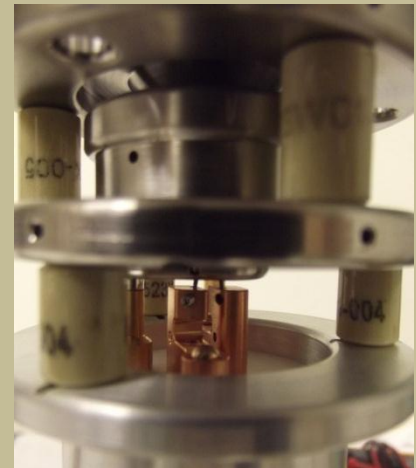


Q-value measurement of the $0\nu 2\beta$ -decay candidate ^{48}Ca The CaTi beam time

A.A. Kwiatkowski
Science Forum
6 June 2012

Accelerating Science for Canada
Un accélérateur de la démarche scientifique canadienne

Owned and operated as a joint venture by a consortium of Canadian universities via a contribution through the National Research Council Canada
Propriété d'un consortium d'universités canadiennes, géré en co-entreprise à partir d'une contribution administrée par le Conseil national de recherches Canada



What is the nature of the neutrino?



“I have done a terrible thing.

I invented a particle that cannot be detected.”

– W. Pauli

Two most outstanding questions in neutrino physics:

1. What is the nature of the neutrino?
2. What is its absolute mass scale?

$0\nu 2\beta$ -decay experiments

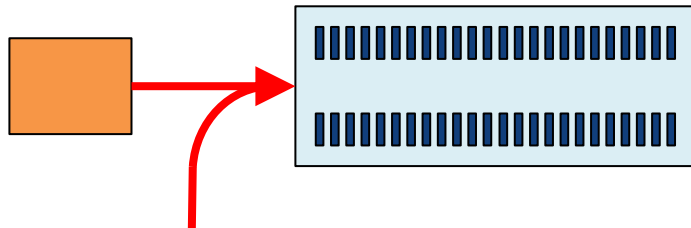
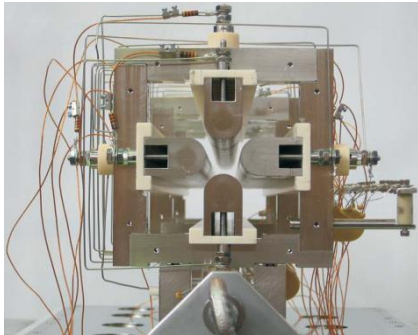
- Forbidden in Standard Model
- Only viable experiment to determine if the neutrino is a Majorana particle

