

TWIST
**The TRIUMF Weak Interaction
Symmetry Test**
Precision Muon Decay at TRIUMF

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University of Alberta

TWIST: Universities of Alberta, British Columbia,
Northern British Columbia, Montreal, Saskatchewan;
TRIUMF, Texas A&M, Valporaiso, KIAE - Russia

Outline

- **Progress since October, 2000**
- **Review questions related to:**
 - **Personnel**
 - **Construction**
 - **Upgrades**
 - **Calibration**
 - **Budget**

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TWIST - Personnel

<p>TRIUMF</p> <ul style="list-style-type: none"> ❖ Willy Andersson ● Yuri Davydov ● Jaap Doornbos ❖ Wayne Faszer ● Dave Gill ● Peter Gumplinger ● Richard Helmer ● Robert Henderson ● John Macdonald ● Glen Marshall ● Art Olin ❖ David Ottewell ❖ Robert Openshaw ● Jean-Michel Poutissou ● Renee Poutissou ❖ Grant Sheffer ● Hans-Christian Walter ● Dennis Wright 	<p>Alberta</p> <ul style="list-style-type: none"> ✘ Andrei Gaponenko ● Peter Green ● Peter Kitching ✘ Rob MacDonald ● Maher Quraan ● Nathan Rodning ❖ John Schaapman ✘ Farhana Sobratee ❖ Jan Soukup ● Glen Stinson <p>British Columbia</p> <ul style="list-style-type: none"> ✘ Blair Jamieson ❖ Doug Maas ● Mike Hasinoff <p>Northern British Columbia</p> <ul style="list-style-type: none"> ● Elie Korkmaz ● Tracy Porcelli <p>Montreal</p> <ul style="list-style-type: none"> ● Pierre Depommier 	<p>Regina</p> <ul style="list-style-type: none"> ● Ted Mathie ✘ George Price ● Roman Tacik <p>Saskatchewan</p> <ul style="list-style-type: none"> ● Bill Shin <p>Texas A&M</p> <ul style="list-style-type: none"> ● Carl Gagliardi ● John Hardy ✘ Jim Musser ● Robert Tribble ● Maxim Vasiliev <p>Valparaiso</p> <ul style="list-style-type: none"> ● Don Koetke ● Robert Manweiler ❖ Paul Nord ● Shirvel Stanislaus <p>KIAE (Russia)</p> <ul style="list-style-type: none"> ● Arkadi Khurchinsky ● Vladimir Selivanov ● Vladimir Torokhov
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- ✘ Students
- ❖ Professional Staff

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TWIST - Overview

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TWIST – Recent Milestones

Recent Success:

- Yoke delivery: 8 December 2000
- Yoke assembly completed: 22 December 2000
- Yoke alignment: mid January 2001
- Solenoid alignment: mid January 2001
- Solenoid commissioning: beginning 6 February 2001
- 38 DC and 4 PC wire planes strung (of 56) as of the end of January
- 86 preamps completed and delivered January, 2001
- First cosmic ray events in six plane stack November, 2000
- Cosmic ray events in dense stack (8 planes) January, 2001

