

# Physics Software Coordination

SCAP 2020 - January 2021  
Alex Olivas - IceCube Software Coordinator

# Improvements - 2018-6

**Biweekly Calls** - Happen fairly regularly (15 calls in 2020 - most in last 5 years). Cancellations due to lack of agenda items, holidays, and collaboration meetings. Also included public call for agenda items one week prior and collected through the week. Automatic Slack reminders sent to the #software channel. **Improved Upgrade/Gen2 coordination starting this year.**

**Code Sprints** - Theme has been ticket resolution over the last year. Historically low number of open tickets. **Future plans to track and report critical ticket lifetimes in quarterly reports.**

**Releases** - 4 seasonal releases in 2020 with subsequent incremental releases. In 2019, the first full 'combo' release took longer than expected, but we had two incremental simulation releases that year. **Developed a 3-week plan from sprint to release.**

**PR Reviews** - Migrating to GitHub is still in-progress. We reached a significant milestone on the development model and policy. **Working on a timely PR model, which will be a challenge for us - basing this on M&O L3s and WG Tech Leads. Working on modernizing C++ coding standards.**

**Bootcamps** - Alternating Strike Team leadership between Olivas, Diaz Velez, Meagher, Schultz, and La Dieu. Each leader will be in charge of the seasonal bootcamp topic. Each leader signs up for one season. C++ refresher bootcamp in the works for Winter 2021. All collaboration members are welcome to join.

- Winter 2021 - A. Olivas (Software Coordinator) "C++ Refresher and Concurrency"
- Spring 2021 - D. Schultz (Production Software)
- Summer 2021 - J.C. Diaz-Velez (Simulation L3)
- Fall 2021 - D. la Dieu (Infrastructure L3)

# Physics Software Priority Matrix

Many of the "Must Do" projects have been high priority for 3-5 years.

Must Do

Should Do

Could Do

	Must Do	Should Do	Could Do
core	GitHub Migration DevOps Modernization Resource Utilization Concurrency Support	'combo' Containers	IceTray Paper Open Source 'combo'
sim	Triggered CORSIKA Continuous Benchmark/Validation SimProd Monitoring LeptonWeighter	ppc/clsim systematics	RNG Review/Cleanup DAQ/Sim Full-Circle Tests DOM Oversizing
reco	Retire ipdf (Spring 2021)	photospline2	
filt		L1/L2 Refactor(Pass3)	

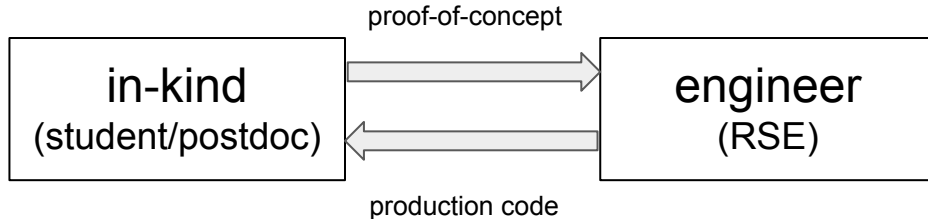
# Development

Great contributions from in-kind resources, but on long timescales.

Increasing software complexity and therefore increasing technical debt.

Decrease in professional maintenance resources.

Professionals can help manage, train, and support in-kind resources.



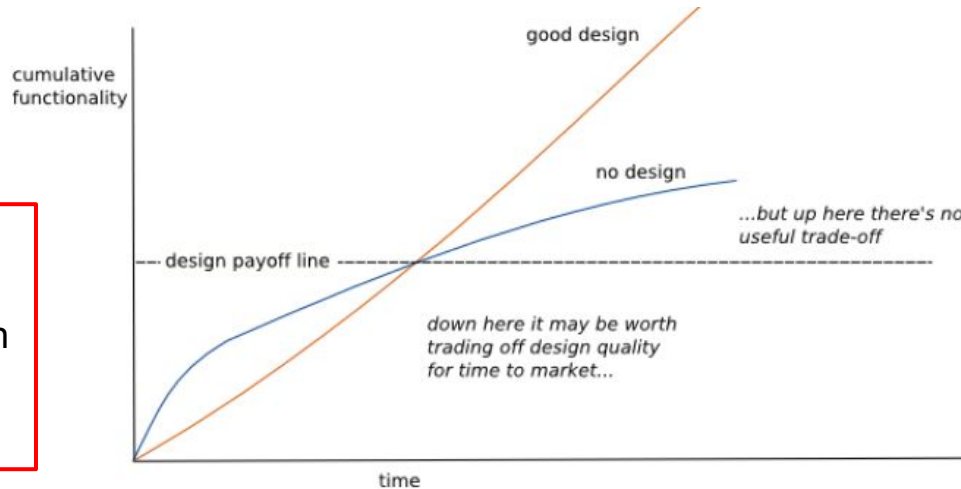
Investments in education (bootcamps) by engineers reduces long term maintenance costs.