TRIUMF's Ion Trap for Atomic and Nuclear science

Surface Ion Source
 $^{48}\text{Ca}^+$

RFQ Trap
Accumulate, cool, & bunch beam

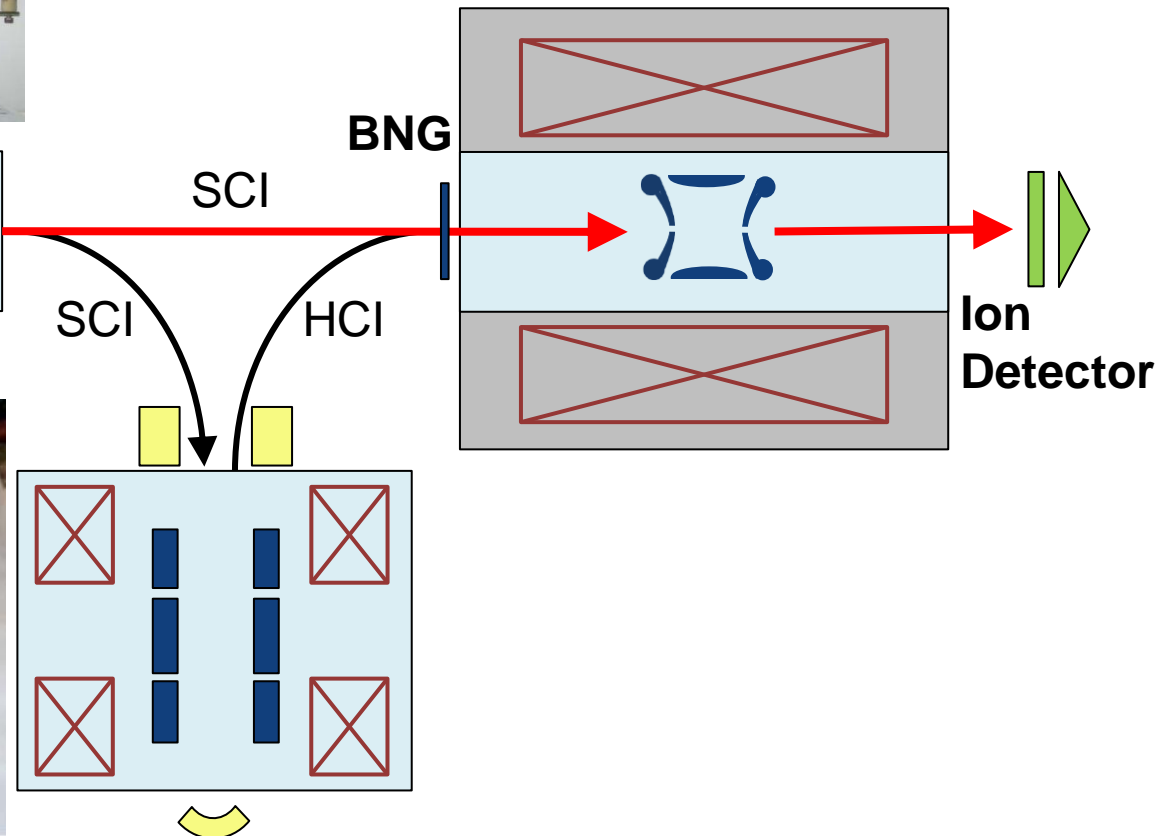
Measurement Penning Trap
High precision mass measurements



