E-JADE is a Marie Sklodowska-Curie Research and Innovation Staff Exchange (RISE) action, funded by the EU under Horizon2020

E-JADE

Staging Scenarios - Detectors

Karsten Buesser

Mini-Workshop on CFS and Infrastructure for Physics and Detectors

KEK
16.05.2017

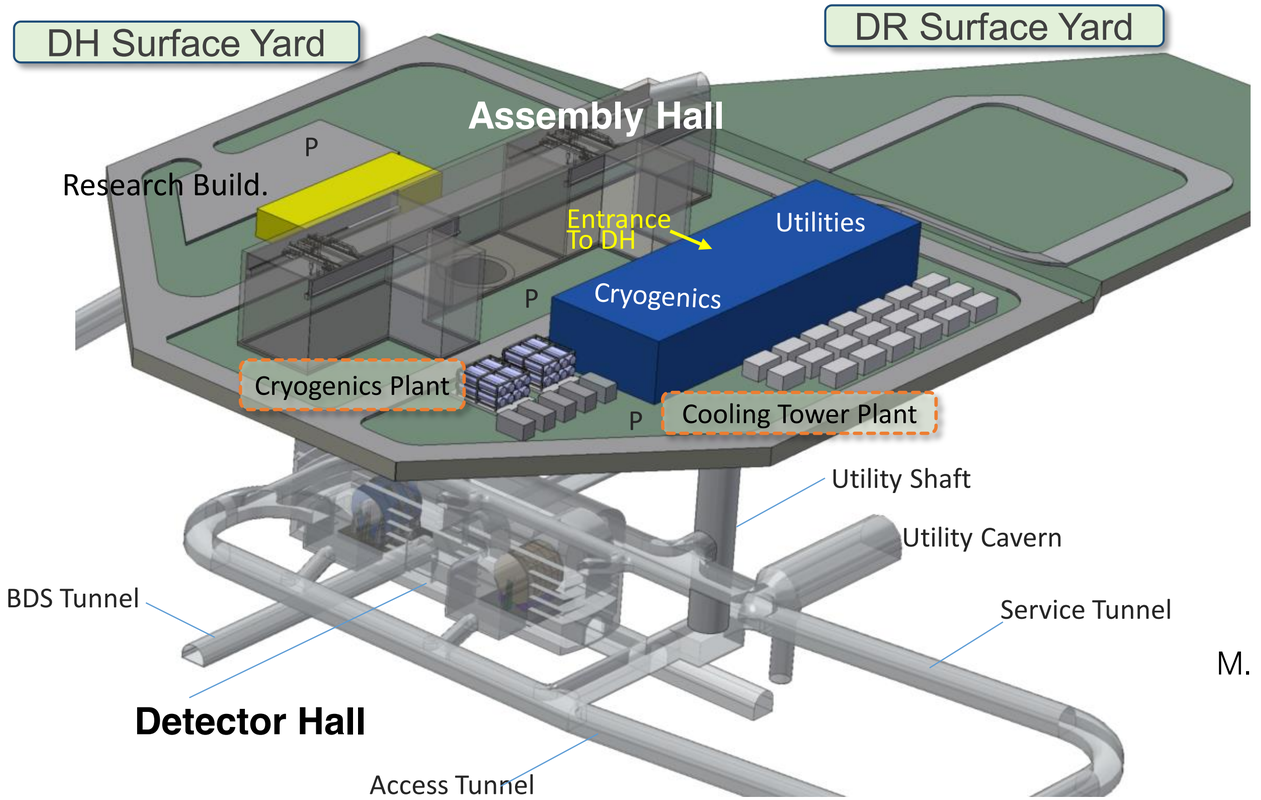
Caveat: Everything that I will present here are just my own thoughts! No formal position from the detector community!

Why Staging?

- Staging is being discussed for the ILC project
  - Goal: reduce the initial cost of the project by O(30-40%)
  - Reduce the initial cms energy to 250 GeV
  - Clear upgrade plan to 500 GeV (with costs and timeline)
    - details under discussion (initial tunnel length, etc.)
- What about the detectors?
  - Detector costs are not part of the project cost, but also given in the TDR
    - but still they are significant: O(300-400) MILCU per detector
    - detector costs are traditionally treated differently than project cost
      - financed via collaborations
      - but in the end (partially) by the same funding agencies
  - We should not talk too loudly about detector staging now…
  - But we should prepare for implications of the machine staging to the detectors!

