TANDEM@Caucasus

Tbilisi Accelerator based Nuclear, Dating and Environmental Monitoring Regional center

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and

HEPI TSU

Outline:

- Motivation
- **AMS** facility for TANDEM
- Research with TANDEM
- Current status and milestones

Motivation:

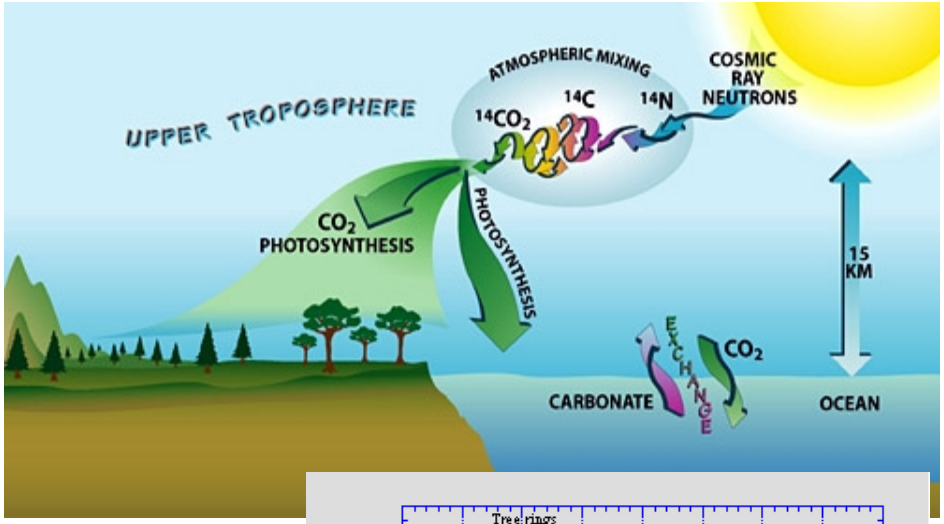
- Modern experimental tools for scientific research and high education.
- Reasonable installation/running costs.
- Possibilty to serve large scientific community in Georgia and South Caucasus region.
- Close collaboration with research groups in EU (USA, Japan,..)

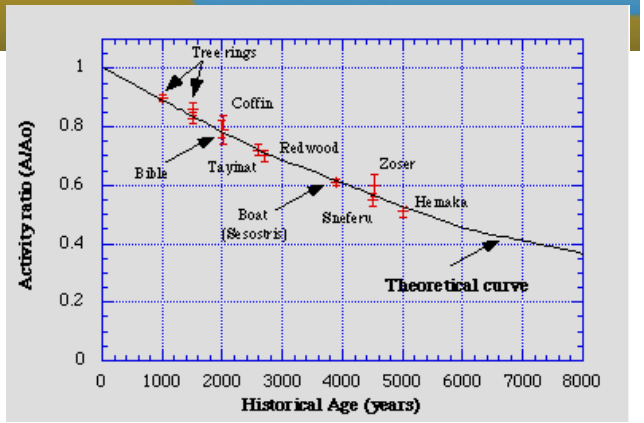
The AMS facility for TANDEM

- The Accelerator Mass Spectrometry (AMS): Ultrasensitive analysis tool for:
- Archeology
- Biology, medicine and pharmacology
- Chemistry
- Environmental studies,
- Physics, . . .

Example: Radiocarbon (^{14}C)

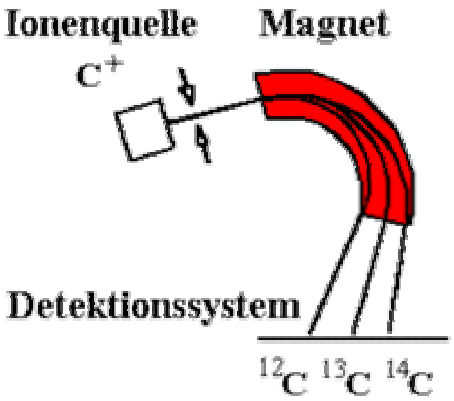
- W.F. Libby ( , 1960)
- Cosmogenic origin:
  ^{12}C:^{14}C=1:10^{-12}
  $T_{1/2}$=5730 y
- Applications: Archeology, Environmental studies, …
- Tbilisi State University: Radiocarbon Laboratory from 1964





Conventional Mass Spectrometry

„Conventional": particle energy ≤ 80keV, positive ions are deflected by a magnet differently according to their mass (to charge ratio)



Concentration of isotopes of interest (e.g. ^{14}C: 10^{-12} - 10^{-15}) is lower by many orders of magnitude than the background!

