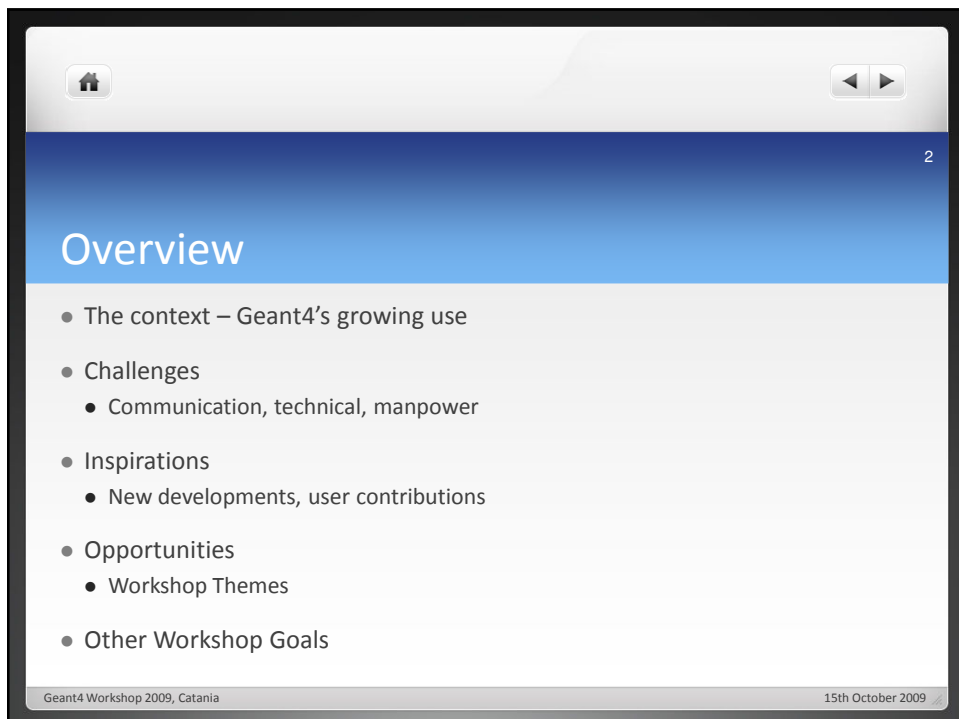


Workshop goals and opportunities

Issues, challenges and themes

John Apostolakis

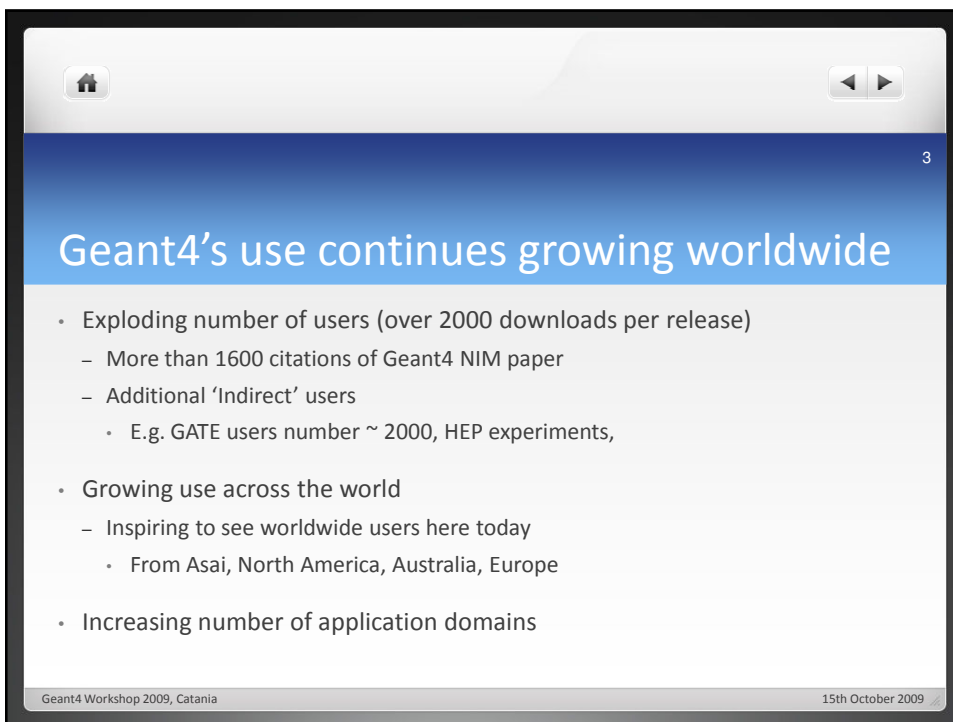
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Overview

- The context – Geant4’s growing use
- Challenges
 - Communication, technical, manpower
- Inspirations
 - New developments, user contributions
- Opportunities
 - Workshop Themes
- Other Workshop Goals

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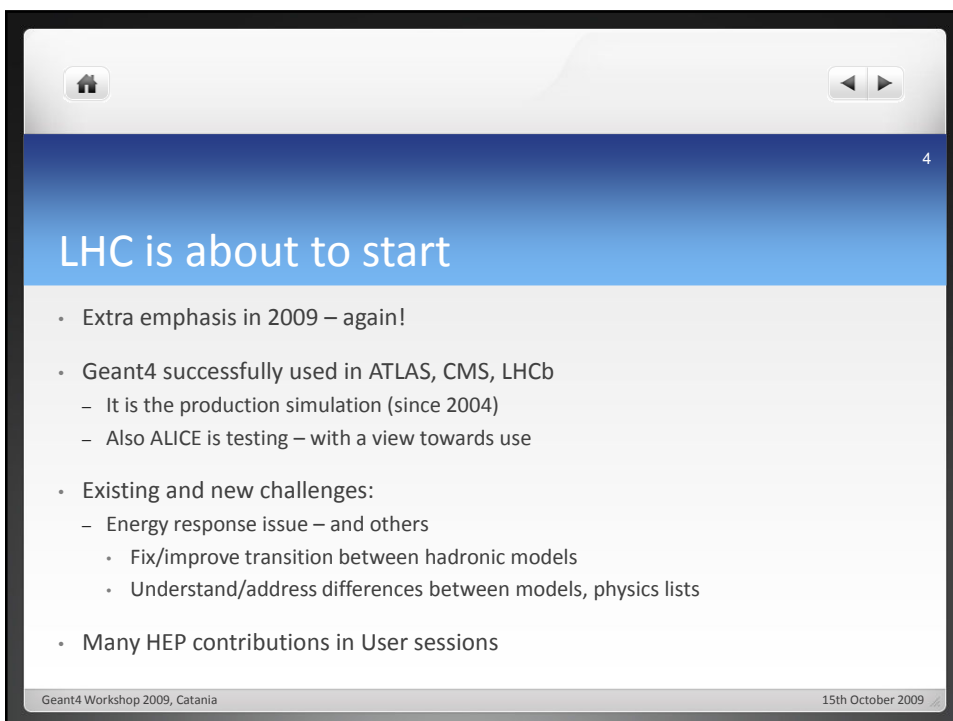


