Measurement of time like π^0 TFF (and true muonium TM)

- Need for low energy e+e- data
- TM – Brodsky-Lebed proposal

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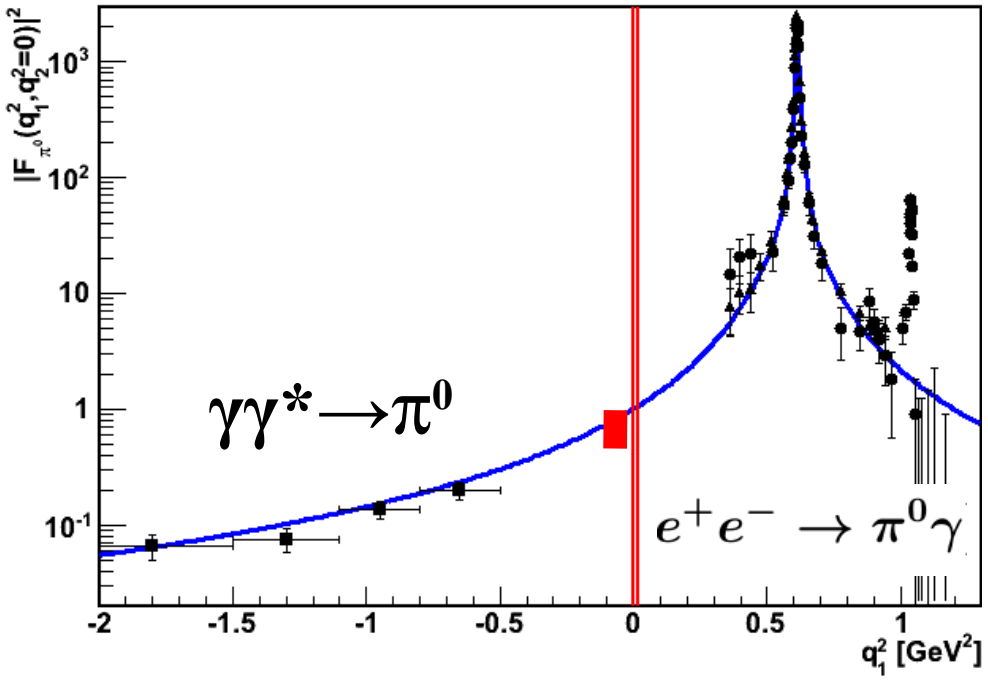
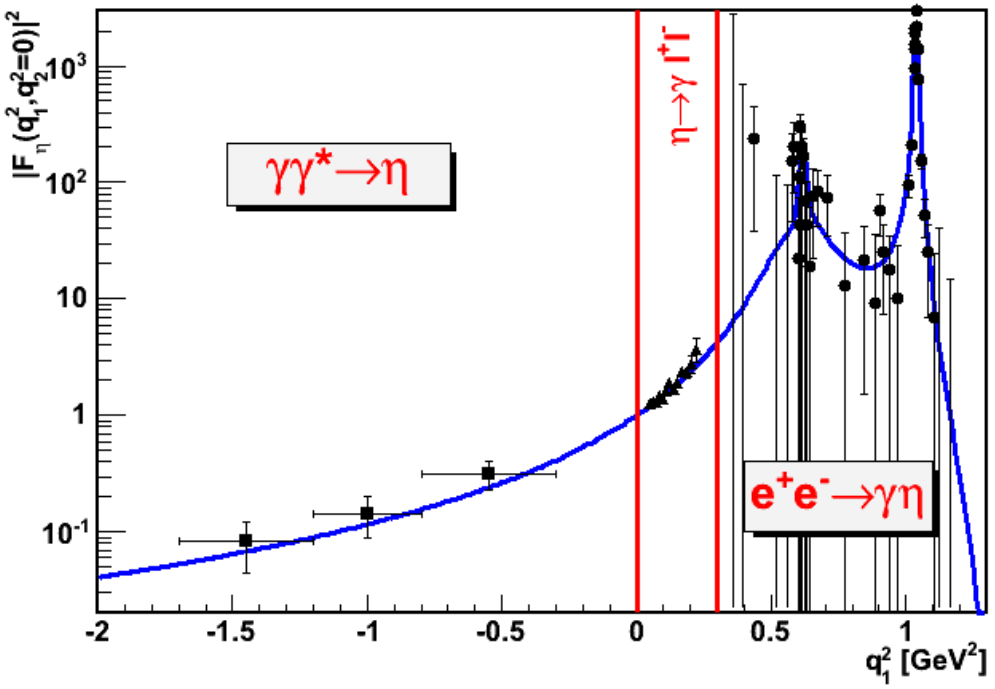
IRIDE meeting, June 24, 2013