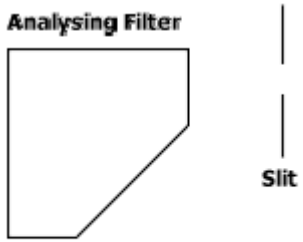
Background ions of mass-14 (^{14}C detection)

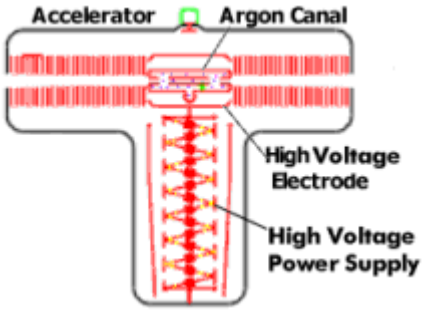
Isobares: $^{14}N^+$

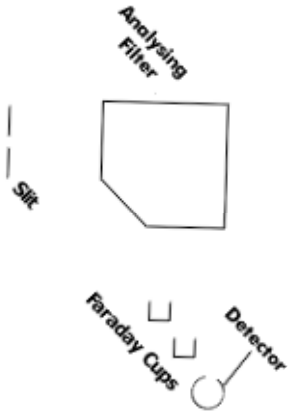
Molecules: $^{13}CH^+$, $^{12}CH_2^+$, $^{7}Li_2^+$

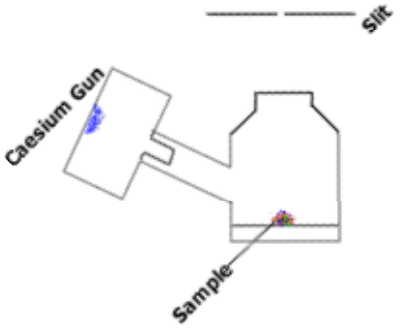
Mass resolution for spectrometers with reasonable acceptance not sufficient to detect rare isotopes like ^{14}C due to the huge background

Accelerator Mass Spectrometry







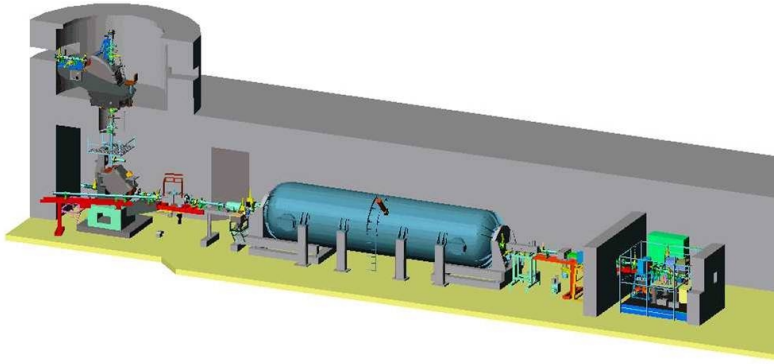


Map of AMS in Europe

- Worldwide: ~ 50 AMS
- Europe: ~ 20
- USA, Japan ~ 10 each
- Argentina, Australia, Brazil, China, India, Israel, New Zeeland, South Korea

The Erlangen EN-Tandem facility

Erlangen Tandem accelerator



•Operational since 1967

•Initial research area: - ***Nuclear physics*** (spectroscopy, polarization, heavy ion reactions)