OLIS Beam
 $^{48}\text{Ti}^+$

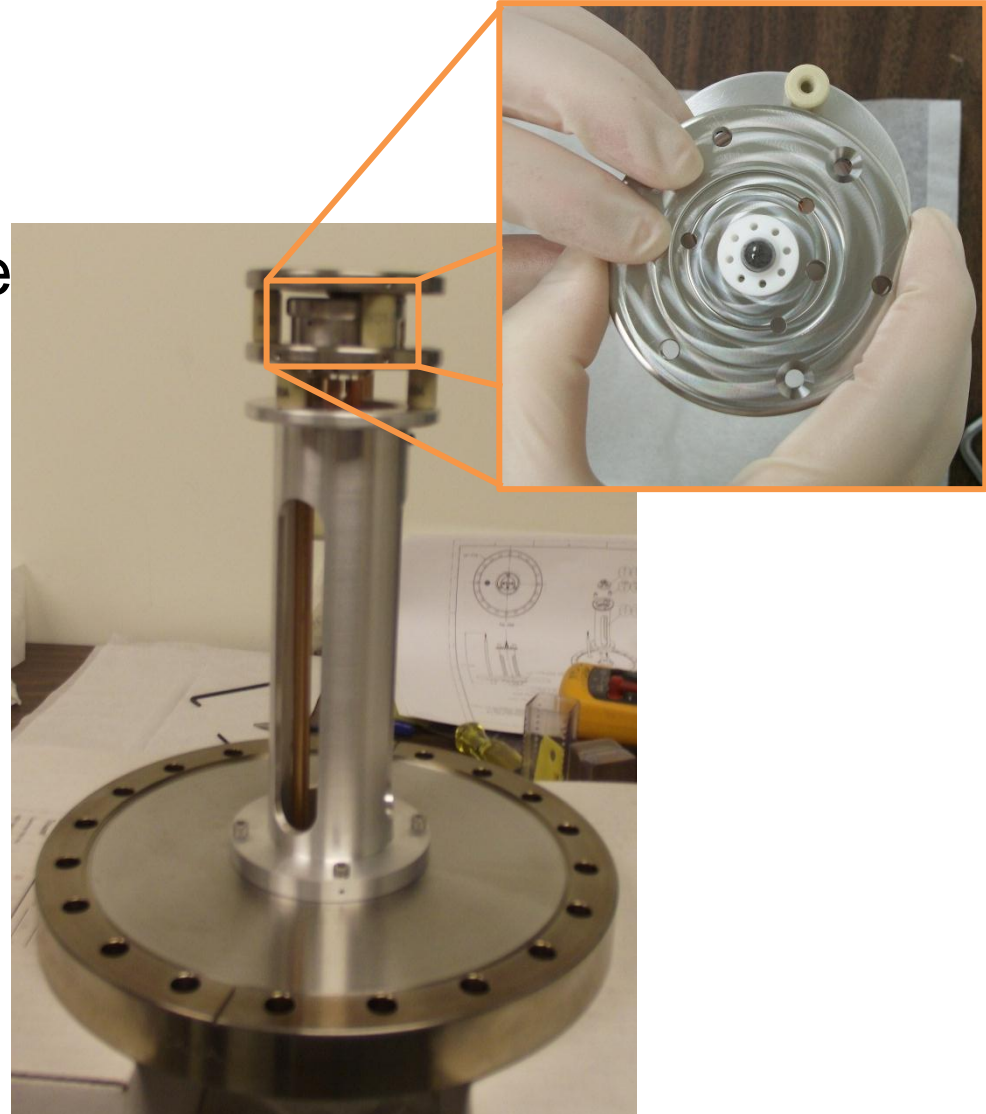


EBIT
ms charge breeding

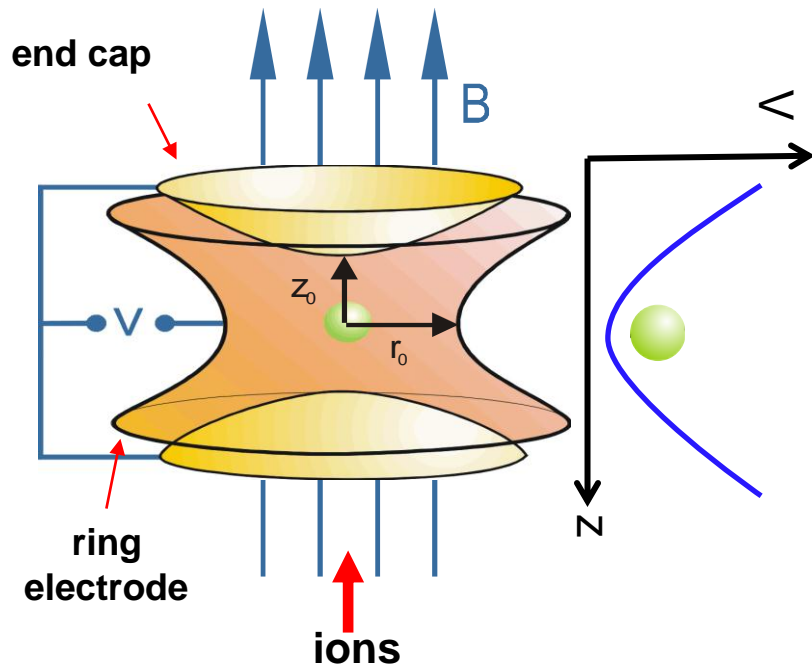


$^{48}\text{Ca}^+$ Source

- 51.7% enriched ^{48}Ca material from Isoflex
- Surface ionization source manufactured by Heatwave
 - Extra precautions to prevent alkali contamination
- Higher temperatures to ionize Ca \rightarrow new TITAN ion source holder
- OLIS supplied $^{48}\text{Ti}^+$



