

Recent validation results for EM standard

*Geant4 Validation & Verification
Workshop*

17-19 July 2006, CERN

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Outline

- ◆ Introduction
- ◆ Testing strategy
- ◆ Results of validation for 8.1
 - ATLAS Barrel
 - ATLAS HEC
 - LHCb
 - CMS
 - ZEUS
- ◆ Prospects

History

- ◆ Long time ago Michel and Laszlo started number of extended EM examples
- ◆ These examples are used by G4 System Testing Team
- ◆ Many user applications start from these examples
- ◆ On the base of TestEm2 SPEC benchmark have been done
- ◆ The testing suite is based on extended examples as well

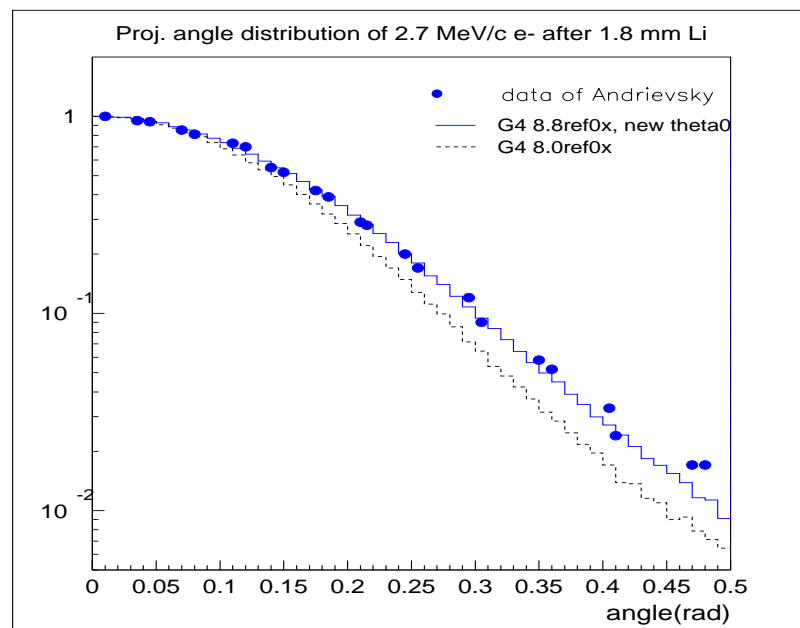
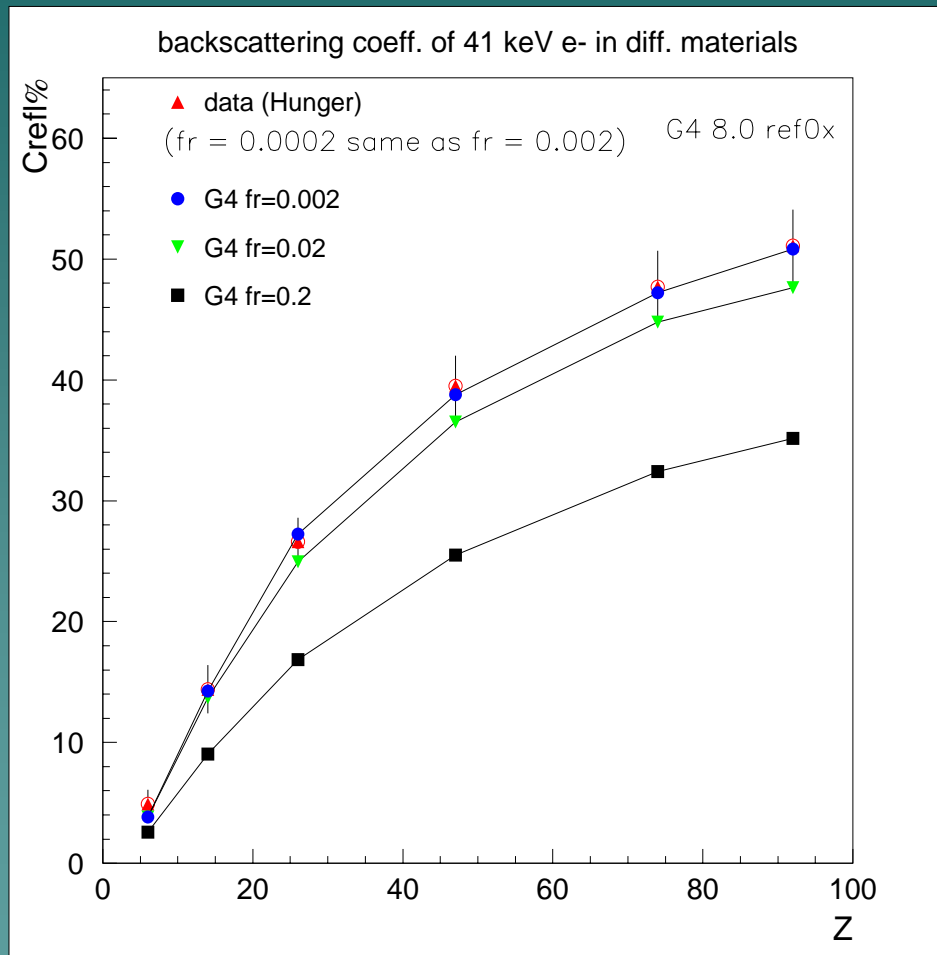
Test	Purpose	Responsible	N macro	G3
TestEm0	G4EmCalculator	M.Maire	5	
TestEm1	Tracking/EM physics in infinite media	M.Maire	15	+
TestEm2	EM shower in homogeneous media	M.Maire	7	+
TestEm3	Sampling calorimeter	M.Maire	23	+
TestEm4	Gamma interactions	M.Maire	3	+
TestEm5	Multiple scattering	L.Urban	18	+
TestEm6	High energy muons	H.Burkhardt	6	
TestEm7	Bragg peak	M.Maire	6	
TestEm8	PAI models	V.Grishine	2	
TestEm9	Crystal Calorimeter	V.Ivanchenko	5	
TestEm10	TRD models	V.Grishine	2	