Detector Infrastructure

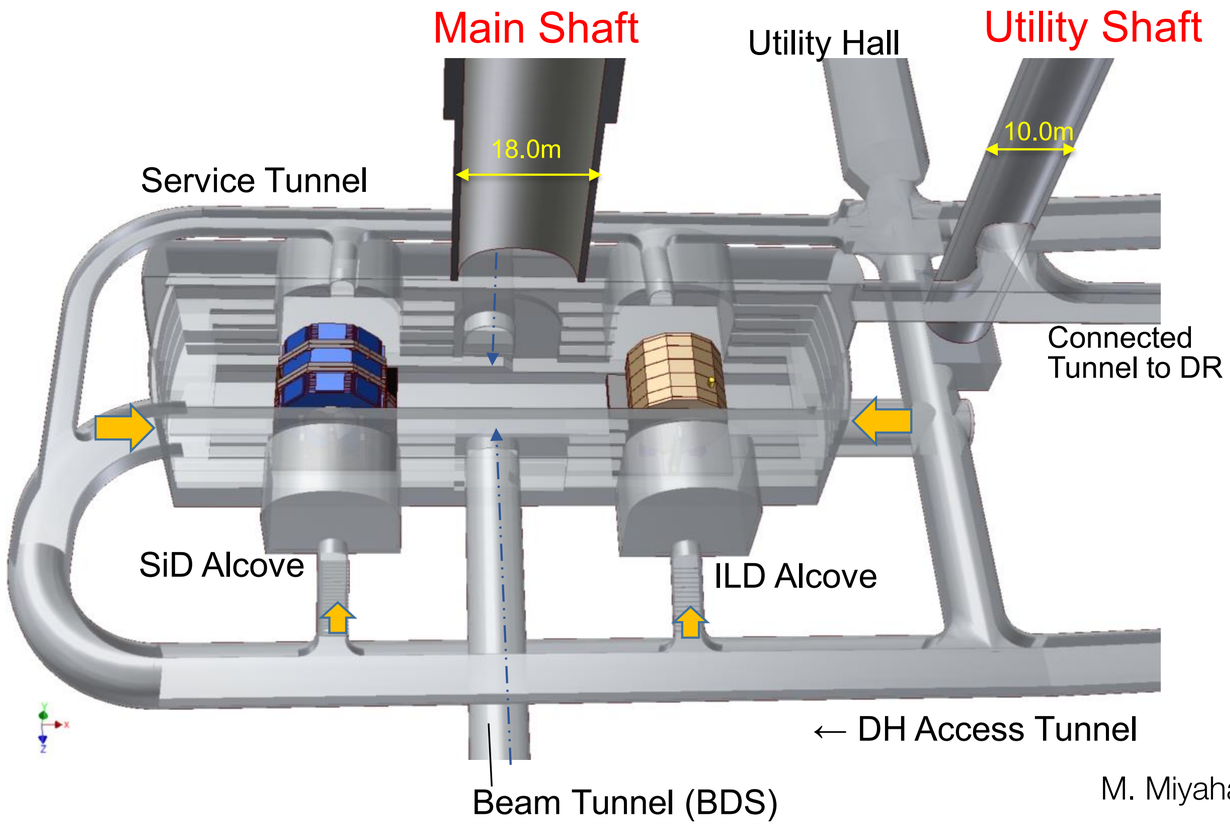
- The expensive parts of the detector related infrastructure are part of the project cost:
  - CFS for underground and surface areas
  - Service supplies: power, cooling, etc.
- So ist there something to be saved for a realistic stating scenario of the detectors?



M. Miyahara

One or Two?

- Often discussed (since Snowmass 2005)
  - one or two detectors?
- This question is not directly related to energy staging of the machine!
  - It has been discussed for many years for the 500 GeV machine
- It could turn into an energy staging question:
  - start with one detector optimised for 250 GeV
  - add a second detector optimised for higher energies later