TFF at low q^2

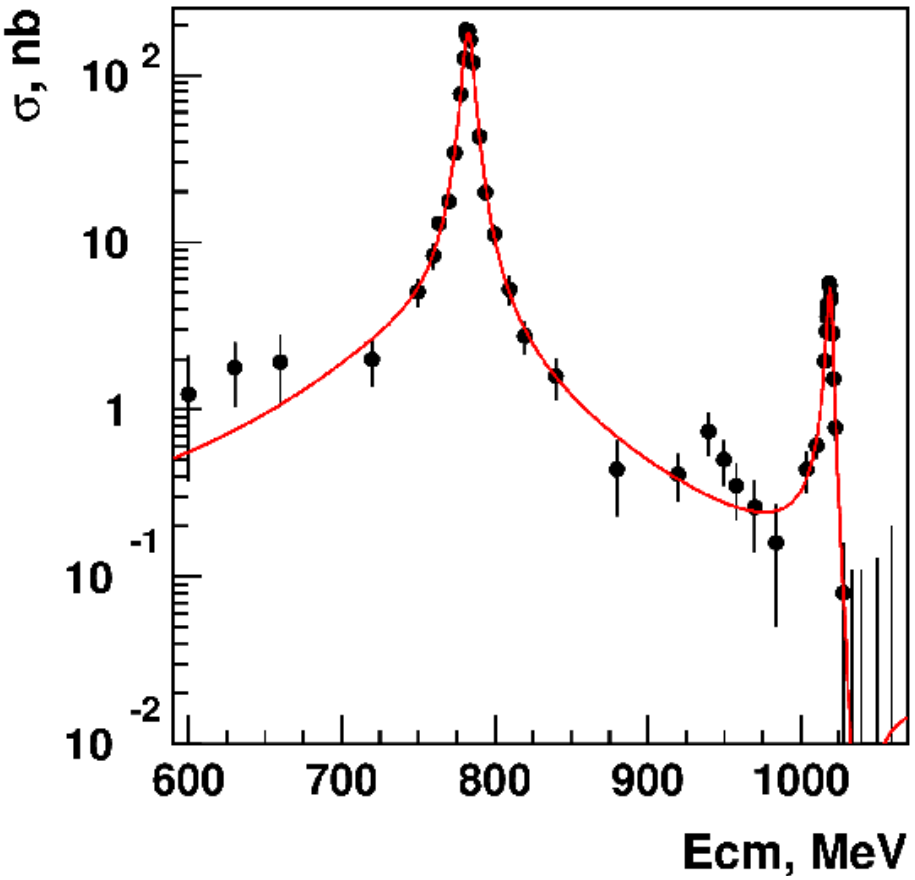


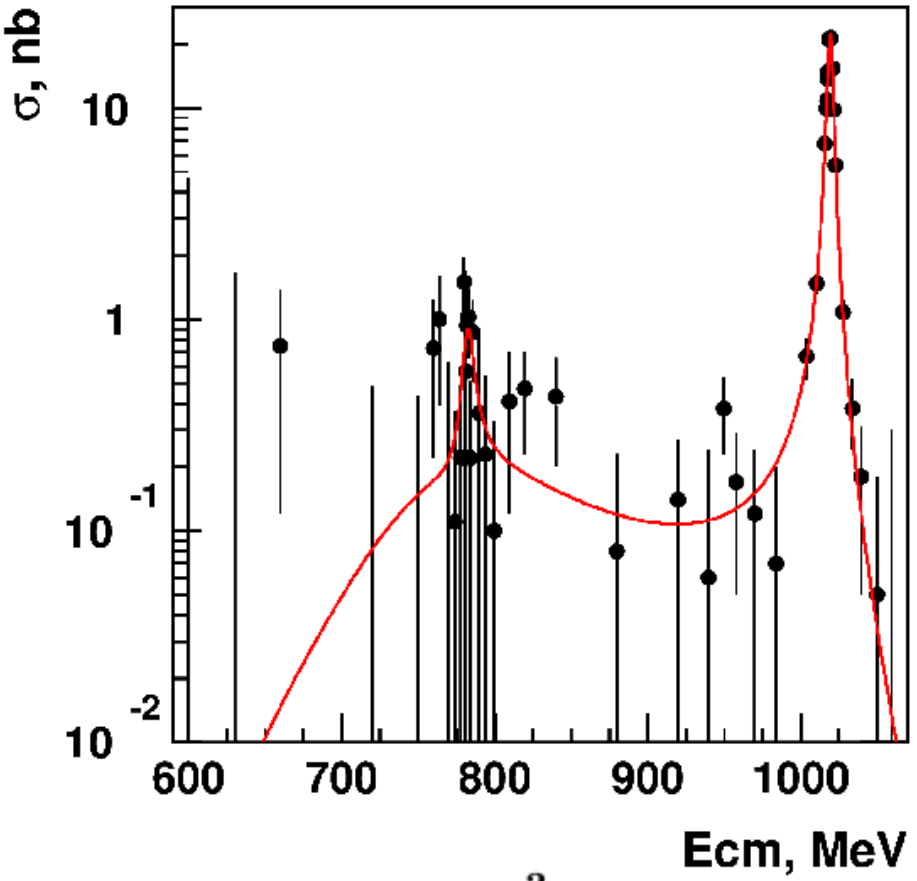


=> $0<q^2<0.6$ GeV $O(100pb)$

=> TFF (interpolation) ... LbL

