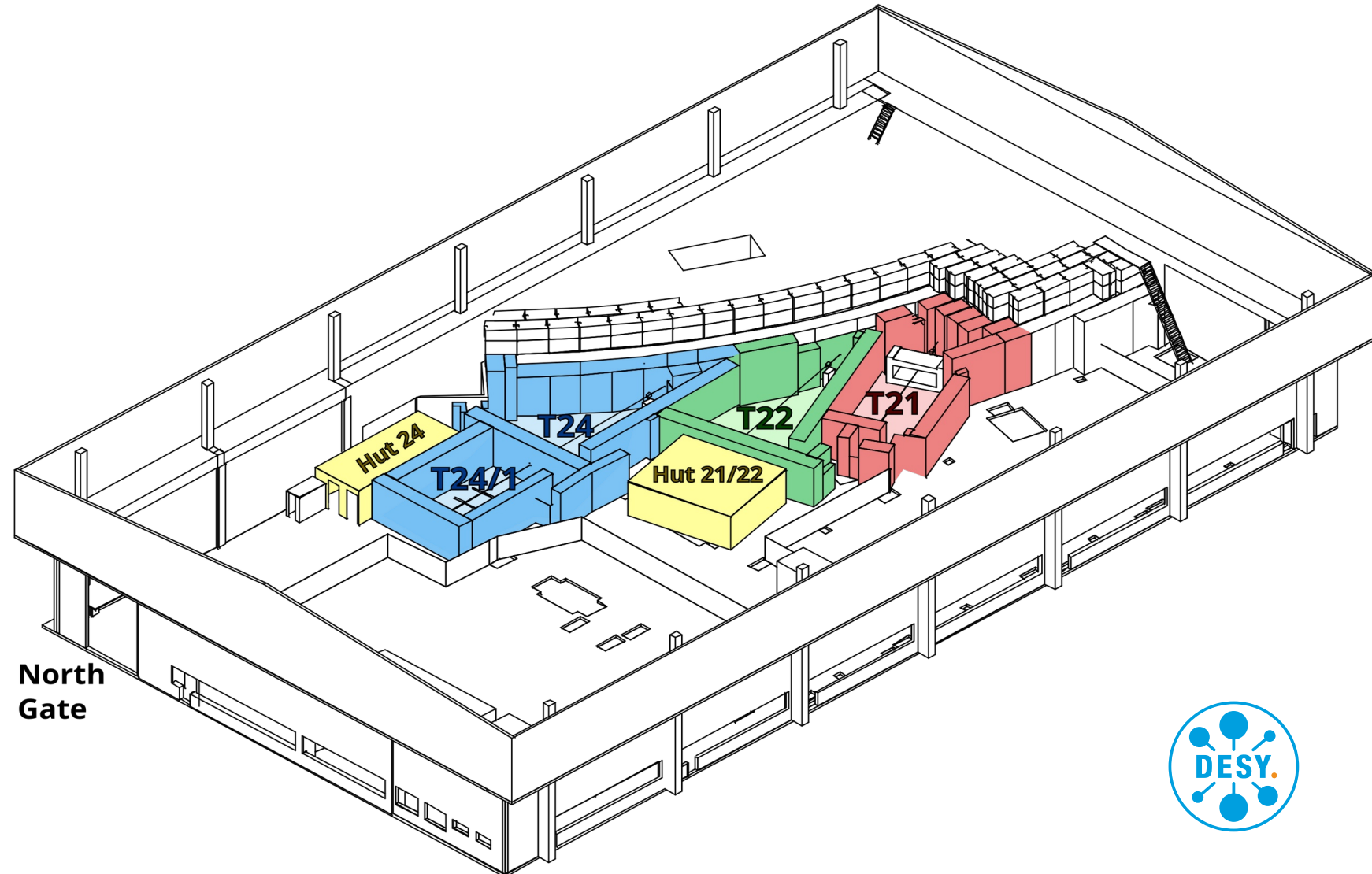


Testbeam and irradiation facilities

LCWS 2021 15.03.21

