Multi-TeV Muon Collider:

Physics, Backgrounds, Detectors

introduction to briefing 06/24/09

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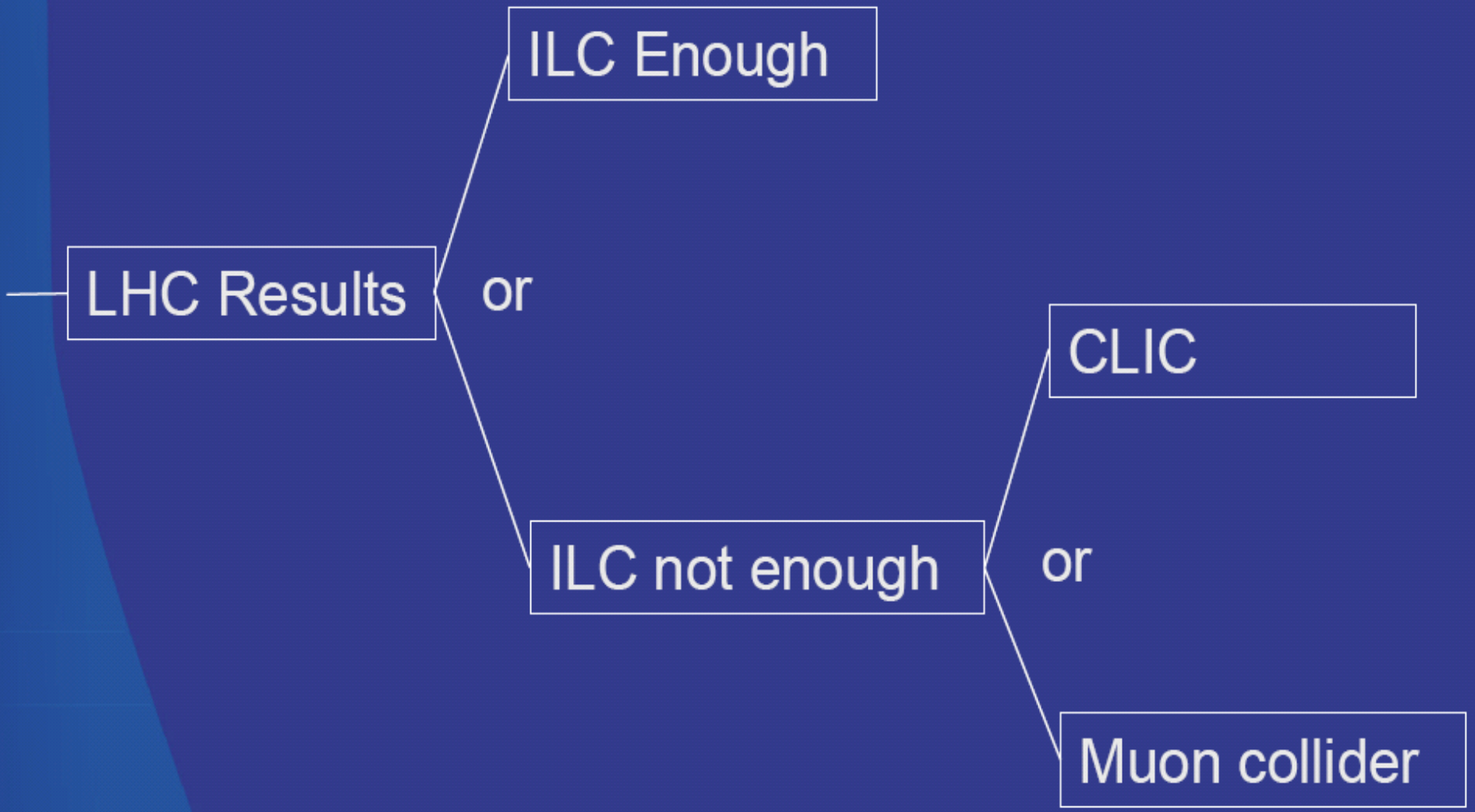
Fermilab