$\sigma(e^+e^- \to \pi^0\gamma, \eta\gamma)$

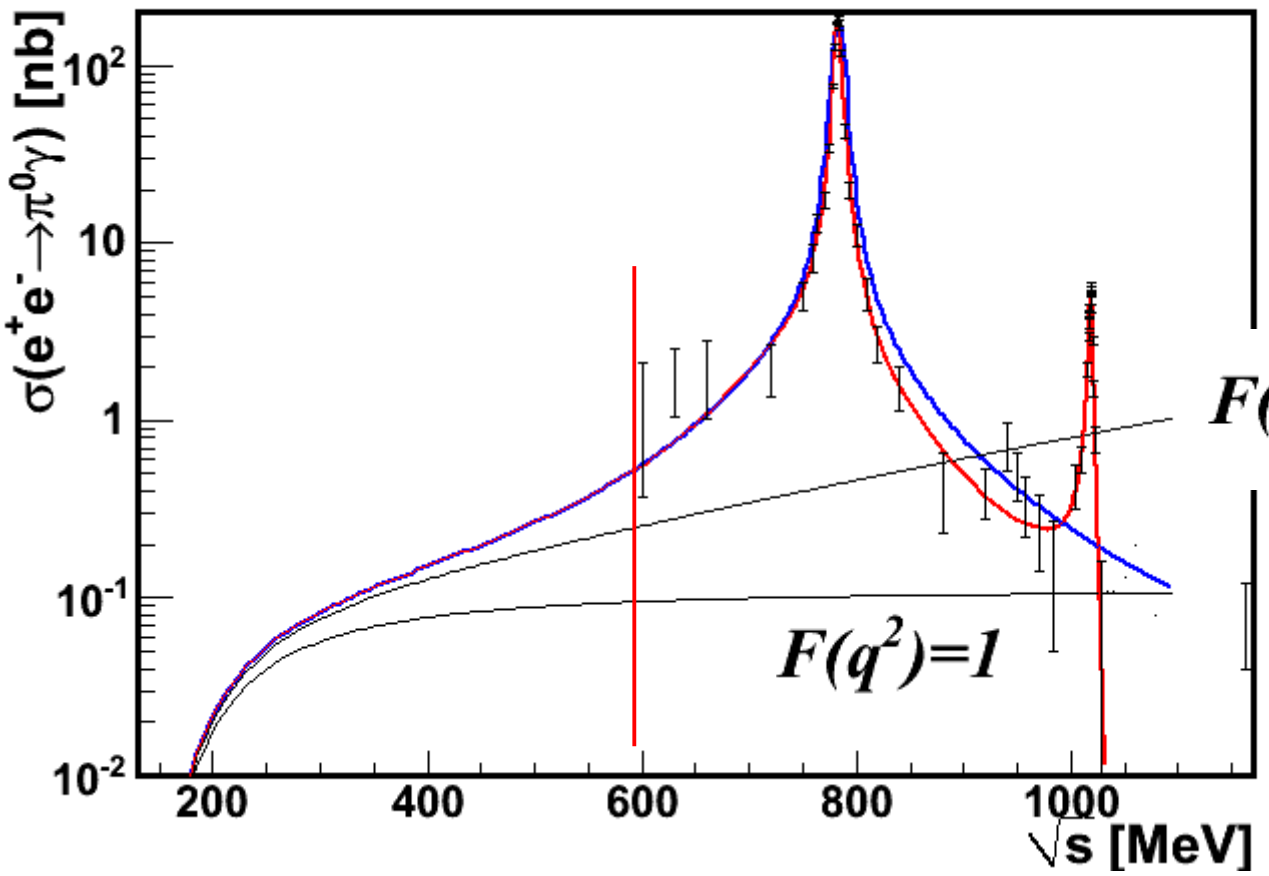




$$\sigma(e^+e^- \to P\gamma) = 4\pi\alpha\Gamma_{\gamma\gamma}|F_P(s,0)|^2 \left(\frac{s-m_P^2}{sm_P}\right)^3$$