Marcel Stanitzki



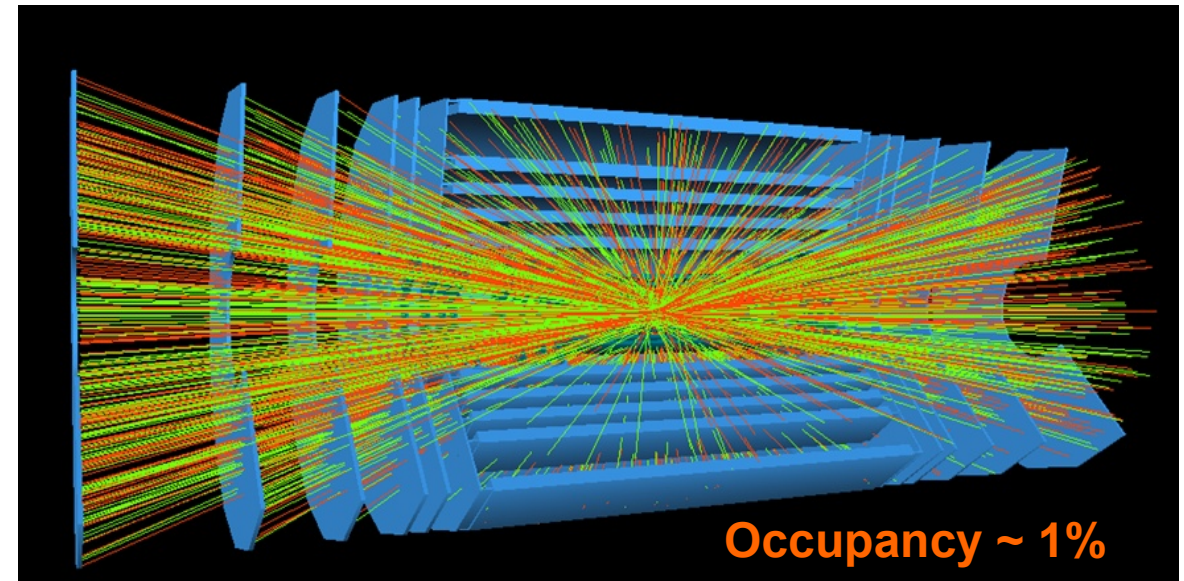
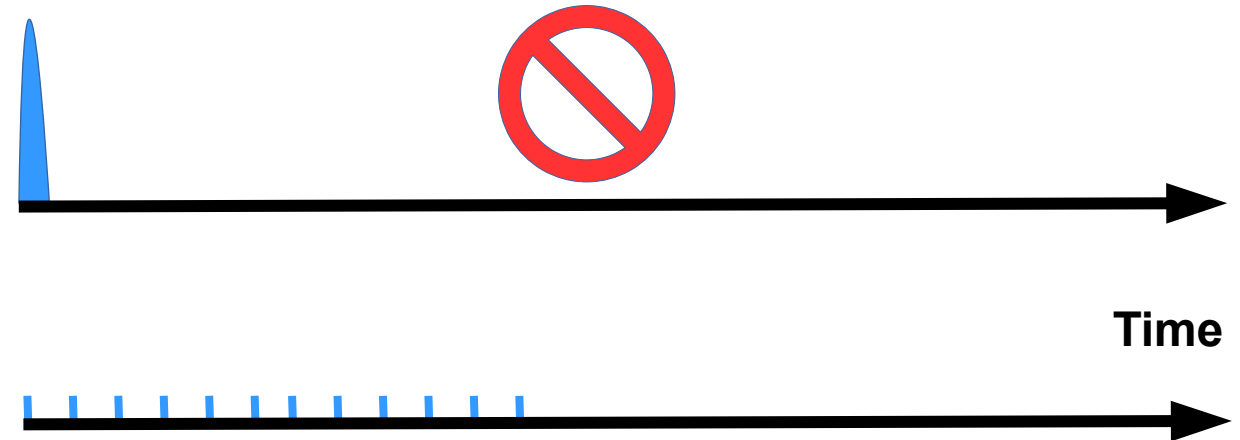
North Gate

