Calorimeter & other SOX plans at TUM

Stefan Schönert, TUM

SOX meeting at APC

5.-7.2.2014

SOX team at TUM

- TUM people involved in SOX
  - Stefan Schönert & Lothar Oberauer
  - Laszlo Papp (engineer)
  - Simon Appel (PhD student)
  - Birgit Neumair (master student)
  - Near future: M. Agositini (postdoc)

  Technical support:
  - H. Hartung (construction)
  - Mechanical workshop team
  - Electronic workshop

Planned activities and funding

DFG funding request for:

- **Calorimeter:** Hardware & instrumentation, production, commissioning and operation
- **Beta spectrum measurement**: (contribution to) measurement of Pr/Ce-144 beta spectrum in collaboration with CEA team; beta spectrometer based on Nils Haag's uranium experiment
- **Personnel** funding requests:
  - 1 postdoc
  - 1 PhD
- **Travel**

Detailed budget need to be worked out after discussion & decision of sharing of responsibilities

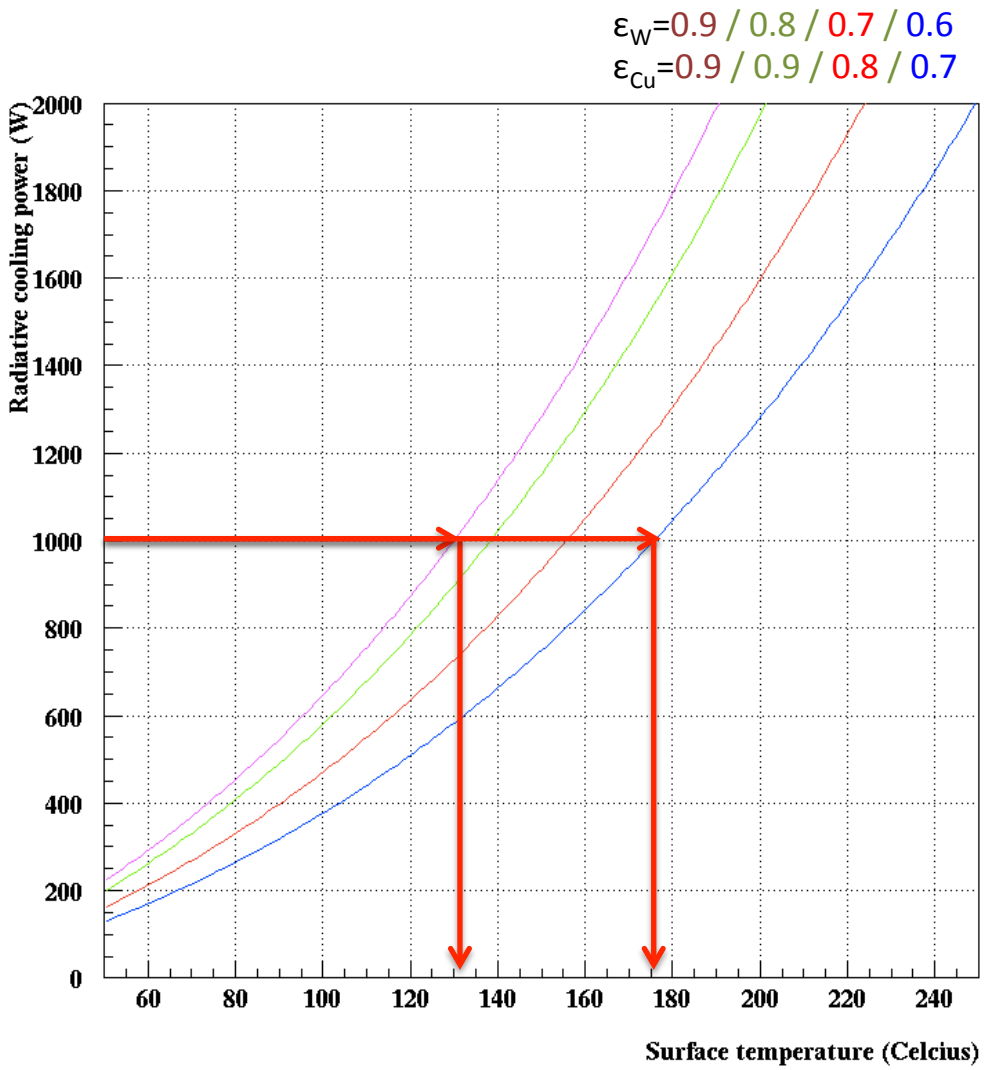
Given the typical time line of DFG funding of approx. 6 months**,** **pre-financing** of critical items (most of them are critical…!)