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Geant4's use continues growing worldwide

- Exploding number of users (over 2000 downloads per release)
 - More than 1600 citations of Geant4 NIM paper
 - Additional 'Indirect' users
 - E.g. GATE users number ~ 2000, HEP experiments,
- Growing use across the world
 - Inspiring to see worldwide users here today
 - From Asai, North America, Australia, Europe
- Increasing number of application domains

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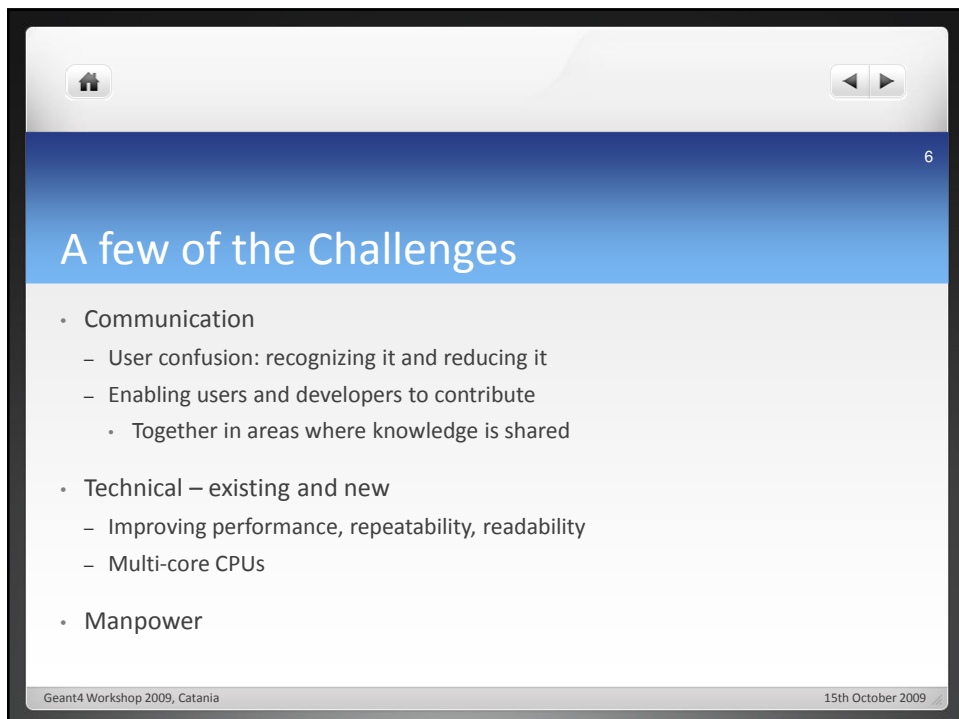
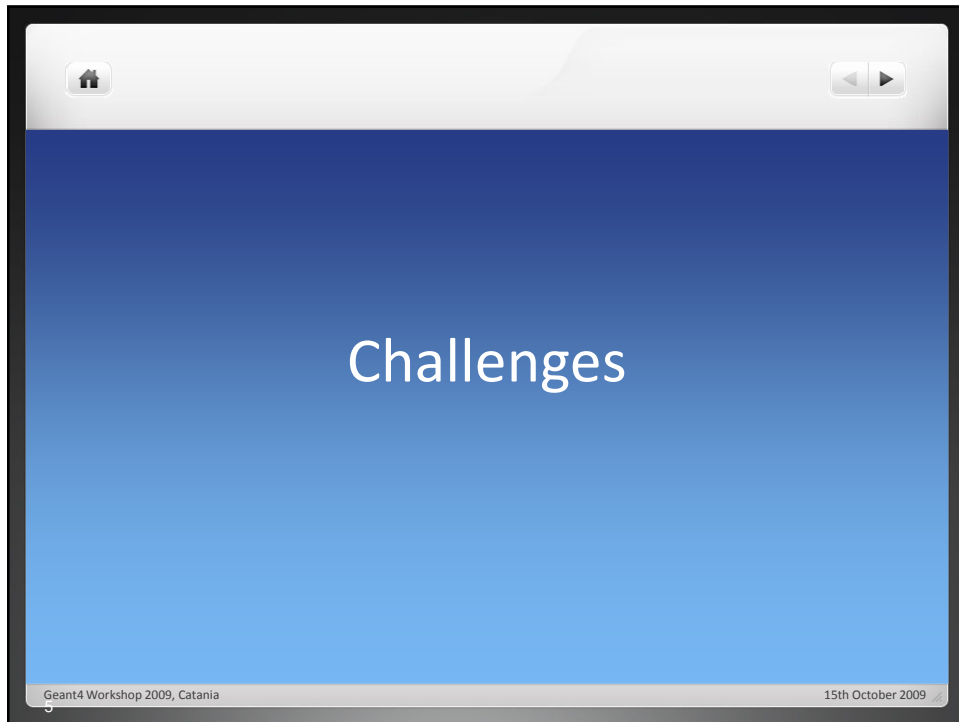


