
Calorimeter Test Beam

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SuperB Detector Workshop I,
SLAC*

Outline

- Test beam site considerations:
 - CERN/DESY/Frascati/PSI
- Prototype issues
 - Crystal layout
 - Photodetector
 - Readout system
- Timescale

Test beam site considerations

1) CERN-SPS



See <http://ab-div-atb-ea.web.cern.ch>

Test beam site considerations

1) CERN-SPS

East Hall: 24 GeV/c primary beam with secondary momenta from 3.5 to 24 GeV/c. (e, μ , hadrons)

North Area: 20-250 GeV/c secondary beams. (e, μ , hadrons)

Primary SPS cycle: 2.4sec; with 400ms flat top.

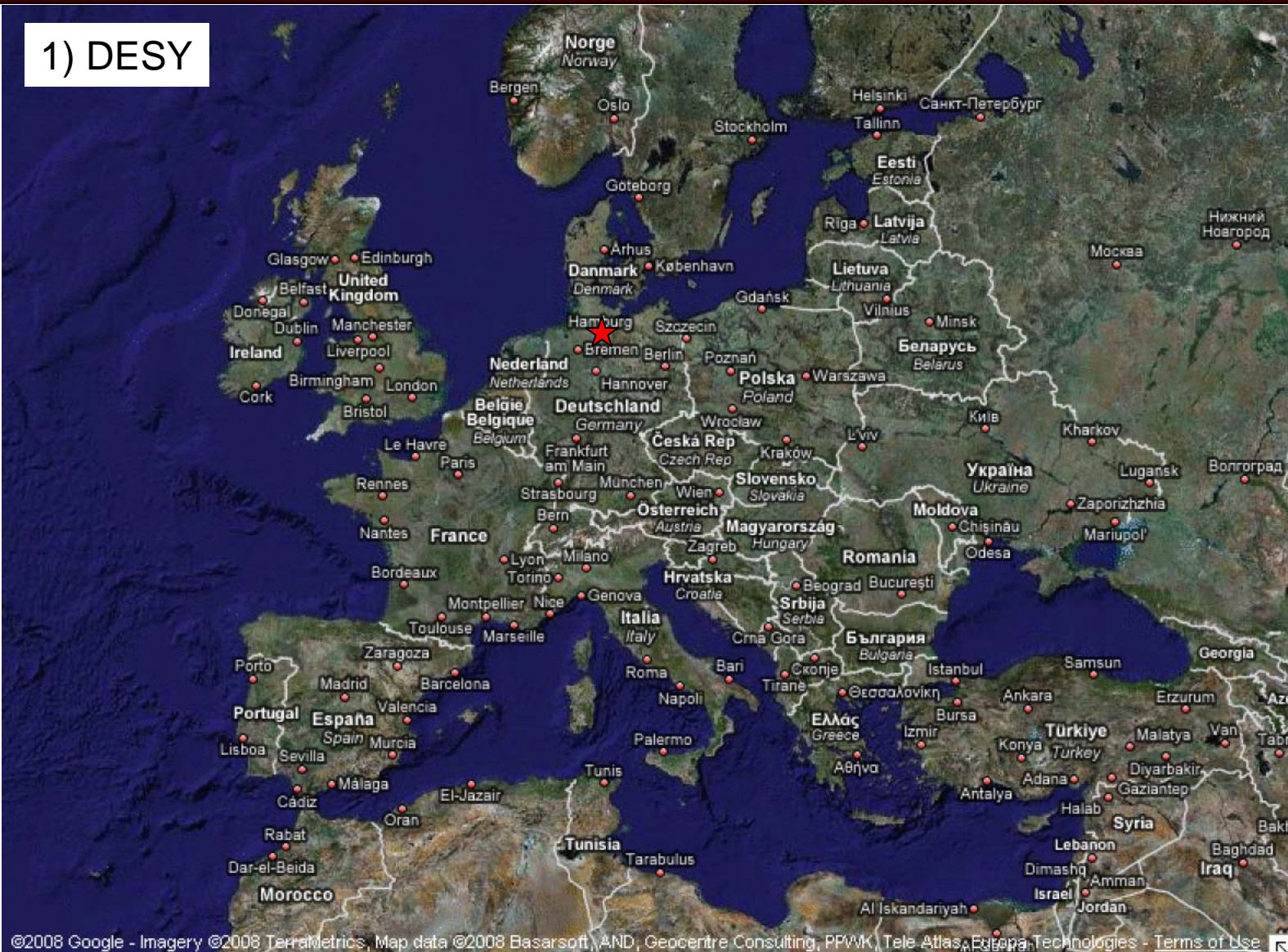
East hall is probably fine (NA has typically 10^{12} ppp for the primary beam).