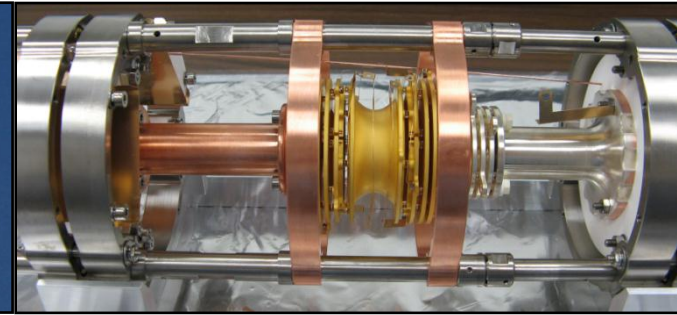
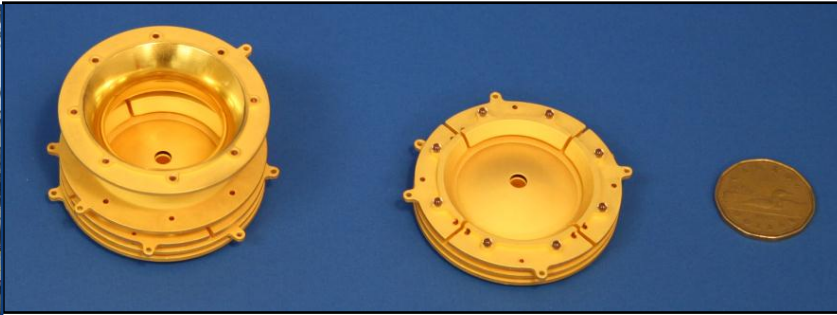
Penning trap mass spectrometry



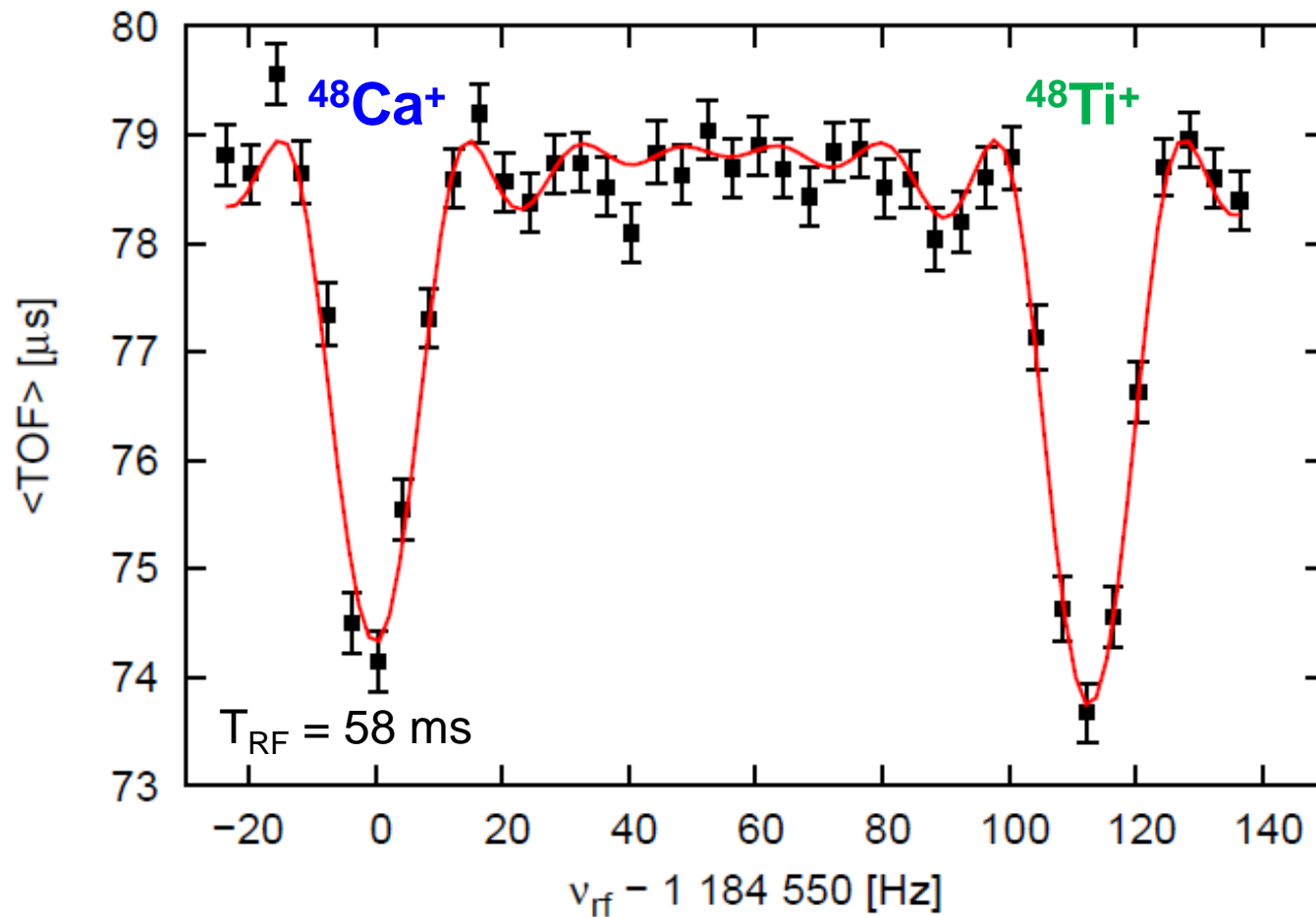
Mass determination via cyclotron frequency

