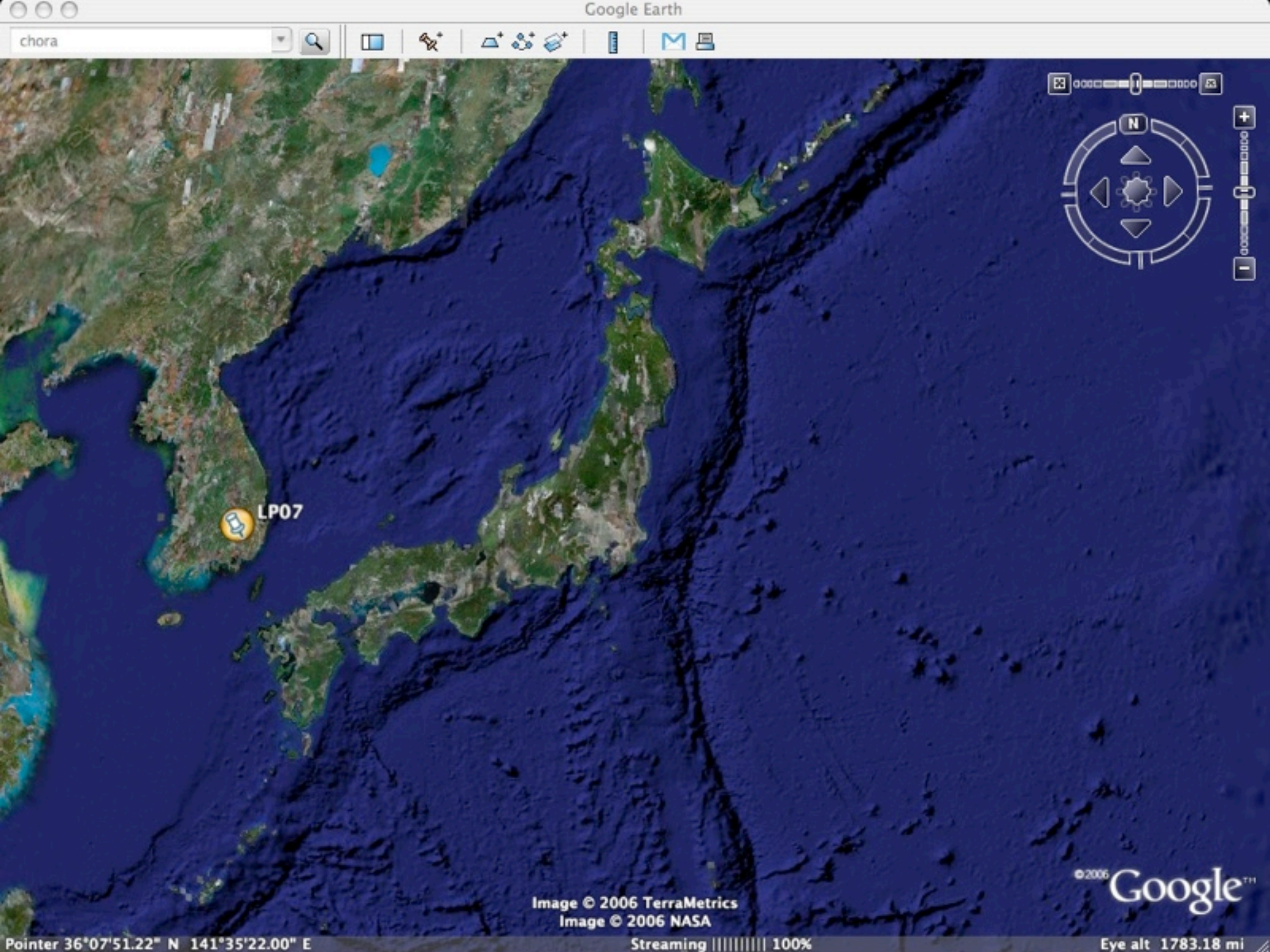
J-Parc Project

Taku Yamanaka
Osaka Univ.