The Energy Frontier: Beyond LHC



Muon Collider:Small Footprint

Negligible synchrotron radiation

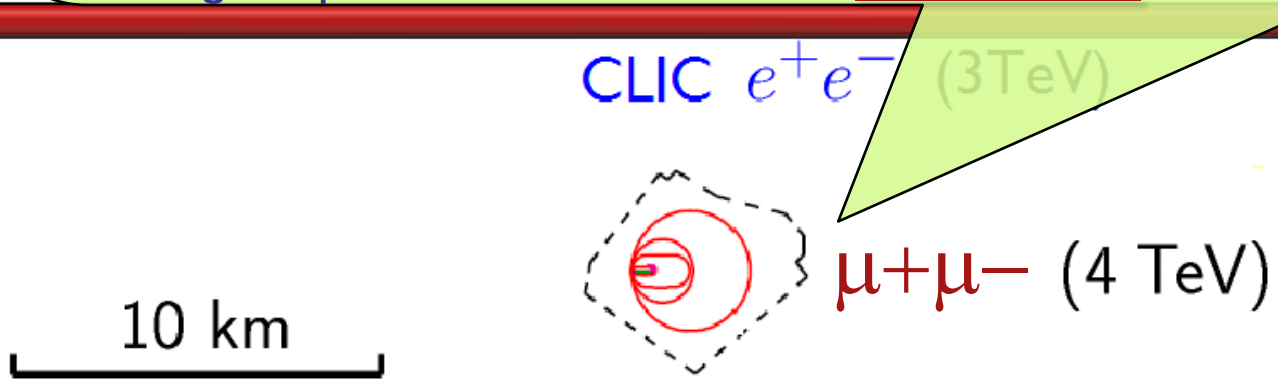
Acceleration in rings rather than linear