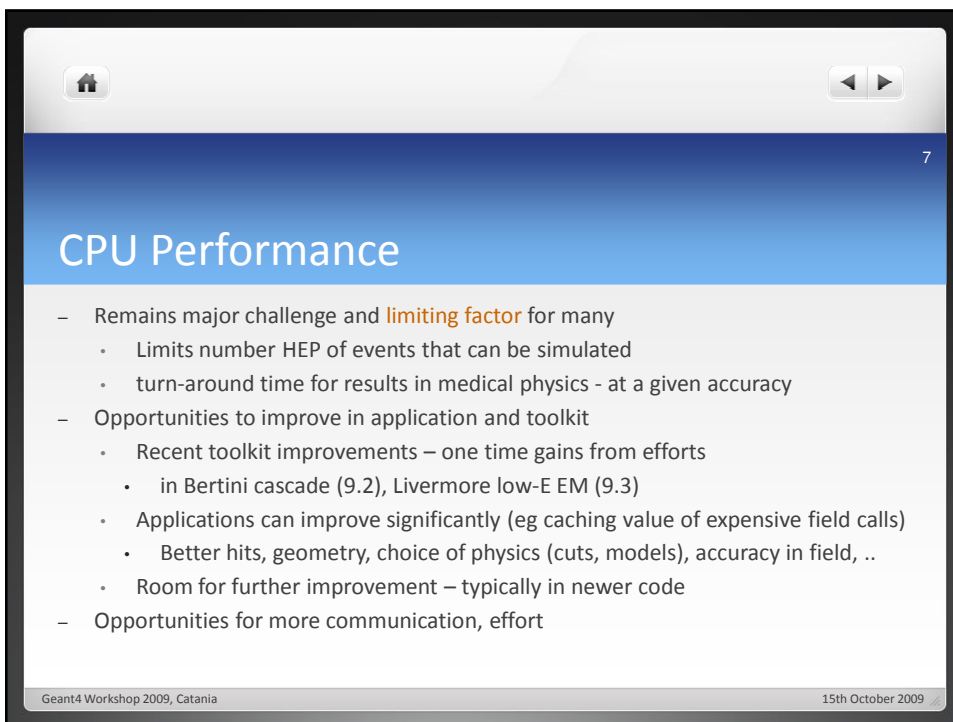
4

LHC is about to start

- Extra emphasis in 2009 – again!
- Geant4 successfully used in ATLAS, CMS, LHCb
 - It is the production simulation (since 2004)
 - Also ALICE is testing – with a view towards use
- Existing and new challenges:
 - Energy response issue – and others
 - Fix/improve transition between hadronic models
 - Understand/address differences between models, physics lists
- Many HEP contributions in User sessions

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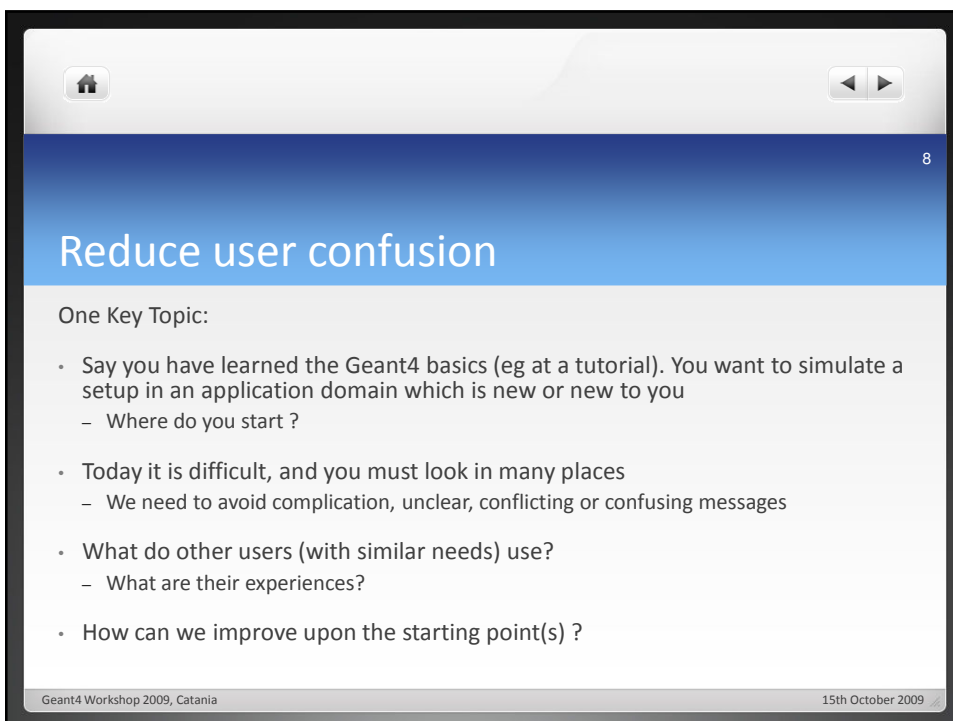


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CPU Performance

- Remains major challenge and **limiting factor** for many
 - Limits number HEP of events that can be simulated
 - turn-around time for results in medical physics - at a given accuracy
- Opportunities to improve in application and toolkit
 - Recent toolkit improvements – one time gains from efforts
 - in Bertini cascade (9.2), Livermore low-E EM (9.3)
 - Applications can improve significantly (eg caching value of expensive field calls)
 - Better hits, geometry, choice of physics (cuts, models), accuracy in field, ..
 - Room for further improvement – typically in newer code
- Opportunities for more communication, effort

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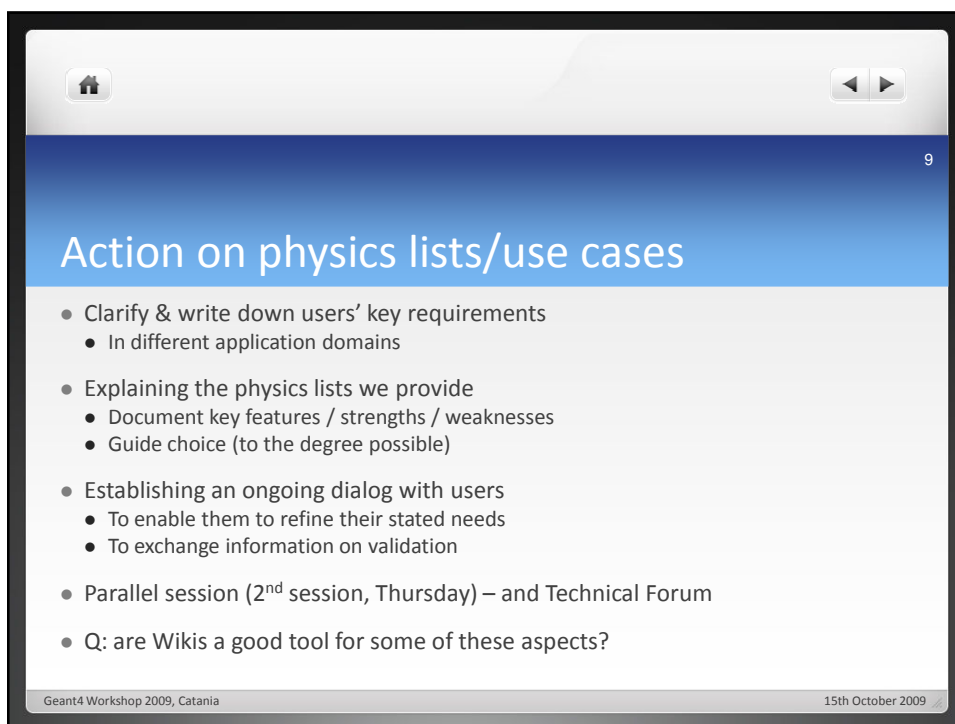
Reduce user confusion

One Key Topic:

- Say you have learned the Geant4 basics (eg at a tutorial). You want to simulate a setup in an application domain which is new or new to you
 - Where do you start ?
- Today it is difficult, and you must look in many places
 - We need to avoid complication, unclear, conflicting or confusing messages
- What do other users (with similar needs) use?
 - What are their experiences?
- How can we improve upon the starting point(s) ?

