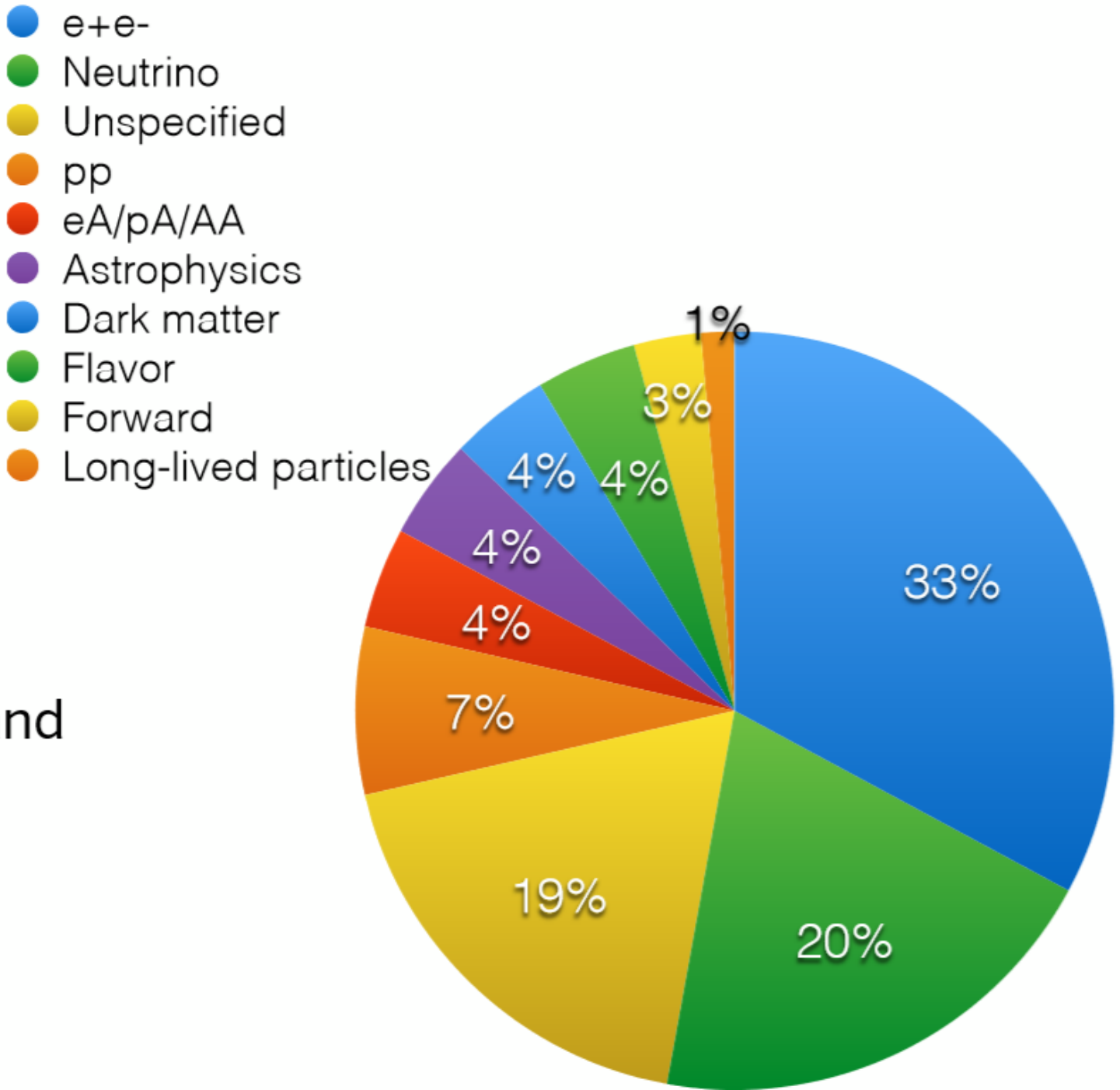
Instrumentation Frontier
IF06 – Calorimetry – Snowmass parallel session
Tuesday, July 19, 2022

Welcome to Instrumentation Frontier TG 6 – Calorimetry!