•Now exclusively - ***Applied physics*** and detector tests

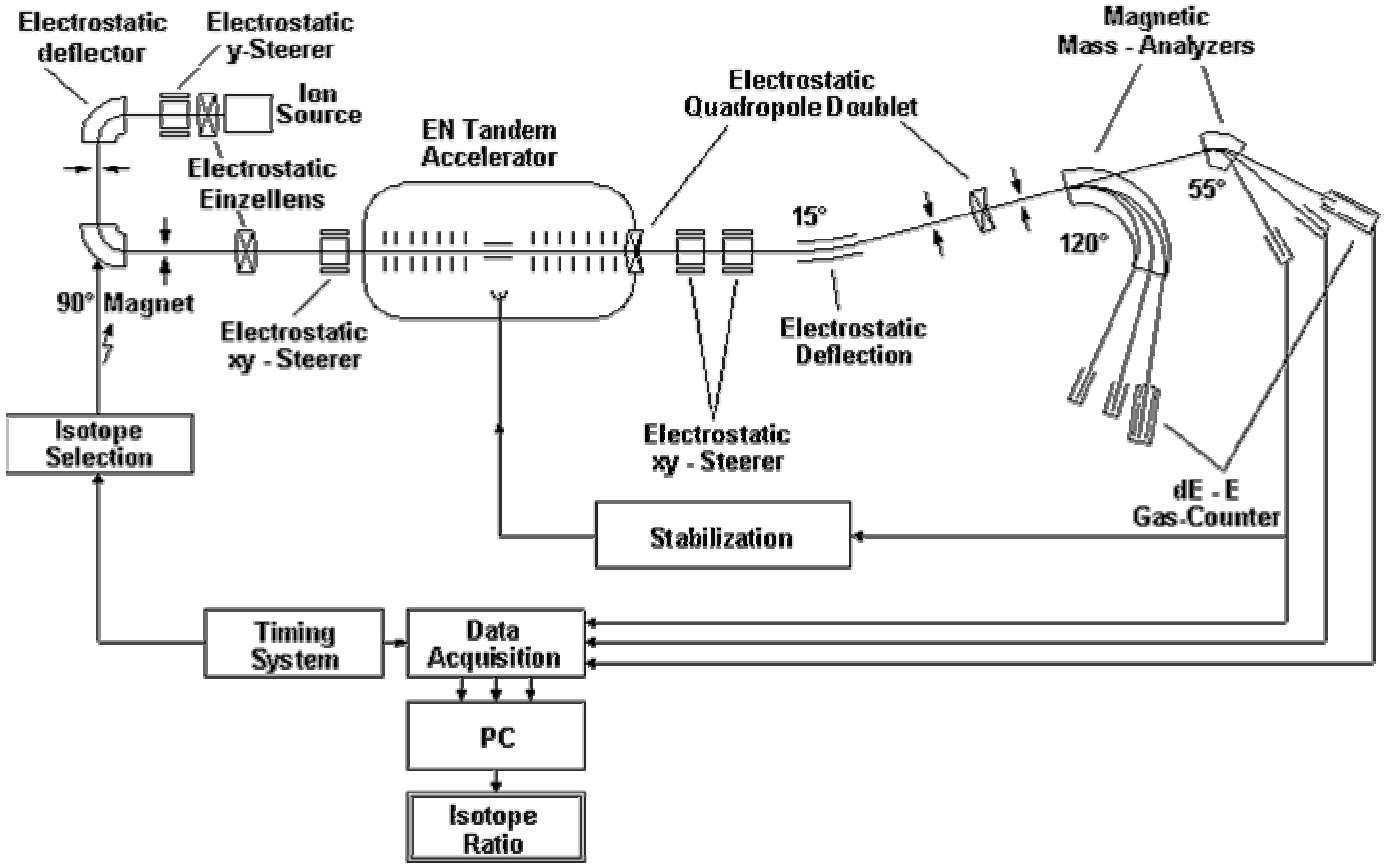
•Two ion sources, one exclusively for AMS