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See <http://ab-div-atb-ea.web.cern.ch>

Test beam site considerations

1) DESY



See <http://adweb.desy.de/~testbeam/>

1) DESY

1 – 6 GeV/c beams (e^\pm).
Typically 10^3 particles per bunch.
 1×1 cm beam spot.
Carbon Fibre target.

The figure shows a map of Europe with a red star marking the location of DESY (Deutscher Elektronen-Synchrotron) at Hamburg, Germany. The map includes labels for various countries and cities across Europe, from the British Isles to the Mediterranean and the Black Sea region. The text in the top right corner provides details about the DESY facility, including its beam energy range (1 – 6 GeV/c), particle bunch size (typically 10^3 particles per bunch), beam spot size (1×1 cm), and target material (Carbon Fibre).

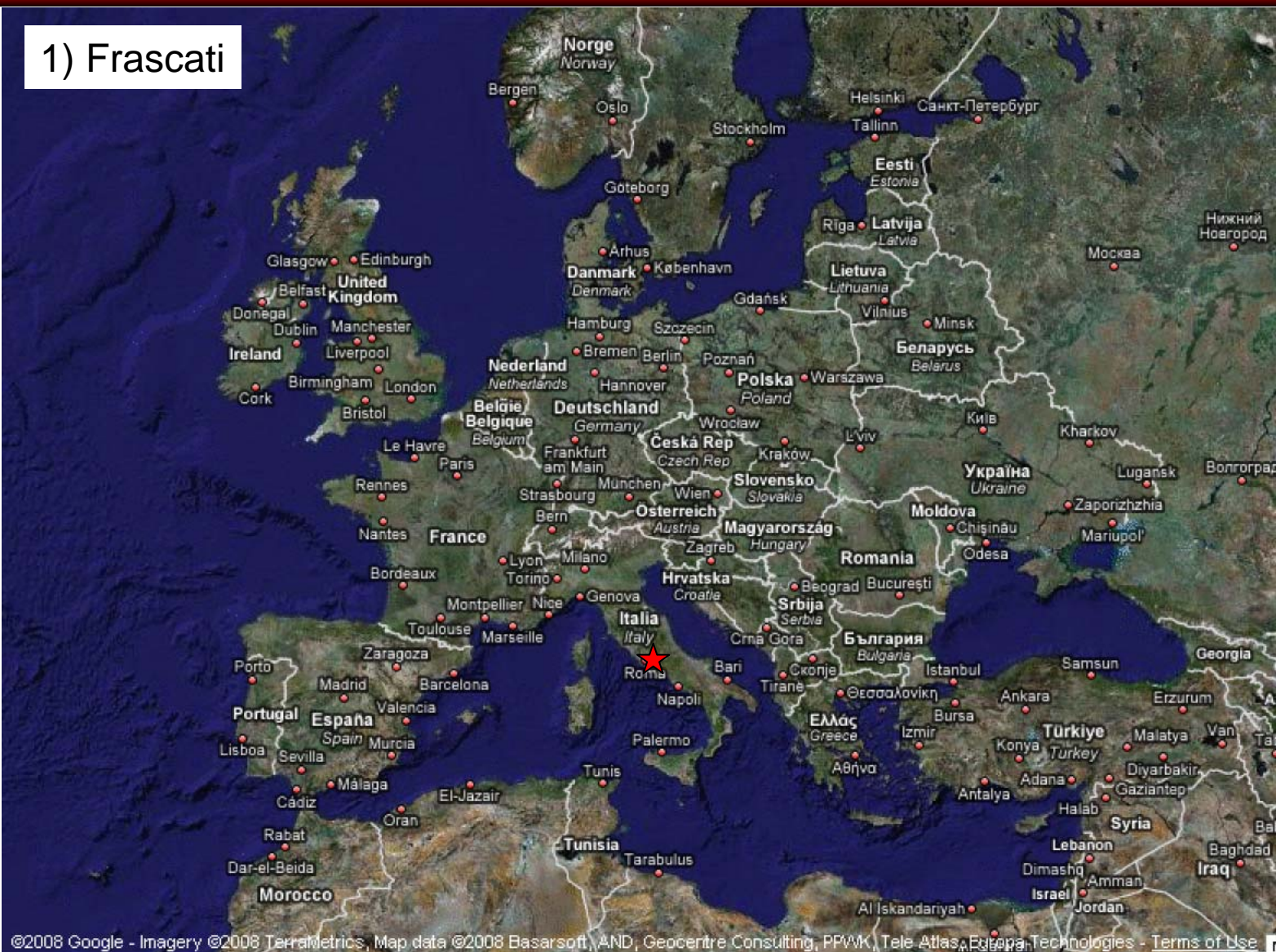
Typically 10^3 particles per bunch.
1 × 1 cm beam spot.
Carbon Fibre target.