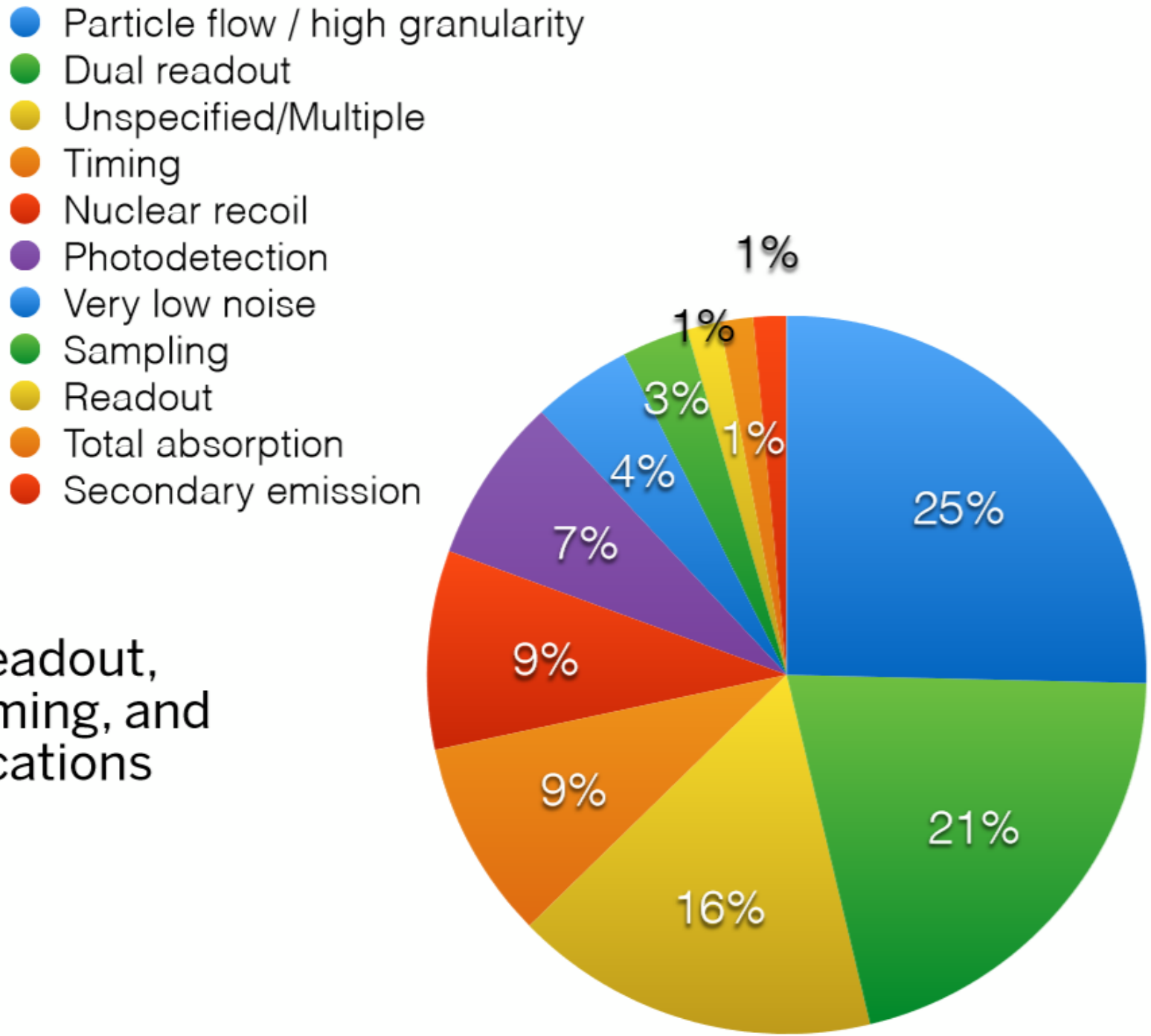
- Short introduction – how we got here

- Four main calorimetry topics – short introductory talk for each followed by discussion.