Less RF , very high energy reach >4TeV

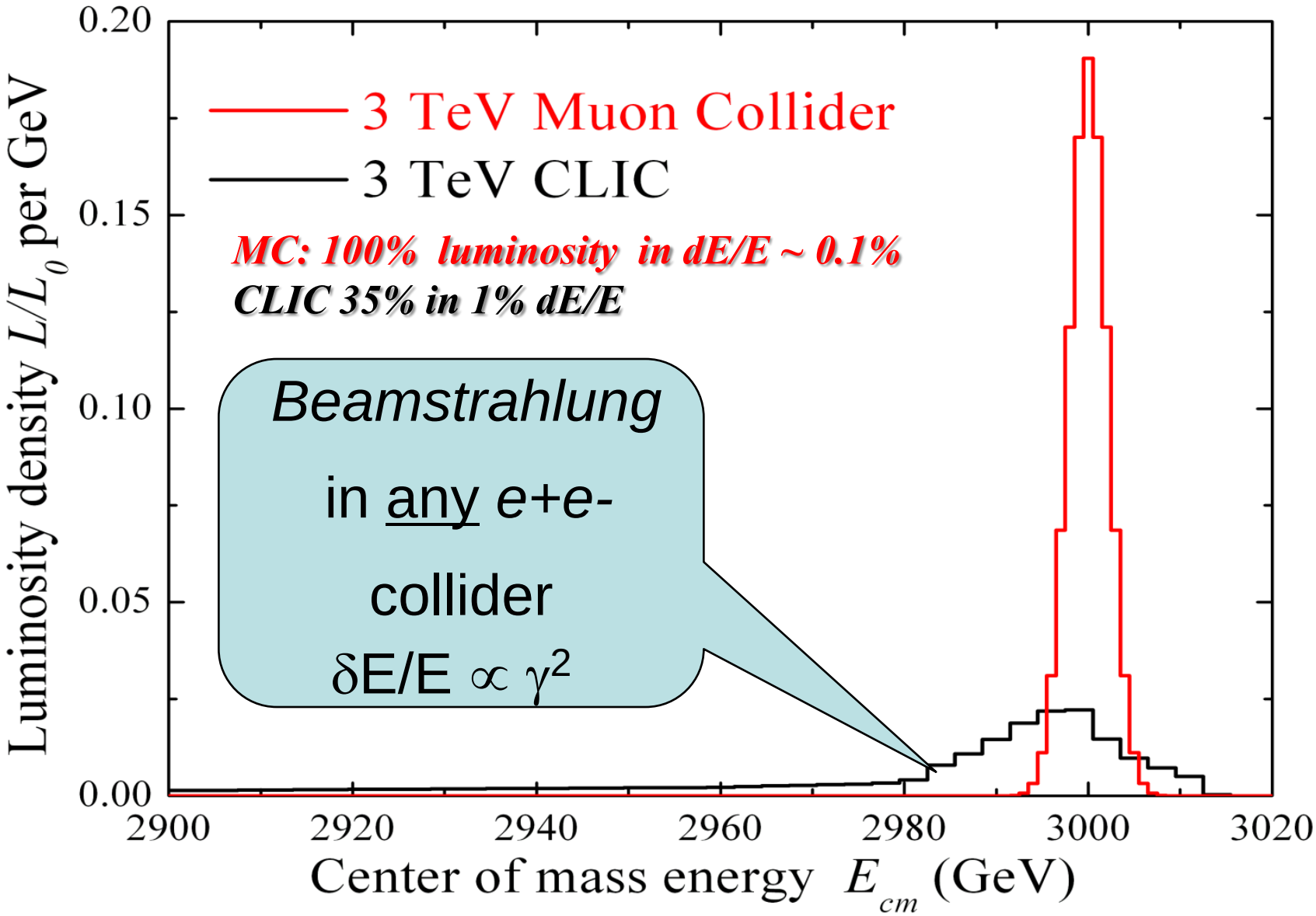
Collider as a Ring

collisions over ~1000 turns of muon lifetime

larger spot, easier tolerances, ***2 detectors***



MC: Superb Energy Resolution



