OBSERVING THE CYCLING OF MATTER IN THE INFRARED

PRESENTED BY:
SOFIA Program Manager
Eddie Zavala

The SOFIA Observatory studies astronomical observations at wavelengths between 0.3 and 1000 microns.

Presented to:
SOFIA USERS GROUP (SUG)

NOVEMBER 2016
Program Manager’s Update

SOFIA
Stratospheric Observatory for Infrared Astronomy
## Agenda

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>SOFIA Top-Level Schedule &amp; Milestones</td>
</tr>
<tr>
<td>02</td>
<td>Program Status (Cycle 4)</td>
</tr>
<tr>
<td>03</td>
<td>Program Status (Cycle 5)</td>
</tr>
<tr>
<td>04</td>
<td>Future Improvements</td>
</tr>
</tbody>
</table>
### SOFIA Top-Level Schedule & Key Milestones

#### Annual Performance Indicator
- FY15: API FY15 EXES Comm. Complete
- FY16: L1-114 Program Office Transition
- FY17: L1-116 1st Gen SI Comm Acceptance Complete
- FY18: L1-117 2nd Gen SI Comm & Acceptance Complete
- FY19: L1-120 2nd Gen Full Science Productivity Achieved

#### Level 1 Milestones
- L1-114: Program Office Transition
- L1-116: 1st Gen SI Comm Acceptance Complete
- L1-117: 2nd Gen SI Comm & Acceptance Complete
- L1-120: 2nd Gen Full Science Productivity Achieved

#### Key Improvement Projects

**1st Generation Instruments**
- FLITECAM Accept.
- FORCAST Accept.
- FIFI-LS Acc. FSI
- FIFI-LS L3 Pipeline Complete

**2nd Generation Instrument (HAWC+)**
- ROSES Solicitation
- Phase 1 Step 1 Prop.
- Phase 2 Study Start
- Phase 2 Submit Due
- 3rd Gen SI Announce
- 3rd Gen CDR

**3rd Generation Instrument**
- HAWC+ Pre-ship
- HAWC+ Comm. PI 1
- HAWC+ Comm. PI 2
- HAWC+ Acc Review
- HAWC+ Accept.

#### Observing Cycles

**Cycle 3**
- Cycle 1 All Data Public
- Cycle 2 All L3 Cal
- Cycle 3 All Data Public
- Cycle 4 All L3 Cal
- Cycle 5 All Data Public
- Cycle 6 All Data Public

**Cycle 4**
- Science Cycle Planning
- Draft Call for Proposals
- Proposals Due
- TACs Complete
- Selection Announced
- Observing Plan

**Cycle 5**
- Science Cycle Planning
- Draft Call for Proposals
- Proposals Due
- TACs Complete
- Selection Announced
- Observing Plan

**Cycle 6**
- Science Cycle Planning
- Draft Call for Proposals
- Proposals Due
- TACs Complete
- Selection Announced
- Observing Plan

**Cycle 7**
- Science Cycle Planning
- Draft Call for Proposals
- Proposals Due
- TACs Complete
- Selection Announced
- Observing Plan

---

Rev. 4 October 2016  November 2016 – Page 3
Program Status (Cycle 4)

- SOFIA is currently in Science Cycle 4 (2 years, 5 months into the Operations Phase)

- Program goals, priorities, and metrics are focused on ensuring scientific production
  - Preparations for the 2018 Senior Review
  - Complete final planning and preparations for start of Cycle 5 science observations
  - The publication and dissemination of unique / impactful science results
  - Rapid production of science ready data from reliable and accurate pipeline software
  - Increased and sustained funding to investigators for the analysis of the results
  - Availability of relevant scientific instruments and observatory capabilities
  - Safe, efficient, and reliable science flight opportunities
  - Improved response to annual call for proposals
Program Status (Cycle 4)

- Cycle 4 Science Observations are proceeding well despite some operations challenges
  - Since 2013, Program operations continue to ramp up with increasing annual flights and research hours
  - Team continues to demonstrate exceptional ability to efficiently plan science flights and adjust to changing conditions (Flight cancellations, Contingency flight options, HAWC+ schedule impacts, etc.)
  - 2016 New Zealand deployment completed with 19 of 25 planned science flights, 1 RTB
  - New operational challenges have occurred that have impacts on dispatch rate; Program is continuously improving, making key adjustments, incorporating lessons learned to achieve improved operational performance
  - Observatory improvement projects targeted for maintaining operational capacity, improved science capability, and observatory improvements
Cumulative Cycle 4 Metrics

- Dispatch rate has been predominately impacted by aircraft issues
- ~7% of contingency flights utilized
- Making adjustments to improve Observatory reliability for Cycle 5

- Research Hour impacts due to flight cancellations and flight schedule changes driven by HAWC+ technical issues
- Program scheduling additional Cycle 4 science flights to achieve 80% RH
- Increasing Cycle 5 margin with more planned contingency flights ~15%
### Cycle 4 Daily Overview (1 of 2)

#### Cycle 4 Start

<table>
<thead>
<tr>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 A FORCAST</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 B FIFI/LS</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 C EXES</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 D</th>
<th>SI Rem</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>31</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4 N</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8 M</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>18</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**February 2016**

#### Cycle 4 A FORCAST

<table>
<thead>
<tr>
<th>9 Flights</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 B FIFI/LS</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 C EXES</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 D</th>
<th>SI Rem</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>23</td>
<td>26</td>
<td>25</td>
<td>27</td>
<td>26</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
</tr>
</tbody>
</table>

**March 2016**

#### Cycle 4 B FIFI/LS

<table>
<thead>
<tr>
<th>4 Flights</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 C EXES</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 D</th>
<th>SI Rem</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>26</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>21</td>
</tr>
<tr>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>24</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>20</td>
</tr>
</tbody>
</table>

**April 2016**

#### Cycle 4 C EXES

<table>
<thead>
<tr>
<th>3 Commissioning Flights</th>
<th>SI Rem</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>28</td>
</tr>
<tr>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>31</td>
<td>1</td>
</tr>
</tbody>
</table>

**May 2016**

#### Cycle 4 D

<table>
<thead>
<tr>
<th>8 Flights</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 E upGREAT</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 F FIFI/LS</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 G FORCAST</th>
<th>SI Rem</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>31</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**June 2016**

#### Cycle 4 E upGREAT

<table>
<thead>
<tr>
<th>4 Flights</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 F FIFI/LS</th>
<th>SI Rem</th>
<th>SI Install</th>
<th>LO</th>
<th>Cycle 4 G FORCAST</th>
<th>SI Rem</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
</tr>
</tbody>
</table>

**July 2016**

### Key

- **Cycle 4 Start**
  - SI Install
  - LO
  - Cycle 4 A FORCAST
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 B FIFI/LS
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 C EXES
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 D
  - SI Rem

- **Cycle 4 A FORCAST**
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 B FIFI/LS
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 C EXES
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 D
  - SI Rem

- **Cycle 4 B FIFI/LS**
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 C EXES
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 D
  - SI Rem

- **Cycle 4 C EXES**
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 D
  - SI Rem

- **Cycle 4 D**
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 E upGREAT
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 F FIFI/LS
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 G FORCAST
  - SI Rem

- **Cycle 4 E upGREAT**
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 F FIFI/LS
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 G FORCAST
  - SI Rem

- **Cycle 4 F FIFI/LS**
  - SI Rem
  - SI Install
  - LO
  - Cycle 4 G FORCAST
  - SI Rem

- **Cycle 4 G FORCAST**
  - SI Rem
  - SI Install
  - LO

### Observing Cycle:

- **Baseline Science Flights:** 101
- **Baseline RHs:** 808
- **Planned Science Flights:** 80
- **Planned RHs:** 632

**Key**

- **Baseline** RHs
- **Baseline** Science Flights
- **Planned** Science Flights
- **Planned** RHs

**Cycle 4:**

- **Baseline Science Flights:** 4
- **Baseline RHs:** 808
- **Planned Science Flights:** 80
- **Planned RHs:** 632

**Key:**

- **Weekend day:** (check box with no fill)
- **US or German Holiday:** (day of week box filled in red)
- **Instr. Commissioning Flight:** (bold white text, purple fill, bold border)
- **Observing Flight:** (bold white text, blue fill, bold border)
- **Ferry/Maint./Non-Sci Flight:** (bold white text, green fill, bold border)
- **Ferry on Flight:** (white star on day of week)
- **Educator on Flight:** (single slash through day and date)
- **Line Operations:** (bold border)
- **Contingency Instr. Comm. Flight:** (day box with purple fill)
- **Contingency Observer. Flight:** (day box with green fill)
- **Media/VIP on Flight:** (yellow star on day of week)
- **Canceled Flight:** (x through day and date)
- **AFRC Regular Day Off:** (day and date shown in red)
- **Deployment Observing Flights:** (bold white text, light blue fill, bold border)
- **Short Flight:** (colored fill only lower half, bold box)
- **Half Sci. & Half Ferry/Maint./Non-Sci Flight:** (two colored fill)
- **Restored Flight:** (check mark below day)
- **Notional Unfund Flight:** (yellow fill with U below day)

**Distributed:** 31 October 2016

**Slide Revision:** 14 October 2016

**November 2016 – Page 7**
# Cycle 4 Daily Overview - 2 of 2

**Key**
- Observing Cycle: 4
- Baseline Science Flights: 101
- Baseline RHs*: 808
- Planned Science Flights: 80
- Planned RHs*: 632

*Max available research hours, PMB sequence approval: 10/14/16

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>T</td>
</tr>
<tr>
<td>W</td>
</tr>
<tr>
<td>Th</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>S</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observing Cycle: 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline Science Flights: 101</td>
</tr>
<tr>
<td>Planned Science Flights: 80</td>
</tr>
</tbody>
</table>

**Notes**
- Flights lost due to delamination repair
- Key near-term Cycle 5 dependency
- PMB Approved Cycle 5 Start
SOFIA Operational Capacity Ramping Up

- Program flight plans approaching full ops levels in Cycle 4 & 5 (dark bars)
- Program demonstrating increase in annual science flight execution and annual Research Hours (light bars)

- Planned Cycle 5 Research Hour estimate is reduced due to:
  - Low HAWC+ hold time (~5.5 hrs) which affects ~25% of Cycle 5
  - New upGREAT commissioning requirements

![Graph of Executed Flights Trend Chart]

![Graph of RH Trend Chart]
Program Status (Cycle 5)

- Cycle 5 Science Planning is proceeding well
  - Draft schedule approved to support Cycle selection announcement
  - Preliminary analysis of HAWC+ characterization flight data indicates that performance is sufficient to support shared-risk science observations
    - Further work is required to improve ADR hold time and instrument sensitivity and meet SI performance requirements
  - The Program Office has adopted an approach that prioritizes preservation of high-priority science flights awarded as shared-risk and implementing technical fixes between awarded flight series to bring the performance of the SI in line with performance requirements
    - Needed repair will be performed in January – April 2017 and May – September 2017 to avoid science schedule impacts
  - SOFIA SMO to develop contingency flight plans for Fall 2017 HAWC+ science flights
Program Status (Cycle 5)

• Cycle 5 Science Planning is proceeding well

  – Approaches to mitigate future observatory outages (Aircraft)
    • Maximize contingency flight opportunities in the schedule; increase to ~15%
    • Expanding ground crew schedule to 7 days/week to provide weekend shifts to fix problems
    • Staging more aircraft spares, including a spare engine, in New Zealand to improve recovery time due to problems
    • Improved maintenance plan and acquisition for engine maintenance, repair, and overhaul
    • Acquisition of additional 747SP airframe with ready access to remove spare parts
    • Collaborating with Pratt & Whitney Canada (PWC) 747SP project team for exchange of best practices and lessons learned for aircraft maintenance

  – Known risks and constraints
    • HAWC+ performance and repair implementation
    • NASA directive for centralized procurement may introduce time-delays for time-critical parts
    • Budget sensitivity to large fuel price changes
### Cycle 5 Daily Overview – DRAFT – Page 1 of 2

#### Cycle 5 Start

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>February – 2017</td>
<td><strong>OC5 A (upGREAT LFA)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>OC5 B (FF1-LS)</strong></td>
</tr>
<tr>
<td></td>
<td><strong>OC5 C (EXES)</strong></td>
</tr>
<tr>
<td>March – 2017</td>
<td><strong>OC5 D (FORCAST)</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>March – 2017</td>
<td><strong>OC5 E (HAWC+)</strong></td>
</tr>
<tr>
<td>April – 2017</td>
<td><strong>OC5 F (EXES)</strong></td>
</tr>
<tr>
<td>May – 2017</td>
<td><strong>OC5 G (upGREAT/HAWC+)</strong></td>
</tr>
<tr>
<td>June – 2017</td>
<td><strong>OC5 H (upGREAT)</strong></td>
</tr>
<tr>
<td>July – 2017</td>
<td><strong>OC5 I (FF1-LS)</strong></td>
</tr>
<tr>
<td>August – 2017</td>
<td><strong>OC5 J (FORCAST)</strong></td>
</tr>
</tbody>
</table>

#### First shared-risk science with HAWC+ (before repair)

- **SI Rem:** Schedule review and planning for upcoming weeks.
- **MD Inst:** Maintenance and installation of equipment.
- **Eng LO:** Engineering and logistical support.
- **Obs Flt:** Observing flights scheduled.
- **Prep:** Preparations for upcoming events.
- **Down:** Deployment activities for equipment.
- **HEALFA:** Equipment and hardware assembly.

**Key:**
- **Ferry/Maint./Non-Sci Flt:** Ferry and maintenance flights.
- **Eng LO:** Engineering and logistical support.
- **EDU:** Educator on flight.
- **Media/VIP:** Media and VIP flights.
- **CANC:** Canceled flights.
- **RTB:** Return to base flights.
- **SCAP:** Strategic capacity flights.

**Observing Flight:**
- **S/F:** Scheduled flight.
- **B/S:** Backup flight.

**Baseline Science Flights:** TBD

**Baseline RHs:** TBD

**Planned Science Flights:** 100

**Planned RHs:** 762

*Max available research hours; PMB sequence approval: 10/14/16*

---

**Distributed:** 31 October 2016

**Slide Revision:** 28 October 2016

---

**November 2016 – Page 12**
### Cycle 5 Daily Overview

#### October - 2017

<table>
<thead>
<tr>
<th>Date</th>
<th>MD Inst.</th>
<th>Ferry PMD</th>
<th>St Rem.</th>
<th>Crew Rest</th>
<th>OC65 J (FORCAST)</th>
<th>OC65 K (FORCAST)</th>
<th>Maintenance / Upgrades #14</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

**First shared-risk science with HAWC+ (after repair)**

#### November - 2017

<table>
<thead>
<tr>
<th>Date</th>
<th>MD Inst.</th>
<th>Ferry PMD</th>
<th>St Rem.</th>
<th>Crew Rest</th>
<th>OC65 J (FORCAST)</th>
<th>OC65 K (FORCAST)</th>
<th>Maintenance / Upgrades #14</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

**First shared-risk science with HAWC+ (after repair)**

#### December - 2017

<table>
<thead>
<tr>
<th>Date</th>
<th>MD Inst.</th>
<th>Ferry PMD</th>
<th>St Rem.</th>
<th>Crew Rest</th>
<th>OC65 J (FORCAST)</th>
<th>OC65 K (FORCAST)</th>
<th>Maintenance / Upgrades #14</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

**Cycle 6 Start**

<table>
<thead>
<tr>
<th>Date</th>
<th>MD Inst.</th>
<th>Ferry PMD</th>
<th>St Rem.</th>
<th>Crew Rest</th>
<th>OC65 J (FORCAST)</th>
<th>OC65 K (FORCAST)</th>
<th>Maintenance / Upgrades #14</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>M</td>
<td>W</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>T</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>F</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>S</td>
<td>M</td>
<td>T</td>
<td>W</td>
<td>F</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

**Key**

- **Observing Cycle:** 5
- **Baseline Science Flights:** TBD
- **Baseline RHs**: TBD
- **Planned Science Flights:** 100
- **Planned RHs**: 762
- US or German Holiday
- Weekend day
- Work day
- AFRC Regular Day Off
- Instr. Commissioning Flight
- Line Operations
- Possible Maint/Up, Check Flt
- Observing Flight
- Contingency Instr. Comm. Flight
- Deployment Observing Flights
- Ferry/Maint/Non-Sci Flight
- Contingency Obser. Flight
- Short Flight
- Half Sci. & Half Ferry/Maint/Non-Sci Flt
- Educator on Flight
- Media/VIP on Flight
- Restored Flight
- Canceled Flight
- Strategical Capacity
- PMB sequence approval: 10/14/16

**Distributed:** 31 October 2016

**Slide Revision:** 28 October 2016

**November 2016 – Page 13**
Future Improvements

- **Observatory Mission Systems**
  - Improved Mission Command and Control System operational software with deployment of new software loads 2-3 times per year
  - Water Vapor Monitor upgrade deployed and flight calibration in progress
  - Data Archiver System Upgrade
  - Cryo-cooler Phase 2 System Upgrade (2-channel, liquid-cooled system)
  - Cavity Environmental Control System
    - Improved/preventative maintenance plan with increase spares
    - Upgraded system to address nuisance operational issues and improve performance

- **Telescope Assembly**
  - Continuous software improvements (2-3 year) for more efficient nodding and increased tracking performance during scans
  - Spare Secondary Mirror Mechanism w/ spare Aluminized mirror
  - Head-ring camera upgrade: Wide-Field Imager and Far-Field Imager
  - Spare subsystem components: Network units, power supplies, and various sub-assembly electronics

- **Aircraft Systems**
  - Required avionics communication system upgrade required for international operations

- **Accelerating plans for next science instrument solicitation for 2017**
Future Improvements

- The scientific success of SOFIA depends on a timely commissioning of new instruments using cutting edge technology. Consequently, NASA plans to solicit the next generation instrumentation in 2017.
  - Agreement secured with NASA HQ to accelerate plans for next science instrument solicitation
  - Schedule details are being formulated and will be released soon
Back-up Charts