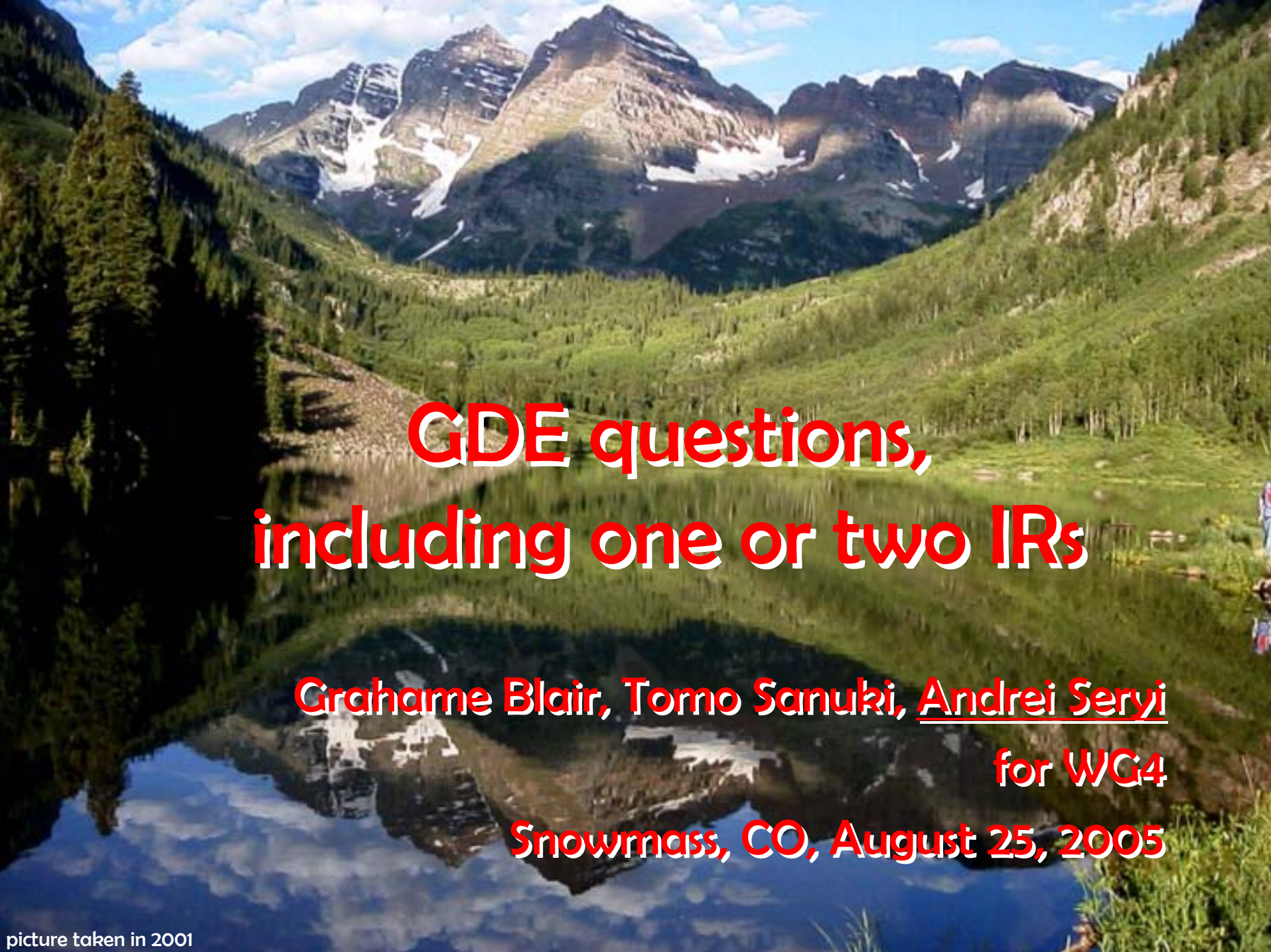

GDE questions, including one or two IRs

Grahame Blair, Tomo Sanuki, Andrei Seryi

for WG4

Snowmass, CO, August 25, 2005

picture taken in 2001

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GDE questions related to WG4