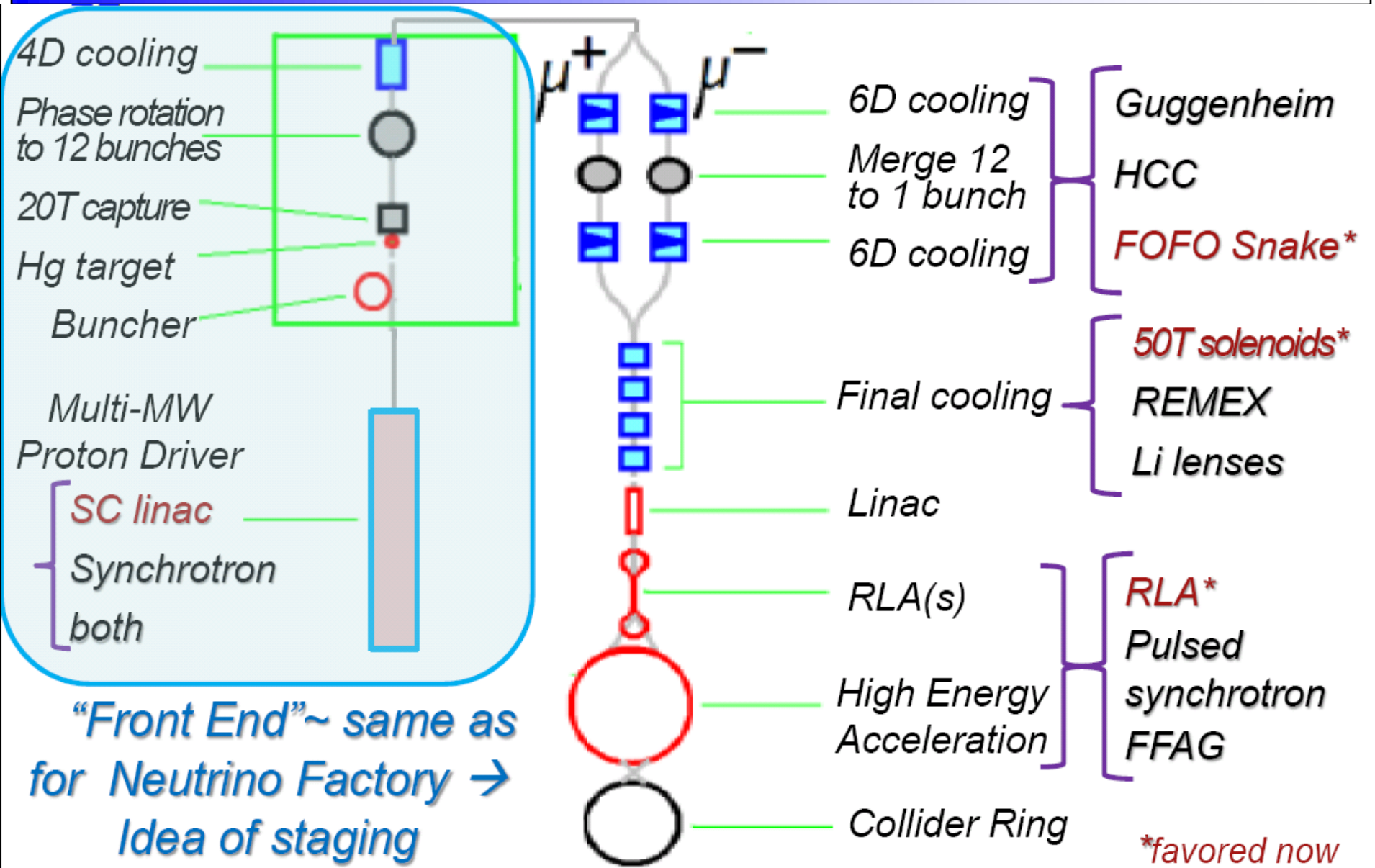
Muon Collider Parameters

CM Energy	**1.5**	**4**	**TeV**
Luminosity	**1**	**4**	**10^{34} $cm^{-2}s^{-1}$**
Muons/bunch	2	2	10^{12}
Ring circumf.	3	8.1	km
Beta at IP $\beta^* = \sigma_z$	10	3	mm
dp/p (rms)	0.1	0.12	%