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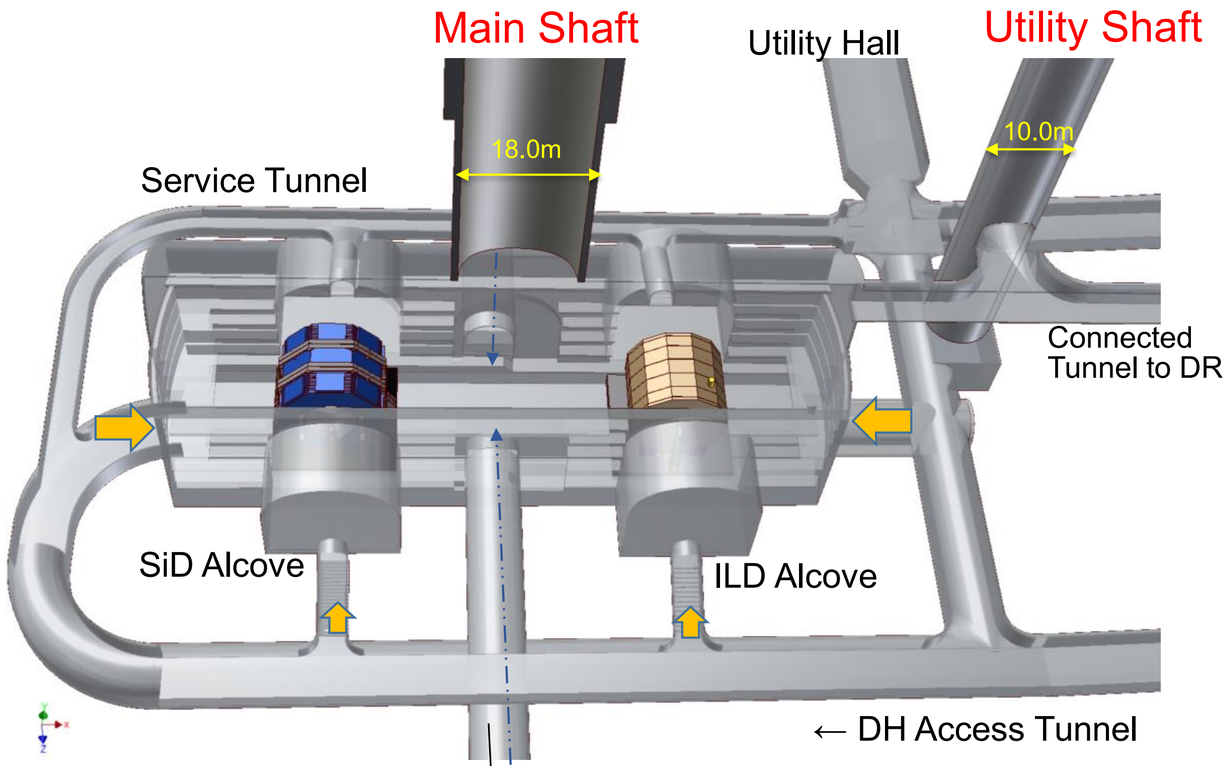
One or Two?

- Infrastructure savings for only one detector:
  - reduce underground volume
  - reduce surface areas
  - reduce services
- Push-pull?
  - you still would need a mechanism to get the detector from the parking position to the beam to allow for commissioning of the beam while maintenance is done on the detector
- Again: this is not directly related to staging! It is related to the question about one vs two detectors that has been answered in the TDR!



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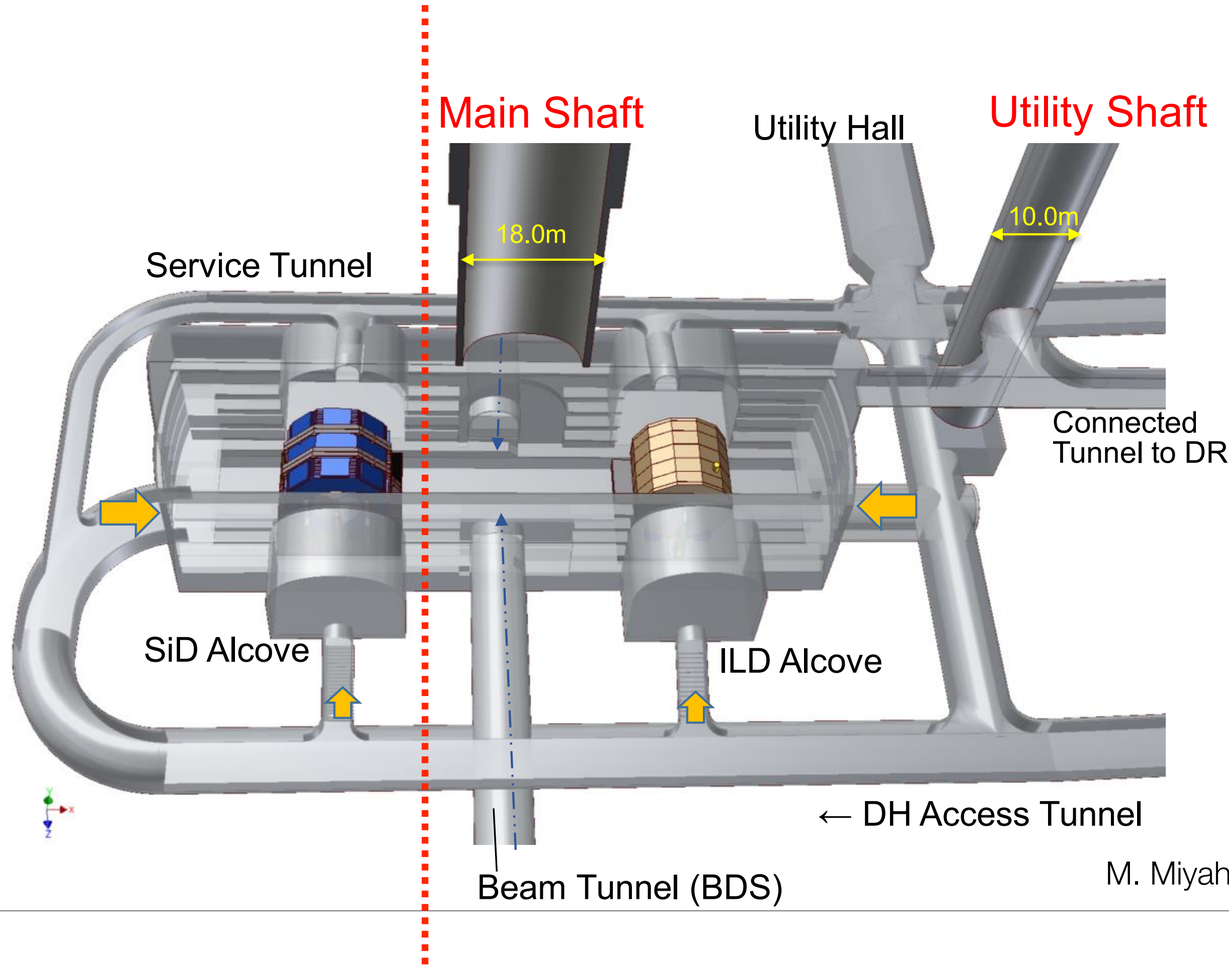