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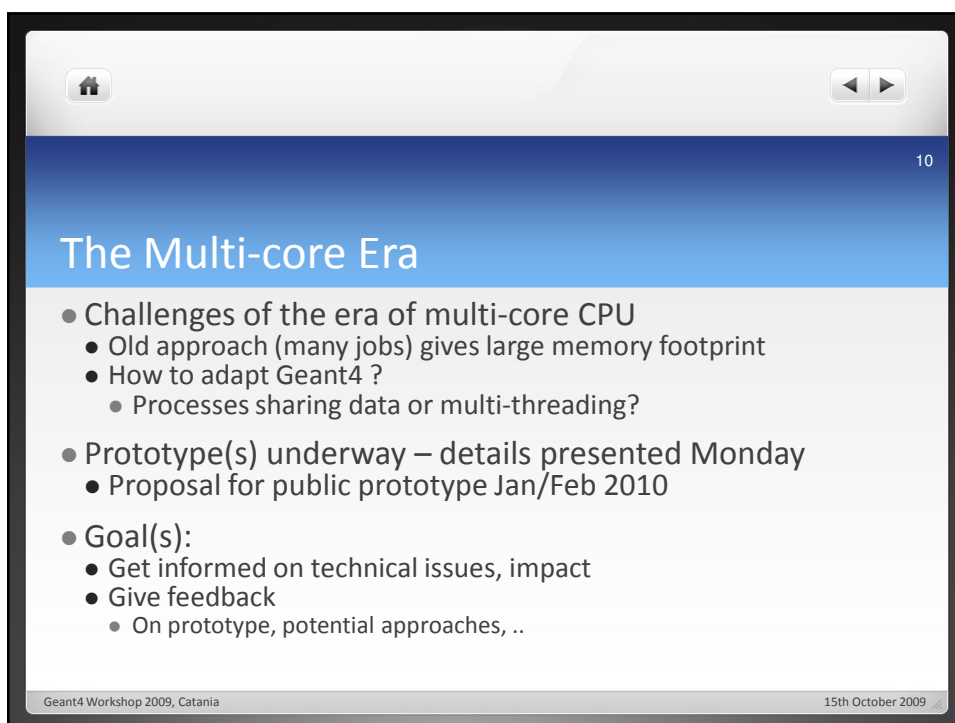


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Action on physics lists/use cases

- Clarify & write down users' key requirements
 - In different application domains
- Explaining the physics lists we provide
 - Document key features / strengths / weaknesses
 - Guide choice (to the degree possible)
- Establishing an ongoing dialog with users
 - To enable them to refine their stated needs
 - To exchange information on validation
- Parallel session (2nd session, Thursday) – and Technical Forum
- Q: are Wikis a good tool for some of these aspects?

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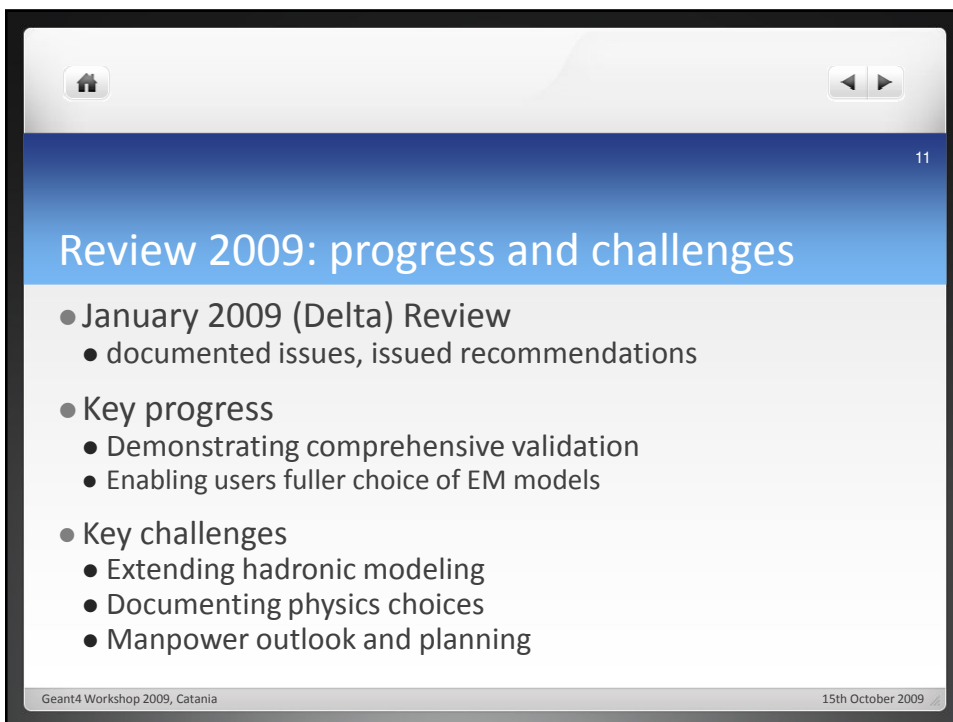


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The Multi-core Era

- Challenges of the era of multi-core CPU
 - Old approach (many jobs) gives large memory footprint
 - How to adapt Geant4 ?
 - Processes sharing data or multi-threading?
- Prototype(s) underway – details presented Monday
 - Proposal for public prototype Jan/Feb 2010
- Goal(s):
 - Get informed on technical issues, impact
 - Give feedback
 - On prototype, potential approaches, ..