1 × 1 cm beam spot.

Carbon Fibre target.

Test beam site considerations

1) Frascati



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See <http://www.lnf.infn.it/acceleratori/btf/>

Test beam site considerations

1) Frascati

25-750 MeV beams (e^\pm).
Typically 10^3 particles per pulse.
1-10 ns pulses at a 50Hz rate

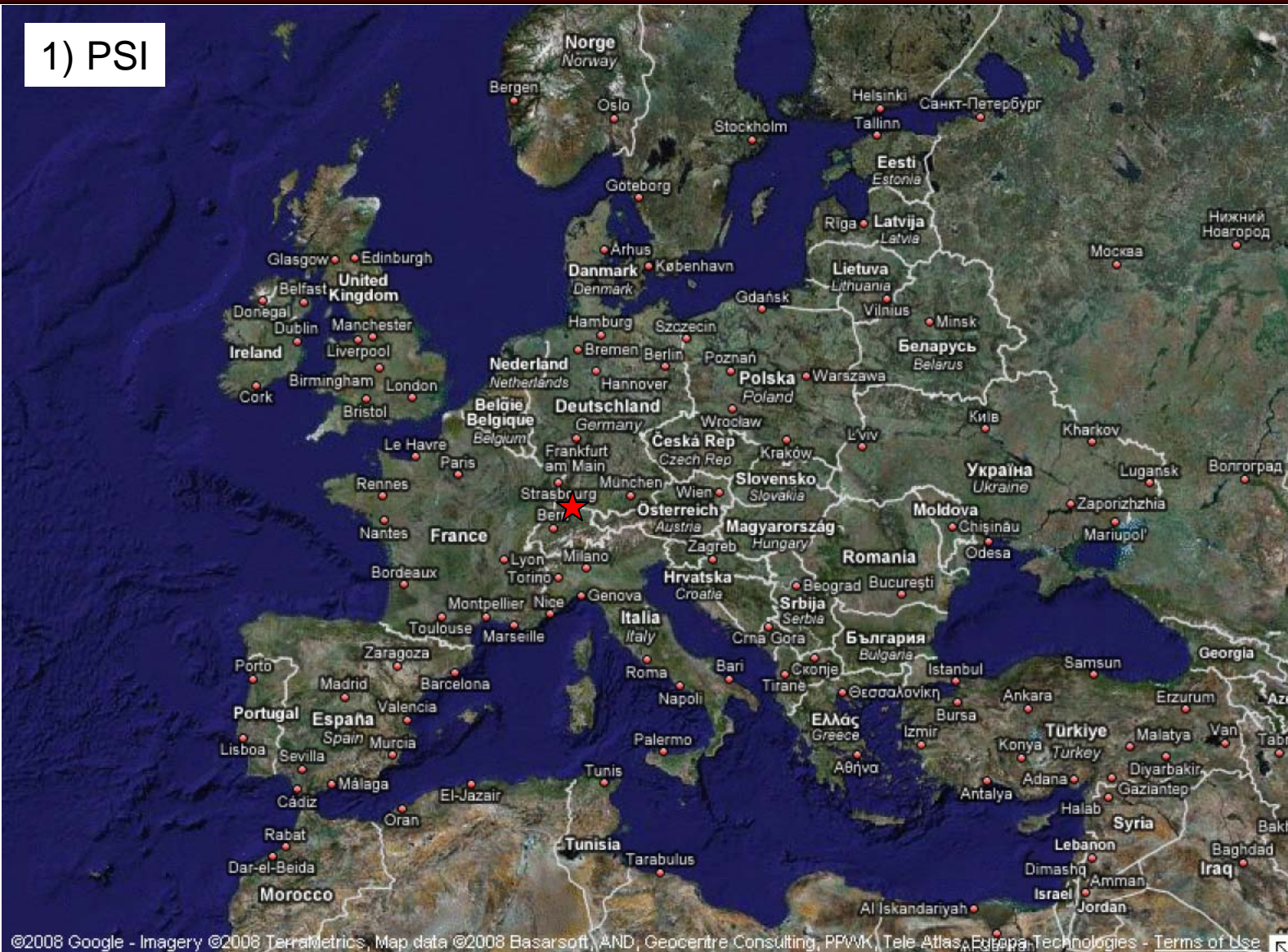


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See <http://www.lnf.infn.it/acceleratori/btf/>