65 LOIs Submitted



- e^+e^-, generalized R&D, and neutrino applications dominate



- Particle flow, dual readout, generalized R&D, timing, and nuclear recoil applications dominate

Organize LOIs into groups for White Paper planning

Collider related

Particle Flow

Title	Contact	File	e	Experiment	Material	Physics
e+e-						
Belle II detector upgrades	sevahsen@hawaii.edu	IF2_IF7_IF3_IF4_IF5_IF6-056.pdf	Multiple	Belle II	Plastic scintillator	e, gamma ID
Detector optimisation and detector technology R&D for the CLIC detector and for the CLD detector of FCC-ee	mbenoit@bnl.gov	IF3_IF6_Mathieu_Benoit-188.pdf	PF	CLIC, CLD	Si, scintillator	e+e-
SiD	A.White	IF3_IF6-EF1_EF4_Andy_White,_Marcel_Stanitzki-027.pdf	PF	SiD/ILC	Si, scintillator	e+e-
Advanced GEM detectors for future collider experiments	A.Colaleo (Bari)	IF5_IF6-EF4_EF0_COLALEO-068.pdf	Sampling	FCC, muon collider	GEM	e+e-, mu+mu-, hh
Development of highly granular scintillator strip electromagnetic calorimeter	wataru@icepp.s.u-tokyo.ac.jp	IF6_IF0_CALICE-058.pdf	PF	CALICE	Scintillator	e+e-
CALICE R&D for a highly granular silicon tungsten electromagnetic calorimeter, SiW-ECAL	Vincent.Boudry@llr.in2p3.f	IF6_IF0_CALICE-077.pdf	PF	CALICE	Si	e+e-
CALICE R&D for compact readout systems for highly granular calorimeters	katja.krueger@desy.de	IF6_IF0_CALICE-082.pdf	PF	CALICE	Asic	e+e-
Digital hadron calorimetry	yasar-onel@uiowa.edu	IF6_IF0_Yasar_Onel-048.pdf	PF	ILC/CLIC/FCC	RPC	e+e-
High-granularity crystal calorimetry	S.Eno	IF6_IF0_Yong_Liu-064.pdf	PF	ILC/CLIC/FCC	Crystals	e+e-
CALICE R&D for compact readout systems for highly granular calorimeters	katja.krueger@desy.de	IF6_IF0-026.pdf	Readout			e+e-
Particle flow calorimeters for the CEPC	liujianb@ustc.ac.cn	IF6_IF0-176.pdf	PF	CEPC	Si, scintillator	e+e-
Fast optical photon transport at GEANT4 with dual-readout calorimeter at future e+e- colliders	hdyoo@yonsei.ac.kr	IF6_IF0-CompF2_CompF0_Hwidong_Yoo-060.pdf	DRO	CEPC, FCCee	Optical fibers	e+e-
Tau reconstruction and identification using machine learning technique with dual-readout calorimeter at future e+e- colliders	hdyoo@yonsei.ac.kr	IF6_IF0-EF1_EF0_Hwidong_Yoo-063.pdf	GEANT, DRO	CEPC, FCCee	Optical fibers	e+e-
pp						
The High Granularity Calorimeter upgrade to the Compact Muon Solenoid detector	ryohay@fsu.edu	IF6_IF0-165.pdf	PF	CMS	Si, scintillator	pp
Advanced optical instrumentation for ultra-compact, radiation hard EM calorimetry applications	rruchti@nd.edu	IF6_IF4-EF1_EF4-102.pdf	Sampling, photodetection	FCChh	Scintillator	pp
Forward region of future colliders, high intensity and low earth orbit cosmic frontiers	irfield.edu	IF6_IF9_David_R_Winn-036.pdf	Photodetection	any	PMT, dynodes	

