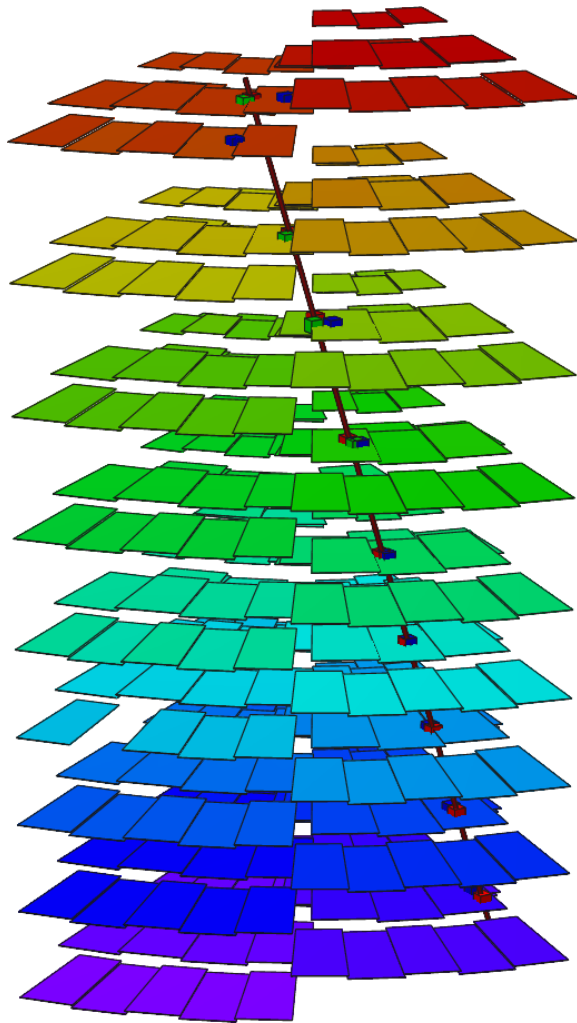


TEC Material Budget



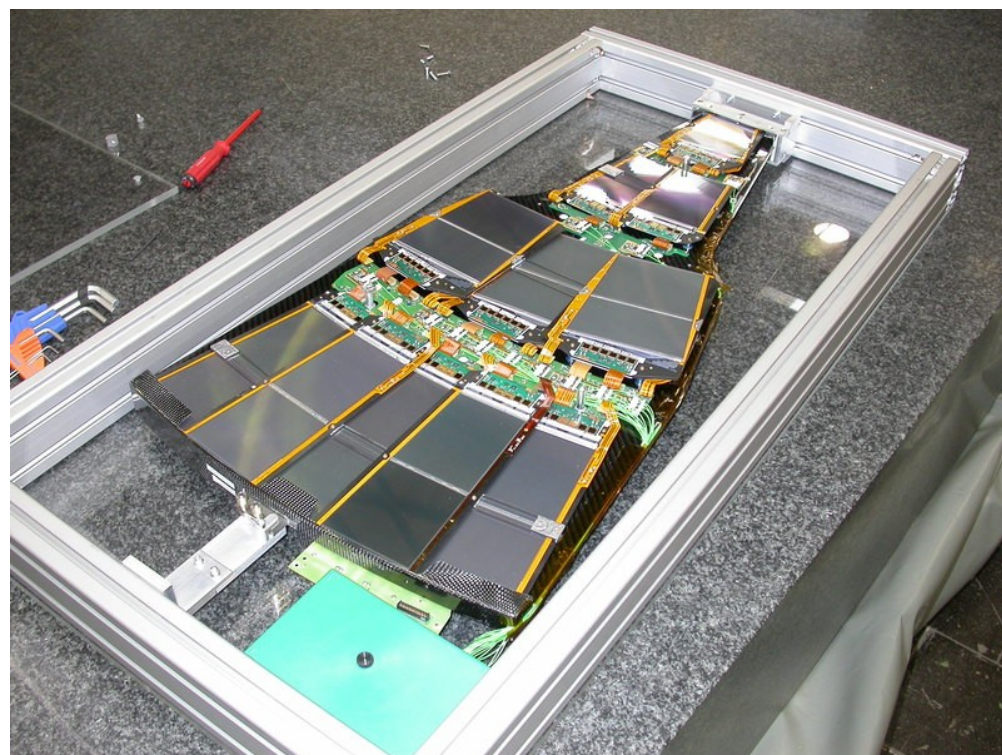
Martin Weber
Matthias Edelhoff
RWTH Aachen