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TWIST - Chambers

TWIST utilizes

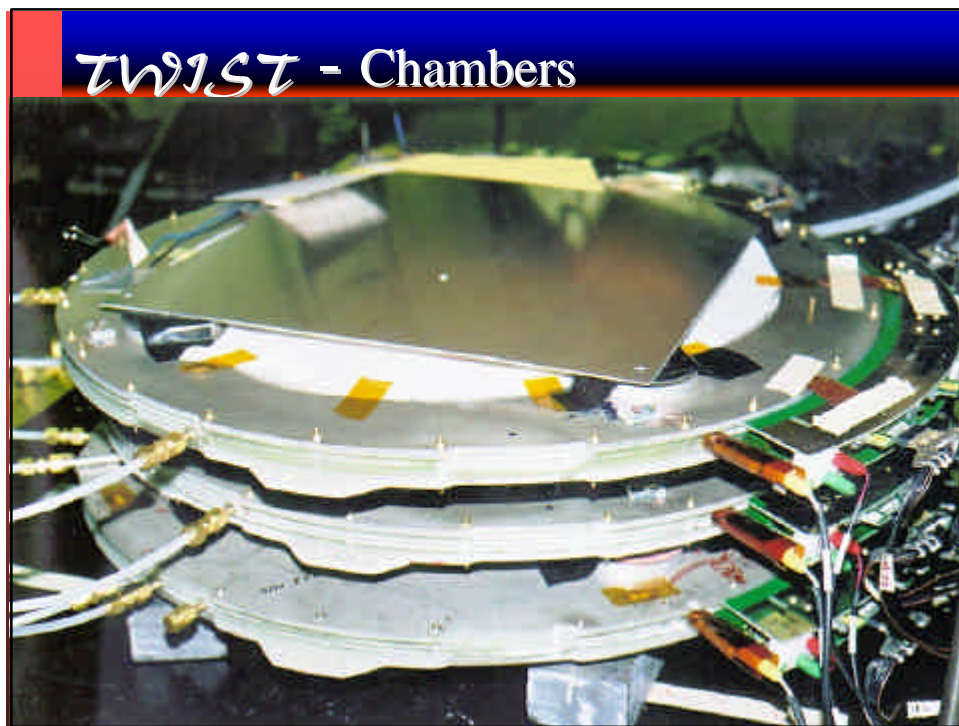
- 44 drift chamber planes and
- 12 proportional chambers

Status

- 14 drift planes have been tested with cosmic rays
- 38 (of 44) DC planes have been strung. Mounting into gas boxes continues
- 4 (of 12) PC planes have been strung

80 sense wires (20 μm Φ) + 2x3 guard wires at 4 mm distance, 22 pairs of drift chambers (each one U and V plane) with DME gas, 6 pairs of proportional chambers with CF₄ / Isobutane, ~3000 wires with VTX preamplifiers

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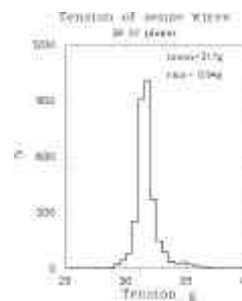
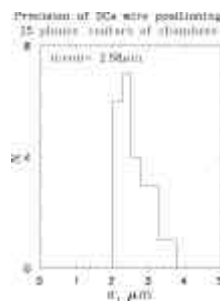
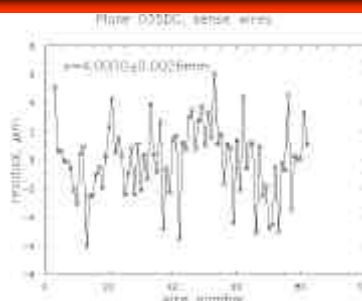
TWIST - Chambers

TWIST - Chambers

Quality Control on stringing of Wire Planes

The figures show:

1. Wire-to-wire variation in z position for a typical plane; $\sigma = 2.6 \mu$
2. Average error in wire position over 25 drift planes; $\sigma = 2.58 \mu$
3. Average wire tension over 38 drift planes; rms = 0.94g



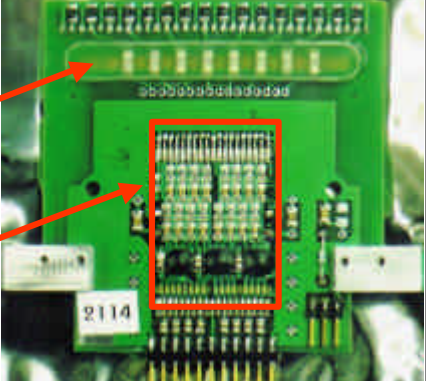
TWIST - Electronics

TWIST Requires

- 240 preamplifiers
- 268 postamplifiers
- 42 TDC's

Status

- 86 preamplifiers tested, 41 in mid-production
- 120 postamplifiers tested, 180 more in production
- 47 TDC's in hand



TWIST preamplifier

16 and 24 channel versions based on Fermilab CDF VTX boards

Cross talk is minimal (0.8% amplitude), and is easily rejected in software by cutting on pulse width