$$2\pi\nu_c = (q/m) \cdot B$$

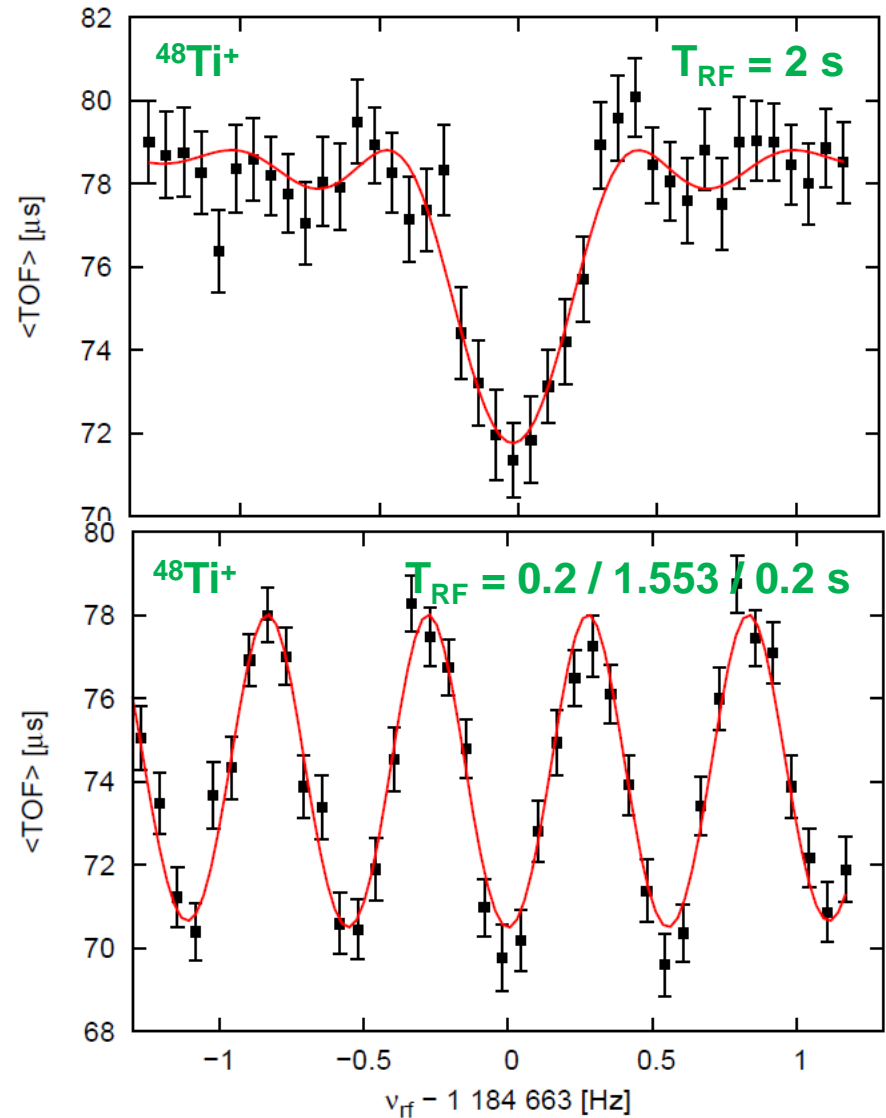
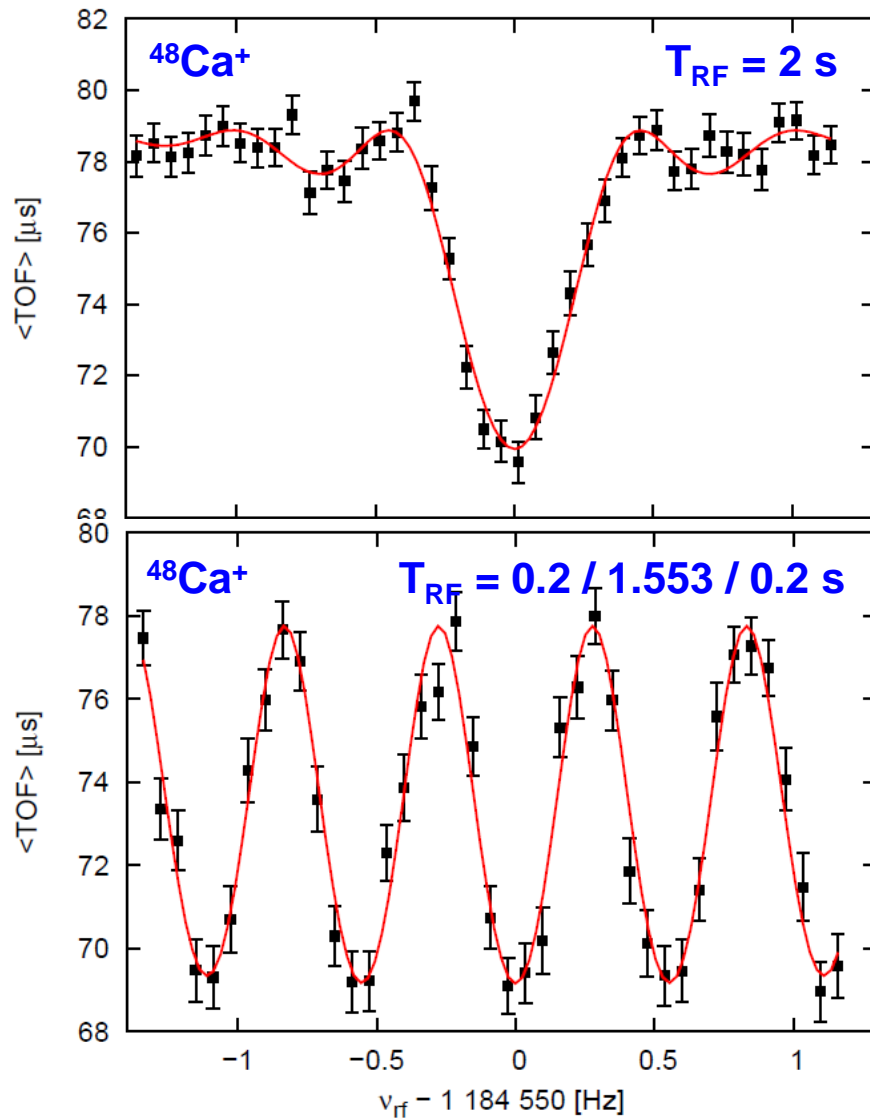
$$Q = \left(\frac{\nu_{c,Ti}}{\nu_{c,Ca}} - 1 \right) (m_{Ti} - m_e)$$



Measurements



Measurements (cont.)