TEC- Review
CERN
19 March 2007

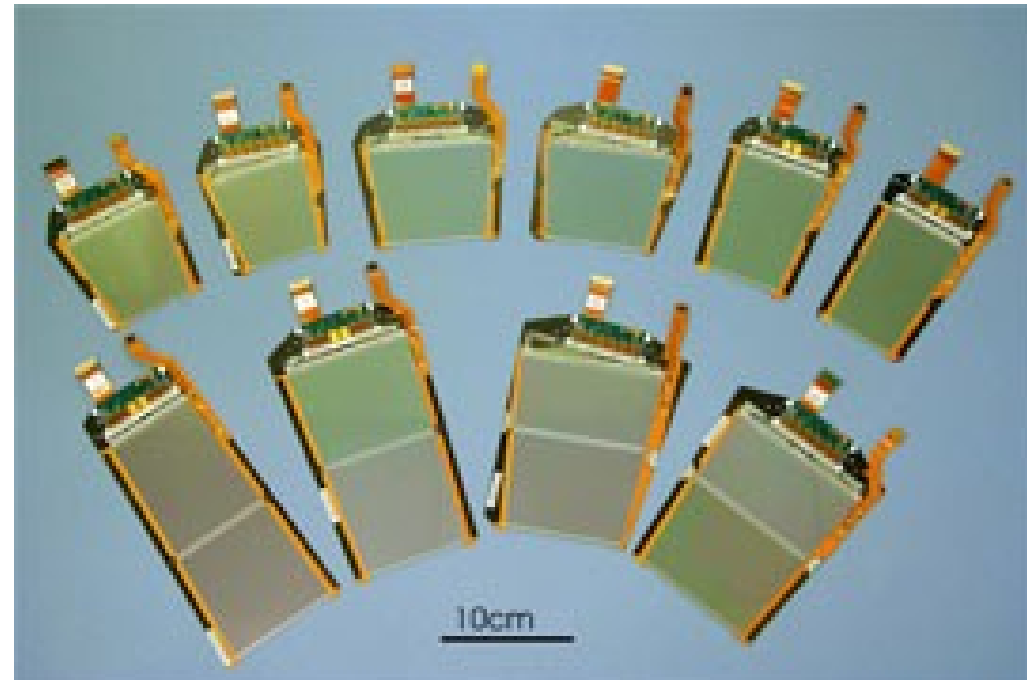
- Hundreds of TEC parts have been weighed and materials recorded...
 - Documentation at http://cern.ch/Martin.Weber/Geometry/tec_parts.html
 - Some examples:

	Front Petal 1-3	Front Petal 4-6	Front Petal 7-9	Back Petal 1-3	Back Petal 4-6	Back Petal 7-9
Front Petal long		1	0		0	0
Front Petal short		0	1		1	0
Back Petal long		0	0		0	0
Back Petal short		0	0		0	1
Optohybrids						
1.1 1200 mm 3						
1.2 1100 mm 3						
1.3 1100 mm 3						
1.4 1100 mm 3						

- **TEC-** has been weighed to 730,1 kg (TEC+ 734,4 kg)
 - Parts to be unmounted (fiber boxes, installation tools, ...) 30 kg (measured @ TEC+)
 - TEC- installed in CMS: 700 kg
- **Calculation from weighed materials: 688,4 kg (~10 kg uncertainty)**
 - Difference 11,7 kg, 1,7 % (TEC+: 16 kg, 2,3%)
 - Some parts have been updated since TEC+ review (crimp repair, grounding, ...)
- **Cross-Check: Back petal (long) weight**
 - Measured: 2440 g,
predicted: 2405 g (1.5% difference)
 - very good understanding of everything inside $r < 110\text{cm}$
 - Disks also very precise
 - Agreement of services on same scale
 - Overall material budget well understood