ID	Decisions	product	Input needed from	Input needed from	Input needed from	Input needed from		
2	beam and luminosity parameters. All groups involved	2	GG1-params	GG3-Ops	WG4-BDS	GG6-options		
3	main linac starting gradient, upgrade gradient, and upgrade path	3	GG5-cost	WG5-Cavitie	GG1-params	WG2-Linac	GG3-Ops	GG4-civil
4	straight or follow earth's curvature?	2	GG5-cost	GG4-civil	WG1-LET	WG4-BDS		
5	1 or 2 IRs, if two, run interleaved?	3	GG5-cost	WG4-BDS	GG6-options	WWS	GG4-civil	
6	1, 1.5, or 2 tunnel	1	GG5-cost	GG3-Ops	WG2-Linac	GG4-civil	GG2-Instr+ctrl	
7	DR size and shape	2	GG5-cost	WG3b-DR	GG1-params	GG6-options	WG1-LET	
8	e+ source type conv/undulator/compton	4	GG5-cost	WG3a-sourc	GG3-Ops	WG3b-DR	GG4-civil	GG6-optio
9	is there an e+ pre damping ring	6	GG5-cost	GG1-param:	WG3b-DR	WG3a-source	GG4-civil	
10	DR location: 1st half tunnel, 2nd half, ceiling, under cryomodules, separate tunnel	2	GG5-cost	GG1-param:	GG3-Ops	WG3b-DR	WG1-LET	WG2-Lina
11	cavity shape/iris size	3	GG5-cost	WG5-Cavitie	WG1-LET	WG2-Linac		
15	crossing angle	2	WG4-BDS	GG4-civil	GG6-options			
17	bunch/train structure	4	GG1-params	WG5-Cavities				
21	gamma-gamma upgrade path	8	WG4-BDS	GG6-options	WG3b-DR	GG1-params		
34	optimize L*	12	WG4-BDS	GG6-options				
35	tail folding octupoles in BDS?	12	WG1-LET	WG4-BDS				
37	collimation stragegy - passive? Order of E and beta	18	WG1-LET	WG4-BDS				
40	FF optics: traditional/local correction	18	WG4-BDS					

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GDE questions related to WG4

- beam and luminosity parameters
- straight or follow earth's curvature?
- 1 or 2 IRs, if two, run interleaved?
- crossing angle
- bunch train structure
- gamma-gamma upgrade path