Ring depth*	13	135	m
PD Rep rate	12	6	Hz
PD Power	**≈4**	**≈2**	**MW**
Transv.emm. ε_T **	**25**	**25**	**π mm mrad**
Long. emm. ε_L	72,000	72,000	π mm mrad

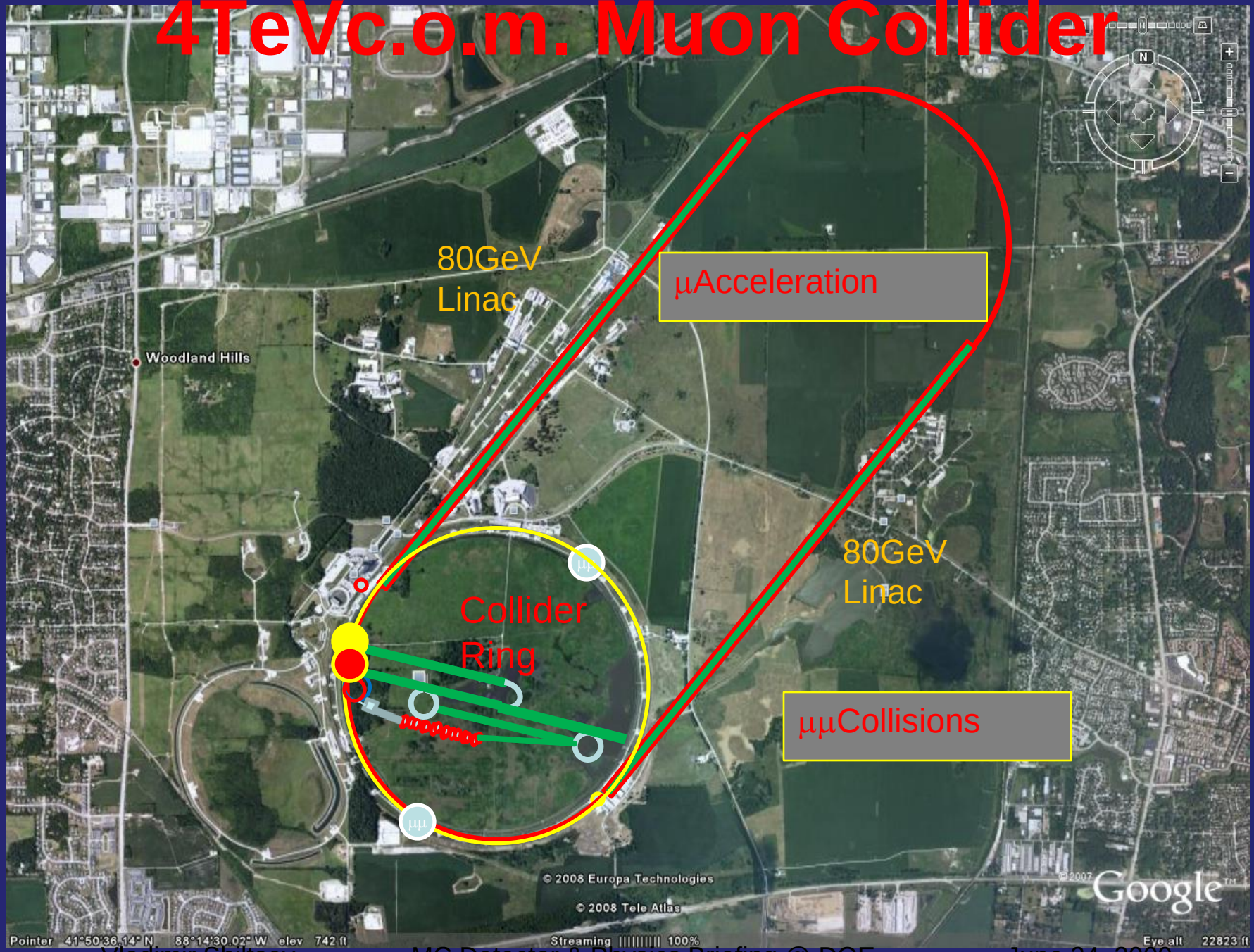
** depth for ν radiation keeps off site dose <1 mrem/yr*