TestEm11	Deep dose profile (plane)	M.Maire	5	+
TestEm12	Deep dose profile (spherical)	M.Maire	4	
TestEm13	Gamma interactions	M.Maire	6	+
TestEm14	Cross sections and mfp	M.Maire	5	+
TestEm15	Multiple Scattering	M.Maire	4	
TestEm16	Synchrotron radiation	H.Burkhardt	3	
TestEm17	Muon processes	R.Kokoulin, A.Bogdanov	6	
GammaTherapy	Bremsstrahlung beam	V.Ivanchenko	5	
test31	Sliced media	V.Ivanchenko	5	

Test Strategy

- ◆ Private tests by developers
 - ◆ Necessary but not enough
- ◆ Fast automatic test on main platform
 - ◆ SLC3 now
 - ◆ Low statistic
 - ◆ 20 macro out of 126
 - ◆ Comparison with previous version
- ◆ Stt test integration and different platform
- ◆ Large statistic tests for major use cases

Multiple Scattering Update (L.Urban)



Testing Suite Directory Structure

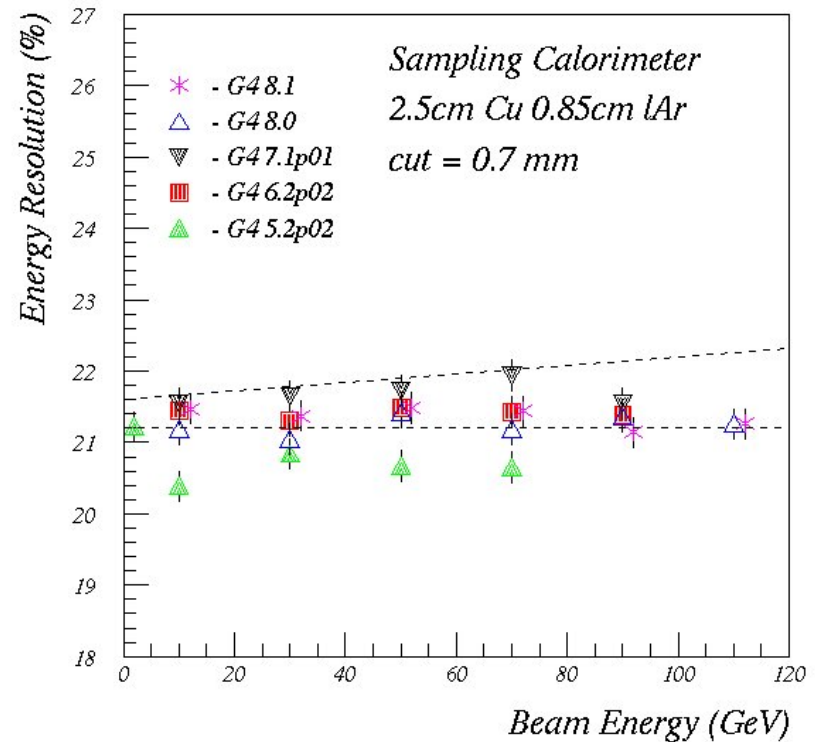
- ◆ AFS public – not CVS
 - ◆ Comparisons between reference tags
 - ◆ Started from 6.0
- ◆ Copy at pcgeant5 and pcgeant6
- ◆ Driving by scripts
- ◆ From 8.1 running at LXBATCH
- ◆ Structured by tags name

```
$VFEM/tests/TestEm1/release../r.out  
          /TestEm2/release../r.out  
$VFEM/atlashec/release../  
          /lhcb/...  
          /cmscal/...
```

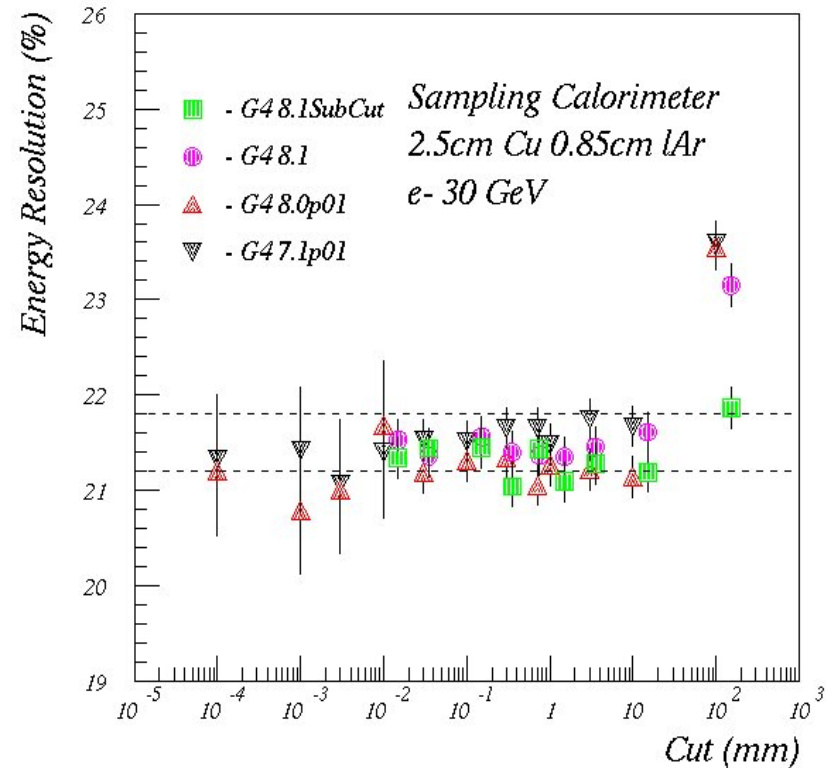
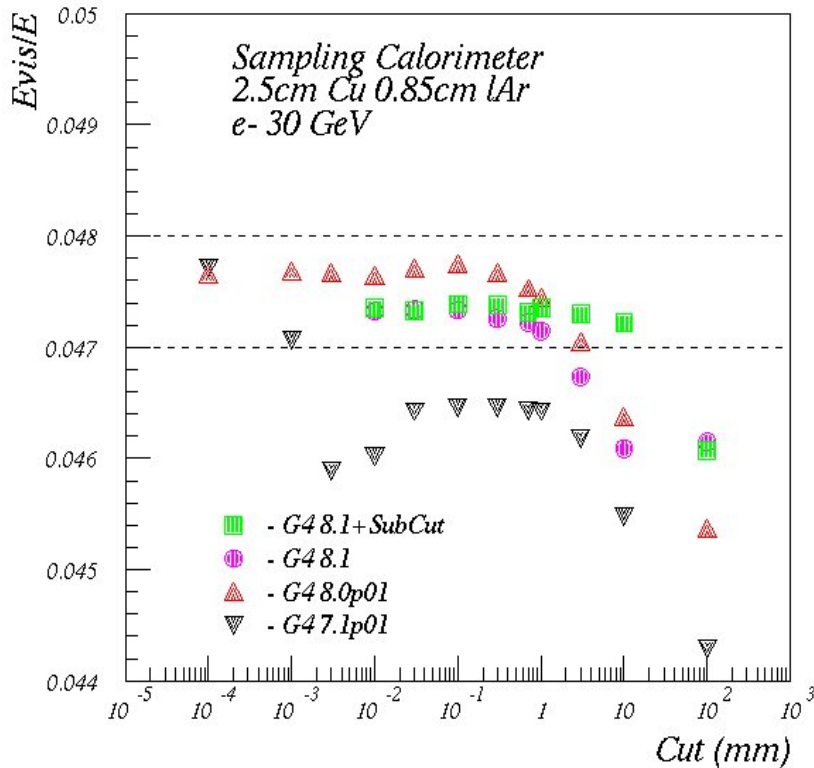