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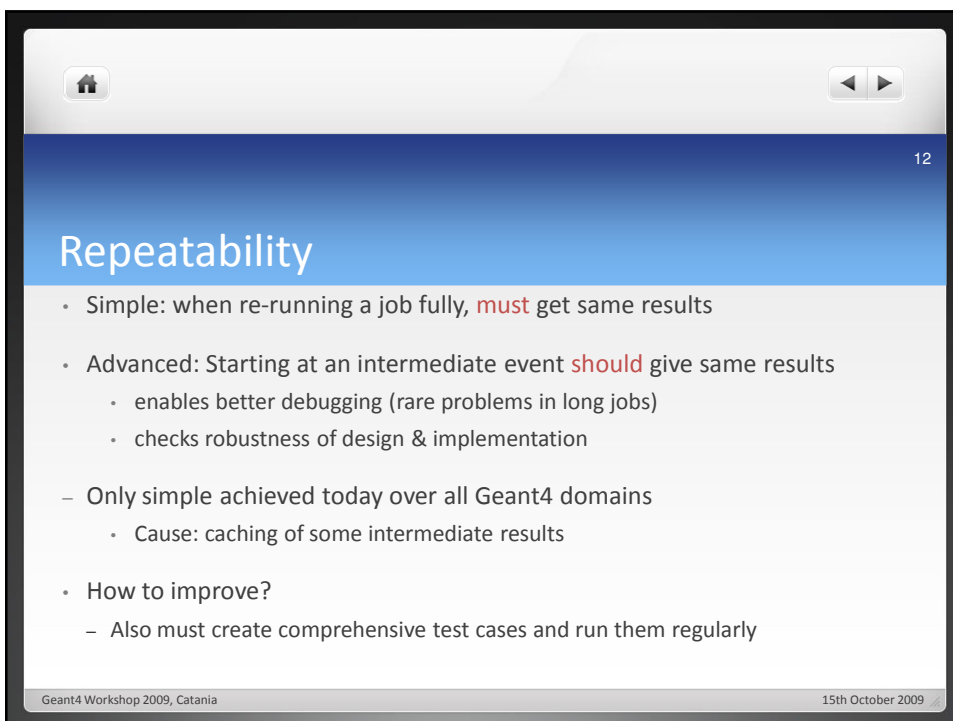


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Review 2009: progress and challenges

- January 2009 (Delta) Review
 - documented issues, issued recommendations
- Key progress
 - Demonstrating comprehensive validation
 - Enabling users fuller choice of EM models
- Key challenges
 - Extending hadronic modeling
 - Documenting physics choices
 - Manpower outlook and planning

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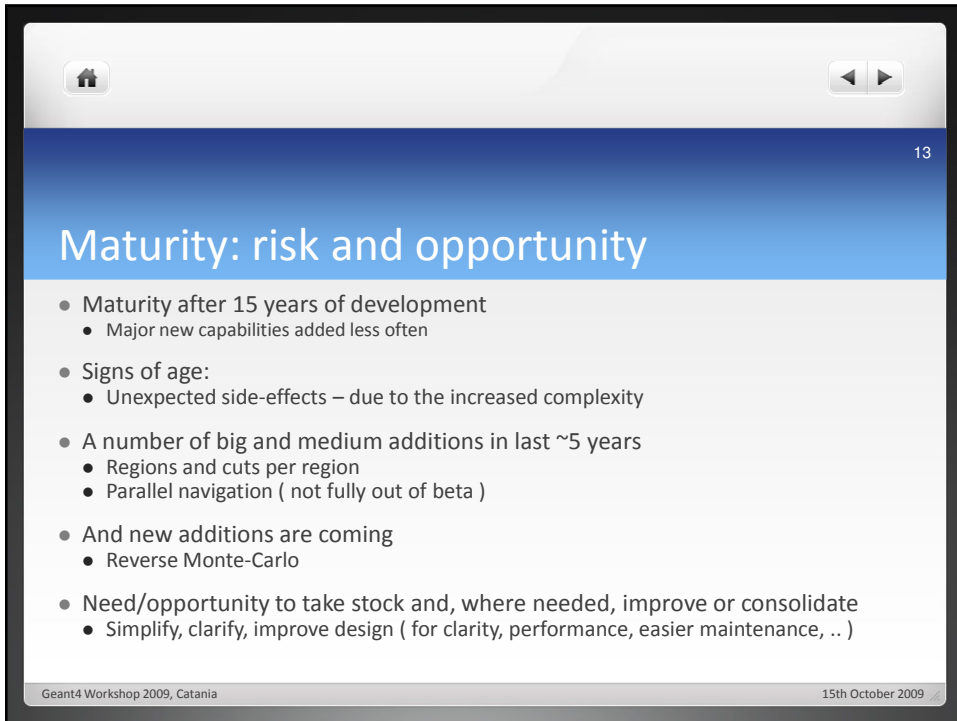


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Repeatability

- Simple: when re-running a job fully, **must** get same results
- Advanced: Starting at an intermediate event **should** give same results
 - enables better debugging (rare problems in long jobs)
 - checks robustness of design & implementation
- Only simple achieved today over all Geant4 domains
 - Cause: caching of some intermediate results
- How to improve?
 - Also must create comprehensive test cases and run them regularly

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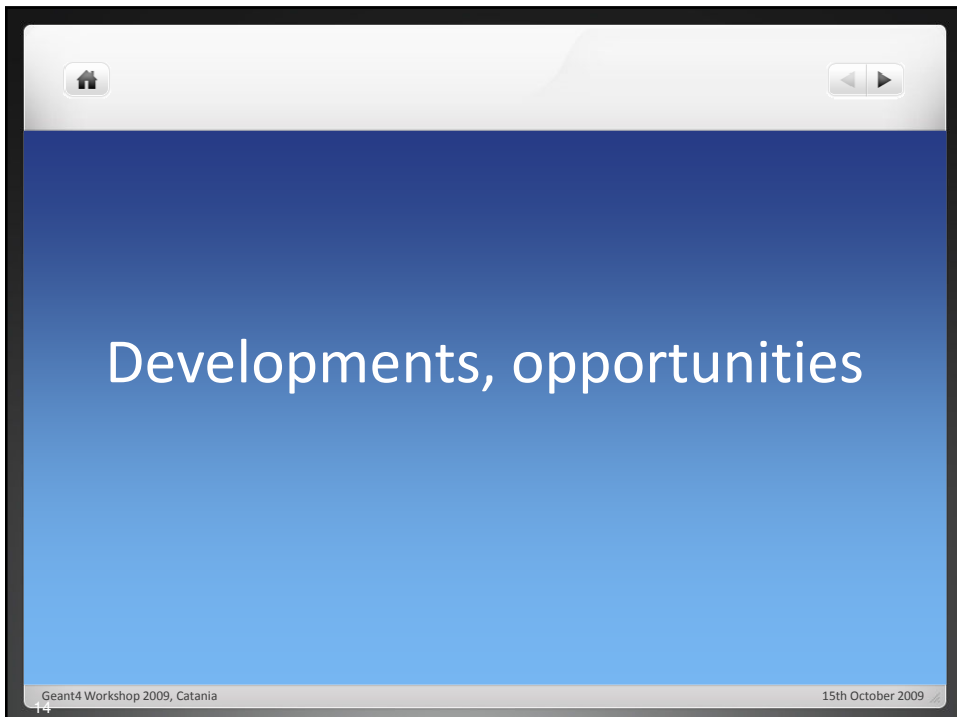


