The TITAN EC project to measure EC branching ratios for the intermediate odd-odd nuclei in ββ decay

First proof-of-principle EC measurements have been carried out at the TITAN EBIT Penning trap system, using two Ge (one LEGe and one HPGe) detectors and one PIPS beta detector. A number of issues were addressed and solved during the first trial runs. It was agreed to advance to the real experiment with a full detector arrangement in two phases, where each of the collaborating institutes would take responsibility for a particular task (work package).

Phase I includes

1) the completion of the setup
2) trial and test measurements with a partially completed setup in the period Nov-2010 – Dec-2010
3) implementation of electronics and DAQ
4) test measurements with fully equipped detector in period May-2011 – Sep-2010
5) setup activities during shutdown period Jan – May-2011

Phase II includes

1) continuing development of digital system for pulse sampling
2) continuing development of simulation software
3) improvement of isobaric purification system (MTOF, CPET)
4) infrastructure development and further infrastructure provision for final experiments

Collaborating institutes and project leaders

TU München, Reiner Krücken
Project responsabilities in phase I and II:
GEANT simulations (improving and advancing the code already available at TRIUMF).
Add'l man-power requirement: 1 student.

Univ. Gießen, Christoph Scheidenberger (Christian Jesch)
Project responsabilities in phase I and II:
Development of the MR-TOF-MS

University Yale, Volker Werner
Project responsibilities in phase I and phase II:
Digital system for the Si(Li) detector pulse sampling ADC
Add'l man-power requirement: 1 grad. student (local technical support).

University Münster, Dieter Frekers
Project responsibilities in phase I:
Acquisition of 7 Si(Li) detectors
Acquisition of HV power supplies for detectors (ISEG, ORTEC)
Supervision of experiment set-up
Providing add'l man power to be on-site for periods of time
Project responsibilities in phase II:
Continuing experimental support for setup and experiment

SFU, Corina Andreoiu
Project responsibilities in phase I:
Setting up local facility for testing the detectors upon arrival in Canada

University of Manitoba, Gerald Gwinner
Project responsibilities in phase I and II:
Development and implemention of CPET purification
CPET ready during shut down and implementation into TITAN-online by 2nd half of 2012

University Dresden, Kai Zuber
Project responsibilities in phase I and II:
CdZnTe / Ge collimation in collaboration with München (DFG application needed)
Realisation (incl. applying for equipment) of normalization procedures

TRIUMF, Jens Dilling (Thomas Brunner)
Project responsibilities in phase I:
support structure for detectors
new Be-windows
implementation of DAQ
active coordination of all on-site activites (incl. provision of infrastructure, e.g. LN2 filling system)
add'l man power requirement: 1 post-doc

Work packages and issues

1) Trap measurements
    a. Storage capacity, storage time, and spatial distribution
    b. Losses during storage and injection and extraction phase
    c. Optimisation of trapping and injection
    d. Detailed simulation of trapping phase

2) Sample production and purification
    a. Isotope production and ionisation
    b. Isobaric purification at front end
    c. Preparation before injection
        i. MR-TOF-MS
        ii. CPET in buffer-gas mode

3) Detection systems
    a. X-ray detectors Si(Li), calibration, efficiency, Be-windows, installation
    b. Beta detector (PIPS), installation, optimisation
    c. Detector and geometry optimisation (GEANT simulation)
    d. Normalisation procedure, strategy and plan development (Ge-detector? - use of standards (e.g. ^{114}In)?, new schemes?)

4) Infrastructure
    a. X-ray detector installation (change to EBIT structure)
    b. X-ray detector LN2 filling system
    c. MR-TOF-MS installation
    d. Vacuum improvements
    e. DAQ system (analog data acquisition)

5) Measurement and analysis strategy
    a. Calibration measurements to determine efficiency
    b. Normalisation strategy
    c. Background analysis and assessments
    d. Anti / coincidences
    e. Duty cycle
    f. Trap-full vs trap-empty strategy

Initial time lines

July 2010	submission of 2x 5-6 days beam request for Oct-Dec 2010
1.-10. Sep.	arrival of 3 Si(Li) at TRIUMF
Nov-2010	6 det. ready and tested
Nvo- 2010	test runs with beam (but without support structure) using 2 Si(Li)s plus 1 HPGe, first beta version of DAQ
until May-2011	TRIUMF shut-down
May-2011	test expmt on100Tc --> intensity and purity of production