Atlas HEC Calorimeter

- ◆ The first setup for the suite
- ◆ ATLAS HEC structure is used as a reference since release 5.2
- ◆ Based on TestEm3
- ◆ Resolution is compared with the data
- ◆ 30 GeV e^- were chosen (Gaussian spectrum)

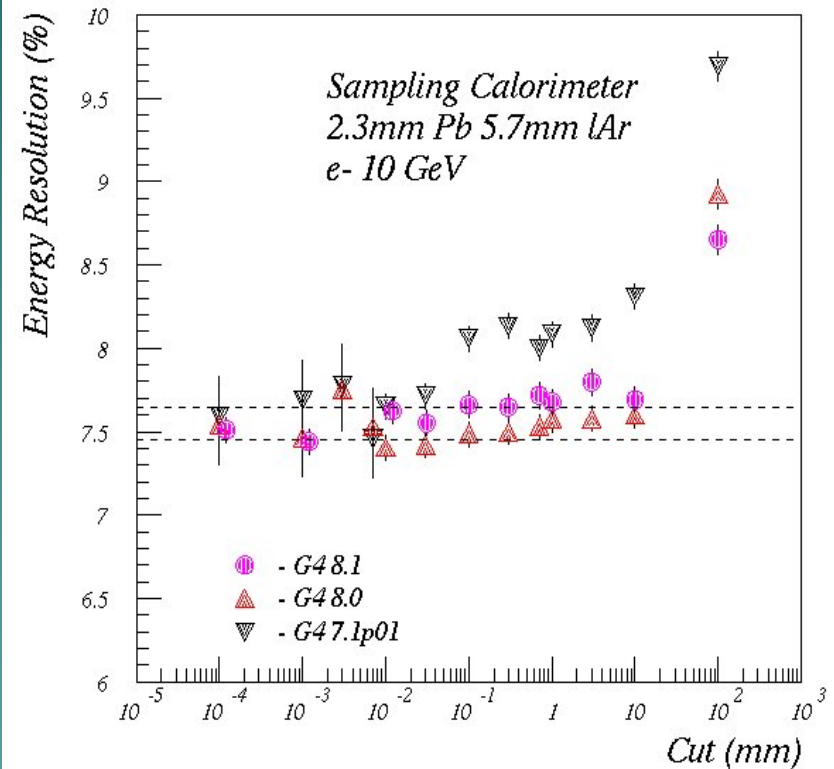
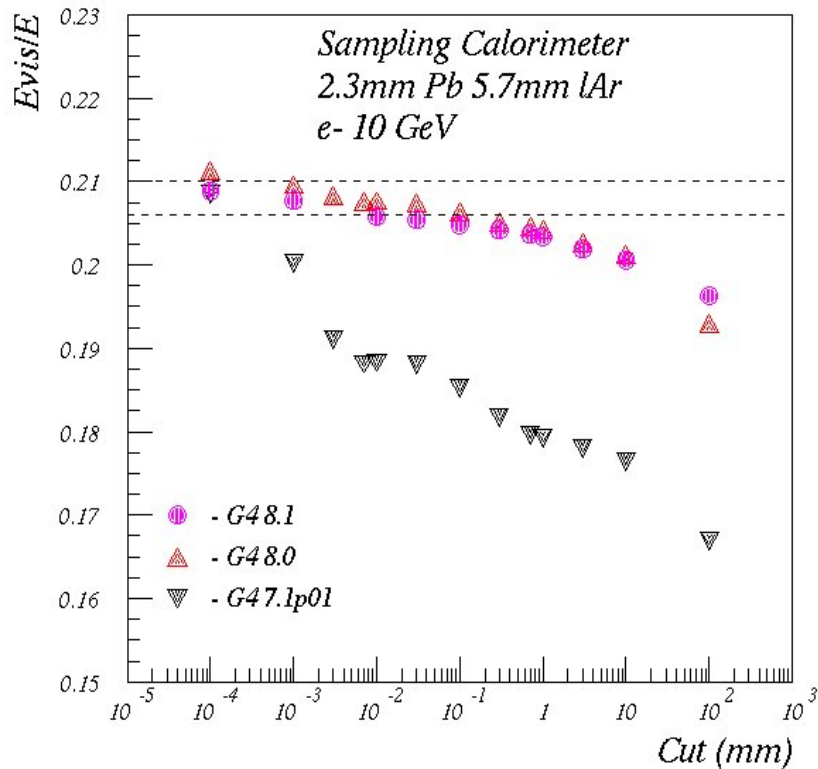
Default EM physics