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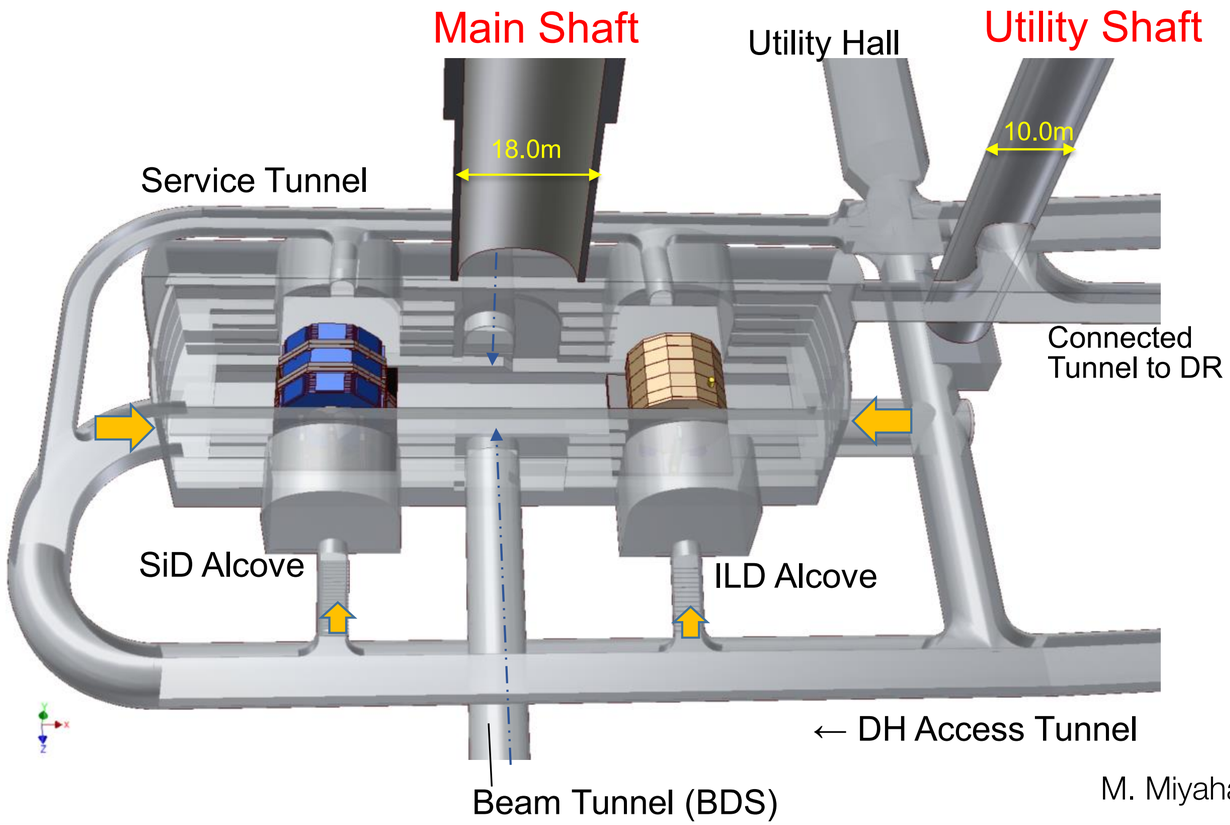
One or Two?