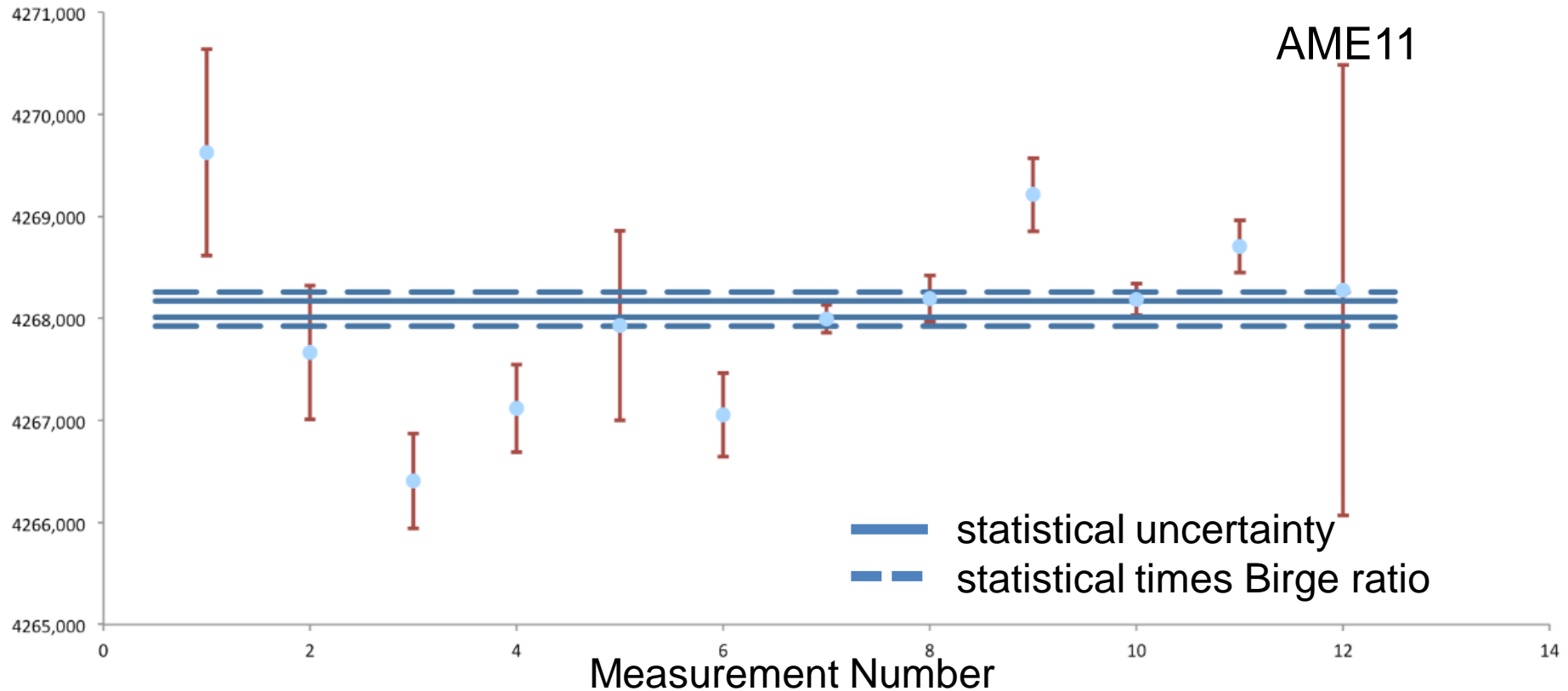


Preliminary Result

TITAN: $4267.96(17)_{\text{stat}} \cdot \text{Birge}$ keV

AME11: $4268.3(2.2)$

Q-value [keV]



Thank you!

Merci

TITAN group: Jens Dilling, Matt Pearson, Mel Good, Ankur Chaudhuri, Alex Grossheim, AAK, Martin Simon, Brad Schultz, Usman Chowdhury, Aaron Gallant, Annika Lenarz, Tegan Macdonald, Vanessa Simon, Jeff Bale, Thomas Brunner, Martin Eibach

OLIS: Keerthi Jayamanna and ISAC operators



TRIUMF: Alberta | British Columbia |
 Calgary Carleton | Guelph | Manitoba |
 McMaster Montréal | Northern British
 Columbia | Queen's Regina | Saint Mary's |
 Simon Fraser | Toronto Victoria | Winnipeg
 | York