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TWIST - Yoke

The TWIST yoke pieces were delivered and assembled before Christmas

Alignment was completed in the first week of January



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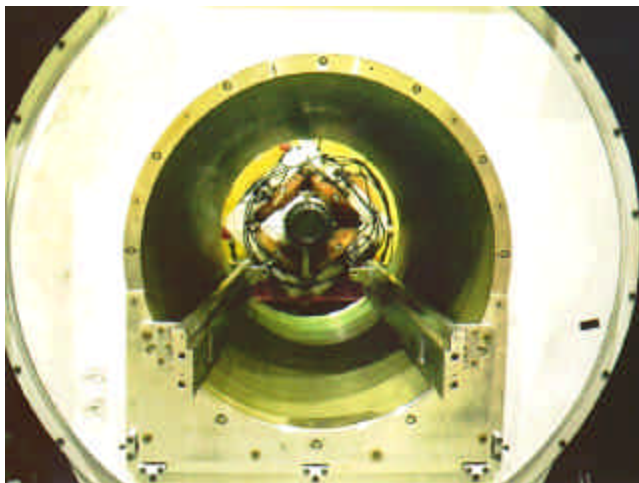
TWIST – Solenoid and WC track

Track is in place and aligned to accept detector cradle and stack

Magnet is cooling

Commissioning begins this week

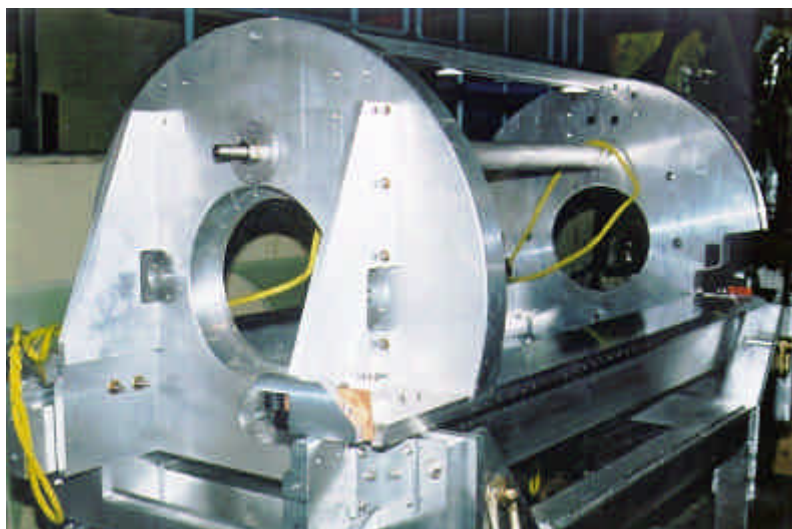
Mapping complete by end of March