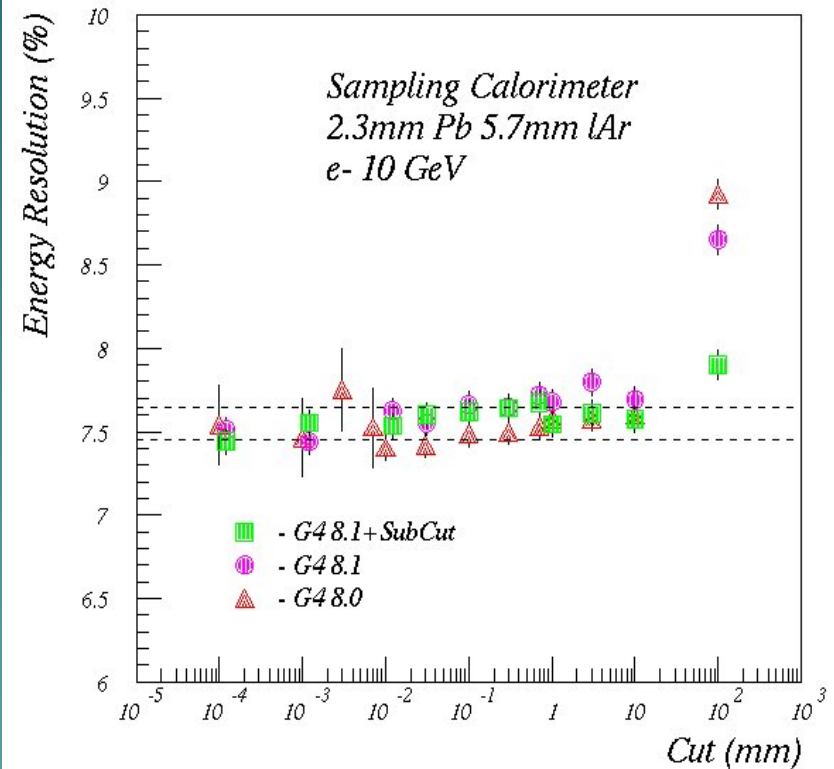
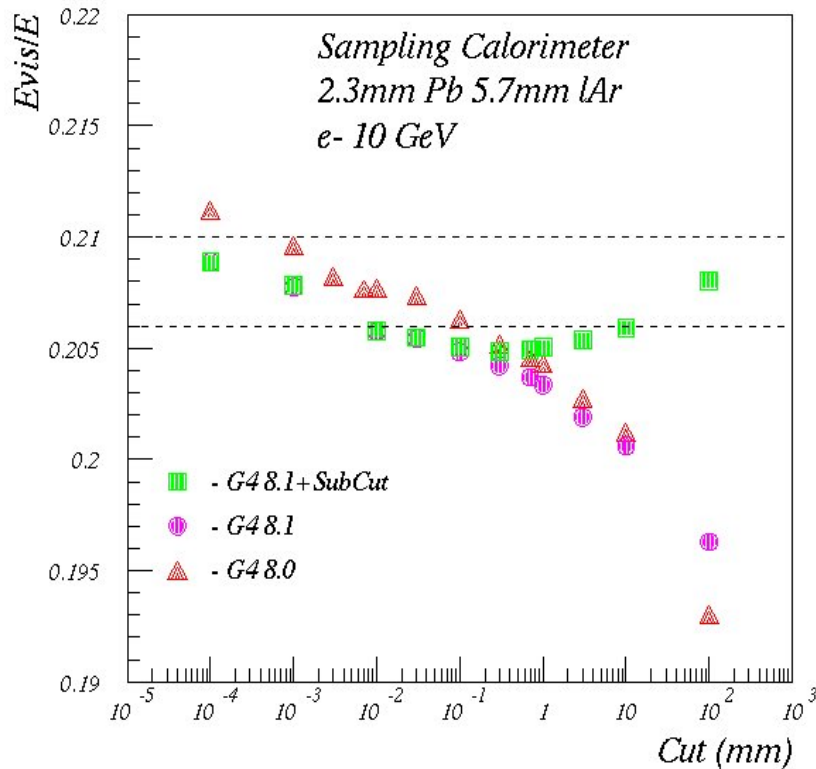
ATLAS HEC Type Calorimeter



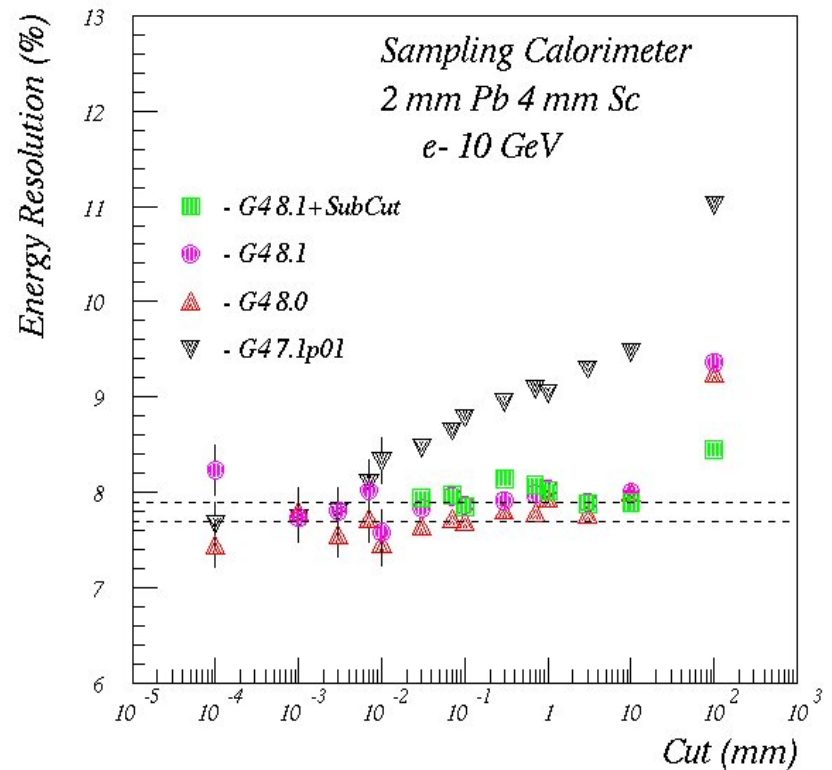
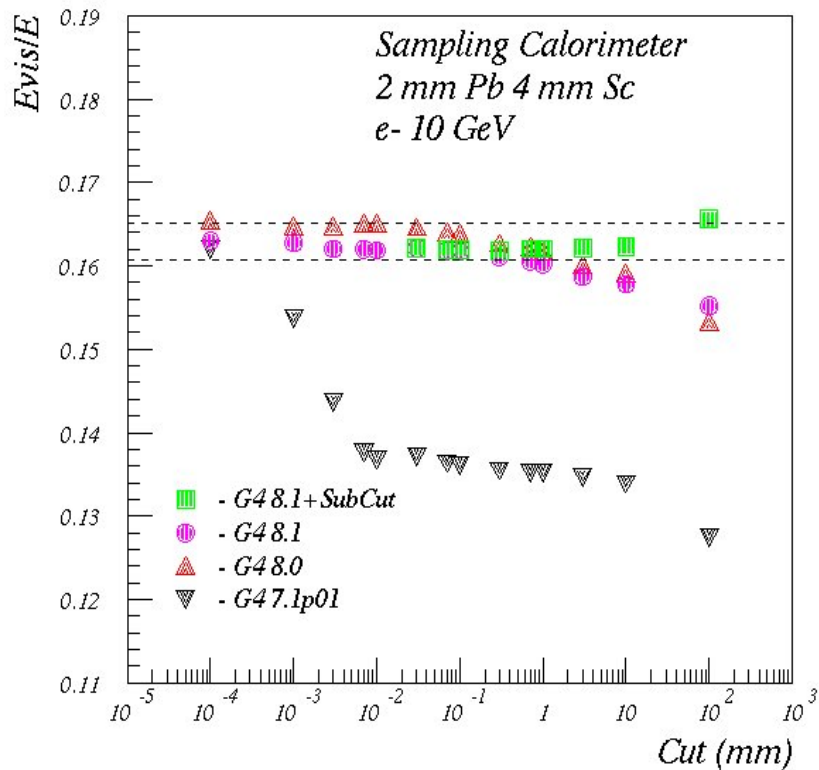
ATLAS Barrel Type Calorimeter