Data: CMD-2,SND

$\sigma(e^+e^- \to \pi^0\gamma)$



$$F(q^2)=1+a\frac{q^2}{m_\pi^2}$$

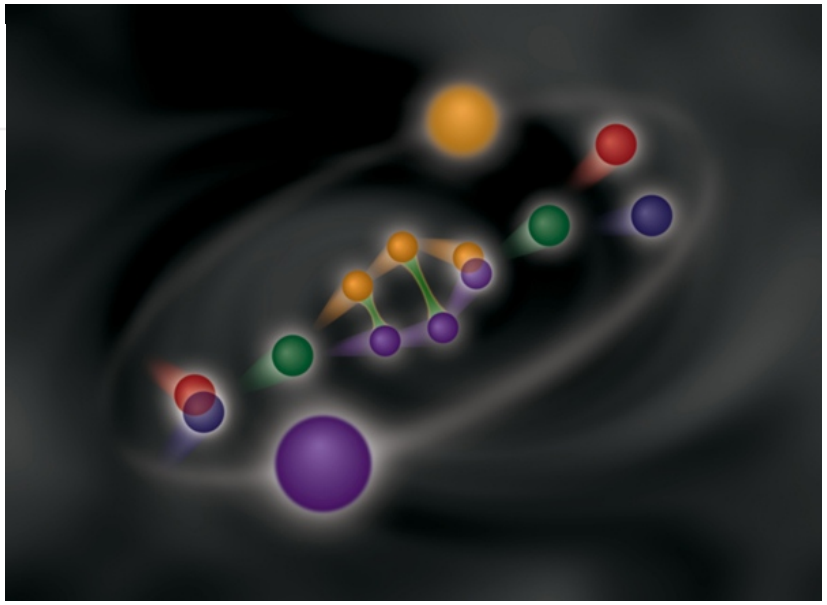
Data: CMD-2,SND

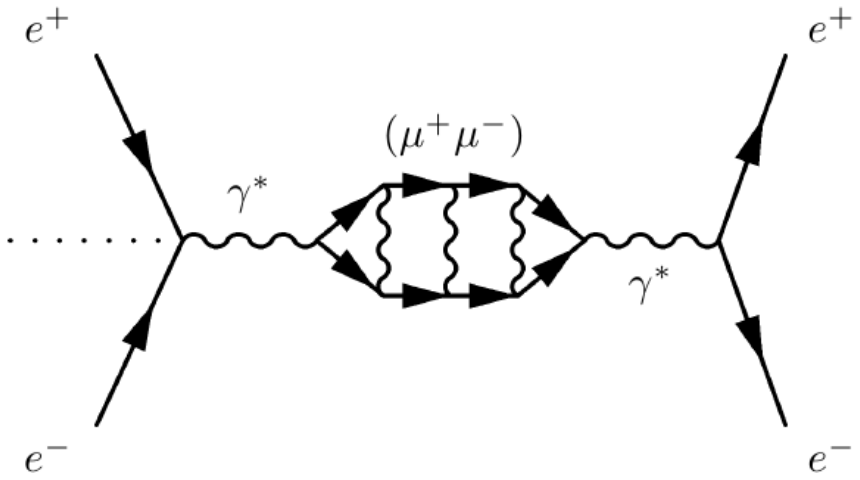
True muonium in e+e-