Test Beam requirements

How does the ideal test beam look like

Requirements by 95% of the users

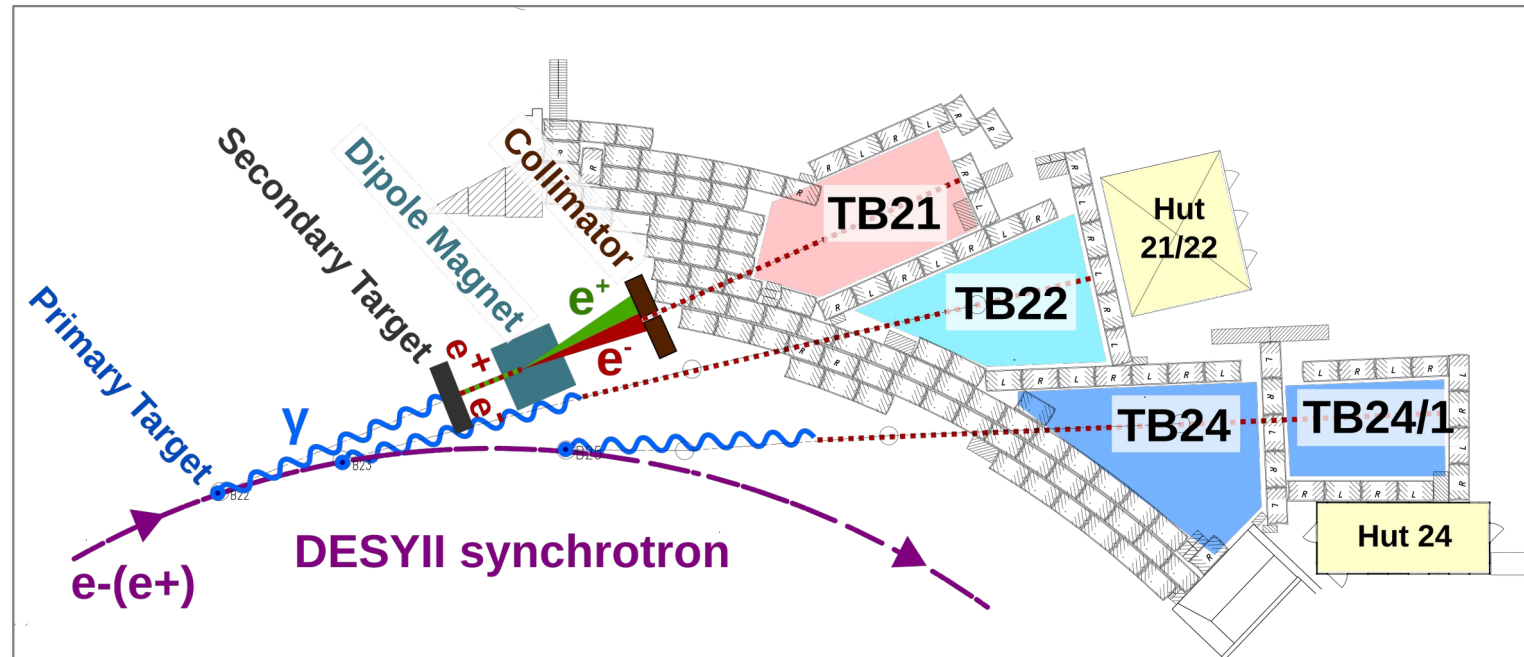
- Monochromatic beam < few percent
- Multiplicity ~ Few particle/bunch/mm²
- Rates from 1 kHz up to 100 kHz
- Energy range between 1-100 GeV
- For Trackers
 - Highest energy possible → reduce the scattering, which limits the resolution
 - But for most cases O(10) GeV is ok
- For Calorimeters
 - Adjustable energy
 - Electrons, positrons & hadrons
- PiD
 - As many particle flavors as possible
- Reliable Beam 24/7 !
- Independent & user-controlled Beam lines