see below

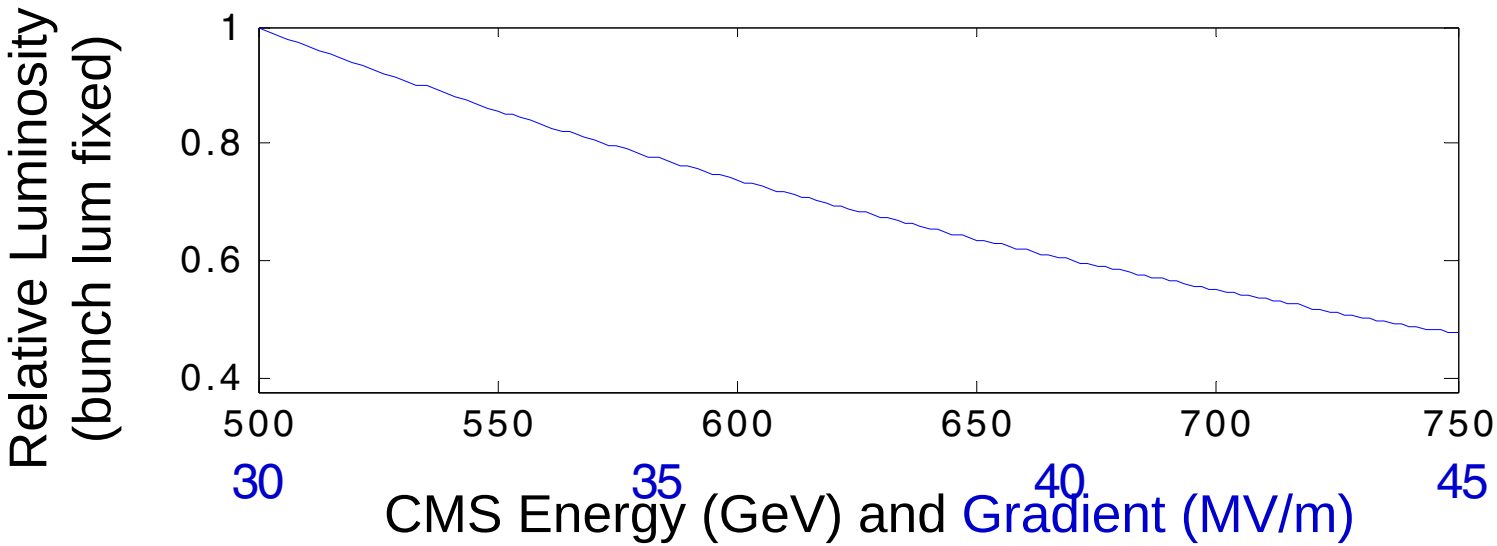
- optimize L*
  - consider range 3.5-4.5m (depend on x-ing angle)
- tail folding octupoles in BDS?
  - yes, included in BDS; collimation must work without them
- collimation strategy - passive? Order of E and beta
  - passive spoiler (survive 2bunch at 500GeV CM, one at 1TeV CM); first beta, then E; detection of E-error by separate chicane in diagnostics section, one bunch (337ns) may go through
- FF optics: traditional/local correction
  - local correction

beam and luminosity parameters

- **Nominal parameters are acceptable**
- **Parameter sets which have large beamstrahlung, may turn out to be not working from the point of view of extraction line energy acceptance and from background (pairs hitting vertex)**
- **High Lumi 1TeV set is not working. Alternative set suggested. Need feedback from DR & LET.**
- **Alternative set for high L 500GeV CM will be suggested**
- **Some other sets (e.g. Low P) may have the same problems (not evaluated in details)**
- **Low Q option is good for background (but Nbunches may be concern for DR?)**

beam and luminosity parameters (cont'd)

- From WG2 summary by Chris Adolphsen: "If decrease current by reducing number of bunches, achieve the following energy reach assuming ~ 50% cooling overhead used and no Q variation with gradient (could lower rep rate if needed). (Assumed that in 10 years, which is probably the earliest the machine could be built, that 45 MV/m could be reached routinely)."
- For 1TeV linac, the energy reach is then 1.5TeV, with 70% of charge ???
- To what max energy/disruption should we spec the hardware: layout, design of BDS beamlines (including in particular the extraction lines and SC quad)?
- Is it 500GeV, 1TeV, 35/31.5*1TeV, or 45/31.5*1TeV?



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straight or follow earth's curvature?

- **Prefer not to have any vertical angle between linac and BDS**
  - **this may be useful if one need to upgrade BDS, add collimation section, or diagnostics section**
  - **if multi-TeV compatibility is considered, preferable not to have vertical angle within some region around IR (for example +-5km? – to be evaluated)**