New Recipe for True Muonium: Take One Muon ...

By KENNETH CHANG
Published: June 9, 2009

The New York Times





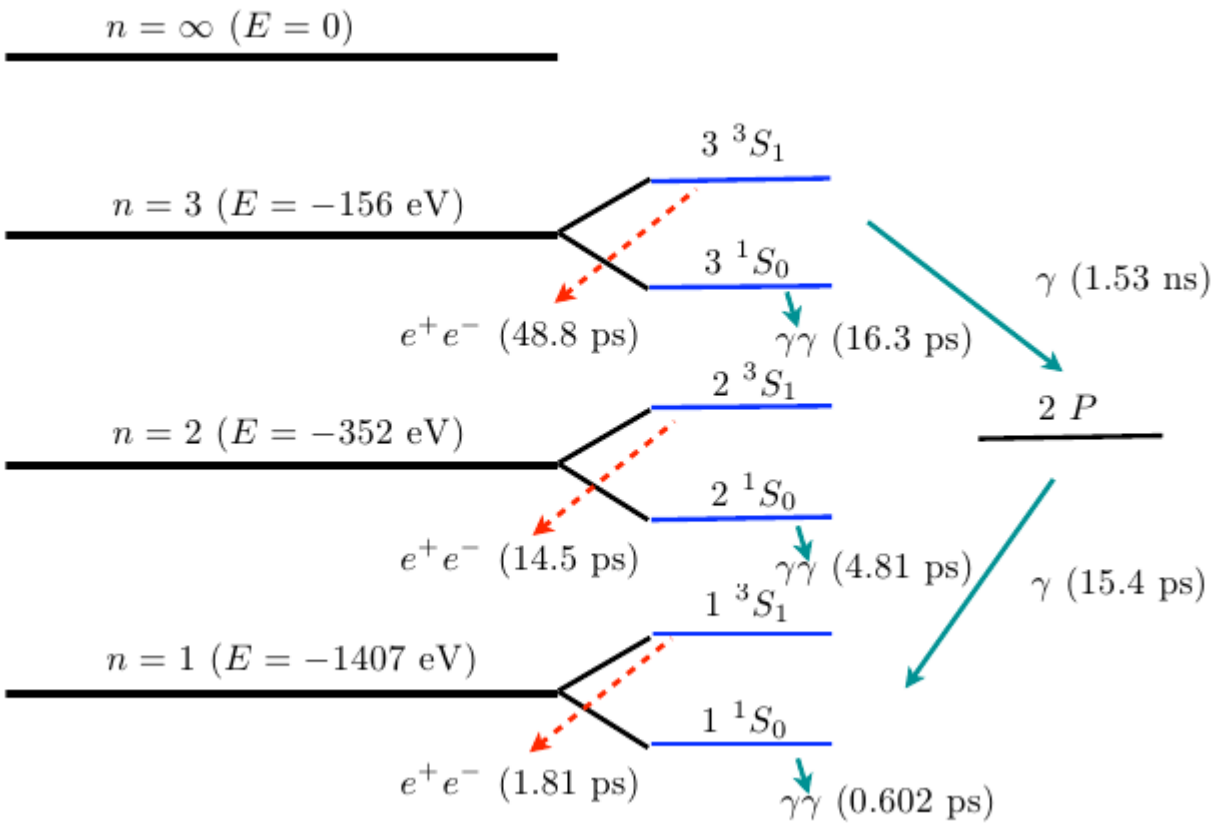
Production of the Smallest QED Atom: True Muonium (mu+ mu-)