•Belt charging system, insulation gas $N_2 + CO_2$ at 14bar : $U_{max} = 5.5MV$

•Tandem and AMS detector in the basement

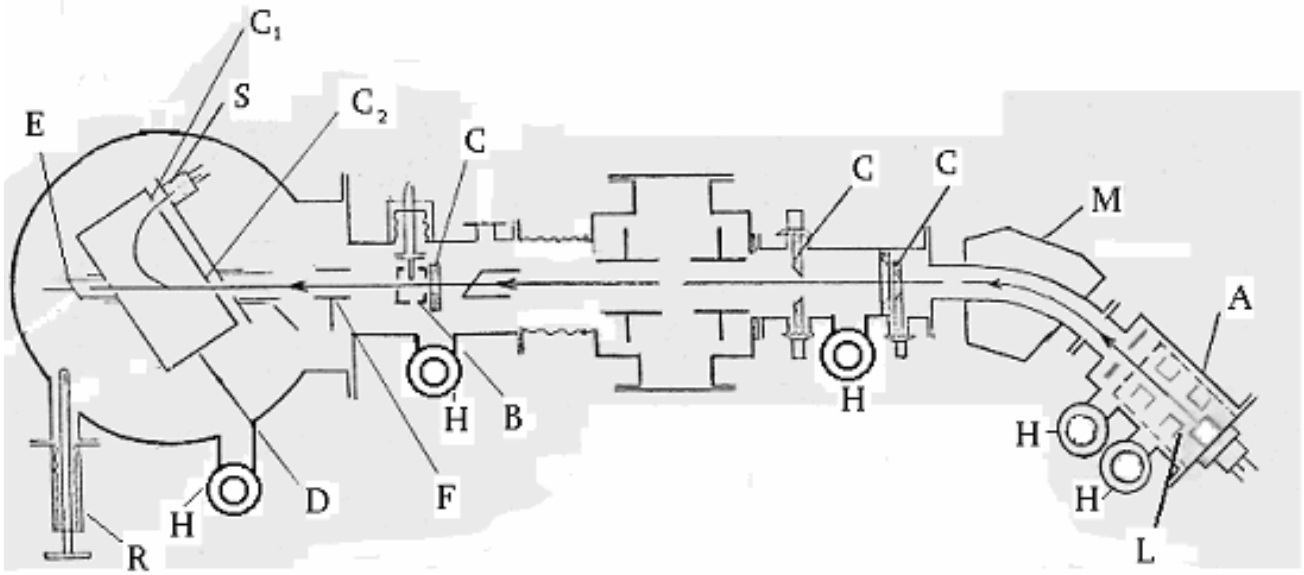
•Beamlines at ground level, fed by the upper turnable 90^o magnet

Schematic view of Erlangen AMS



Ion-atomic scattering

Laboratory of Atomic and molecular processes
Nuclear Physics Division of Physics Department, TSU

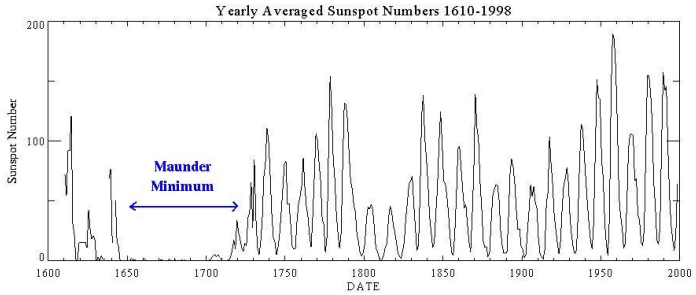


Experimental setup: A- ion source, L- accelerating and focusing system ,M magnetic mass-analyzer
C- collimating slits, B- collision chamber , H- differential pamping system,B-collision chamber,
D-electrostatic analyzer, S- secondary electron multyplier. R-analizator rotating system
E-ion detector ,F-capacitor