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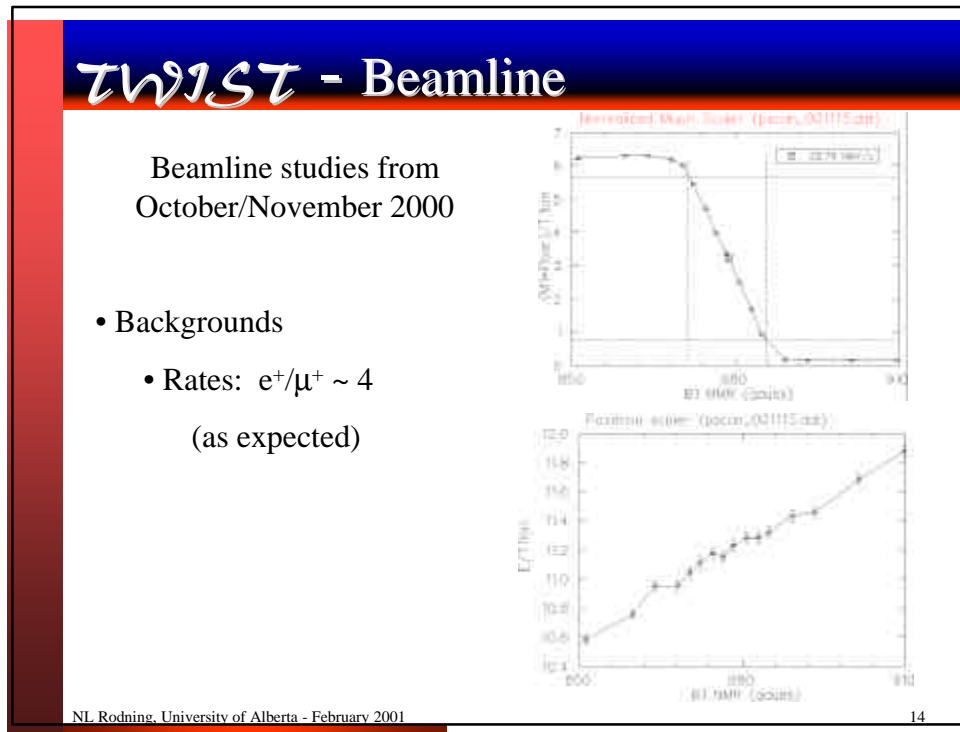
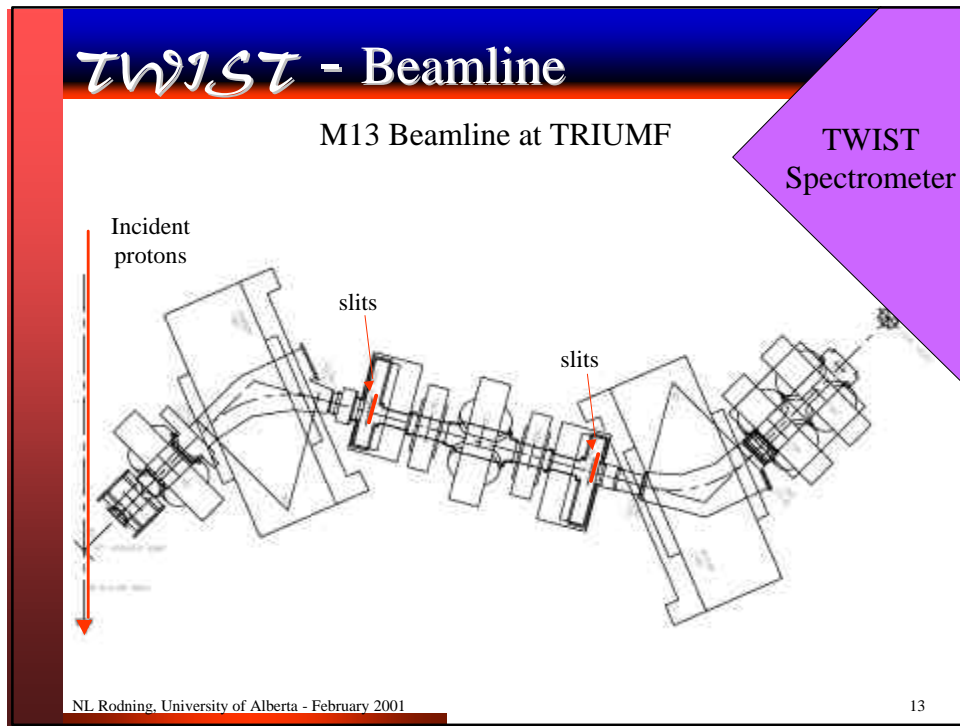
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TWIST – Chamber Support Cradle



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TWIST - Beamline

Flight time through beamline

Surface Muons gated on cyclotron RF

Time characteristic of π decay

Backgrounds (extrapolated from higher momentum)

Cloud Muons

Rate: 9% that of surface muons

RF Time of Flight (data/L1_240_p22_mu01.swf)