- Even if the project would start with only one detector
- I would strongly suggest to keep the underground areas as they are planned now!
- It is quite unrealistic to assume that a later extension of the underground hall would/ could be done without massively interfering with the data taking!
- And: the ILC installation will be a research infrastructure that will exist for many decades. Major upgrades or technology changes (PWA, CLIC, Lightsource) could come in the future! Any space in the underground hall to prepare for a new experiment would be needed!



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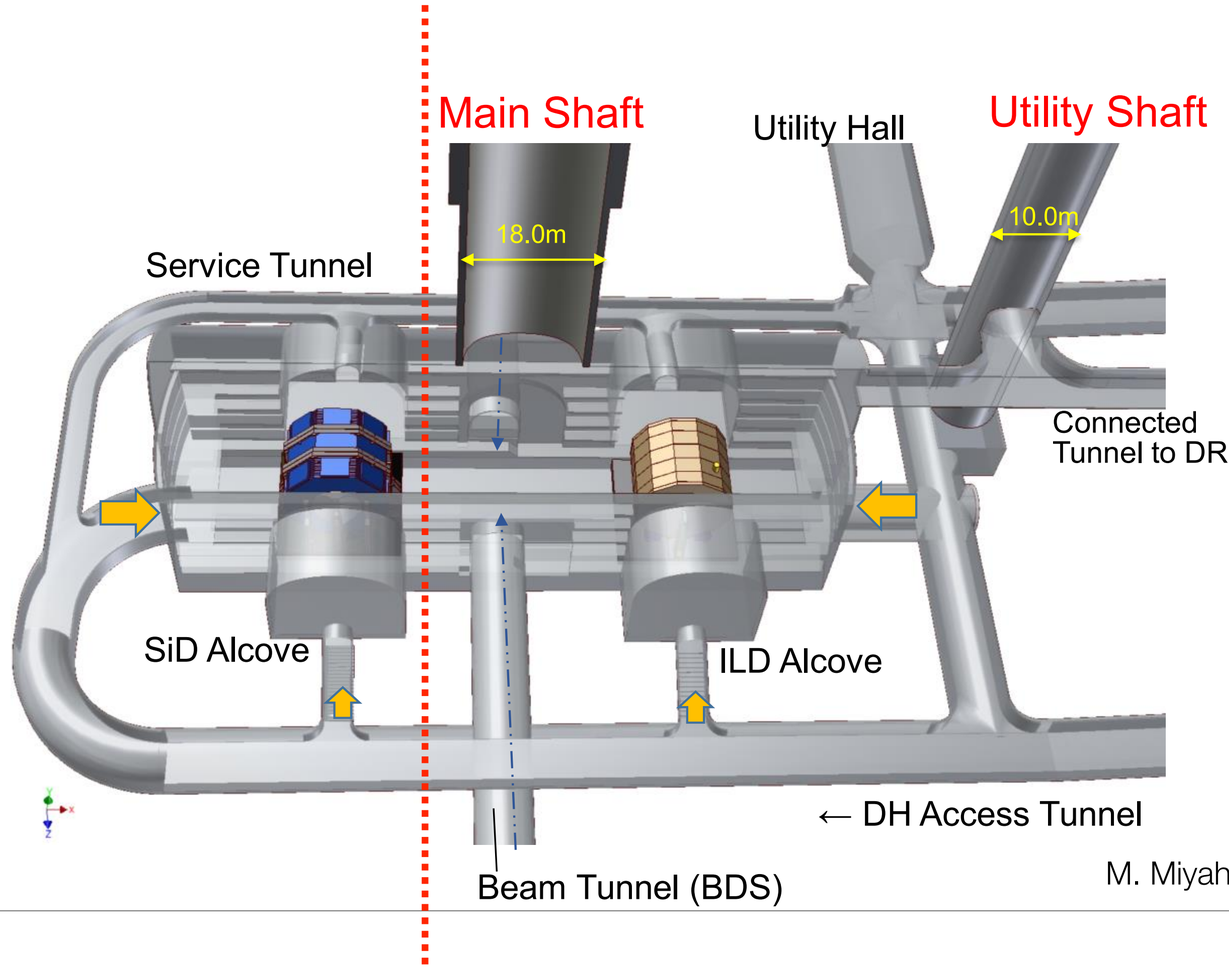
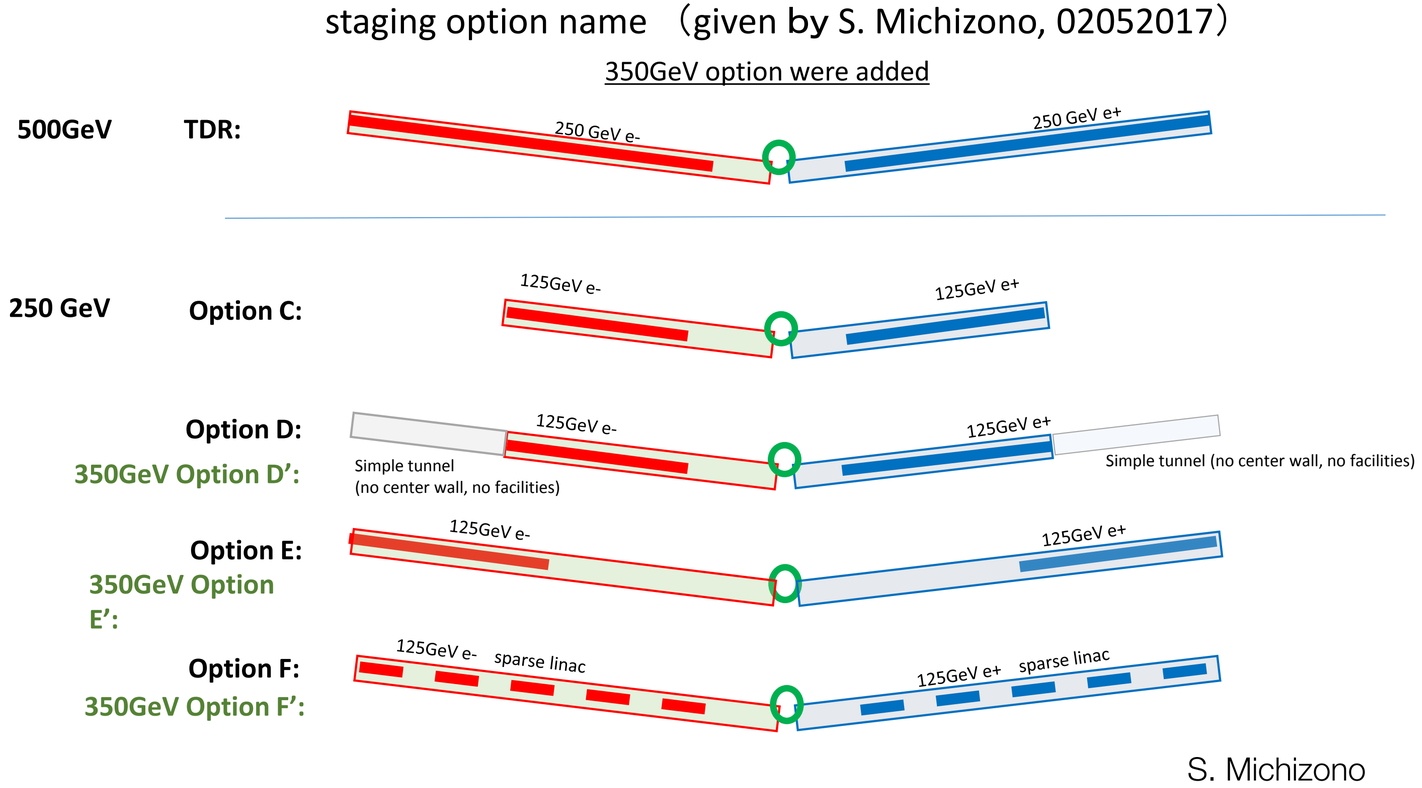