Bunch train structure

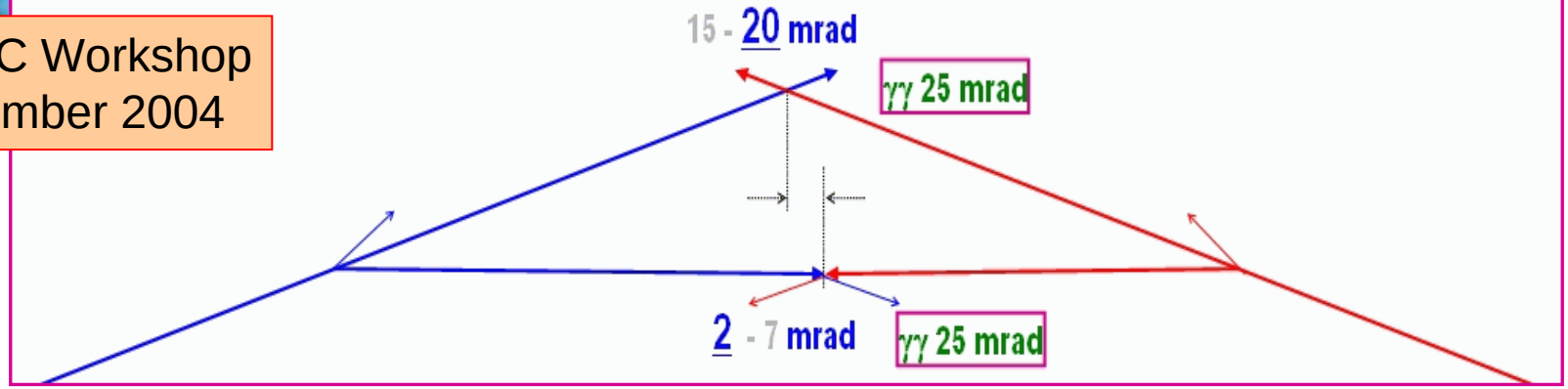
- With collider hall separated by dZ in baseline…
- and with undulator e+ source…
- and with fast (train to train) interleaved operation..
- There may be difficulties providing collisions at both detectors with different (/2 or *2) time separation

- Considering that fast interleaved operation is excluded (?) …
- DR need to have turn around for feedforward…
- => it should be possible to provide collisions regardless of train structure (may need additional turn-arounds)

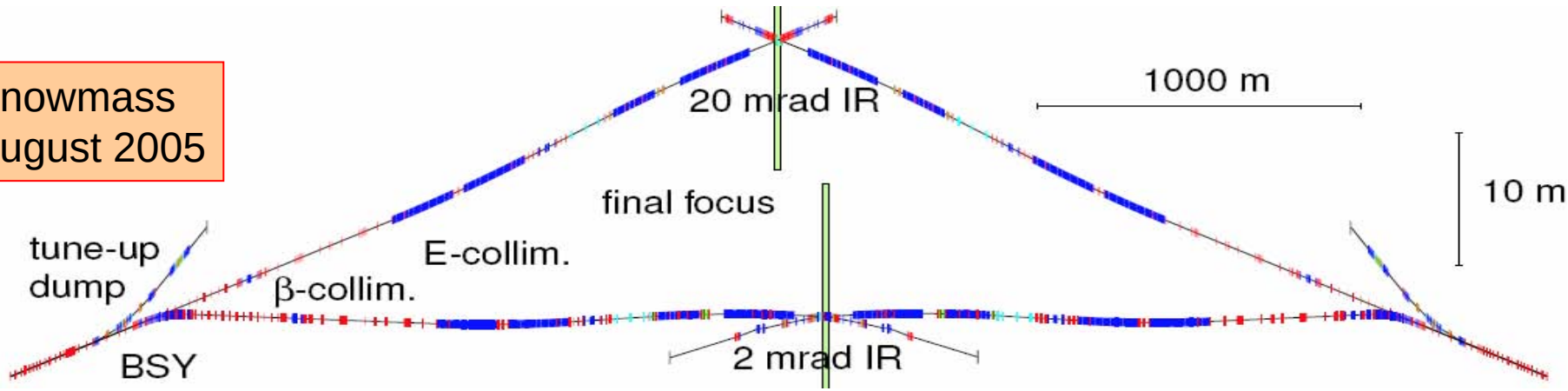
Recommendations from the WG4

Tentative, not frozen configuration, working hypotheses, "strawman"