Projected muon peaks at 28 MeV/c

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TWIST - Beamline

Surface muons

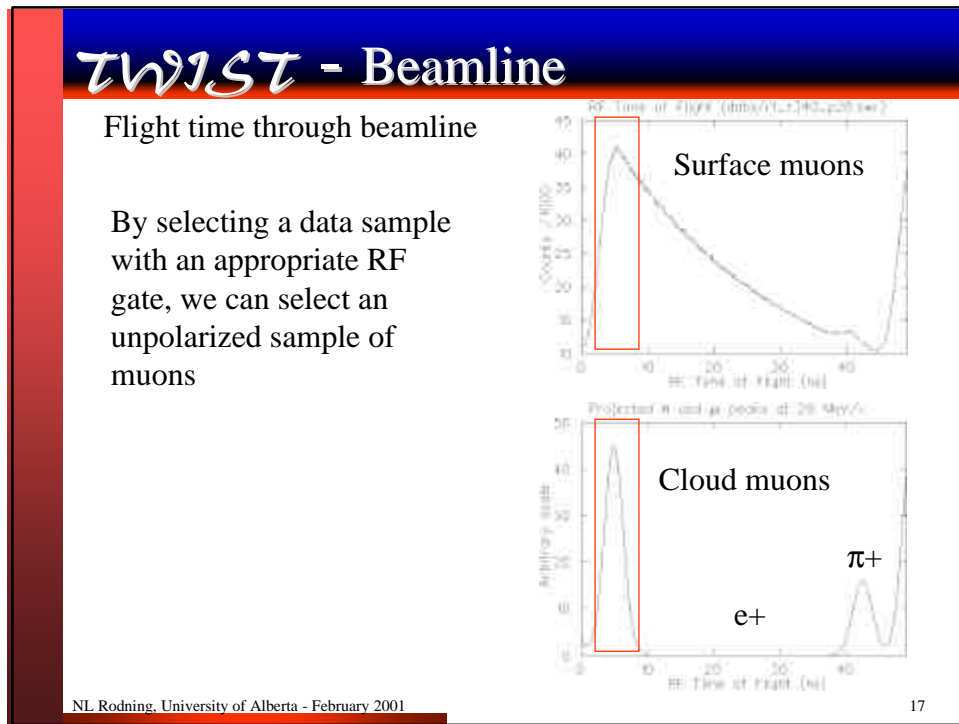
Polarization of the cloud muons is approximately 0.30 (opposite to the surface muon polarization of -1.0)

Cloud muon flux is 9% that of the surface muons

28 MeV/c (Surface Muons)

11 MeV/c (Cloud Muons)