# Timescales

## Collaborator Timescale ~3 years.

- Need feature development timescale ~1 year to be useful for career development/advancement.
- Ideally should be robust for decades.

Students and postdocs under pressure to publish work on short timescales.



Quality software engineers, who focus on the long term, can be an asset to a decade-scale observatory.

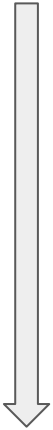
<https://martinfowler.com/bliki/DesignStaminaHypothesis.html>

In industry the pressure comes from time-to-market. In academia it's time-to-publication.

# Risks

Likelihood

Low



High

## Publication Retraction

- Hasn't happened yet, but it is a concern
- Damages IceCube's reputation

## Lower Quality Analysis

- Analyses that suffer from low-statistics simulation background need to get creative

## Delayed Publications (1 -> 5 years)

- This has happened unfortunately

## Wasting Resources

- We have plenty of experience.
- We should try to minimize this.

Damage

High



Low

# Physics Production Software

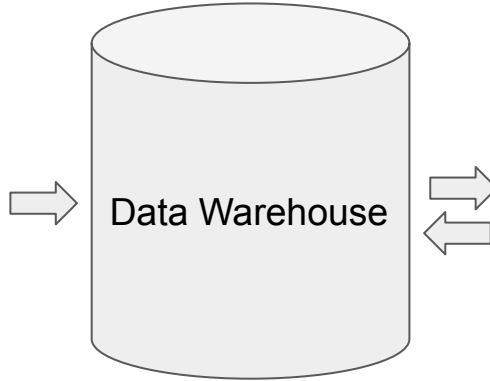
This illustrates why we need an increase in resources for physics software support.

\*IceTray is 15 years old. It will be 25+ years old through Gen2.

## Real Data

- 15 Engineers
- Most full-time
- 100 Nodes
- 2 OSes
- Static Detector
- Highly Controlled Environment

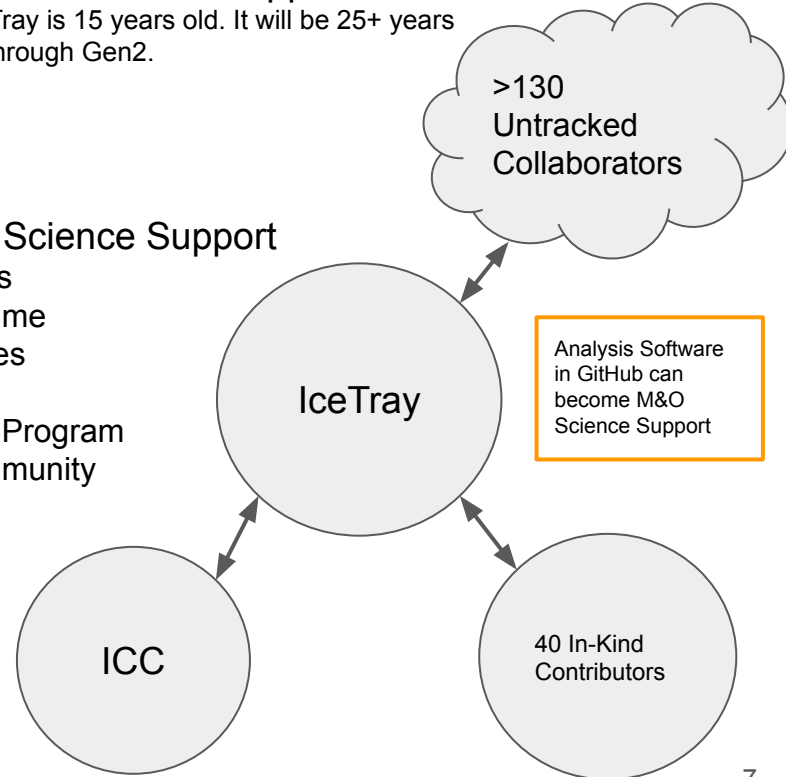
\*Pre-Upgrade. Both sides will increase in complexity with the Upgrade and Gen2.



Most data in the DW is in I3File format. Long-term maintenance of our serialization library is a concern/challenge.