1st ILC Workshop
November 2004



Snowmass
August 2005



Strawman tentative configuration turns into real design: Full optics for all beamlines; Mature 20mrad optics and magnets design; Several iteration of optics for 2mrad IR; Upstream and downstream diagnostics for both IRs

Baseline: two BDSs, 20/2mr, 2 detectors, 2 longitudinally separated IR halls

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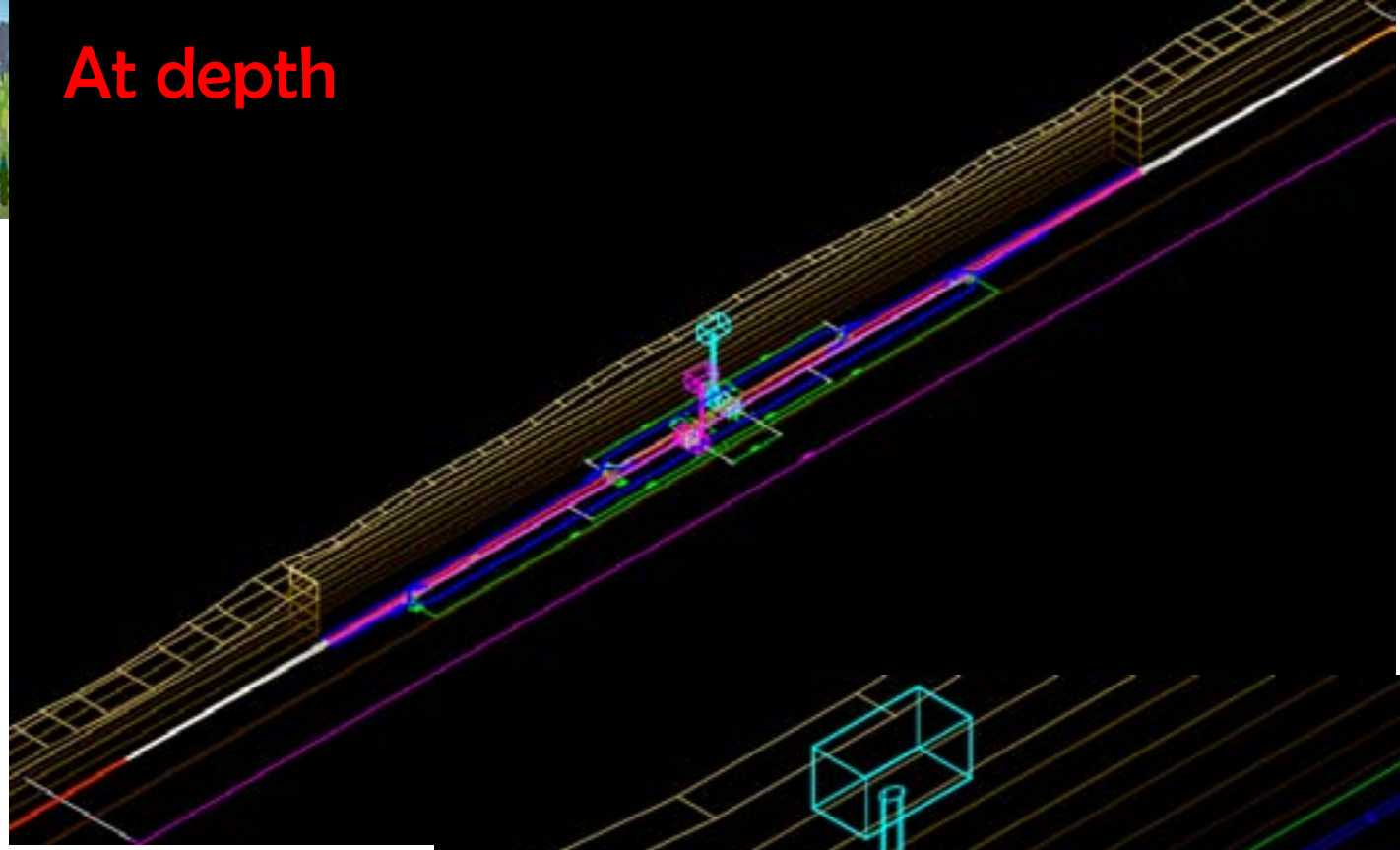
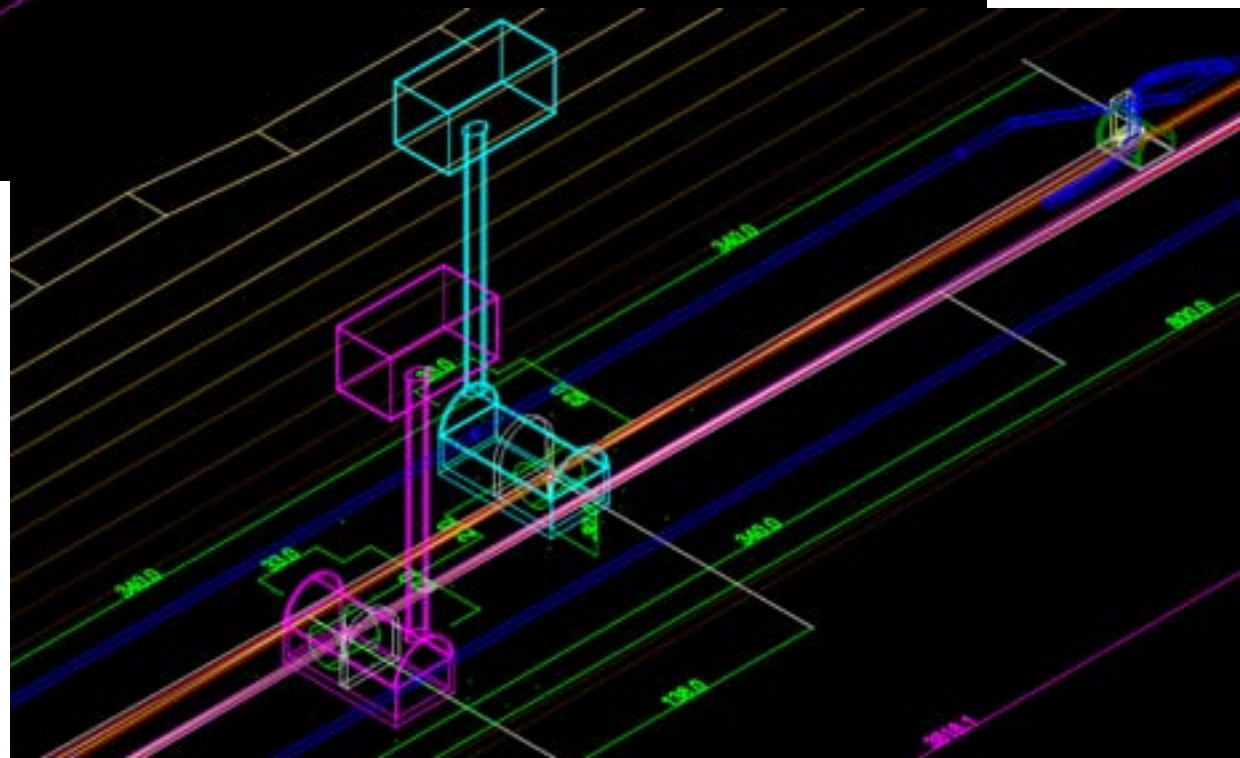
At depth