Test beam site considerations

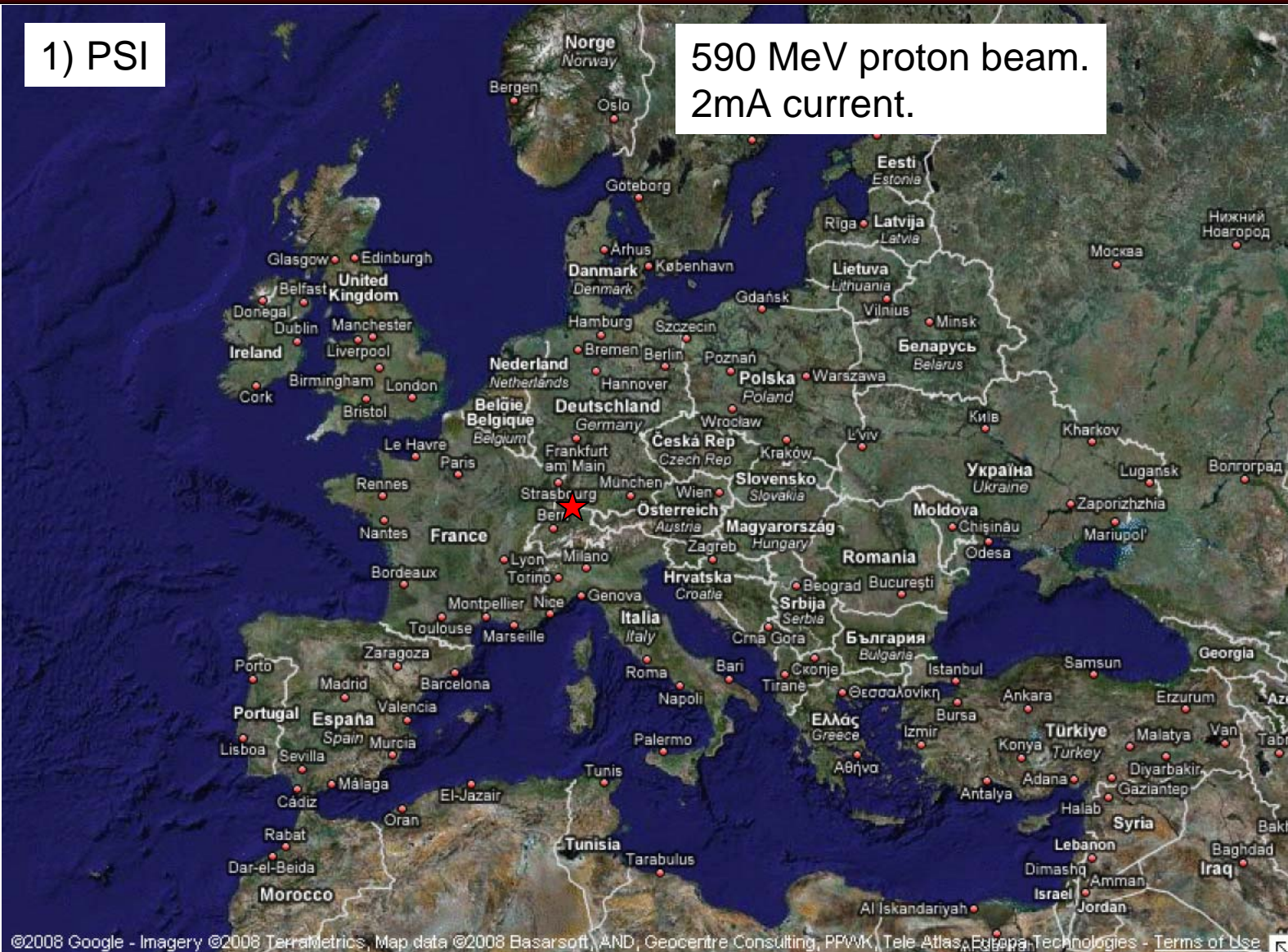
1) PSI



Test beam site considerations

1) PSI

590 MeV proton beam.
2mA current.



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See http://www.psi.ch/forschung/benutzerlabor_protonen_e.shtml

Prototype Issues

Crystal Layout