Stanley J. Brodsky (SLAC) , Richard F. Lebed (Arizona State U.)

Apr 2009 - 4 pages

Phys.Rev.Lett. 102 (2009) 213401
DOI: 10.1103/PhysRevLett.102.213401
SLAC-PUB-13575
e-Print: arXiv:0904.2225 [hep-ph] | PDF

γe- → (μ+μ-)$_b$e-?



$\Gamma_{TM1} = 10^{-4}\Gamma_{\pi 0}$

$e\text{-}Z \rightarrow Z(\mu^+\mu^-)_b e\text{-}?$

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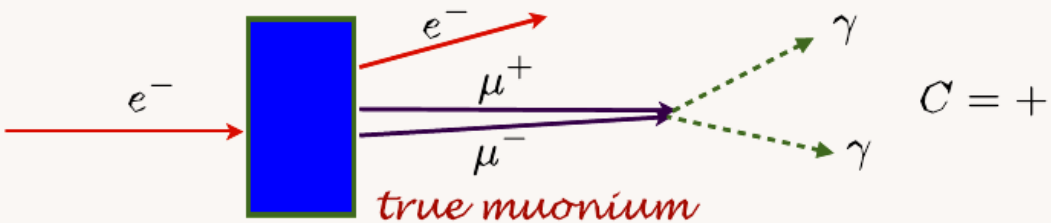
Production and discovery of true muonium in fixed-target experiments

Andrzej Banburski and Philip Schuster
Perimeter Institute for Theoretical Physics, Waterloo, Ontario N2L 2Y5, Canada

- **Production of True Muonium [$\mu^+\mu^-$]**

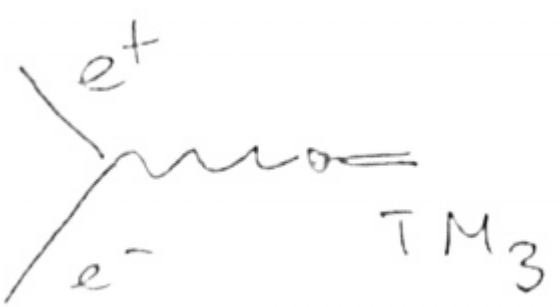
$$eZ \rightarrow eZ[\mu^+\mu^-]_{nS} \qquad q_{min} \simeq \frac{M^2_{\mu^+\mu^-}}{\nu} \sim 10 \text{ MeV}$$