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Maturity: risk and opportunity

- Maturity after 15 years of development
 - Major new capabilities added less often
- Signs of age:
 - Unexpected side-effects – due to the increased complexity
- A number of big and medium additions in last ~5 years
 - Regions and cuts per region
 - Parallel navigation (not fully out of beta)
- And new additions are coming
 - Reverse Monte-Carlo
- Need/opportunity to take stock and, where needed, improve or consolidate
 - Simplify, clarify, improve design (for clarity, performance, easier maintenance, ..)

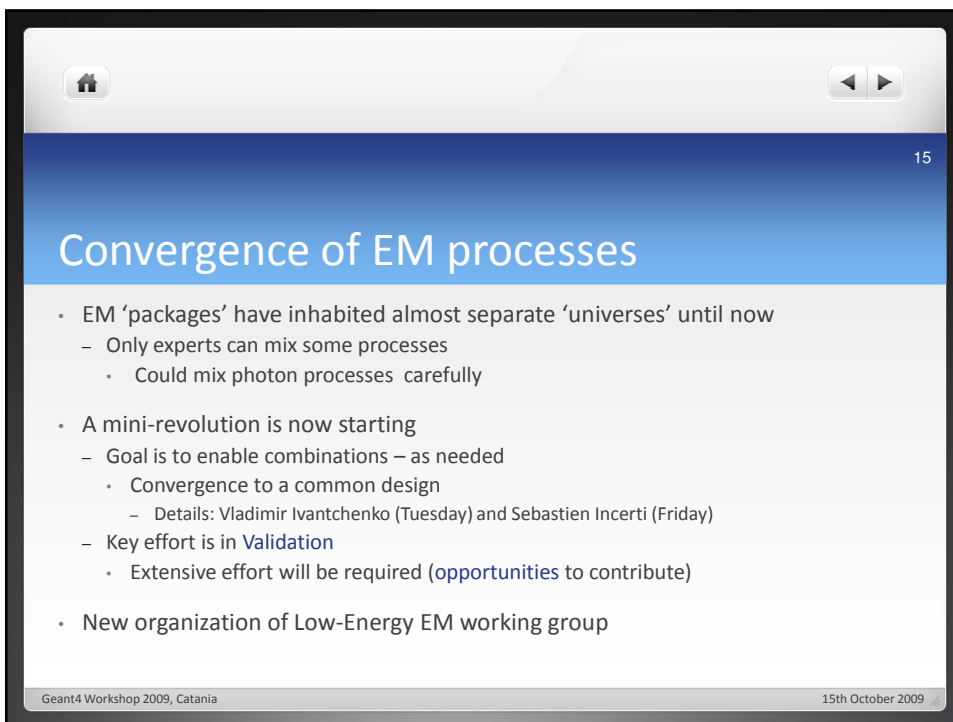
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Developments, opportunities

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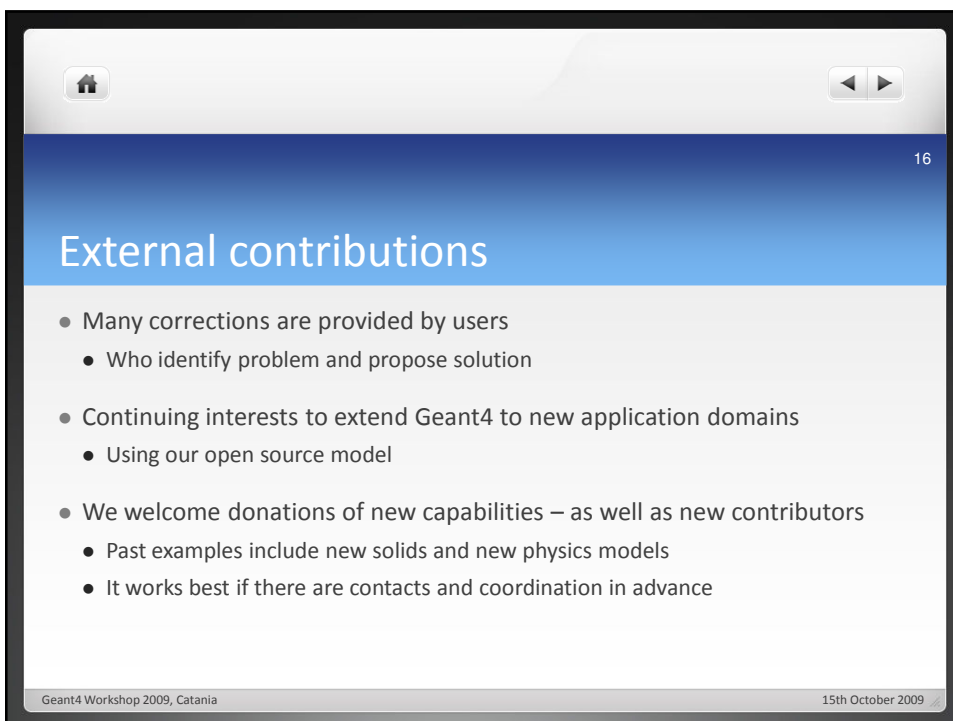


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Convergence of EM processes

- EM 'packages' have inhabited almost separate 'universes' until now
 - Only experts can mix some processes
 - Could mix photon processes carefully
- A mini-revolution is now starting
 - Goal is to enable combinations – as needed
 - Convergence to a common design
 - Details: Vladimir Ivantchenko (Tuesday) and Sebastien Incerti (Friday)
 - Key effort is in **Validation**
 - Extensive effort will be required (**opportunities** to contribute)
- New organization of Low-Energy EM working group

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External contributions

- Many corrections are provided by users
 - Who identify problem and propose solution
- Continuing interests to extend Geant4 to new application domains
 - Using our open source model
- We welcome donations of new capabilities – as well as new contributors
 - Past examples include new solids and new physics models
 - It works best if there are contacts and coordination in advance