May 24, 2006
Kaon'07 @INFN

Where is it?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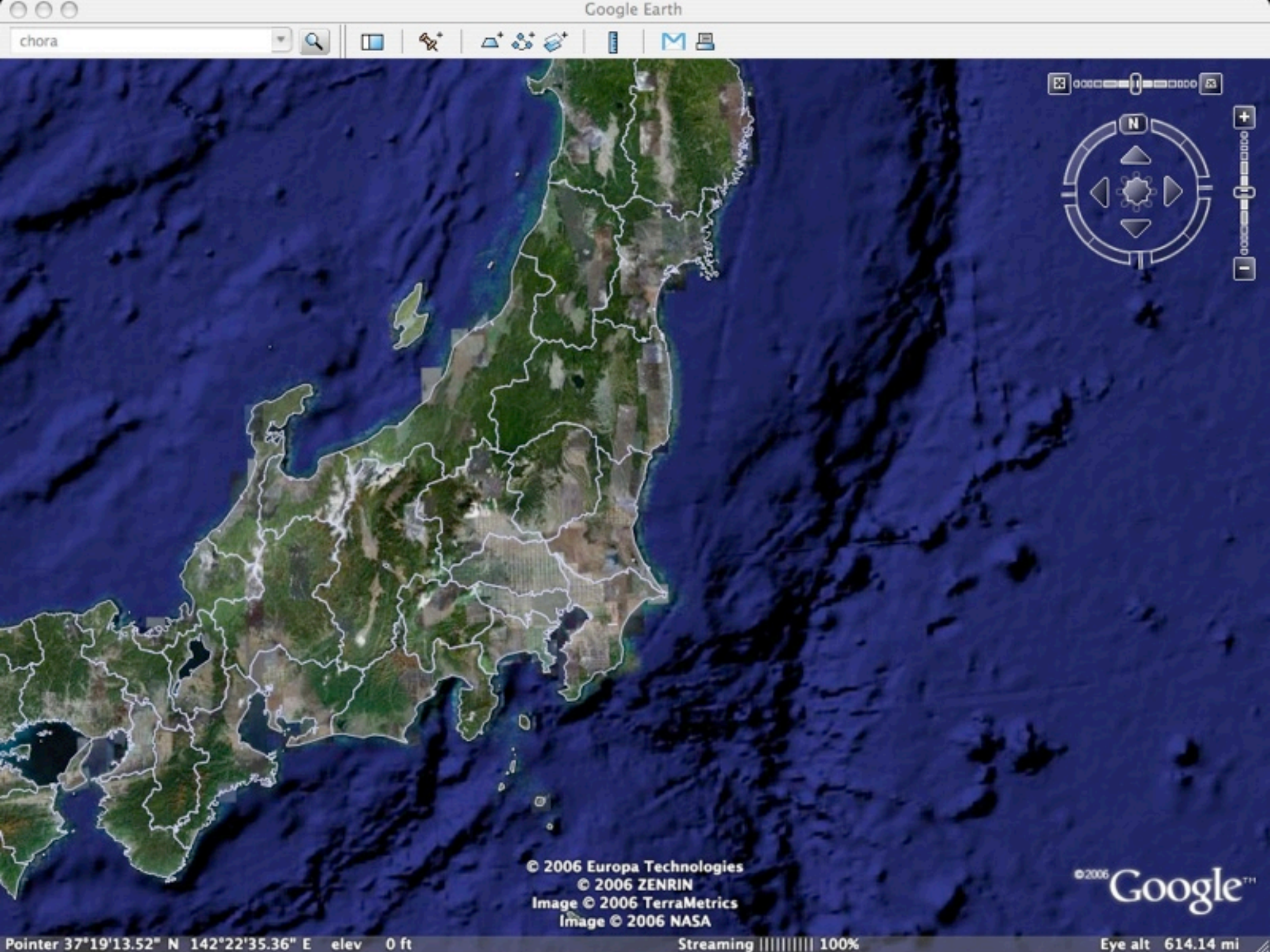
Eye alt 1783.18 mi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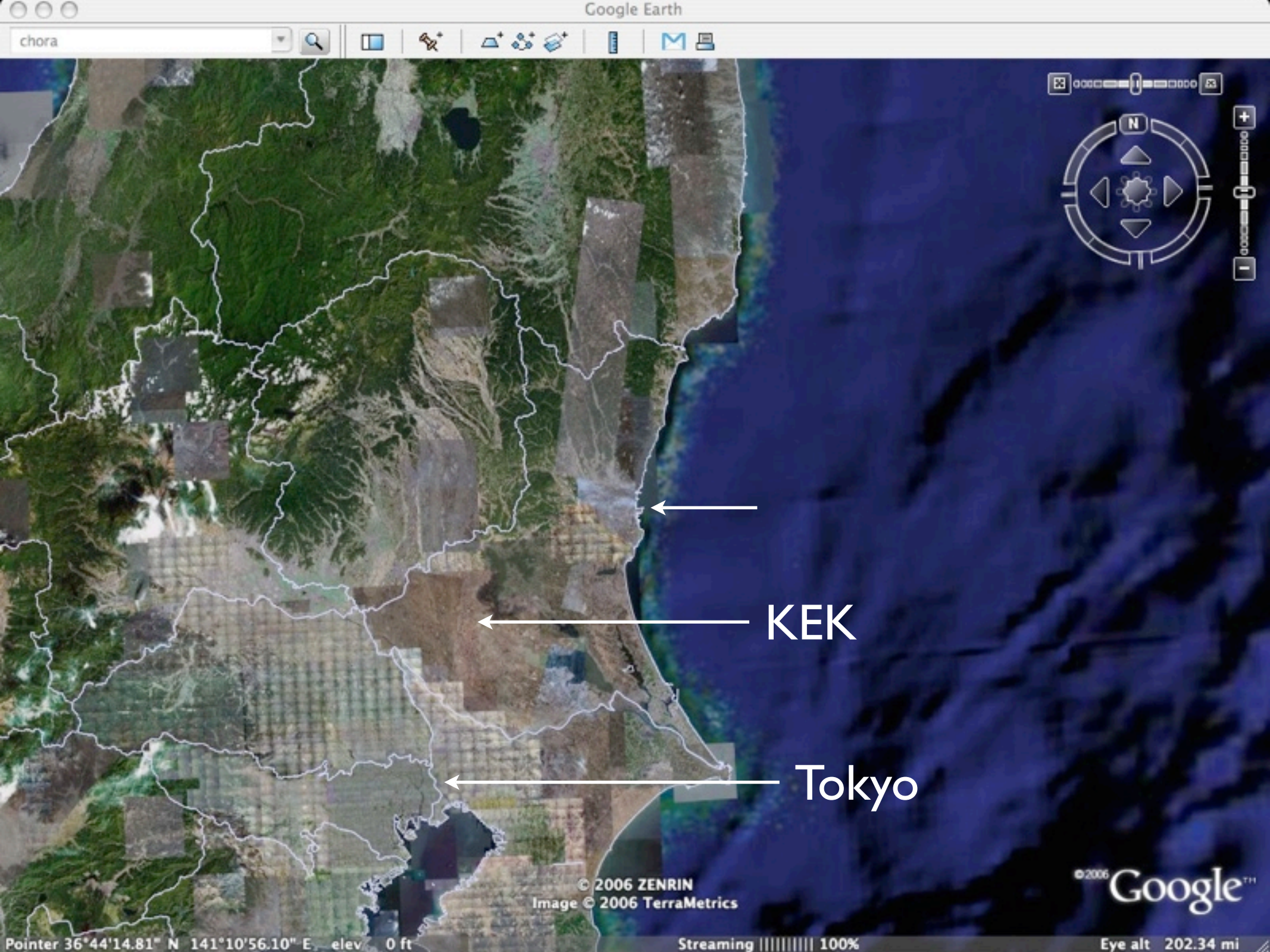
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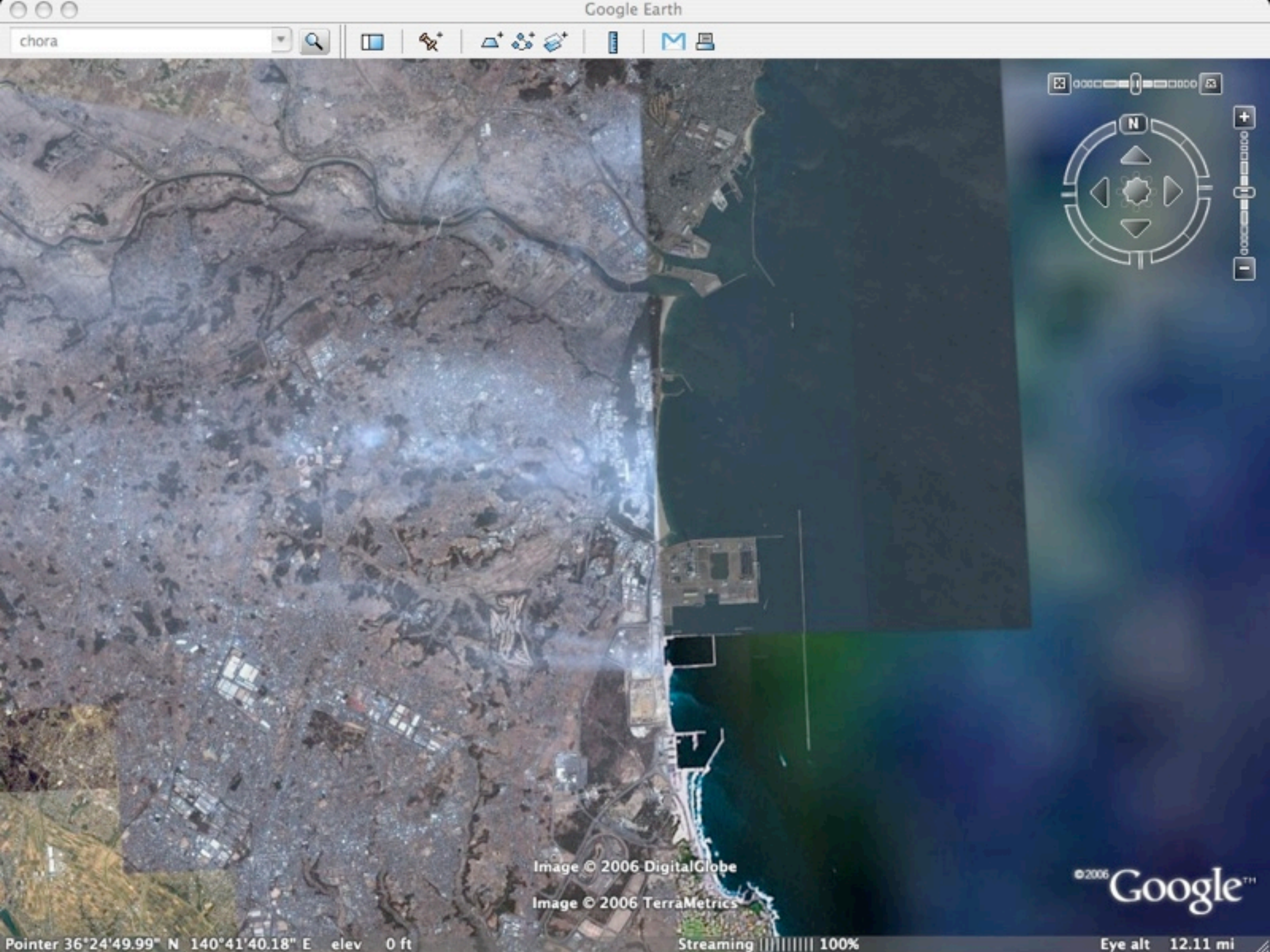
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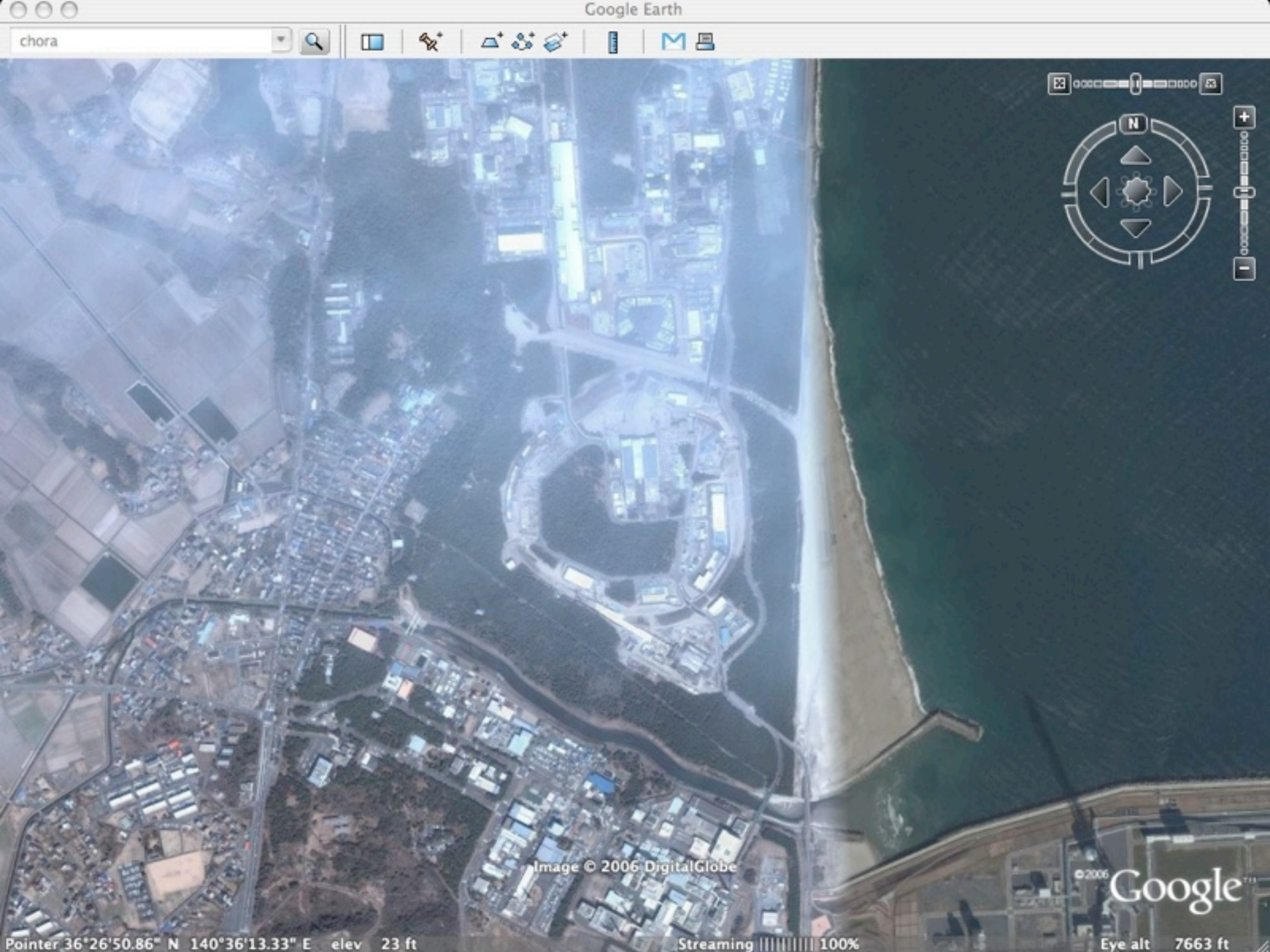
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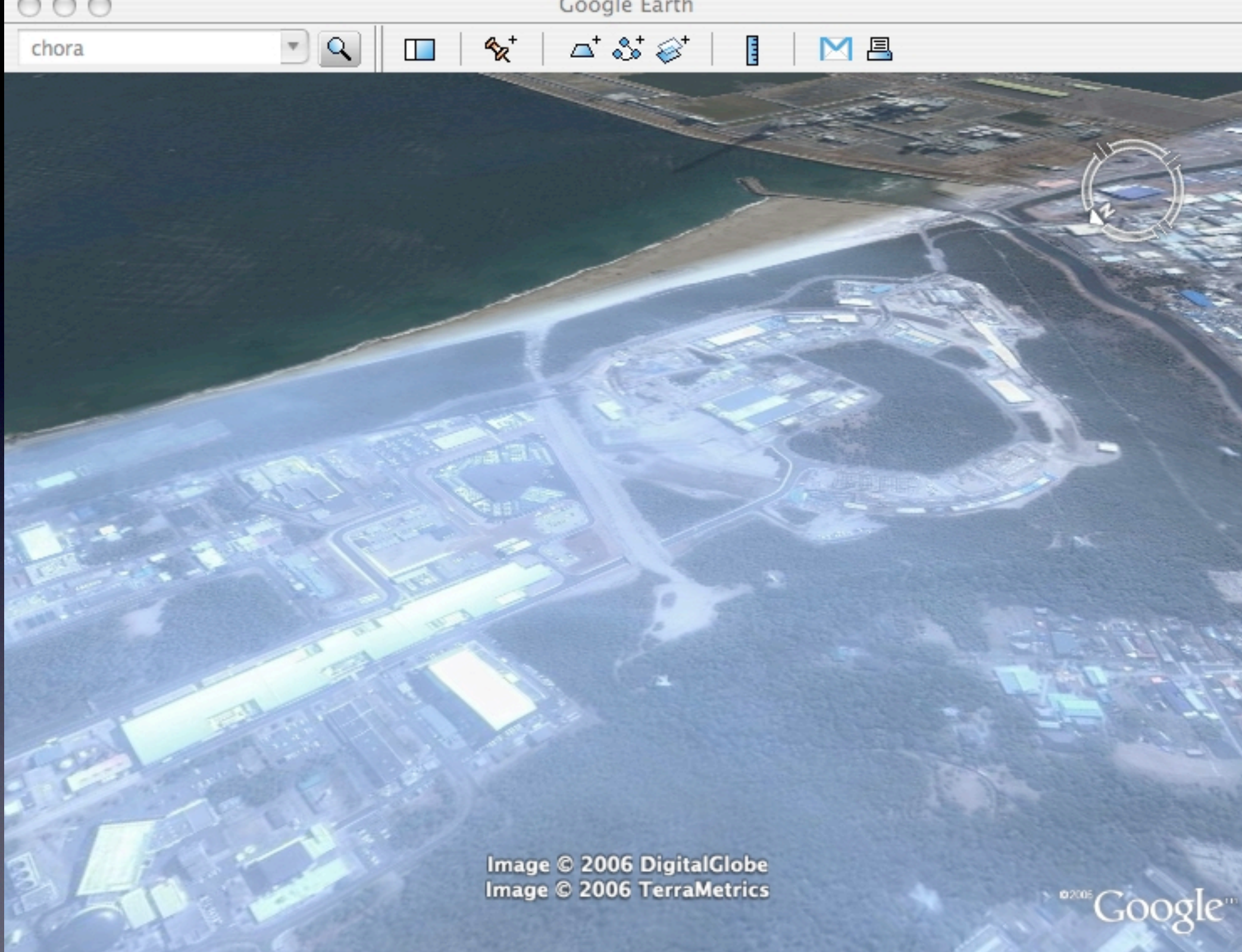
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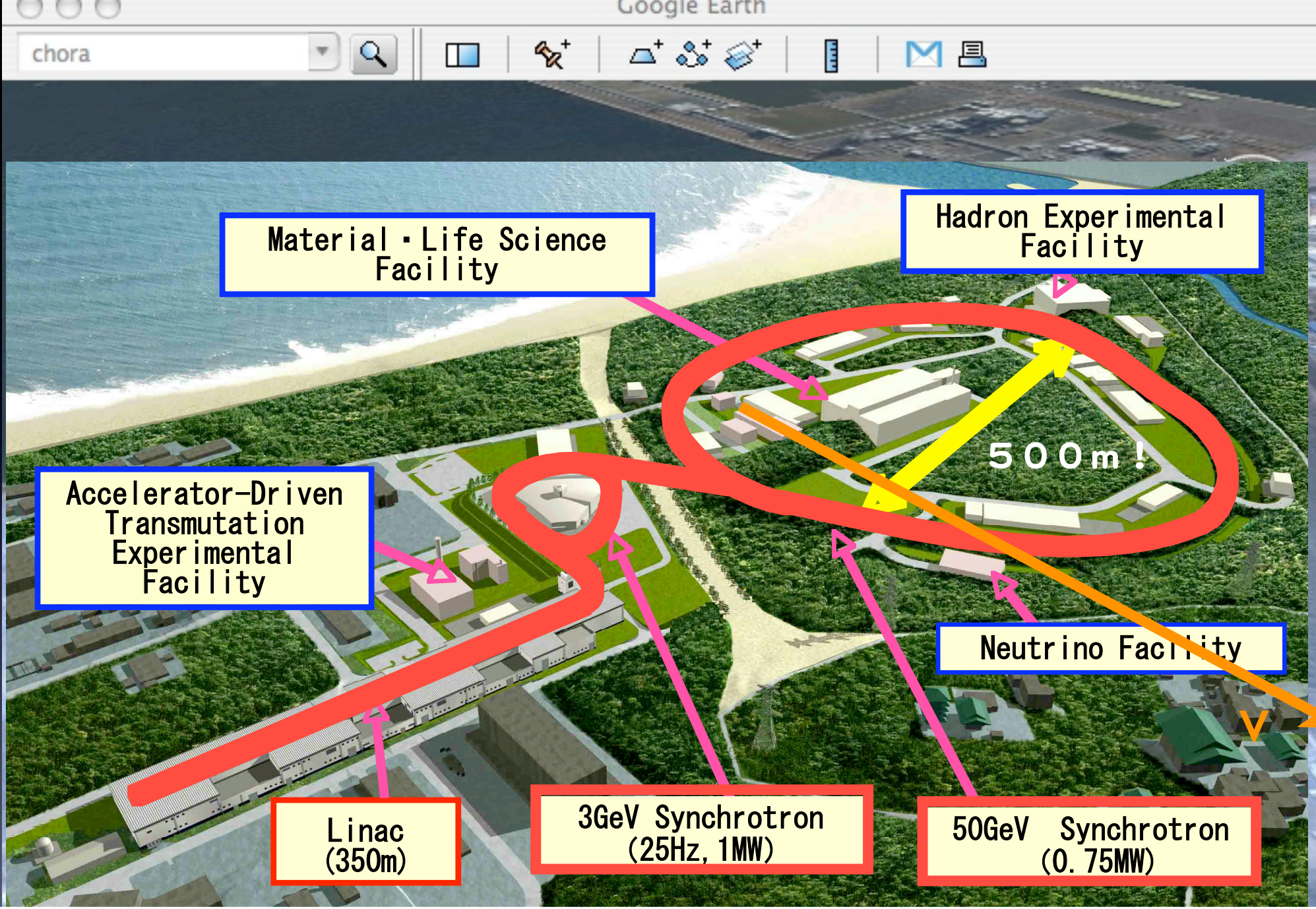
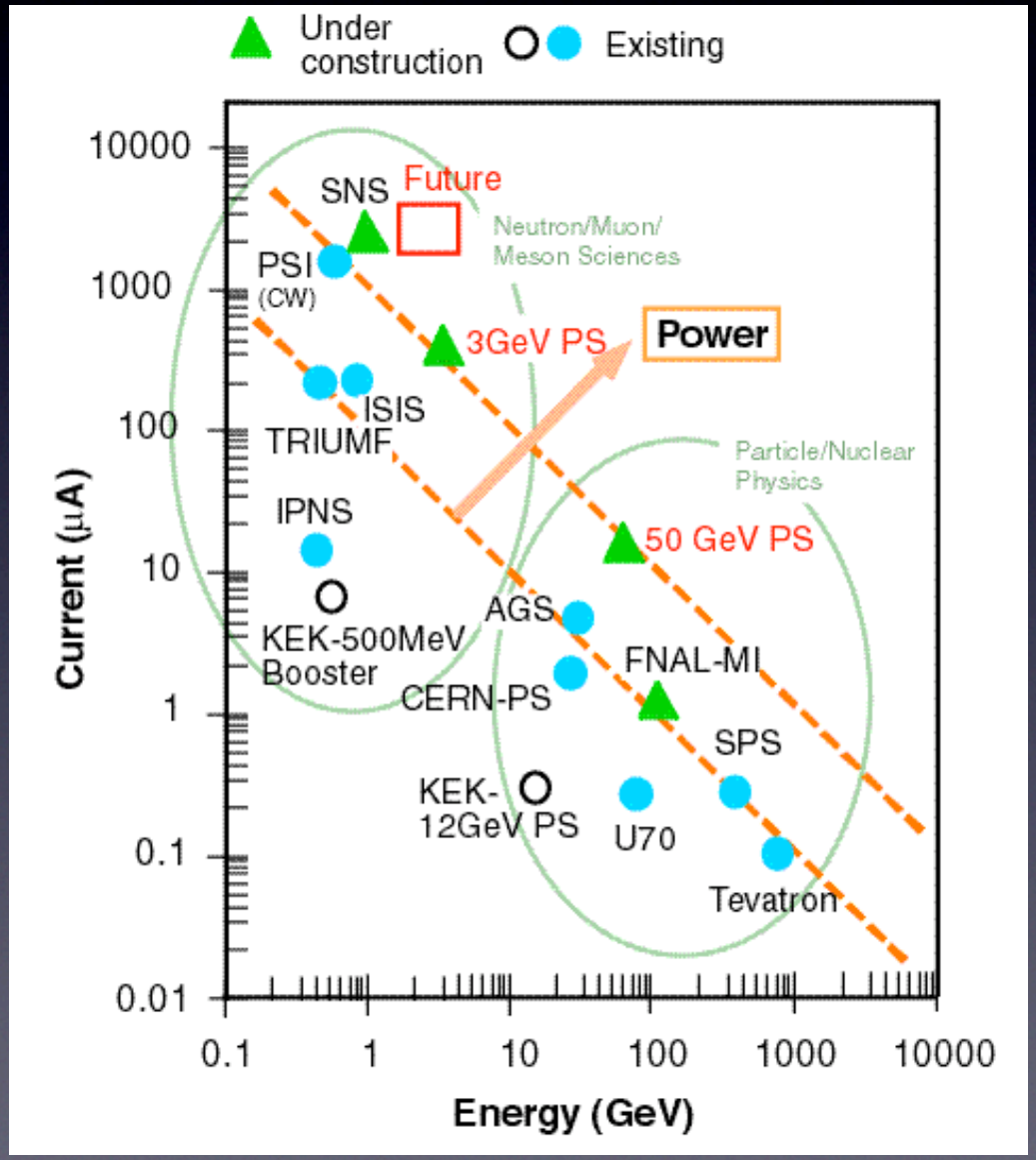