M. Miyahara

Energy Staging for Detectors

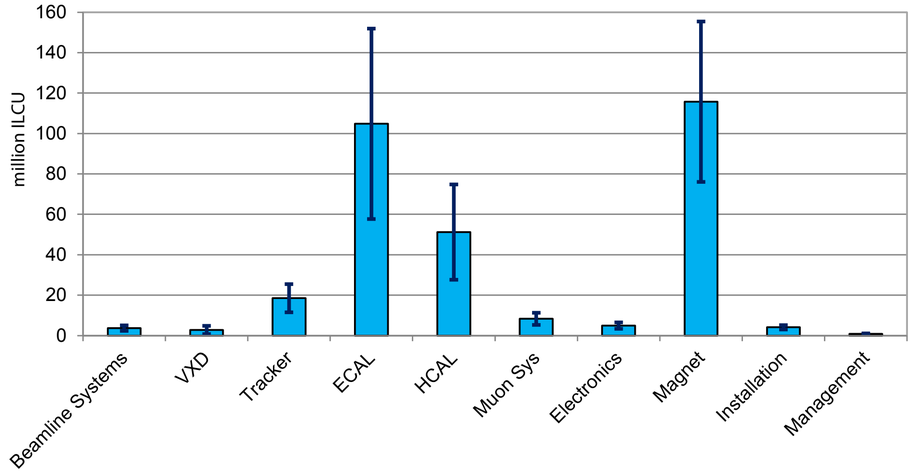
- Is there a way to save money in an energy staging scenario for the detectors?
- Two cases:
  - either there will be an initial detector that is designed for energies of 250 GeV and below that will be replaced or supplemented by another high-energy detector
    - essentially no upgrade to the existing detector, but replacement
  - or a multi-purpose detector with an initial 250 GeV design that will be extended to 500 GeV (or 1 TeV) later