DESY II Test Beam Facility

Beam Generation & Beam lines

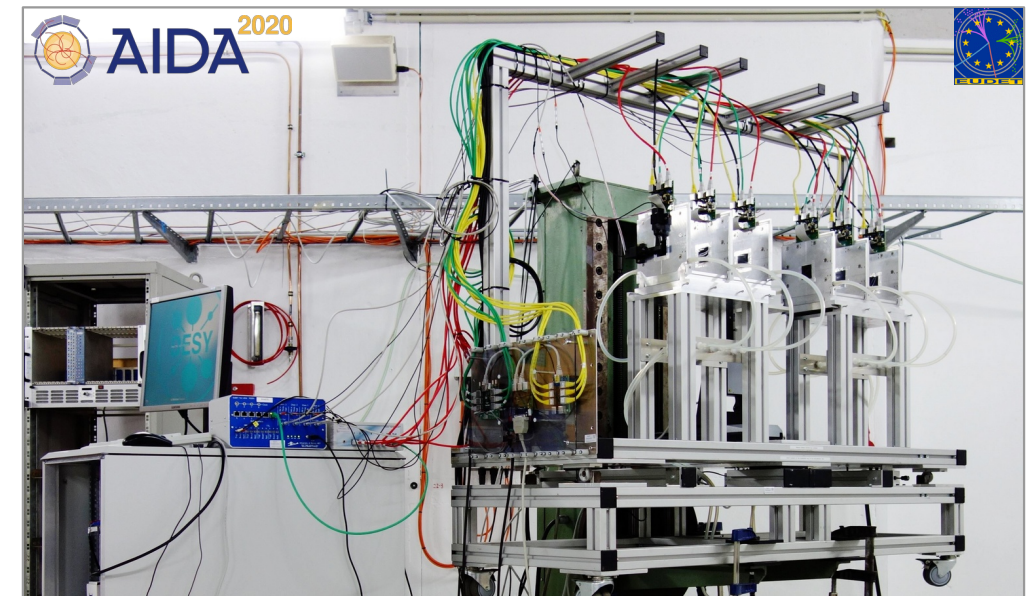
- One of two user facilities offering multi-GeV test beams in Europe
 - The other one being the CERN PS&SPS
 - Worldwide : Fermilab & SLAC
- Beam Generation Carbon fiber targets in the electron beam generate bremsstrahlung photons
 - Conversion at thin metal plate target to e^+/e^-
 - Momentum selection by dipole + collimator
 - Three individual beam lines
- Already meets many requirements
 - Energy 1-6 GeV (1-100 GeV)
 - Rate ~ 10 kHz (100 kHz)
 - Spread <5 % (a few %)
 - 1 e/ Bunch/mm² (few/bunch/mm²)
 - Independently operated
- Very reliable operation
 - Beam always available



Services, Magnets & Telescopes

Infrastructure is key to success

- **Services**
 - Stages, cables, network, fibers, Dry nitrogen, cooling water
 - Gas & Gas Safety System
- Beam monitoring & Common slow control system
- **Magnets**
 - Test Detectors in a magnetic field
 - High-field tests necessary e.g. for power pulsing
- **EUDET-type Beam Telescopes**
 - Six pixel planes: $2 \times 1 \text{ cm}^2$, $18.4 \mu\text{m}$ pitch
 - Provides a reference track
 - Few micron tracking resolution
 - Seven copies around the world



Irradiation facilities

Mostly needed for LHC so far

- **This activity has been driven by LHC/HL-LHC needs**
 - Vast amount of experience
- **Two main categories**
 - **X-rays (Surface damages)**
 - Usually done using sources
 - **Protons & Neutrons (bulk damage)**
 - Neutrons at reactors (Ljubljana/Rhode Island)
 - Protons at e.g. PS, KIT, B'ham ...
- **Irradiation with electrons**
 - There has been significantly less activity and experience
 - Interest from other communities (e.g. Material science, space)
- Operating an Irradiation facility requires significant manpower
 - Dosimetry, Shipping & Handling ...etc

What could be done where ?

- **Given the requirements stated**
 - Where can we generate a low intensity beam with sufficient rep rate ?
 - Assume this be mostly an electron/positron beam facility
 - We could do secondary (pion/muon) production -
 - e.g. The SLAC way with a a Be target ...
 - How do access the beam lines
- **Timeline**
 - When would this be available ?
- The ILC project view
 - To be useful for the Detector R&D and construction, it would need to be available before major detector construction already
 - So a test beam at the ILC lab will most likely come very late
- The ILC as a long-term infrastructure view
 - A test beam is a key infrastructure for HEP and beyond
 - Essential for ILC detector upgrades
 - It is a great way to attract people to the lab.

What could be done where ?

- **Assuming we do irradiation with electrons**
 - Where can we irradiate samples without evaporating them (main beam is probably out)
 - Access /Sample management ?
- **Timeline**
 - When would this be available ?
- The ILC project view
 - To be useful for the Detector R&D and construction, it would to be available before major detector construction already
 - So like the test beam it will come late
- The ILC as a long-term infrastructure view
 - A unique infrastructure
 - Attracts people beyond HEP

Test beam and Irradiation facilities

- Test Beams and Irradiation facilities are essential infrastructures for detector R&D
- Both enhance the ILC Laboratory in the long term
 - Attract new users to the lab
 - Broaden usage beyond ILC community
 - Train next generation
- The ILC project view
 - As these facilities will come up in parallel with the ILC, they'll come very late
- The ILC as a long-term infrastructure view
 - Shows the long-term future of the ILC laboratory
- Infrastructure
 - It's not just the beam, the infrastructure for the Users is key for its success
- Operations
 - The amount for FTE required to run such a facility is small (5-10)
 - To be successful, it has to be long-term commitment