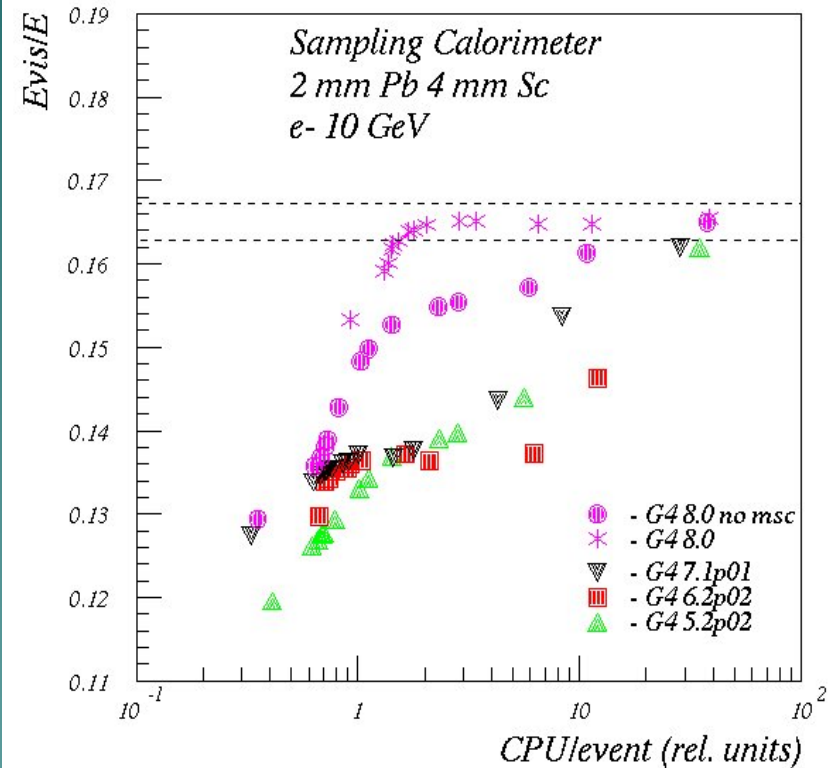
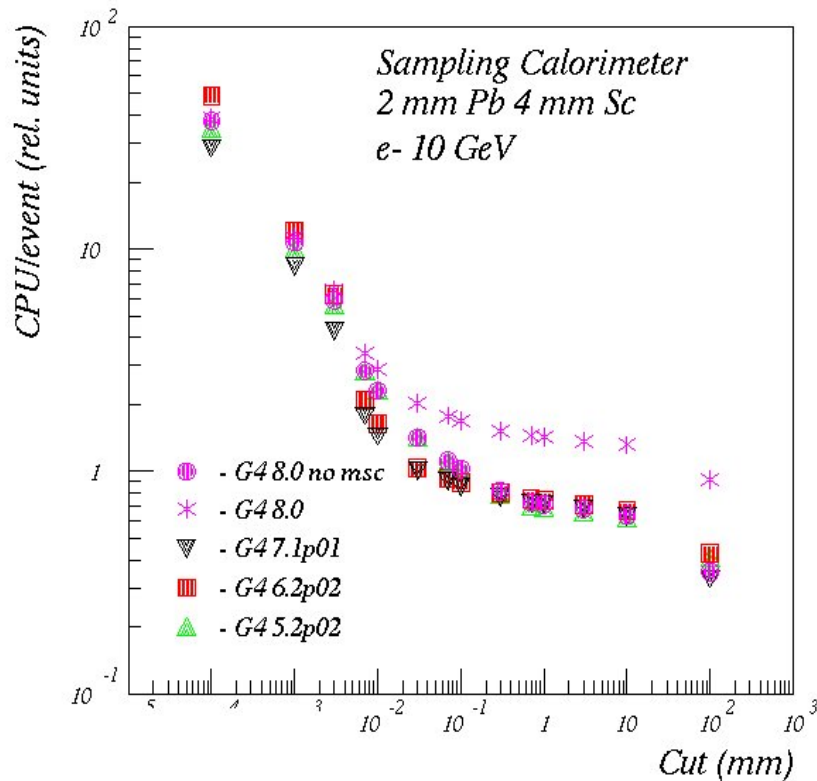
ATLAS Barrel Type Calorimeter