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TWIST - NSERC Review Questions

- **Only selected questions are discussed here.**
 - All questions are addressed in the written response.

Gas Selection:

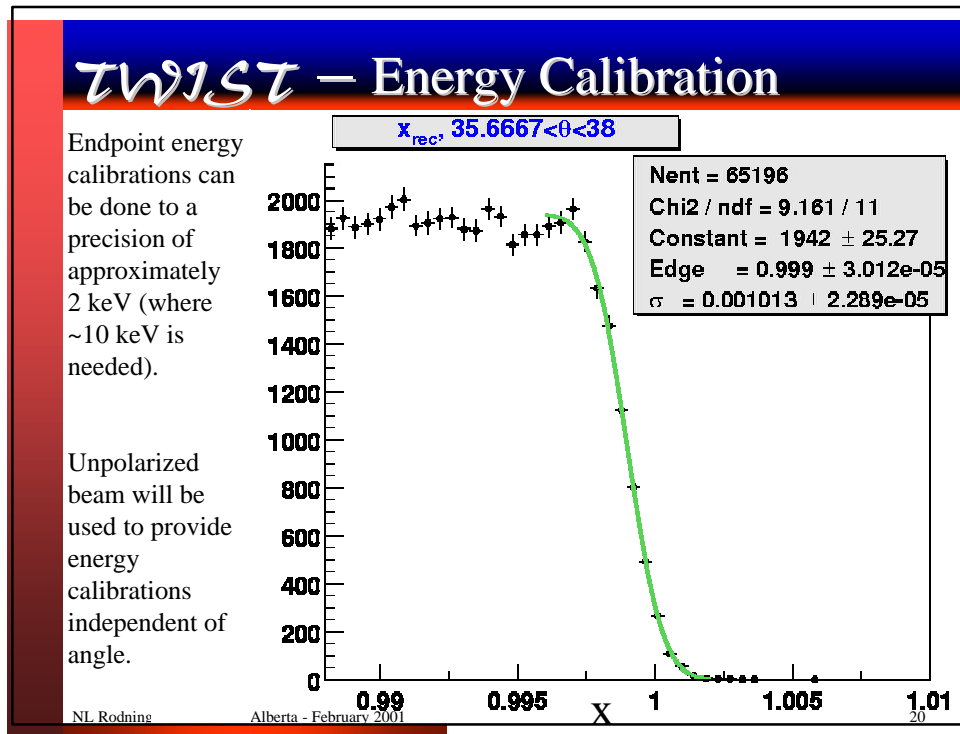
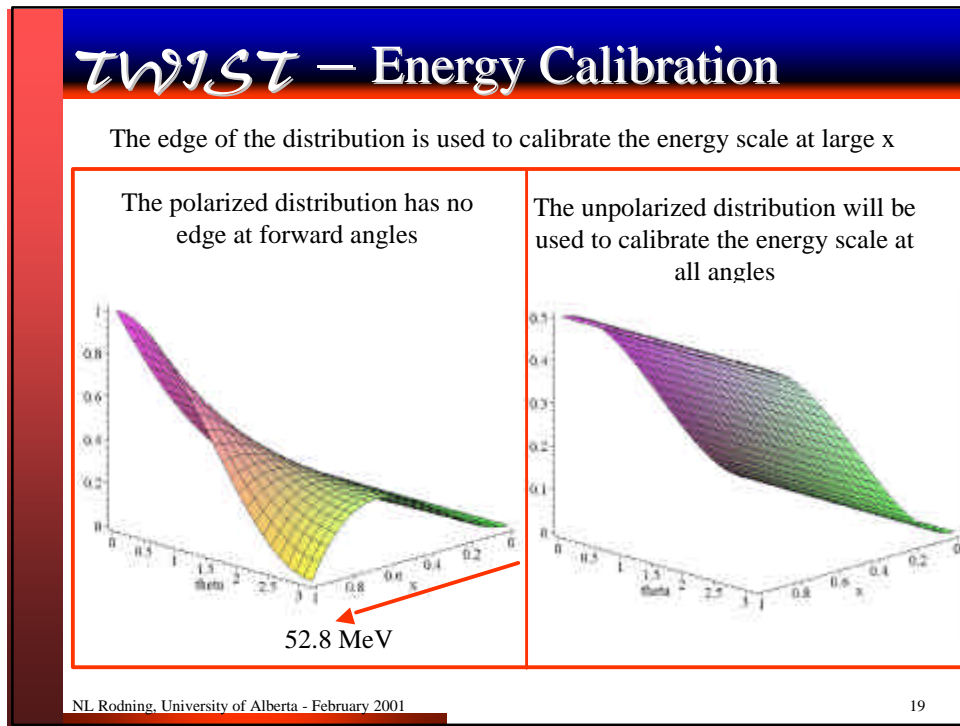
We feel we need DME to achieve the desired resolution