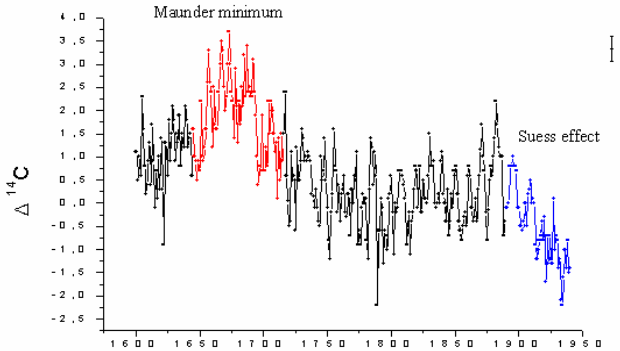
M.Gochitashvili et. Al.,
NIM, B205(2003),494

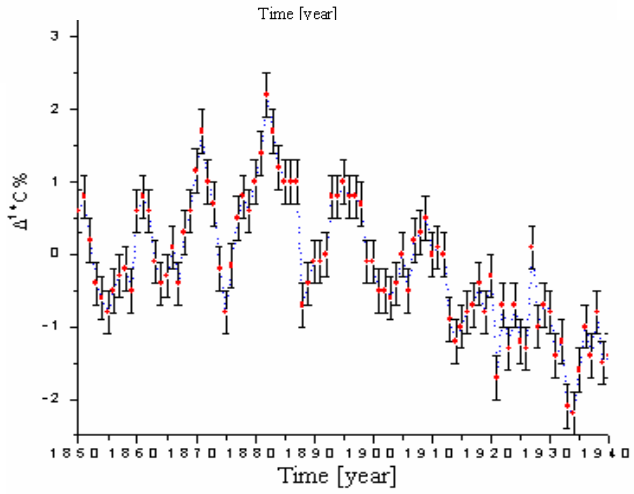
^{14}C and the Maunder Minimum

- The Maunder minimum:
  ´Little Ice Age' ~ 1645-1715



- Astrophysics, Climate and Environment sudies, … (Stradivary violins)
- G.E. Kocharov, P.Kereselidze, Z.Lomtatidze, R. Metskvarishvili, Z. Tagauri, S. Tsereteli – Variation of Radiocarbon Content in Tree Rings During the Maunder Minimum of Solar Activity. Radiocarbon, 34(1992),213.





TANDEM: First steps

Kvali forum, 9-12/7/2004, Tbilisi, Georgia
Presentations from E.Steffens, R.Shanidze,

E.Steffens and L.Kurdadze after meeting at IPAS, 12/07/04

Meeting at Institute of Physics (GAS), Expression of Interest, 12/07/2004

გერმანელები ახალი სამეცნიერო ცენტრის შექმნას გვთავაზობენ

Germans will help with new Scienific Center Kviras (weekly), 22-29/08/04.

TANDEM Proposal

(Preliminary list of interested scientists)

J.Amiranashvili
Center of Archeological Study
M.Gochitashvili, T.Kereselidze, L.Kurdadze, R.Lomsadze, S.Pagava, G.Sakhelashvili
Physics Department, Tbilisi State Univesity
L.Abesalashvili, B.Chiladze, T.Djobava, M.Nioradze, N.Lomidze, R.Shanidze, M.Tabidze, Y.Tevzadze
High Energy Physics Institute, Tbilisi State University
D.Virsaladze
Tbilisi Medical University
J.Chikvaidze
Institute of Botany, Georgian Academy of Sciences
V.Bregadze, L.Chikovani, D.Khachidze, A.Naskidashvili, D.Tananashvili
Institute of Physics, Georgian Academy of Sciences

Possible site

HEPI TSU:
Space for TANDEM accelerator,
Internet center for research and education.

IPAS: main building in Tbilisi and former research nuclear reactor centre near Mtskheta.

Milestones for TANDEM:

in collaboration with Erlangen University:

- TANDEM Proposal (end of 2004)
- Project Evaluation (I half of 2005)
- Submition for funding (II half 2005)
- AMS installation (end 2006)
- TANDEM starts : 2007

Caucasus:

Բոլոր մարդիկ ծնվում են ազատ ու հավասար իրենց արժանապատվությամբ ու իրավունքներով: Նրանք ունեն բանականություն ու խիղճ – միմյանց պետք է եղբայրաբար վերաբերվեն: