

# Introduction

2nd FACET-II Program Advisory Committee Meeting

V. Yakimenko

October 26, 2020



# FACET Celebration Party - April 2016





# FACET to FACET-II



## FACET: ARRA Funded Project \$14.6M + \$12M AIP

- CD-0 2008, CD-4 2012, Commissioning (2011)

### Experimental program (2012-2016)

- National user facility - externally reviewed program
- **Per year:** 8 months operation, 25 experiments, 150 Users

### Key Plasma WakeField Acceleration Milestones:

- ✓ Mono-energetic e<sup>-</sup> acceleration
- ✓ High efficiency e<sup>-</sup> acceleration (*Nature 2014*)
- ✓ First high-gradient e<sup>+</sup> PWFA (*Nature 2015*)
- ✓ PWFA injector (*Nature Phys. 2019*)

## FACET-II: MIE Project \$25.6M

- CD-0 2015, CD-4 *Dec.2020*, Commissioning (2020)

### Three stages:

- Photoinjector (e<sup>-</sup> beam only)
- *e<sup>+</sup> damping ring (e<sup>+</sup> or e<sup>-</sup> beams) (not funded)*
- *“sailboat” chicane (e<sup>+</sup> and e<sup>-</sup> beams) (not funded)*

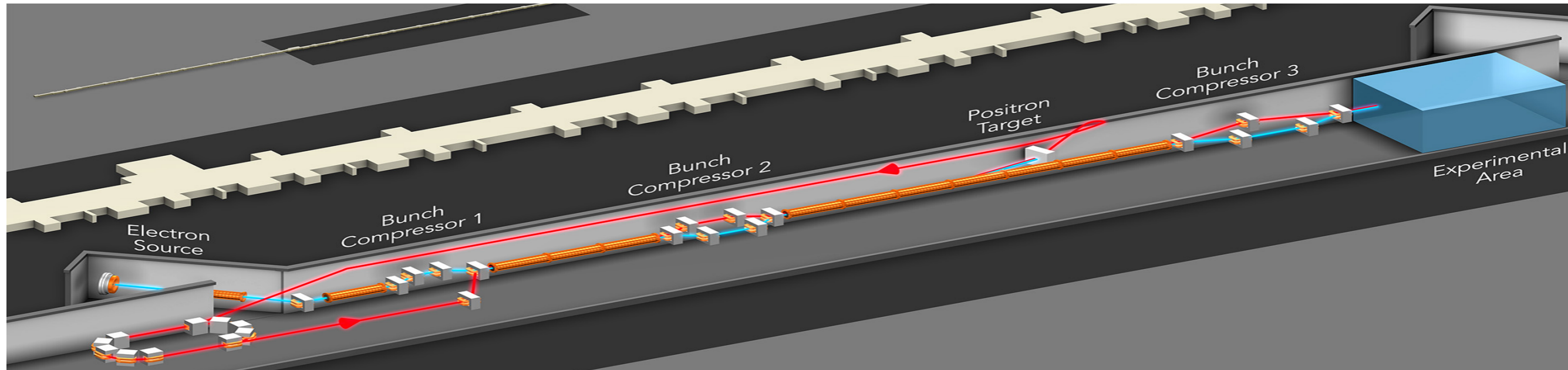
### Experimental program (2021-2026)

### Key Plasma WakeField Acceleration Milestones:

- High brightness beam generation, preservation, characterization
- Generation of high flux gamma radiation
- e<sup>+</sup> acceleration in e<sup>-</sup> driven wakes
- Staging challenges with witness injector

### Beam physics of ultra short bunches

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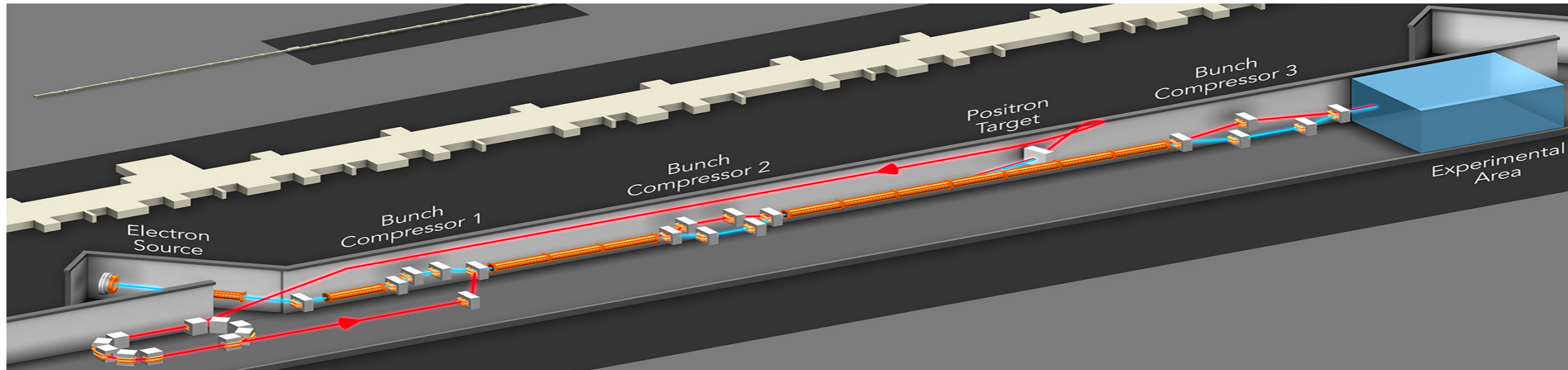
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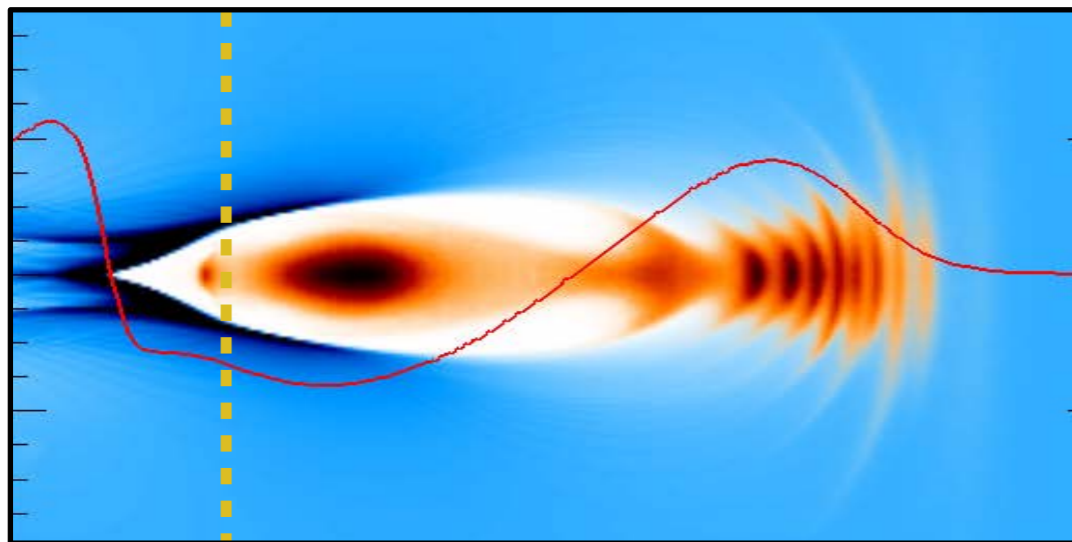
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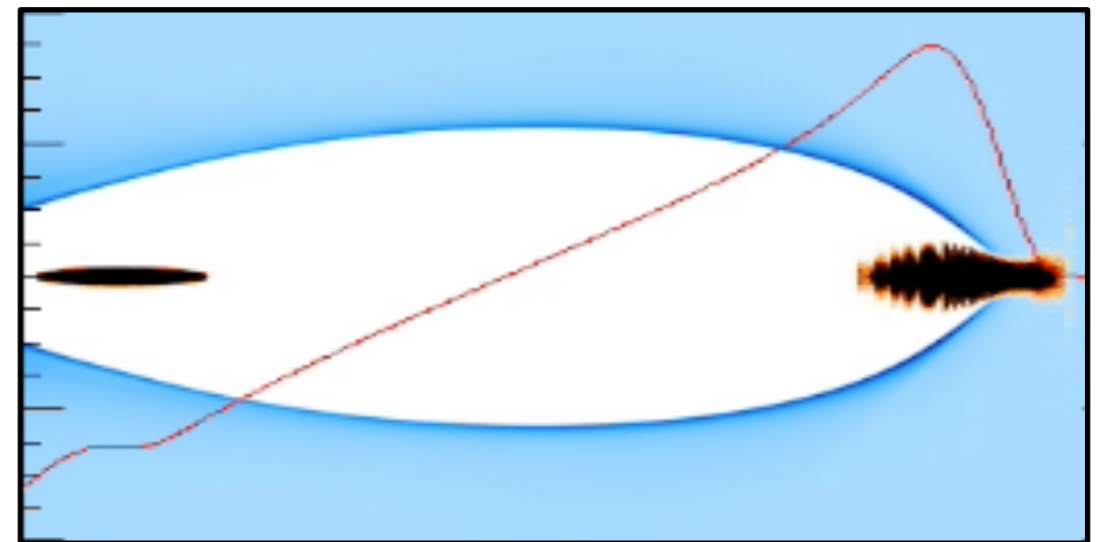
# FACET to FACET-II



PWFA simulations with **FACET** driver:



PWFA simulations with **FACET-II** driver:



Upgraded source (photoinjector) in FACET-II improves quality of the drive beam to support cleaner PWFA experiments as well as qualitatively new research programs



# FACET-II: 1st Program Advisory Committee Meeting



**35 proposals (for Stage 1 only) were reviewed at 1st PAC:**

- 7 received “Excellent” ranking
- 23 were ranked “Very Good” or “Good”
- 2 proposals were ranked “Fair”
- 3 were not ranked and are encouraged to resubmit

**Proposals represent:**

**Proposals with “Excellent” ranking:**

- Energy Doubling of Narrow Energy Spread Witness Bunch while Preserving Emittance with a High Pump-to-Witness Energy Transfer Efficiency
- Transverse wakefields and instabilities in PWFA
- Generation and Acceleration of Positrons at FACET II
- Optical visualization of beam-driven PWFA
- Trojan Horse-II
- Beam filamentation and bright Gamma ray Burst
- Probing Strong-field QED at FACET-II



FACET-II program is structured around 7 experiments with “Excellent” ranking



# PAC Agenda:



| <span>Monday</span> <span>Tuesday</span> <span>Wednesday</span> <span>Thursday</span> |   |                               |          |
|---|---|-------------------------------|----------|
| <b>Day 1: Monday, 26 October 2020</b>   |   |                               |          |
| <i>Facility Status</i>  |   |                               |          |
| Start Time  | Topic                                     | Speaker                       | Duration |
| 07:00   | <b>Executive Session</b>                  | Edda Gschwendtner (CERN)      | 30m      |
| 07:30   | Welcome                                   | Norbert Holtkamp (SLAC)       | 10m      |
| 07:40   | Meeting Structure, Exp. schedule          | Vitaly Yakimenko (SLAC)       | 10m      |
| 07:50   | Beam commissioning                        | Jerry Yocky (SLAC)            | 20m      |
| 08:10   | Experimental area and plans               | Mark Hogan (SLAC)             | 20m      |
| 08:30   | Remote user management                    | Christine Clarke (SLAC)       | 20m      |
| 08:50   | <b>Break</b>                              |                               | 15m      |
| <i>Upgrade Plans</i>  |   |                               |          |
| 09:05   | Experimental Laser                        | Brendan O'Shea (SLAC)         | 20m      |
| 09:25   | PB + diagnostics                          | Robert Ariniello (CU Boulder) | 20m      |
| 09:45   | Spectrometer diagnostics                  | Doug Storey (SLAC)            | 20m      |
| 10:05   | S20 chicane + Linearizer and Laser heater | Glen White (SLAC)             | 30m      |
| 10:35   | Q&A                                       | Vitaly Yakimenko (SLAC)       | 30m      |
| 11:05   | <b>Adjourn</b>                            |                               |          |



# PAC Agenda:



Monday Tuesday Wednesday Thursday

| Day 2: Tuesday, 27 October 2020 |   |                           |          |
|---------------------------------|---|---------------------------|----------|
| New Proposals                   |   |                           |          |
| Start Time                      | Topic   | Speaker                   | Duration |
| 07:00                           | <b>Executive session</b>  | Edda Gschwendtner (CERN)  | 20m      |
| 07:20                           | Ultra-solid Beams using Nanostructure Nanoplasmonic Wiggler and Accelerator   | Aakash Sahai (CU)         | 20m      |
| 07:40                           | Near-field-CTR-based self-focusing in beam-multifoil collisions: towards solid-density beams, extremely-dense gamma-ray pulses, and laserless SFQED | Matteo Tamburini (MPIK)   | 20m      |
| 08:00                           | E305nano (extension of E305scope) Feasibility studies of the FACET-II beam interaction with CNT materials   | Toshiki Tajima (UCI)      | 20m      |
| 08:20                           | Positron Acceleration in an Electron Beam-Driven Plasma Filament Wakefield  | Spencer Gessner (SLAC)    | 20m      |
| 08:40                           | Electron and positron acceleration in self-generated, thin, warm hollow plasma channels   | Thales Silva (I.S.T)      | 20m      |
| 09:00                           | Stable Positron Acceleration Mode in Hollow Plasma Channel Driven by an Asymmetric Beam   | Wei Lu (Tsinghua)         | 20m      |
| 09:20                           | <b>Break</b>  |                           | 20m      |
| 09:40                           | Two Stage Cascaded High-Transformer-Ratio Plasma Wakefield Accelerator  | Wei Lu (Tsinghua)         | 20m      |
| 10:00                           | Attosecond XUV/X-ray source driven by a plasma accelerator  | Agostino Marinelli (SLAC) | 20m      |
| 10:20                           | Relativistic doppler shift of coherent transition radiation   | Agostino Marinelli (SLAC) | 20m      |
| 10:40                           | Compressing FACET-II e-beam to hundreds of kA   | Yichao Jing               | 20m      |
| 11:00                           | Extreme Nonlinear Coherent Transition Radiation: dielectric response of materials to supercritical fields   | David Reis (SLAC)         | 20m      |
| 11:20                           | Neural network based tuning to exploit machine-wide sensitivities in pursuit of high beam quality   | Auralee Edelen (SLAC)     | 20m      |
| 11:40                           | <b>Executive Session</b>  | Edda Gschwendtner (CERN)  | 20m      |
| 12:00                           | <b>Adjourn</b>  |                           |          |



# PAC Agenda:



| Monday   | Tuesday   | Wednesday                 | Thursday |
|--|---|---------------------------|----------|
| <b>Day 3: Wednesday, 28 October 2020</b>           |   |                           |          |
| <b>Goals and Timeline for approval experiments</b> |   |                           |          |
| Start Time   | Topic   | Speaker                   | Duration |
| 07:00  | <b>Executive Session</b>  | Edda Gschwendtner (CERN)  | 20m      |
| 07:20  | E300: Energy Doubling of Narrow Energy Spread Witness Bunch while Preserving Emittance with a High Pump-to-Witness Energy Transfer Efficiency in a Plasma Wakefield Accelerator | Chan Joshi (UCLA)         | 15m      |
| 07:35  | E301: Tailored Plasma Source for Emittance Preservation in Plasma Wakefield Acceleration and High-Brightness Plasma-Injected Beams  | Mike Litos (CU Boulder)   | 15m      |
| 07:50  | E305/E303: Beam filamentation and bright gamma-ray bursts/Generation and Acceleration of Positrons at FACET II  | Sebastien Corde (LOA)     | 15m      |
| 08:05  | E304: Downramp Trapping in PWFA for generating low emittance beams  | Chaojie Zhang (UCLA)      | 15m      |
| 08:20  | E315: Plasma Afterglow Attosecond Metrology   | Bernhard Hidding (Strath) | 15m      |
| 08:35  | E320: Probing Strong-field QED at FACET-II  | Sebastian Meuren (SLAC)   | 15m      |
| 08:50  | E321: Dielectric wakefield acceleration at GV/m gradients   | James Rozensweig (UCLA)   | 15m      |
| 09:05  | <b>Break</b>  |                           | 30m      |
| 09:35  | E323: A post-plasma longitudinal bunch diagnostic for FACET-II with fs resolution   |                           | 15m      |
| 09:50  | E324: Optical visualization of beam-driven plasma wakefield accelerators  | Mike Downer (UT Austin)   | 15m      |
| 10:05  | E326: Non-Intercepting Diagnostics for High Intensity Beams and Computer Control  | Brendan O'Shea (SLAC)     | 15m      |
| 10:20  | E327: Virtual diagnostic for phase space prediction and customization at FACET-II   | Claudio Emma (SLAC)       | 15m      |
| 10:35  | <b>Executive session</b>  | Edda Gschwendtner (CERN)  | 1h       |
| 11:35  | <b>Adjourn</b>  |                           |          |



# PAC Agenda:



| Monday                                  | Tuesday                  | Wednesday                | Thursday |
|---|--------------------------|--------------------------|----------|
| <b>Day 4: Thursday, 29 October 2020</b> |                          |                          |          |
| <b>Q &amp; A and Closeout</b>           |                          |                          |          |
| Start Time                              | Topic                    | Speaker                  | Duration |
| 07:00                                   | <b>Executive Session</b> | Edda Gschwendtner (CERN) | 20m      |
| 07:20                                   | Q&A                      |                          | 2h       |
| 09:20                                   | <b>Break</b>             |                          | 15m      |
| 09:35                                   | <b>Executive Session</b> | Edda Gschwendtner (CERN) | 2h       |
| 11:35                                   | <b>Closeout</b>          |                          | 30m      |



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|---|--------------------------|--|--|---------|--|--|--------------------------|-----------|--|--|--|----------|--|--|--|
| <b>Day 4: Thursday, 29 October 2020</b> |                          |  |  |         |  |  |                          |           |  |  |  |          |  |  |  |
| <b>Q &amp; A and Closeout</b>           |                          |  |  |         |  |  |                          |           |  |  |  |          |  |  |  |
| Start Time                              | Topic                    |  |  |         |  |  | Speaker                  | Duration  |  |  |  |          |  |  |  |
| 07:00                                   | <b>Executive Session</b> |  |  |         |  |  | Edda Gschwendtner (CERN) | 20m       |  |  |  |          |  |  |  |
| 07:20                                   | Q&A                      |  |  |         |  |  |                          | 2h        |  |  |  |          |  |  |  |
| 09:20                                   | <b>Break</b>             |  |  |         |  |  |                          | 15m       |  |  |  |          |  |  |  |
| 09:35                                   | <b>Executive Session</b> |  |  |         |  |  | Edda Gschwendtner (CERN) | 2h        |  |  |  |          |  |  |  |
| 11:35                                   | <b>Closeout</b>          |  |  |         |  |  |                          | 30m       |  |  |  |          |  |  |  |

Collaborations made great progress in planning of approved experiments,  
Number on new exciting ideas will be proposed at this meeting  
Lets do important science



# Timeline