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IF06 – Calorimetry – White Papers

- **Collider**

1. **Particle Flow Calorimetry for Future Colliders**
   - Katja Kruger (DESY), Randi Ruchti (Notre Dame)
   - Submitted: https://arxiv.org/abs/2203.15138

2. **Dual Readout Calorimetry for Future Colliders**
   - Sarah Eno (Maryland), Franco Bedeschi (INFIN-Pisa),Nural Akchurin (Texas Tech)
   - Submitted: https://arxiv.org/abs/2203.04312

3. **Precision Timing for Collider Experiment based Calorimetry**
   - Frank Simon (MPP Munich), Sergei Chekanov (ANL)
   - Submitted: https://arxiv.org/abs/2203.07286

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IF06 – Calorimetry – White Papers – cont.

- **Materials**

6. Materials for Future Calorimeters

- Ren-Yuan Zhu (Caltech), Minfang Yeh (BNL)
- Submitted: https://arxiv.org/abs/2203.07154

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IF06 – Calorimetry – White Papers – Summary

Completed first draft and Exec Summary. Sent to community for comment

Calorimetry

A. White, M. Yeh, R. Yohay

(contributors from the community)

6.1 Calorimetry: Executive Summary

The IF06 Calorimetry group has considered major issues in present and future calorimetry. Input has been taken from a series of talks, group discussions, LOIs, and White Papers. Here we report on two major approaches to calorimeter systems - Particle Flow and Dual Readout, the critical extra dimension of precision timing, and the development of new materials for calorimeters.

The potential for precision timing at the 10ps level or better opens new possibilities for precise event reconstruction and the reduction of the negative effects of challenging experimental environments. Precise timing can directly benefit calorimetry in several ways ranging from detailed object reconstruction to the mitigation of confusion from pile-up. It can also lead to improved performance for both particle flow and duel readout-based calorimeters. Given these possible performance enhancements, the focus is now on the study of timing implementation both at the device level and the calorimeter system level. Successful implementation can lead to highly performant calorimeter systems well matched to the demands from both future physics

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8:00 AM → 12:00 PM **Instrumentation Frontier: IF6** 248 (MGH)

Conveners: Andy White (U. texas at Arlington), Minfang Yeh (Brookhaven National Laboratory), Rachel Yohay (Florida State University)

8:00 AM **Recap of the process (Calorimetry talks, LOIs, White Papers, Summary)** 20m

The IF06 session will consist of a short introductory talk followed by a discussion period - for each of the four main calorimetry subjec (Precise Timing, Dual-Readout, Particle Flow, and Materials)

Speakers: Andy White (U. texas at Arlington), Minfang Yeh (Brookhaven National Laboratory), Rachel Yohay (Florida State University)

8:20 AM **Precise timing** 50m

Summary of main points/highlights from WP/Summary
Critical issues, challenges, questions (10 min)
followed by discussion.

Speaker: Frank Simon (Max-Planck-Institute for Physics)

9:10 AM **Particle Flow** 50m

Summary of main points/highlights from WP/Summary
Critical issues, challenges, questions (10min) Katja Kruger
"High granularity MAPS ECal" Jim Brau
followed by discussion.

Speakers: James Brau (Univ. of Oregon), Dr Katja Kruger (DESY)

10:00 AM **Dual-Readout** 50m

Summary of main points/highlights from WP/Summary
Critical issues, challenges, questions (10 min)
followed by discussion

Speaker: Sarah Eno (U. Maryland)

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10:50 AM **Materials for Calorimetry** 50m

Summary of main points/highlights from WP/Summary
Critical issues, challenges, questions
followed by discussion

Speaker: Renyuan Zhu (Caltech)

11:40 AM **General discussion** 20m

Speakers: Andy White (U. texas at Arlington), Minfang Yeh (Brookhaven National Laboratory), Rachel Yohay (Florida State University)