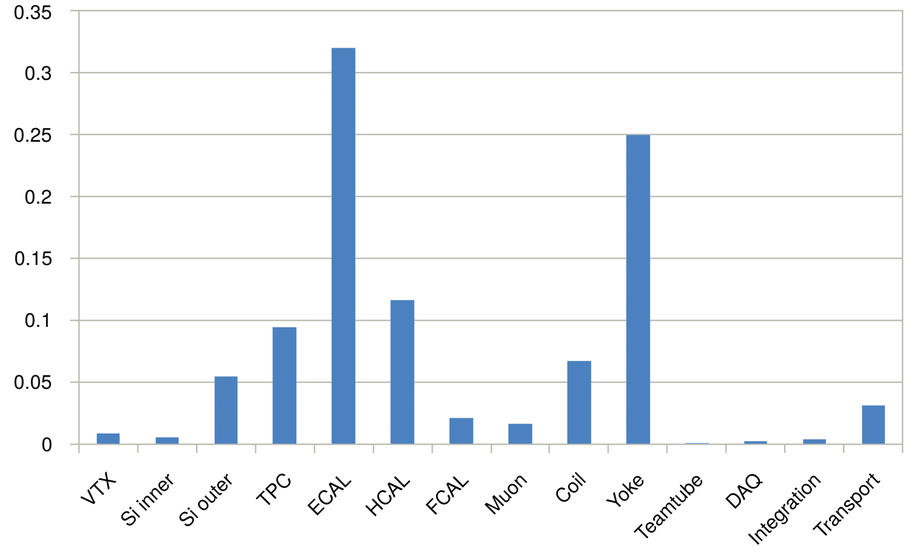


S. Michizono

Detector Cost

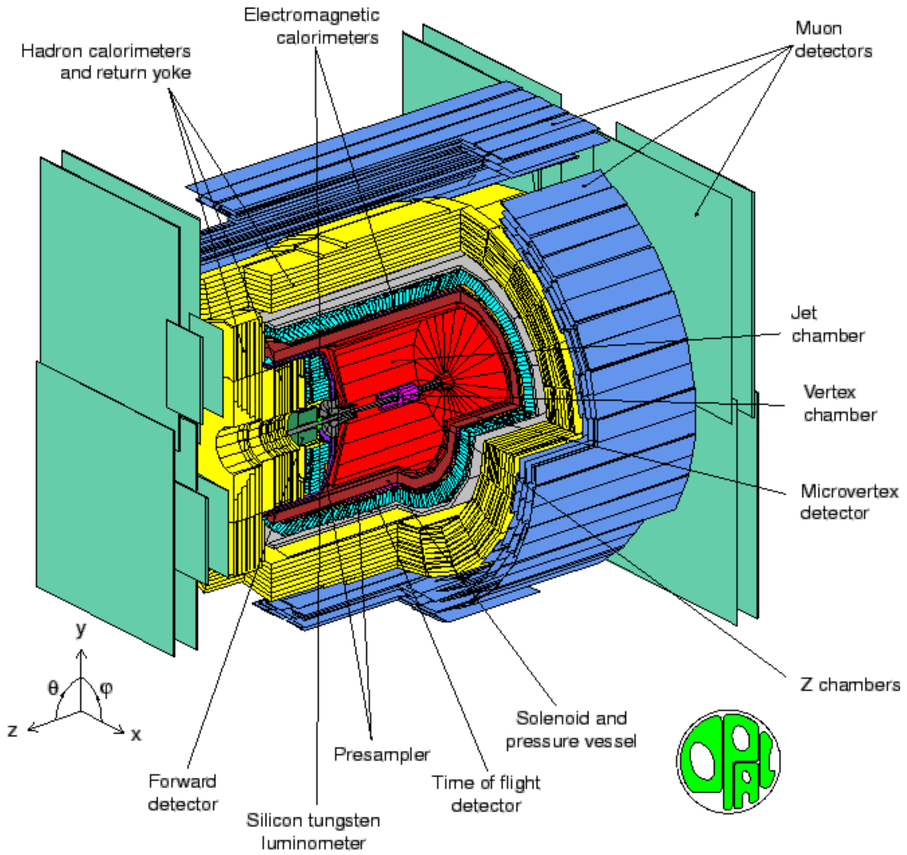
- The big cost drivers are ECAL and Coil/Yoke
  - Together O(60-70%) of the total cost per detector
- Coil and Yoke will most probably never be changed in the detectors
  - this means that any detector that should also be able to run at high energies (up to 1 TeV) cannot save on this in a 250 GeV stage
- Can the ECAL thickness be reduced (or less sampling)?
  - needs detailed studies, but I guess this would have a quite significant impact on the photon energy resolution
- Reduction of the tracking system outer radius?
  - Yes, this should help: see difference between SiD and ILD!
  - ILD study on smaller detector model on-going
- Other sub-detectors?
  - Possibly savings, studies required, total cost volume is small
- What about a dedicated 250 GeV detector?
  - Needs to be studied… could be smaller, maybe cheaper
  - but you would need the high-energy detector in the next energy phase anyhow…