Material・Life Science Facility
Hadron Experimental Facility
500m!
Accelerator-Driven Transmutation Experimental Facility
Neutrino Facility
Linac (350m)
3GeV Synchrotron (25Hz, 1MW)
50GeV Synchrotron (0.75MW)

Design Spec.

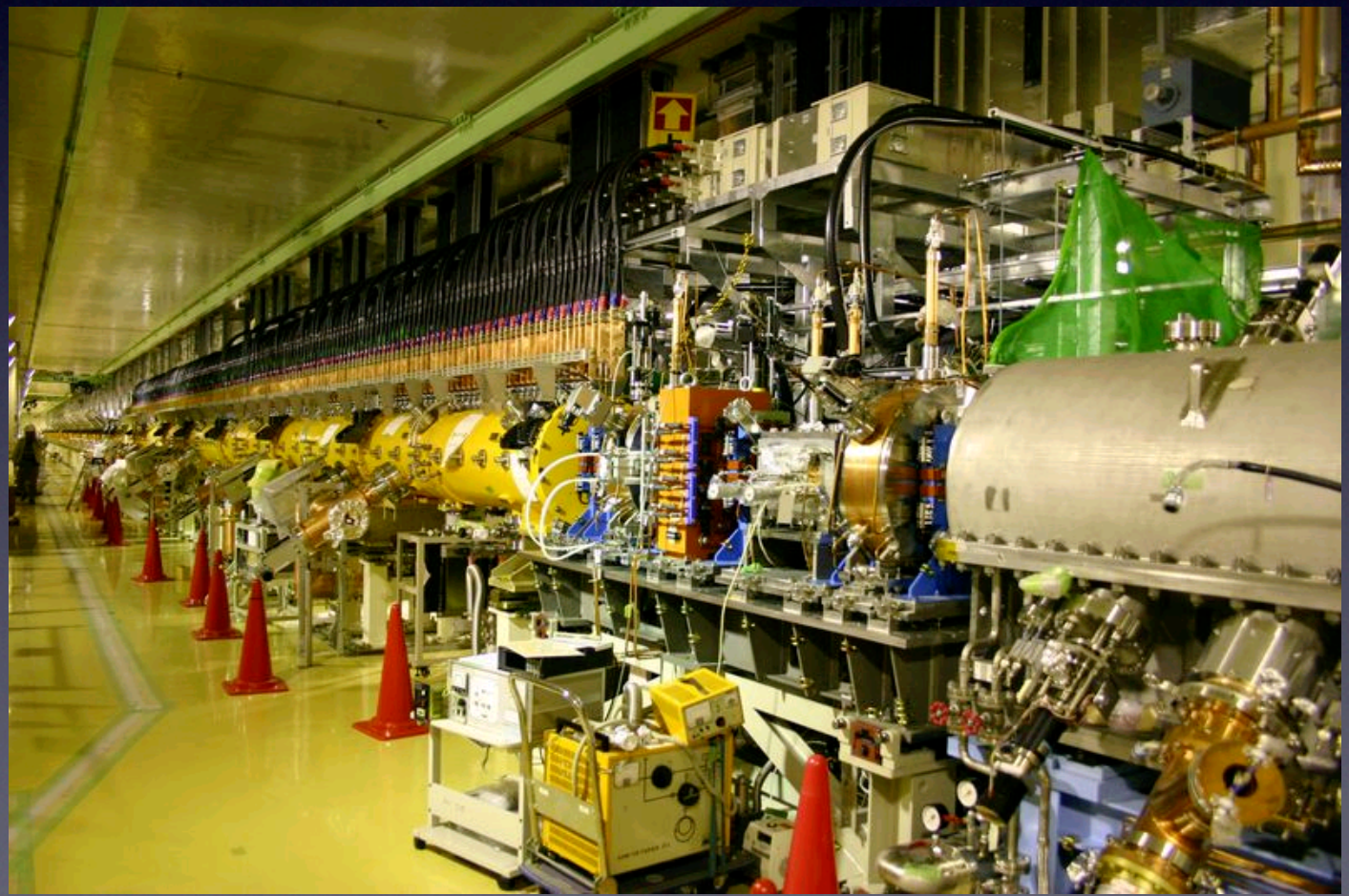
- 30-50GeV
- 3E14 protons/3.3sec
- Fast extraction for neutrino experiment
- Slow extraction for Kaon, nuclear physics, hadron physics



Status

Linac

- Jan. 24, 2007: Accelerated up to 181 MeV
- Extraction for 3GeV synchrotron is scheduled in Oct, 2007.