## Simulation and Science Support

- 7 Engineers
- Most part-time
- 10's k Nodes
- 6-9 OSes
- Expanding Program
- Entire Community



# NSF 5-year Proposal

## Software Engineers - Roles and Responsibilities

- Bug Fixes - Rapid, short timescale work.
- Feature Development - Longer projects on month-year timescales.
- Research - Investigating future technologies with an eye on productivity.
- Education - Teaching collaborators and fellow engineers (help manage technical debt).

How time is allocated between each is going to depend, but there's a minimum threshold at which effort is ineffective. For example, someone who can dedicate only 10% of their time can't do all of these well and needs to choose which to focus on. **There's an unspoken in-kind/volunteer efficiency factor as well.**



# NSF 5-year Proposal

## Software Engineers - Roles and Responsibilities

- Bug Fixes - Rapid, short timescale work.
- Feature Development - Longer projects on month-year timescales.
- Research - Investigating future technologies with an eye on productivity.
- Education - Teaching collaborators and fellow engineers (help manage technical debt).

In-progress : Tracking and managing with proper PM tools (e.g. smartsheet), both in-kind and professional RSE.

## Proposal - 5 New Hires in M&O

- Production Workflow - IceProd, Pyglidein, grid services, etc...
- IceTray Core - Visualization, framework, I/O serialization, ML formats, etc...
- Heterogeneous Computing - GPU, TPU, FPGA, APU, etc...
- Simulation - Generators, detector simulation, trigger simulation, RNGs, etc...
- Reconstruction - Resource optimization in production environments

Software Engineers

Research Software Engineers

# Conclusion

We've supported a successful experiment for more than a decade.

- Decoupled Modular Design - We do have project dependency creep.
- Coding Standards - Need to modernize for new C++ standards.
- Code Reviews - Backlog of regular reviews. PRs are going to make this more challenging.
- Tests - Decent test coverage. Unknown quality. Exploring better tools.
- Documentation - Decent coverage. Poor docs only help those who don't need them.

The physics scope, **with a static detector**, has expanded in that time.

We've accumulated significant technical debt and need and increase of resources to support the expanding detector through the Upgrade and bridge to Gen2.

**Q: Is our request for more resources reasonable?**

# BACKUP SLIDES

# Software - Key Performance Metrics

Performance Metric	Objective	Achieved (PY4)	Description
Releases	4	2	Quarterly releases meeting minimal quality standards.
Test Line Coverage	> 66%	56%	Fraction of lines of code executed in the test suite.
CI uptime	> 90%	N/A	Fraction of days all tests pass on all supported platforms.
CD uptime	> 50%	44%	Fraction of days full-chain tests pass on single platform.
Critical Ticket Lifetime	90% < 1 mo.	65%	Fraction of tickets resolved for a given timescale.

Table 8: Physics software (WBS 2.5) performance metrics.

Test coverage reports are now bundled with release documentation.

Cicada reports unit test results to slack (#release-prep). Failures are reported to #software.

There's a lot of room for improvement here.

- Critical tickets are "blocker" and "critical"
- "major" and "normal" resolved before the next release.

## Combo Stable Advancements

There's a lot of room for improvement here.

- Benchmark comparisons now in production
- Unit tests must pass
- Expect stable container builds soon.

# Fall 2020 Release Process

SEPTEMBER 2020						
SUN	MON	TUE	WED	THU	FRI	SAT
No New Projects		1	2	3	4	5 No New Feature
6	7	8	9	10	11	12
Candidate Open to Bug Fixes ONLY						
13	14	15	16	17	18	19
20	21	22 Release	23	24	25	26
27	28	29	30			

Holidays and Observances: 7: Labor Day

www.wiki-calendar.com

## 2 Week Testing Phase

### Deadlines

- **Aug 30th** - No new projects
- **Aug 5th** - No new features
- **Aug 7th** - Generate prod samples
  - NuGen
  - CORIKA
  - MuonGun
- **Aug 11th (18th)** - Phone Call
- Release when all criteria, including QA checks.
  - Tests pass on supported platforms
  - Cicada histograms comparisons

# Human Resource Allocation

## Management Wishlist Item

Decide on a decent metric, track, and use for resource allocations.

Name	Project Count	FTE Estimate <small>*Code Contributions Only</small>	Maintenance Burden	Technical Debt/ Software Entropy
Core	23	0.25	High	
Simulation	19	0.50	Very High	
Reconstruction	23	0.10	Medium	
Filtering	6	0.10	Medium	
Oscillations	3	0.05	Low	
Nu Sources	5	0.05	Medium	
BSM	4	0.05	Medium	
Cosmic Ray	13	0.10	High	
Diffuse	9	0.05	Medium	
Science Support	2	0.00	Unknown	