- We appreciate the need to freeze design soon for the preparation of authorization requests
- Calorimeter design based on last year's discussion at APC meeting and on the detailed work done by the Genova group
- Calorimeter design compatible with Ce-ANG and Cr-NG
- Measurement of (A)NG heat during measurement in SOX-pit
- Assembly and commissioning at accelerator lab (MLL) at TUM (high-bay, crane, vicinity of workshop & technical staff)

Main distinction to current design

- Heat dissipation of W-shield by radiation (αT^4)
  - W-shield can be decoupled mechanically from heat exchanger which ensures steady heat dissipation. Insensitive to in time changing thermal contacts between W-shield and heat exchanger because of different thermal expansions.
  - Heat exchanger encloses ANG hermetically
- Intrinsically safe provided that temperature of Ce-steal / Cr- capsule acceptable (need to be checked!)
- If temperature of steel capsule too high, Improve thermal properties:
  - Increase thermal coupling of steel capsule to W-shield (by Cu-mesh/wrinkled Cu foil)
  - Surface treatment of W-shield for high emissivity
  - Surface treatment of inner side of Cu-shield for high emissivity (=absorptivity)
- Details of modified calorimeter design see Laszlo's presentation

Example for radiative cooling



Calculation of radiative heat transfer between two surfaces incl. reflection

Surface of W-shield: 1.08 m^2

Cu-wall (heat exchanger) kept at fixed temperature: T=10 C

Different emissivities chosen for ε_W and ε_{Cu}

Surface temperature of W-shield for 1 kW power dissipation between approx. 130 and 175 degree Celcius

Note: Temperature of stainless steel Ce-capsule dependent on thermal coupling between steel and W-shield. Consider to use copper mesh/ wrinkled foil to fill gap in order to significantly decrease stainless steel temperature.

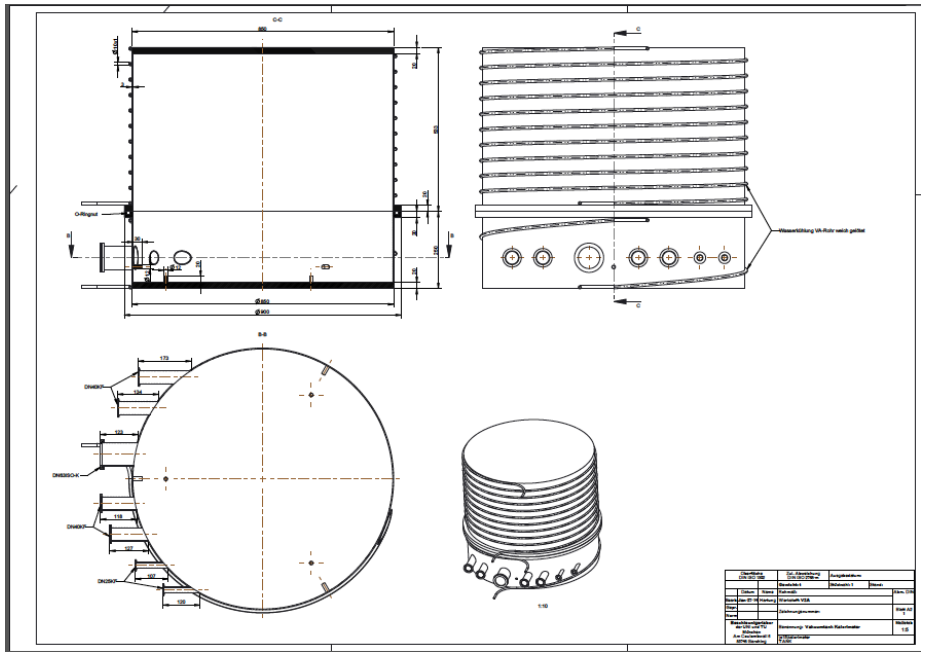
A straw man's schedule

- Until end of March 2014: Finalize design of critical components
- April 2014: Start of procurement of components
  - E.g. vacuum tank 10 weeks (+ contingency)
- December 2014: Complete assembly at TUM accelerator laboratory (high bay with crane) and commissioning
- March 2015: Install at LNGS
- July 2015: calorimeter ready to receive ANG

Plan also for

- Test runs with mock-up
- Test runs with W-shield, steal capsule & heating system

First iteration with potential producer of vacuum tank based on Genova tank design



Budget quote available:

PREIS:	netto, zuzgl. gesetzl. Mehrwertsteuer
LIEFERZEIT:	10 Wochen ab Auftragseingang und Klärung aller techn. Details bzw. nach Vereinbarung
LIEFERUNG:	ab Werk, zuzgl. Verpackung und Transportversicherung
ZAHLUNG:	30 Tage rein netto
ANGEBOTSGÜLTIGKEIT:	3 Monate

Project details to be defined and interfaces worked out

- TUM Project **could** include (discuss work sharing with Genova group):
  - Vacuum tank (incl. all feed through)
  - Internal instrumentation (heat exchanger, thermal shields, sensors)
  - External instrumentation (flow meters, sensors, vacuum pumps, gauges, piping etc...)
- Interfaces with
  - Shield lifting / lowering system
  - Railway system (interface: weight distribution)
  - Tungsten shield (emissivity of surface (special treatment?), Ce/ Cr capsule thermal coupling to W-shield ?)
  - Mockup with sensors (M. Wurm)