3GeV Synchrotron

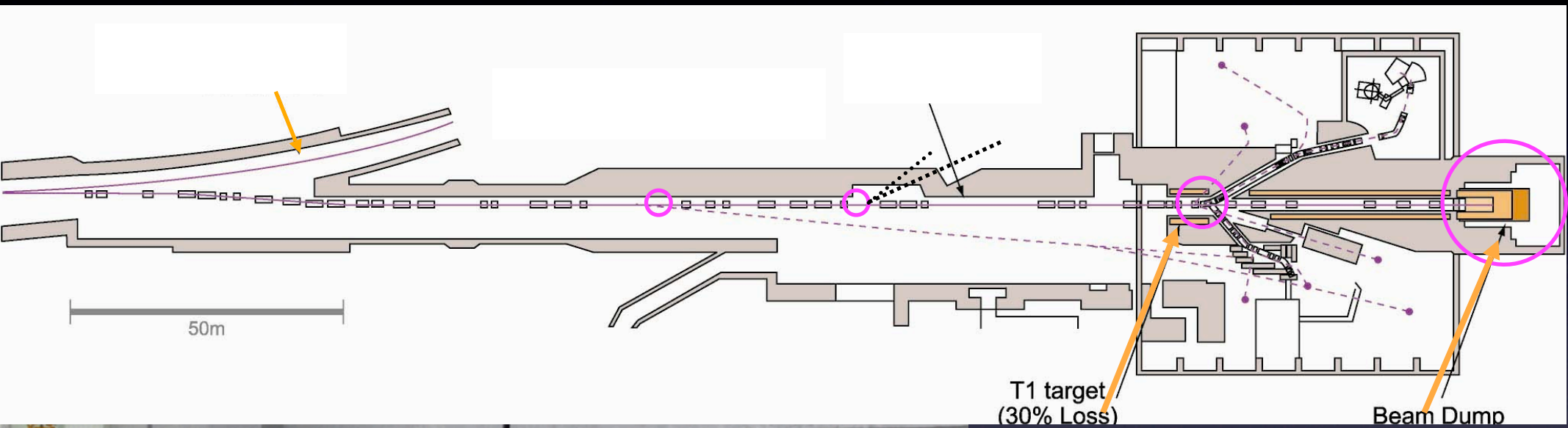
- All the magnets are in
- Commissioning starts in 2007

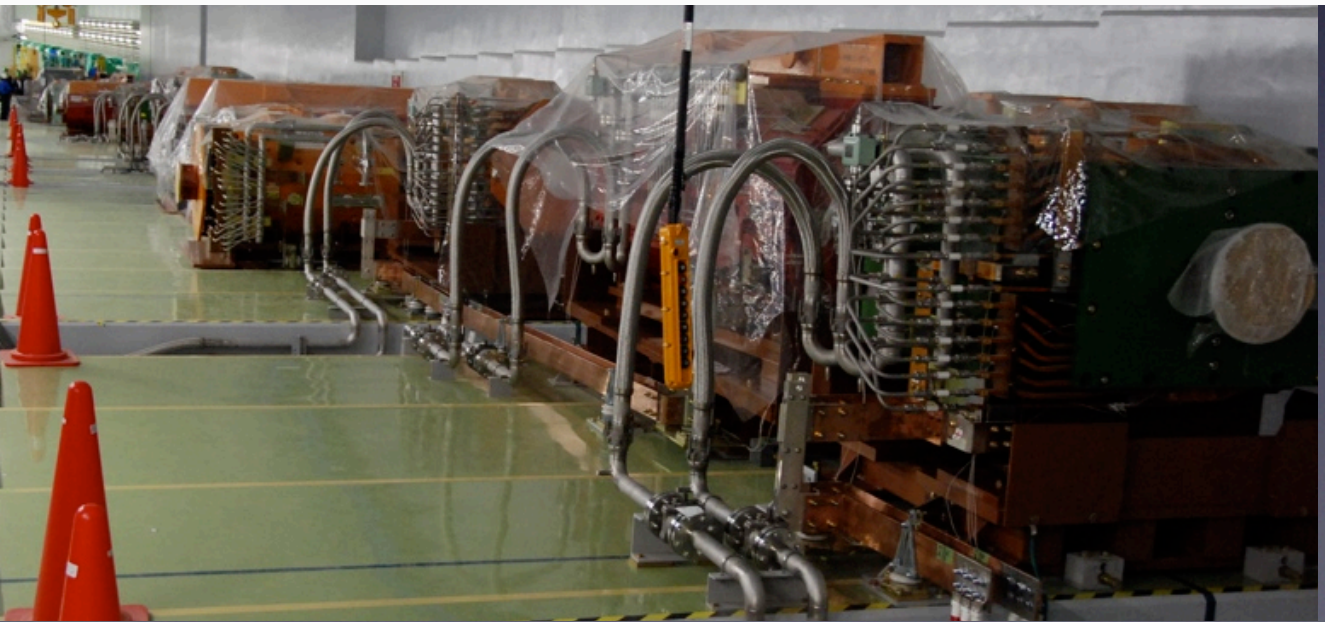
50GeV Ring

- Magnets are installed
- First beam in December 2007

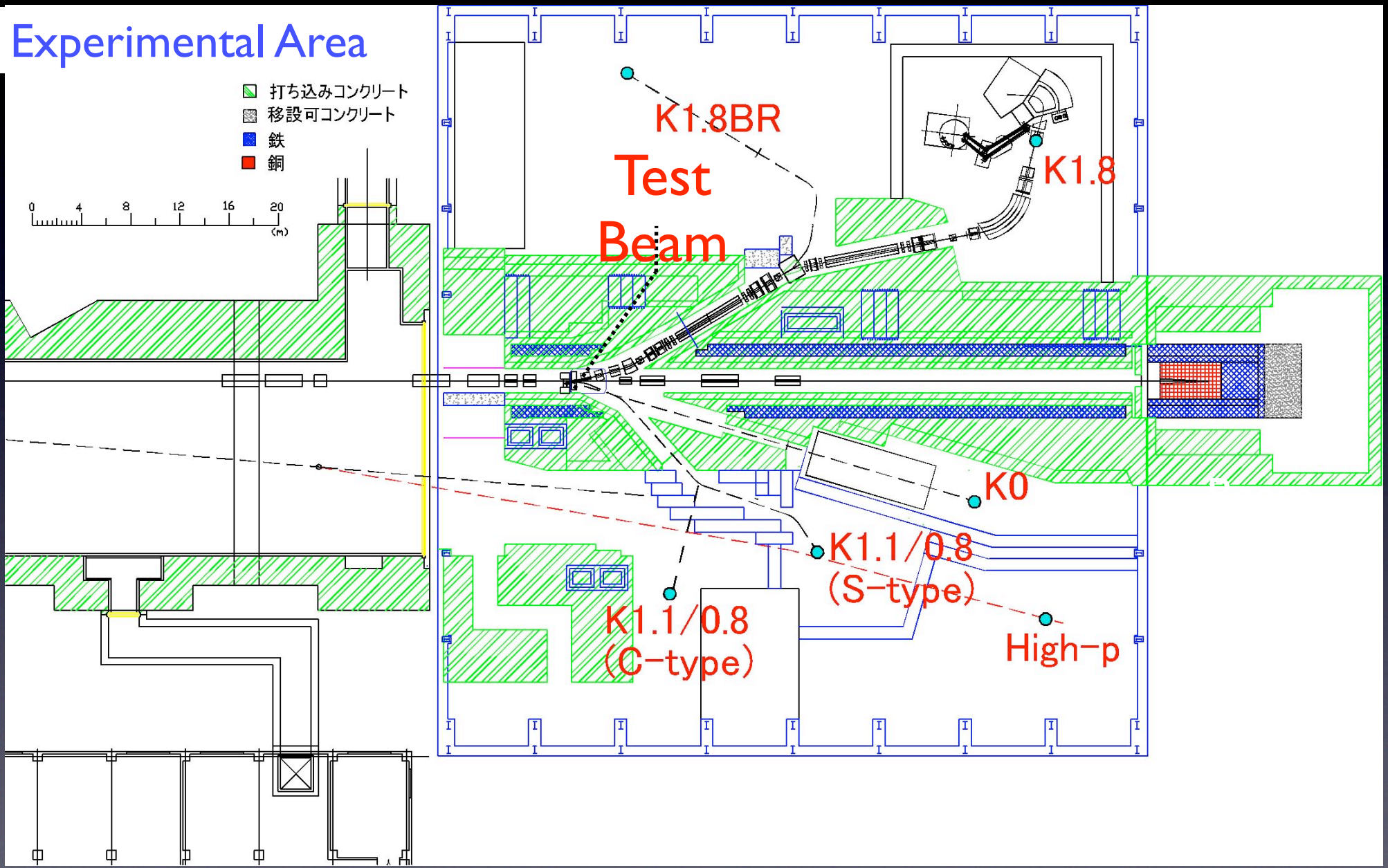
Plane view of Hadron Beamline

NP-HALL
56m(L)×60m(W)





Plan view of Hadron Experimental Hall



Hadron Hall

Hadron Hall

Schedule

- 50GeV-Ring will
  - start Dry Run in Dec, 2007.
  - accept beam from 3GeV-Ring in April ~ July, 2008.
  - install extraction magnets for Hadron bl. during summer shutdown in 2008.
- Hadron beamline will
  - accept first beam in Dec. 2008.
  - start beam tuning → until end of March, 2009.

☆Hadron Experimental Hall will be available in Summer, 2007.

- Neutrino beamline will accept first beam on April 1st, 2009, and will start T2K experiment.

Kaon Physics at J-Parc

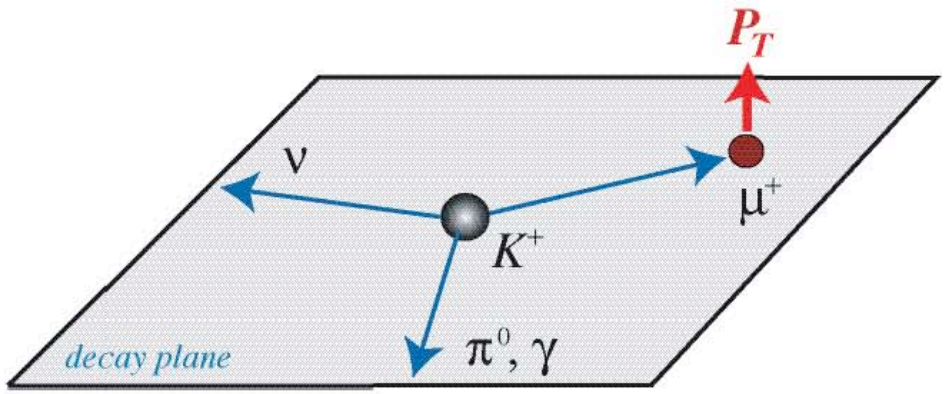
What do you do with
2~3E14 30GeV protons / 3.3sec?

T-violation experiment

Transverse muon polarization in Kμ3

$$P_T = \frac{\boldsymbol{\sigma}_\mu \cdot (\boldsymbol{p}_{\pi^0} \times \boldsymbol{p}_\mu)}{|\boldsymbol{p}_{\pi^0} \times \boldsymbol{p}_\mu|}$$

$$K^+ \longrightarrow \pi^0 \mu^+ \nu$$



t → -t

p → -p

σ → -σ

$$P'_T = \frac{-\boldsymbol{\sigma}_\mu \cdot (-\boldsymbol{p}_{\pi^0} \times -\boldsymbol{p}_\mu)}{|-\boldsymbol{p}_{\pi^0} \times -\boldsymbol{p}_\mu|}$$

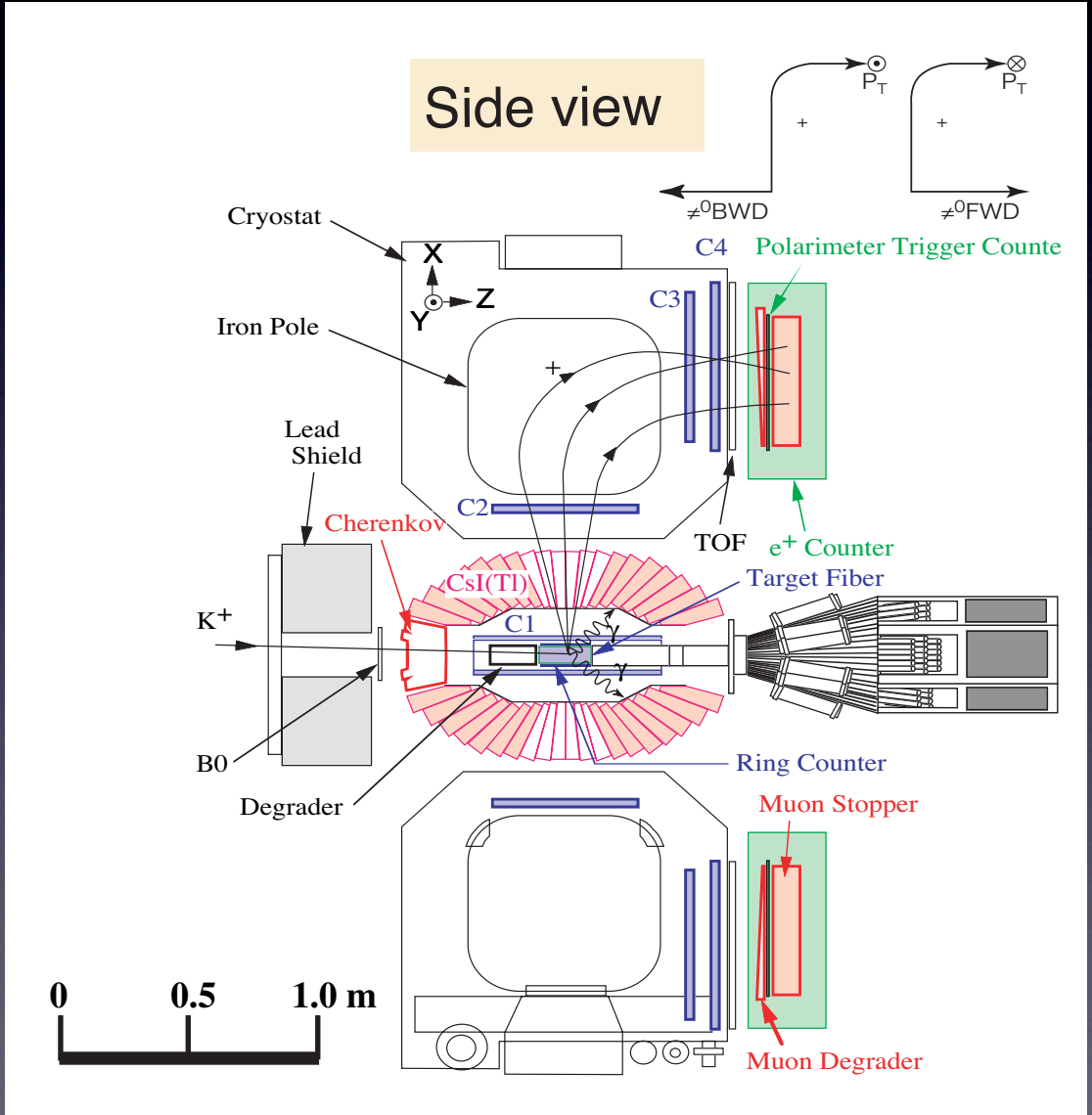
$$= -P_T$$

T-violation exp. @ J-Parc

- KEK PS E246: $dP_T = 2.5 \times 10^{-3}$
- J-Parc E04 aims $dP_T = 10^{-4}$
  - x 30 beam intensity
  - x 10 acceptance
  - high analyzing power for polarization
  - better misalignment measurements
  - correction of systematic effects

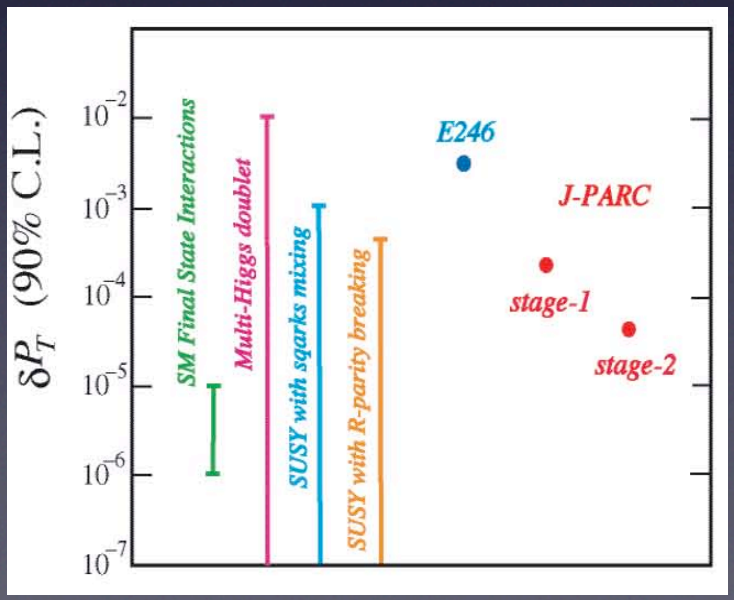
@J-Parc: Improve E246

- Active polarimeter
- Dedicated magnet to hold muon polarization
- finer target
- improved tracking
- ...



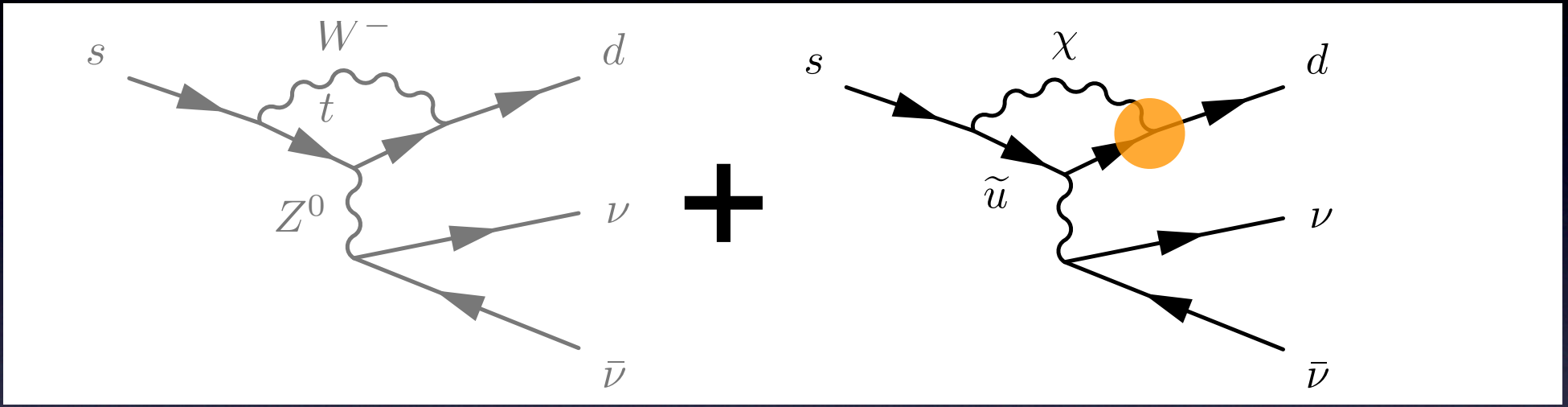
Sensitivity

- Statistical error : 1.35E-4 w/
  - 1E7 sec running time
  - 9μA proton beam on target
  - 3MHz K^+ beam
  - 7.2E8 events for analysis
- Systematic error: 1E-4