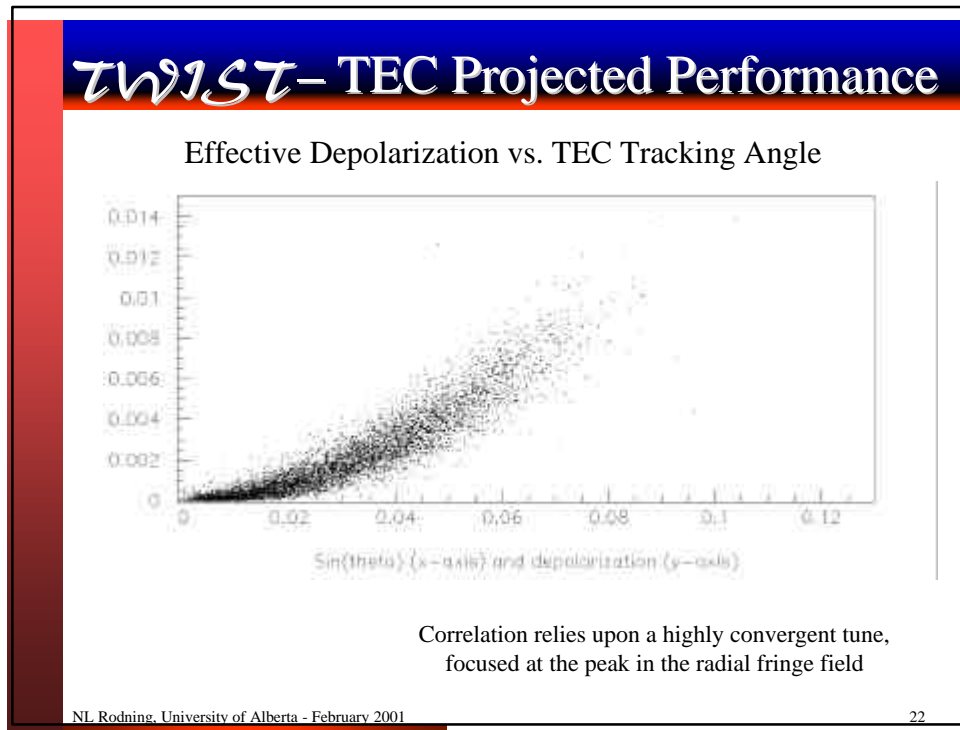
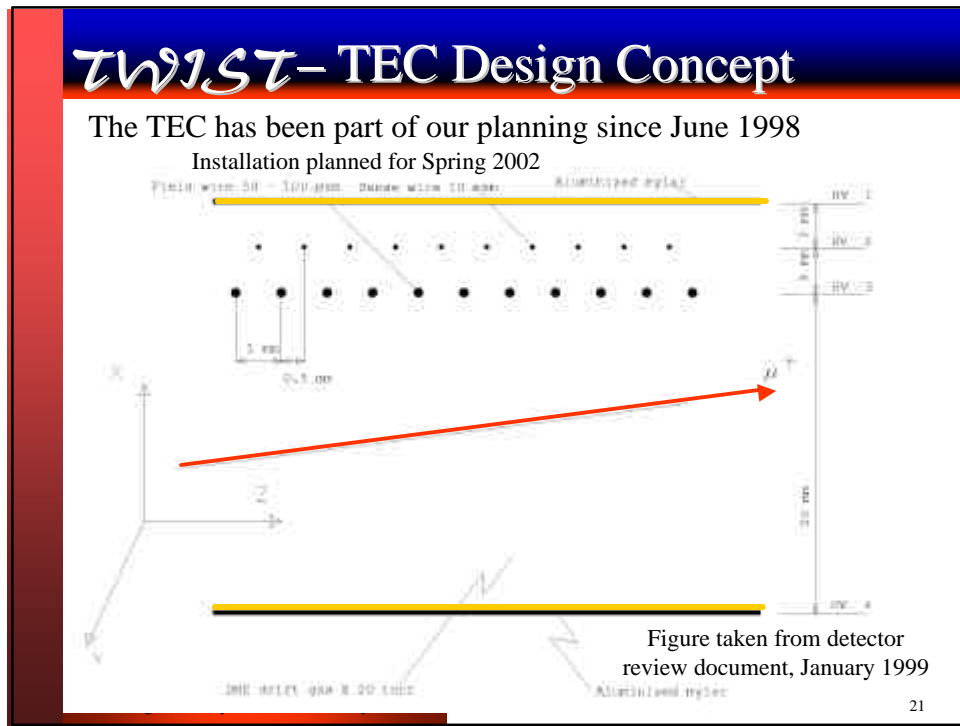
- DME has a small Lorentz angle (maximum of about 8 degrees)
 - CO₂ has a maximum Lorentz angle of 18 degrees, and a small gas gain
 - DME has a very slow drift speed
 - The required resolution has been achieved in beam tests (with DME, without magnetic field)