CF cost saving is most significant for deep configuration

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One or two IRs, crossing angle Baseline & Alternatives

- **Baseline: two BDSs, 20/2mr, 2 detectors, 2 longitudinally separated IR halls**
  - **$\gamma\gamma$ assumed to work at 20mr**
- **Alternative 1: two BDSs, 20/2mr, 2 detectors in 1 IR hall @ Z=0**
  - **pro: civil engineering savings, no constraints on bunch separation**
  - **con: vibration issues/operational & installation constraints**
- **Alternative 2: single IR/BDS, wide enough for 2 push-pull detectors**
  - **pro: cost savings, no constraints on bunch separation**
  - **con:**
    - vibration issues/operational & installation constraints
    - GG6: $\gamma\gamma$ may not be feasible since need long & invasive modifications of IR implying very long switch over time
  - **note:**
    - transforms adiabatically into alternative 1, if required by physics
      - build additional tunnels for 2nd IR with desired configuration (small, intermediate or large angle, for e+e- or $\gamma\gamma$)
      - optimize 2nd IR using experience gained with 1st IR
    - question of one or two detectors is decoupled
      - study technical feasibility & implication of supporting two detectors (wide IR hall?; FD is part of detector for faster detector exchange?, etc…)
- **Intermediate x-ing angle (10-15mr) is a variant for any of the above**
  - **unlikely to be $\gamma\gamma$ compatible**

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Alternative 1

• two BDSs, 20/2mr, 2 detectors in 1 IR hall @ Z=0

• pro: civil engineering savings, no constraints on bunch separation
• con: vibration issues/operational & installation constraints

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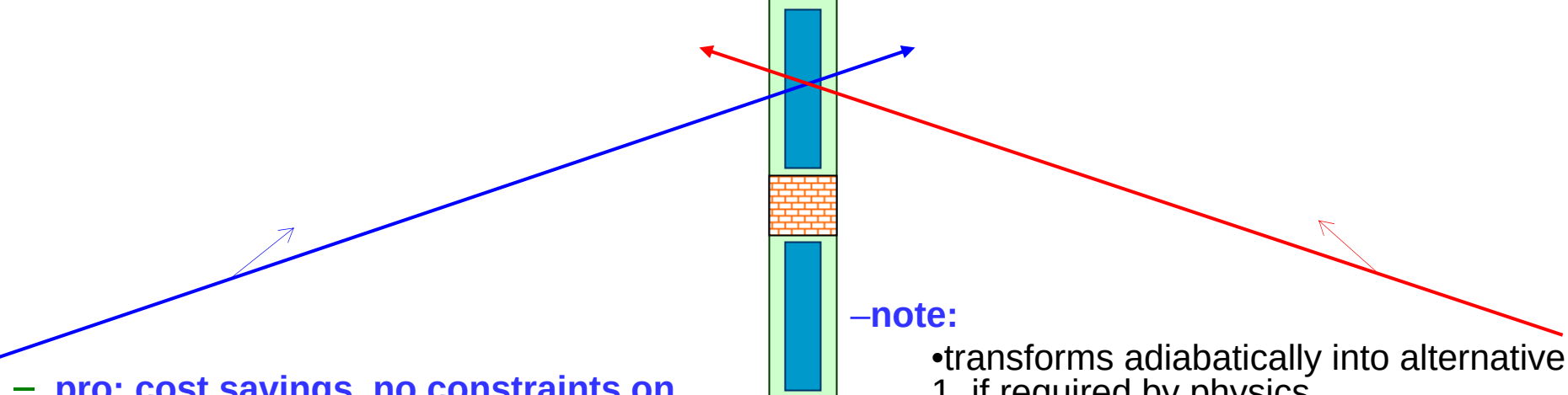
Alternative 2