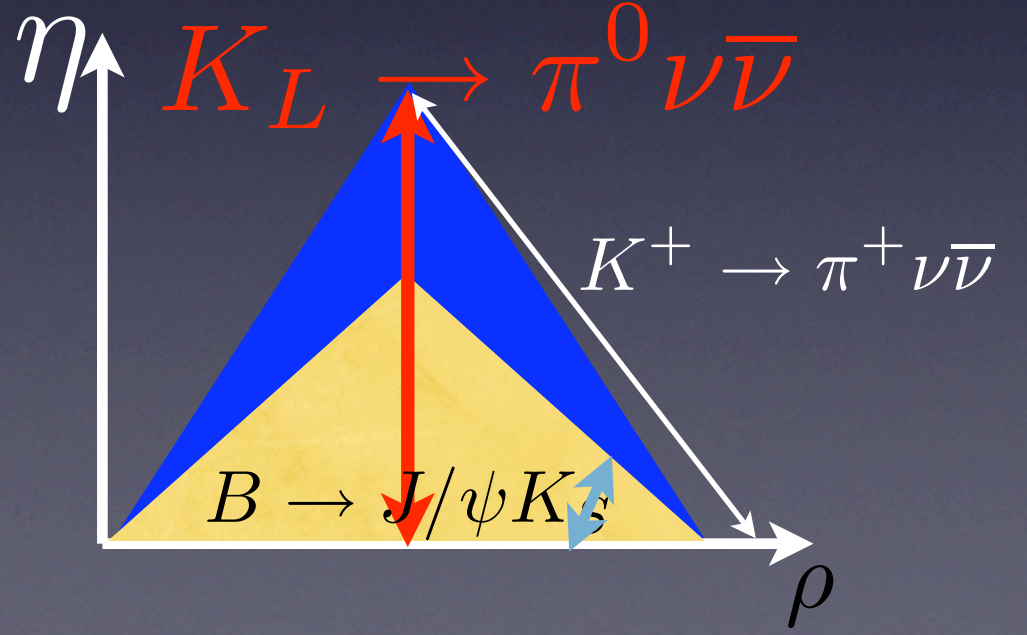


$$K_L \longrightarrow \pi^0 \nu\overline{\nu}$$

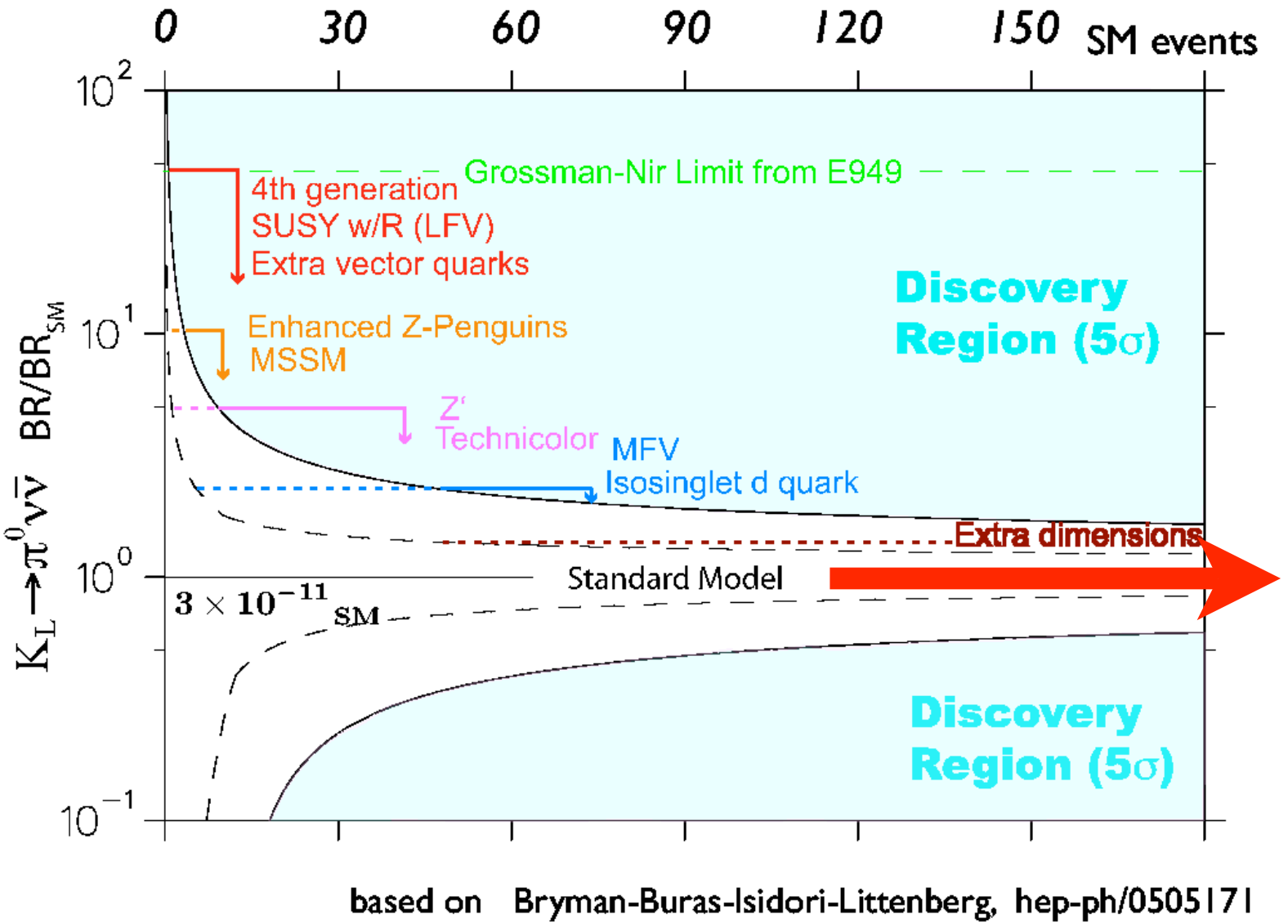
Precise window for new physics

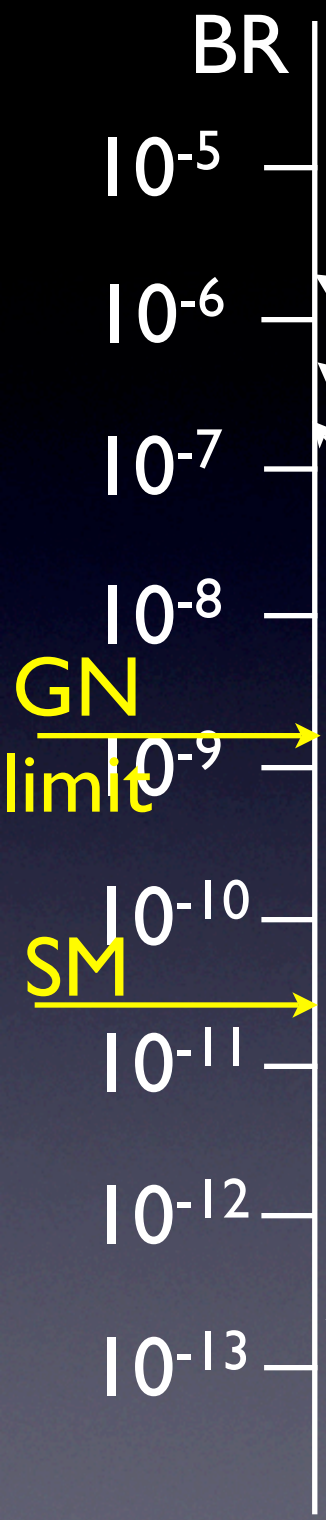


- Still the same 1-2% theoretical error!
- Compare with B results



probe New Physics



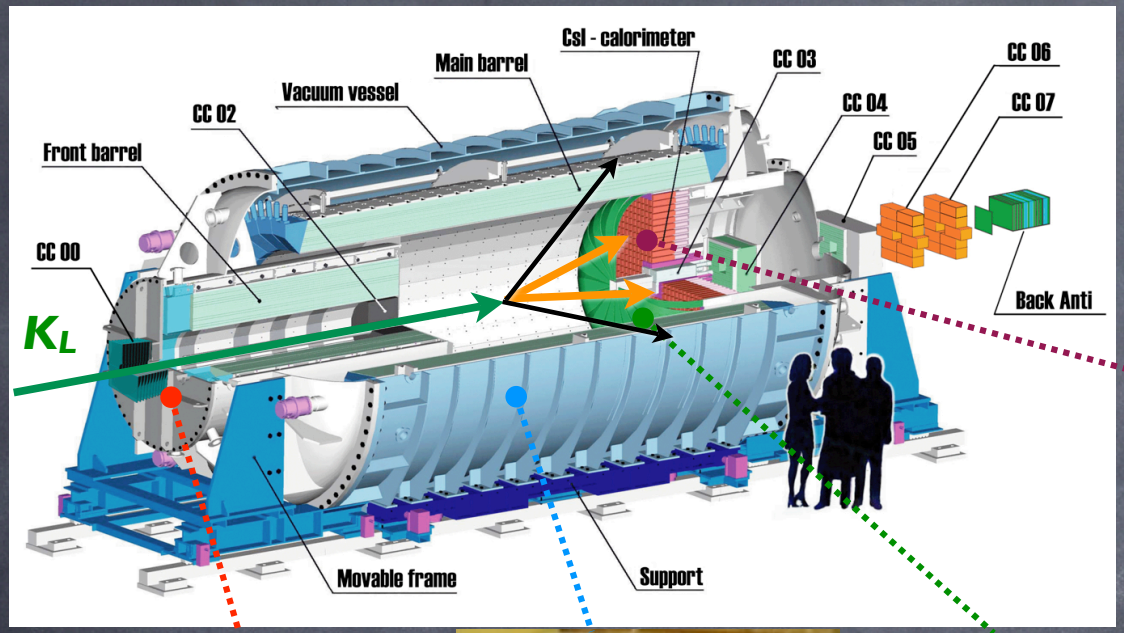


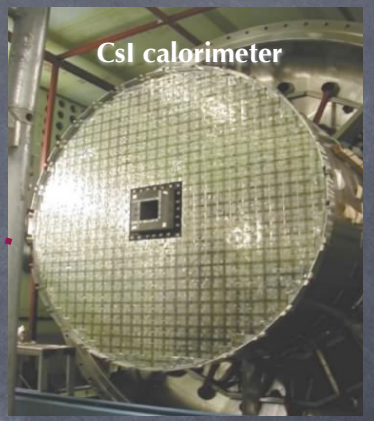
Step by Step

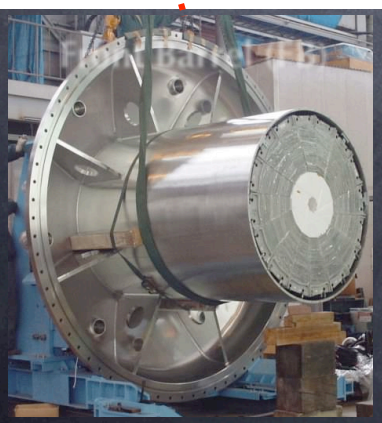
- KTeV/Nakaya
- KTeV/Hanagaki: Π^0->eeγ
- KEK PS E391a 1week/Sakashita
- KEK PS E391a
- J-Parc Step 1: beyond GN limit, 1st observation
- J-Parc Step 2: >100 SM events