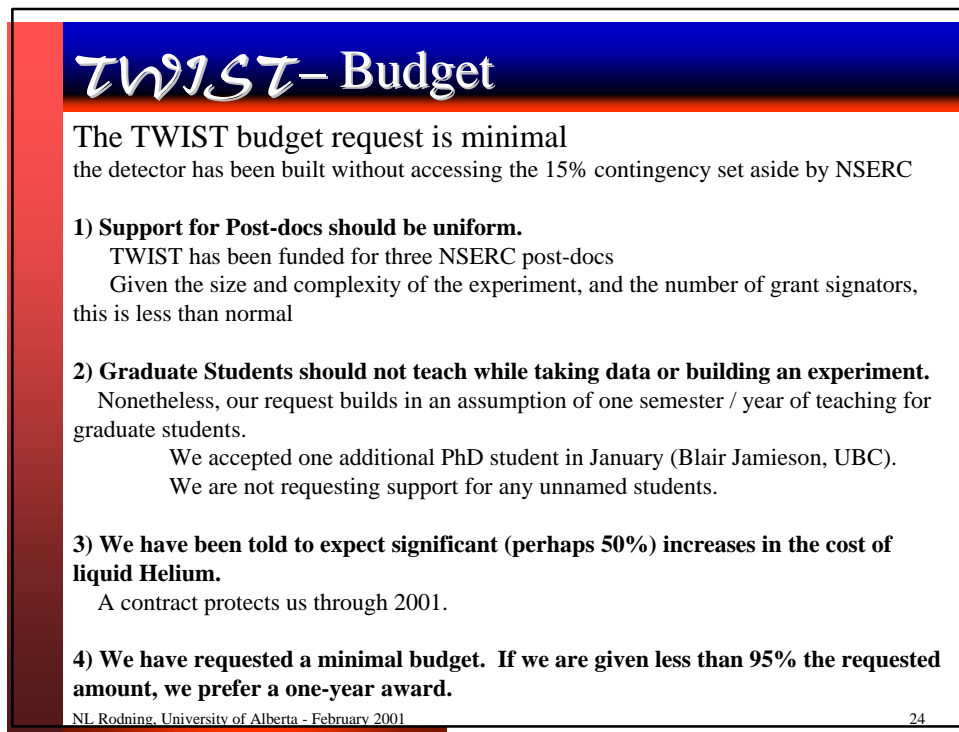
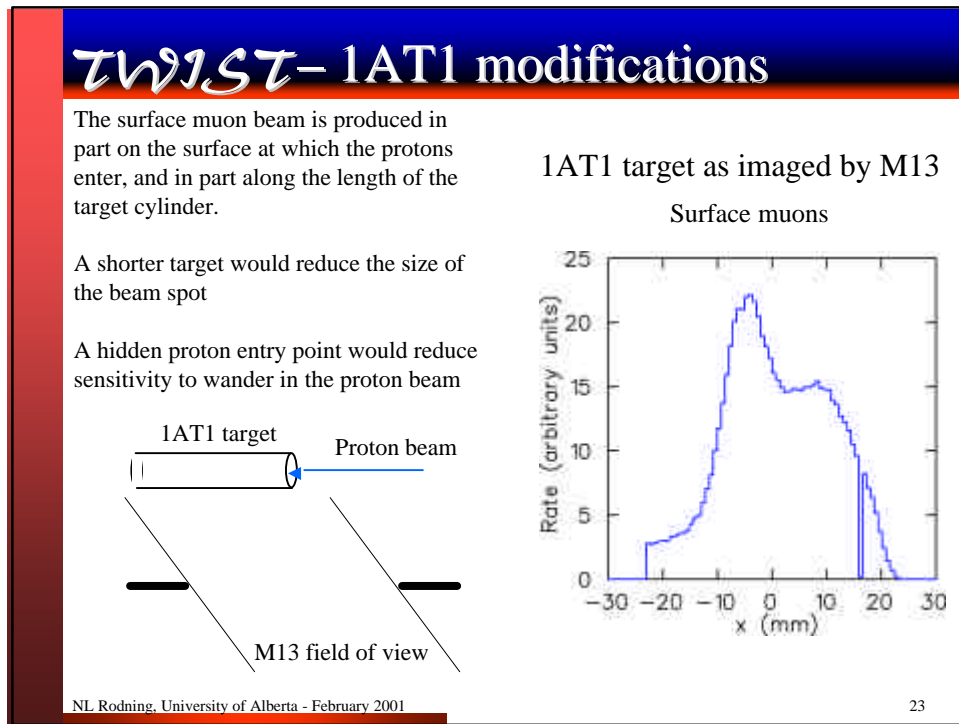
It is well known that DME is an aggressive gas (as is isobutane). It is for that reason that extensive damage tests have been done. These tests have been used to avoid materials which interact significantly with DME.

- Even beam muons will deposit only about 5% of the test charge during the life of the experiment.

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TWIST - Goals		
Summer 2001	-	Commissioning data. Preliminary alignments and calibrations
End of 2001	-	Michel distributions on tape suitable for preliminary determination of r and d
2002	-	Installation of the TEC
	-	Modified production target
	-	Beamline improvements, including realignments
	-	Improved Michel distributions based upon experience with alignments and calibrations
	-	Field alignment studies
2003	-	Studies of depolarization in the stopping target
	-	Preliminary P_{m^x} data
	-	Precision measurements of r, d and h

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