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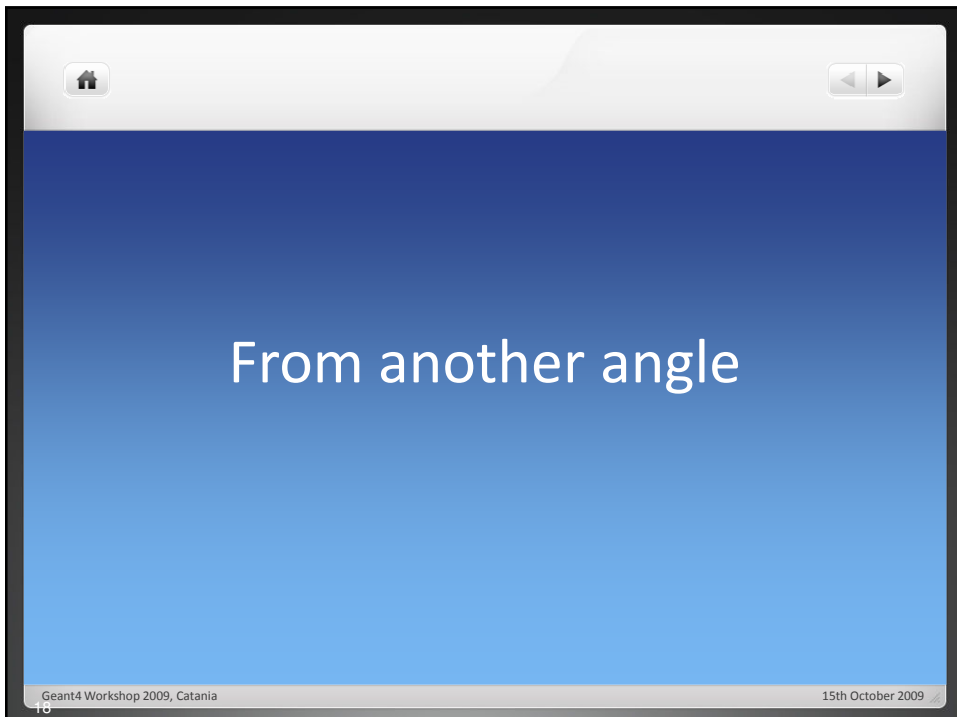


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Workshop Themes

- Overall – many are topics for discussion sessions or Technical Forum
 - Improving application performance, including Geant4 performance
 - Physics: validating and improving (models, mixing)
 - Explaining physics lists (reducing confusion)
 - How to provide a basic service and involve users to extend it?
 - Informing about ongoing improvements, developments
- Internal
 - Assessing system integration testing & improving Multi-core
 - Preparing assessment, revision of architecture

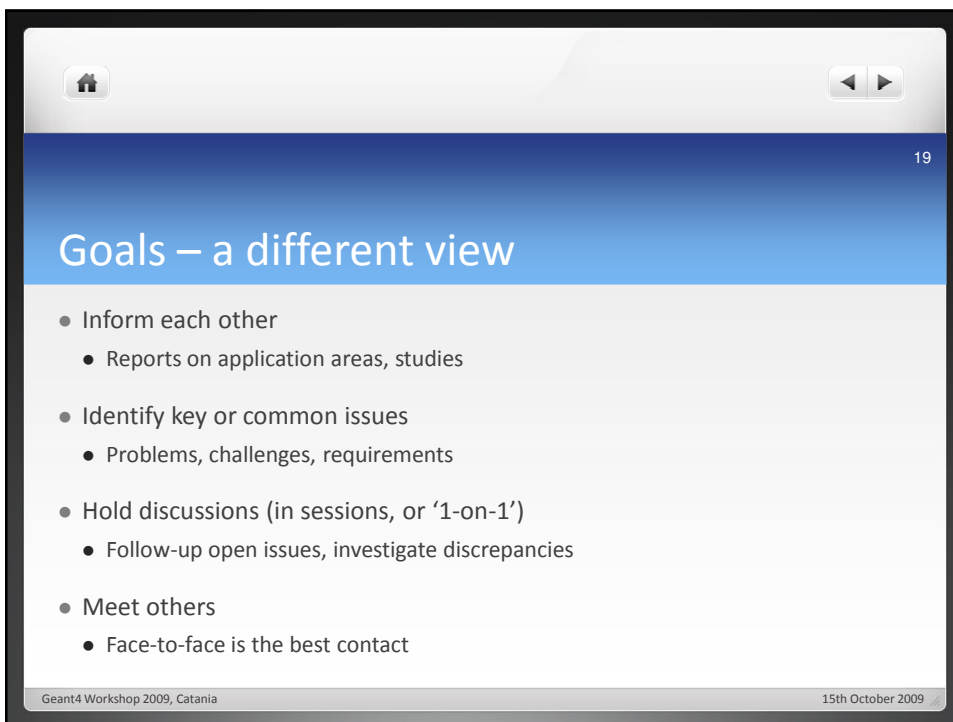
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From another angle

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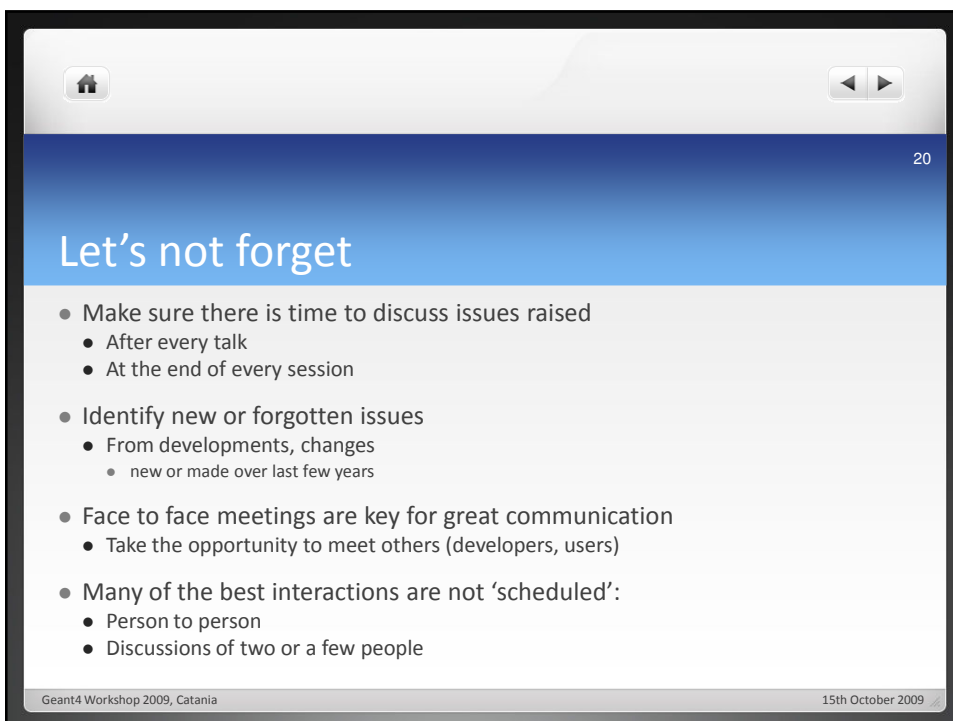