*** lower emittance option is under consideration*

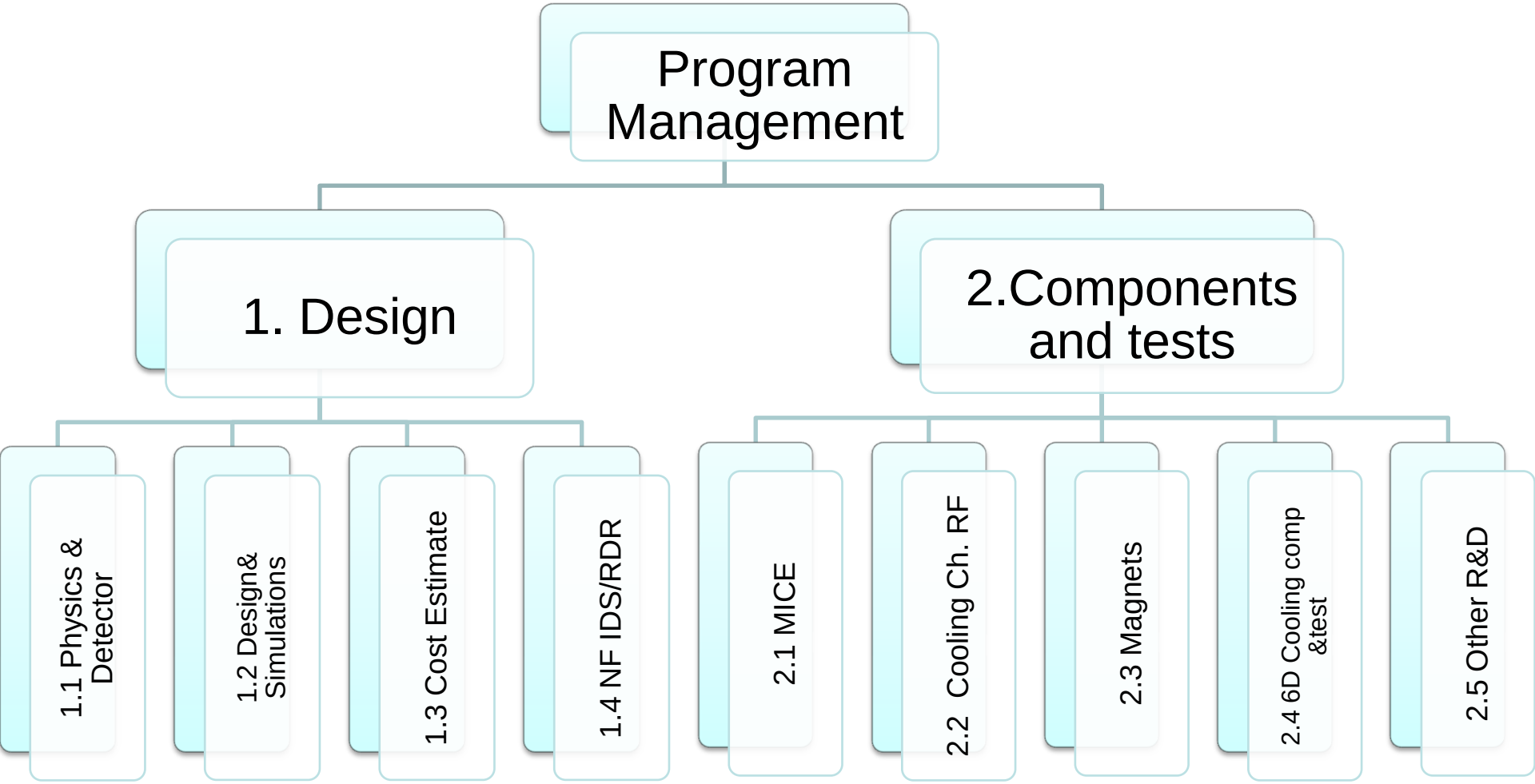
Muon Collider Scheme



4TeVc.o.m. Muon Collider



US Muon Accelerator R&D Program 5 yr plan (2009-2013)



Muon Accelerator R&D Proposal

- Pulled together by NFMCC and MCTF
- Addresses key R&D issues, including
  - Maximum RF gradients in magnetic field
  - High pressure RF tests with ionizing beam
  - 6D cooling section prototype
  - Full start-to-end simulations
  - Proton bunching ring design
  - Magnet designs for acceleration, collider and HTS
- **Deliverables by ~2013:**
  - Muon Collider Feasibility Report and ν-Factory RDR
  - Results of hardware R&D to make technology choice
  - Cost estimate
- **Funding increase needed to ~20M$/yr (about 3x present level); total cost 90M$**

Lepton Colliders Comparison Table

	ILC	MC	CLIC
com Energy TeV	0.5	1.5-4	3
Acceleration feasible (techn.)	~yes	yes by 2013*	yes by 2011
Performance (L) feasible now?	~yes x1/10-1	? x1/1000	? x1/100
Cost : known?	~16B$	by 2013	by 2011
Hi-Tech length	36km	14-20km	~60km
wall power, MW	230	120-200	380-430
Complexity # of elements	~24,000	~6,000	~220,000

Comparative Summary

- Physics reach and technical difficulties of the Muon Collider and CLIC are comparable:
  - dE/E vs polarization
  - >4TeV c.o.m possible with Muon Collider
  - this is the US entry vs European entry on the path to energy frontier
- Our choice will not be made on base of different physics and detector:
  - that will be cost and risk (both higher for CLIC)

This briefing is about:

- How we expect to do physics at a muon collider:
  - what are the Physics program options
  - what kind of a detector could we build
  - how would it work in the background of decaying muons.
- (the best) desired outcome: you are convinced that the MC detectors to do interesting physics can be built, challenges are understood and R&D plan exists

Proposed schedule

1. This Introduction - Vladimir Shiltsev (10')
2. Physics at Muon Colliders (low/high energy, low-high luminosity) – Estia Eichten (15')
3. Muon Collider Detector Background (issues, solutions, etc) – Stephen Geer (15')
4. Muon Collider detector R&D (challenges, comparison/synergy with LHC/ILC/CLIC) – Marcel Demarteau (15')
5. Discussion (<1 hr)