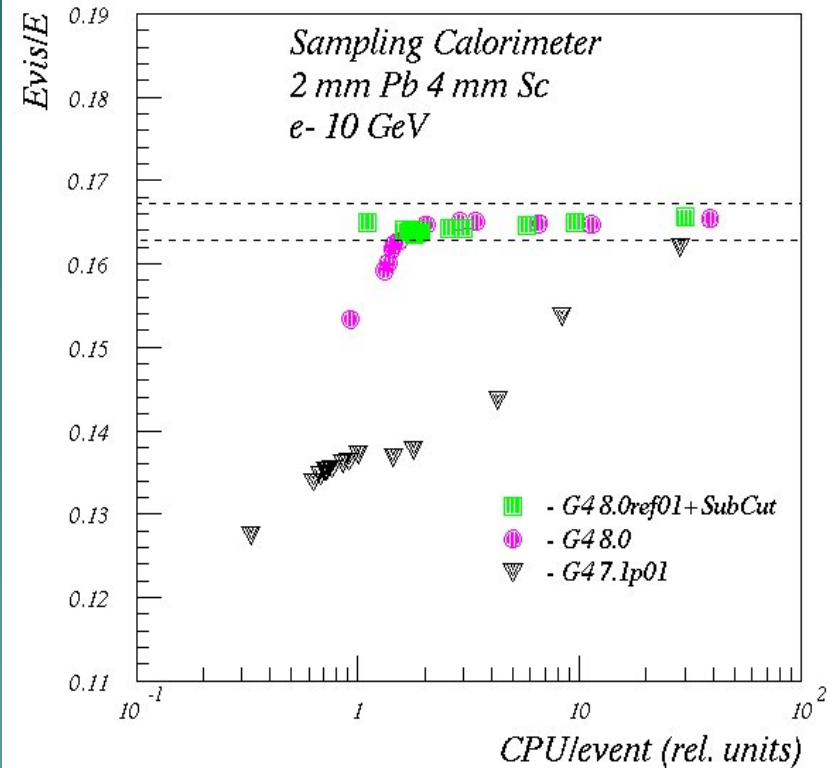
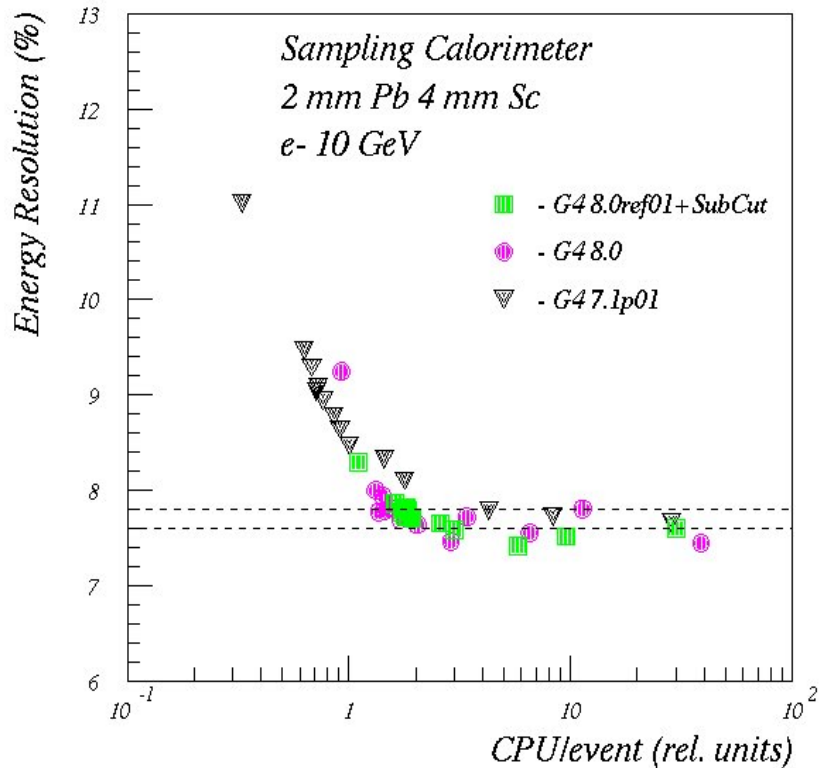
LHCB Type Calorimeter