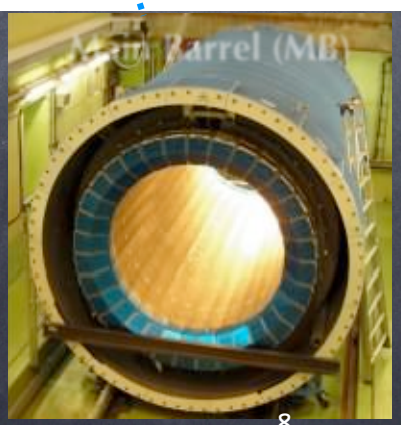
Step 0=KEK E391a w/12GeV protons

E391a Detector



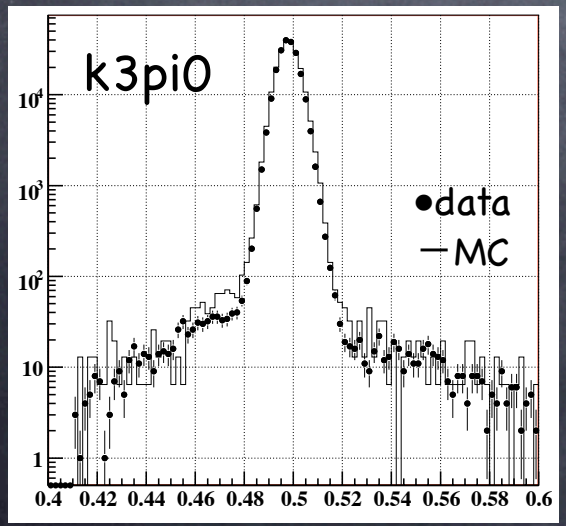


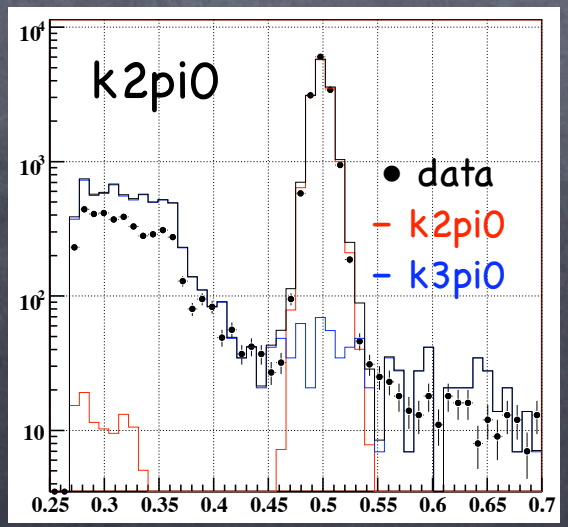


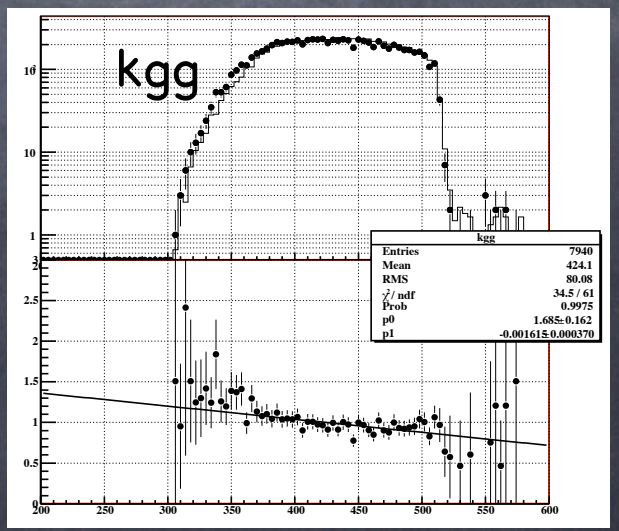


E391a status

- Had Runs 1, 2 and 3
- Published BR<2.1x10^{-7} (90% CL) based on 10% of Run 1
- Analyzing Run 2 => Talks tomorrow

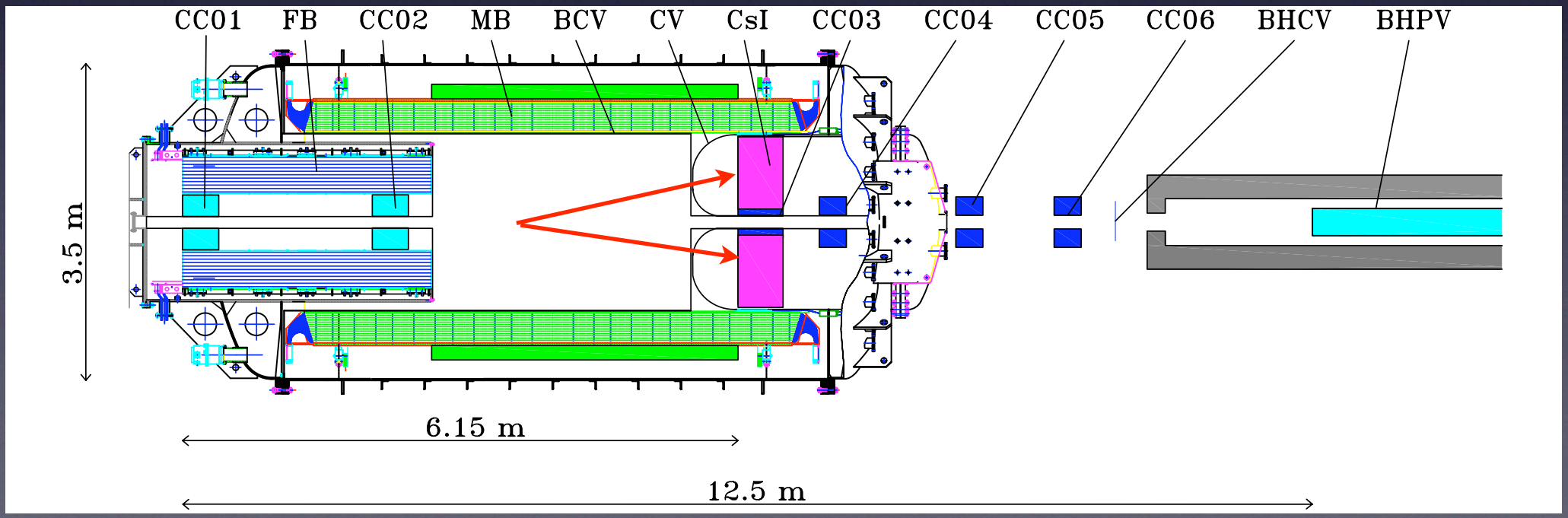






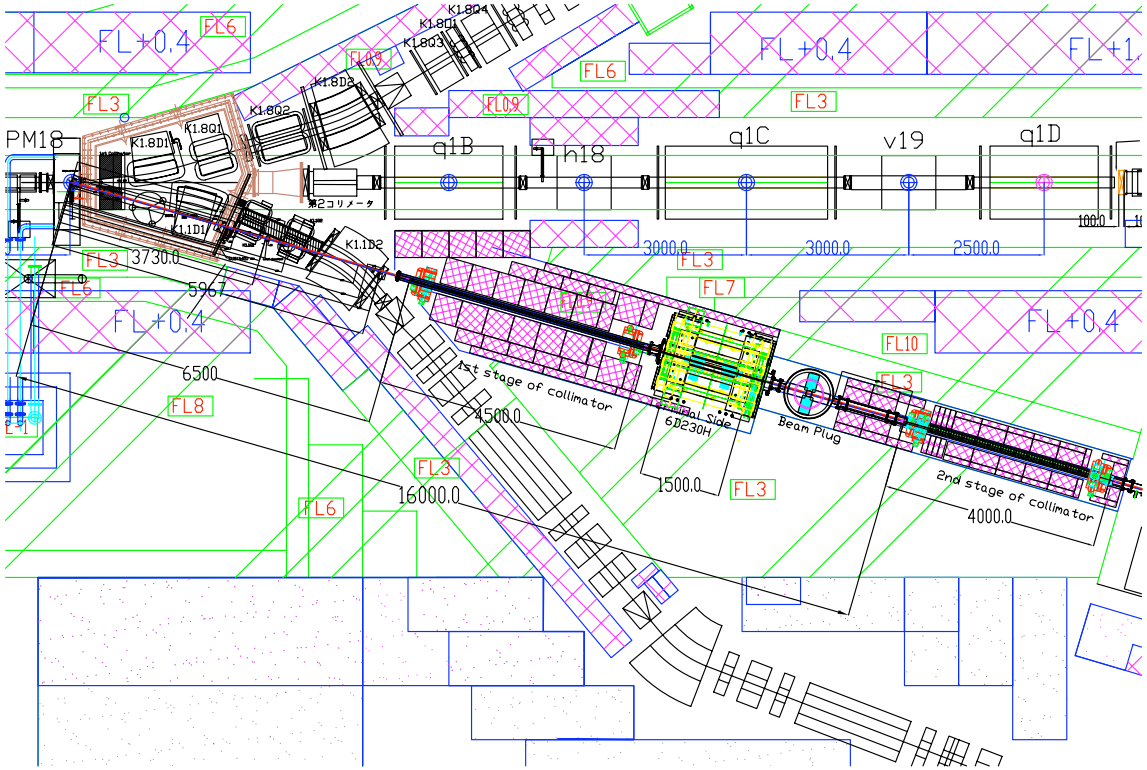
J-Parc: Step 1 Detector

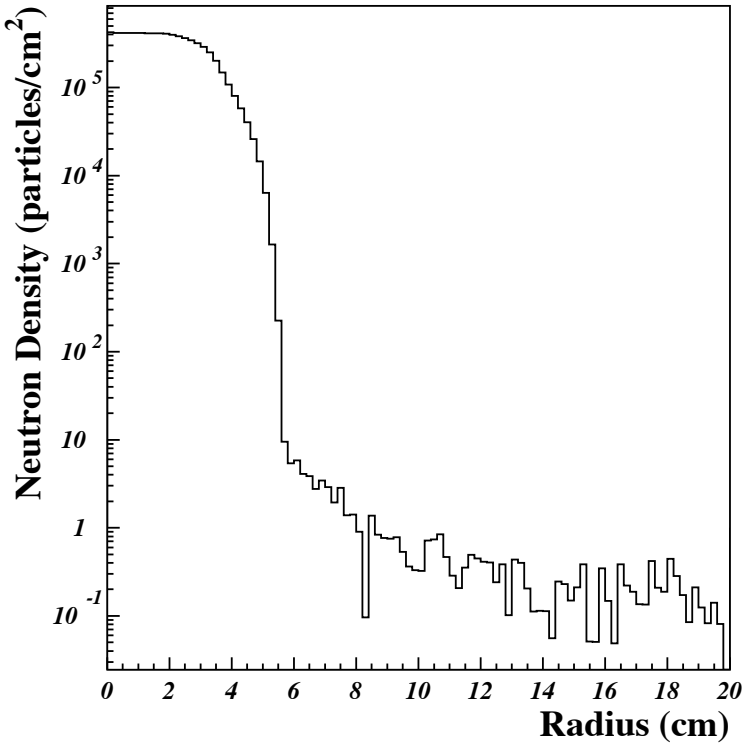
- fine granularity (KTeV) calorimeter
- Hermetic veto system w/high detection efficiency
- Waveform digitization