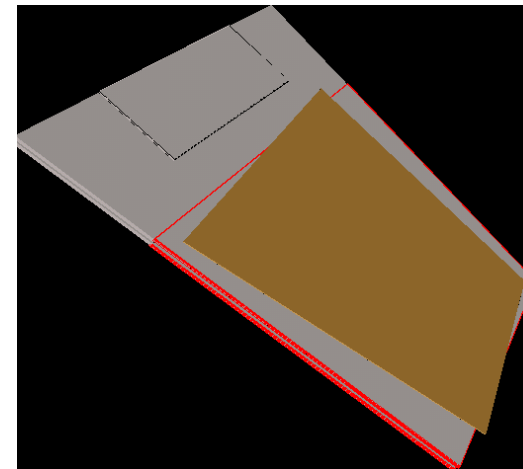
- **General strategy has been defined in a joint TIB+TOB+TEC meeting:**
 1. Start reviewing the modules, proceed to larger structures
 - For TEC: Module, Petal, Disk, TEC, Services
 - Complex task: 10 module types, 8 petal types, 6 disk types, services, ...
 2. For each part, verify correctness of detector material and description:
 - Measure dimensions from engineering drawings and compare with DDD
 - Check real material and DDD material description
 - Measure the weight of all real parts and compare with DDD
 - If any disagreement is found:
 - Update if needed the DDD description
 - Limit the number of new volumes to the absolute necessary (CPU time)
 - Verify that the position of sensitive elements did not change



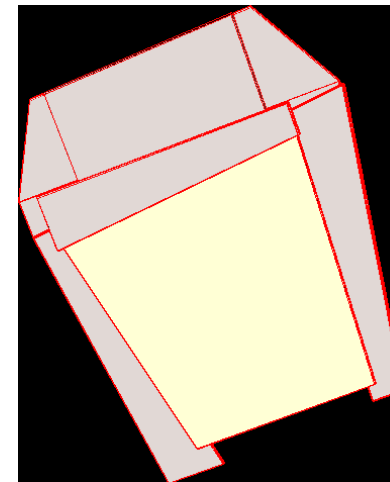
- Many improvements on module level

- (necessary for 10 different module types → very time consuming)
- Separation of mono and stereo modules (too different to be modelled with same parameters)
- Introduction of supply boxes under silicon (electrical contact+thermistors+silver glue)
- Modification and correction of top frame
- Correction of PA material and shape
- Correction of hybrid size
- Introduction of silicon reinforcements (1 for rings 0-3, 2 for rings 4-6)
- Two corrected leg materials instead of one (Rings 0-3, rings 4-6)
- Correction of hybrid material (from TOB) + inclusion of ceramic spacer

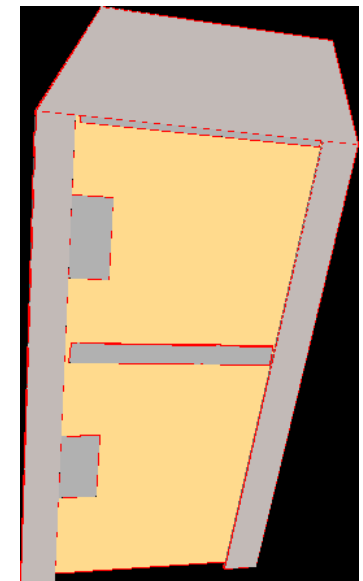
- Changes will go in CMSSW_1_4_0



Old ring 0



New ring 0
(front)



New ring 5
(back)

Backup



- **TEC DetId has been reworked (R. Ranieri)**
 - Unstable modules sorting at $\varphi=0$ has been replaced by stable one
 - Module numbering now as close to hardware as possible
 - Includes numbering for TEC- starting at $\varphi=180^\circ$ and decreasing with phi
 - Many thanks to Riccardo!
- **Module position in agreement with engineering drawings**
 - Detailed comparison for TEC+
 - Mono modules in excellent agreement, difference $< 10 \mu\text{m}$
 - Only stereo modules are shifted by $100 \mu\text{m}$, $260 \mu\text{m}$
 - Will try to update that (today + tomorrow)
- **All modules reworked (117 kg / 700 kg)**



- Elements being smeared usually non-metallic
 - Exception: petal cooling pipe (for reason see slide 2)
- Cables, ribbons, pipes are implemented but mixed together
 - Detail level will be improved when the lower level finished
- Metrology data will not go to the geometry
 - Survey (photogrammetry) will be implemented as “alignment object”