CPU Optimization

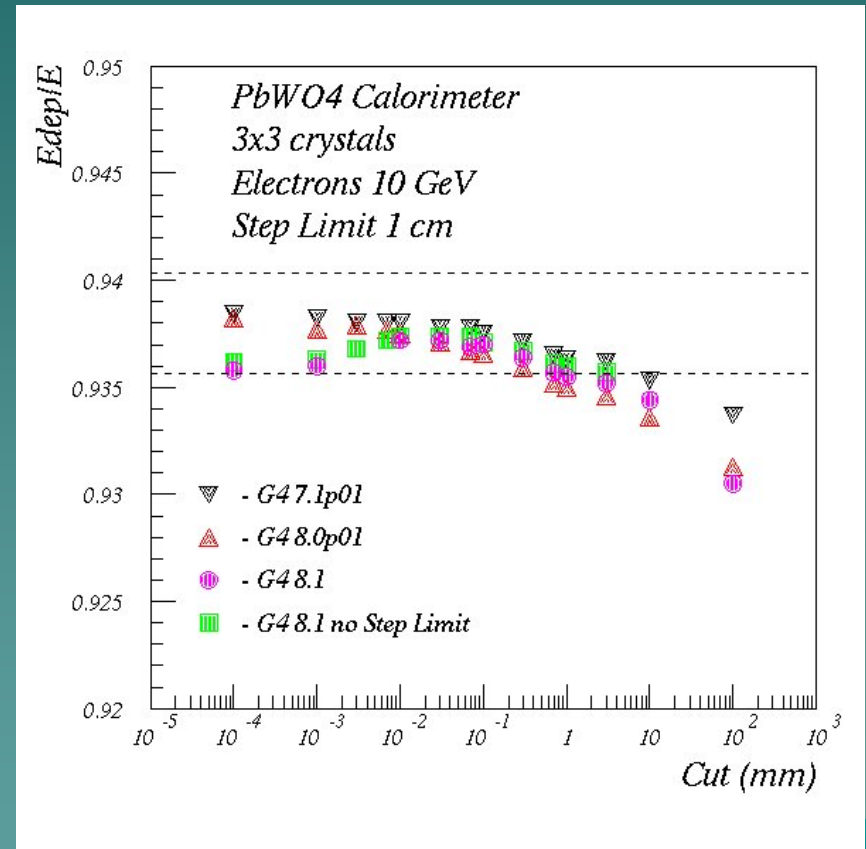


CPU Optimization



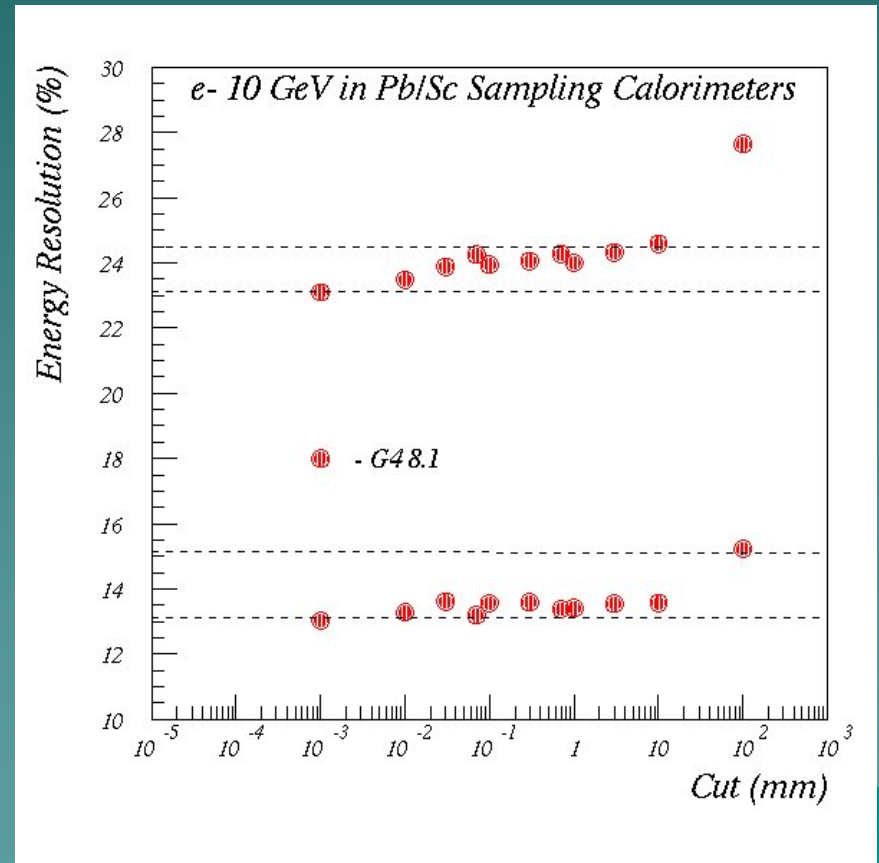
CMS Crystal Calorimeter

- ◆ Based on TesEm9
- ◆ Matrix of 5x5 crystals
- ◆ Energy deposition inside
 - ◆ central crystal
 - ◆ 3x3 matrix
 - ◆ 5x5 matrix
- ◆ 10 GeV e^- were chosen



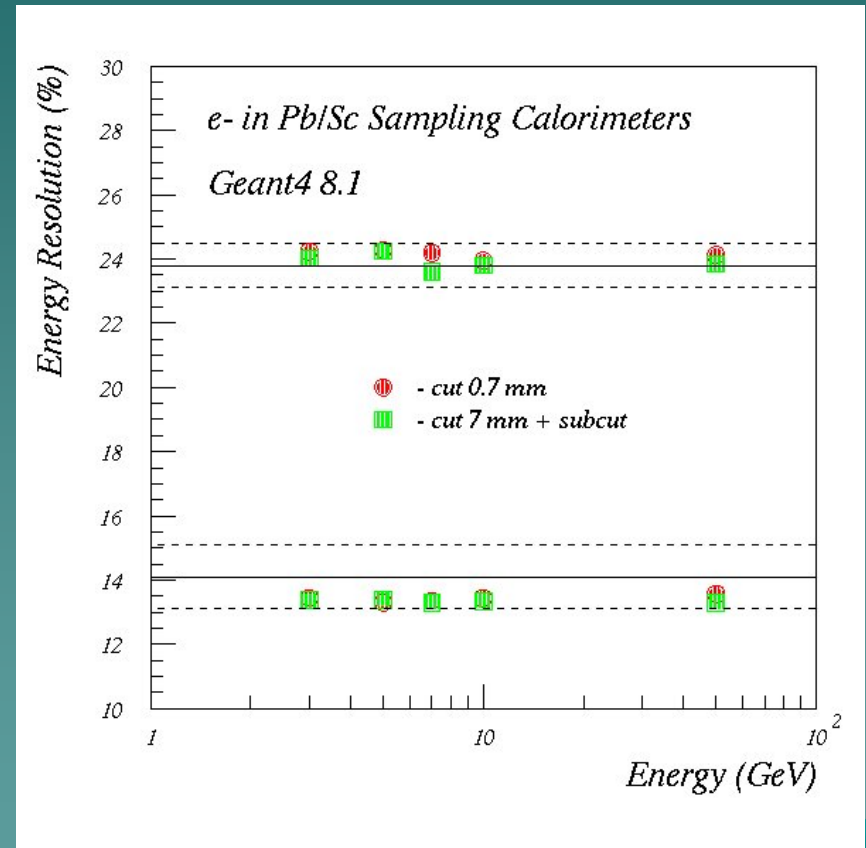
Comparison with Published Data

- ◆ ZEUS calorimeter test beam data
 - NIM A262 (1987) 229
 - NIM A274 (1989) 134
 - E. Bernardi thethis
 - PS CERN measurements
- ◆ Two calorimeter structures:
 - ◆ 5mm Pb/5mm Sc
 - ◆ 10 mm Pb/2.5 mm Sc
- ◆ Accurate description of sizes and materials was needed



Comparison with Published Data

- ◆ The results with standard cut 0.7 mm and higher cut and subcutoff regime are similar
- ◆ The EM calibration of these data are done – hadronic comparisons need to be performed