Crystal Layout

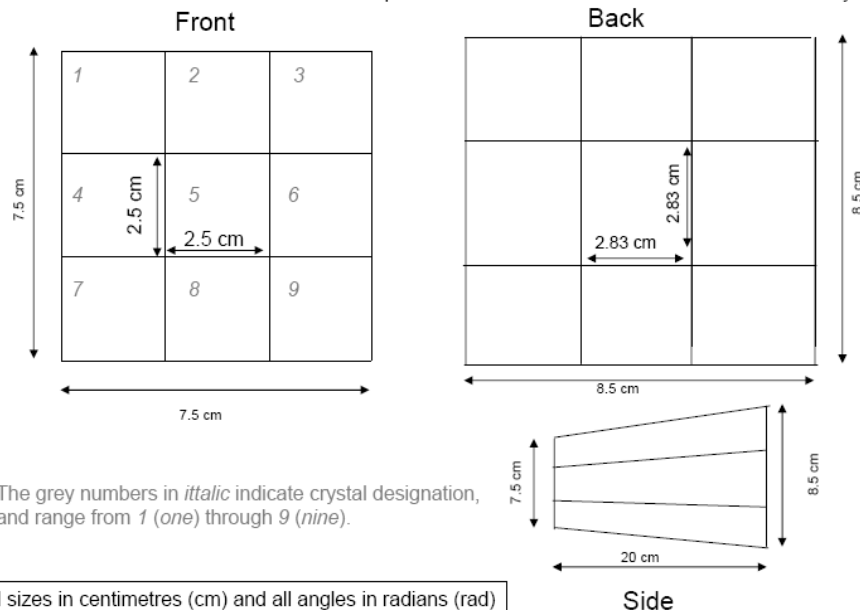
- Need a large enough prototype to contain a complete shower:
 - 5×5 or 7×7 crystals.
- All LYSO vs LYSO core with CsI (or other cheaper material around the core).
- Projective geometry of some kind vs non-projective geometry.
- Need to figure out all pros and cons.

