time. However, we would like to stress that the 2mrad crossing angle is clearly desirable than larger crossing angles for the coannihilation region slepton search, and R&Ds related to 2mrad should be encouraged. We also note that the slepton signal above is a representative of physics signals with two slow particles with large missing energy and is not restricted to SUSY scenarios.

nb: The luminosity loss is less than a few % when anti-DID is used regardless of the size and strength of the detector solenoid. And also the rotation of polarization vector within the detector solenoid should be manageable.

#### 2. Single experimental hall

When the crossing angles of the two IR are both 14mrad, the transverse separation between two IRs will be 28.4m. With 3m-thick wall between two IRs, this will give 12.7m from the beamline to the separating wall. Even though this is tight and seems to constrain the design of detector access, it seems to be manageable. There is a concern about the mechanical coupling of the two IRs such as

vibration; the problem, however, seems to be non-critical. Also, there is a possibility of doing without the separating wall using self-shielding detectors. Thus, MDI panel believes that the single experimental hall containing two IRs is acceptable as the baseline.

**Subject: WWS response to the BDS CCR**  
**From: Hitoshi Yamamoto**  
**To: Nobu Toge**  
**Date: Sat, 19 Aug 2006 18:58:41 +0900**

Dear CCB,

Here is the response by WWS to the BDS CCR.

Best

- Hitoshi

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WWS response to CCR

#### 1. Two 14mrad crossing IRs

The proposal indicates that small-angle crossing will not be included in the baseline.

A preliminary study shows that the luminosity needed for the 'coannihilation region' slepton measurement for 14mrad crossing is about twice that for 2mrad crossing, where use of anti-DID is assumed for the 14mrad case. Also, the crab crossing technology, which is needed for 14mrad crossing, is still not firmly established. In addition, for the 14mrad case, there is a luminosity loss of a few % or less due to emittance growth within detector solenoids.

On the other hand, we understand that BDS for 2mrad crossing is substantially more expensive than that for 14mrad crossing, and that there are still some difficulties associated with the magnets for the 2mrad case. Also, the aforementioned study shows that the pair background with 14mrad crossing and anti-DID is as small as with 2mrad crossing.

Thus, WWS can accept 14mrad crossing as baseline at this stage, provided that R&Ds for small-angle crossing continue and is strongly encouraged. Studies of slepton search need to be continued covering wider SUSY parameter space and with more complete levels of simulation, of which WWS will take responsibility of.

#### 2. Single experimental hall containing two IRs

We understand that the essence of this proposal is in having two IRs at the same z location, which seems to force two IRs to be housed in one experimental hall.

Given the machine flexibilities gained by this configuration, we can accept this configuration as baseline at this stage provided that reliable studies of vibrations caused by activities on one IR reaching another IR. This may involve radiation safety issues. The operational assumptions such as detector assembly/upgrade and maintenance would have to be specified for such studies, and the WWS is

eager to work with the GDE.

We were told that a new CCR which proposes surface assembly of detector will be submitted soon. This will have a large impact on the timeline, general design and operation of the detectors, and we are looking forward to close collaboration with the GDE on this matter as well.

**Subject:** Re: MDI/WWS panel responses to CCB on BDS CCR  
**From:** Hitoshi Yamamoto  
**To:** N.Toge  
**Date:** Mon, 21 Aug 2006 13:08:15 +0900

Dear Nobu,

Thank you for reading the reports carefully. Here are replies to your questions.

Cheers

- Hitoshi

On 2006/08/20, at 19:32, N.Toge wrote:

> Dear Hitoshi,  
>  
> Thank you for transmitting the responses from MDI and responses  
> from WWS on the BDS CCR.  
>  
> The WWS comments are very cleanly stated. I have only one question  
> at this moment.  
>  
> 1. Two 14mad crossing angle  
> 1a. Please, give us a short description of the following technical  
> term for non physics experts within CCB, me included.  
>  
> - "coannihilation region" slepton measurement

This is a region of the SUSY parameter space which is allowed by cosmological constraints and corresponds to small slepton-LSP mass difference (typically 5 GeV is used for simulation).

> On the MDI remarks to WWS, I have a few more questions.  
>  
> 2. 14mrad crossing angle  
>  
> 2a. Please, give us short descriptions of the following technical  
> terms on detectors at ILC, for non physics experts within  
> CCB, me included.  
>  
> - BEAMCAL

This is the calorimeter at the smallest angle wrt beamline. It is the key element to tag the two-photon background in the slepton measurement.

> - anti-DID  
>

DID stands for 'Detector-Integrated Solenoid'.

DID (anti-DID) is wound on the detector solenoid to make the incoming (outgoing) beam parallel to the B field. Anti-DID thus collimates the pair background along the direction of the outgoing beam which minimizes the pair background hitting detector elements.

DID was originally 'invented' to remove the emittance growth and polarization rotation before the collision, but the effect is now understood to be manageable without it (or with anti-DID)

- > 2b. In paragraph 2 under "Two 14mrad IRs" in "WWS response to CCR"
- > states that the luminosity needed for coannihilation region slepton
- > measurement for 14mrad case is about twice that for 2mrad crossing.
- >
- > On the other hand, paragraph 1 under "14mrad crossing angle"
- > in "MDI response", states that with anti-DID at 14mrad, the background
- > level is comparable to 2mrad yet the signal efficiency is
- > less by 30 - 40%.
- >
- > Are you concluding that an efficiency reduction of 30-40% translates
- > into the increased luminosity requirement of "about twice" ?
- > I thought that it would be additional 40-60% luminosity demand.
- > Or are you taking possibly the different background condition
- > into your consideration?
- >

In the MDI response, the background considered there was the pair background only. There are however other backgrounds including Bhabhas which favors the 2mrad crossing even further. The study of 'other backgrounds' are very preliminary and we certainly need more studies.

- > 2c. Under "NB:" at the bottom of "14mrad crossing angle" the "MDI
- > response" is referring to the luminosity loss being "a few %
- > when anti-DID is used". Do I take it correctly by this you are
- > referring to the luminosity reduction as caused by the introduction
- > of anti-DID" or "simple geometric factor" or others?
- > But this seems different from the "luminosity" that you are
- > referring to in 2b. If so, what is it?
- > Please, clarify.
- >

With anti-DID, the outgoing beam becomes parallel to the B field for both beams, but it increases the transverse component of B field for the incoming beams. This results in emittance growth due to SR, corresponding to a luminosity loss of a few % or less. This is considered acceptable. For 20mrad with anti-DID, this luminosity loss will be more than 10% and we think full anti-DID is not a viable solution for 20mrad (thus forcing a compromised setting of the anti-DID field).

**END**