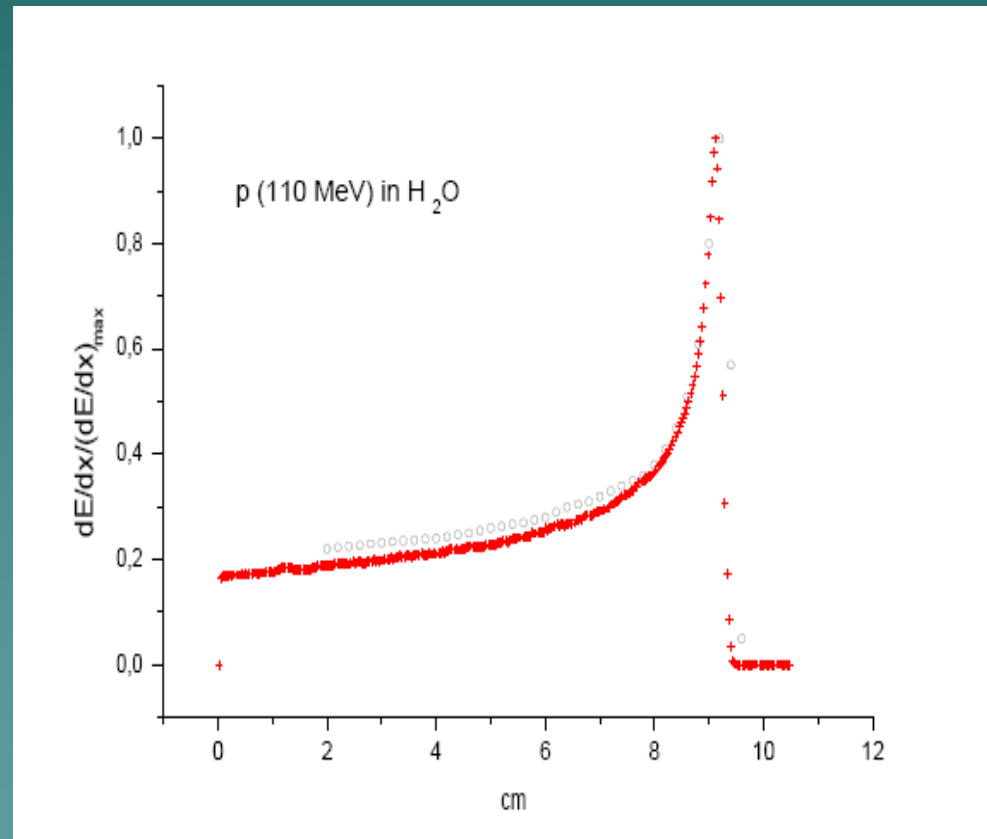
Summary

- ◆ There is the established testing suite
- ◆ Several level of testing
- ◆ For large statistic test major LHC calorimeter structures are implemented
- ◆ Improvements are foreseen
 - Bragg peak test
 - High energy muon multiple scattering

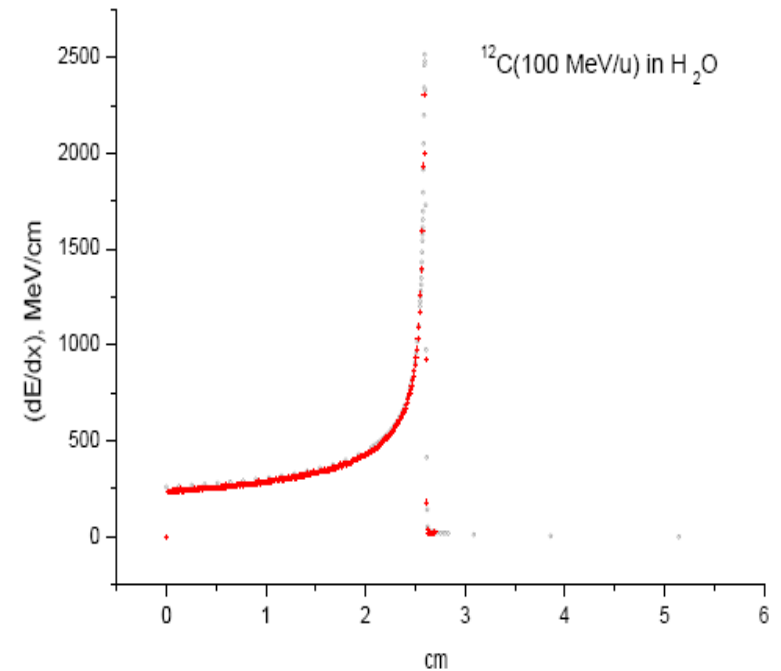
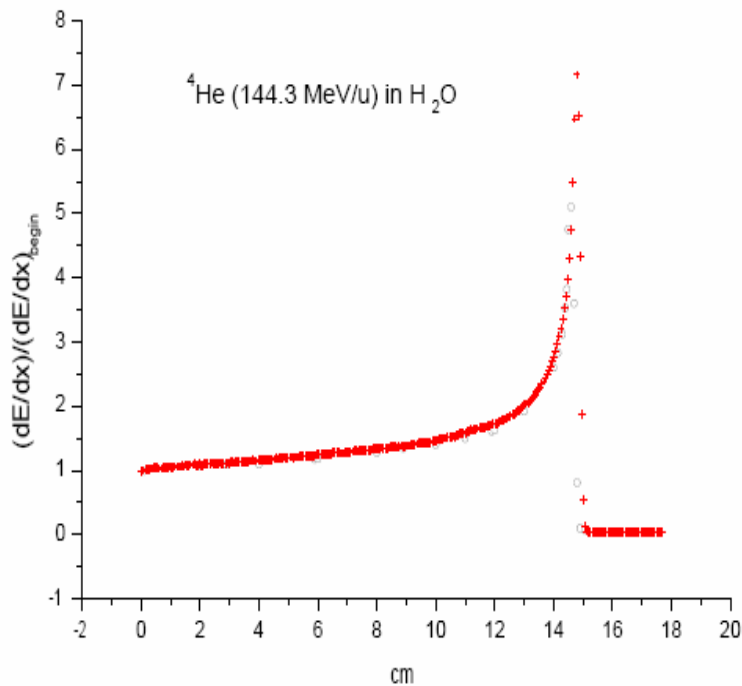
Prospects

- ◆ Bragg peak test may be provided on base of IonBeam application developed by A.Baguaia, I.Gudowska, V.Ivanchenko, N.Starkov (first results were reported at Bordeaux)
- ◆ Control on Bragg peak in regression and against data
- ◆ Use relatively low energy beam data to reduce hadronic effects

N.Starkov – preliminary!



Preliminary Results from N.Starkov



Preliminary results for 8.1 in much better agreement with The data than results of 7.1 !