• Alternative 2: single IR/BDS, wide enough for 2 push-pull detectors



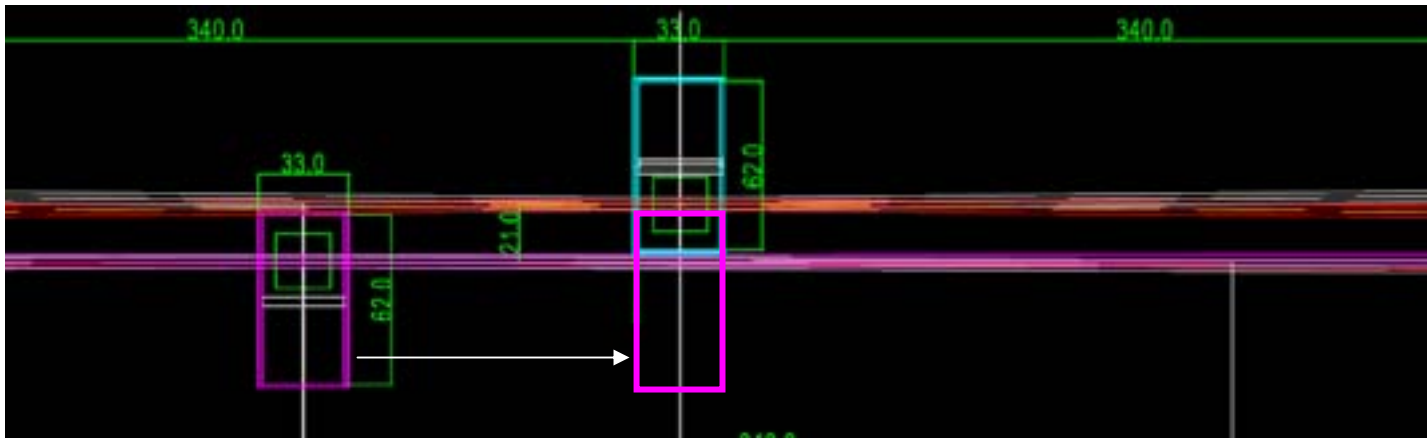
– **pro: cost savings, no constraints on bunch separation**

–**con:**

- •vibration issues/operational & installation constraints
- •GG6: γγ may not be feasible since need long & invasive modifications of IR implying very long switch over time

–**note:**

- •transforms adiabatically into alternative 1, if required by physics
  - –build additional tunnels for 2nd IR with desired configuration (small, intermediate or large angle, for e+e- or γγ)
  - –optimize 2nd IR using experience gained with 1st IR
- •question of one or two detectors is decoupled
  - –study technical feasibility & implication of supporting two detectors (wide IR hall?; FD is part of detector for faster detector exchange?, etc…)



- In near surface configuration, especially with single collider hall, the cost difference of tunnels for 2nd IR may be very small, since anyway may need to remove soil in the entire area wider than tunnel separation, and then build the tunnel structure
- Thus, decision to have tunnels for one or two IRs may be deferred

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R&D for baseline &alternatives

- **For two IRs, the baseline x-ing angle is 20/2mrad**
- **R&D for baseline**
  - **compact SC quad, crab cavity, …**
  - **large bore quads & sextupoles, extraction magnets, …**

plus many other r&d which is the same for any IR config

- **Alternatives are 10-12mrad and 0mrad**

- **Discussing extra R&D and timescale needed for alternatives**
  - **e.g. 0mrad with rf kicker => several years (?) of r&d on feasibility and stability of rf kickers, their mps isseus, etc.**
  - **0mrad with electrostatic separator => design studies, r&d on feasibility and stability of separators, perhaps their beam tests, etc. Several years?**

- **Connection of r&d for alternatives with r&d for baseline**
  - **large bore sc quads for 0mrad may be similar as quads for 2mrad**
  - **r&d for 10-12mrad is synergic with r&d for 20mrad**

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Single IR configuration

- **For two IRs, the baseline x-ing angle is 20/2mrad and alternatives are 10-12/0mrad**
- **For the case of single IR, need more work (2-3month for design study) & wider discussion**

- **With two IR configuration, which complement each other, may allow one of IRs be more risky in terms of machine performance (2mr) in expectation of better backgrounds and detector hermeticity**
- **With one IR configuration, need to put the overall performance, reliability and operability on the first place**
- **With one IR the optimal baseline may be neither 20mr nor 2mr**
- **The intermediate crossing angle (10-12) with compact SC quads will be studied and may turn out to be the best choice**

- **Also, need input from WWS on the approach to gamma-gamma**