Crystal Layout

- Example: 3x3 projective LYSO core (surrounded by one or two layers of cheaper crystals).

LYSO Calorimeter Test-beam Possible Geometry

LYSO region of calorimeter will be a 3x3 array of crystals with a projective geometry as indicated here. Assume that the interaction point is a perpendicular distance of 1.5 meters from the surface of the crystals, and that the beam axis of the test beam experiment is co-incident with the axis of the central crystal:



The grey numbers in *italic* indicate crystal designation, and range from 1 (*one*) through 9 (*nine*).

All sizes in centimetres (cm) and all angles in radians (rad)
NOT TO SCALE

Just an example of a possible projective geometry:

Assumes:

2.5x2.5 cm front crystal surface

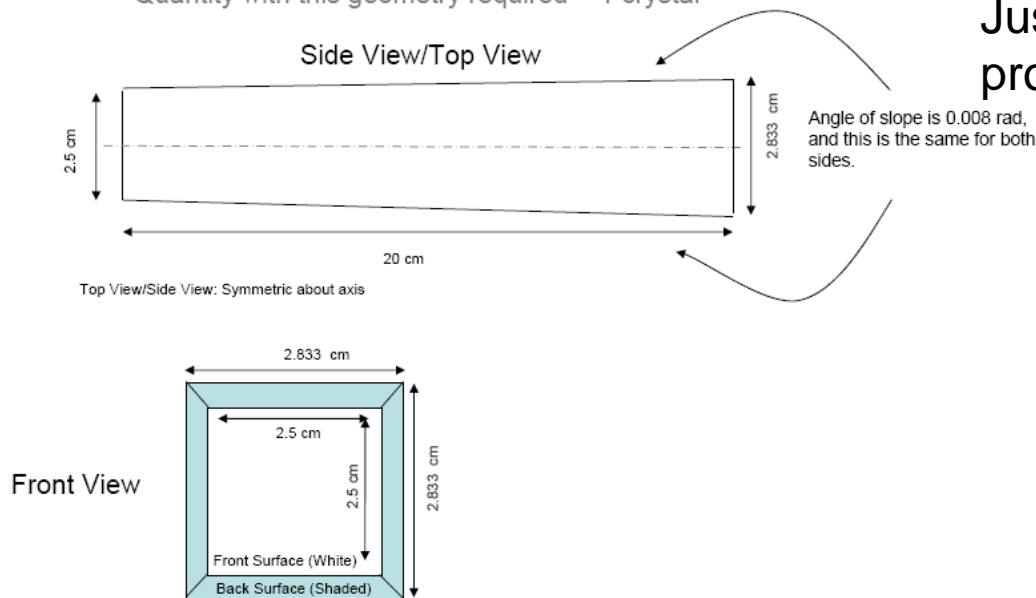
‘Beamspot’ 1.5m from this surface to define projectivity.

Crystal Layout

- Example: 3x3 projective LYSO core (surrounded by one or two layers of cheaper crystals).

TYPE 1 : Crystal Number 5

Quantity with this geometry required = 1 crystal



Just an example of a possible projective geometry:

Central crystal for a projective geometry.

All sizes in centimetres (cm) and all angles in radians (rad)
NOT TO SCALE

Pros and Cons

- Projective vs non-projective geometry has *significant* impact on
 - i) cost of crystals
 - ii) timescale for delivery



To Do

- Need to make sure we work to a crystal production timescale that fits in with the test-beam plans (and within whatever budget we ultimately have)

Prototype Issues

Photodetectors

Photodetectors

- Ren Yuan has been using Hamamatsu APDs (from CMS) for lab tests.
- Continue to use this chain for readout vs start to investigate and adopt an alternative (also what is the cost at production level for such a readout?)

Prototype Issues

Readout

Timescales