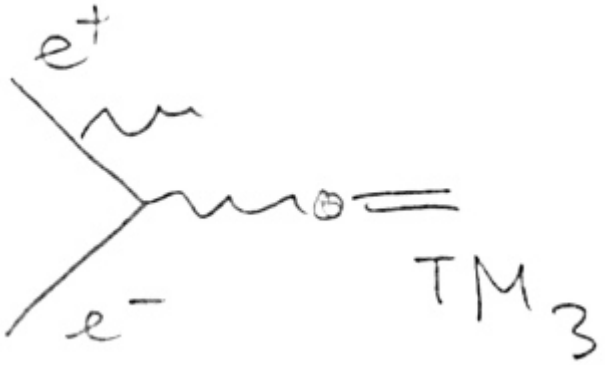


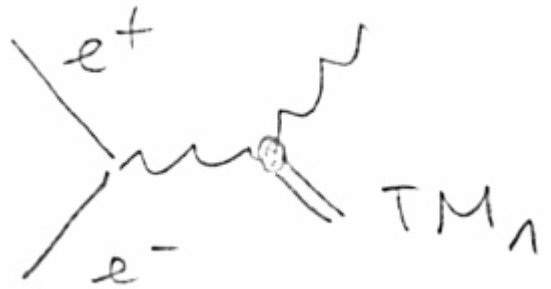
- **Produces all nS Rydberg Levels**
- **Analytic connection to continuum production -- enhanced by Schwinger Sakharov Sommerfeld Effect at threshold**
- **Gap multiplied by Lorentz boost**
- **Excite/De-excite levels with external fields, lasers**

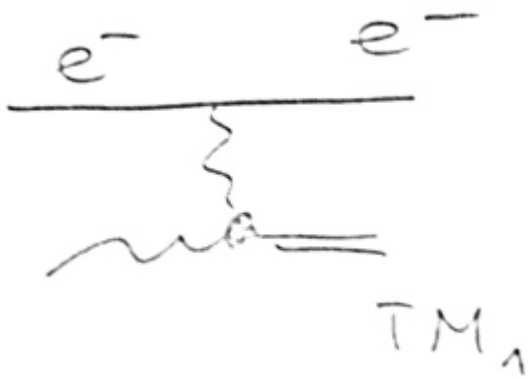
S. Brodsky

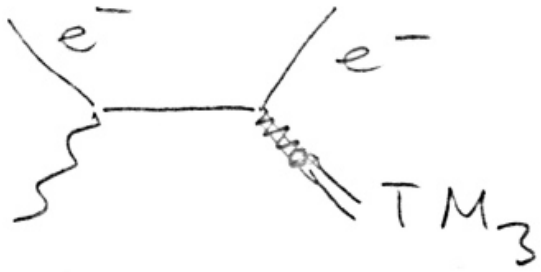
True Muonium e+e-,e-e-,e-γ

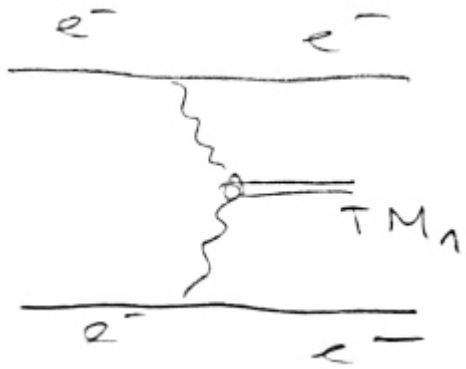












Conclusions

- Low energy e+e- collider
  150<$\sqrt{s}$ <400 MeV
  Luminosity, δE
- π^0, True Muonium, pionium?
- Options: e-γ, e-Z