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Goals – a different view

- Inform each other
 - Reports on application areas, studies
- Identify key or common issues
 - Problems, challenges, requirements
- Hold discussions (in sessions, or '1-on-1')
 - Follow-up open issues, investigate discrepancies
- Meet others
 - Face-to-face is the best contact

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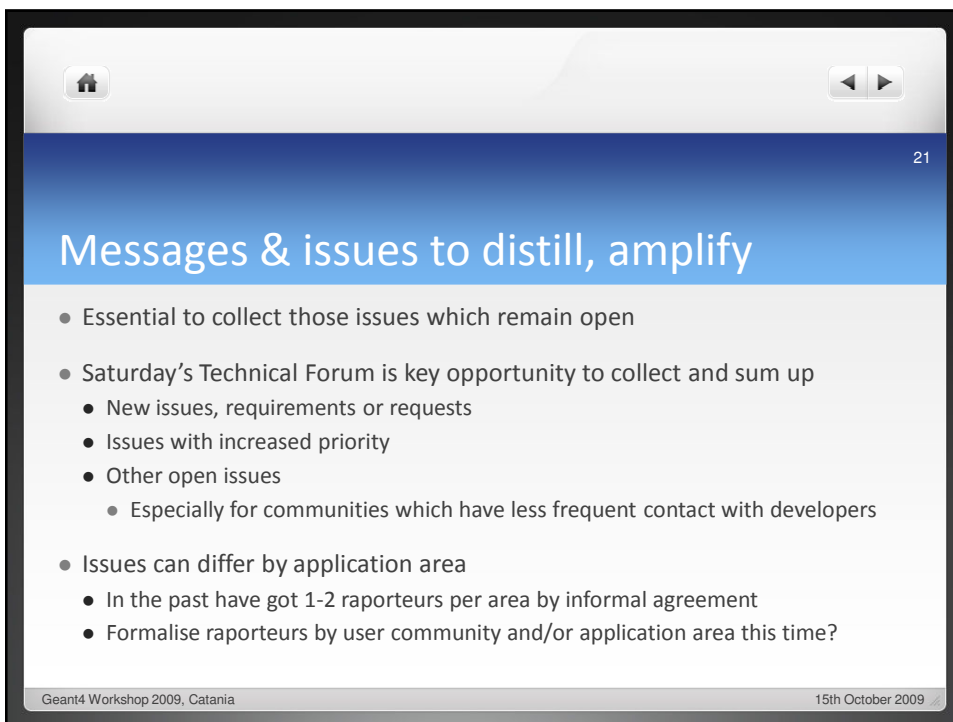


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Let's not forget

- Make sure there is time to discuss issues raised
 - After every talk
 - At the end of every session
- Identify new or forgotten issues
 - From developments, changes
 - new or made over last few years
- Face to face meetings are key for great communication
 - Take the opportunity to meet others (developers, users)
- Many of the best interactions are not 'scheduled':
 - Person to person
 - Discussions of two or a few people

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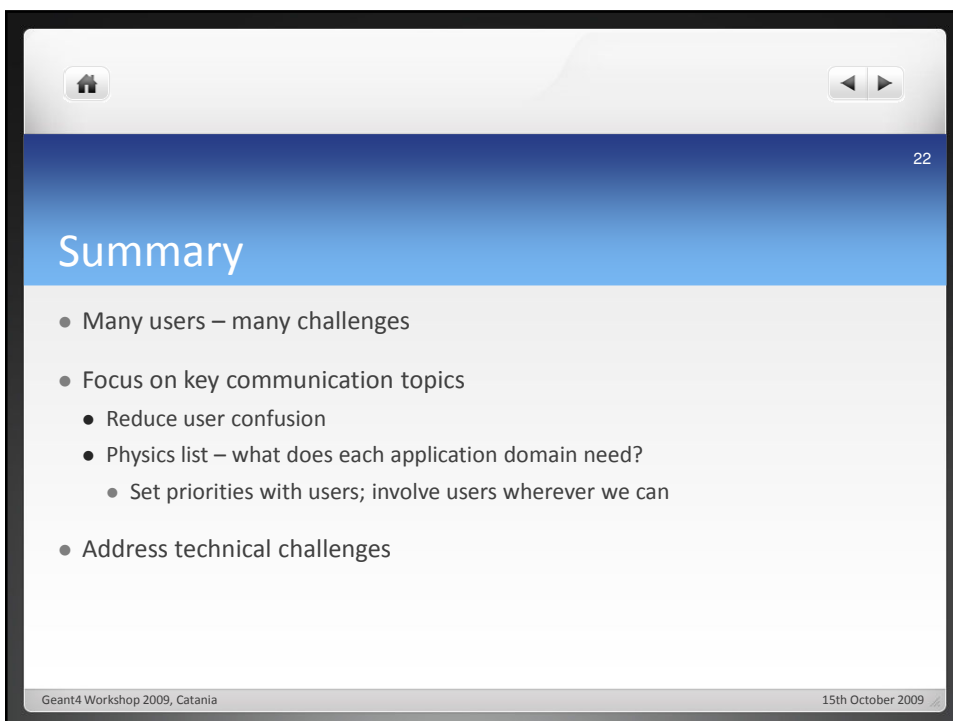


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Messages & issues to distill, amplify

- Essential to collect those issues which remain open
- Saturday's Technical Forum is key opportunity to collect and sum up
 - New issues, requirements or requests
 - Issues with increased priority
 - Other open issues
 - Especially for communities which have less frequent contact with developers
- Issues can differ by application area
 - In the past have got 1-2 rapporteurs per area by informal agreement
 - Formalise rapporteurs by user community and/or application area this time?

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Summary

- Many users – many challenges
- Focus on key communication topics
 - Reduce user confusion
 - Physics list – what does each application domain need?
 - Set priorities with users; involve users wherever we can
- Address technical challenges

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