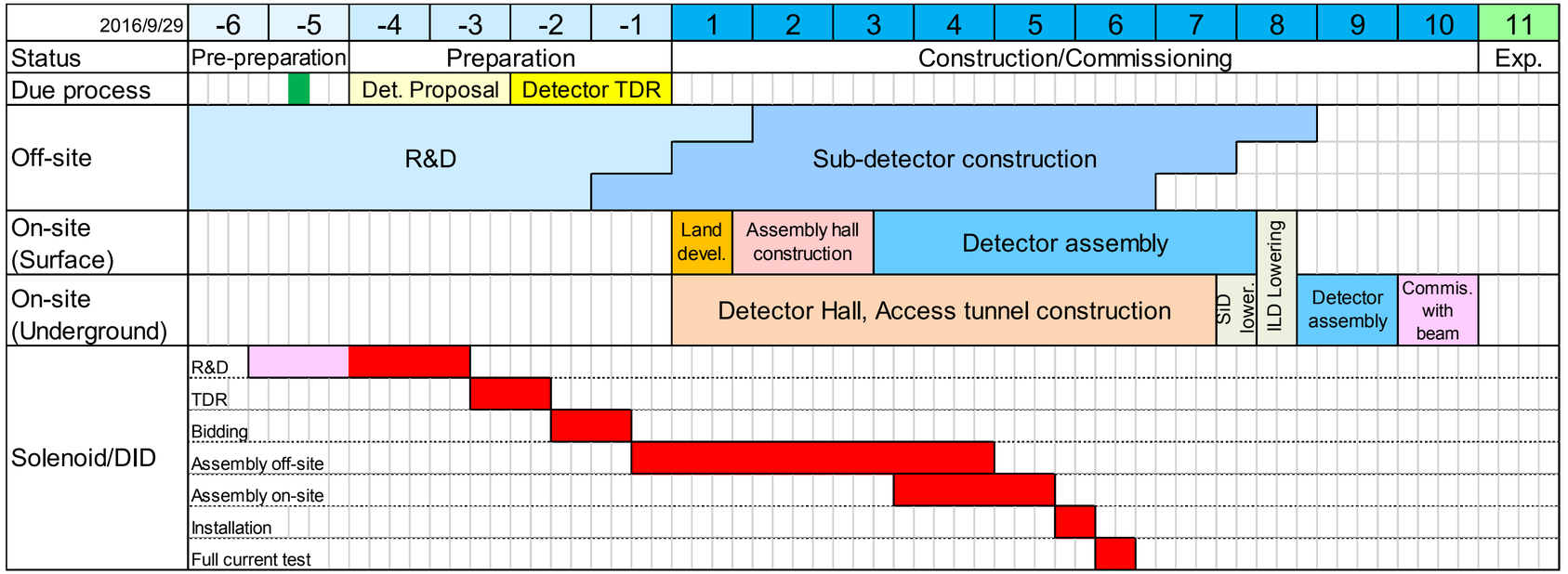
A Dedicated 250 GeV Detector?

- A dedicated 250 GeV detector could be cheaper:
  - smaller radius
  - lower B-field
  - smaller yoke
- But: this requires a detailed physics study!
- And in the end it will still be a device with costs of several 100 MEUR…
- And it will NOT be able to run at higher energies and reach the physics goals
  - not attractive for international collaborators!
- The high-energy detector needs to be built anyhow for the later stages
- So I would suggest to not follow this direction



Timing

- How can the detectors adapt to a reduced construction time of the staged machine?
  - need to save 6-12 months?
- next talk…



T. Schoerner/Y. Sugimoto

Summary

- A more detailed effort has to be started to understand staging scenarios for the detectors
- The question of one vs two detectors is not a staging discussion!
- Two scenarios:
  - build a dedicated low-energy (250 GeV) detector that will be cheaper than a high-energy detector
  - plan for a high-energy detector that would start in a reduced 250 GeV version
- First scenario is not attractive and does not necessarily save money over the project time range
- Second might save some money, but it is marginal w.r.t. the DBD detector designs
  - and financing of the detectors is done by different means (collaborations)
- Detector assembly time lines need to be checked to match a possibly reduced machine timeline in the first energy stage