Step 1 beamline

- halo neutrons/core < 10^{-5}

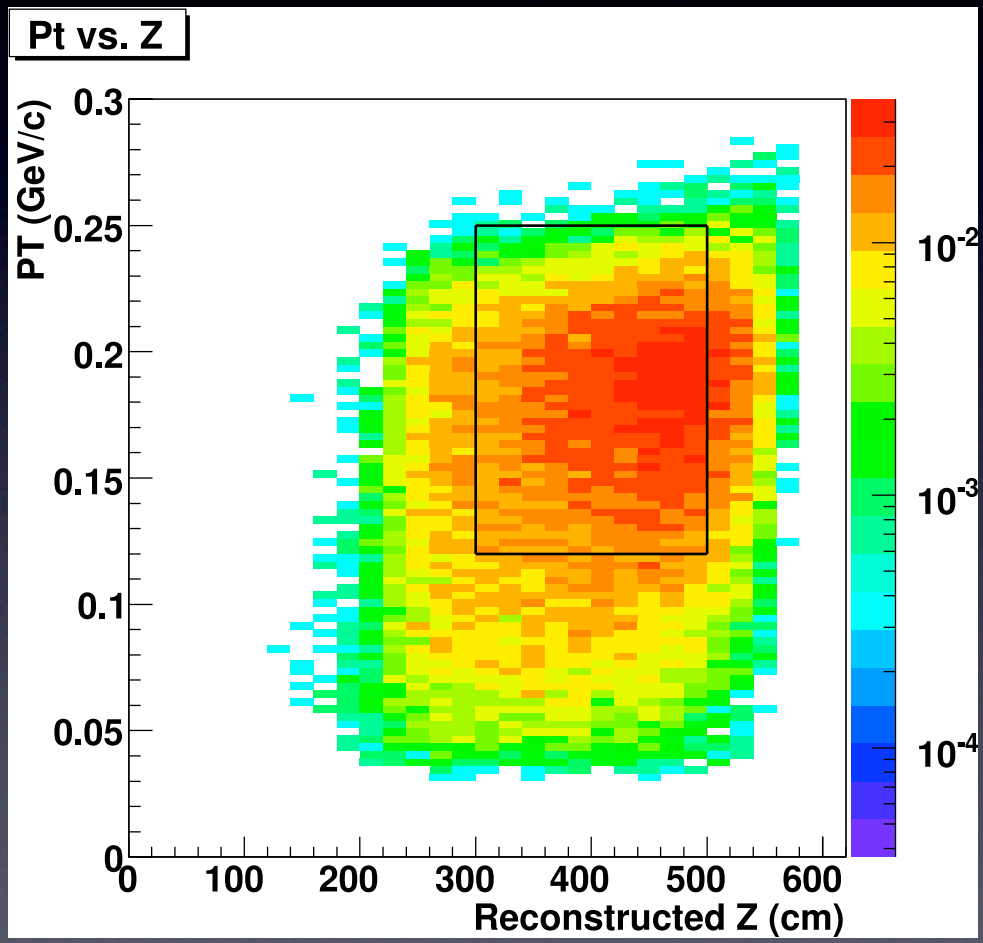




Step 1: Signal Sensitivity

- acceptance
  - 9.4% x 0.5 = 4.7%
- 2.6x10^{12} K_L decays w/ 2E14 protons x 3E7 sec
- Sensitivity =8x10^{-12}

  3.5 SM evts



Backgrounds

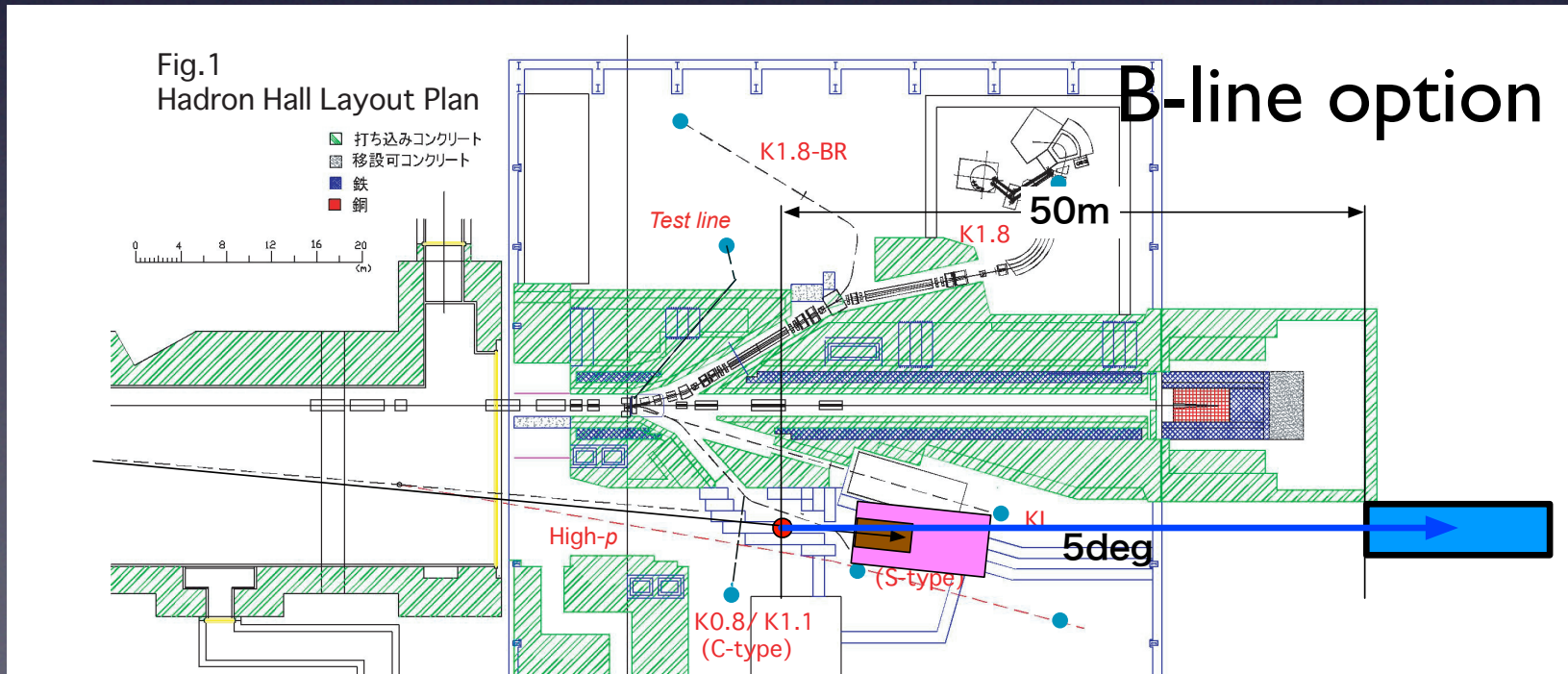
- KL->$2\pi^0$: 1.8 evts
  - mostly even pairing background events
- KL->$\pi^+\pi^-\pi^0$: 0.4 evts
- KL->$\pi e \nu$: 0.005 evts
- KL->2gamma : negligible
- Neutron interaction : <0.28 evts

Schedule

- 2007
  - Start moving KTeV CsI
  - Develop readout system, and beam test @FNAL
- 2008
  - Build K0 beamline => First beam survey
- 2009
  - Assemble detector
  - More beam survey and detector tuning
- 2010: First run

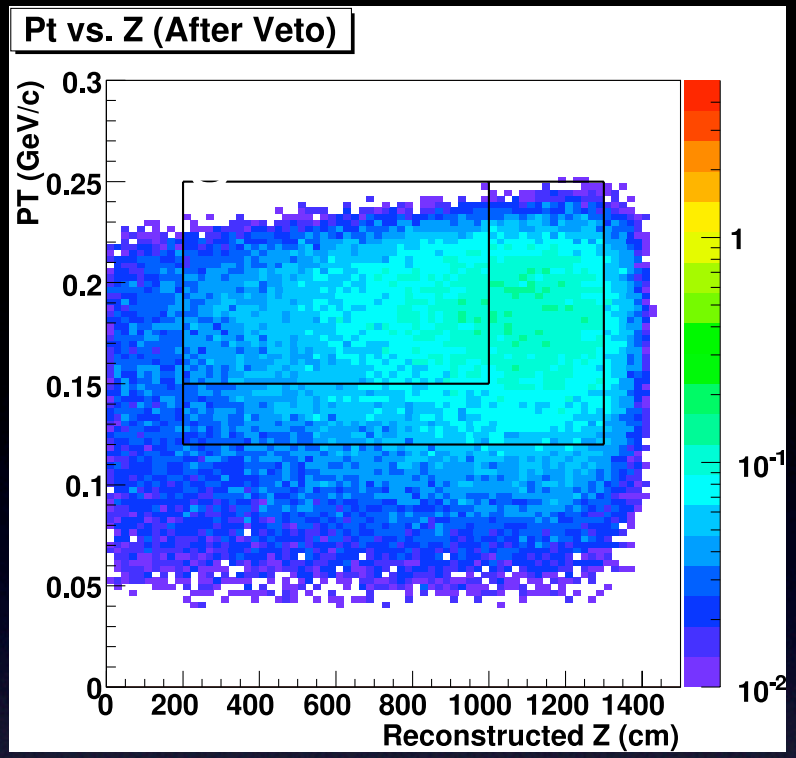
Step 2

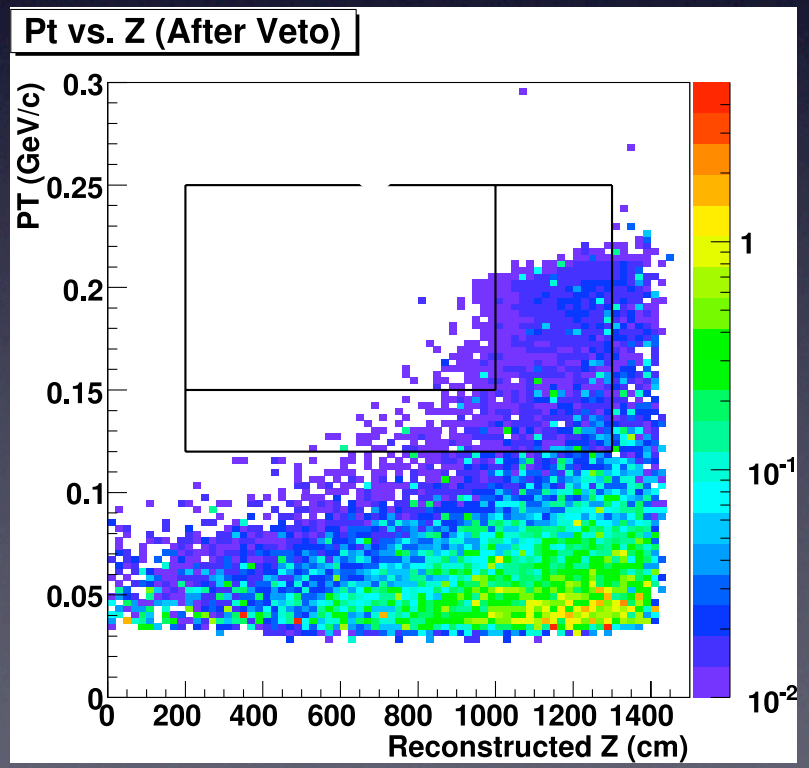
- Optimized beamline with 5deg angle for
  - higher KL momentum <PK>=5.2GeV/c
  - higher yield: 4.4E7/2μsr /3E14pot



Step 2

- Longer(15m) and larger (3m) detector for
  - longer decay volume: 6% decay in 11m
  - higher KL momentum
  - higher acceptance
- 133 SM events/ 3E14 x 3E7sec
- S/N = 4.8
  - 19 2pi0 bkg
  - 8 $\pi^+\pi^-\pi^0$ bkg





J-Parc in the LHC era

- Energy frontier: LHC, LC, ...
  - direct search for new physics, such as SUSY
- INTENSITY FRONTIER: J-Parc
  - Precise CKM measurement
  - FLAVOR PHYSICS beyond the standard model

J-Parc

- Together with NA48/3 = P326, J-Parc will determine the Triangle from Kaons,

  to probe New Physics beyond the SM.